ADDI-DATA®
PARTNER FÜR PRÄZISION

Technical Description

APCIe-3701 und APCI-3701

Length measurement board, optically isolated

DIN EN ISO 9001:2015 certified

Edition: 04.05-03/2022

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.
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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	Information on inductive displacement transducers
5	Description of the individual functions of the board
6	Standard software: Information on the API software functions
7	Procedure for returning (repairing, etc.) or disposing of the board
8	List of technical data and limit values of the board
9	Appendix with glossary and index
10	Contact and support address

1 Definition of application, user, handling

1.1 Definition of application

1.1.1 Intended use

The board **APCIe-3701** or **APCI-3701** must be inserted in a personal computer (PC) with PCI Express or PCI slots which is used as electrical equipment for measurement, control and laboratory pursuant to the standard DIN EN IEC 61010-1.

The used personal computer (PC) must fulfil the requirements of DIN EN IEC 62368-1 and DIN EN 55032 or IEC/CISPR 32 and DIN EN 55024 or IEC/CISPR 24.

The use of the board **APCIe-/APCI-3701** in combination with external screw terminal panels requires correct installation according to the standard DIN EN IEC 61439-1 (Low-voltage switchgear and controlgear assemblies).

1.1.2 Usage restrictions

The board **APCIe-/APCI-3701** must not be used as a safety-related part (SRP).

The board **APCIe-/APCI-3701** must not be used for safety-related functions, such as emergency stop functions.

The board **APCIe-/APCI-3701** must not be used in potentially explosive atmospheres.

The board **APCIe-/APCI-3701** 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.

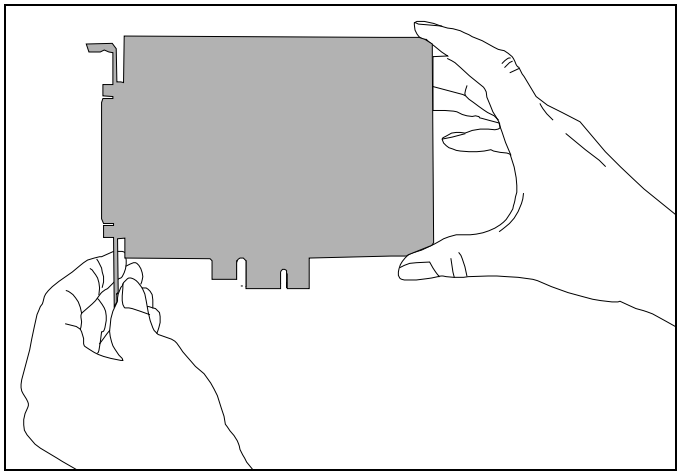
1.2.2 Country-specific regulations

Do observe the country-specific regulations regarding

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

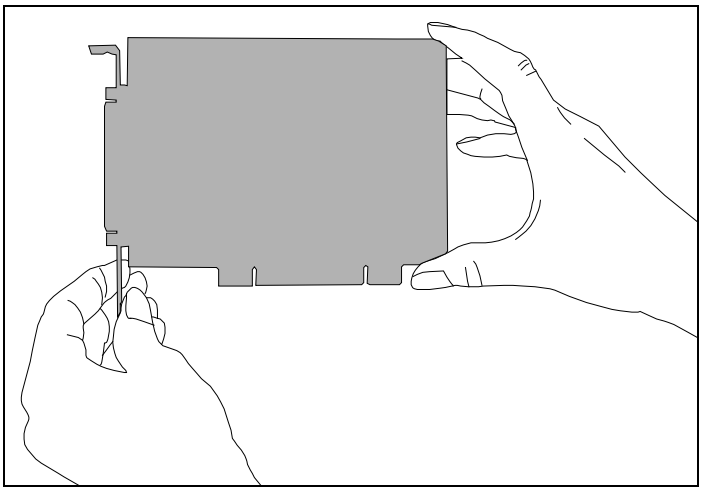
1.3 Handling of the board

Fig. 1-1: APCIe-3701: Correct handling



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

Fig. 1-2: APCI-3701: 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-/APCI-3701** can be downloaded for free at: https://drivers.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

- **APCIe-3701:** Acquisition of 16 inductive displacement transducers (HB, LVDT, Mahr)
- **APCI-3701:** Acquisition of 16 inductive displacement transducers (HB, LVDT)
- 16-bit resolution
- 8 digital inputs, 8 digital outputs (24 V)
- 1 timer (12-bit)
- Software tool **ConfigTools** to select and calibrate the transducers
- Optical isolation
- Input filters
- Diagnostic function in case of short-circuit or line break
- Overtemperature and overvoltage protection
- Protection against fast transients (burst), electrostatic discharge and high-frequency EMI

2.2 Block diagram

Fig. 2-1: APCIe-3701: Block diagram

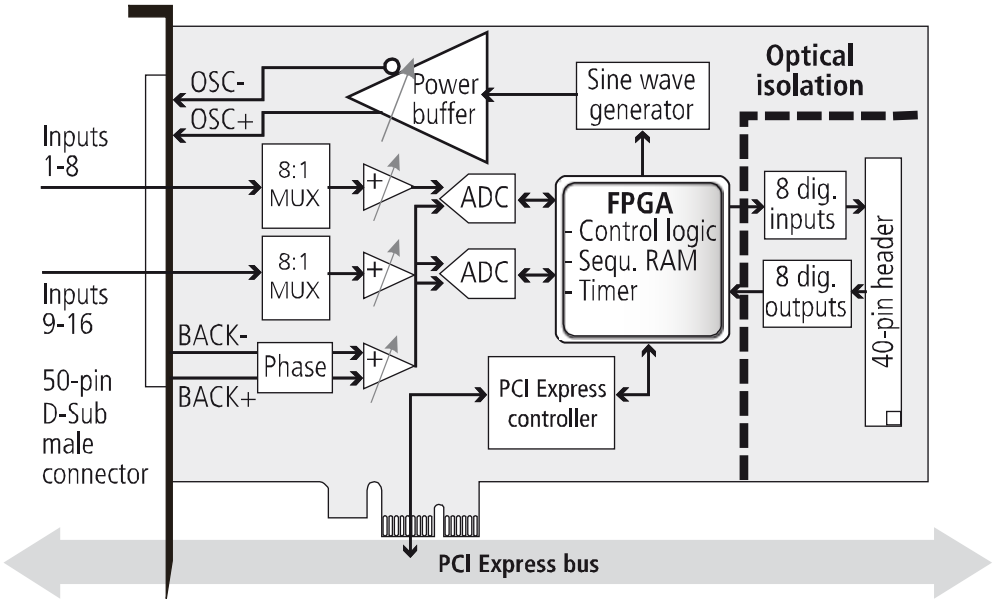
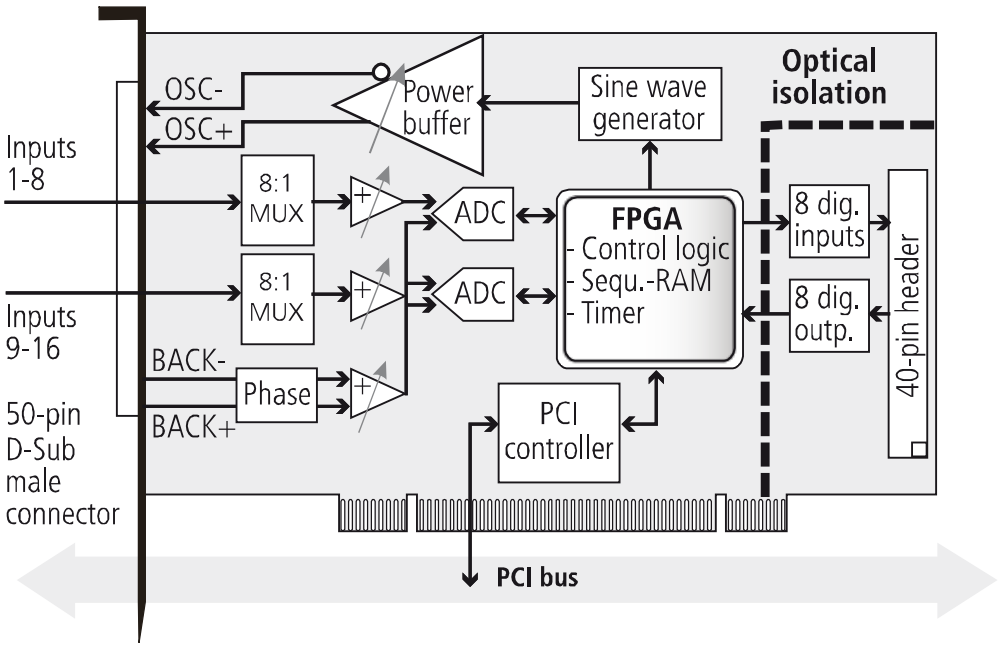


Fig. 2-2: APCI-3701: Block diagram



3 Insertion and installation of the board

3.1 Insertion of the APCIe board

Risk of injury!
Be sure to follow the safety precautions!
Improper use of the board may lead to property damage and personal injury.

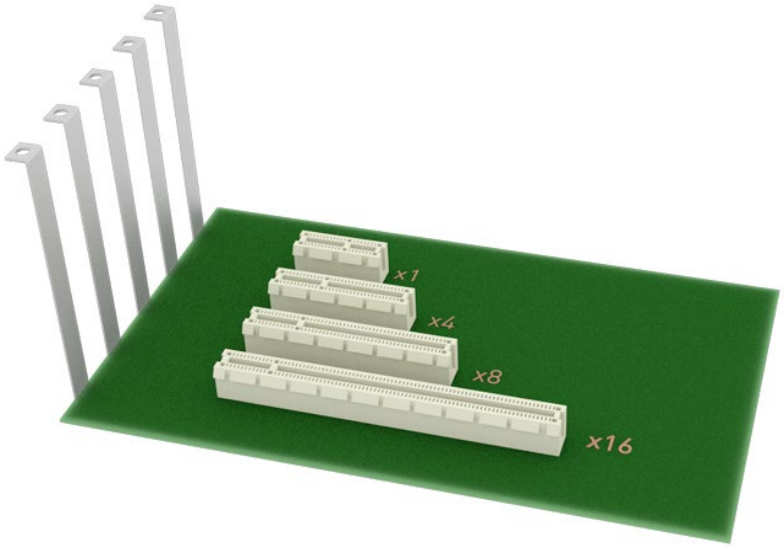
3.1.1 Opening the PC

- 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 1-lane (x1), 4-lane (x4), 8-lane (x8) or 16-lane (x16) PCI-Express slot for the board.

Fig. 3-1: PCI Express slot types

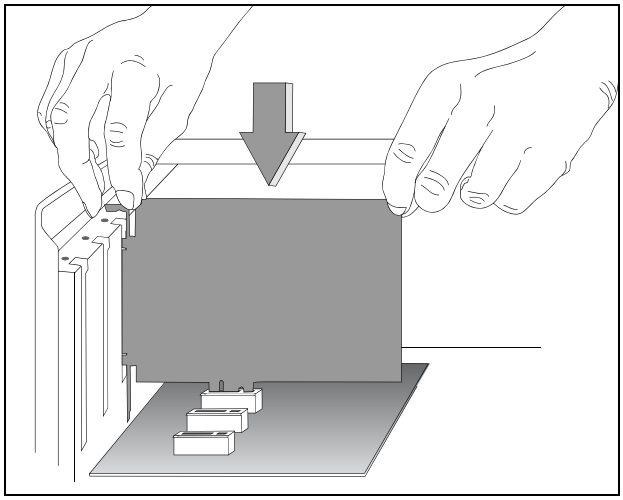


- Unscrew the back cover from the selected slot. For this, follow the operating instructions provided by the PC manufacturer!
  Keep the back cover in a safe place. You will need it if you remove the board.
- Provide for potential equalisation.
- Take the board out of its protective packaging.

3.1.3 Inserting the board

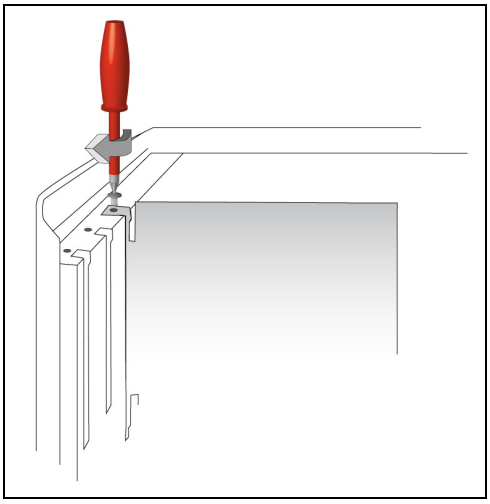
- Insert the board vertically from above into the selected slot.

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 Insertion of the APCI board

Risk of injury!
Be sure to follow the safety precautions!
Improper use of the board may lead to property damage and personal injury.

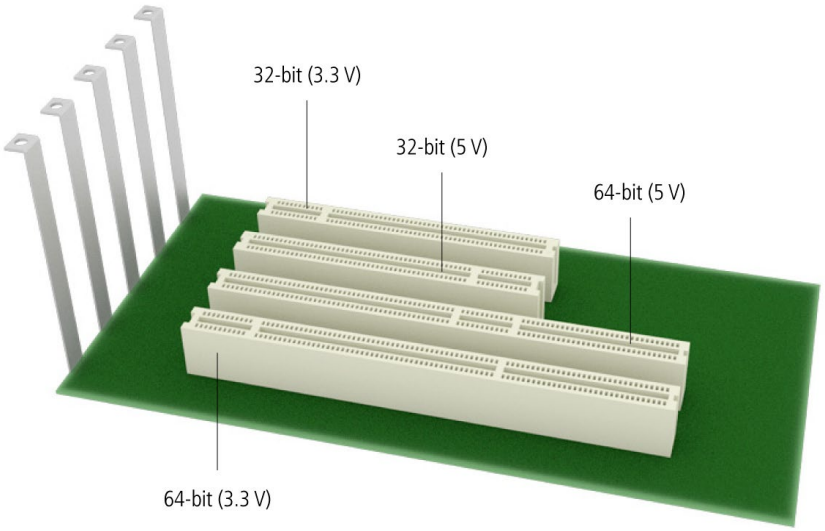
3.2.1 Opening the PC

- 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.

3.2.2 Selecting a slot

- Select a free 32-/64-bit PCI slot (5 V or 3.3 V) for the board.

Fig. 3-4: PCI slot types

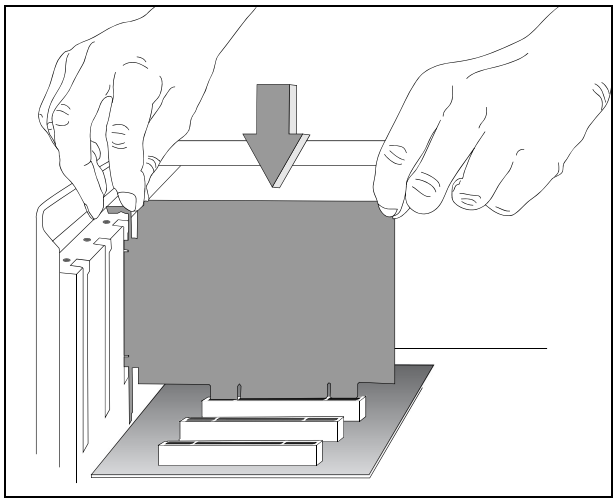


- Unscrew the back cover from the selected slot. For this, follow the operating instructions provided by the PC manufacturer!
  Keep the back cover in a safe place. You will need it if you remove the board.
- Provide for potential equalisation.
- Take the board out of its protective packaging.

3.2.3 Inserting the board

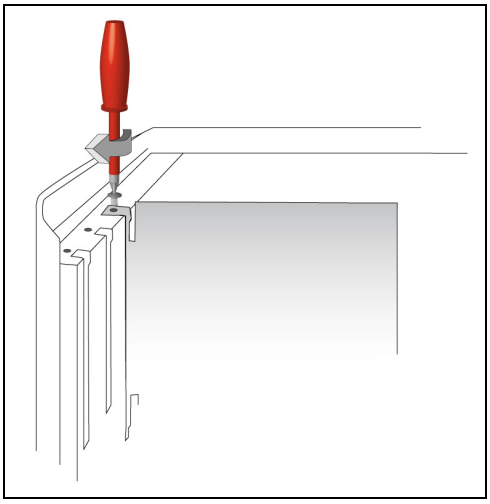
- Insert the board vertically from above into the selected slot.

Fig. 3-5: 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. 3-6: PC housing: Fasten the board



- Tighten all loose screws.

3.2.4 Closing the PC

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

3.3 Connecting the accessories

3.3.1 Connection of connection box and screw terminal panel

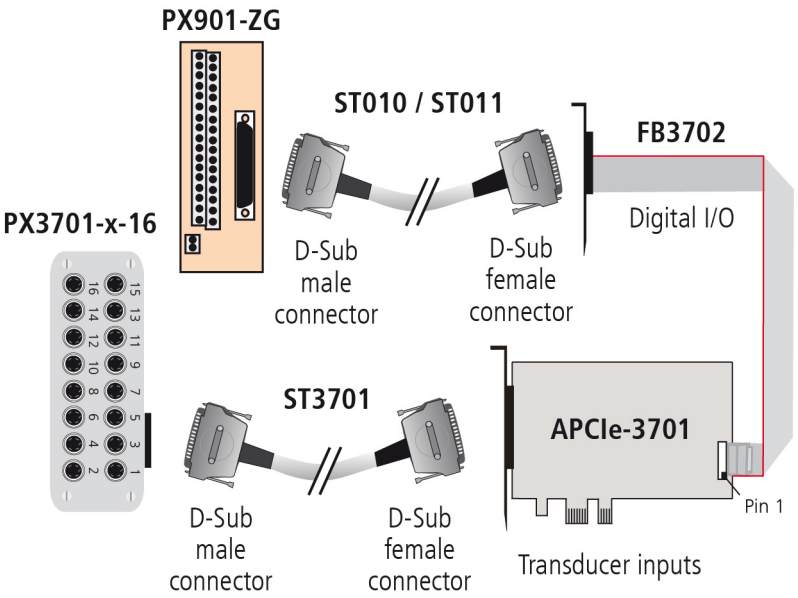
Between the board **APCIe-3701** or **APCI-3701** and the peripherals, analog signals are exchanged via the connection box **PX3701-x-16** and the cable **ST3701**, which needs to be connected to the 50-pin D-Sub male connector of the board. In terms of electromagnetic compatibility (EMC), this cable has the following properties:

- Metallised connector housing
- Shielded cable
- Cable shield folded back over insulation and firmly screwed on both sides to the connector housing.

For the digital inputs and outputs of the board, the ribbon cable **FB3702** is connected to the 40-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.

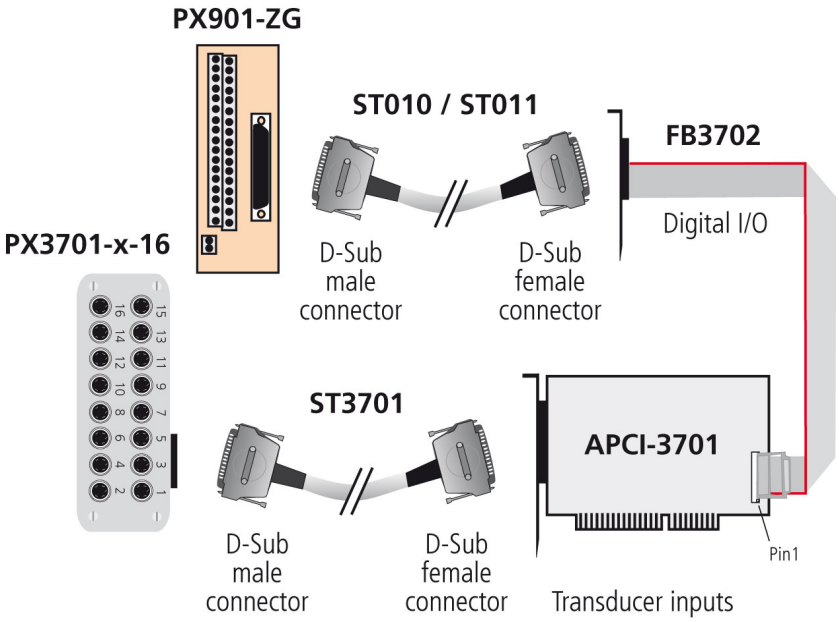
To operate the digital outputs of the board, an external supply voltage is required (see Chapter 8.4.4). The screw terminal panel **PX901-ZG** enables this supply voltage to be connected.

Fig. 3-7: APCIe-3701: Connection of connection box and screw terminal panel



NOTICE!
Plug the **FB3702** cable into the connector by inserting the red (or blue or black) cable line into pin 1.

Fig. 3-8: APCI-3701: Connection of connection box and screw terminal panel



NOTICE!
Plug the **FB3702** cable into the connector by inserting the red (or blue or black) cable line into pin 1.

3.3.2 Pin assignment

Fig. 3-9: APCIe-/APCI-3701-16: 50-pin D-Sub male connector (transducer inputs)

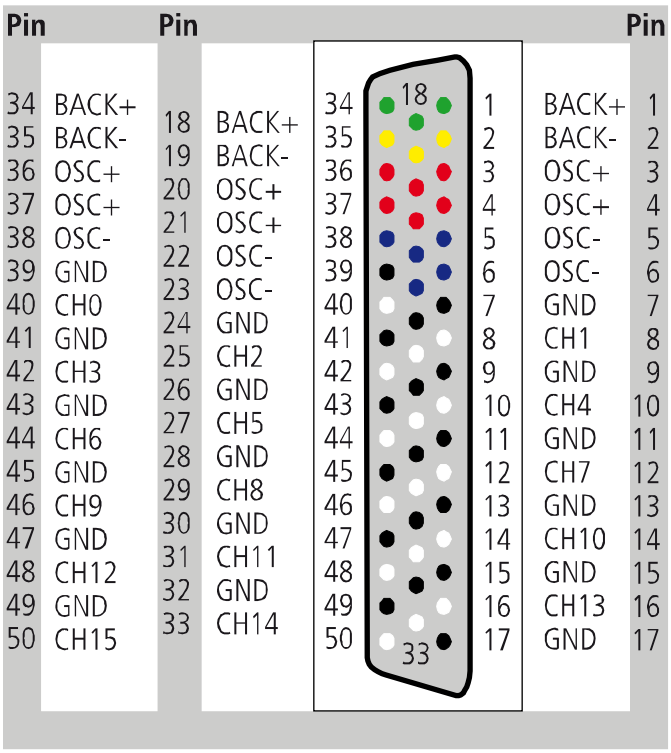


Table 3-1: Transducer inputs: Signals

Signal name	Pin colour	Function
OSC+	red	Phase-shifted supply signal of the inductive transducers
OSC-	blue	
BACK+	green	Supply voltage return to measure the amplitude; serves as the actual value signal of the supply voltage oscillator
BACK-	yellow	
CHx	white	Transducer input (x = input number)
GND	black	GND

Fig. 3-10: 37-pin D-Sub male connector (digital I/O)

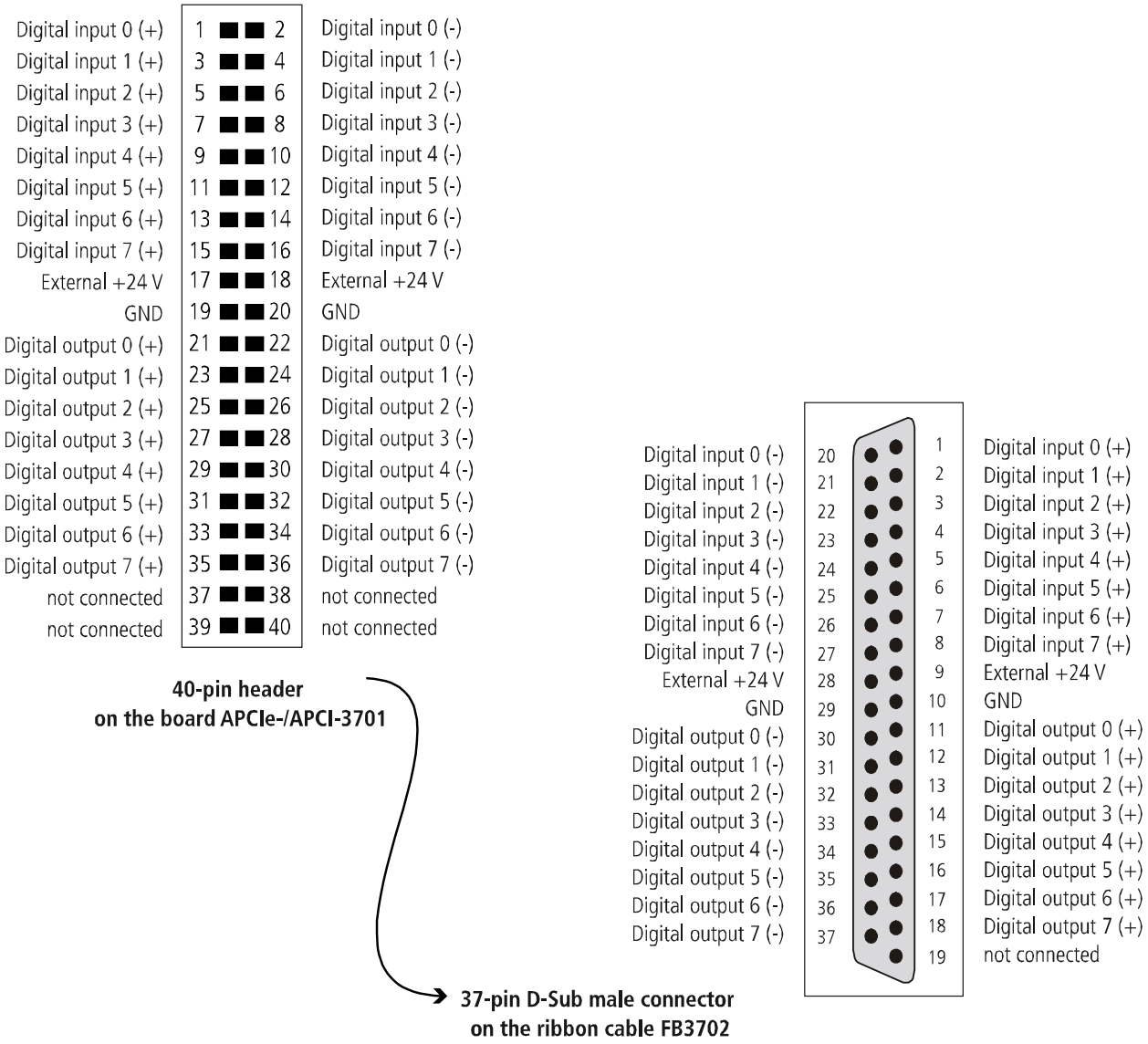


Table 3-2: Pin description (digital I/O)

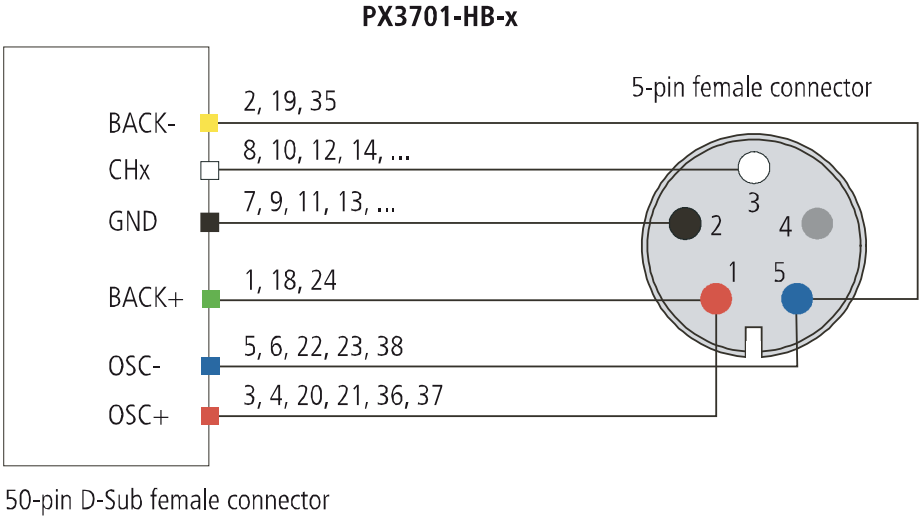
Pin No. (40-pin header)	Pin No. (37-pin D-Sub male connector)	Pin function
1	1	Digital input 0+
2	20	Digital input 0-
3	2	Digital input 1+
4	21	Digital input 1-
5	3	Digital input 2+
6	22	Digital input 2-

Pin No. (40-pin header)	Pin No. (37-pin D-Sub male connector)	Pin function
7	4	Digital input 3+
8	23	Digital input 3-
9	5	Digital input 4+
10	24	Digital input 4-
11	6	Digital input 5+
12	25	Digital input 5-
13	7	Digital input 6+
14	26	Digital input 6-
15	8	Digital input 7+
16	27	Digital input 7-
17	9	24 V voltage supply (digital outputs)
18	28	24 V voltage supply (digital outputs)
19	10	GND (digital outputs)
20	29	GND (digital outputs)
21	11	Digital output 0+
22	30	Digital output 0-
23	12	Digital output 1+
24	31	Digital output 1-
25	13	Digital output 2+
26	32	Digital output 2-
27	14	Digital output 3+
28	33	Digital output 3-
29	15	Digital output 4+
30	34	Digital output 4-
31	16	Digital output 5+
32	35	Digital output 5-
33	17	Digital output 6+
34	36	Digital output 6-
35	18	Digital output 7+
36	37	Digital output 7-

3.3.3 Connection of the transducers to the connection box

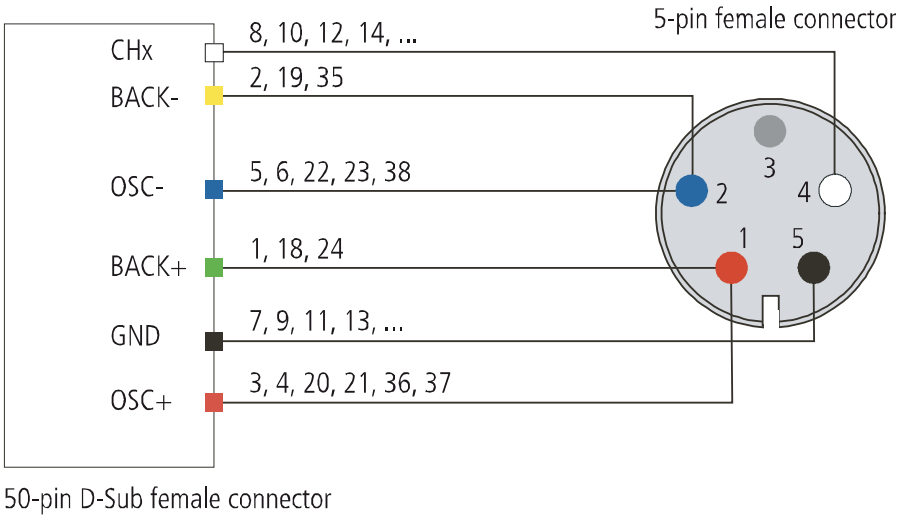
1) Half-bridge transducers

Fig. 3-11: Pin assignment: PX3701-HB-x



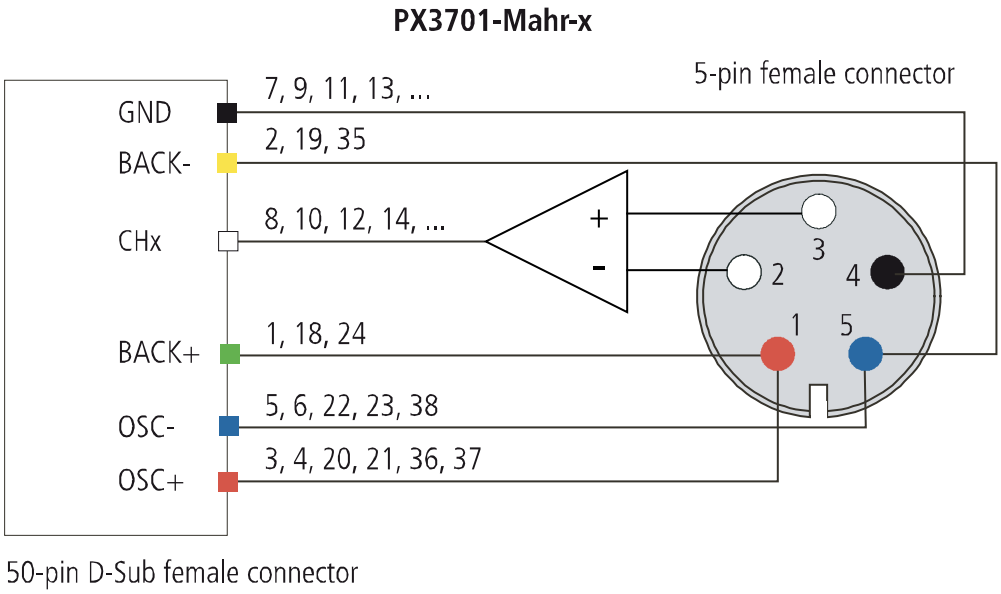
2) LVDT transducers

Fig. 3-12: Pin assignment: PX3701-LVDT-x



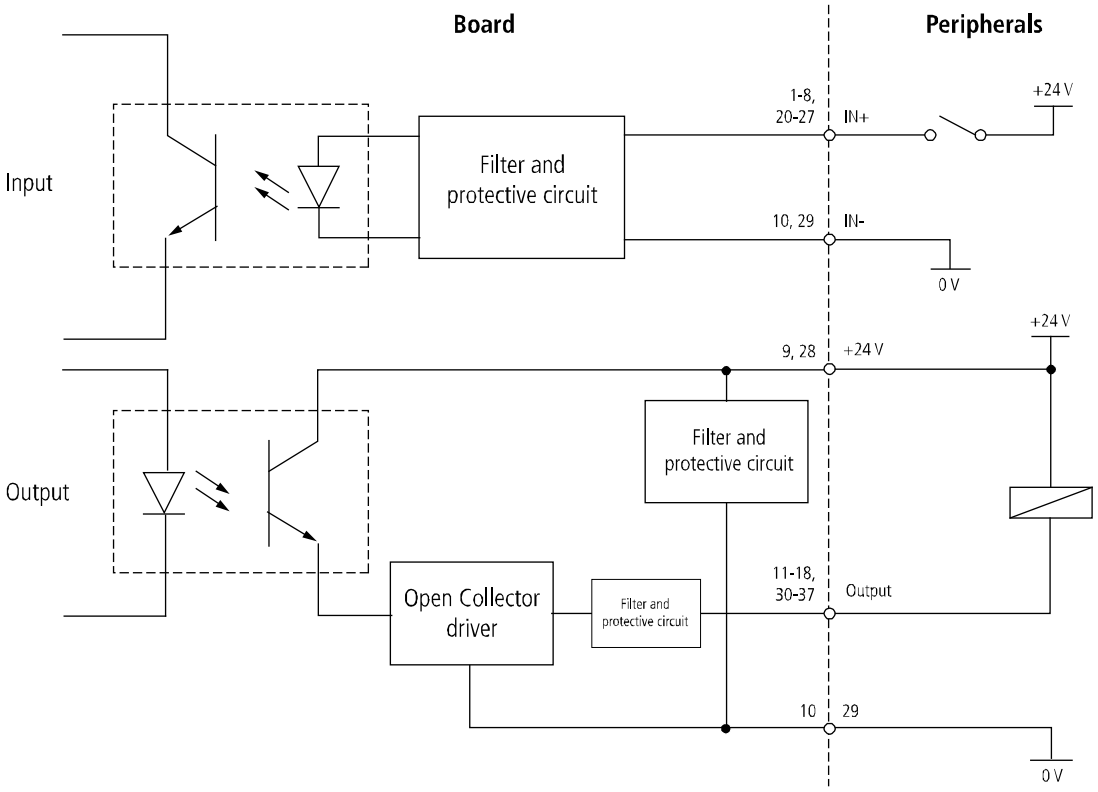
3) Mahr transducers

Fig. 3-13: Pin assignment: PX3701-Mahr-x



3.3.4 Connection example

Fig. 3-14: Connection example



NOTICE!
Please note that an external voltage source is required for the digital outputs (see Chapter 8.4.4).

3.4 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).

3.5 Software tool “ConfigTools”

The software tool **ConfigTools** supports you in working with your board.
It allows you, for example, to carry out firmware updates and calibrate connected transducers.

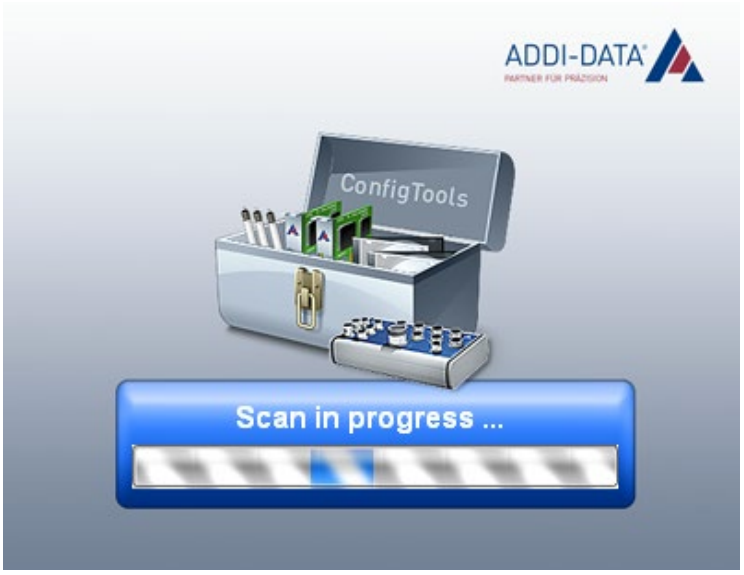
3.5.1 First steps

ConfigTools is to be found on the ADDI-DATA website https://drivers.addi-data.com, under “Drivers / Tools (Windows)”. To install this software tool, proceed as follows:

- Save the downloaded .zip file in a directory of your choice and unpack it afterwards.
- Double-click on the “ConfigTools_setup.exe” file and follow the instructions of the installation program.

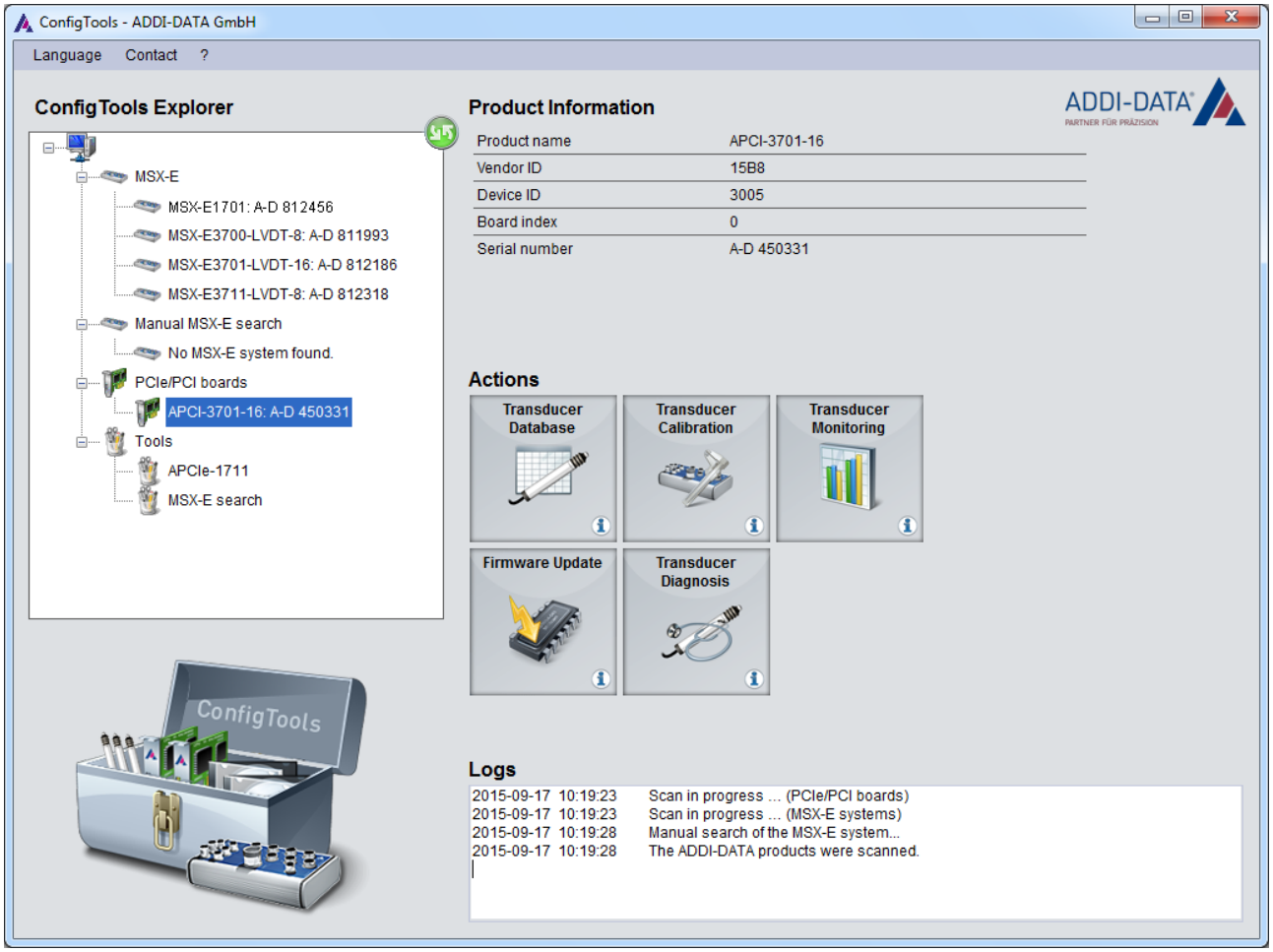
As soon as you have started the installed software tool on your computer, the inserted boards are scanned.

Fig. 3-15: ConfigTools: Scan boards



3.5.2 Main window structure

Fig. 3-16: ConfigTools: Main window



The **ConfigTools** main window comprises the following areas:

- Menu bar
- ConfigTools Explorer
- Product information
- Actions
- Logs.

1) Menu bar

Via the menu bar, you can define the language of the user interface. Available languages are English, German, French and Chinese.
Moreover, you can view the contact data of ADDI-DATA GmbH, and under "? / About ConfigTools", the version of the software tool.

2) ConfigTools-Explorer

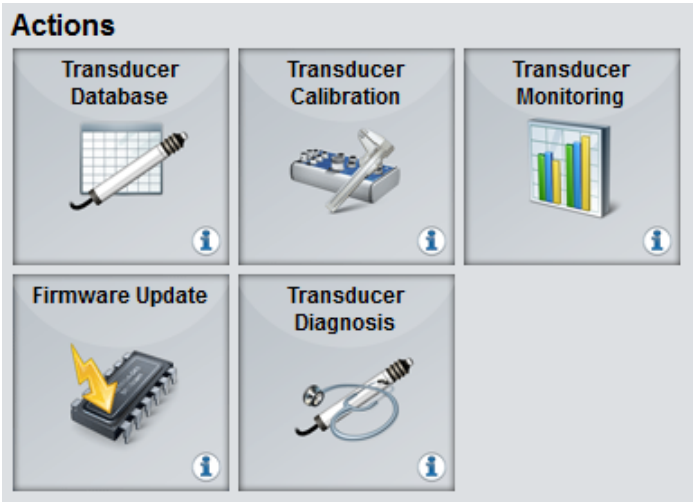
After scanning, all inserted boards are listed in the ConfigTools Explorer.
When you click on a board name, corresponding product information, such as the serial number of the board, will be shown on the right side of the main window.

To scan the inserted boards once again, for example after inserting another board, you have to click on the green icon in the top right of the ConfigTools Explorer area.

3) Actions

Below the "Product Information" area, there are buttons that enable you to perform various actions.

Fig. 3-17: ConfigTools: Action buttons



- **Transducer Database:** Edit the user's transducer database, that is, for example, change transducer features and add new transducers. The Board database must contain the transducers that will be connected to the board in order for the board to detect them.
- **Firmware Update:** Update the firmware of the board. The required firmware file is available on request. The file name corresponds to the firmware version.
- **Transducer Calibration:** Calibrate transducers connected to one or more channels.
- **Transducer Diagnosis:** Test transducers for errors (short-circuit, open load)
- **Transducer Monitoring:** Select the channels to be acquired and start the acquisition with monitoring. For each channel, each acquired value is immediately displayed in a diagram.

4 Displacement transducers

In this chapter, the properties of the different displacement transducers are described in more detail. This should help you to find the right transducer for your measuring system and to identify and prevent possible measuring errors in advance.

4.1 Inductive transducers

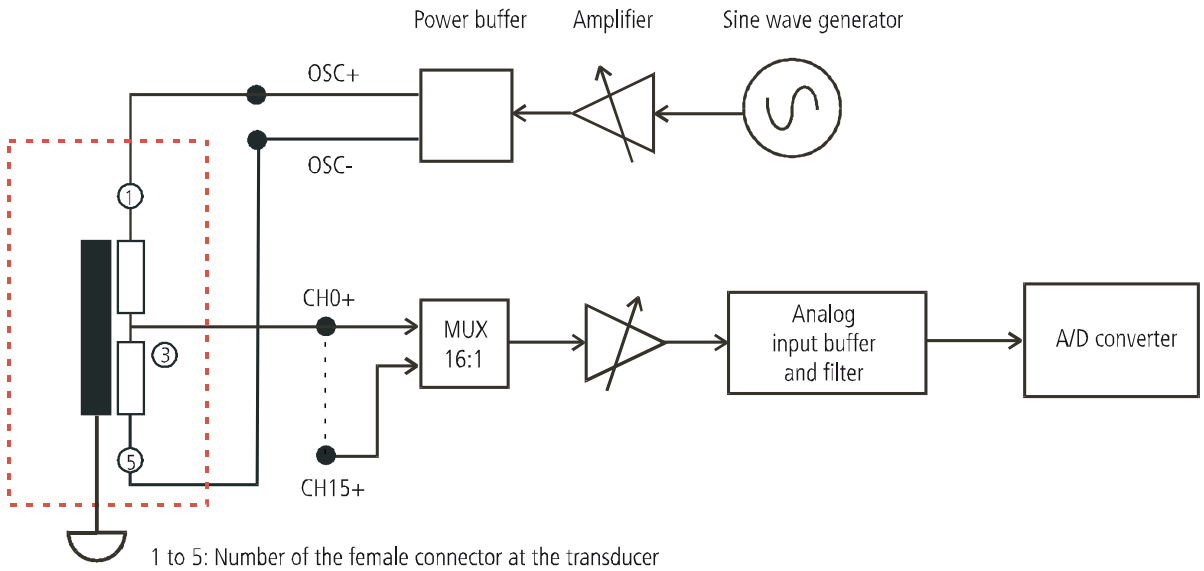
Inductive transducers are used for precise measurement of a defined distance. They are displacement/ voltage sensors, whose output voltage changes linearly along with the moving magnetic core (ferrite).

The magnetic core moves according to a straight line in a transformer, which consists of a central primary coil and two external secondary coils (cylindrical windings). The power buffer provides an AC voltage source to the primary coil. The secondary voltage changes according to the position of the magnetic core.

4.1.1 Half-bridge transducers

A half-bridge transducer consists of two inductive coils (windings). These are fed directly with two sinusoidal voltage signals, i. e. a positive and a negative oscillator voltage.
A measuring bolt moves along the two coils with a ferromagnetic core. Depending on its position, this core changes the voltages in the two coils. The measuring bolt thus functions like a variable voltage distributor. The change in voltage at the coils results in the sinusoidal measurement signal to be evaluated.

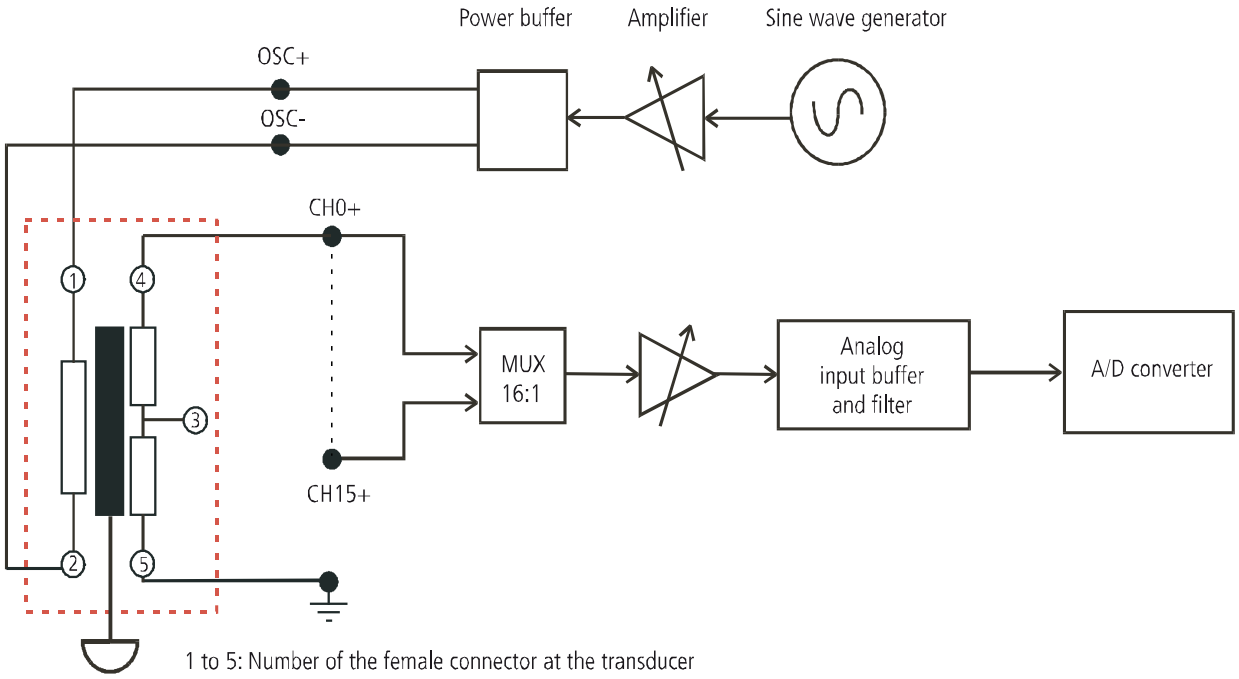
Fig. 4-1: Half-brige transducer



4.1.2 LVDT transducers

An LVDT transducer features three coils: a primary coil and two secondary coils. These coils are positioned concentrically around the mobile core and form two symmetrical transformers with respect to the electrical zero point of the transducer.
The primary coil is fed by two sinusoidal voltage signals, i. e. a positive and a negative one, whereas both secondary coils (switched in phase opposition) produce an electrical signal proportional to the measured displacement.

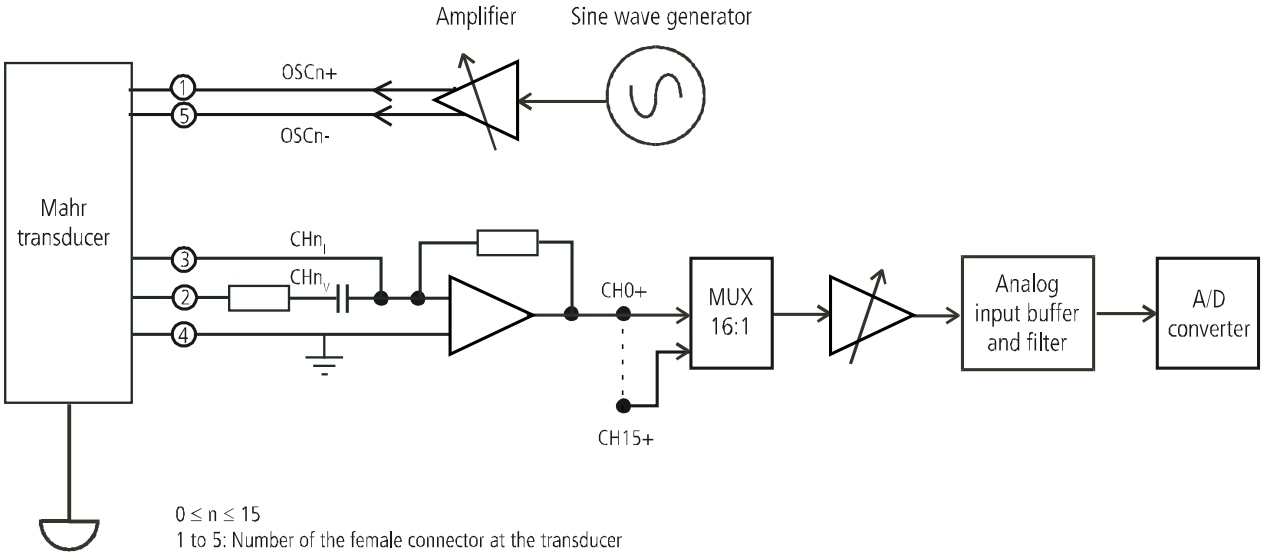
Fig. 4-2: LVDT transducer



4.1.3 Mahr transducers

A Mahr transducer is a highly linear patented VLDT sensor (Very Linear Differential Transducer).

Fig. 4-3: Mahr transducer



4.2 Transducer properties

In the **ConfigTools** program, in the User database, the following properties of a transducer can be defined:

- Name
- Type
- Nominal frequency (Hz)
- Impedance (ohms)
- Nominal supply voltage V_{eff} (V_{rms})
- Sensitivity (mV/V/mm)
- Measurement range (mm).

After selecting the connected transducer type, these properties are set by the board.

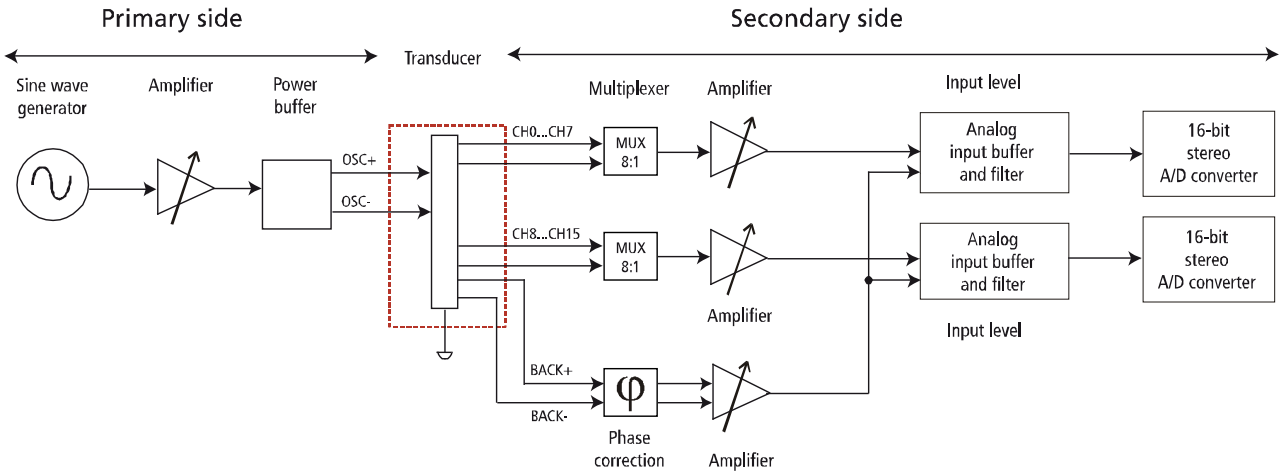
5 Function description

5.1 Transducer inputs

The **APCIe-3701** or **APCI-3701** has 16 single-ended inputs for inductive displacement transducers.

5.1.1 Acquisition principle

Fig. 5-1: APCIe-/APCI-3701: Acquisition principle



The board provides all signals required for the supply of the inductive transducers.

By means of a sine wave generator, the primary side of the transducer is supplied. The output frequency and the signal size (amplitude) of the sine wave generators can be programmed through software.

The transducers are supplied via a differential power buffer. Its high performance enables the two excitation lines (OSC+ and OSC-) to be supplied with a maximum of 260 mA each.
To avoid internal interference such as PC noise, the power buffer is equipped with analog filters. Therefore, the quality of the outgoing signal rises and its distortion is reduced. In case of a short-circuit, the outputs are switched off by internal fuses.

With the **APCIe-3701** or **APCI-3701**, the incoming measurement signals are led over a multiplexer.

Table 5-1: Multiplexer

Board	Multiplexer
APCIe-3701-16	2 x 8:1
APCI-3701-16	

The board provides for a phase correction to compensate the phase difference between the supply signal of the transducer (primary side) and the measurement signal (secondary side).

The measurement signal passes through a software-programmable amplifier. Then the signal is led over an analog low-pass filter and acquired by a 16-bit ADC. Parallel to the measurement signal, the supply signal of the transducer is monitored via a second input at the ADC.

5.1.2 Calibration

By means of the software tool **ConfigTools** (see Chapter 3.5), the signals of the selected transducer are adapted to the board electronics. In this way, the optimal measurement accuracy can be reached for the respective transducer.

5.1.3 Input modes

The acquisition can be carried out in the following modes:

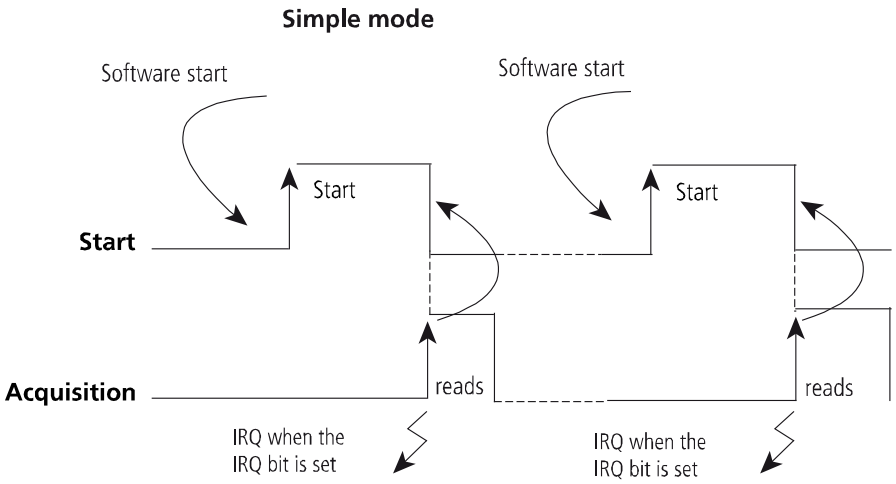
1) Simple mode

2) Sequence mode (with DMA function)

3) Auto-refresh mode

1) Simple mode

The software initialises and starts the A/D conversion. After that it reads in the digital value from one or more channels. This can be done either with or without interrupt.



2) Sequence modes (with DMA function)

Two sequence modes are available, which are described below with examples:

a) Simple sequence mode (examples 1 and 2)

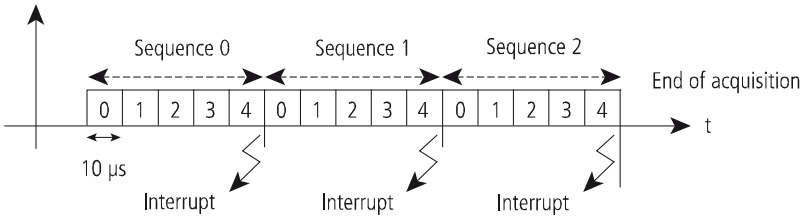
b) Sequence mode with delay.

NOTICE!
Please note that the Sequence mode always uses DMA (Direct Memory Access).

a) Simple sequence mode

Example 1

In this example, the interrupt is released at the end of each sequence (after 5 acquisitions at a time). The whole acquisition is completed after 3 sequences.



b_SequenceSize = 5

b_Channels = 0, 1, 2, 3, 4

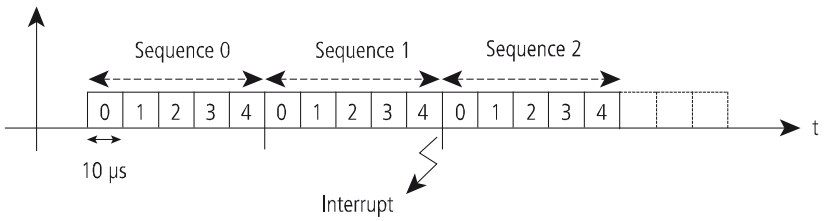
dw_DelayTime = 0

w_SequenceCount = 3

dw_SequencebeforeInterrupt = 1

Example 2

Here, the interrupt is released after 2 sequences (10 acquisitions). The entire acquisition is completed via the following function: i_PCI3701_StopTransducerAcquisition



b_SequenceSize = 5

b_Channels = 0, 1, 2, 3, 4

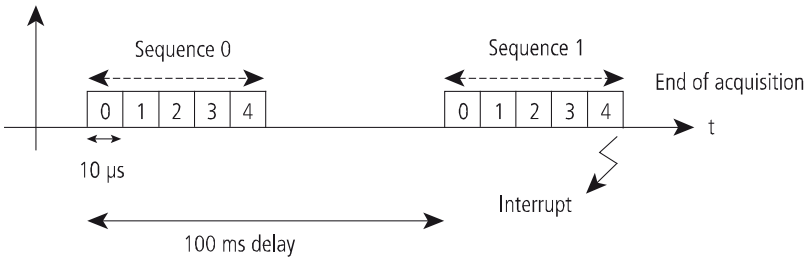
dw_DelayTime = 0

w_SequenceCount = 0

dw_SequencebeforeInterrupt = 2

b) Sequence mode with delay

The interrupt is released after 2 sequences (10 acquisitions). At the same time, the acquisition is completed. The delay between the starts of two sequences is 100 ms.



b_SequenceSize = 5

b_Channels = 0, 1, 2, 3, 4

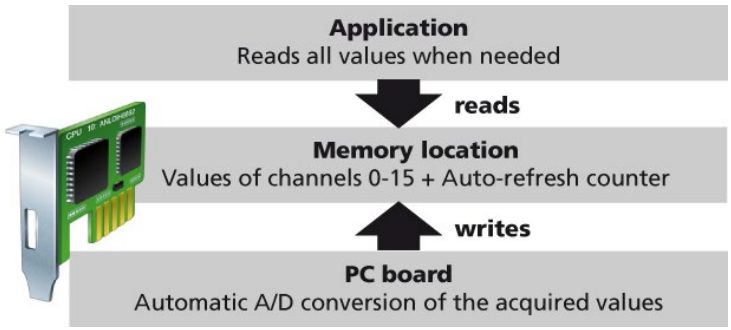
dw_DelayTime = 100

w_SequenceCount = 2

dw_SequencebeforeInterrupt = 2

3) Auto-refresh mode

The analog acquisition is initialised and the channel values are written in a fixed memory location on the board. The PC reads the data asynchronously to the acquisition.



5.1.4 Diagnostic function

Each input has a diagnostic function to detect a short-circuit or line break on the primary or secondary side of the transducer.

The short-circuit detection on the primary side is continuously monitored. The secondary short-circuit detection as well as the primary and secondary line break detection must be activated by software functions.

Short-circuit detection

On the primary side, the supply voltage of the power buffer is monitored. If a short-circuit occurs, the voltage drops and the outputs are switched off by internal fuses. The information is returned by software (see Chapter 6). As soon as the short-circuit has been eliminated, a rearm has to be carried out to reactivate the output.

On the secondary side, the number of the channel that has caused a short-circuit is returned by software.

Line break detection

In case the connection to a transducer is interrupted, i.e. if a transducer is not properly connected or a connection cable is defective, a line break will be detected on the primary or secondary side. This is checked by a software function.

NOTICE!
Please ensure that all transducers are correctly connected!

On the secondary side, the number of the channel that has an open line is returned by software.

5.2 Digital inputs

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 (DIN EN IEC 61131-2):

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

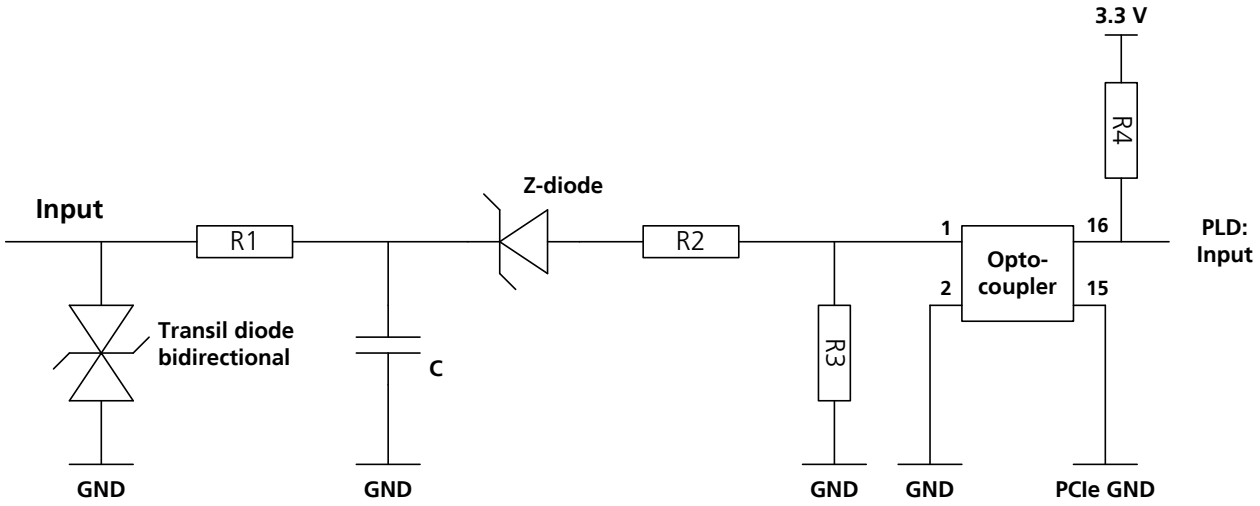
The current demand for each input is 7.5 mA at nominal voltage (see Chapter 8.4.3). The maximum input voltage is 30 V.

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. 5-2: Digital input stage



5.3 Digital outputs

For the digital outputs, positive logic is used:

- Logic “1”: Set output through software
- Logic “0”: Reset output.

All outputs have a common ground line: “GND” (pins 10 and 29 of the 37-pin D-Sub connector).

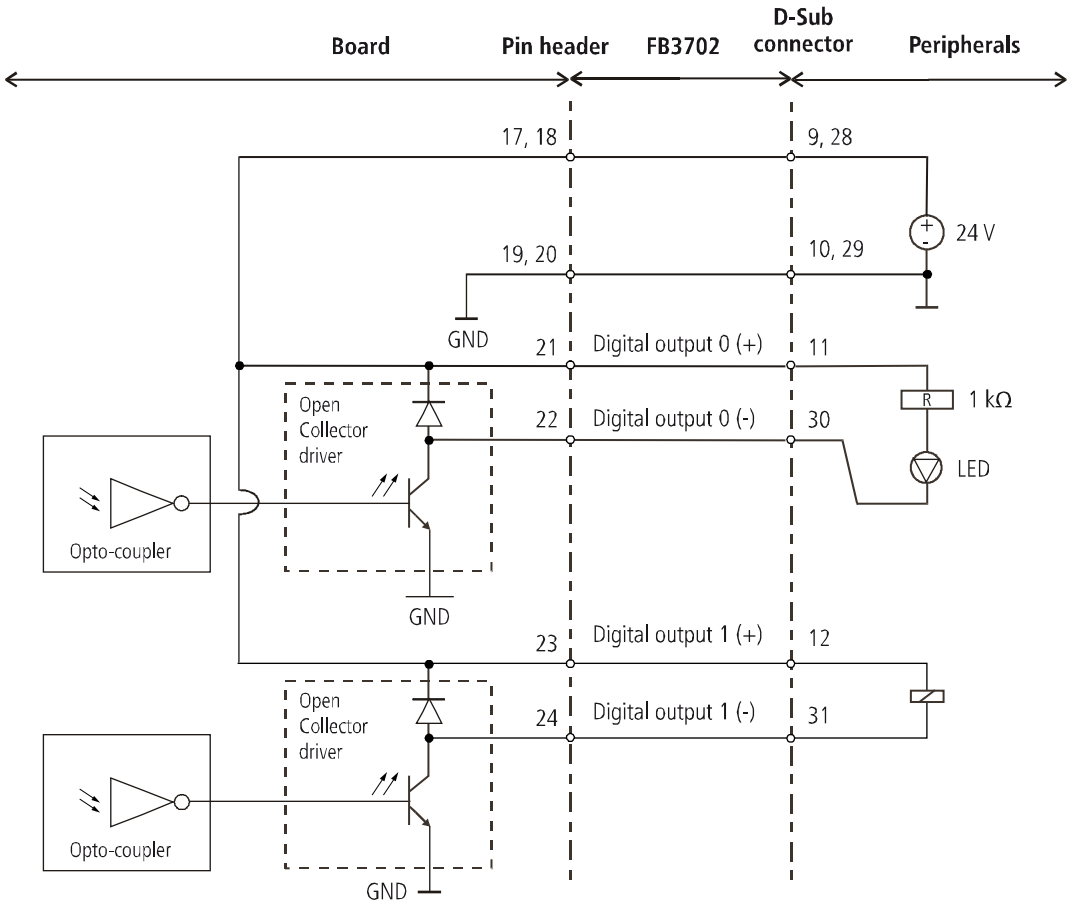
The maximum supply voltage is 30 V (see Chapter 8.4.4). Each output can switch a current of 50 mA. The current per eight outputs is limited to 0.3 A by a polyswitch fuse element.

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

TVS diodes, C-filters 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. Possible noise emitted by the output driver is also reduced by C-filters.

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.

Fig. 5-3: Output circuit



5.4 Interrupt

The board has an interrupt line, which is assigned by the BIOS. Interrupt sources are the following:

- Sequence counter overflow
- DMA interrupt; DMA counter overflow
- FIFO overflow
- Timer
- Short-circuit

The interrupt source information is provided to the user program via an interrupt routine: "_INT_i_PCI3701_SetBoardIntRoutine" (variable "dw_InterruptMask").

5.5 Timer

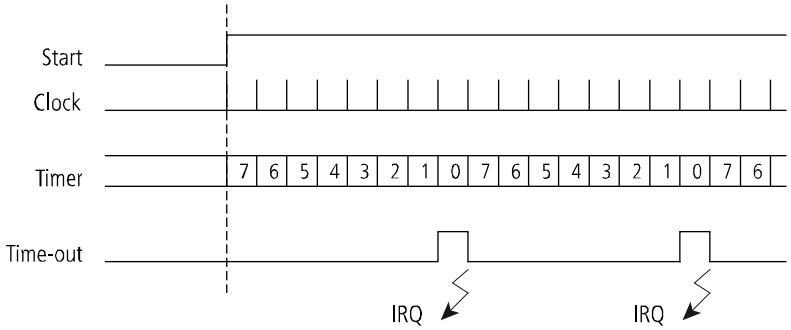
Independently from the PC clock, the timer provides a time base to synchronise operations, for example. The 12-bit timer is a downward counter which can release an interrupt after the programmed cycle time has elapsed (time-out).
The current timer value and the start value (reload value) as well as status and interrupt registers can be read back through software. The cycle time can be programmed in the range from 1 µs to 4095 s.

Example

Reload value = 7
Initialisation with a rising edge
Interrupt enabled

When the timer value is “0”, the reload value “7” will be reloaded with the next valid edge and an interrupt will be released.

Fig. 5-4: Timer (example)



6 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”.

7 Return or disposal

7.1 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. 7-1: 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:

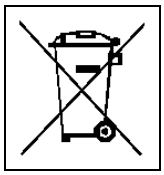
  Phone: +49 7229 1847-0
  E-mail: info@addi-data.com

7.2 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: info@addi-data.com.

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

Fig. 7-2: 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.

8 Technical data and limit values

8.1 Electromagnetic compatibility (EMC)

The board **APCIe-/APCI-3701** is suited for installation in personal computers (PCs) which comply with the European EMC directive.

The board **APCIe-/APCI-3701** complies with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the standard DIN EN IEC 61326-1. 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.

8.2 Mechanical structure

Fig. 8-1: APCIe-3701: Dimensions

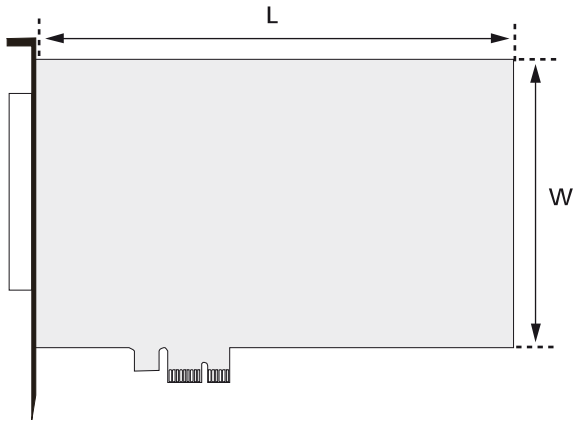
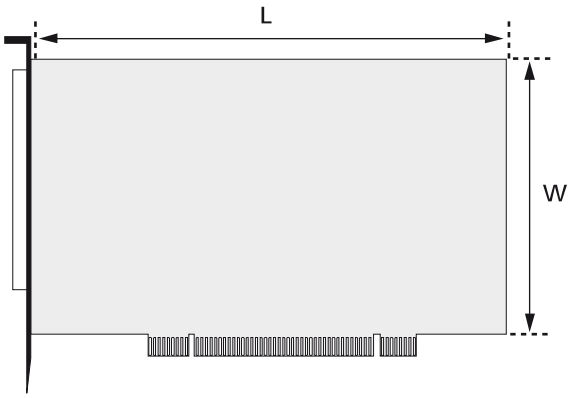


Fig. 8-2: APCI-3701: Dimensions



Dimensions (L x W):	**APCIe-3701:**	180 x 130 mm
	APCI-3701:	138 x 107 mm
Weight:	**APCIe-3701:**	approx. 160 g
	APCI-3701:	119 g

Insertion into:	**APCIe-3701:** PCI Express slot **APCI-3701:** PCI slot
Connection to peripherals:	
Front connector:	50-pin D-Sub male connector (transducer inputs)
Additional connector:	40-pin header (digital I/O)
Accessories: [1]	see the following table and Chapter 3.3

Table 8-1: Accessories

	APCIe-3701	APCI-3701
Accessories	**Transducer inputs**	
Cable	**ST3701**	
Connection box	**PX3701-HB-16 / PX3701-LVDT-16 / PX3701-M-16**	**PX3701-HB-16 / PX3701-LVDT-16**
	Digital I/O	
Cable	**FB3702, ST010 / ST011**	
Screw terminal panel	**PX901-ZG**	

Connection box PX3701-x-x:	
Versions:	**PX3701-HB-16:** for 16 HB transducers **PX3701-LVDT-16:** for 16 LVDT transducers **PX3701-M-16:** for 16 Mahr transducers
Dimensions (L x W x H):	**PX3701-x-16:** 80 x 57 x 250 mm
Weight:	**PX3701-x-16:** approx. 980 g
Housing:	cast aluminium alloy
D-Sub connector:	50-pin female connector (for the connection to the PC board)
Circular connector:	16 x 5-pin female connector DIN 45322 (for the connection of inductive transducers)
Temperature range:	0-60 °C
Protection:	protection caps for circular connectors, dustproof, IP 54
Wall mounting:	via 2 screw channels in the bottom part of the housing

NOTICE!

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

[1] Not included in standard delivery

8.3 Versions

The board **APCIe-/APCI-3701** is available in the following versions:

Table 8-2: Versions

Version	Features
APCIe-3701-16	for 16 displacement transducers (HB, LVDT, Mahr)
APCI-3701-16	for 16 displacement transducers (HB, LVDT)

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

8.4 Limit values

Height:	2000 m over NN
Operating temperature:	0-60 °C (with forced ventilation)
Storage temperature:	-25 °C to +70 °C
Relative air humidity at indoor installation:	50 % at +40 °C 80 % at +31 °C
Minimum PC requirements:	
System bus:	**APCIe-3701:** 1-/4-/8-/16-lane PCI Express according to PCI Express Base Specification, Revision 1.0a (PCI Express 1.0a) **APCI-3701:** PCI 32-bit
Link speed:	**APCIe-3701:** 2.5 Gbit/s
Bus speed:	**APCI-3701:** ≤ 33 MHz
Required space:	- Transducer inputs: 1 PCI Express or PCI slot - Digital I/O: 1 PCI Express or PCI slot (for **FB3702** cable)
Operating system:	Windows 10, Windows 7, Linux
Safety:	
Optical isolation:	1000 V
Energy demand:	
Operating voltage from the PC:	**APCIe-3701:** 3.3 V and 12 V **APCI-3701:** 5 V ± 5 %
Current consumption (typ., without load)	see Table 8-3

Table 8-3: Current consumption

	APCIe-3701-16	APCI-3701-16
+5 V from the PC	-	800 mA ± 10 %
+3.3 V from the PC	360 mA ± 10 %	-
+12 V from the PC	250 mA ± 10 %	-

8.4.1 Transducer inputs

Number of inputs:		16 (multiplexed)
Input type:		single-ended
Coupling:		DC
Resolution:		16-bit
Accuracy:		13-bit
Sampling frequency f_S:	on 1 channel: $f_S = f_P$	at a primary frequency f_P of: 4.883 kHz 7.512 kHz 9.766 kHz 13.951 kHz 19.531 kHz
	from n ≥ 2 channels: $f_S = \frac{f_P}{SP \cdot n}$	f_P = primary frequency SP = settling period (5 ≤ SP ≤ 255) f_S applies to all n channels here
	Example with TESA GT21	
	on 1 channel: $f_S = f_P$	= 13.951 kHz
	from n ≥ 2 channels:	
	on 8 channels: $f_S = \frac{13.951\,kHz}{5 \cdot 8}$	= 348.7 Hz
	on 16 channels: $f_S = \frac{13.951\,kHz}{5 \cdot 16}$	= 174.4 Hz
Input stage:		
Input impedance (software-programmable):		2 kΩ 10 kΩ 100 kΩ 10 MΩ
Input range:		± 3.3 V max. (programmable)

8.4.2 Sine wave generator (transducer supply)

Number of outputs:	2
Coupling:	AC
Programmed signals:	
Type:	sine differential (180° phase shift)

Output frequency f_P (primary frequency):	4.883 kHz 7.512 kHz 9.766 kHz 13.951 kHz 19.531 kHz

8.4.3 Digital inputs

Number of inputs:	8
Nominal voltage:	24 V
Filter/Protective circuit:	input filter, TVS diode, RC filter, Z-diode, opto-coupler
Optical isolation:	1000 V (via opto-couplers)
Input voltage:	0-30 V
Input current (at nominal voltage):	7.5 mA typ.
Max. input frequency (at nominal voltage):	Channel 0: 1 MHz Channels 1-7: 5 kHz
Logic input levels:	UH_{max}: 30 V UH_{min}: 19 V UL_{max}: 14 V UL_{min}: 0 V

8.4.4 Digital outputs

Number of outputs:	8
Output type:	Open Collector
Nominal voltage:	24 V
Filter/Protective circuit:	TVS diode, C-filter, opto-coupler
Optical isolation:	1000 V (via opto-couplers)
Supply voltage:	5-30 V
Current limit:	0.3 A (per 8 channels, via PTC)
Output current per output:	50 mA typ.

8.4.5 Timer

Number:	1 (interruptible)
Resolution:	12-bit
Time base:	µs, ms, s (programmable)
Time value range:	1 to 4095
Tolerance:	≤ 1 µs, ms, s

9 Appendix

9.1 Glossary

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.

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

Edge
Edges can either be rising or falling.
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. The rising edge is the transition from the status “0” to “1”; the falling edge is the opposite transition.

EMC
= Electromagnetic Compatibility

According to the European EMC Directive, electromagnetic compatibility is “the ability of equipment to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to other equipment in that environment.”

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.

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.

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 there is no flow of electrical current between the circuit to be measured and the measuring system.

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.

PTC
= Positive Temperature Coefficient

The best-value resistance sensors are either specified as PTC or NTC thermistors. A PTC thermistor has a positive temperature coefficient, hence, “PTC”.

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

Short-circuit
A short-circuit exists between two terminals of an electric circuit if the relevant terminal voltage is zero.

Short-circuit current
A short-circuit current is the current between two short-circuited terminals.

Timer
A timer is used for adjusting time-dependent program processes between the processor and peripheral devices. It contains counters that are mostly independent of each other and can be programmed like a programmable I/O module via a control word register for different operating types.

TVS
= Transient Voltage Suppression

9.2 Index

10 Contact and support

Do you have any questions? Write or call us:

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Airport Boulevard B210
77836 Rheinmünster
Germany

Phone: +49 7229 1847-0
Fax: +49 7229 1847-222

E-mail: info@addi-data.com

Manual and software download from the Internet:

https://drivers.addi-data.com