

Counter & Digital I/O PCIe card PCT-8424/8425/8426 User Guide

My DAQ Card Details:

type of card: (e.g. PCT-8424)
serial number: (e.g. 83010108)
purchase date:
card owner:

Manufacturing, sales office, service center, technical support and headquarters:

address: TEDIA® spol. s r. o.
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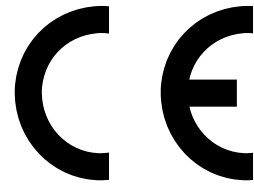
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CE Declaration of Conformity

All TEDIA® products described in this user guide comply with the essential requirements of the following applicable European Directives:

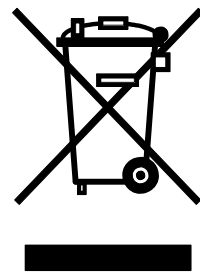
- Electromagnetic Compatibility (EMC) Directive 2014/30/EU
- RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU

The CE Declaration of Conformity original document is stored at the manufacturer and its copy may be provided on request.



Waste Electrical and Electronic Equipment (WEEE)

This symbol indicates that waste products should be disposed of separately from municipal household waste according to WEEE Directive 2012/19/EU of the European Parliament and the Council on waste electrical and electronic equipment (WEEE). All products at the end of their life cycle must be sent to a WEEE collection and recycling center. Proper WEEE disposal reduces environmental impact and the risk to human health due to potentially hazardous substances used in such equipment. Your cooperation in proper WEEE disposal will contribute to the effective usage of natural resources.



1. Introduction

1.1 Description

The PCT-8424/8425/8426 are add-on PCI Express cards intended especially for laboratory and industrial automation and measuring systems.

The PCT-8424/8425/8426 cards provide especially these features:

- 24 isolated digital inputs; signal levels depending on the type of card (5 V or 24 V)
- 24 counters and timers with capture register (all 32 bit depth)
- three 8-bit bidirectional digital ports, software configurable as input or output
- IRQ logic with interrupt sources derived from rising or falling edge of each digital port signal (i.e. 96 individually programmable interrupt sources) and internal timer

Available types and versions of cards:

PCT-8424	standard format card intended for 5 V signal levels (common GND)
PCT-8424/LP	low-profile format card of PCT-8424
PCT-8425	standard format card intended for 24 V signal levels (common GND)
PCT-8425/LP	low-profile format card of PCT-8425
PCT-8426	standard format card intended for 24 V signal levels (common 24 V)
PCT-8426/LP	low-profile format card of PCT-8426

In the following text, unless otherwise stated, the designation **PCT-842x** applies to all types and versions of card.

1.2 General instructions for use

The PCT-842x card is suitable for installation in either office or industrial computers that are fitted with the PCI Express bus (Gen 1 compatible).

Cable types and their maximum length are described in paragraph 2.5 General data.

Caution:

The cards are designed for DAQ&C applications and may be used only according to the manufacturer's recommendations and precautions given in this manual and other general standards and terms and may be used only such a way, that its failure caused by any reason will not be dangerous to any person or property.

1.3 Note on the contents of the manual

This manual contains all information related to card features, I/O connectors etc., but does not include a description of installing and using drivers.

For information about drivers and programming check the dedicated documentation.

1.4 New firmware versions and customer's firmware

The PCT-842x card is based on a FPGA unified core providing implementation of PCI Express bus and all peripheral circuitry, e.g. solution that gives maximum control and supervision over full functionality. High concentration of control algorithms within FPGA allows to add or modify functions without redesign the board (e.g. firmware with added special custom features or a build completely new custom firmware).

A simple software utility for user-friendly firmware upgrade is available.

2. Specifications

2.1 Digital inputs

Input type:

PCT-8424, PCT-8424/LP	HC/HCT/TTL	
PCT-8425, PCT-8425/LP	24 V, common GND	(designed for PNP outputs)
PCT-8426, PCT-8426/LP	24 V, common 24 V	(designed for NPN outputs)

Number of inputs: 24

Parameters of HC/HCT/TTL type inputs:

signal level L:	< 0.8 V	
signal level H:	> 2.0 V	
input impedance:	10 kOhm approx.	(pull-up resistor against 5 V)
overvoltage protection:	-10 V / +15 V	

Parameters of 24 V type inputs:

signal level L:	< 5 V	(see Fig. 4 and 5 in Appendix)
signal level H:	15÷30 V	(see Fig. 4 and 5 in Appendix)
input impedance:	10 kOhm approx.	
overvoltage protection:	±40 V max. 1 s	

Isolation voltage:	1000 V _{DC}	(standard version of the card)
	600 V _{DC}	(card with ESD-X1 option)

Note: ESD-X1 option includes Surge Arrester (protection of the isolation barrier).

2.2 Digital ports

Number of ports: three 8-bit bidirectional ports

Operating levels: HC/HCT/TTL

Load impedance of outputs: 500 Ohm min.

Note: Digital bidirectional ports are not protected against overvoltage, stresses outside the range 0÷5 V will may cause permanent damage.

The digital ports in the output mode are durable to permanent short-circuit against GND while maintaining the maximum current of the 5V power source (see paragraph 2.5 General data).

2.3 Counters and timers

Number of counters:	24	
Counting depth:	32 bits	
Counting mode:	upward counting with software triggering	
Counting frequency:	2 MHz max.	(PCT-8424)
	200 kHz max.	(PCT-8425, PCT-8426)
Signal asymmetry (L/H ratio):	L > 0.2 μs, H > 0.2 μs	(PCT-8424)
	L > 2 μs, H > 2 μs	(PCT-8425, PCT-8426)

Number of timers:	24
Timers mode:	period measurement, with assigned capture register
Timers depth:	32 bits
Time base:	25 MHz (ie. 171 second max.)

2.4 Interrupt logic

Interrupt sources:	timestamp IRQ generator (1÷255 ms), all digital ports
Interrupt trigger event:	timestamp generator overflow, any combination of rising or falling edges on all digital ports and digital inputs

2.5 General data

Bus type:	PCI Express (x1, Gen 1)
PCI ID:	VID=1760 _H , DID=0830 _H (PCT-8424, PCT-8424/LP) VID=1760 _H , DID=0831 _H (PCT-8425, PCT-8425/LP) VID=1760 _H , DID=0832 _H (PCT-8426, PCT-8426/LP)
Bus power consumption:	300 mA typ. @ 3.3 V (500 mA max.) 150 mA typ. @ 12 V (500 mA max.)
Internal power supply:	700 mA max. @ 5 V (see note below)
Board dimensions::	56 x 128 mm approx. (PCE-8019 not included)
Connectors - digital ports:	D-Sub 25 - male (digital & conouter inputs) 10 pin header type (DIO ports 0, 1 a 2)
Operating temperature:	0÷60 °C
Storage temperature:	-20÷70 °C
Operating humidity:	10÷90 %, noncondensing
Recommended cable length:	shielded cables, 2 m max.

Note: The internal 5V power supply voltage is generated by the on-board circuits from the 12V PCI Express bus power source and is used to supply the DIO ports and also to supply PCE-16xx series external boards (see description of KX1÷KX3 connectors). The total current of all 24 DIO signals when output mode is selected, including the current consumption of PCE-16xx boards, must not exceed the permitted value.

3. Installation

3.1 Introduction

Attention has been focused on achieving a high quality and reliability during the manufacturing process and attention was also paid to an inspection of the card before being shipped to you. Detailed reading of this guide and following the instructions precisely are highly recommended for achieving full quality and to prevent any damage during installation. For further information see manufacturer's website <http://www.tedia.eu>.

3.2 Hardware configuration

The PCT-842x card contains a single configuration element - a two-segment DIP switch (the status of this switch can be read by the program to identify multiple cards as CardID value). Check Figure 1 in Appendix of this manual for more information.

3.3 Installation

Important Warning:

While installing the card, please follow the principles for handling the circuits, which are sensitive to the electrostatic discharge damage. Touch the card carefully only by the edges, and do not touch the components or metal contacts on the bottom of the card.

The computer must be switched off before the card is installed. Always disconnect the power supply cord and other cables connected to the PC!

The cards may be stored only in an antistatic wrapper outside of the computer. Failure to comply with the rules listed above may lead to damage of the sensitive circuits of the card, or even of the whole computer.

After removing the slot cover plate, plug the configured card into a free slot for expansion PC cards and fix it in place.

If you plan to use the digital ports DIO1 and DIO2 of standard format card, install the PCE-16xx series board (not included in the delivery package of the card) into the next position and connect the flat cables. Similarly, if you plan to use the digital ports DIO0, DIO1 and DIO2 of low-profile card, install the PCE-8025/LP adaptor board (not included in the delivery package) into the next position and connect the flat cables.

Note: *In the event of any queries, please contact the manufacturer's technical support. See <http://www.tedia.eu> for more contact information.*

3.4 Location of switches and connectors

See the Appendix, Figure 1 for location of configuration switches and connectors.

3.5 Connector pin assignment

The connector pin layouts are shown in Table 1 through Table 3, the connector pin assignment is shown in Figure 2 (all in Appendix of this manual).

4. Counters and Timers

4.1 Introduction

The PCT-842x cards contain 24 counters and 24 timers with capture registers connected to 24 digital inputs (ie. each digital input controls one functional block composed of one counter, one counter and one capture register).

4.2 Description of counters

The counters of all PCT-842x cards work as unidirectional (count upwards) with the possibility of software triggering (ie. the processing of input signal can be enabled/disabled by software), counter value programming and reading the current value.

Although each block of counter/timers can be software controlled independently of the others, the card also allows synchronous operation of any set of blocks.

The PCT-8424 card counters respond to the falling edge, ie. the contents of the counter are incremented by one at the time of the signal change from 1 to 0 in the data register.

Conversely, the PCT-8425/8426 card counters respond to the rising edge.

Note: Check the digital inputs description for detail information about signal levels definition.

4.3 Description of timers & capture registers

Each counter is equipped with a timer and capture register.

The timer works as a unidirectional (counts upwards) with time base of 25 MHz (ie. is incremented every 40 ns) and stops when the value reaches $2^{32}-1$.

The timer & capture register block responds to the same event as the counter (ie. falling or rising edge on input signal) and two operations occur at the time the event is detected...

- the current timer value is transferred to the capture register,
- the timer is set to zero.

In other words, the capture register provides the time difference between the last two events and the timer provides the time elapsed since the last event. Both values can be effectively used to calculate frequency of events, especially in case of low frequencies.

The PCT-842x cards support not only synchronous reading of all measured values in one functional block (ie. current values of counter, timer and capture register), but also synchronous reading of all values of any selection of blocks.

5. Digital Inputs and Ports

5.1 Introduction

The PCT-842x card provides 24 isolated digital inputs (signal levels depending on the type of card) and three 8-bit bidirectional digital ports.

All digital inputs (identified as DIN00÷DIN23) use the D-Sub 25 connector located on the card bracket, three digital ports (identified as DIO0, DIO1 and DIO2) use header type connectors located at the back edge of the card.

In case of the standard format card (ie. PCT-842x), the DIO0 port is accessed on the card bracket via adapter cable PCE-8019 terminated with D-Sub 9 connector. Remaining two ports (ie. DIO1 and DIO2) can be accessed via adapter cable PCE-1620 (card bracket with D-Sub 9 connector), or other types from the PCE-16xx series adapter boards.

Note: *Unlike the adapter cable PCE-8019, the PCE-16xx boards are not included in the delivery package of the card.*

In case of the low-profile format card (ie. PCT-842x/LP) all three ports DIO0, DIO1 and DIO2 can be accessed via adapter cable PCE-8025/LP (low-profile card bracket with D-Sub 25 connector); there are currently no other option available.

Note: *The PCE-8025/LP adaptor board is not included in the delivery package of the card.*

The signal direction of DIO port (ie. input or output option) can be selected independently for each 8-bit port (it is not possible to select direction individually for each of the eight signals of one DIO port) from the user software.

The port direction and output data after computer is turned on or restarted are stored in the on-board EEPROM memory and can be modified by the software utility (by default, all ports are set as input).

5.2 Description of digital inputs

All cards of the PCT-842x series contain 24 isolated digital inputs they differ from each other only by signal levels and input connections.

The PCT-8424 card digital inputs work with HC/HCT/TTL levels and use HCTMOS circuits providing high input impedance, very low leakage current and protection diodes. The unconnected state of inputs represents the H logic level generated by pull-up resistors 10 kOhm against a voltage of 5 V, and the inputs can be therefore also used to direct connecting of floating contacts.

Check the Appendix, Figure 3 for detail information.

The PCT-8425 card digital inputs support 24 V signals level and work with positive polarity against the common rail (inputs are designed for PNP outputs).

Check the Appendix, Figure 4 for detail information.

Similar to PCT-8425 card, digital inputs of the PCT-8426 card support 24 V signals level, but work with negative polarity against the common rail (inputs are designed for NPN outputs).

Check the Appendix, Figure 5 for detail information.

5.3 Description of digital ports

Drivers and receivers based on HCTMOS technology were used for digital ports.

In the output mode (ie. driver mode), the HCTMOS circuits provide true 5 V signal levels with a high output current with low voltage drop and can therefore be used for direct control of LEDs, optocouplers, or miniature relays (coil parameters 5 V, 500 Ohm).

In the input mode (ie. receiver mode), the HCTMOS circuits provide not only TTL signal compatibility, but moreover high input impedance, very low leakage current and protection diodes. The unconnected state of inputs represents the H logic level generated by pull-up resistors 10 kOhm against a voltage of 5 V, and the inputs can be therefore also used to direct connecting of floating contacts.

Check the Appendix, Figure 6 for detail information.

Note: *Unfortunately, the concept of bidirectional ports does not provide the overvoltage protection available to other ports of PCI/PCIe TEDIA cards.*

5.4 Interrupt logic

The PCT-842x card allows to trigger an interrupt (simultaneously with the timestamp IRQ generator) by any combination of rising or falling edges of the signals of all digital inputs and digital ports.

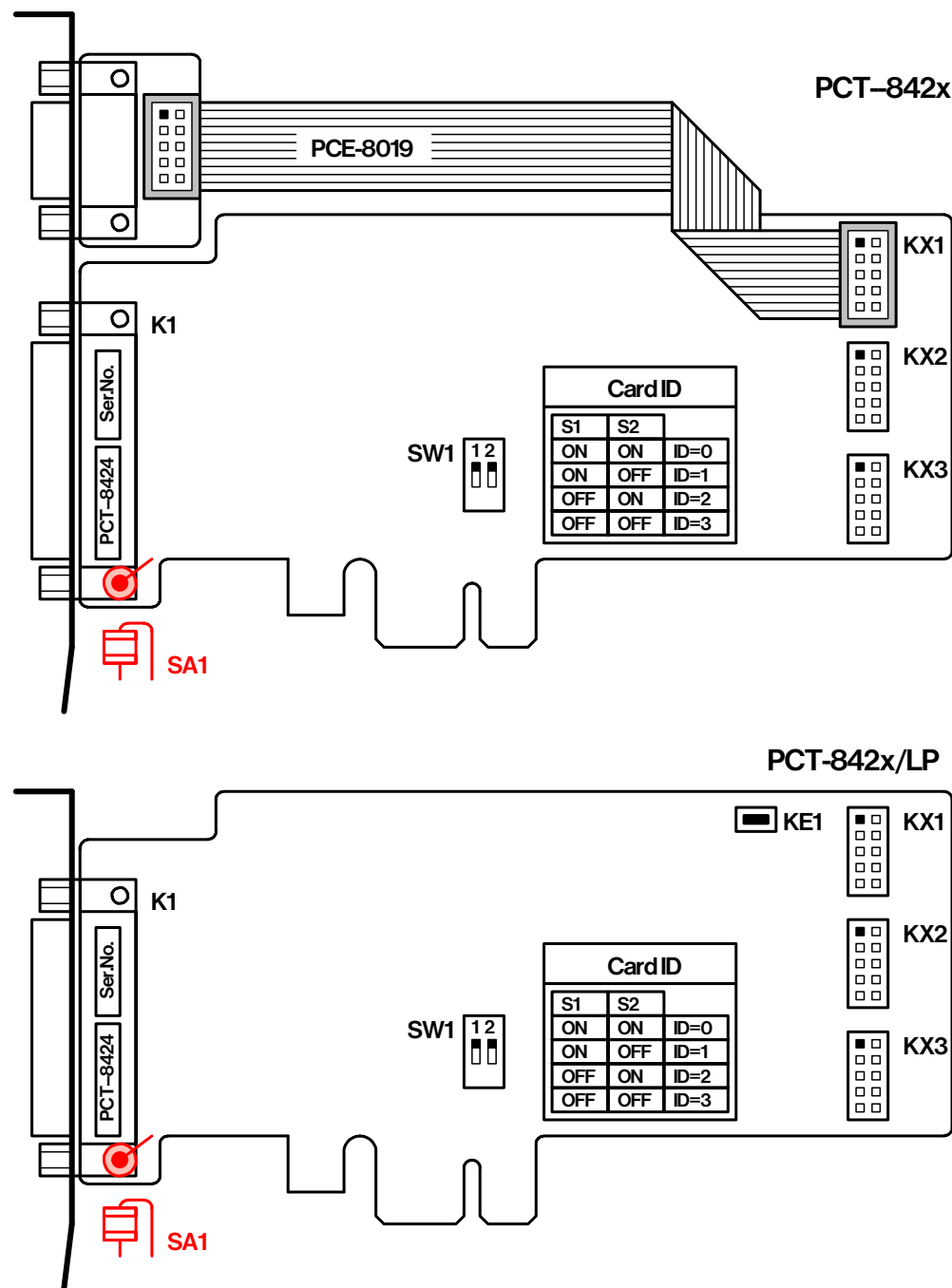


Figure 1. Location of switches and connectors on both version of cards.

- K1 connector of digital inputs DIN00÷DIN23 (D-Sub 25 - male)
- KX1 connector of digital port DIO0, ie. DIO00÷07 signals (2x5 pin header type)
- KX2 connector of digital port DIO1, ie. DIO08÷15 signals (2x5 pin header type)
- KX3 connector of digital port DIO2, ie. DIO16÷23 signals (2x5 pin header type)
- SW1 DIP switch for identifying multiple cards (CardID value)
- PCE-8019 adapter cable PCE-8019 terminated with D-Sub 9 male connector (included in the delivery package of the standard format card)
- KE1 button for activating backup firmware (intended for service purposes)
- SA1 Surge Arrester (cards with ESD-X1 option)

K1 signal (PCE-8025/LP)	pin	pin	K1 signal (PCE-8025/LP)
DIN00 (DIO00)	C1	C14	DIN01 (DIO01)
DIN02 (DIO02)	C2	C15	DIN03 (DIO03)
DIN04 (DIO04)	C3	C16	DIN05 (DIO05)
DIN06 (DIO06)	C4	C17	DIN07 (DIO07)
DIN08 (DIO08)	C5	C18	DIN09 (DIO09)
DIN10 (DIO10)	C6	C19	DIN11 (DIO11)
DIN12 (DIO12)	C7	C20	DIN13 (DIO13)
DIN14 (DIO14)	C8	C21	DIN15 (DIO15)
DIN16 (DIO16)	C9	C22	DIN17 (DIO17)
DIN18 (DIO18)	C10	C23	DIN19 (DIO19)
DIN20 (DIO20)	C11	C24	DIN21 (DIO21)
DIN22 (DIO22)	C12	C25	DIN23 (DIO23)
COM (GND)	C13		

Table 1. D-Sub 25 (male) connector pin assignment.

Note: The signal names before the bracket apply to the connector K1 located on card, the signal names in brackets apply to the connector located on PCE-8025/LP adapter.

KX1/KX2/KX3 signal	pin	pin	KX1/KX2/KX3 signal
DIO00/08/16	D1	D2	DIO01/09/17
DIO02/10/18	D3	D4	DIO03/11/19
DIO04/12/20	D5	D6	DIO05/13/21
DIO06/14/22	D7	D8	DIO07/15/23
GND	D9	D10	5V (see specification chapter)

Table 2. Header type connector pin assignment.

Note: In case of the standard format card, the DIO0 port is accessible on the card bracket via adapter cable PCE-8019 terminated with D-Sub 9 connector. Remaining two ports (ie. DIO1 and DIO2) can be accessed via adapter cable PCE-1620 (card bracket with D-Sub 9 connector), or other types from the PCE-16xx series adapter boards. In case of the low-profile format card all three ports DIO0, DIO1 and DIO2 can be accessed via adapter cable PCE-8025/LP (see Table 1).

signal	pin	pin	signal
DIO00/08/16	C1		
DIO02/10/18	C2	C6	DIO01/09/17
DIO04/12/20	C3	C7	DIO03/11/19
DIO06/14/22	C4	C8	DIO05/13/21
GND	C5	C9	DIO07/15/23

Table 3. D-Sub 9 (male) connector pin assignment located on PCE-8019 (single DIO port adapter cable) and PCE-1620 (dual DIO port adapter cable).

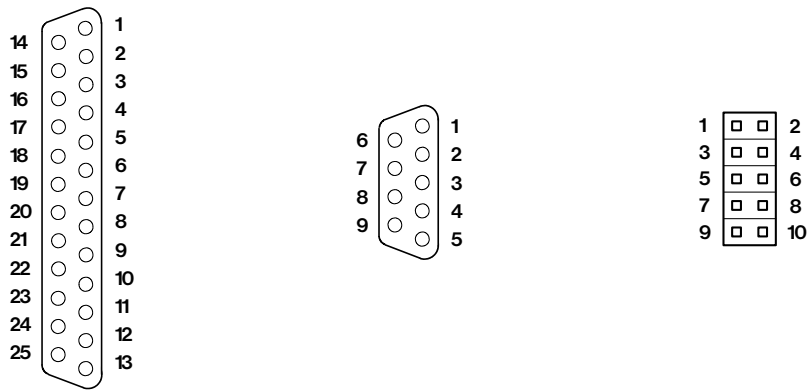


Figure 2. Pin layout on D-Sub 25 (male), D-Sub 9 (male) and header type connectors (2x 5 pins, 2.54 mm pitch).

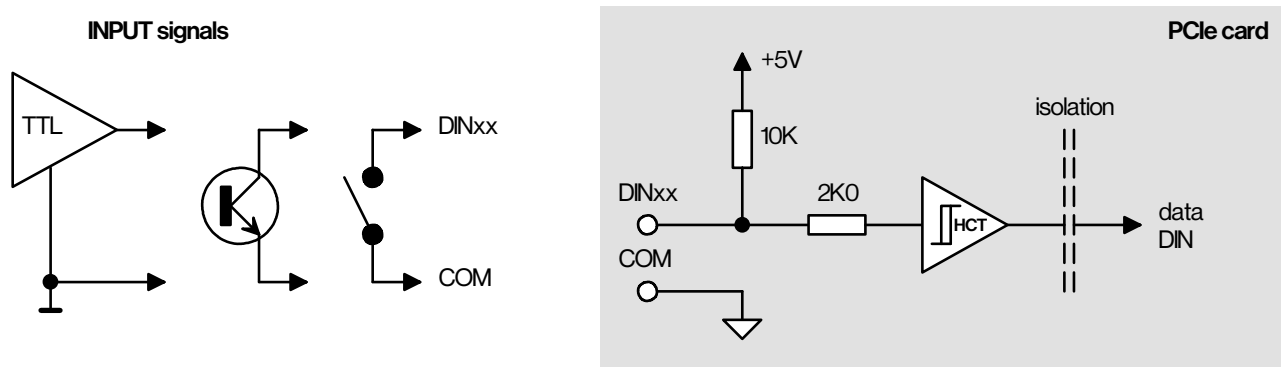


Figure 3. Simplified schematic of isolated inputs PCT-8424.

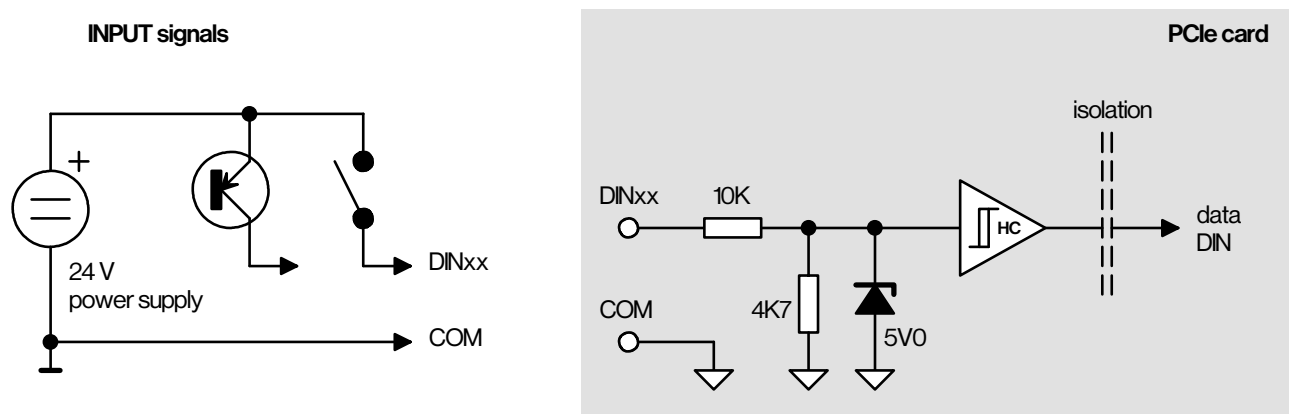


Figure 4. Simplified schematic of isolated inputs PCT-8425.

As can be seen from the schematic, DINxx inputs handle signals with positive polarity against the common rail (COM).
Unconnected input or signal voltage lower than 5 V is represented by the value 0 in the data register of the card, the signal voltage greater than 15 V is represented by the value 1.

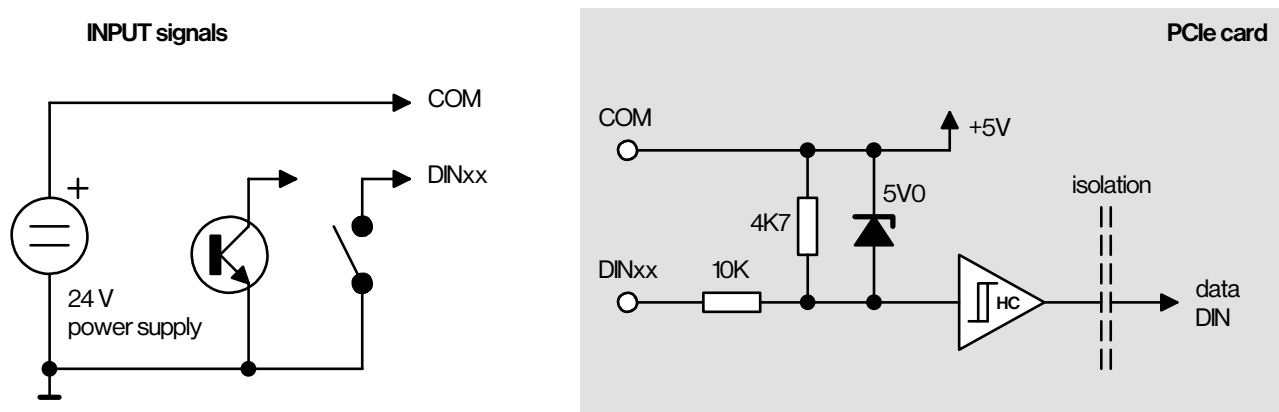


Figure 5. Simplified schematic of isolated inputs PCT-8426.

As can be seen from the schematic, DINxx inputs handle signals with negative polarity against the common rail (COM).

Unconnected input or signal voltage lower than 5 V is represented by the value 0 in the data register of the card, the signal voltage greater than 15 V is represented by the value 1.

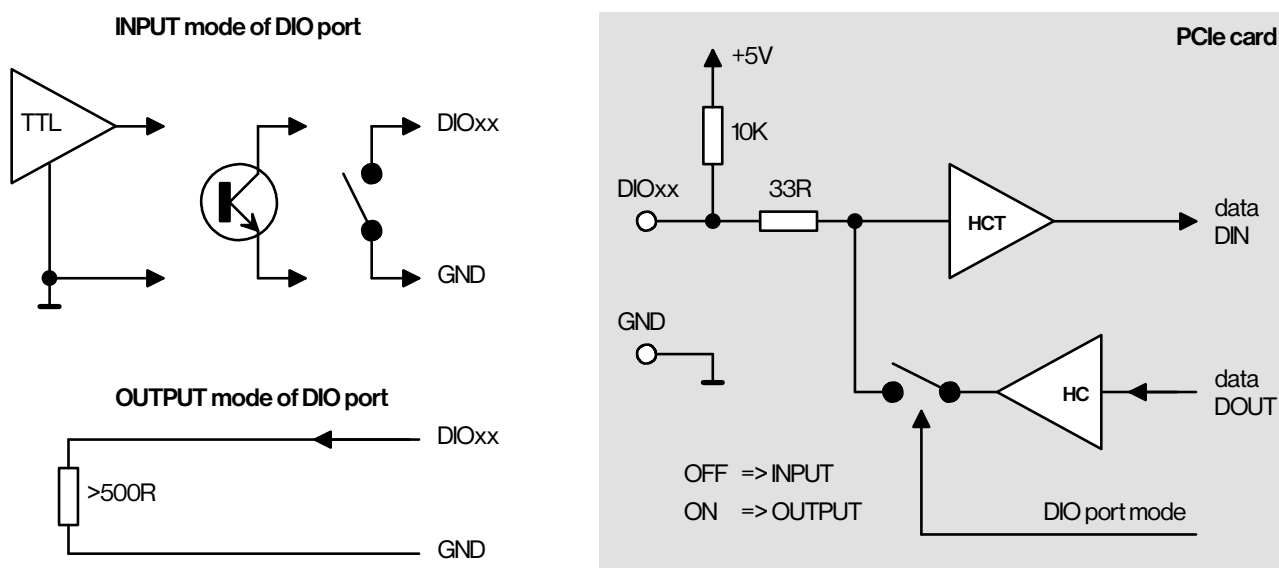
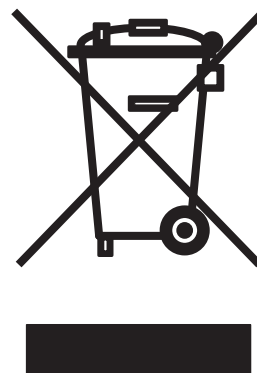


Figure 6. Simplified schematic of DIO ports.

The diagram shows one bidirectional I/O channel.

The signal direction of DIO port (ie. input or output option) can be selected independ for each 8-bit port, but it is not possible to select direction individually for each of the eight signals of one DIO port.

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