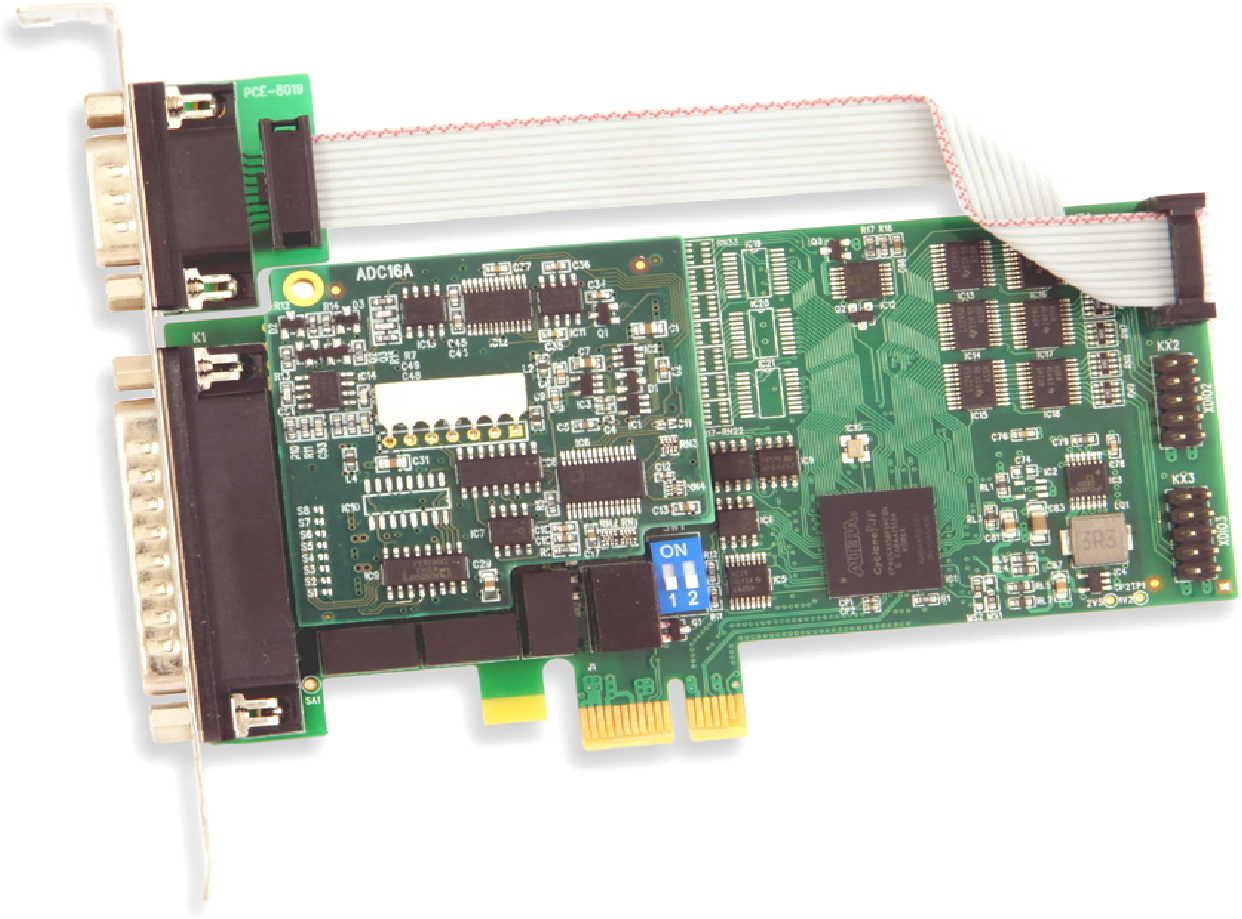

Multifunctional DAQ PCIe card PCA-8428/8429/8438/8439 User Guide

My DAQ Card Details:

type of card: . . . . . (e.g. PCA-8428)

serial number: . . . . . (e.g. 84010108)

purchase date: . . . . . .

card owner: . . . . . .

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

address: TEDIA® spol. s r. o.
Zábělská 12
31211 Plzeň
Czech Republic

website: http://www.tedia.eu

phone/e-mail: https://www.tedia.eu/contacts

tech. support: https://www.tedia.eu/support

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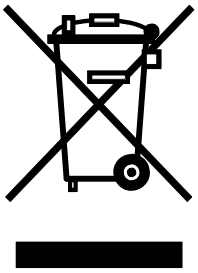
CE Declaration of Conformity

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 PCA-8428/8429/8438/8439 are add-on PCI Express cards intended especially for laboratory and industrial automation and measuring systems.

The PCA-8428/8429/8438/8439 cards provide especially these features:

- eight or sixteen isolated analog inputs equipped with 14-bit A/D converter
- with/without two isolated analog outputs equipped with 12-bit D/A converters
- 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. 48 individually programmable interrupt sources) and internal timer

Available types and versions of cards:

PCA-8428	8 analog inputs, 2 analog outputs, three 8-bit DIO ports
PCA-8429	8 analog inputs, three 8-bit DIO ports
PCA-8438	16 analog inputs, 2 analog outputs, three 8-bit DIO ports
PCA-8439	16 analog inputs, three 8-bit DIO ports
PCT-84xx/LP	low-profile format card of PCA-8428, PCA-8429, PCA-8438 and PCA-8439

In the following text, unless otherwise stated, the designation **PCA-84xx applies to all types and versions of card.**

1.2 General instructions for use

The PCA-84xx 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 2.7 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 PCA-84xx 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 Analog inputs

Number and type of inputs:	8x S.E.	(PCA-8428, PCA-8429)
	16x S.E.	(PCA-8438, PCA-8439)
A/D converter resolution:	14 bits	
Basic input range:	±10 V	
Programmable gain:	1x, 2x, 4x, 8x, 16x, 32x (ie. ranges ±10 V, ±5 V, ±2.5 V, ... , ±0.3125 V)	
Measuring error:	±0.10 % max.	(range ±10 V)
(see note below)	±0.12 % max.	(ranges ±5 V, ±2.5 V, ±1.25 V)
	±0.15 % max.	(ranges ±0.625 V, ±0.3125 V)
Input impedance:	>10 MOhm	
Maximum input voltage:	±24 V	(permanently)
ESD protection:	TVS diode 26 V	(230 W @ 8/20 µs)
Isolation voltage:	1000 V_{DC}	(standard version of the card)
	600 V_{DC}	(card with ESD-X1 option)

Note: *The measuring error is related to the range (not to the measured value) and after full setling. Calibration constants are stored in the on-board EEPROM separately for each measuring range to compensate for offset and gain.*
Achieving the error defined above requires periodical adjustment/calibration.

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

2.2 Analog outputs

Number of outputs:	2	
D/A converters resolution:	12 bits	
Output ranges:	±10 V with software max./min. limiting thresholds	
Output voltage error:	±0.15 % max.	(see note below)
Settling time:	5 µs typ.	
Output impedance:	<1 Ohm	
Load impedance:	>2 kOhm	(see note below)
Isolation voltage:	both analog outputs are isolated together with the analog inputs, see previous paragraph	

Note: *The output voltage error is related to the range (not to the output value) and after full signal setling. Calibration constants are stored in the on-board EEPROM separately for each channel to compensate for offset and gain.*
Achieving the error defined above requires periodical adjustment/calibration.

Note: *The output can be loaded with a current of up to 5 mA (ie. 10 V with a load of 2 kOhm), but the current consumption of all outputs is limited to 20 mA in total.*
The outputs are short-circuit resistant to AGND.

2.3 Counters, encoders

Number of counters:	2	
Counting mode:	bidirectional with programmable input encoder	
Counting depth:	32 bits (configurable in range of 2÷4294967295)	
Counting modes:	IRC quadrature modes X1, X2, X4 "up/down", "count/dir", "count/gate"	
Counting frequency:	2 MHz max.	(IRC modes, w/o filter)
	4 MHz max.	(other modes, w/o filter)
	800 kHz max.	(IRC modes, with filter)
	1.6 MHz max.	(other modes, with filter)
Type of counter inputs:	counters use digital port signals (DIO0)	

2.4 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 2.7 General data).

2.5 Trigger and scan logic

Trigger sources:	software start, internal timer, external digital signal	
Data sources of scan logic:	all inputs and outputs (ie. current status readback), measurement timestamp generator, global timestamp generator	
Timer trigger frequency:	1.5 Hz ÷ 100 kHz	
Software trigger frequency:	single measurement up to hundreds of Hz	
Analog input measurement time:	10 µs	(gain 1x÷8x)
	13 µs	(gain 16x)
	18 µs	(gain 32x)
	+20 µs	(high resolution mode)
Other channels processing time:	1 µs	
Minimum sampling period:	the sum of the measurement/processing time of all channels in the measurement sequence	
Data buffer for measured data:	main FIFO with a capacity of 32 kB low capacity FIFO for software-triggered mode (512 B)	

Note: The maximum sampling frequency (depending on measuring sequence configuration) is equal to the reciprocal value of the minimum sampling period.

2.6 Interrupt logic

Interrupt sources:	EOS (ie. End Of the measurement Sequence), FIFO memory control circuits, timestamp IRQ generator (1÷255 ms), all digital ports
Interrupt trigger event:	EOS (software trigger mode), number of samples in FIFO memory (max. 32768 B), timestamp generator overflow, any combination of rising or falling edges on all digital ports

2.7 General data

Bus type:	PCI Express (x1, Gen 1)	
PCI ID:	VID=1760_H, DID=0840_H	(PCA-8428, PCA-8428/LP)
	VID=1760_H, DID=0841_H	(PCA-8429, PCA-8429/LP)
	VID=1760_H, DID=0842_H	(PCA-8438, PCA-8438/LP)
	VID=1760_H, DID=0843_H	(PCA-8439, PCA-8439/LP)
Bus power consumption:	300 mA typ. @ 3.3 V	(500 mA max.)
	300 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:	D-Sub 25 - male	(analog inputs/outputs)
	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 PCA-84xx 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 5, the connector pin assignment is shown in Figure 2 (all in Appendix of this manual).

4. Analog Inputs

4.1 Introduction

The PCA-8428 and PCA-8429 cards offer eight analog inputs and the PCA-8428 and PCA-8429 cards offer sixteen analog inputs.

Analog inputs are isolated from the computer, the isolation barrier is shared for all analog inputs, resp. it si shared with both analog outputs (ie. all inputs and outputs are solved by one isolated circuit block).

4.2 Description of analog inputs

Block analog input is composed of a signal chain (Check Figure 3 in Appendix of this manual for more information) consisting of folowing parts:

- input multiplexer for 8 or 16 signals with continuous overvoltage range ±24 V
- amplifier with programmable gain from 1x to 32x; the amplifier output has a nominal signal of ±10 V for all measuring ranges
- 14-bit A/D converter; due to calibration A/D converter processes the input voltage in the range exceeding the nominal output signal of the amplifier (approx. ±10.4 V)
- basic measurement mode (data obtained by one A/D converter measurement) and high resolution mode (averaging of eight consecutive measurements)
- computing unit for compensating offset and gain error of analog signal path (ie. mainly A/D converter and programmable amplifier)
- main FIFO data buffer with a capacity of 32 kB for storing measured data; this buffer is used only in modes triggered by internal timer and external digital signal (see paragraph 7.4 with the description of alternative functions of digital ports)
- independent low capacity FIFO data buffer for software-triggered measurements

The card allows recording not only analog inputs, but all inputs, outputs (ie. current status readback) and current status of two timestamp generators.

Caution:
Although the analog inputs have a high input impedance, it should be noted that the output impedance of the signal source fundamentally affects the function of the input signal multiplexer (ie. prolongs the time required to stabilize after switching the analog input).
In case of signal source with an output impedance greater than 1 kOhm it is necessary to set a longer delay to stabilize the amplifier; the card allows to set the measurement time up to 255 µs separately for each range.
Insufficient settling time causes unstable measured value, usually influenced by signals of other measured inputs.

4.3 Adjustment and calibration

The analog inputs are calibrated numerically by the card's internal circuits and the card therefore does not contain any potentiometers or other hardware calibration elements.

Note: *The cards are adjusted/calibrated during production by the manufacturer, for recalibration contact the manufacturer's technical support for details.*

5. Analog Outputs

5.1 Introduction

The PCA-8428 and PCA-8438 cards offer two analog outputs isolated from the computer, the isolation barrier is shared for both analog outputs and all analog inputs (ie. all inputs and outputs are solved by one isolated circuit block).

5.2 Description of analog outputs

The analog outputs are controlled by eight D/A converters (alternatively 12 or 16 bits) allowing the PC program to make single writing the values of the generated signals; the current firmware does not support block transfer with FIFO memory.

All outputs operate in a single bipolar range ±10 V, if necessary, configurable threshold limiters can be used and the real operating range can be set individually for each output (each channel allows to set the minimum and maximum value).

The initial output values and threshold limiters data after computer is turned on or restarted are stored in the on-board EEPROM memory and can modify by the software utility (by default, all ports are set to ±10 V ranges and zero output voltage).

Check the Appendix, Figure 4 for detail information.

5.3 Adjustment and calibration

The analog outputs are calibrated numerically by the card's internal circuits and the card therefore does not contain any potentiometers or other hardware calibration elements.

After writing the value of the analog output, these data are processed by the procedure...

- the data are compared with the value of the minimum threshold limiter; if the entered data value is lower (or "more negative") than the value of the limiter, the data is replaced by the value of the limiter;
- the data are compared with the value of the maximum threshold limiter; if the entered data value is lower (or "more positive") than the value of the limiter, the data is replaced by the value of the limiter;
- the data are processed by calibration constants compensating offset and gain of the D/A converter and amplifiers;
- the data is written to the D/A converter.

Everything mentioned above takes time less than 1 μs.

Each output is equipped with its own set of calibration constants.

The calibration constants are stored in the on-board EEPROM and are automatically transferred to the calibration circuits after each start or restart. Calibration constants can be modify by the software utility.

Note: The cards are adjusted/calibrated during production by the manufacturer, for recalibration contact the manufacturer's technical support for details.

6. IRC Encoders and Counters

6.1 Introduction

The PCA-84xx cards contain two independent bidirectional counters equipped with programmable input encoders supporting a wide range of operating modes.

In addition, each counter is equipped with minimum/maximum detectors ensuring the capture of extremes between two position readings.

All the mentioned functions are implemented in a powerful FPGA gate array.

6.2 Description of inputs

The signals of the digital port DIO0 are also used as counter inputs (see paragraph 7.4 with the description of alternative functions of digital ports).
If it is necessary to connect the sensors with differential signals (especially in the case of long cables), a signal converter RS-422/TTL have to be inserted into DIO port signals.

6.3 Programmable encoder

The programmable encoder allows configuration to most of the used operating modes, see the Appendix, Figure 5 through Figure 8 for details.

Modes that allow the detection of incorrect combinations or sequences of input signals, the encoder generates error information.

In case of input signal "ringing" a low-pass filter can be activated (available for all modes).

6.4 Counters

The card contains 32-bit bidirectional counters with the possibility of cycle shortening in the range of 2÷4294967295; the counter therefore works in the range...

counting range	incrementation	decrementation
1	0 - 1 - 0 - 1 - ...	1 - 0 - 1 - 0 - ...
2	0 - 1 - 2 - 0 - 1 - ...	1 - 0 - 2 - 1 - 0 ...
4294967295	4294967295 - 0 - 1- ...	1 - 0 - 4294967295 - 4294967294 - ...

The card allows to preset any 32-bit value for each counter individually or for selected set of counters simultaneously. Similarly, the counter values can be read individually or simultaneously for any set of counters.

6.5 Other functions

Each counter is equipped with minimum/maximum detectors ensuring the capture of extremes between two position readings.

7. Digital Ports

7.1 Introduction

The PCA-84xx card provides three 8-bit bidirectional digital ports.

All 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. PCA-84xx), 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. PCA-84xx/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 independ 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 modify by the software utility (by default, all ports are set as input).

7.2 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 9 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.

7.3 Interrupt logic

The PCT-83xx card allows to trigger an interrupt (simultaneously with the timestamp IRQ generator and FIFO memory control circuits) by any combination of rising or falling edges of the signals of all digital ports.

7.4 Alternative functions of DIO ports

Digital ports are used for alternative functions depending on the firmware.

The standard PCA-84xx firmware uses the DIO0 port as an input for triggering measurement sequence and as counter inputs:

DIO00 input for starting the measuring sequence (active the falling edge)
DIO01 encoder/counter CNT0, input A
DIO02 encoder/counter CNT0, input B
DIO03 encoder/counter CNT0, input R
DIO04 encoder/counter CNT1, input A
DIO05 encoder/counter CNT1, input B
DIO06 encoder/counter CNT1, input R
DIO07 not used for alternative functions in the current version of firmware

Note: *For proper function the DIO port must be configured as an input.*

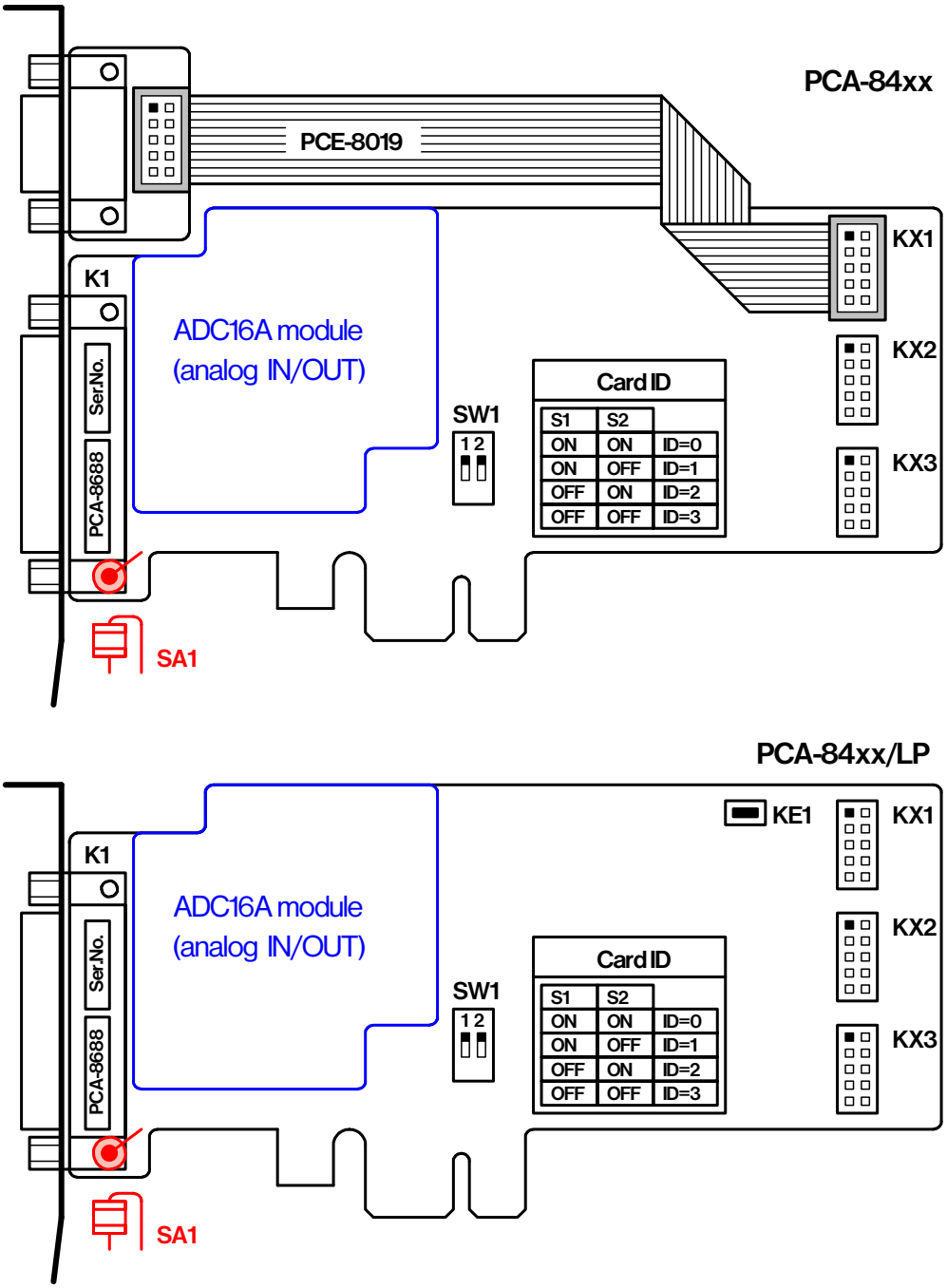


Figure 1. Location of switches and connectors on both version of cards.

K1	connector of analog inputs and outputs (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	pin	pin	K1 signal
- - -	C1		
- - -	C2	C14	- - -
AOUT1 (see note below)	C3	C15	- - -
- - -	C4	C16	AOUT0 (see note below)
AGND	C5	C17	- - -
AGND	C6	C18	AIN7
AGND	C7	C19	AIN6
AGND	C8	C20	AIN5
AGND	C9	C21	AIN4
AGND	C10	C22	AIN3
AGND	C11	C23	AIN2
AGND	C12	C24	AIN1
AGND	C13	C25	AIN0

Table 1. PCA-8428/8429, D-Sub 25 (male) connector pin assignment.

Note: The AOUT0/AOUT1 signals are active only on PCA-8428 card.

K1 signal	pin	pin	K1 signal
- - -	C1		
- - -	C2	C14	- - -
AOUT1 (see note below)	C3	C15	- - -
- - -	C4	C16	AOUT0 (see note below)
AIN15	C5	C17	- - -
AIN14	C6	C18	AIN7
AIN13	C7	C19	AIN6
AIN12	C8	C20	AIN5
AIN11	C9	C21	AIN4
AIN10	C10	C22	AIN3
AIN9	C11	C23	AIN2
AIN8	C12	C24	AIN1
AGND	C13	C25	AIN0

Table 2. PCA-8438/8439, D-Sub 25 (male) connector pin assignment.

Note: The AOUT0/AOUT1 signals are active only on PCA-8438 card.

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 (viz. technické parametry)

Table 3. 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 5).

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

signal	pin	pin	signal
DIO00	C1		
DIO02	C2	C14	DIO01
DIO04	C3	C15	DIO03
DIO06	C4	C16	DIO05
DIO08	C5	C17	DIO07
DIO10	C6	C18	DIO09
DIO12	C7	C19	DIO11
DIO14	C8	C20	DIO13
DIO16	C9	C21	DIO15
DIO18	C10	C22	DIO17
DIO20	C11	C23	DIO19
DIO22	C12	C24	DIO21
GND	C13	C25	DIO23

Table 5. PCE-8025/LP adapter board, D-Sub 25 (male) connector pin assignment.

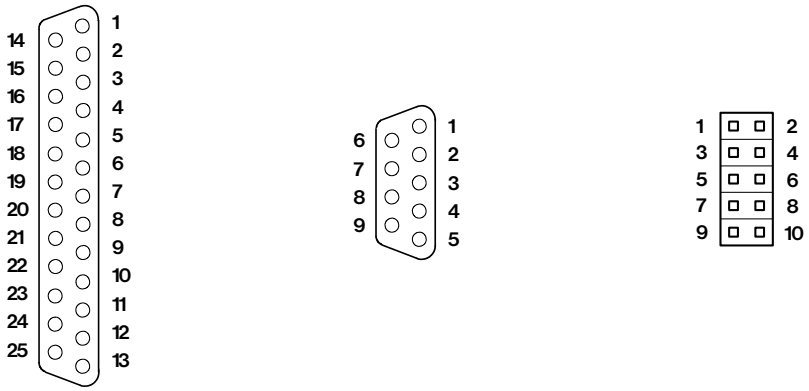


Figure 2. Pin layout on D-Sub 25 (male), D-Sub 9 (male) and header type connectors (2x 5 pins, 2.54 mm pitch).

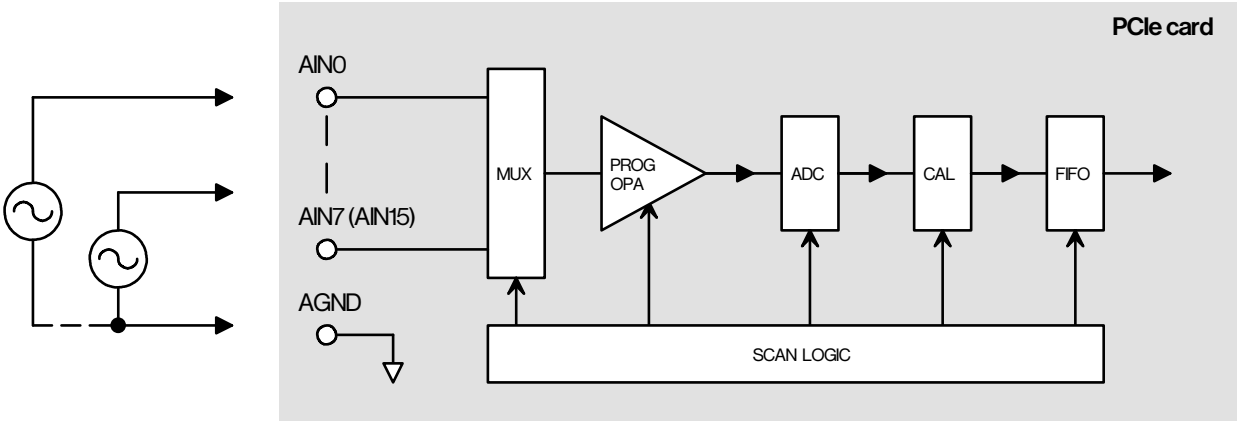


Figure 3. Simplified schematic of analog outputs.

The schematic shows basic functional circuits of the measuring chain.

MUX	input multiplexer alternatively for 8 or 16 signals
PROG OPA	amplifier with programmable gain in the range of 1x to 32x
ADC	14-bit A/D converter
CAL	computing unit to compensate for offset and gain error
FIFO	FIFO data buffer with a capacity of 32 kB for storing measured data
SCAN LOGIC	circuits to control all parts of the measuring chain (allow to configure the measured inputs, gain and sampling frequency)

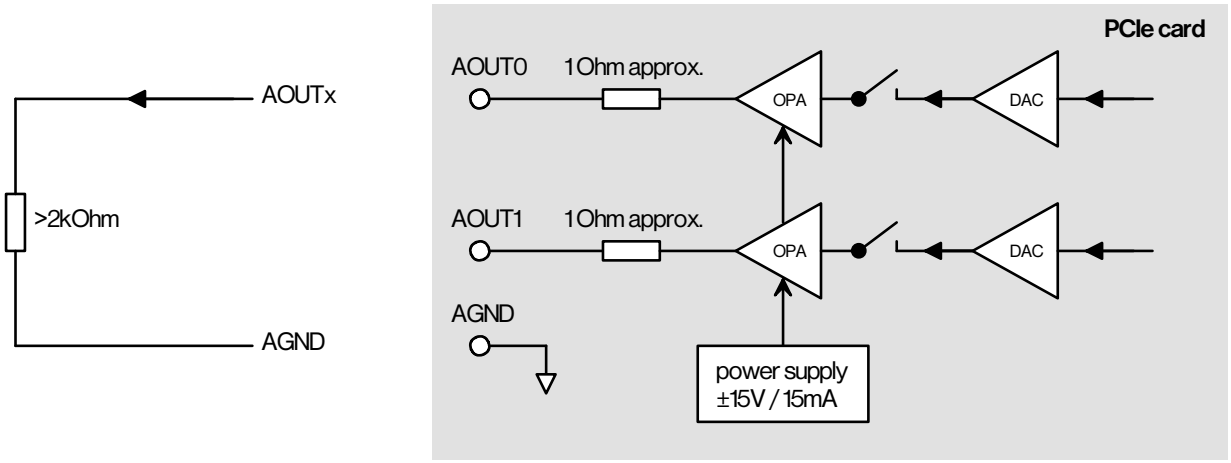


Figure 4. Simplified schematic of analog outputs.

The schematic shows two D/A converters (DAC) and two output amplifiers (OPA).
The output amplifiers are separated from the D/A converters (in the schematics shown by switches) providing zero voltage at the outputs until the power-up procedure is completed.
Both output amplifiers are powered from a single source; the maximum current of each output must not exceed 5 mA and the load impedance should not be less than 2 kOhm.

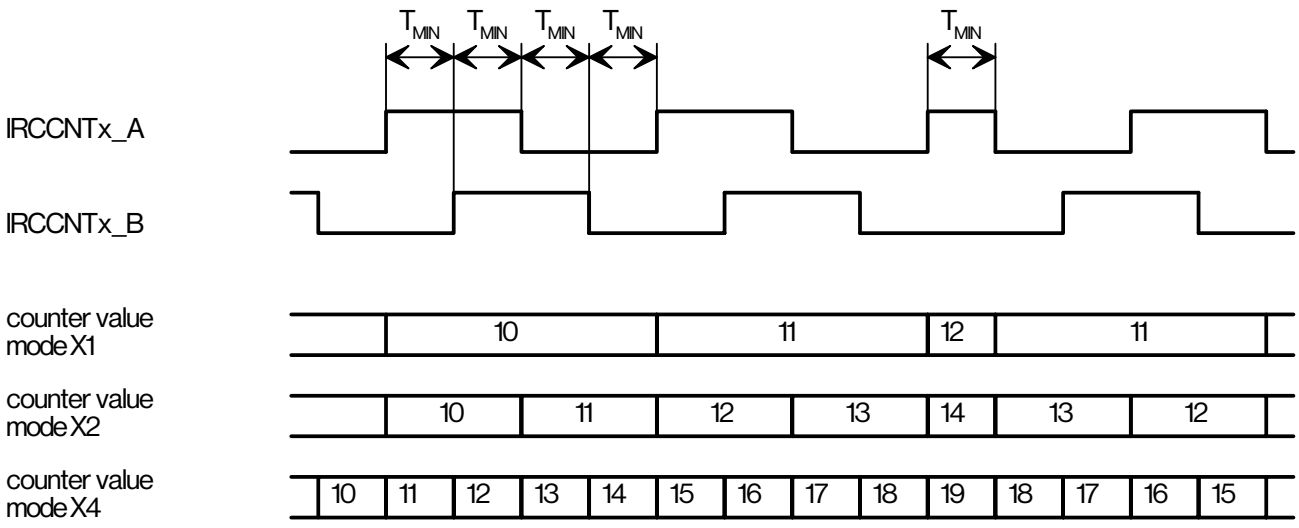


Figure 5. "Quadrature X1, X2 and X4" counting mode.
(T_{MIN} at least 25 ns long when filter is disabled, resp. 310 ns when enabled)
(the encoder detects discontinuous quadrants changes and signals as an error)

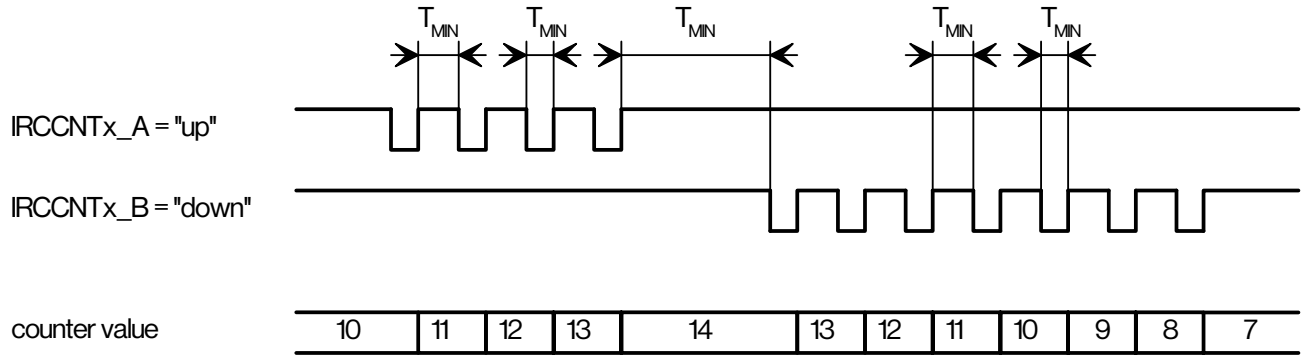


Figure 6. "Up/Down" counting mode.
(T_{MIN} at least 25 ns long when filter is disabled, resp. 310 ns when enabled)
(the encoder detects both "up/down" signals at level L and signals as an error)

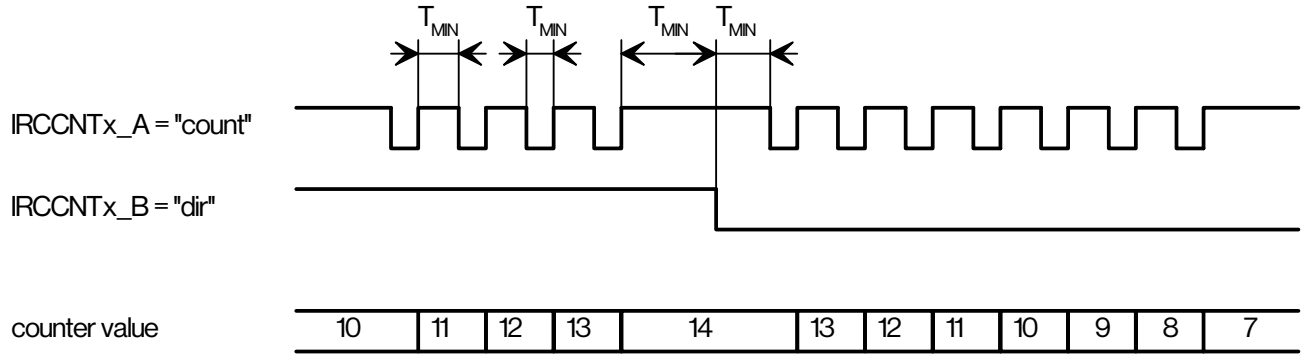


Figure 7. "Count/Dir" counting mode.
(T_{MIN} at least 25 ns long when filter is disabled, resp. 310 ns when enabled)

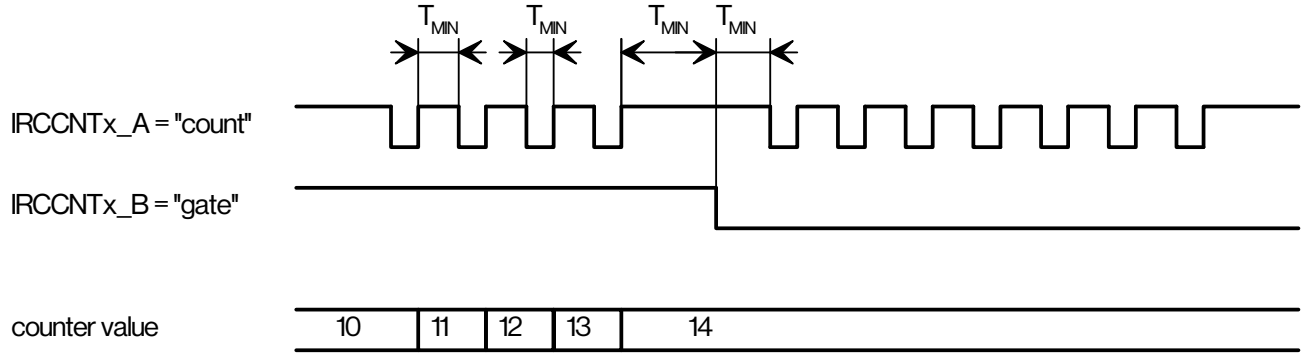


Figure 8. "Count/Gate" counting mode.
(T_{MIN} at least 25 ns long when filter is disabled, resp. 310 ns when enabled)

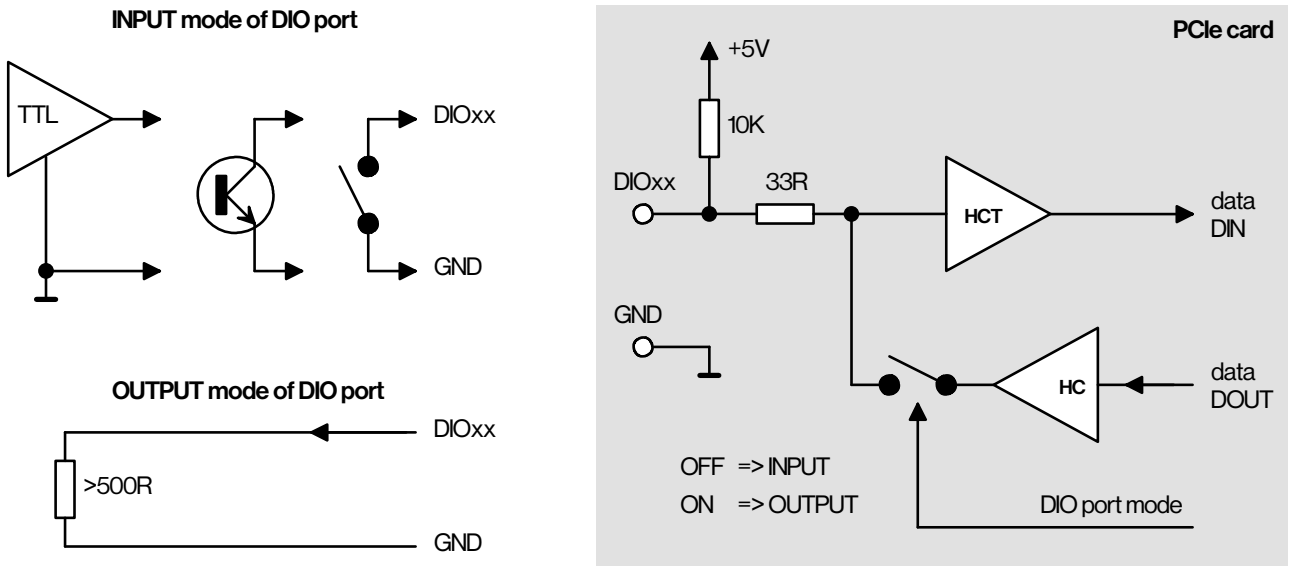
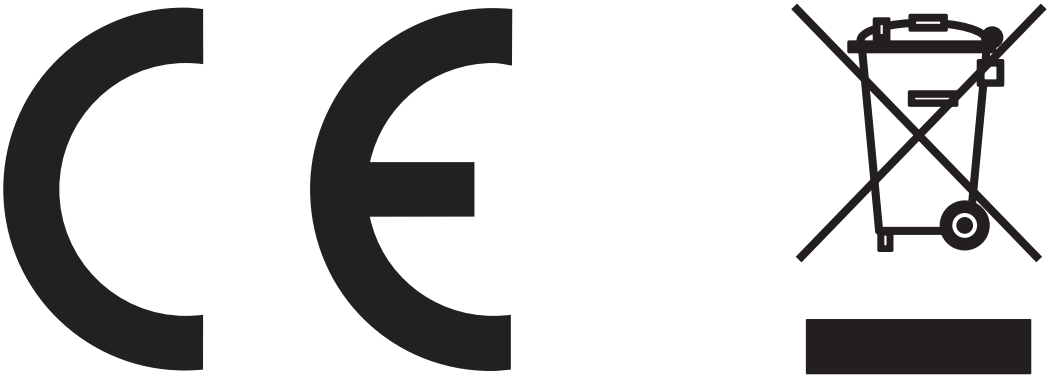


Figure 9. Simplified schematic of DIO ports.

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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