

OPTORE-PCle16 STANDARD

EDP No.: A-822200

16 Optocoupler Isolated Digital Inputs
16 Relay Outputs

wasco[®]

user's guide

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1. Description

The **wasco**[®] interface board OPTORE-PCIe16^{STANDARD} features 16 digital input channels and 16 digital output channels, each of which are galvanically isolated individually. Inputs are electrically isolated by high quality optocouplers, the outputs by 16 relays. The input optocouplers are bipolar. Additionally the inputs are protected against harmful voltage peaks by protection diodes.

You easily can adjust two different input voltage ranges by setting jumpers. The output relays cope with a switching current of max. 1 A.

The connections of the output relays are connected to a 37-pin Sub-D female socket on the slot bracket of the board. The optocoupler inputs are connected to a 40-pin box header on the board. An optionally available connection cable (set of female connector, ribbon cable and 37pin female sub-D-connector with slot bracket) can relocate the connection to a slot of your PC casing. The pin assignments are identical to the PCI bus card OPTORE-PCI16^{STANDARD} and the ISA bus card OPTORE-16^{STANDARD}, switching to PCIe is therefore easily to implement.

Furthermore, the card comes with a jumper block for card identification in order to distinguish between several identical cards in the computer.

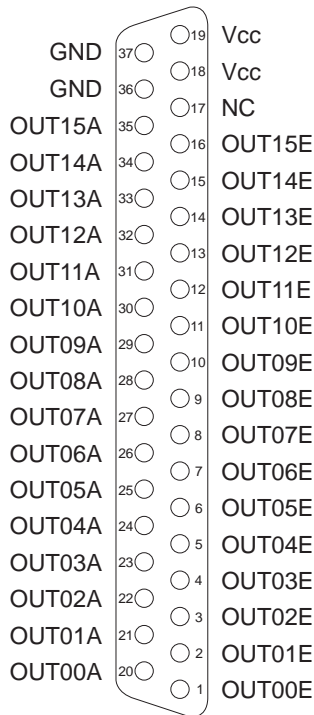
2. Installing the OPTORE-PCle16_{STANDARD}

2.1 Installing the card into your system

Before you insert the OPTORE-PCle16 unplug the power cord or make sure, that there is no current to/in the computer. Inserting the interface card in a running system may cause damaging or destroying not only the card OPTORE-PCle16, but even other already inserted cards of your computer.

Choose an empty PCIe slot of your computer for then inserting the card. Please refer to the computer's manual for support. Secure the circuit board by screwing the slot bracket to the casing of the computer to prevent the card from coming loose by effects of the connecting cables.

3.2 Pin Assignment of CN1



Vcc:

Connector for internal voltage source (+ 5V) (a wiring bridge must be soldered on L11),
Never apply an external voltage across this pin.

GND:

Ground connection (only when a wiring bridge is soldered on L12).

NC:

not connected

3.3 Pin Assignment of CN2

NC	40	○	○	39	NC
NC	38	○	○	37	Vcc
GND	36	○	○	35	Vcc
GND	34	○	○	33	NC
IN15-	32	○	○	31	IN15+
IN14-	30	○	○	29	IN14+
IN13-	28	○	○	27	IN13+
IN12-	26	○	○	25	IN12+
IN11-	24	○	○	23	IN11+
IN10-	22	○	○	21	IN10+
IN09-	20	○	○	19	IN09+
IN08-	18	○	○	17	IN08+
IN07-	16	○	○	15	IN07+
IN06-	14	○	○	13	IN06+
IN05-	12	○	○	11	IN05+
IN04-	10	○	○	9	IN04+
IN03-	8	○	○	7	IN03+
IN02-	6	○	○	5	IN02+
IN01-	4	○	○	3	IN01+
IN00-	2	○	○	1	IN00+

Vcc:

Connector for internal voltage source (+ 5V) (a wiring bridge must be soldered on L21),
Never apply an external voltage across this pin.

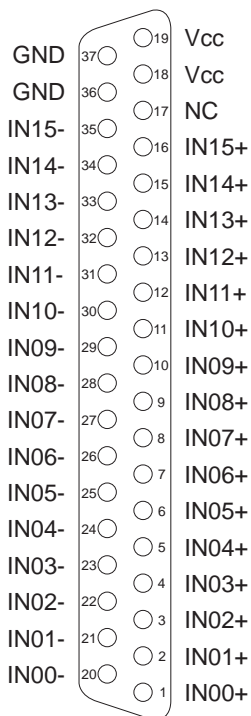
GND:

Ground connection (only when a wiring bridge is soldered on L22).

NC:

not connected

3.4 Pin assignment of CN2 on D-Sub37 flat ribbon cable



Vcc:

Connector for internal voltage source (+ 5V) (a wiring bridge must be soldered on L21),
Never apply an external voltage across this pin.

GND:

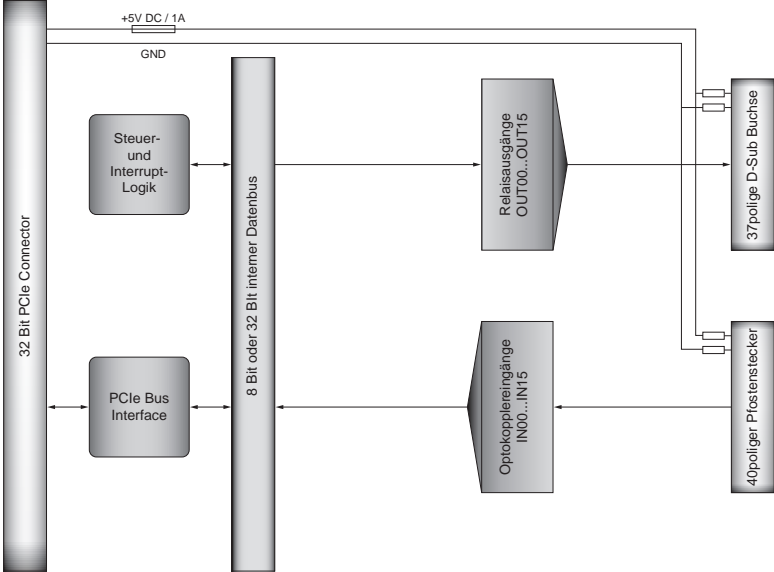
Ground connection (only when a wiring bridge is soldered on L22).

NC:

not connected

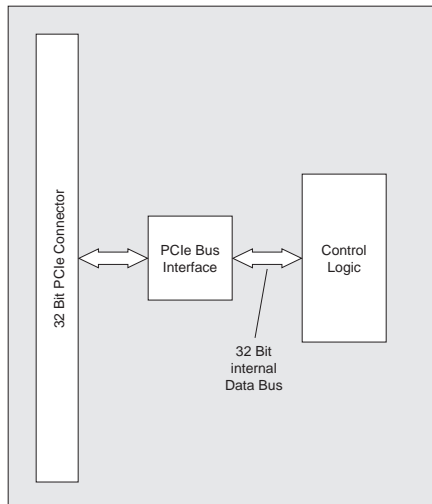
4. System Components

4.1 Block Diagram



4.2 Access to the system components

You can access to the hardware components of the OPTORE-PCIe16 by reading from or writing to Memory Mapped I/O addresses using library functions. The addresses relevant to the OPTORE-PCIe16 result from a base address assigned by the BIOS. Access to the OPTORE-PCIe16 is exclusively in double-word access. In the compatibility mode, the wasco driver functions only process or allow for the least significant byte. (You will find more information in the chapter Programming as well as in the example programs on the supplied CD)



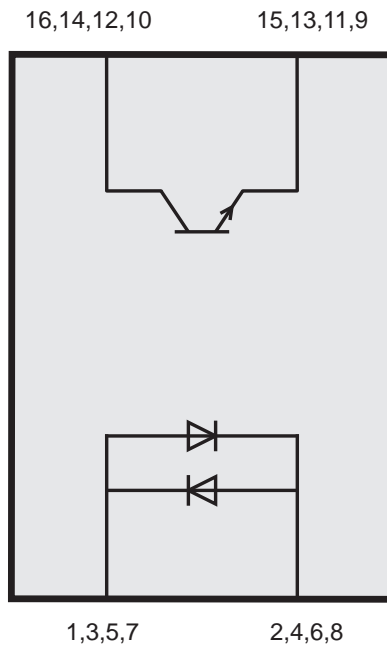
4.3 Power supply

To monitor the different operating voltages, there are six control LEDs on the circuit board.

5. 16 Optocoupler Isolated Digital Inputs

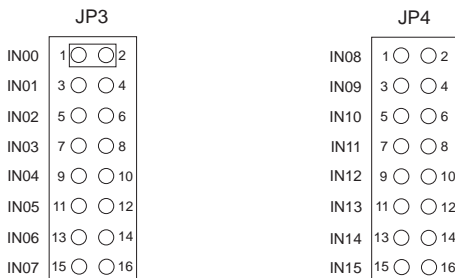
The OPTORE-PCle16 provides 16 input channels, each of which is optically isolated by optocouplers. The isolation voltage between GND and input is 500 V_{DC}. The voltage within the input channels is limited to 50 Volt. The optocouplers are bipolar.

5.1 Pin assignment of the input optocouplers



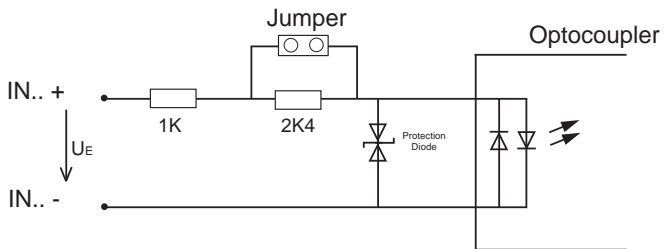
For the data of the two input voltage ranges, please see the following table:

Jumper	low	high
closed	0...1 V	5...15 V
open	0...2 V	14...30 V



By placing a jumper over Pin1 and Pin2 of the jumper block JP3 the input voltage range of IN00 changes from 0..2V (Low) and 14..30V (High) to 0..1V (Low) and 5..15V (High). The remaining input voltage ranges keep unaffected.

5.3 Input circuitry



5.4 Input current

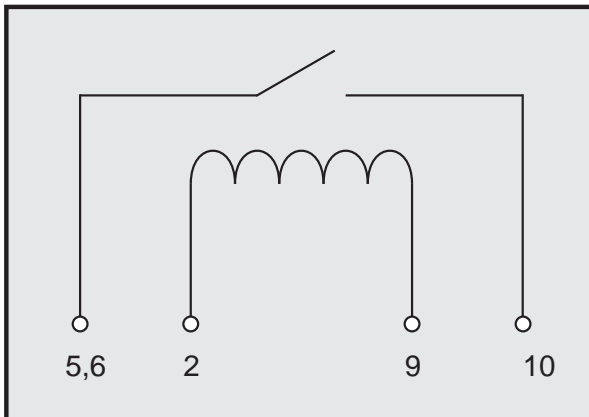
$$I_E \approx \frac{U_E - 1,1V}{3400\Omega} \quad (\text{Jumper off})$$

$$I_E \approx \frac{U_E - 1,1V}{1000\Omega} \quad (\text{Jumper on})$$

6. 16 Relay Outputs

The OPTORE-PCIe16 provides 16 output channels, galvanically isolated by relays.

6.1 Pinout of the Relays



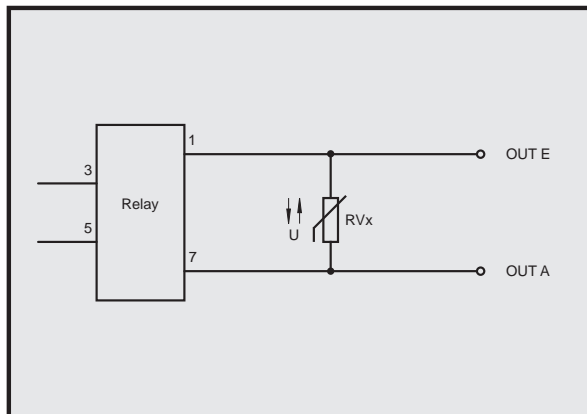
6.2 Specification of the Relays

Switching voltage:	50 Volt DC max.
Switching current:	1A max.
Switching capacity:	60VA max.
Switching time:	max. 5ms
Release time:	max. 2ms
Lifetime:	400,000 cycles at 24V DC and 0,5A
Min. switching load	1mA, 1V DC

6.3 Contact Protection Circuit

Protection varistor RV100-RV115

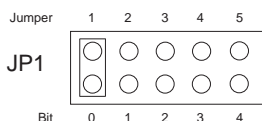
For switching an inductive load, it may be of benefit to set a protection varistor in parallel with the relay switching contacts (see figure below). For this user-specific additional circuit, OPTORE-PCle16^{STANDARD} comes with the soldering points RV100-RV115.



Find more examples of contact protection circuits in the appendix "Contact Protection Circuit".

7. Hardware Configuration

7.1 Board Identification



The board identification is used to distinguish between several PC cards of the same type on the computer. This is done by a jumper block, which can be read by software.

The board identification to be read consists of one Byte (8 Bit) and is structured as follows:

Bit	31	8	7	6	5	4	3	2	1	0
Jumper								5	4	3	2	1
Board ID Register	0	0	0	0	0	0	0	x	x	x	x	x

„x“ is „1“, if the jumper is on, otherwise „0“

The jumper setting of the jumper block JP1 can be read out by means of the read command. The unused bits are basically „0“, a closed jumper is read as „1“.

e.g.



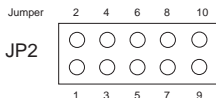
Result of the read command: \$05

7.2 Access with 8 or 32 Bit

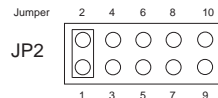
The jumper block JP2/1-2 can be used to set the access data width. If the jumper block JP2/1-2 is not set (Default), the board is working in compatibility mode. In this mode, the board is accessed in 8-bit mode. Additionally, the offset addresses of the PCI board OPTORE-PCI16^{STANDARD} are valid with a factor of 4.

If the jumper is set, the card is working in 32-bit mode, and the offset addressing is compatible with other PCIe boards as well as with the PCIe16^{ULTRA}.

The offset addresses of both of the modes are discussed in chapter 8.4 „Assignment of the Memory Mapped I/O Addresses“ .



8-Bit mode



32-Bit mode

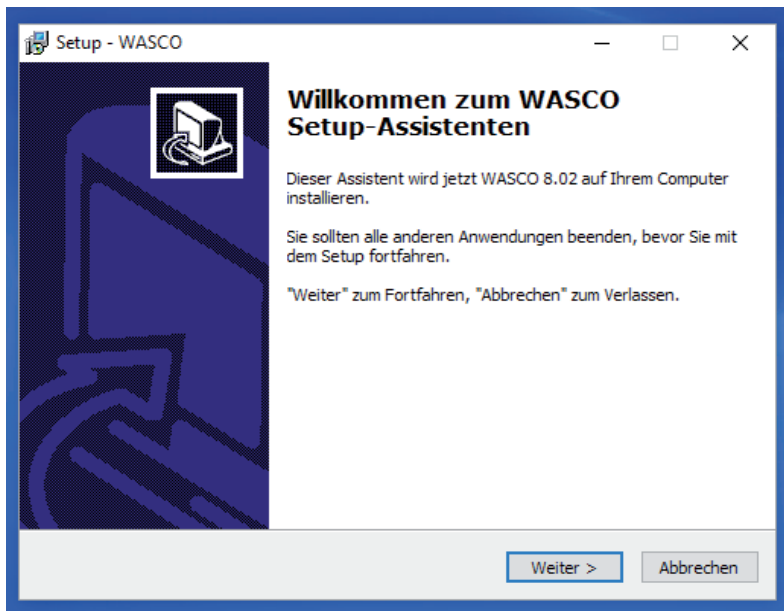
8. Programming on Windows[®]

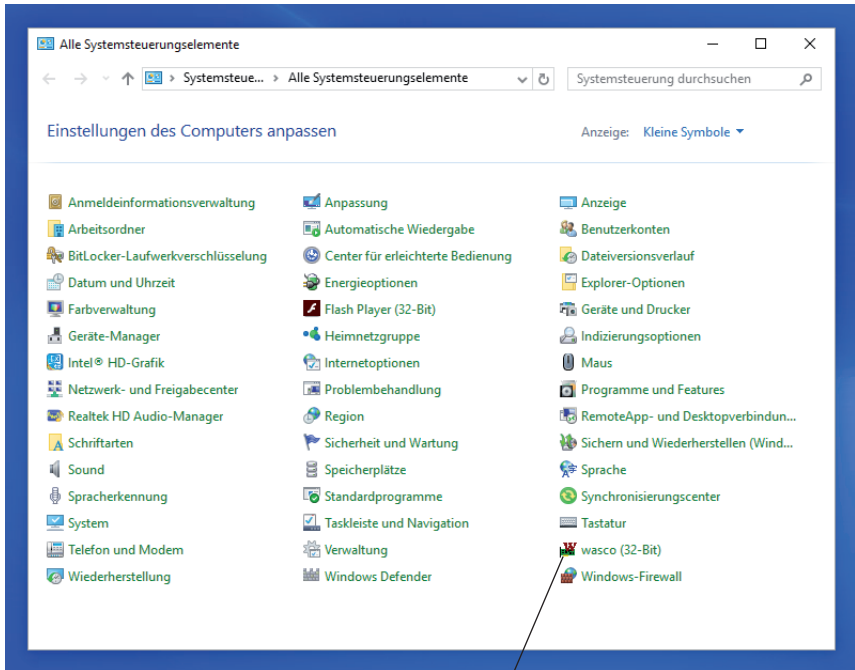
8.1 Installation of the Windows[®] driver

In order to implement the card under Windows[®], it is necessary to install a special driver that allows access to the card. The operating system under Windows[®] 10, 8 and 7 automatically reports after starting the PC, that a new hardware component has been found. In this case, insert the data medium and instruct to the system to install the driver files herefrom. If the operating system does not respond, the driver also can be installed in the Device Manager.

8.2 Installation of the Windows[®] development files

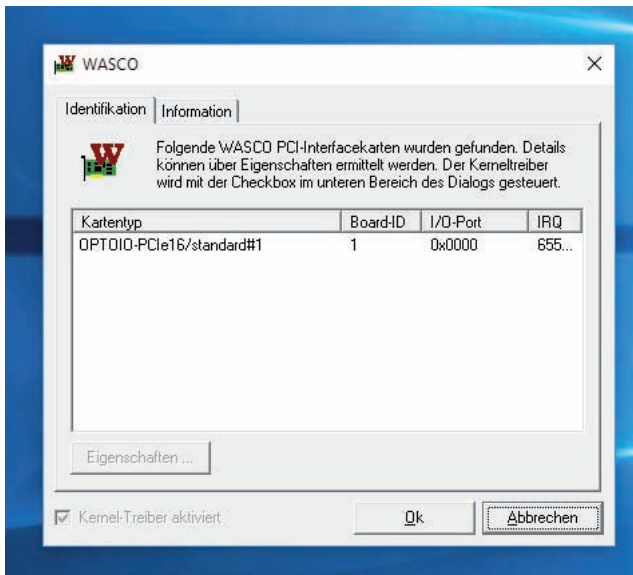
To install the development files, please run the file „Setup.exe“ in the Driver folder on the accompanying CD and follow the installation instructions.





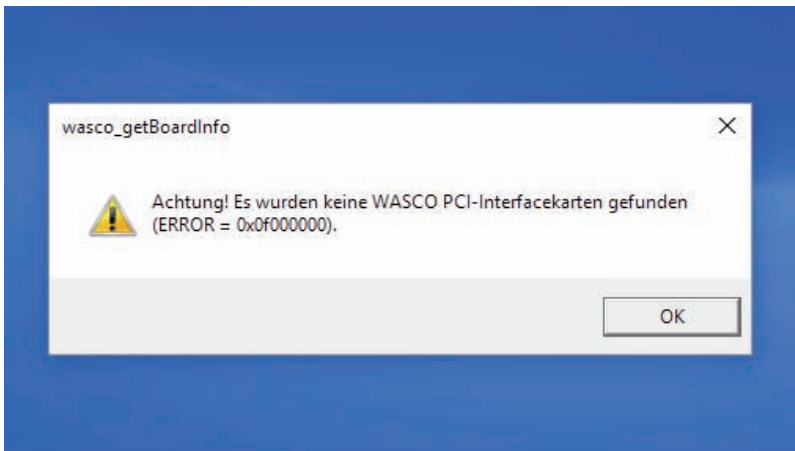
Once the driver and development files have been installed completely, you will find an icon in the control panel of your computer to localize all **wasco®** PCI and PCIe cards available in the system.

Start the card query by double-clicking the „wasco®“ Icon. The following window appears: (An OPTOIO-PCIe16STANDARD is used as an example)



If your card has been recognized in the system, the board name WASCO-PCIe8264, Board-ID, I/O address as well as the possible interrupt number of the respective card are displayed in this window. Furthermore, the driver version and the location of the driver file can be ascertained via the „Information“ tab..

If your card was not recognized in the system, following error message will be displayed:



Possible causes are covered in the chapter Troubleshooting.

8.3 Programming the OPTORE-PCIe16 with **wasco**® driver

After installing the development files of Kithara by means of the setup program, the folder **wasco** contains of the relevant development files and the sample programs. Further sample programs specified for access to the OPTORE-PCIe16 you can find on the enclosed CD or please visit our homepage.

Programming the hardware components of the OPTORE-PCIe16 is realized by access to Memory Mapped I/O addresses which depend on the base address assigned by the system's BIOS for the OPTORE-PCIe16. Find a more detailed description for programming in the driver documentation.

8.4 Assignment of the Memory Mapped I/O Addresses

The Memory Mapped I/O addresses of the single hardware components depend on the base address, as shown in following table:

8-bit mode

Port/Register	BA + Offset	RD/WR
Optocoupler Input Port A (IN00...IN07)	BA + \$0	RD
Optocoupler Input Port B (IN08...IN015)	BA + \$4	RD
Relay Output Port A (OUT00...OUT07)	BA + \$8	RD/WR
Relay Output Port B (OUT08...OUT15)	BA + \$C	RD/WR
Board Identification	BA+ \$3E0	RD

32-bit mode

Port/Register	BA + Offset	RD/WR
Optocoupler Input Port A (IN00...IN15)	BA + \$0	RD
Relay Output Port A (OUT00...OUT15)	BA + \$8	RD/WR
Board Identification	BA+ \$FF8	RD

Attention! The offset constants of the driver work directly only with PCI boards. When programming, we recommend to use offsets instead of the constants.

9. Linux[®] Programming

To use the board with Linux[®], you can find a Linux wasco[®] driver on the CD provided or on our website. This is in code form and therefore can be changed and customized by the customer at any time.

9.1 Installing the Linux[®] driver

To apply the card under Linux[®] a special driver has to be installed, that enables access to the card. Insert the data medium and copy the folder of the Linux driver to your system. For installation, follow the instructions of the readme file.

9.2 Supported Linux Distributions/Kernelversions

The wasco[®] driver has been tested in the following environments:

Ubuntu[®] 18.04.4 LTS (Kernel: 5.3.0)

9.3 Programming the OPTORE-PCle16 with **wasco**[®] driver

Programming the hardware components of the OPTORE-PCle16 is realised by accessing Memory Mapped I/O addresses which depend on the base address assigned by the system's BIOS for the OPTORE-PCle16.

The access is done via the functions `pread` und `pwrite`. For this, under programming language C and C/C++ no further external libraries are required. Examples for the exact access to the OPTORE-PCle16 can be found on the enclosed CD as well as on our homepage.

9.4 Access to the OPTORE-PCIe16^{Standard}

The access to the OPTORE-PCIe16^{Standard} is done exclusively via the board name (type of card) WASCO-PCIe8264

9.5 Assignment of the Memory Mapped I/O addresses

The Memory Mapped I/O addresses of the single hardware components depend on the base address according to following table:

32-Bit mode

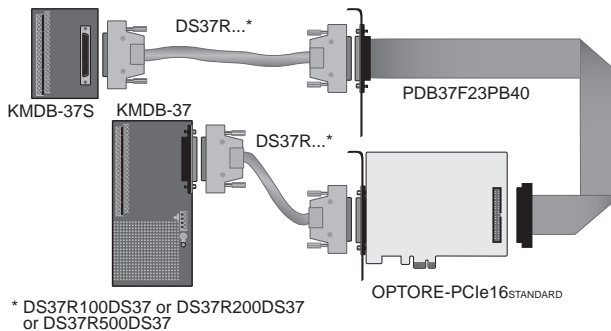
Port/Register	BA + Offset	RD/WR
Optocoupler Input Port A (IN00...IN31)	BA + \$0	RD
Board Identification	BA+ \$FF8	RD

10. Accessories

10.1 Fitting **wasco**[®] accessories

Connecting parts	EDP-No.
DS37R500DS37 Connecting cable (5 meters)	A-202800
DS37R200DS37 Connecting cable (2 meters)	A-202400
DS37R100DS37 Connecting cable (1 meter)	A-202200
KMDB-37S Terminal Module	A-204910

10.2 Connection Technique (application examples)



11. Troubleshooting

In the following you will find a short compilation of most frequently known error causes, that may occur while starting-up or running OPTORE-PCIe16. Please check the following points before you contact your dealer or distributor:

1. Is OPTORE-PCIe16 properly inserted to the connector?
2. Are all cable connections alright?
3. Did your system detect the card correctly?
Please check all settings of your computer or contact your system administrator. (Since these are BIOS settings we cannot expand on this issue. We point to your computer's system user's guide)
4. Did you install the latest driver version for the **wasco**[®] drivers?
Updates you can find here: <http://www.messcomp.com>

12. Specifications

Optocoupler Inputs

Optocoupler: LTV-244 or compatible

16 channels, optically isolated

Galvanic isolation also between every single channel with each two separate connections

Overtoltage protection by protection diodes

Two different input voltage ranges selectable by jumpers:

Range 1 high = 14..30 Volt
 low = 0..2 Volt

Range 2: high = 5..15 Volt
 low = 0..1 Volt

Input frequency: max. 10 kHz

Relay Outputs

Channels: 16 channels, galvanically isolated

Relay type: SY-12-K or compatible

Contact current: 1 A max.

Contact voltage: 50V

Switching capacity: 60 VA

Operating lifetime: 400,000 operations at 24V DC and 0,5A

Switching time: typ. 5 ms

Release time: typ. 2 ms

Connectors

1 * 37 pin Sub-D female connector

1 * 40-pin box header

Bus system

32-bit PCIe-Bus

(8 or 32 bit data access)

Dimensions of the Board

129 mm x 111 mm (l x b)

standard height, half length card

6-layer Multi layer PCB

Others

Control LEDs for power supply

13. Product Liability Act

Information for Product Liability

The Product Liability Act (Act on Liability for Defective Products - Prod-HaftG) in Germany regulates the manufacturer's liability for damages caused by defective products.

The obligation to pay compensation can already be given, if the product's presentation could cause a misconception of safety to a non-commercial end user and also if the end user is expected not to observe the necessary safety instructions when handling this product.

It must therefore always be provable, that the non-commercial end user has been familiarized with the safety rules.

In the interest of safety, please always indicate your non-commercial customer of the following safety instructions:

Safety instructions

The valid VDE regulations must be observed, when handling products that come into contact with electrical voltage.

Particularly the following instructions must be observed:
VDE100; VDE0550/0551; VDE0700; VDE0711; VDE0860.

The instructions are available from:
Vde-Verlag GmbH
Bismarckstr. 33
10625 Berlin

* unplug the power plug before you open ta device or make sure, that there is no current to/in the device.

* You only may start up any components, boards or devices, if they have been installed in a secure touch-protected casing before. During installation they must be de-energized.

* Make sure that the device is disconnected from the power supply before using any tools on any components, boards or devices. Any electrical charges stored in components in the device are to be discharged prior.

* Voltaged cables or wires, which are connected with the unit, the components or the boards, must always be inspected for insulation faults or breaks. In case of any defect the device must be taken out of operation immediately until the defective cables has been replaced.

* When using components or boards you must strictly comply with the characteristic data of the electrical parameters specified in the corresponding description

* As a non-commercial end-user, if it is not clear whether or not the electrical characteristic data given in the provided description apply to a component, you must consult a specialist.

In all other respects, compliance with building and safety regulations of all kinds (VDE, TÜV, industrial injuries corporation, etc.) is the responsibility of the user/purchaser.

14. EC Declaration of Conformity

This is to certify, that the following product with CE marking

OPTORE-PCIe16^{STANDARD}
EDP number A-822200

comply with the requirements of the relevant EMC directives 2014/30/EU. This declaration will lose its validity, if the instructions given in this manual for the intended use of the products are not fully complied with.

Following standards were regarded:

EN 55011: 2009 + A1. 2010 (Group 1, Class A)

EN 55022: 2010 / AC: 2011

EN 55024: 2010

EN 61000-6-4: 2007 + A1: 2011

EN 61000-6-2: 2005 / AC: 2005

(EN 6100-4-2: 2008; EN 6100-4-3: 2006 + A1: 2007 + A2; EN 6100-4-4: 2012;
EN 6100-4-5: 2014; EN 6100-4-6: 2013; EN 6100-4-8: 2009; EN 6100-4-11: 2004)

The following manufacturer is responsible for this declaration:

Messcomp Datentechnik GmbH
Neudecker Str. 11
83512 Wasserburg

given by

Dipl.Ing.(FH) Hans Schnellhammer

Wasserburg, 16.10.2019



Reference system for intended use

This PC expansion board is not a stand-alone device. The CE-conformity only can be assessed when using additional computer components simultaneously. Therefore, the CE conformity only can be confirmed when using the following reference system for the intended use of the PC expansion board:

Electrical enclosure:	Vero IMRAK 3400	804-530061C 802-563424J 802-561589J
19" Casing:	Vero PC-Casing	145-010108L
19" Casing:	Additional Electronic	519-112111C
Motherboard:	ASUS P5G41-M LE	
Interface:	OPTORE-PCIe16 _{STANDARD}	A-822200

Contact Protection Circuits

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2. **Circuit Example RC Element**
3. **Circuit Example Diode**
4. **Circuit Example Diode and Zener Diode**
5. **Circuit Example Varistor**

1. Overview

It is always recommended to use a protective contact circuit, because this will extend the electrical lifetime of the relays. However, incorrect application of a protective contact circuit may result in the opposite effects, such as extension of the relay release time.

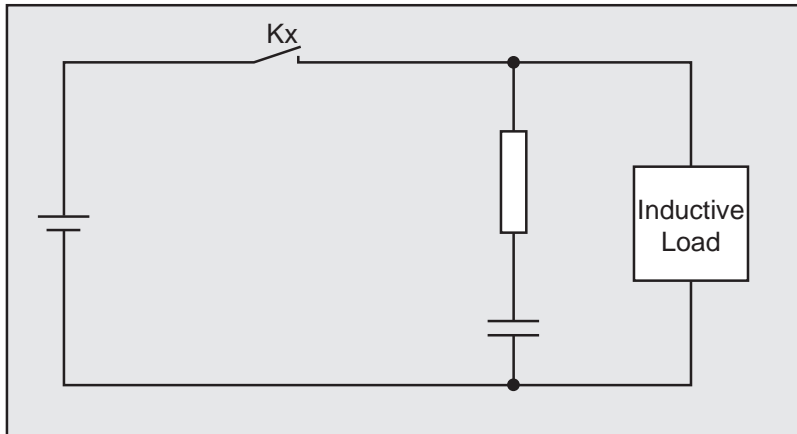
Following you can find some general circuit examples, which you can apply according to the use cases.

Note:

The circuit examples listed in the following serve as a source of information of a general scope. That means, they are not specially developed for **wasco**[®] products, but they are also applicable for all to **wasco**[®] cards connected peripherals. Please note, that not all protective circuit contacts are suitable for **wasco**[®] cards and **wasco**[®] modules, because the suitability depends on each use case and the connected peripheral.

Please pay attention to the relevant VDE Instructions!

2. Circuit Example RC Element

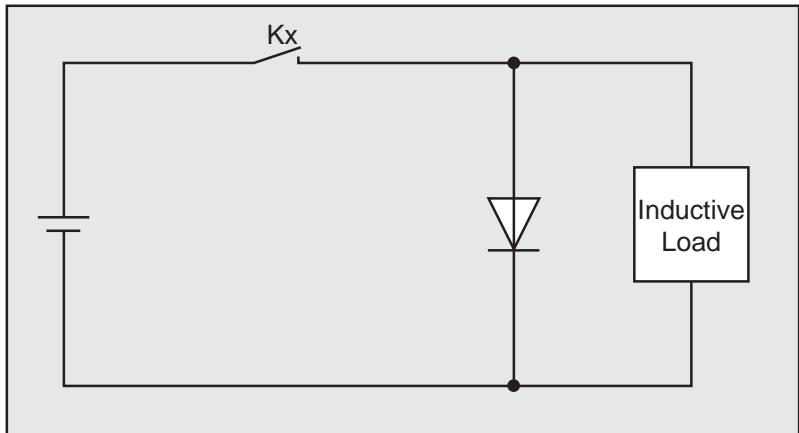


Suitability

A/C voltage: good
D/C voltage: good

When applying a load, for example in the form of a relay, the release time of the contacts is delayed. This circuit is effective when you connect the load and when mains voltage is between 24 and 48 Volt. A mains voltage between 100 and 240 Volt requires a connection in parallel with the contacts.

3. Circuit Example Diode



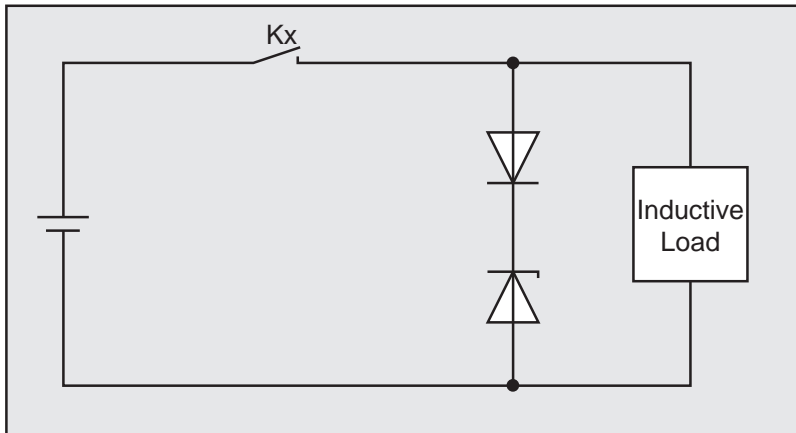
Suitability

A/C voltage:	poor
D/C voltage:	good

The energy (inductive load) stored in a coil generates a current flow across the diode connected in parallel to the coil, when the load is switched off. The current will discharge via the resistance of the inductive load. This connection delays the fall time more than an RC connection does.

The used diode has to provide a peak voltage that is more than 10x the switching voltage, and a forward current exceeding the load current.

4. Circuit Example Diode and Zener Diode



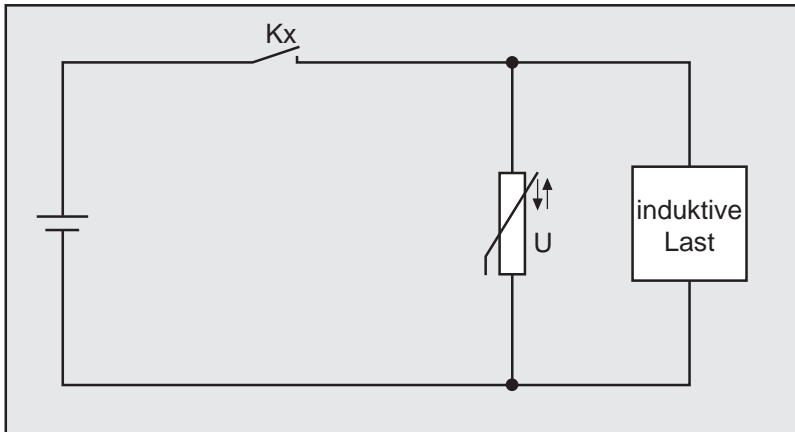
Suitability

A/C voltage: poor
D/C voltage: good

If in special applications the fall time achieved by a diode protection circuit is too long, this connection effectively will reduce the fall time.

The reverse voltage of a Zener diode approximately should correspond to the mains voltage.

5. Circuit Example Varistor



Suitability:

A/C voltage:	good
D/C voltage:	good

This circuit prevents the emergence of high voltage at the contacts. The fall time of the contacts will be delayed slightly when using this circuit. A varistor connected in parallel to the load will be effective at a mains voltage between 24 and 48 Volt. At a mains voltage between 100 and 240 Volt the connection has to be connected in parallel to the contacts.