

■ PCIe-BASE

Data acquisition and control card (PCIe)

Measurement & Control. Multifunctional.

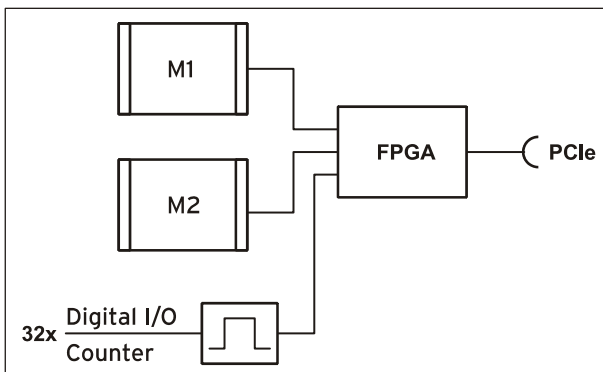
Stationary measurement data acquisition in latest technology: The PCIe-BASE is a multifunctional data acquisition and control card. Its modular structure guarantees individual and flexible adjustment to a measuring task.

Modular concept. Optimize price-performance-ratio.

Perfectly adapted to the respective measurement application, data acquisition modules can be selected to equip the two module slots of the PCIe-BASE. It is the customer who decides about performance and price of his DAQ system!

Modules: MAD. MDA. MCAN. What would you like?

A great variety of analog plug-on modules is available differing in the number of inputs and outputs, resolution and sampling rate. If an MAD module is combined with a CAN interface module, analog measurements and via the CAN interface are sampled time-synchronously.



Functional diagram



PCI
EXPRESS

32 digital I/O. 1 counter.

The PCIe-BASE features 32 digital lines, which means that the base board is a digital I/O card itself. The direction of the two 16-bit ports is set via software. One counter accessible via any digital input allows the acquisition of counting pulses or the connection of an incremental encoder.

PCIe. Be on the cutting edge.

Designed in "PCIe x1" format, the PCIe-BASE can be installed in any PCIe slot. In the long term, this extremely powerful interface will completely replace the predecessor "PCI" in the PC. Due to Plug&Play, the card is recognized automatically by the PC making installation a lot easier.

All Windows® or something.

The PCIe-BASE can be used on Windows® 7/XP. The entire software for installation and programming (ActiveX Control) of the multifunction card is included for free.



NextView®4. Try for free.

The DAQ system is supported by NextView® 4, the software for data acquisition and analysis. A fully functional 30-day trial is included with delivery to directly test the functionality of the PCIe-BASE.

1 Module concept

1.1 Overview

The following PCB view shows the module slots M1 and M2, which can be assembled with analog data acquisition modules (MAD series), analog control modules (MDA series) or a CAN interface module (MCAN). They can be used in any combination.

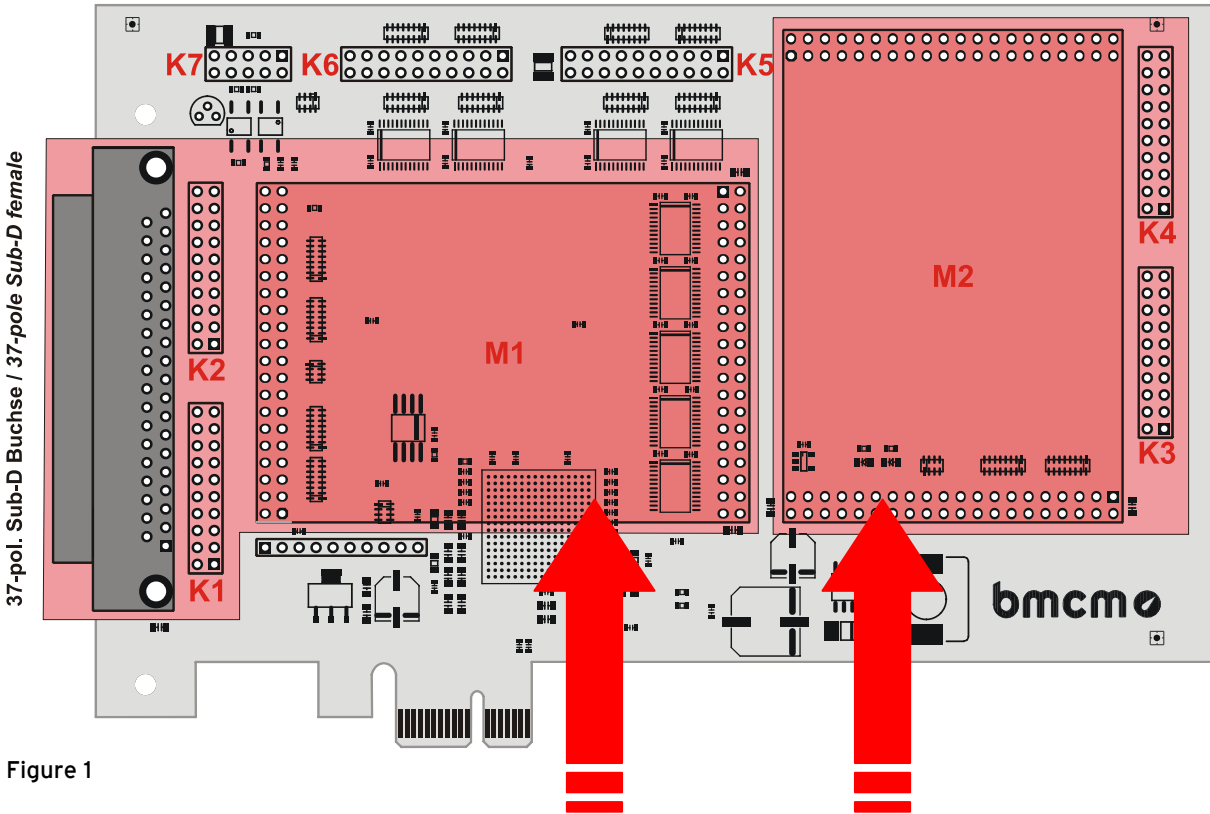


Figure 1



- ▶ **MAD16f**
16 AIn, 500kHz, 16 bit
- ▶ **MAD16a**
16 AIn, 100kHz, 16 bit
- ▶ **MAD12a**
16 AIn, 100kHz, 12 bit
- ▶ **MDA16-8i/-4i/-2i**
8/4/2 AOut (isolated), 10µs, 16 bit
- ▶ **MDA12**
2 AOut, 10µs, 12 bit
- ▶ **MDA12-4**
4 AOut, 10µs, 12 bit
- ▶ **MCAN**
2 CAN (isolated), max. 1Mbit

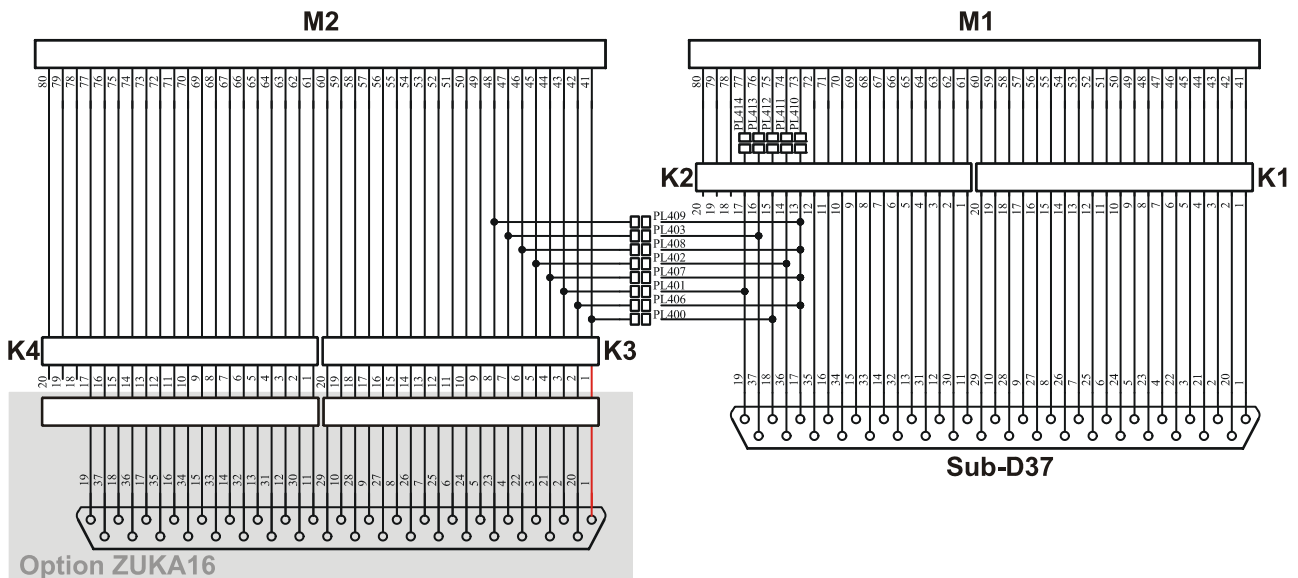
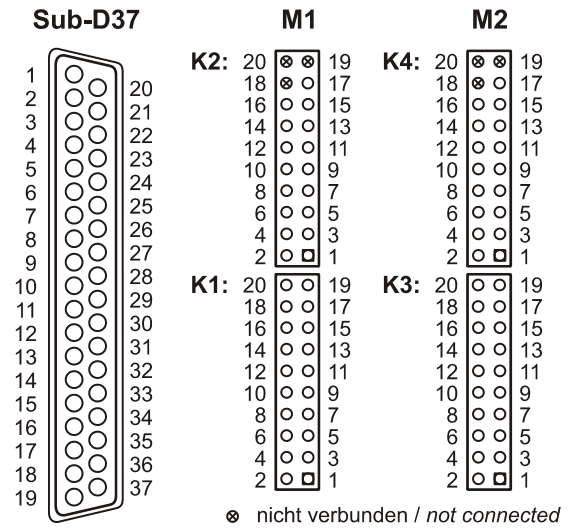
1.2 Module slots M1 and M2

The channels of the module slot M1 are available at the 37-pole Sub-D connector as well as at the pin connectors K1, K2.

The connections of the second module slot M2 are accessible at the pin connectors K3, K4.

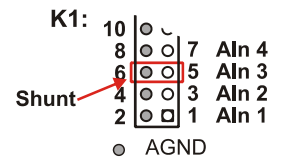
With the optional accessory *ZUKA16* (see chapter 5), the channels of the module slot M2 are lead out to an additional 37-pole Sub-D female connector (connect line 1 (colored) of *ZUKA16* with pin 1 of the pin connector K3 (square pad), attach 2. connector in parallel to K4).

The figure below shows the pin assignment of the module slots M1 and M2 of the PCIe-BASE:



1.2.1 Current measurement

Analog input modules (MAD) installed on module slot M1 can be also used for current measurement. To install current shunts (e.g. *ZU-CS250R*) at the 20-pole pin connectors K1 and K2, connect the pin of the relating analog input with the opposite ground pin by a resistor (current shunt).

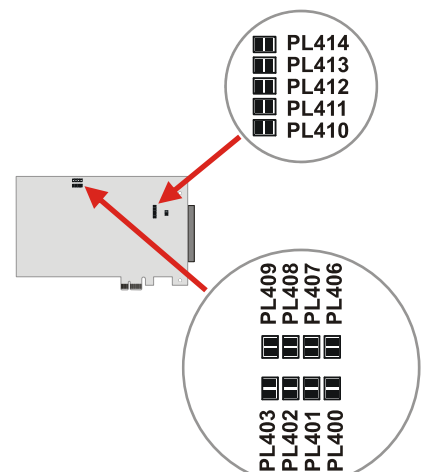


1.2.2 Lead connections from M2 to Sub-D37

By closing the solder bridges PL400-403 and PL406-409 and opening PL 410-414 on the bottom side of the PCIe-BASE board, the first four channels of an analog module (MAD or MDA series) mounted on slot M2 are led to the free pins of the 37-pole Sub-D female to be available from the outside.

Line M2	Solder bridge		MAD (se)	MDA	Pin K2	Sub-D37
	close	open				
41	400	412	AIn 1	AOut1	15	18
43	401	414	AIn 2	AOut2	17	19
45	402	411	AIn 3	AOut3*	14	36
47	403	413	AIn 4	AOut4*	16	37
42, 44, 46, 48	406, 407, 408, 409	410	AGND		13	17

* not: MDA12, MDA16-2i





- Channels of MCAN modules cannot be reached in that way at the Sub-D37 female connector!
- Only analog inputs connected in single-ended mode can be led out.
- The corresponding ground pin for the analog channels of the M2 module slot is exclusively available at pin 17 of the Sub-D37.

1.3 Pin assignments of the module slots

Analog inputs of a MAD module can be operated both in single-ended (se) and differential (diff.) mode.

MODULE SLOT M1		DATA ACQUISITION and CONTROL MODULES				MODULE SLOT M2	
Sub-D37 (PCle-BASE)	Plug / Pin	MAD (se)	MAD (diff.)	MDA	MCAN	Sub-D37 (ZUKA16)	Plug / Pin
1	K1/ 1	AIn 1	+AIn 1	AOut 1	-	1	K3/ 1
2	K1/ 3	AIn 2	+AIn 2	AOut 2	CAN1 L	2	K3/ 3
3	K1/ 5	AIn 3	+AIn 3	AOut 3**	CAN1 GND	3	K3/ 5
4	K1/ 7	AIn 4	+AIn 4	AOut 4**	-	4	K3 / 7
5	K1/ 9	AIn 5	+AIn 5	AOut 5***	-	5	K3/ 9
6	K1/11	AIn 6	+AIn 6	AOut 6***	-	6	K3/11
7	K1/13	AIn 7	+AIn 7	AOut 7***	CAN2 H	7	K3/13
8	K1/15	AIn 8	+AIn 8	AOut 8***	-	8	K3/15
9	K1/17	AIn 9	-AIn 1	-	CAN2 5V	9	K3/17
10	K1/19	AIn 10	-AIn 2	-	-	10	K3/19
11	K2/ 1	AIn 11	-AIn 3	-	-	11	K4/ 1
12	K2/ 3	AIn 12	-AIn 4	-	-	12	K4/ 3
13	K2/ 5	AIn 13	-AIn 5	-	-	13	K4/ 5
14	K2/ 7	AIn 14	-AIn 6	-	-	14	K4/ 7
15	K2/ 9	AIn 15	-AIn 7	-	-	15	K4/ 9
16	K2/11	AIn 16	-AIn 8	-	-	16	K4/11
17*	K2/13	-	-	-	-	17	K4/13
18*	K2/15	-	-	-	-	18	K4/15
19*	K2/17	-	-	-	-	19	K4/17
20	K1/ 2	AGND	-	AGND	-	20	K3/ 2
21	K1/ 4	AGND	-	AGND	CAN1 H	21	K3/ 4
22	K1/ 6	AGND	-	AGND**	-	22	K3/ 6
23	K1/ 8	AGND	-	AGND**	CAN1 5V	23	K3/ 8
24	K1/10	AGND	-	AGND***	-	24	K3/10
25	K1/12	AGND	-	AGND***	CAN2 L	25	K3/12
26	K1/14	AGND	-	AGND**	CAN2 GND	26	K3/14
27	K1/16	AGND	-	AGND***	-	27	K3/16
28	K1/18	AGND	-	-	-	28	K3/18
29	K1/20	AGND	-	-	-	29	K3/20
30	K2/ 2	AGND	-	-	-	30	K4/ 2
31	K2/ 4	AGND	-	-	-	31	K4/ 4
32	K2/ 6	AGND	-	-	-	32	K4/ 6
33	K2/ 8	AGND	-	-	-	33	K4/ 8
34	K2/10	AGND	-	-	-	34	K4/10
35	K2/12	AGND	-	-	-	35	K4/12
36*	K2/14	-	-	-	-	36	K4/14
37*	K2/16	-	-	-	-	37	K4/16

* assignment changes if analog channels of the 2nd slot are led through (see chapter 1.2.2)

** not: MDA12, MDA16-2i

*** only MDA16-8i

2 Digital channels

The PCIe-BASE features two digital ports with 16 inputs or outputs each. The lines are bidirectional and set in groups of eight. The connections are designed as two 20-pole connectors (male) on the board (see Figure 1, p.2).

- Pin connector K6 => port A, line 1..16
- Pin connector K5 => port B, line 1..16



- **The digital inputs and outputs are protected by serial resistors!**
- **At PC start, port A is set to input, port B to output.**

With the optional accessory *ZUKA16* (see chapter 5), the digital channels are lead to an additional 37-pole Sub-D female connector (connect line 1 (colored) of *ZUKA16* with pin 1 of the pin connector K5 (square pad), attach 2. connector in parallel to K6).

The right figure shows the connection of the pin plugs K5, K6 with the Sub-D37 of a *ZUKA16*.

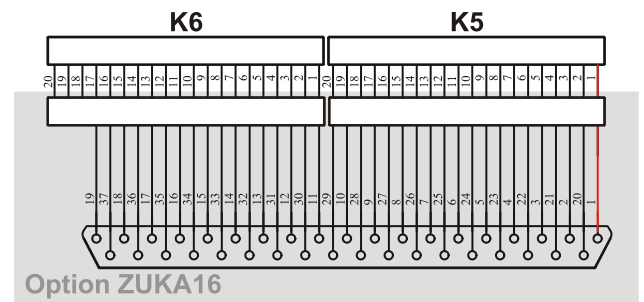
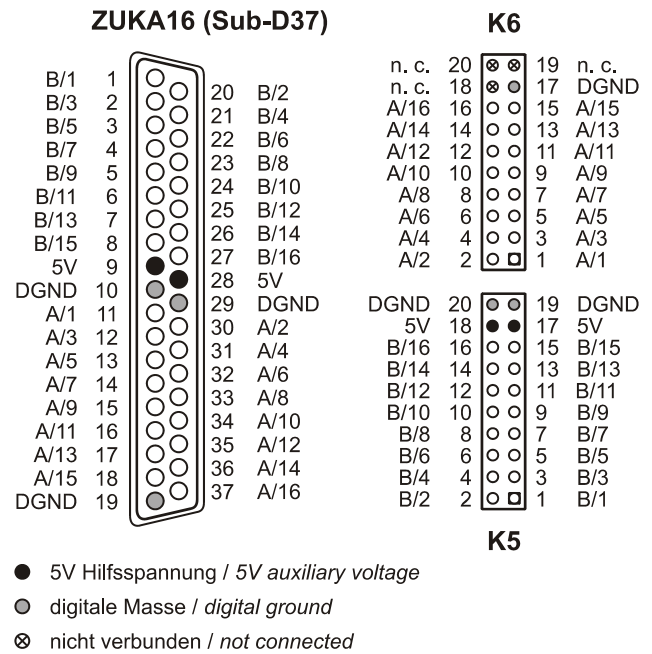
2.1 5V auxiliary voltage

The PCIe-BASE provides an auxiliary voltage (e.g. for sensor supply) at pin 17, 18 of the pin connector K5. The 5V DC output (100mA) is protected by a fuse (multifuse). In case of overload, it is sufficient to interrupt the power supply (turn off PC or disconnect the consumer load). After app. 1 min., the multifuse will be re-generated.

2.2 Pin assignment

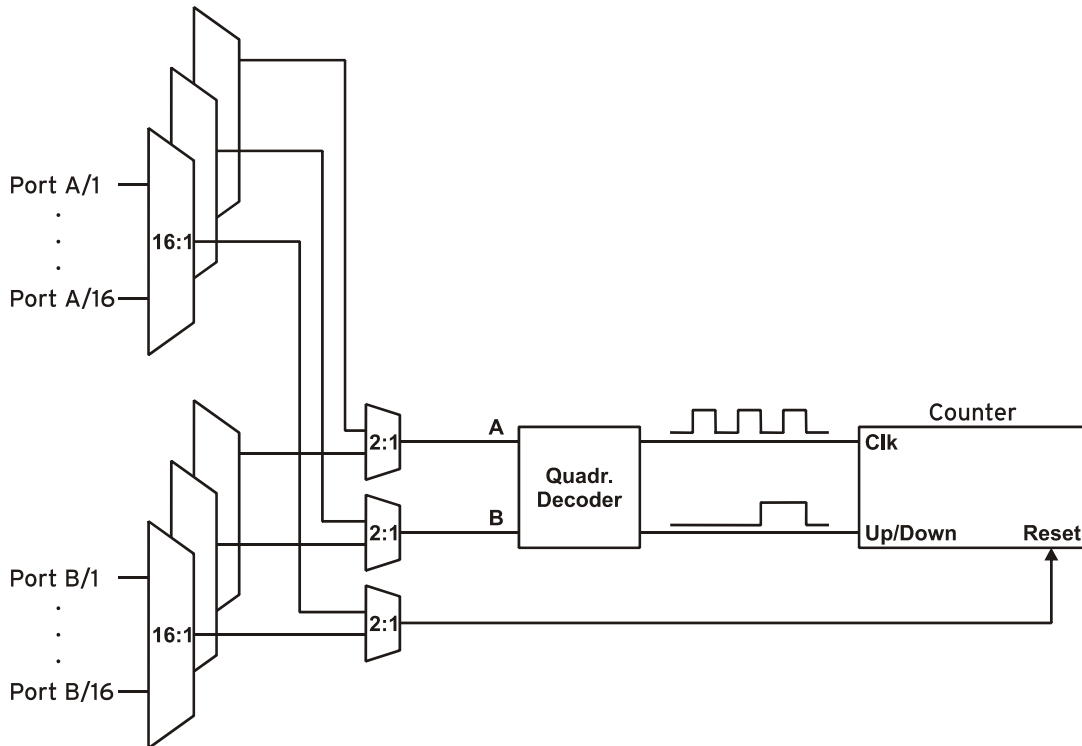
The following table shows the pin assignment of the pin connectors K5, K6 and of the 37-pole Sub-D female connector of the *ZUKA16*, at which the digital lines are accessible:

Port/Line	Sub-D37 (ZUKA16)	Connector / Pin	Port/Line	Sub-D37 (ZUKA16)	Connector / Pin	Misc.	Sub-D37 (ZUKA16)	Connector / Pin
B/1	1	K5 / 1	A/1	11	K6 / 1	5V	9	K5 / 17
B/2	20	K5 / 2	A/2	30	K6 / 2	5V	28	K5 / 18
B/3	2	K5 / 3	A/3	12	K6 / 3	DGND	10	K5 / 19
B/4	21	K5 / 4	A/4	31	K6 / 4	DGND	29	K5 / 20
B/5	3	K5 / 5	A/5	13	K6 / 5	DGND	19	K6 / 17
B/6	22	K5 / 6	A/6	32	K6 / 6	n. c.	-	K6 / 18
B/7	4	K5 / 7	A/7	14	K6 / 7	n. c.	-	K6 / 19
B/8	23	K5 / 8	A/8	33	K6 / 8	n. c.	-	K6 / 20
B/9	5	K5 / 9	A/9	15	K6 / 9			
B/10	24	K5 / 10	A/10	34	K6 / 10			
B/11	6	K5 / 11	A/11	16	K6 / 11			
B/12	25	K5 / 12	A/12	35	K6 / 12			
B/13	7	K5 / 13	A/13	17	K6 / 13			
B/14	26	K5 / 14	A/14	36	K6 / 14			
B/15	8	K5 / 15	A/15	18	K6 / 15			
B/16	27	K5 / 16	A/16	37	K6 / 16			



2.3 Counter

The PCIe-BASE features a 32-bit counter allowing the connection of an incremental encoder. The counter or incremental encoder and external counter reset, if required, are attached to any digital lines (also see chapter 3.1.4).



The PCIe-BASE counts the number of incoming pulses (max. 16MHz) sampled at the connection of signal A. If the maximum counting range of 32 bit is reached, the counter will be reset to 0. If the external counter reset is connected, the counter can be reset at any time.

In comparison to a counter, incremental encoders consider the counting direction by decoding a second phase-shifted signal.

To activate the counting function, the respective digital lines of the PCIe-BASE must be programmed to counter operation via software.

Function	Description	Max. pulse frequency	Connection	Digital pins used
Counter	count ↑	16MHz	Signal A	1
Incremental encoder	count ↑↓	4MHz	Signal A, Signal B	2
Counter reset	set counter to 0	-	Reset	1



- **Make sure the relating digital port is set to input since otherwise the counter inputs are connected to the digital outputs of the PCIe-BASE and might be damaged.**
- **Please refer to the relevant documentation of your product for further information about connecting your incremental encoder.**

3 Interfacing examples

In the following examples, the signal is always connected at port A, line 1 (pin 11). Before, however, the relating digital port must have been switched to input (see chapter 3.1) or output (see chapter 3.2).

3.1 Interfacing examples for digital inputs

The 3.9kΩ pull-down resistor sets the input to low if no voltage is applied there.

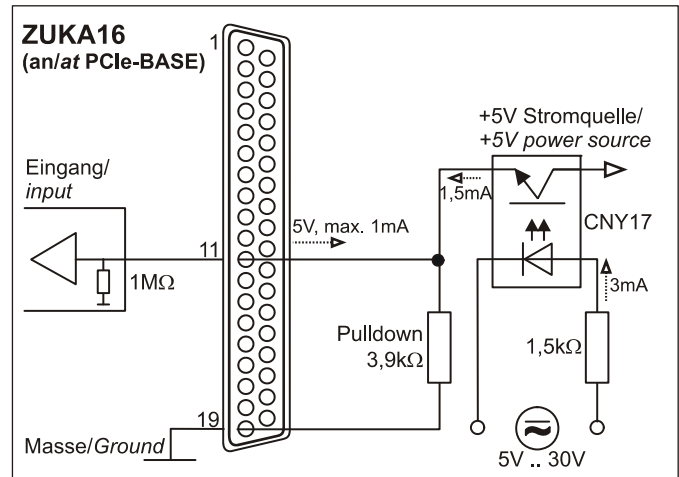
3.1.1 Connecting an optocoupler

Optocouplers provide optimum protection at each input line. With them, it is possible to connect higher voltages and to protect the hardware from being destroyed.

In this regard, please also see application examples of the optocoupler you use.



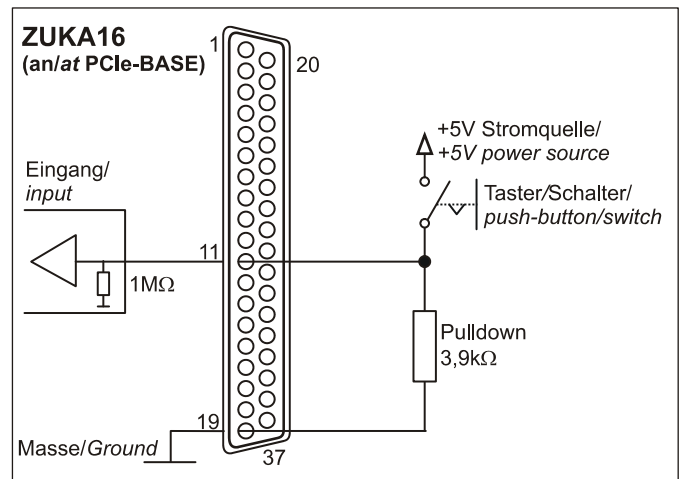
Optocoupler boards with 8 or 16 inputs are available at bmcm.



3.1.2 Connecting a push-button / switch

Please make sure to use a push-button with debounce protection, because otherwise several pulses might be recorded.

The 3.9kΩ pull-down resistor is absolutely necessary to create a defined low signal!



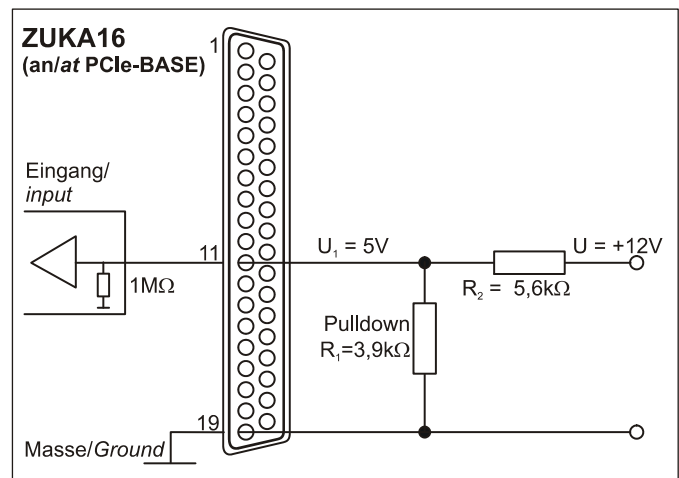
3.1.3 Connecting a voltage divider

If connecting a DC voltage higher than 5V, a voltage divider must be used so that 5V at the maximum are applied at the device input. Exceeding the 5V input voltage might cause damages to the device.

The relation between the two resistors to be used is calculated with the following formula:

$$U/U_1 = (R_1 + R_2) / R_1$$

Input voltages less than 5V are also sufficient (*high* ≥ 3V).



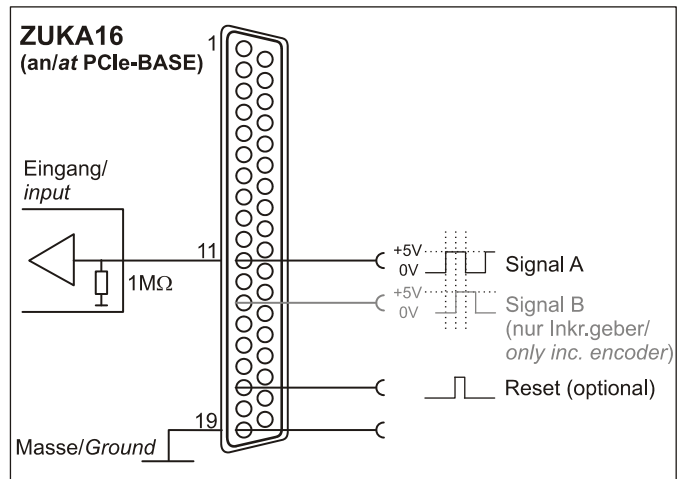
3.1.4 Connecting a counter / incremental encoder

The connection of "Signal A", "Signal B" and "Reset" is possible at any digital line.

At maximum performance ($2^{32}-1$), the counter is reset and starts from zero again.



Make sure to program the relating digital lines to counter operation.



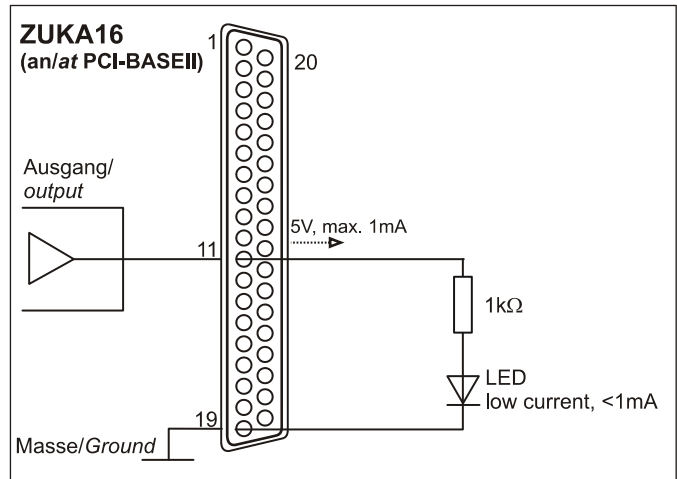
3.2 Interfacing examples for digital outputs

Serial resistors in the output lines limit the current and protect the hardware from being destroyed.

3.2.1 Connecting an LED

Only so-called low-current LEDs can be used, because they already work with 1mA current.

Please also observe the total current listed in the technical data (see chapter 7).

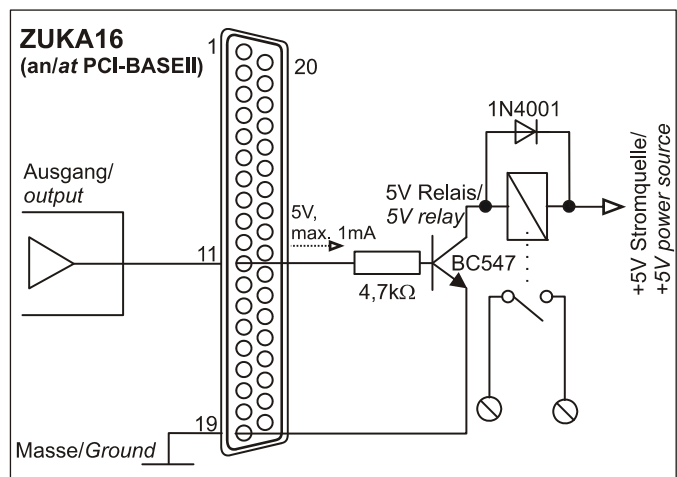


3.2.2 Connecting a relay

A connected relay is ideal to switch higher currents. Since the field coil of the relay requires a higher current than provided by the measurement system at one line, a transistor is connected ahead.



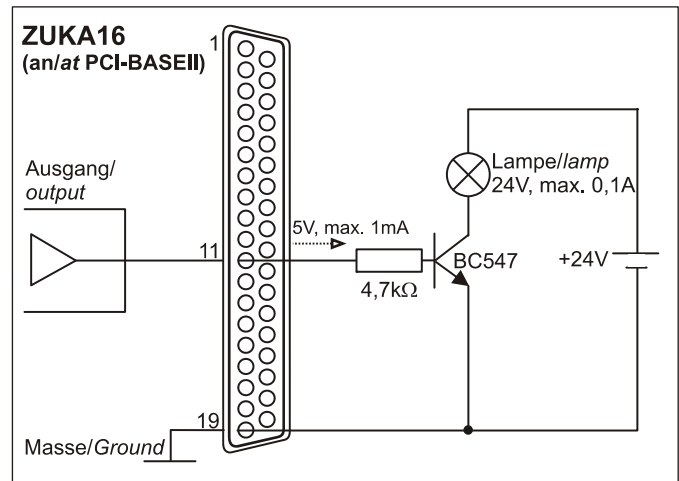
Relay boards with 8 relays or 16 semiconductor relays are available at bmc.



3.2.3 Connecting a lamp

A transistor can be used to switch higher loads. The selected transistor must comply with the maximum switchable current.

The figure on the right shows an application with a maximum current of 100mA.



4 Software installation



All software and documentation available for the PCIe-BASE are integrated on the "Software Collection" CD included with delivery. When inserting the CD, a CD starter opens automatically (otherwise: start **openhtml.exe**).



PCIe-BASE

Change to the product page of the PCIe-BASE by selecting the entry "Products" in the CD starter and then the hardware ("PCIe-BASE ") listed under the interface "PCI/PCIe".



For detailed information about installing or operating the software, please see the corresponding manuals. The Adobe Acrobat Reader is required to open the documentation in PDF format.



You can run the installation directly from CD. If your browser prevents this, first save the setup program to hard disc before running it separately.

Software	Software product	Notes	Documentation
Device driver	BMCM-DR (driver package)	1. install driver package to hard disc 2. Windows® Plug&Play installation	BMCM-DR-IG (driver installation manual)
Program- ming	STR-LIBADX	ActiveX control for hardware independent programming	STR-LIBADX-IG (installation / programming manual)
	STR-LIBADX-EX	example programs for LIBADX ActiveX control	-
	SDK-LIBAD	SDK with example programs for C/C++ on Windows®	SDK-LIBAD-IG (installation / programming manual)
Operating program	NV4	measuring software NextView®4 available in the Standalone versions: <ul style="list-style-type: none"> • <u>Lite</u>: "slim" version with basic functions • <u>Pro</u>: full version with complete functional range • <u>Analysis</u>: version for the analysis of stored measuring data NextView®4 can be used for free as a fully functional 30-day trial version. After purchasing the software, all projects, measurement files, and settings can still be used.	DS-NV4 (data sheet) UM-NV4 (user manual) "First steps" in the NextView®4 demo project (displayed when first starting the software)
	NV4-SRV NV4-WORK	Client/Server version of NV4 consisting of NextView®4 Server and NextView®4 Workstation	

4.1 Driver installation



A driver installation is always required for the PCIE-BASE. Only then additional software can be installed. To make sure the installation is done correctly, please follow the instructions in the order as described below.

4.1.1 Install driver package

The prior installation of the bmc driver package [BMCM-DR](#) to the hard disc of your PC makes the driver search for Windows® much easier. Especially in case of driver updates, only the new driver package has to be installed, the hardware automatically uses the new version.

The driver package is provided on the PCIE-BASE product page of the "Software Collection" CD.

4.1.2 Plug&Play installation

Mount the PCIE-BASE into a free PCIE card slot of the off-state PC. When starting the PC, the system announces the new hardware. Since the driver package has been copied to hard disc before, the hardware will be installed automatically under Windows® 7. Under Windows® XP, the automatic hardware detection is started by selecting the following option:



- **Windows® 7:** no specifications required
- **Windows® XP:** "Install the software automatically" (SP2: do not connect with Windows® Update!)

4.1.3 Check installation

The entry "Data Acquisition (BMC Messsysteme GmbH)" is included in the Windows® Device Manager after successful installation displaying the installed bmc hardware. To open the Device Manager, proceed as follows:



- **Windows® 7:** Start / Control Panel / System and Security / System / Device Manager
- **Windows® XP:** Install Start / Control Panel / System / TAB "Hardware" / button "Device Manager"

Double click the PCIE-BASE to show its properties. For general information, any existing device conflicts and possible sources of error, see TAB "General".

4.2 Programming

Programming the PCIE-BASE with Visual Basic®, Delphi®, Visual C++™ under Windows® 7/XP is possible with the hardware independent [STR-LIBADX](#) ActiveX control or with the LIBAD4 SDK ([SDK-LIBAD](#)). They are available on the PCIE-BASE product page of the "Software Collection" CD. After installation, the ActiveX control must be loaded into the respective programming environment.



- **Visual Basic®:** menu "Project / Components", entry "LIBADX Object Library 4.0"
- **Delphi®:** menu "Components / Import ActiveX", entry "LIBADX Object Library 4.0"


If you select the entry [STR-LIBADX-EX](#) listed directly under the installation program of the corresponding ActiveX control, you can install example programs (with source code) demonstrating how to apply the ActiveX control.




- **Using the LIBAD4 SDK requires advanced programming experience!**
- **MCAN modules on the data acquisition card can only be programmed with the LIBAD4 SDK. All other modules on the PCIE-BASE can be addressed with the LIBADX ActiveX control.**
- **The counter of the PCIE-BASE and the generator function of the MDA16-2i/-4i/-8i are only available with the LIBAD4 SDK.**

4.3 Using PCIe-BASE with NextView®4

Install the fully functional trial of the professional software NextView®4 for measurement data acquisition and processing to directly test the features and functions of the PCIe-BASE.

 The setup program [NV4](#) is available on the product page of the card. When first starting the software, request a license number with the option "Request 30 days free trial version" being checked and select your DAQ system (PCIe-BASE) in the following dialog "Device Setup".

The data sheet and the start project of NextView®4 contain first instructions about how to install and operate the program. For detailed information, an online help is provided.

 **The trial is valid for 30 days after requesting the license number. If a license is not purchased within this period, the functional range of NextView®4 will considerably be cut back!**

5 Connection cable ZUKA16

Via a flat ribbon cable, the optionally available connection cable *ZUKA16* leads the channels provided at two 20-pole pin connectors each to a 37-pole Sub-D female connector with bracket, which is mounted at a free PC slot.

With the *ZUKA16*, the channels provided by module slot M2 (see chapter 1.2) and the digital lines of the PCIe-BASE (see chapter 2) can be reached externally.

The line of the flat ribbon cable leading to pin 1 of the Sub-D37 is colored.



6 Important notes for using the PCIe-BASE

- The device is only suitable for extra-low voltages - please observe the relevant regulations! For reasons relating to EMC, it must only be used in closed PC housings. ESD voltages at open lines may cause malfunction.
- For cleaning only use non-solvent detergents. The product is designed to be maintenance-free.
- Signal cables are connected at the 37-pole Sub-D female connector – preferably use shielded cables. For best possible interference suppression, connect shield at one end only. Close open inputs if necessary.
- The device must not be used for safety-relevant tasks. With the use of the product, the customer becomes manufacturer by law and is therefore fully responsible for the proper installation and use of the product. In the case of improper use and/or unauthorized interference, our warranty ceases and any warranty claim is excluded.
- Improper installation of the modules on the PCIe-BASE may damage the modules and/or the PCIe-BASE. When removing the modules, only use blunt tools! Exposing the card to strong vibrations requires additional protection of the modules.
- If connecting internal ribbon cables to the PCIe-BASE, please make sure the modules are well ventilated to prevent excess heating. Also observe the temperature ranges of the PC.
- In case of overload, interrupt the power supply (turn off PC) so that the multifuse on the board is regenerated. The fuse will be ready for use after app. 1 min.



Do not dispose of the product in the domestic waste or at any waste collection places. It has to be either duly disposed according to the WEEE directive or can be returned to bmcm at your own expense.

7 Technical data

(typical at 20°C, after 5min.)

• Sampling parameters (with measuring and analysis software NextView®4)

Max. total sampling rate*:	dep. on the modules used, max. 1 MHz with 2x MAD16f
FIFO:	4kByte
Memory depth:	depending on the RAM or HD space available

* The total sampling rate is the sum of the sampling rates of the individual used channels (e.g. if 5 channels are scanned with 10kHz, the total sampling rate adds up to 50kHz).

• Digital input/outputs

Channels:	2x 16 lines (bidirectional, set in groups of 8), 1x counter/incremental encoder (32 bit, opt. counter reset) connectable at any digital inputs
Level:	CMOS/TTL compatible (low: 0V..0.7V; high: 3V..5V)
Input resistance:	1MΩ
Surge protection:	20V DC, max. ±20mA in total of all inputs!
Output resistance:	1kΩ
Output current:	1mA

• Signal connection

Channels of the plug-on modules:	all channels are accessible at a 37-pole Sub-D female connector at the PC-card bracket, via pin connectors or (with ZUKA16 option) at an additional PC-bracket (37-pole Sub-D female)
Digital channels (of PCIe-BASE):	2x20-pole pin connectors on the board; with ZUKA16 (optional) accessible at a PC-bracket (Sub-D37)

• General data

Bus connection:	PCIe x1 (PCIe bus)
CE standards:	EN61000-6-1, EN61000-6-3, EN61010-1; for decl. of conformity (PDF) visit www.bmcm.de
ElektroG // ear registration:	RoHS and WEEE compliant // WEEE Reg.-No. DE75472248
Max. permissible potentials:	60V DC acc. to VDE , max. 1kV ESD on the lines
Temperature ranges:	operating temp. -25°C..+50°C, storage temp. -25°C..+70°C
Relative humidity:	0–90% (not condensing)
Size:	without PC-card bracket: 174 x 111 x 16 mm ³
Delivery:	product, PC-bracket, "Software Collection" CD, description
Available accessories:	cable with PC-bracket for internal connection ZUKA16, 37-pole Sub-D plug ZUST37, connecting cables ZUKA37SB, ZUKA37SS, optocoupler board OI16-PC, connector panels ZU37BB/-CB/-CO, current shunt ZU-CS250R, modules of the series MAD/MDA/MCAN
Warranty:	2 years from date of purchase at bmcm, claims for damages resulting from improper use excluded

• Software

Software on CD (included):	ActiveX Controls LIBADX (hardware independent) for programming on Windows® 7/XP; LIBAD4 SDK for C/C++ programming on Windows® 7/XP; trial version of the measuring software NextView®4 to test and operate the hardware
NextView®4 (optional):	professional software (versions: Professional, Lite, Client/Server) for the acquisition and analysis of measurement data on Windows® 7/XP