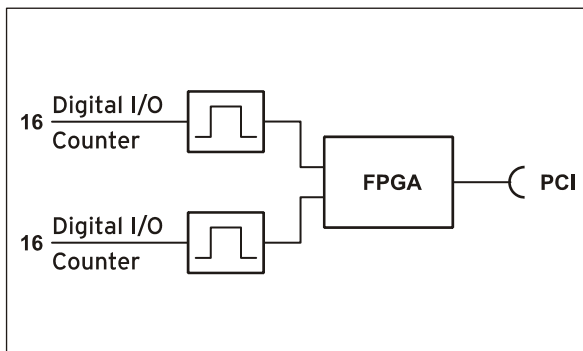# PCI-PIO

Digital I/O card (PCI)

32 channels. Digital.
Signal output & Monitoring.

Record and output digital signals. The PCI-PIO features two 16-bit bidirectional digital ports. The port lines are led out to a 37-pole Sub-D female connector. The short latency of the PCI interface makes the card especially attractive for controlling tasks.

Connect incremental encoder.
Count up and down.

Up to 3 counters or incremental encoders can be connected at any digital inputs of the PCI-PIO. The relevant digital lines are programmed to counter mode via software. To set an incremental encoder to the zero position, the use of an external counter reset is supported.

Functional diagram

PCI. Well fitted in the PC.

The PCI-PIO is installed in a free PCI slot and is supplied by the PC - all this without annoying cables. The PC housing provides optimum protection against interferences. Due to Plug&Play, the card is recognized automatically by the PC making installation a lot easier.

All Windows® or something.

The PCI-PIO can be used on Windows® 7/XP. The entire software for installation and programming (ActiveX Control) of the digital I/O card is included for free.

NextView®4. Try for free.

The DAQ card 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 PCI-PIO.

1   Start-up procedure

Install the bmcm driver package (see chapter 4.1.1) on the PC first. Then, fix the included bracket to the PCI-PIO by means of the two hexagonal bolts.

To mount the card into the PC, shut down and turn off the PC and open the PC housing. After removing a blank bracket, plug the PCI-PIO in a free PCI slot of the off-state PC. Boot up the PC and start the Plug&Play installation (see chapter 4.1.2). The power supply of the card is provided via the PCI bus. If required, additional software components can be installed as described in chapter 4.

To avoid damages to the card and the PC, turn off the PC before mounting the PCI-PIO!
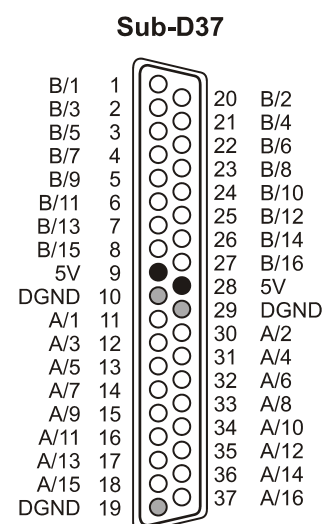
2   Digital channels

The PCI-PIO features two digital ports with 16 inputs or outputs each. The lines are bidirectional. The direction is set to input or output in groups of 8 via software.

2.1   Pin assignment

The following table and figure shows the pin assignment of the 37-pole Sub-D female connector of the PCI-PIO, at which the digital lines are accessible:

Port/Line	Sub-D37	Port/Line	Sub-D37
B/1	1	A/1	11
B/2	20	A/2	30
B/3	2	A/3	12
B/4	21	A/4	31
B/5	3	A/5	13
B/6	22	A/6	32
B/7	4	A/7	14
B/8	23	A/8	33
B/9	5	A/9	15
B/10	24	A/10	34
B/11	6	A/11	16
B/12	25	A/12	35
B/13	7	A/13	17
B/14	26	A/14	36
B/15	8	A/15	18
B/16	27	A/16	37

Sub-D37

B/1	1		20	B/2
B/3	2		21	B/4
B/5	3		22	B/6
B/7	4		23	B/8
B/9	5		24	B/10
B/11	6		25	B/12
B/13	7		26	B/14
B/15	8		27	B/16
5V	9		28	5V
DGND	10		29	DGND
A/1	11		30	A/2
A/3	12		31	A/4
A/5	13		32	A/6
A/7	14		33	A/8
A/9	15		34	A/10
A/11	16		35	A/12
A/13	17		36	A/14
A/15	18		37	A/16
DGND	19			

● 5V Hilfsspannung / *5V auxiliary voltage*
○ digitale Masse / *digital ground*

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

2.2   5V auxiliary voltage

The PCI-PIO provides an auxiliary voltage (e.g. for sensor supply) at pin 9, 28 of the 37-pole Sub-D female. 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 regenerated.

2.3 Counter

The PCI-PIO features three 32-bit counters allowing the connection of incremental encoders. The counters or incremental encoders and external counter reset, if required, are attached to any digital lines (also see chapter 3.1.4).
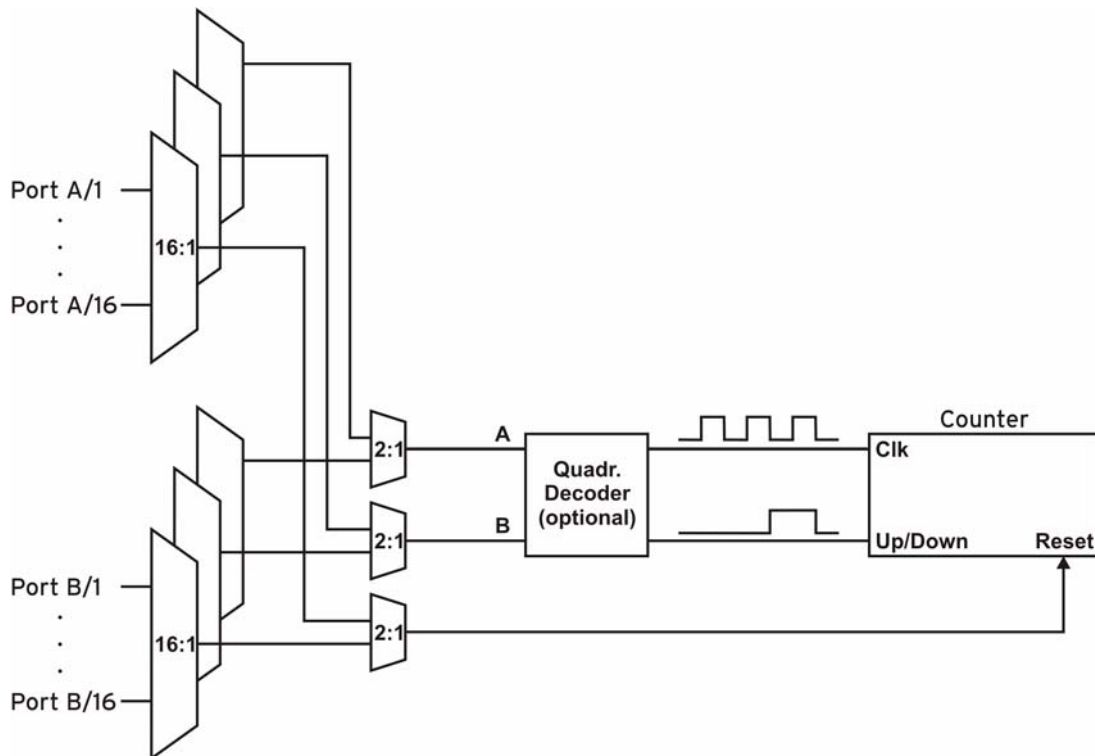
The PCI-PIO counts the number of incoming pulses (max. 16MHz) sampled at the connection of signal A. If the maximum counting range of 32 bit is reached, the counter will be reset to 0. If the external counter reset is connected, the counter can be reset at any time.

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 PCI-PIO 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 PCI-PIO 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.
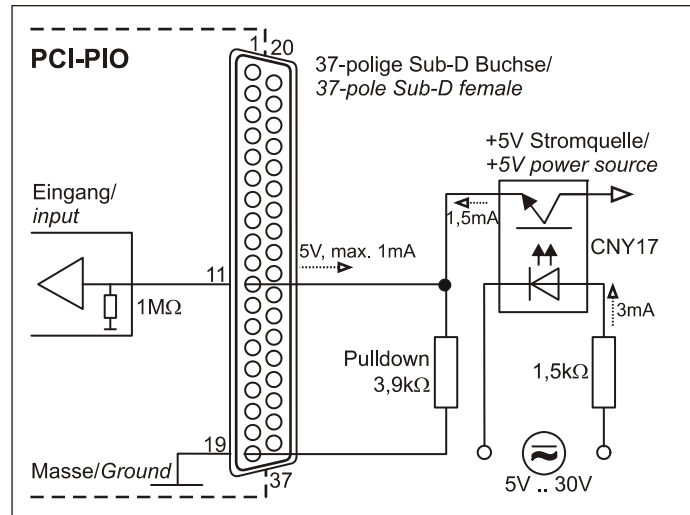
3.1.2 Connecting a push-button / switch

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!
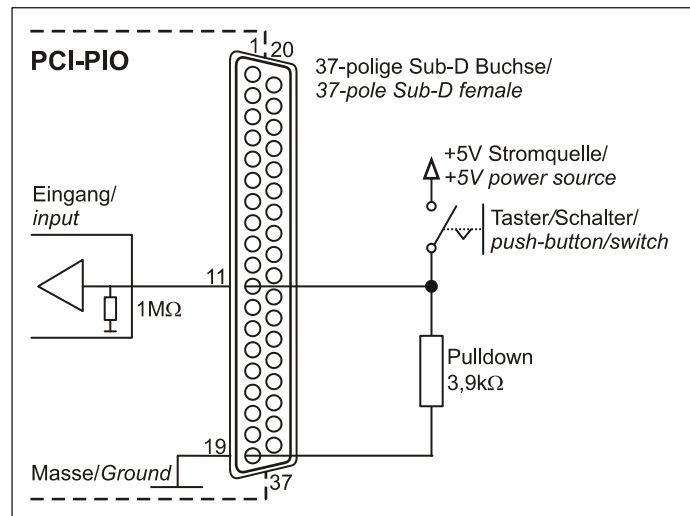
3.1.3 Connecting a voltage divider

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:

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

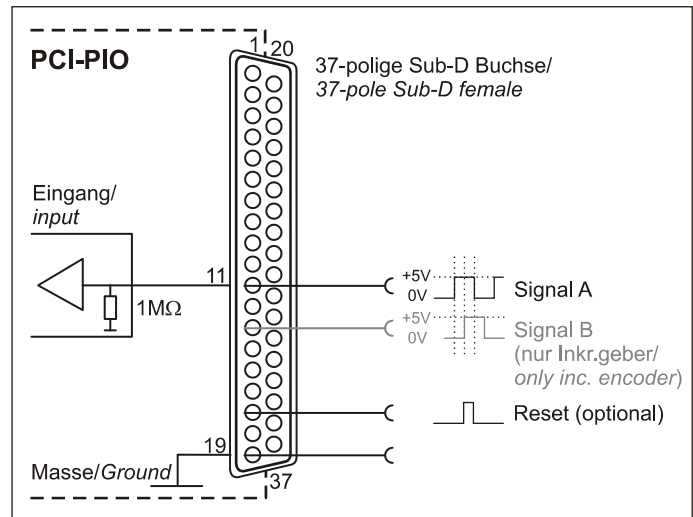Input voltages less than 5V are also sufficient (*high* $\geq 3V$).
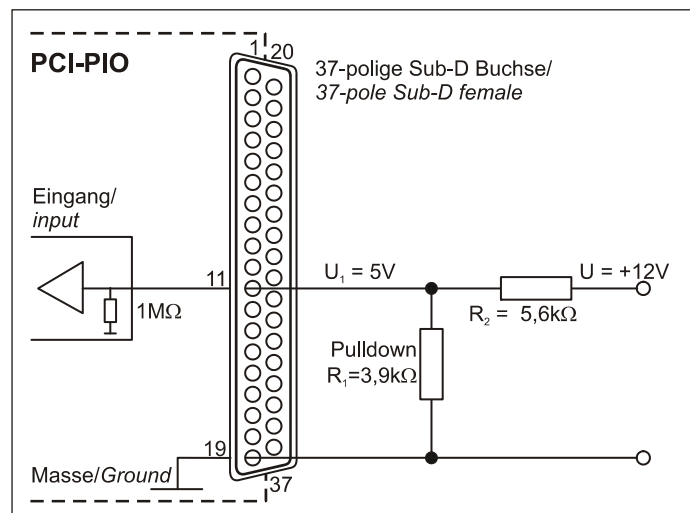
3.1.4 Connecting a counter / incremental encoder

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.

PCI-PIO

37-polige Sub-D Buchse/
37-pole Sub-D female

Eingang/
input

11

1MΩ

19

Masse/*Ground*

+5V
0V   Signal A

+5V
0V   Signal B
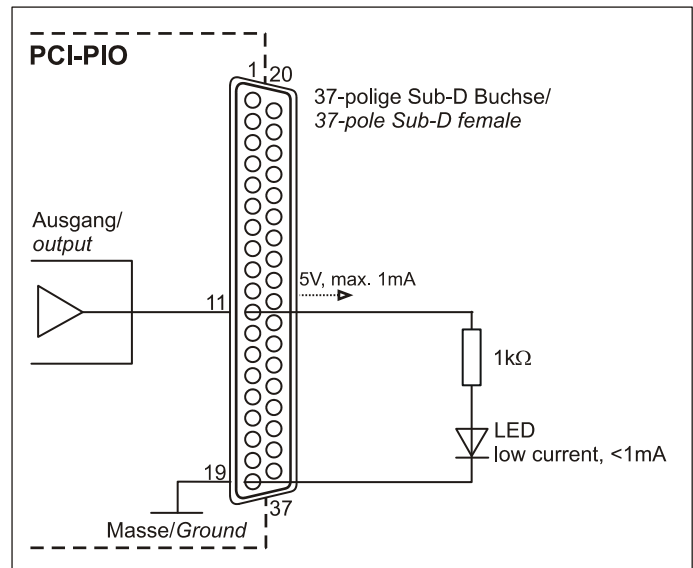(nur Inkr.geber/
only inc. encoder)

Reset (optional)

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 6).

PCI-PIO

37-polige Sub-D Buchse/
37-pole Sub-D female

Ausgang/
output

5V, max. 1mA

11

1kΩ

LED
low current, <1mA
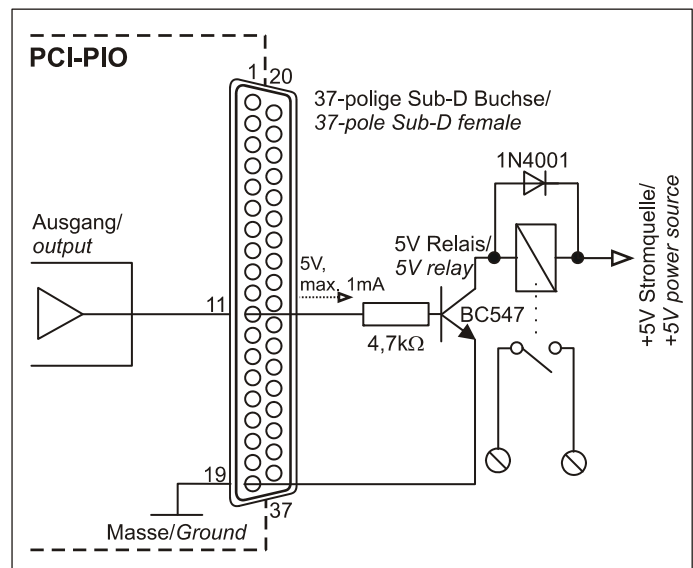
19

Masse/*Ground*

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 bmcm.

PCI-PIO

37-polige Sub-D Buchse/
37-pole Sub-D female

Ausgang/
output

1N4001

5V,
max. 1mA

5V Relais/
5V relay

11

4,7kΩ   BC547

+5V Stromquelle/
+5V power source

19

Masse/*Ground*

4   Software installation

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

Change to the product page of the PCI-PIO by selecting the entry "Products" in the CD starter and then the hardware ("PCI-PIO") 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)
Programming	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: • Lite: "slim" version with basic functions • Pro: full version with complete functional range • Analysis: 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

The driver installation is always required for the PCI-PIO. 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 bmcm 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 link to install the driver package is located on the PCI-PIO product page of the "Software Collection"-CD.

4.1.2 Plug&Play installation

Mount the PCI-PIO into a free PCI 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 bmcm 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 PCI-PIO to show its properties. For general information, any existing device conflicts and possible sources of error, see TAB "General".

4.2 Programming

Programming the PCI-PIO 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 PCI-PIO 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!**
- **The counters of the PCI-PIO can only be programmed with the LIBAD4 SDK.**

4.3 Using PCI-PIO 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 PCI-PIO.

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 (PCI-PIO) 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 Important notes for using the PCI-PIO

- 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.
- 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.

6 Technical data

(typical at 20°C, after 5min.)

- **Digital inputs/outputs**

Channels:	2x 16 lines (bidirectional, set in groups of 8), 3x counters/incremental encoders (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:	all channels are accessible at a 37-pole Sub-D female connector at the PC-card bracket

- **General data**

Bus connection // PCI specification:	PCI bus (universal slot: 3.3V and 5V) // PCI Bus Spec 3.0
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: 181 x 107 x 16 mm^3
Delivery:	product, PC-bracket, "Software Collection" CD, description
Available accessories:	37-pole Sub-D plug ZUST37, connecting cable ZUKA37SB, ZUKA37SS, optocoupler board OI16
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®4.4 (optional):	professional software (versions: Professional, Lite, Client/Server) for the acquisition and analysis of measurement data on Windows® 7/XP/2000

Manufacturer: BMC Messsysteme GmbH. Subject to change due to technical improvements. Errors and printing errors excepted. Rev. 3.0 10/12/2010

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