**bmcm**

bmc messsysteme gmbh

# ■ USB-AD16f

USB Data Acquisition System

## Measurement & Control. Extremely Powerful.

Precisely record and output signals with the USB-AD16f: The high-performance USB data acquisition system accommodated in a stable aluminum housing impresses by high technical standard and excellent price-performance ratio. It is especially suitable for dynamic applications.

## 16 Analog Inputs. 250kHz 16 Bit. ±10V, ±5V, ±2V, ±1V.

16 analog inputs can be sampled with 16 bit resolution and 250kHz total sampling rate so that even slightest peaks of high-frequent signals do not remain undetected. The measuring range is selected via software for each channel separately.

## 2 Analog Outputs. 16 Bit. ±10V.

The two 10V outputs can be used for analog controls with 16 bit accuracy.

## Clearly Safe.

Due to the galvanic isolation of the analog channels the DAQ system and the PC are perfectly protected.



Functional diagram

## 4 Digital Inputs/Outputs Each. 1 Counter.

Digital states are recorded or set at four digital inputs and outputs each. Digital inputs are sampled time-synchronously with the analog inputs. The additional counter input is galvanically isolated.

## Plug & Play.

The connection to the PC is realized via USB. The USB-AD16f provides all typical USB features (e.g. Plug&Play, Hot-Plug). Up to 127 devices can be connected and installed during operation.

## Powered by USB.

The device is supplied with power via the USB interface. This reduces cabling efforts to a minimum and makes mobile measurements a lot easier.

## Optimal for Windows.

The drivers and programming interface is optimized for 64Bit under Windows® 10/11. All software for installation and programming of the USB-AD16f is included free of charge.

## NextView®. Try for Free.

The DAQ system is supported by NextView®, the software for data acquisition and analysis. A fully functional 14-day trial is included with delivery to directly test the functionality of the USB-AD16f.

www.bmcm.de  |  www.nextview.de
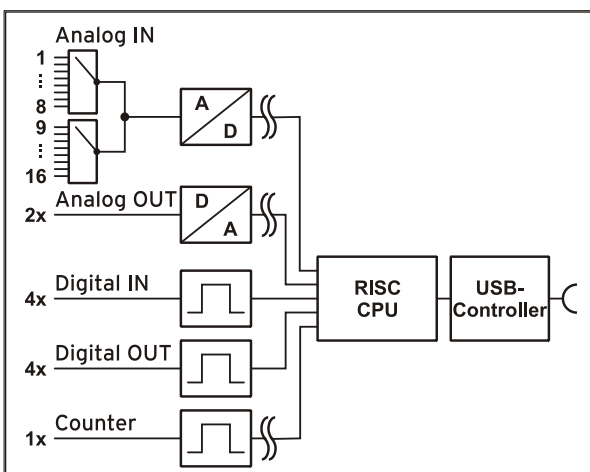
# 1 Start-up procedure

All available software and documentation for the USB-AD16f are located on http://www.bmcm.de/usb-ad16f-en in the tab **Downloads.**

### 1. Step: Connect up
Please attach both of the red frames with the feet facing down with light pressure at the ends of the housing as shown on the product picture. Connect the provided USB cable to the device and to a free USB port of the PC. Then start the plug and play installation. The device gets its power supply through the USB connection.
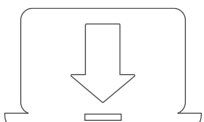
### 2. Step: Installation device driver
Install the latest driver package in order to use the USB measurement device. You will find the package on http://www.bmcm.de/usb-ad16f-en in the tab **Downloads** in the category **BMCM – Drivers**.
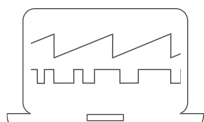
### 3a. Step: Measuring with NextView
To be able to use your measurement system with NextView, you just need to download and install the latest version of NextView on www.nextview.de/go-en. In case you did not buy NextView, request a free of charge trial version when first starting NextView. Find more information about NextView and its installation on www.nextview.de.
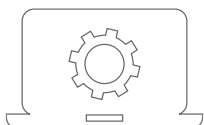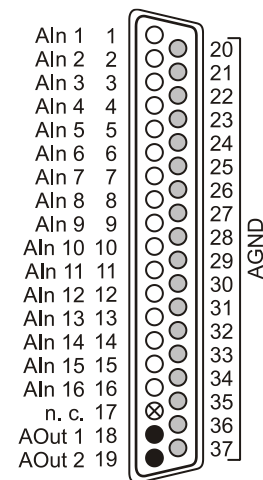
### 3b. Step: Measuring with API
In case you want to use the measurement device without NextView, you need to download and install the free of charge programming interface LIBAD4. You can find this on www.bmcm.de/usb-ad16f-en in the tab **Downloads** in the category **LIBAD – Programming Interface (API)**, too. Find more information on www.bmcm.de/libad-en.

## 2 Analog Inputs and Outputs

The 37-pin D-Sub female connector at the front of the device is designed for the connection of the analog inputs and outputs. The following table shows the pin assignment of the 37-pin D-Sub connector:



○ AIn = Analogeingang / *analog input*
● AOut = Analogausgang / *analog output*
◉ AGND = analoge Masse / *analog ground*
⊗ n. c. = nicht verbunden / *not connected*

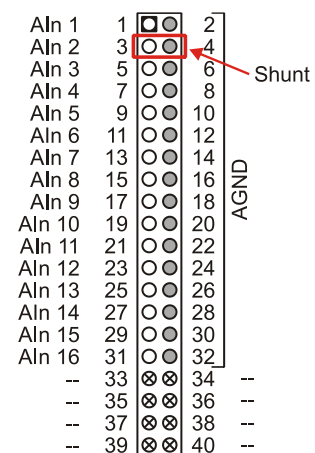| Pin | Assignment | Pin | Assignment |
|---|---|---|---|
| 1 | AIn 1 | 11 | AIn 11 |
| 2 | AIn 2 | 12 | AIn 12 |
| 3 | AIn 3 | 13 | AIn 13 |
| 4 | AIn 4 | 14 | AIn 14 |
| 5 | AIn 5 | 15 | AIn 15 |
| 6 | AIn 6 | 16 | AIn 16 |
| 7 | AIn 7 | 17 | n. c. |
| 8 | AIn 8 | 18 | AOut 1 |
| 9 | AIn 9 | 19 | AOut 2 |
| 10 | AIn 10 | 20..37 | AGND |
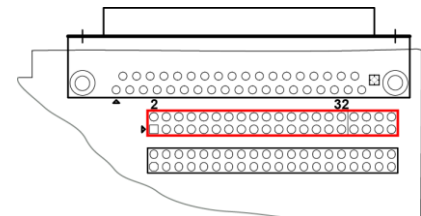
**The max. potentials to ground must not exceed ±12V. Any channel overload may influence measurements of other channels and may lead to wrong values.**

The internal connection of the 16 analog inputs is provided via a 40-way pin connector (see figure on the right, here: current measurement at channel 2) on the USB-AD16f board, which, for example, can be used to connect current shunts (*ZU-CS250R* available as accessory).
The following table shows the pin assignment of the 40-way pin connector:



○ AIn = Analogeingang / *analog input*
◉ AGND = analoge Masse / *analog ground*
⊗ -- = interne Verwendung / *internal use*

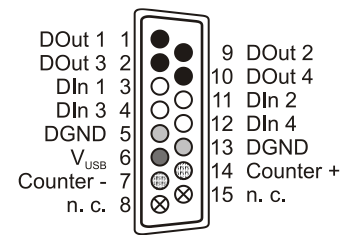| Pin. | Assignment | Pin | Assignment |
|---|---|---|---|
| 1 | AIn 1 | 17 | AIn 9 |
| 3 | AIn 2 | 19 | AIn 10 |
| 5 | AIn 3 | 21 | AIn 11 |
| 7 | AIn 4 | 23 | AIn 12 |
| 9 | AIn 5 | 25 | AIn 13 |
| 11 | AIn 6 | 27 | AIn 14 |
| 13 | AIn 7 | 29 | AIn 15 |
| 15 | AIn 8 | 31 | AIn 16 |
| 2, 4, .., 30, 32 | AGND | 33, 34, .., 39, 40 | n. c. |

# 3 Digital Inputs and Outputs

The USB-AD16f features 4 digital inputs and outputs each (*low*: 0V..0.7V; *high*: 3V..5V) and an isolated counter input. The 5V auxiliary voltage at pin 6 can be used e.g., for sensor supply.
All connections are led to the 15-pin D-Sub female connector on the back of the device. The pin assignment is as follows:



| DOut 1 | 1 | | 9 | DOut 2 |
| DOut 3 | 2 | | 10 | DOut 4 |
| DIn 1 | 3 | | 11 | DIn 2 |
| DIn 3 | 4 | | 12 | DIn 4 |
| DGND | 5 | | 13 | DGND |
| V$_{USB}$ | 6 | | 14 | Counter + |
| Counter - | 7 | | 15 | n. c. |
| n. c. | 8 | | | |

○ DIn = Digitaleingang / *digital input*
● DOut = Digitalausgang / *digital output*
◔ DGND = digitale Masse / *digital ground*
◕ 4-5V; max. 20mA
◉ Zählereingang / *counter* input
⊗ n. c. = nicht verbunden / *not connected*

| Pin | Assignment | | Pin | Assignment |
|-----|------------|---|-----|------------|
| 1 | DOut 1 | | 5, 13 | DGND |
| 9 | DOut 2 | | 6 | V$_{USB}$ (4-5V; max. 20mA) |
| 2 | DOut 3 | | 7 | counter input low |
| 10 | DOut 4 | | 14 | Counter input high |
| 3 | DIn 1 | | 8, 15 | n. c. |
| 11 | DIn 2 | | | |
| 4 | DIn 3 | | | |
| 12 | DIn 4 | | | |

- **The digital lines are protected by 1kΩ resistors. If the input voltage is not within the permitted voltage range of 0V..5V, the device may be damaged.**
- **The digital inputs and outputs are not galvanically isolated except for the counter.**
- **The digital ground (DGND) is connected with the PC ground.**

# 4 Interfacing Examples for the Digital Lines of the USB-AD16f

The following basic connection examples demonstrate the use of the digital inputs and outputs and the connection of a counter to the USB-AD16f. The pin assignment of the 15-pin D-Sub female connector is described in chapter 3.

## 4.1 Interfacing Examples for the Counter Input

The galvanically isolated 16-bit counter is connected at pin 7 and 14.
At maximum performance ($2^{16}$-1), the counter is reset and starts from zero again.
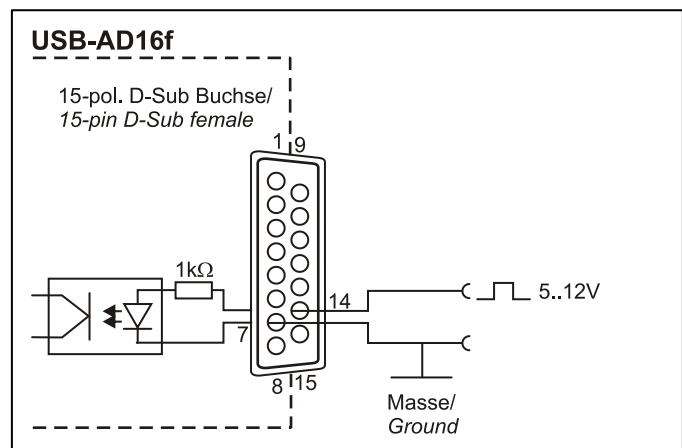
## 4.2 Interfacing Examples for Digital Inputs

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

### 4.2.1 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.
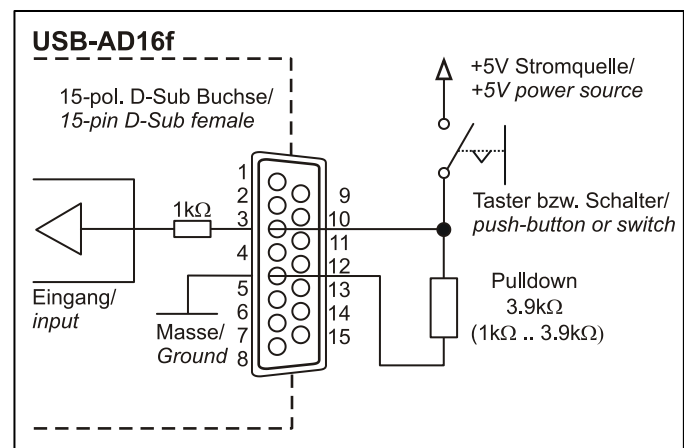
**Optocoupler cards featuring 8 inputs are available at bmcm.**
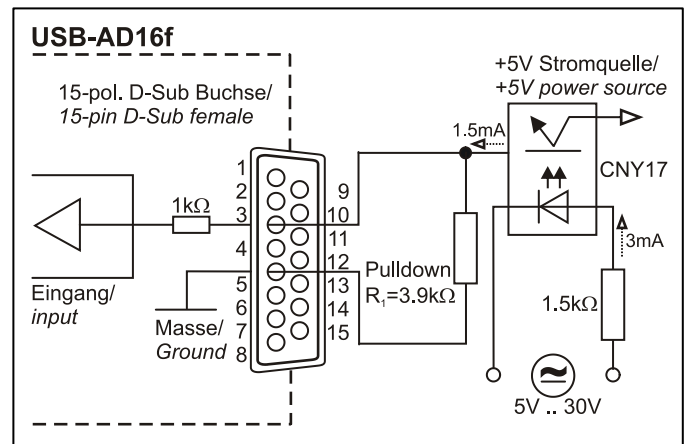


### 4.2.2 Connecting a Push-Button / Switch

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!



### 4.2.3 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).
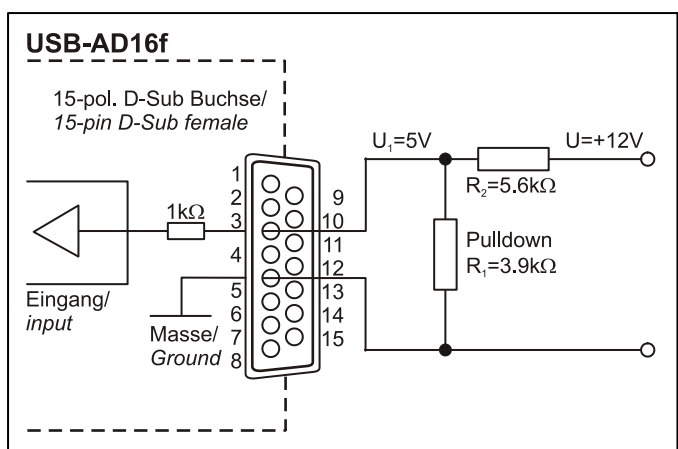
### 4.3 Interfacing Examples for Digital Outputs

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

#### 4.3.1 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 5).
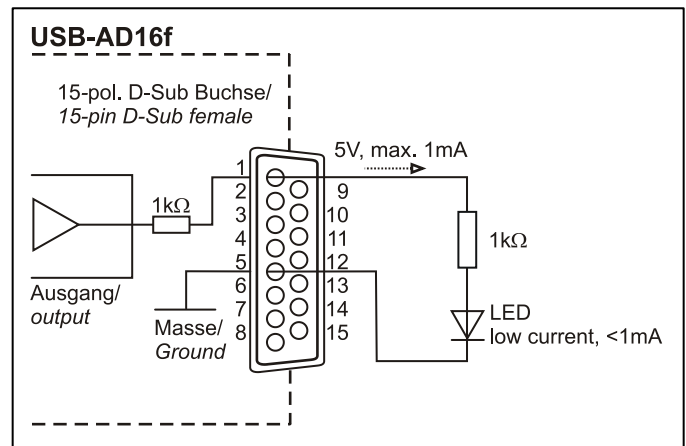


#### 4.3.2 Connecting a Relay

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 cards featuring 8 outputs are available at bmcm.**
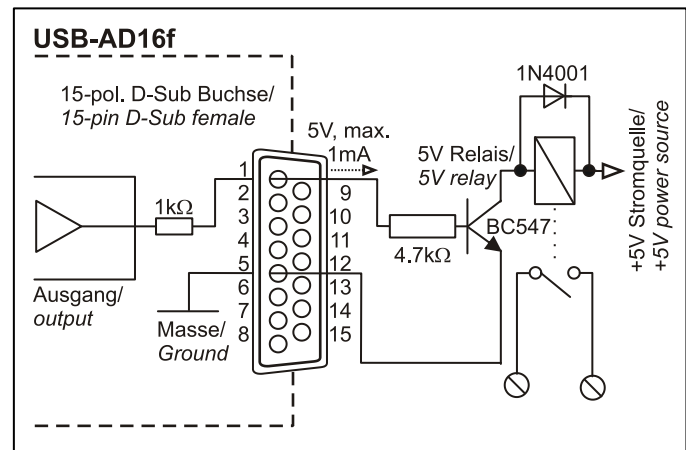


#### 4.3.3 Connecting a Lamp

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.
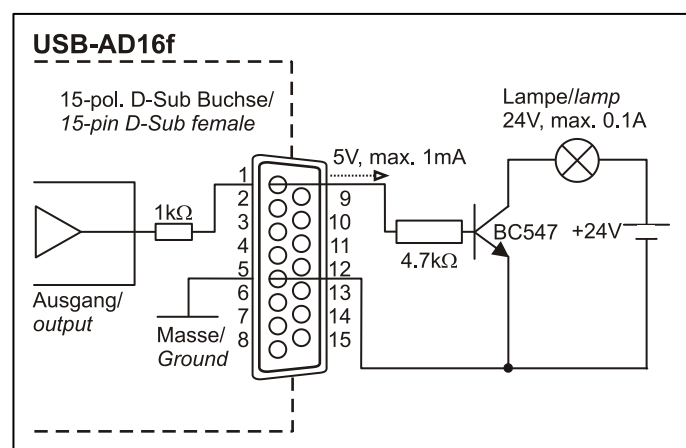
# 5  Important Notes for Using the USB-AD16f

- The device is only suitable for extra-low voltages - please observe the relevant regulations! Only use the device with housing closed. ESD voltages at open lines may cause malfunction.
- Only use non-solvent detergents for cleaning. The product is designed to be maintenance-free.
- Signal cables are connected at the 37-pin or 15-pin D-Sub female connector – preferably use shielded cables. For best possible interference suppression, connect shield at one end only. Close open inputs if necessary.
- The device ground and the chassis are electrically connected to the chassis of the PC, which is usually also connected to ground. Be sure to avoid ground loops since they will cause measuring errors!
- The gain is adjusted to even values. Therefore, only 64000 values (for 16 bit) of the full range of the converter are used. As a result, the measuring ranges are slightly larger (e.g. ±10.24V) than the indicated measuring ranges so that overranges can be recognized.
- 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.
- 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., +5V supply)

- ## Analog Inputs

| | |
|---|---|
| Channels // Meas. ranges* // Resolution: | 16 inputs, electrically isolated from PC // ±10V, ±5V, ±2V, ±1V // 16 bit |
| Total sample rate** // min. sample rate/cha: | 250kHz // 4μs |
| Converter error: | typ. ±2 LSB |
| Accuracy***: | typ. ±0,1% |
| Surge protection: | max. ±35V (when turned on), max. ±20V (when turned off), max. ±20mA in total of all input channels! |
| Input resistance // Input capacity: | 1MΩ (with PC turned off: 1kΩ) // 5pF |
| Zero shift // Gain drop: | typ. ±36ppm/K // typ. 35ppm/K |
| Frequency accuracy: | max. ±20ppm |

\*        The MADDA16II modules are factory set in the range of ±5V. The measuring range can be set for each channel separately.
\*\*     The total sampling rate is the sum of the sampling rates of all used channels (e.g., 5 channels à 10kHz => 50kHz total sampling rate).
\*\*\*    Errors can add up in the worst case.

- ## Analog Outputs

| | |
|---|---|
| Channels // Output range // Resolution: | 2 outputs, electrically isolated from PC // ±10V // 16 Bit |
| Temperature drift: | Offset typ. ±25ppm/K / Amplification typ. ±30ppm/K |
| Output current // Output resistance: | max. 1mA // <10Ω |
| Relative accuracy: | ±1 LSB |

- ## Digital Inputs/Outputs

| | |
|---|---|
| Channels // Level: | 4 input and 4 output channels // CMOS/TTL compatible (low: 0V..0.7V; high: 3V..5V) |
| Current pick-up per output pin: | 1mA (with app. 4V level), max. 2.5mA (with app. 3V level) |
| Surge protection: | max. ±5.5V, protected with 1kΩ, max. max. ±20mA in total of all channels! |
| Counter: | 1MHz, 16 bit, galvanically isolated, 5..12V input voltage |

- ## General Data

| | |
|---|---|
| Power supply: | +4.5V..+5.5V from USB connection to the PC, max. 100mA |
| Connections analog: | all channels at a 37-pin D-Sub female at the device front |
| Connections digital: | all channels at a 15-pin D-Sub female at the device back |
| LEDs: | device status is indicated by 4 LEDs at the device back |
| 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 open lines |
| Temperature ranges // Relative humidity: | operating temp. 0..70°C, storage temp. −25..+85°C // 0-90% (not condensing) |
| Dimensions // Protection type: | 167 x 113 x 30 mm$^3$ // IP30 |
| Delivery: | device in aluminum housing, 1m USB connection cable |
| Available accessories (optional): | DIN rail set ZU-SCHI, current shunt ZU-CS250R, D-Sub plugs ZU37ST, ZU15ST, connecting cables ZUKA37SB, ZUKA37SS, connector boards ZU37BB/CB/CO, waterproof housing ZU-PBOX-PG |
| Warranty: | 2 years from date of purchase at bmcm, claims for damages resulting from improper use excluded |

- ## Software

| | |
|---|---|
| Software free of charge download: | LIBAD4 64bit SDK for programming on Windows® 10/11 trial version of the measuring software NextView® to test and operate the hardware |
| NextView® (optional): | professional software (versions: Professional, Lite) for the acquisition and analysis of measurement data on Windows® 10/11 |