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# Instruction Manual

## Fast ALMEMO® measuring module for voltage and current

**Voltage DC ZAD 900-ABx**
**Current DC ZAD 901-ABx**
**Voltage AC ZAD 903-ABx**
**Current AC ZAD 904-ABx**

D6 technology
English
V 1.1
25.10.2022

# 1 Table of Contents

# 2 Explanation of Symbols

| | |
|---|---|
|  | Safety note |
| ! | Requirement |
| → | Request |
| 👉 | Notice |
| ➢ | Result |
| Back | Text displayed within a software |

# 3 Safety Notes

→ The measuring modules are – depending on the type – able to measure voltages, currents and powers for potentials above 50V. During operation and especially when connecting the measuring module or the adaptor plug, make sure that you do not touch any high voltage components.

→ When connecting the measuring modules for AC /DC signals or the adaptor plug, use the supplied touch proof connector cables (or equivalent).

→ The measuring module for DC signals must only be used for direct voltage respectively direct current according to the measuring range indicated on the type plate.

→ Be particularly careful that the current modules are always connected in series to the load i.e. in an input lead, and that they must not be directly connected to the voltage source. When using the adaptor plug, make sure to connect the appropriate sockets of the adaptor plug and the measuring module (A-A, V-V, COM-COM). In this context, the color of the sockets must be taken into account.

→ Never use the measuring device, the measuring module or the adaptor plug in wet or damp environments.

→ Keep the plastic housing away from open fire and hot surfaces (e.g. burners).

→ The measuring module and the adaptor plug must no longer be used when damaged on the outside or in case they do no longer work, possibly due to an incorrect connection attempt.

→ In case the measuring module or the adaptor plug was used for purposes other than intended or was used incorrectly, we cannot accept any liability for any damages caused as a result.

→ If the measuring module or the adaptor plug is used in a way that is not intended by the manufacturer, the protection supported by the device may be impaired.

→ The measuring module`s internal current measurement path is not intended for continuous operation for currents greater than 10A. In that case, the measurement can only be run for a maximum of 10 minutes. After this period of time, the device must be cooled down to ambient temperature.

→ The adaptor plug shall only be used for the actual measurement.

## 3.1 Intended Use

The fast ALMEMO® measuring module for voltage and current is intended for measuring current and voltage signals. These include voltage DC, current DC, voltage AC, current AC, and frequency. The measuring module is qualified for voltage measurements up to 400V (DC) and 400$V_{eff}$ (AC) as well as for current measurements up to 20A (DC) respectively 20$A_{eff}$ (AC).

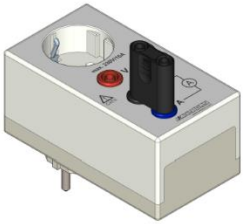
The adaptor plug allows measuring voltages and currents on electrical circuits that are electrically directly connected to the low voltage grid (CAT II). The adaptor plug shall only be used in combination with the measuring module. The use of other operating modes is not approved.

# 4 Product

## 4.1 Scope of Delivery

→ When unpacking, please pay attention to damages to the measuring instrument as well as to the completeness of the delivery.

☞ The precise compilation of your delivery depends on your purchase order.

| | | |
|---|---|---|
| **Measuring module for**<br>voltage DC<br>current DC<br>voltage AC<br>current AC | <br>ZAD 900-ABx<br>ZAD 901-ABx<br>ZAD 903-ABx<br>ZAD 904-ABx |  |
| **Connecting cable** | Measuring lead CAT III with a two-way safety connector | |
| Optionally available:<br>**Adaptor plug including short circuit bar**<br>ZE 2000-PA | |  |
| **Present Instruction Manual** | | |

⟶ In the event of a damage caused during transportation, please keep the packaging material and contact the supplier immediately.

⟶ In case accessories, which do not meet the CAT III (500 V) category, are used, the measuring category will be reduced to the lowest value of the resulting combination of accessory and measuring module.

## 4.2 Description of the Measuring Module

The ALMEMO® DC measuring modules ZAD 900-ABx and ZAD 901-ABx record the momentary value, the maximum value, the minimum value and the average value of an DC current or an DC voltage signal. Every time the monitoring station is queried, the values will be transferred to the ALMEMO® device.

The ALMEMO® AC measuring modules ZAD 903-ABx and ZAD 904-ABx record the true RMS value of an AC current and/or an AC voltage signal. This means that the measuring signal with curves of any shape will be digitalized at 1kHz and the true RMS value will be calculated and then be displayed on the measuring device.

The measuring module provides 6kV galvanic isolation and overvoltage protection. The measuring module can be connected to any arbitrary ALMEMO® measuring device. It is also possible to connect several measuring modules to one measuring device.

The power for the measuring module is supplied by the ALMEMO® measuring device via a DCDC converter (insulation voltage 6 kV). The current supply of the measuring module is loaded with 50 mA, which means that for long-term operations, a mains adaptor is required.

**True RMS value measurement**

The AC voltage signal is continuously sampled at 1kHz and the overall RMS value is calculated from the DC and AC voltage components.

$$V_{rms} = \sqrt{VAC^2 + VDC^2}$$

## 4.3 Article numbers and measuring ranges of measuring module upon delivery

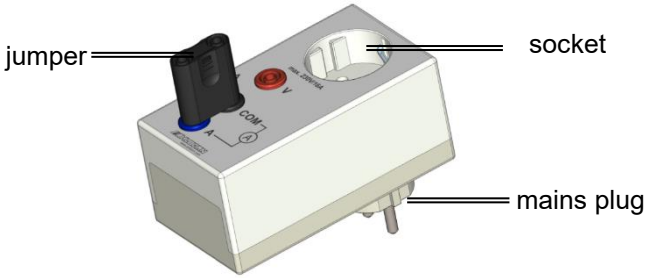
| Designation | Performance<br><br>DC | Range | | Measuring range | Dim. | Resolution |
|---|---|---|---|---|---|---|
| **ZAD 900-AB3** | Voltage | | | | | |
| 1. U60.00 | 60V DC | B-01 | **DACT** | -62.00 to +62.00 | V | 0.01 V |
| 2. *max. value | | B-02 | **DMAX** | | | |
| 3. *min. value | | B-03 | **DMIN** | | | |
| 4. *average value | | B-04 | **DAVG** | | | |
| **ZAD 900-AB5** | Voltage | | | | | |
| 1. U400.0 | 400V DC | B-01 | **DACT** | -440.0 to +440.0 | V | 0.1 V |
| 2. *max. value | | B-02 | **DMAX** | | | |
| 3. *min value | | B-03 | **DMIN** | | | |
| 4. *average value | | B-04 | **DAVG** | | | |
| **ZAD 901-AB1** | Current | | | | | |
| 1. I20.00mA | 20 mA DC | B-01 | **DACT** | -22.00 to +22.00 | mA | 0.01 mA |
| 2. *max. value | | B-02 | **DMAX** | | | |
| 3. *min. value | | B-03 | **DMIN** | | | |
| 4. *average value | | B-04 | **DAVG** | | | |
| **ZAD 901-AB2** | Current | | | | | |
| 1. I200.0mA | 200 mA DC | B-01 | **DACT** | -220.0 to +220.0 | mA | 0.1 mA |
| 2. *max. value | | B-02 | **DMAX** | | | |
| 3. *min. value | | B-03 | **DMIN** | | | |
| 4. *average value | | B-04 | **DAVG** | | | |
| **ZAD 901-AB3** | Current | | | | | |
| 1. I2.000A | 2 A DC | B-01 | **DACT** | -2.200 to +2.200 | A | 0.001 A |
| 2. *max. value | | B-02 | **DMAX** | | | |
| 3. *min. value | | B-03 | **DMIN** | | | |
| 4. *average value | | B-04 | **DAVG** | | | |

| Designation | Performance | Range | Measuring range | Dim. | Resolution |
|---|---|---|---|---|---|
| **ZAD 901-AB5**<br>1. I20.00A<br><br>2. *max.-value<br>3. *min. value<br>4. *average value | Current<br>20 A DC | B-01 **DACT**<br><br>B-02 **DMAX**<br>B-03 **DMIN**<br>B-04 **DAVG** | -22.00 to +22.00 | A | 0.01A |
| | **AC** | | | | |
| **ZAD 903-AB3**<br>1. U25.00<br>2. FREQ | Voltage<br>25 $V_{rms}$<br>250 Hz | B-01 **DUEF**<br>B-02 **DFRQ** | up to 27.00<br>20.00 to 250.00 | $V_{rms}$<br>Hz | 0.01 $V_{rms}$<br>0.01 Hz |
| **ZAD 903-AB5**<br>1. U400.0<br>2. FREQ | Voltage<br>400 $V_{rms}$<br>250 Hz | B-01 **DUEF**<br>B-02 **DFRQ** | up to 440.0<br>20.00 to 250.00 | $V_{rms}$<br>Hz | 0.1 $V_{rms}$<br>0.01 Hz |
| **ZAD 904-AB1**<br>1. I1.800<br>2. FREQ | Current<br>1,8 $A_{rms}$<br>250 Hz | B-01 **DIEF**<br>B-02 **DFRQ** | up to 2.000<br>20.00 to 250.00 | $A_{rms}$<br>Hz | 0.001 $A_{rms}$<br>0.01 Hz |
| **ZAD 904-AB3**<br>1. I20.00<br>2. FREQ | Current<br>20 $A_{rms}$<br>250 Hz | B-01 **DIEF**<br>B-02 **DFRQ** | up to 22.00<br>20.00 to 250.00 | $A_{rms}$<br>Hz | 0.01 $A_{rms}$<br>0.01 Hz |

* Measured value acquisition: The measuring signal is continuously sampled at 1kHz and on this basis the maximum value, the minimum value, and the average value will be calculated. With every manual or cyclic query of the monitoring station, in addition to the current measured value, the maximum, minimum and average values will be output via the 4 channels of the ALMEMO® plug, and afterwards the values will be deleted (element flag 4 is set on delivery). In case the maximum, minimum, and average values shall be generated considering the conversion rate, the element flag 4 needs to be deleted.

## 4.4 Description of the adaptor plug

The adaptor plug featuring the article number ZE 2000-PA is optionally available. The adaptor plug is intended to serve as a safe assistive device to measure voltage, current, and power at circuits that are electrically connected directly to the low-voltage grid (CAT II).
For safety reasons, the jumper can only be connected to the black socket (COM) and the blue socket (A). The jumper can only be used when no current measurement is required and the circuit shall merely be closed.

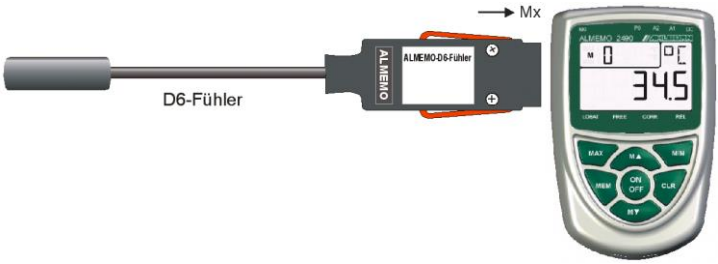



## 4.5 Digital ALMEMO® D6 sensor

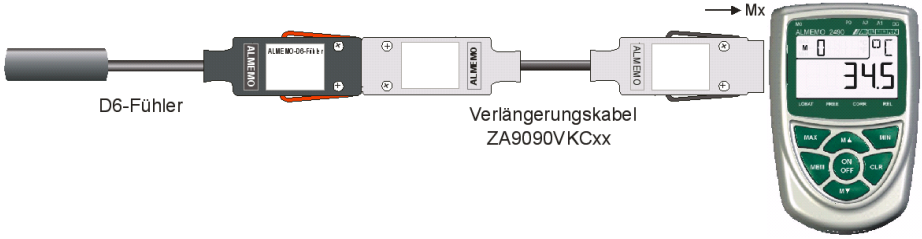
In addition to the I²C port, the ALMEMO® D6 sensors feature a second serial port. That way, as a sensor with “DIGI” range they can be plugged on every ALMEMO® measuring device. In doing so, new functions and ranges that are not supported by the ALMEMO® devices themselves can be configured and used with the ALMEMO® Control software via a sensor menu stored on the sensor. Regarding the measured values, all functions concerning calibration, correction, and multi-point adjustment are available as before.

## 4.6 Operation as sensor on ALMEMO® measuring devices

Via the measuring range “DIGI”, the ALMEMO® D6 sensor supplies digital measured values - from 1 to 4 measuring channels - to the ALMEMO® measuring device, where the measured values are processed as usual. Any channel can be switched off respectively deactivated and can then be activated again. Certain function channels can also be programmed and used. The sensor is supplied with power via the measuring device. To operate a sensor in sleep mode for some sensors it is necessary to extend the programmed sleep period.




Extension



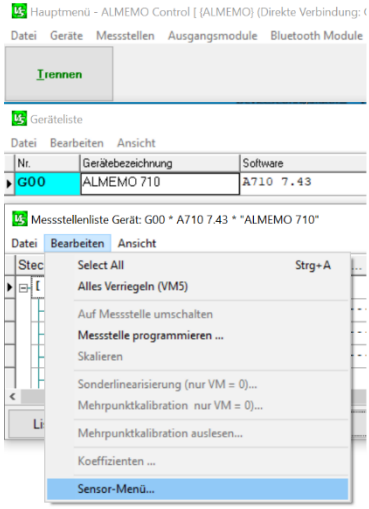

The universal extension cables ZA 9090-VKCxx, through which the measured values and the programming of the plug will be transmitted serially and free from interference via RS485 drivers, serve to extend the sensor on the measuring device. Since there is no driver for the second port, the extension must not be longer than 10 meters to still be able to configure the sensor menu. In case the extension cable is used, you cannot operate the device in sleep mode.

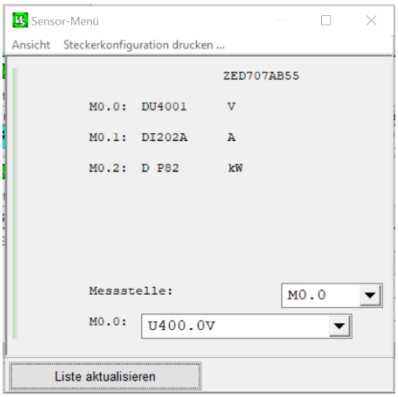
## 4.7 Measured Value Correction

For the primary measuring channels, it is possible to store adjustment values or multi-point adjustments on the D6 sensor (ex works or via the ALMEMO® measuring device featuring option KL). Correction values (zero point, slope, basic, factor) are already processed in the sensor.

## 4.8 Sensor Menu

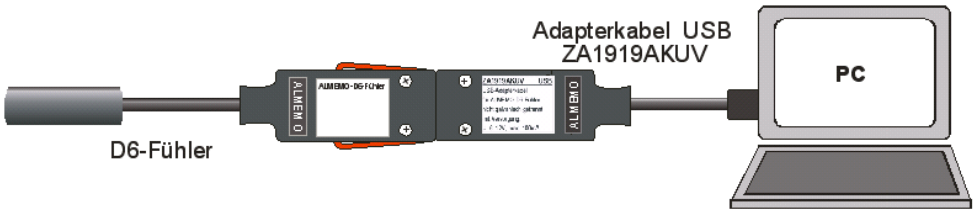
In order to retain the sustainability for many years without changing the measuring device, every D6 sensor features an individual sensor menu, which can be accessed via every ALMEMO® V7 measuring device. This way it is possible to configure measuring ranges or other specific sensor functions. As a control unit, you can use a V7 measuring device as well as a PC.




## 4.9 Configuration on the PC via USB adaptor cable

The ALMEMO® D6 sensor can be directly connected to the PC with the USB coupler adaptor cable ZA 1919-AKUV with a baud rate of 115.2kBd. A microcontroller within the adaptor cable automatically adjusts the necessary power supply as well as the baud rate and the device address.



The ALMEMO® Control program enables the configuration via the sensor menu (starting with V. 5.14.0.330). For this purpose, you will find the “Sensor Menu” under “Edit” in the list of the monitoring points. In this “Sensor Menu” you can primarily program up to 4 monitoring points with the specific measuring ranges of the D6 sensor and further settings. The measuring ranges will be displayed on the port featuring descriptive acronyms. Other than the range, an up to 2-digit dimension and a comment will be automatically programmed and afterwards the channel will be locked with 5. To delete a range, you need to select “- - - -” in the list.

# 5 How to measure with the measuring module

Pay attention to the measuring range indicated on the nameplate when connecting the measuring module.

☞ In case you want to use the adaptor plug as an assistive device for measuring voltage and current on power circuits that are directly connected to the low-voltage circuit, pay attention to the Notices in chapter 6 How to use the adaptor plug.

☞ The measuring module features an ALMEMO® D6 plug, on which the measuring range and the dimension are pre-programmed. As a consequence, the measuring module will be automatically recognized by every ALMEMO® measuring device. No programming is necessary before the device can be used.

## 5.1 How to measure voltage DC with the module ZAD 900-ABx

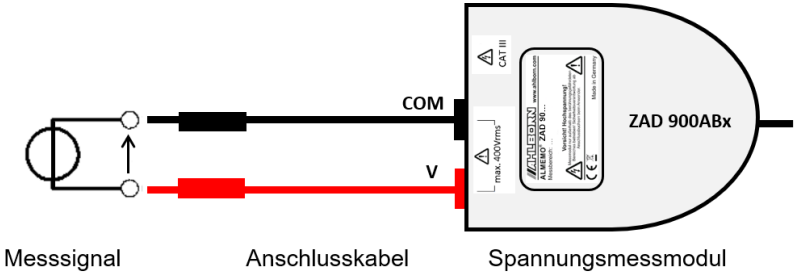
Wire in a zero potential condition (especially for measurements above 50V). Switch on the voltage afterwards.

During operation never touch any exposed connections and components to avoid electric shocks.

Use the supplied touch protected connection cables.

1. Switch off the voltage on the voltage source and then check that no voltage is applied to the module.
2. Insert the ALMEMO® plug of the measuring module into an ALMEMO® input socket of the ALMEMO® measuring device.
3. Switch the ALMEMO® measuring device on.
4. Connect the voltage source by means of the connection cables to the sockets of the measuring module. In doing so, make sure that the red connection cable is connected to the positive pole and the red socket.
5. Switch on the voltage on the voltage source.

➢ The measured values will be displayed on the ALMEMO® measuring device.




## 5.2 How to measure current DC with the module ZAD 901-ABx

For currents higher that 10A, the device internal current measurement path is not intended for continuous operation. A measurement shall last for no longer than 10 minutes at most. After 10 minutes, the device must cool down to ambient temperature.

Wire in a zero-potential condition (especially for measurements above 50V). Switch on the voltage afterwards.

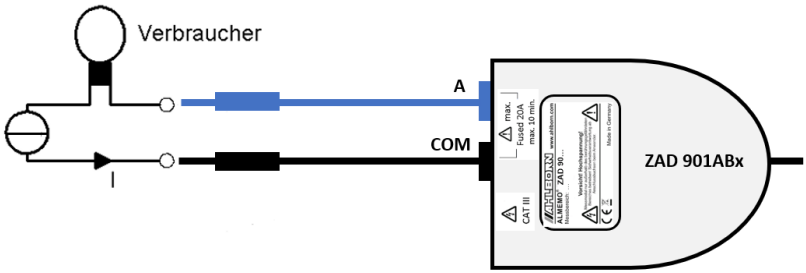
During operation never touch any exposed connections and components to avoid electric shocks.

Use the supplied touch protected connection cables.

Never connect the current measuring module without a load directly to the voltage source because by doing so the module could be destroyed and there is danger of overheating.

1. Connect a load to the current source.
2. Switch off the load to make sure no current flows and check that no voltage is applied to the module.
3. Insert the ALMEMO® plug of the measuring module into an ALMEMO® input socket of the ALMEMO® measuring device.
4. Switch on the ALMEMO® measuring device.

5. Connect the measuring module to the current path of the load whereby the blue connection cable must be connected to the positive pole and the blue socket (A). The black connection cable must be connected to the ground (COM).




6. Switch on the load.

➢ The measured values will be displayed on the ALMEMO® measuring device.

## 5.3 How to measure voltage AC with the module ZAD 903-ABx

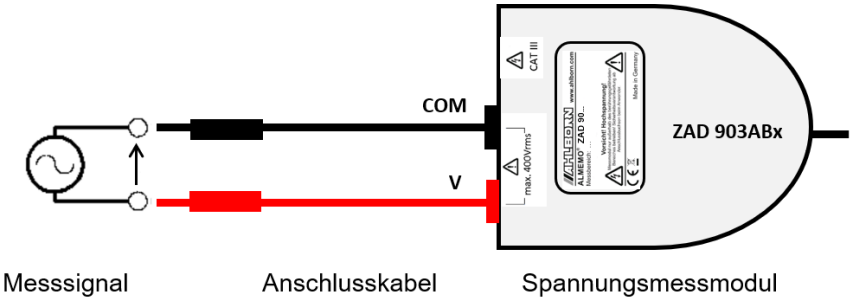
Wire in a zero-potential condition (especially for measurements above 50V). Switch on the voltage afterwards.

During operation never touch any exposed connections and components to avoid electric shocks.

Use the supplied touch protected connection cables.

1. Switch off the voltage on the voltage source, and check that no voltage is applied to the module.
2. Insert the ALMEMO® plug of the measuring module into an ALMEMO® input socket of the ALMEMO® measuring device.
3. Switch on the ALMEMO® measuring device.

4. Connect the voltage source by means of the connection cables to the sockets of the measuring module.




5. Switch on the voltage on the voltage source.

➢ The measured values will be displayed on the ALMEMO® measuring device.

## 5.4 How to measure current AC with the module ZAD 904-ABx

For currents higher that 10A, the device internal current measurement path is not intended for continuous operation. A measurement shall last for no longer than 10 minutes at most. After 10 minutes, the device must cool down to ambient temperature.

Wire in a zero-potential condition (especially for measurements above 50V). Switch on the voltage afterwards.

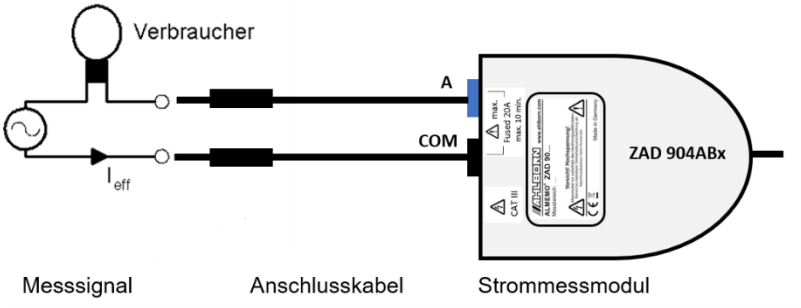
During operation never touch any exposed connections and components to avoid electric shocks.

Use the supplied touch protected connection cables.

Never connect the current measuring module without a load directly to the voltage source because by doing so the module could be destroyed and there is danger of overheating.

1. Connect a load to the current source.

2. Switch off the load to make sure no current flows and check that no voltage is applied to the module.
3. Insert the ALMEMO® plug of the measuring module into an ALMEMO® input socket of the ALMEMO® measuring device.
4. Switch on the ALMEMO® measuring device.
5. Connect the measuring module to the current path of the load.




6. Switch on the load.

➢ The measured values will be displayed on the ALMEMO® measuring device.

# 6 How to use the adaptor plug

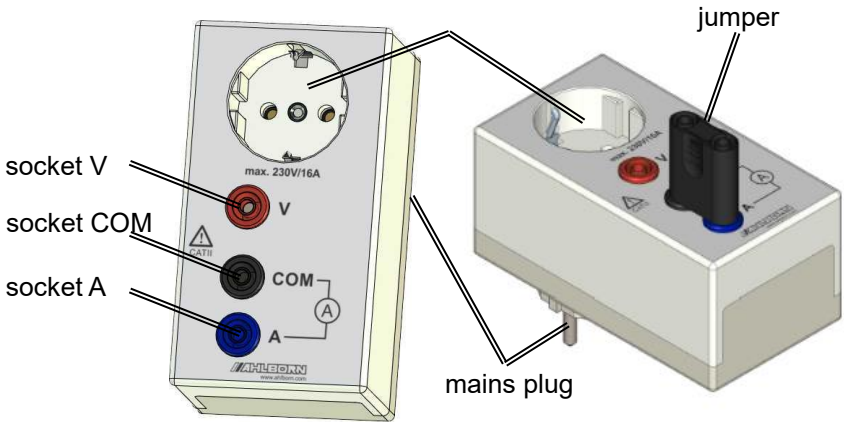
Please keep in mind that while installing the mains adaptor, a quick disconnection from the power supply must be possible at all times.

Wire in a zero-potential condition (especially for measurements above 50V).

During operation never touch any exposed connections and components to avoid electric shocks.

Use the supplied touch protected connection cables.

Be particularly careful that the current modules are always connected in series to the load i.e. in an input lead, and that they must not be directly connected to the voltage source. When using the adaptor plug, make sure to connect the appropriate sockets of the adaptor plug and the measuring module (A-A, V-V, COM-COM). In this context, the color of the sockets must be observed.



## 6.1 Voltage measurement with the adaptor plug

1. Plug in the jumper to the sockets A and COM of the adaptor plug.
2. Connect the red connection cable to the red socket (V) of the measuring module and to the red socket (V) of the adaptor plug.
3. Connect the black connection cable to the black socket (COM) of the measuring module and to the socket of the jumper that is plugged into the COM socket of the adaptor plug.
4. Connect the mains plug of the adaptor plug to a wall socket and the mains plug of the load to the socket of the adaptor plug.
5. Follow the instructions given in chapter 5.1 “How to measure voltage DC with the module ZAD 900-ABx” respectively in chapter 5.4 “How to measure current AC with the module ZAD 904-ABx”.

## 6.2 Current measurement with adaptor plug

☞ The jumper is not needed.

1. Connect the blue connection cable to the blue socket (A) of the measuring module and to the blue socket (A) of the adaptor plug.
2. Connect the black connection cable to the black socket (COM) of the measuring module and to the black socket (COM) of the adaptor plug.
3. Insert the mains plug of the adaptor plug in a mains wall socket and the mains plug of the load in the socket of the adaptor plug.
4. Follow the instructions given in chapter 5.2 How to measure current DC with the module ZAD 901-ABx respectively in chapter 5.4 5.4 How to measure current AC with the module ZAD 904-ABx.

# 7 Maintenance and Care

**How to clean the housing**

The devices must not be opened by the operator.

The devices need to be disconnected from the power supply.

→ If soiled, clean the housing with a dry cloth. Do not use any cleaning agents.

**How to maintain and repair the device**

All repair and maintenance work shall only be performed by the Ahlborn Company (Ahlborn Mess- und Regelungstechnik GmbH).

→ In case of necessary repair or maintenance work, please send the device(s) to the service department of the Ahlborn Company.

# 8 Warranty

Before leaving the factory, every device has passed several quality tests. For proper functioning, a 2 year warranty is granted beginning with the day of delivery. In case of a defect, please use – if possible – the original packing material and attach a precise description of the defect as well as of the corresponding boundary conditions.

The following cases are excluded from warranty:

- Unauthorized interventions and changes within the device performed by the customer
- Operation outside the indicated environmental conditions applicable for this product
- Use of improper power supply and peripheral devices
- Improper use of the device
- Disregard of the Instruction Manual

We reserve the right to make changes in product features in favor of technical progress or due to new construction elements.

# 9 Disposal

The symbol of a crossed-out waste bin implies that the product must be disposed of separately in the European Union.
This applies to the product itself as well as to all accessory components labeled with this symbol. The products must not be discarded via the unsorted municipal waste.

→ Dispose of defect rechargeable batteries / empty batteries in accordance with the legal requirements.

→ When no longer in use, the product must be disposed of at the collecting point specified for electrical and electronic equipment. In doing so, please observe the local disposal regulations.

→ Dispose of the packing material in accordance with local regulations

# 10 Technical Data

**Measuring module**

| | | |
|---|---|---|
| Input socket | Safety sockets CAT III, 20 A, Ø 4 mm | |
| Galvanic isolation | 6 kV | |
| Sampling rate | 1 KHz intern | |
| Refresh rate DC | Recording the current, max., min., and average value and transferring these values to the ALMEMO® device with every query of the monitoring station. | |
| Accuracy | 0.1% of EV ± 2 Digit | |
| Temperature drift | Maximum of 0.003 %/K (30 ppm/K) | |
| Nominal conditions | 23 °C ± 2 K, 10 to 90% RH (non-condensing) | |
| Operating conditions<br>operating temperature<br>ambient air humidity<br>Max. altitude above sea level | <br>+5 to +40 °C<br>10 to 90% RH<br>2000 m | <br>(storage temperature: -20 to +60 °C)<br>( non-condensing ) |
| Input resistance $R_I$<br>Voltage measurement<br><br>Current measurement | 25/60 V<br>400 V<br>20 mA / 200 mA<br>2 A / 20 A | 1 x $10^6$ Ohm<br>4 x $10^6$ Ohm<br>4,7 Ω / 1 Ω<br>100 mΩ / 8 mΩ |
| Measuring period of current measurement | In case the effective value of the current is greater than 10 A, the device needs to cool down to ambient temperature after 10 minutes at the latest. | |
| Housing | ABS,<br>dimensions L127 x W83 x H42 mm | |
| Operating voltage | 9 to 12 V via ALMEMO® device | |
| Nominal current | AC: max. 80 mA (plug and module)<br>DC: max. 85 mA (plug and module) | |
| **AC measurement** | | |
| Refresh rate | 0.5 seconds | |
| Operating range U, I | DC … 250 Hz | |
| Response threshold U, I | Signal U and I > 1 % of EV | |
| Settling time | 4 periods (max. 200 ms, e.g. for 50 Hz: 80 ms) | |
| Measuring range frequency | 20 to 250 Hz, resolution 0.01 Hz | |
| Measuring ranges voltage, current (DC/AC) | See chapter 4.3 | |

Subject to technical modifications without prior notice!

**Adaptor plug**

| | |
|---|---|
| Input sockets/ jumper | Safety sockets CAT II, 16 A, Ø 4 mm<br>230 V, 16 A, 50 Hz |
| Nominal conditions | 23 °C ± 2 K, 10 to 90% RH ( non-condensing) |
| Operating conditions<br>operating temperature<br>ambient air humidity<br>Max. altitude above sea level | <br>+5 to +40 °C (storage temperature: -20 to +60 °C)<br>10 to 90% RH (non-condensing )<br>2000 m |
| Housing | ABS,<br>dimensions: L120 x W65 x H94 mm |

Subject to technical modifications without prior notice!

Notes

You will find the present and further Instruction Manuals, as well as the ALMEMO® Manual on **www.ahlborn.com** under the tab SERVICE on DOWNLOADS



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