User Manual

AED9301B

Digital Transducer Electronics
Basic Device PROFIBUS

I1694-2.0 en

HBM

Content

Typographical conventions

For clear identification and improved legibility, the following conventions have been used in this documentation:

Important paragraphs are marked with a symbol to draw attention to them.

CE Designation

Statutory marking requirements for waste disposal

Italics	Points out external documents and files
“File → Open“	All menus and menu commands appear in quotes, here the “File” menu and the “Open” sub-menu.
“Start”	Quotes and italics are used for buttons, input fields and user input.
MSV	All commands are set out in a bold font style or as a link to the command description.

Important information

Neither the design of the device nor any technical safety aspects may be modified without the express permission of Hottinger Baldwin Messtechnik GmbH. Any modification excludes Hottinger Baldwin Messtechnik GmbH from any and all liability for any damage resulting therefrom.

It is strictly forbidden to carry out any repairs and soldering work on the motherboards or to replace any components. Repairs may only be carried out by persons authorized thereto by Hottinger Baldwin Messtechnik GmbH.

All the factory defaults are stored safe from power failure at the factory, not in the measuring amplifier where they can be deleted or overwritten. They can be reset at any time by using the command **TDD**0. For more information, see aed_help_e AD103C; “Description of the basic commands”.

The production number is set at the factory and cannot be changed.

The transducer connection must always be assigned.
It is essential for a transducer or a bridge model to be connected up for operation.

Safety instructions

- There are not normally any hazards associated with the product, provided the notes and instructions for project planning, assembly, appropriate operation and maintenance are observed.
- Each time, before starting up the modules, you must first run a project planning and risk analysis that takes into account all the safety aspects of automation technology. This particularly concerns personal and machine protection.
- It is essential to comply with the safety and accident prevention regulations applicable to each individual case.
- Installation and start-up must only be carried out by suitably qualified personnel.
- Do not allow the equipment to become dirty or damp.
- During installation and when connecting the cables, take action to prevent electrostatic discharge as this may damage the electronics.
- The required power supply is an extra-low voltage with safe disconnection from the mains.
- When connecting additional devices, comply with the local safety requirements.
- All the interconnecting cables must be shielded cables. The screen must be connected extensively to ground on both sides.
  The power supply and digital I/O connection cables only need to be shielded if the cables are longer than 30 m (32.81 yd) or are routed outside closed buildings.
- The CE mark enables the manufacturer to guarantee that the product complies with the requirements of the relevant EC directives (the declaration of conformity is available at http://www.hbm.com/HBMdoc).
- In accordance with national and local environmental protection and material recovery and recycling regulations, old devices that can no longer be used must be disposed of separately and not with normal household garbage.
  If you need more information about waste disposal, please contact your local authorities or the dealer from whom you purchased the product.

1 Introduction and appropriate use

AED9301B digital transducer electronics are part of the AED component family that digitally conditions signals from mechanical measurement sensors and networks them with bus capability. These include digital amplifier motherboards, basic devices with serial interfaces and intelligent sensors with integrated signal processing. The purpose of these components is to directly digitize and condition the measurement signals at the transducer location.

Using AED9301B digital transducer electronics, you can connect SG[1)] transducers in a full-bridge circuit directly to a Profibus DP. This enables you to connect complete measurement chains to a field bus quickly and with little extra work.

The AED9301B basic device can contain the AD103C measuring amplifier board. It provides mechanical protection, shields the amplifier board (EMC protection) and allows a Profibus connection and implements full electrical isolation of all connections.

The AD103C amplifier motherboard is not included in the scope of supply of the basic device.

Two digital inputs and four digital outputs allow:

- processes to be controlled via four limit values (**LIV**1…4),
- triggered measured values to be determined (**MAV**) and
- a filling or dosing process to be controlled.

The PC software *AED PANEL 32* is available to facilitate parameter settings, to display dynamic measurement signals and for comprehensive analysis of the dynamic system.
The HBM display unit DWS2103 can be connected to all AED basic devices.

All basic devices of the AED family can be connected with the digital display unit DWS2103. This unit supports all implemented functions of the AED.

The Profibus communication is described in the file aed_help_e, AED9301B; “Description of the Profibus communication” .

All commands are described in the help file aed_help_e.

The abbreviation **AED** is also used for AD103C transducer electronics in the following text.

1) **S**train **G**age

2 Mechanical construction

The basic device extends the functionality of the AD amplifier boards and provides:

- mechanical protection (IP65)
- a slot for the AD103C amplifier board
- the power supply for the amplifier motherboard and transducer excitation (electrically isolated)
- total transducer bridge resistance 80 ...4000 Ω
- a Profibus DP interface (electrically isolated from the amplifier and from the digital inputs /outputs)
- digital inputs/outputs (electrically isolated from the amplifier and from the Profibus)
- EMC protection
- Diagnostic bus

The amplifier motherboard (AD103C) is designed as a plug-in board that can be plugged into the carrier board of the basic device via a 25-pin sub-D connector. The basic device contains terminals for the transducer, power pack, digital inputs/outputs and Profibus connections, slide switches for bus disconnection and termination resistor connection and the voltage stabilizer. The connection cables exit the casing via PG glands on the side.

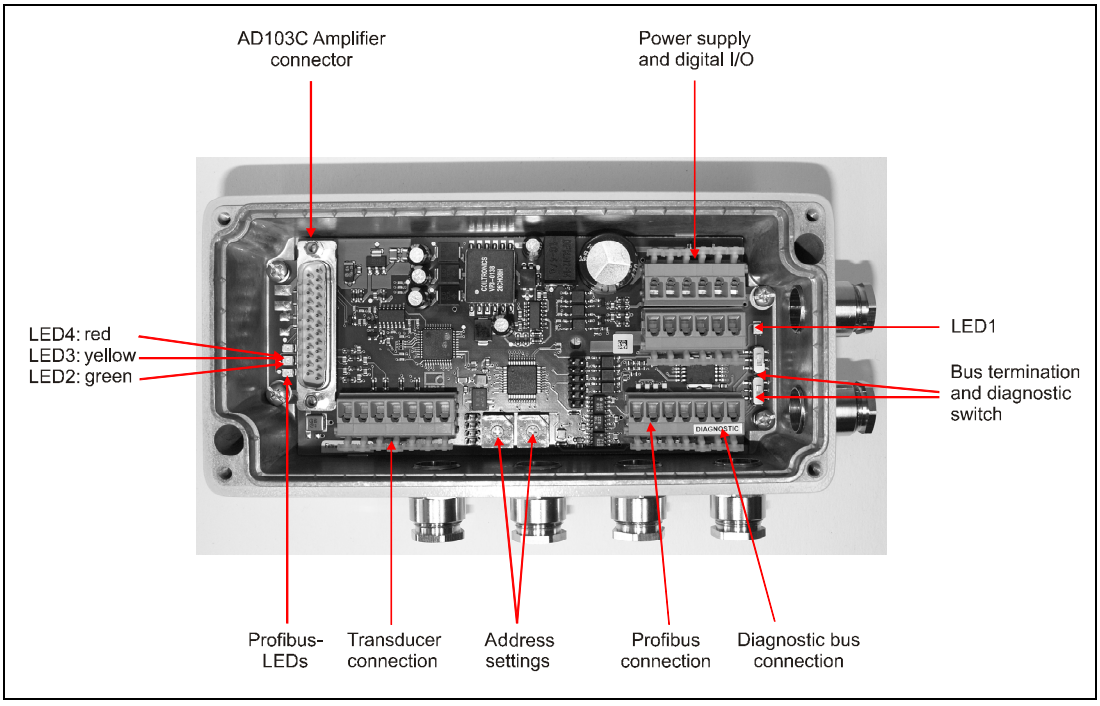


Fig. 2-1: Mechanical construction AED9301B (without amplifier)

3 Electrical connections

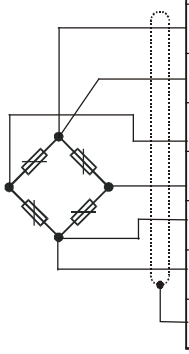
The AED9301B basic device comes with a connection diagram.

When making the connections, please ensure that the wires of the cable do not protrude beyond the connection terminals (risk that loops may form). Please make sure that the cable shielding is properly connected to the PG gland (see the AED9301B cable connection via PG glands section).

If it should be necessary, a separate cable can be used to establish potential equalization between the transducer and the AED and between the AED and the Master control unit (grounding concept). The cable shielding must not be used for this potential equalization.

3.1 Transducer connection

The transducer connection must always be assigned (connect the transducer).



	Color code HBM	Pin
Bridge excitation voltage (+)	blue	3
Sense line (+)	green	3'
Measuring signal (-)	red	4
Measuring signal (+)	white	1
Sense line (-)	grey	2'
Bridge excitation voltage (-)	black	2
Cable shield	Cable braid	Housing

Fig. 3.1-1: Transducer connection in 6-wire circuitry (HBM color-coding)

You can connect SG transducers in a full-bridge circuit with a total bridge resistance of R_B = 80...4000 Ω. With a transducer resistance of >1000 Ω, increased noise (measurement ripple) must be taken into account.

The bridges are supplied with power in the AED9301B basic device at 5 V_{DC}.

The 6-wire connection avoids the effect of a long cable on the measured value. When several transducers and a junction box are used, the 6-wire circuitry is routed to the junction box.

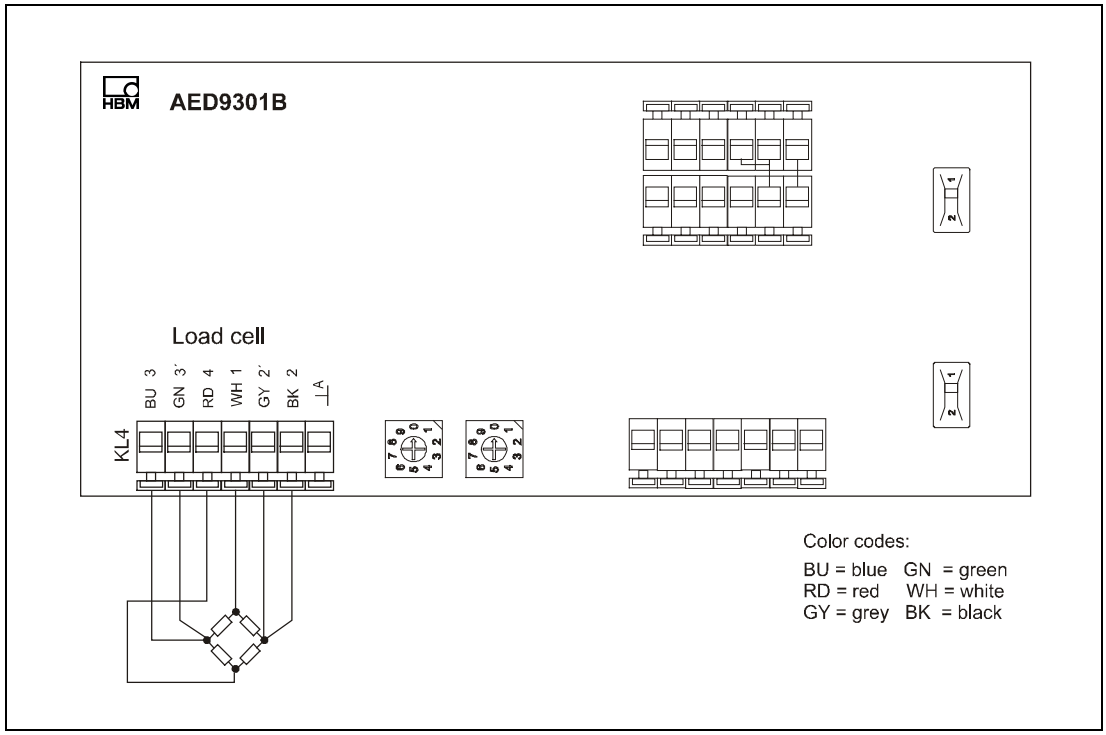


Fig. 3.1-2.: Transducer connection in the AED9301B basic device for a 6-wire connection

There are two methods of connection for transducers implemented in four-wire circuitry:

- Connection via a 6-core extension cable; bridged sensor circuit in the transducer connector (connect terminals 3 and 3' and 2 and 2').

- Connection without an extension cable; sensor circuit bridged at the transducer electronics (connect terminals 3 and 3' and 2 and 2').

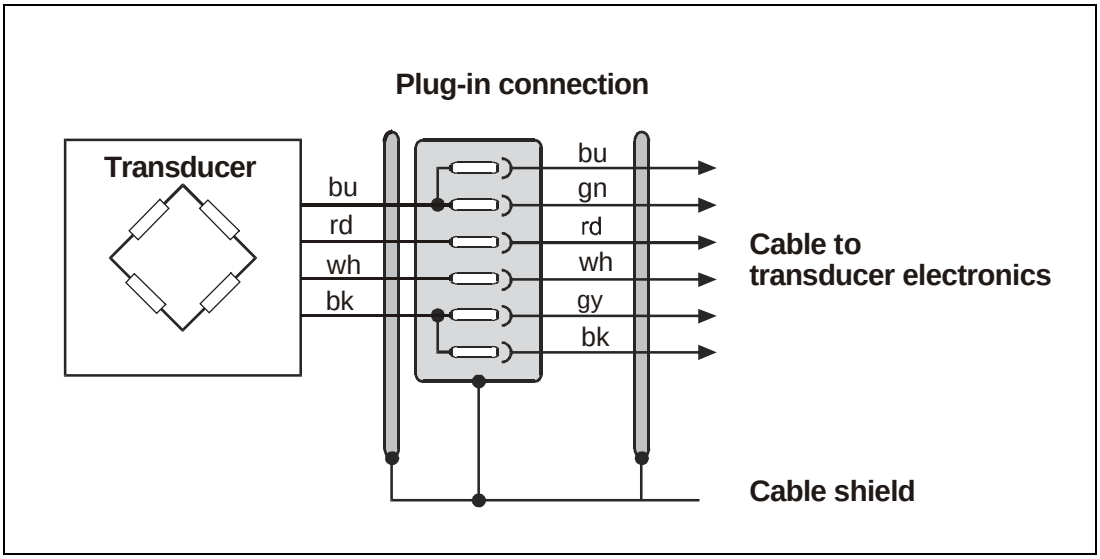


Fig. 3.1-3: Transducer connection in 4-wire circuitry via a 6-core cable extension

When connecting several transducers, it is advisable to use an HBM junction box VKKx. In general, the feed lines running to the AED should be shielded cables.

Notes on type of connection, length and cross-section of cables:

Depending on the bridge resistance of the load cell being used and the length and cross-section of the load cell connection cable, there may be voltage drops that can reduce the bridge excitation voltage. The voltage drop at the connection cable is also dependent on temperature (copper resistance). Likewise, the output signal of the load cell changes in proportion to the bridge excitation voltage.

Effect on the measurement result with the internal Auto calibration function:

Auto calibration safeguards the measurement accuracy of the measuring amplifiers (see “Hardware and Functions” of the AD103C).

6-wire circuit (standard mode of operation):

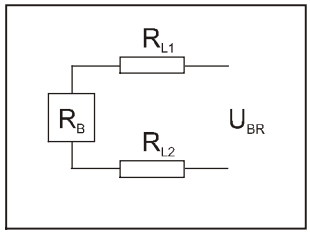
This will correct all the effects of the load cell cabling up to the feedback points. Even changing the length of a cable after calibration will not make any difference to the measurement results.

For load cells with a 6-wire connection, feedback lines 2´ and 3´ are bridged in the load cell with excitation 2 and 3 (Fig. 3.1-2). For load cells with a 4-wire connection, the feedback bridges must be implemented directly at the load cell connection (Fig. 3.1-3).

4-wire circuit:

As correction through AUTOCAL can only ever take place up to feedback points 2´, 3´, all the changes of cable resistances affect the measurement result. This means that even if no further changes are made to the 4-wire cable used for calibration, there will still be measurement errors when there are temperature changes, because the cable resistance and possibly the contact resistances at the connectors are temperature-dependent. With the 4-wire circuit, feedback lines 2´ and 3´ are directly connected at connection terminals 2 and 3 in the AED (see Fig. 3.1-4).

Equivalent circuit of the bridge with bridge resistance R_B and supply lines with line resistances R_{L1} and R_{L2}:



$R_{L1} = R_{L2} = (4 * p_{CU}/\pi) * (l\ [m] / A\ [mm^2])$

$p_{CU} = 0{,}0178\ [\Omega\ mm^2/m]$ for copper

$\pi = 3{,}14$ l = Length of cable, A = Cross-section of cable

$\rightarrow R_{L1} = R_{L2} = 1{,}6\ \Omega$ bei l = 10 m and A = 0,14 mm^2

The voltage drop over the bridge feeder cables can be determined from bridge resistance RB, cable length l, cable cross-section A and the bridge excitation voltage:

$U_B + U_{RL1} + U_{RL2} = U_{BR}$

For
R_B = 80 Ω, R_{L1} = R_{L2} = 1.6 Ω (l = 10 m) and U_{BR} = 5 V

there is an excitation current of
$I_{BR} = U_{BR} / (R_{L1} + R_{L2} + R_B)$ = 60 mA

and thus a voltage drop over the two line resistances totaling approx. 0.2 V
(U_{Bridge} = 4.8 V).

For
R_B = 80 Ω, R_{L1} = R_{L2} = 16 Ω (l = 100 m) and U_{BR} = 5 V

there is an excitation current of
$I_{BR} = U_{BR} / (R_{L1} + R_{L2} + R_B)$ = 45 mA

and thus a voltage drop over the two line resistances totaling approx. 1.4 V
(U_{Bridge} = 3.6 V).

This is irrelevant for the 6-wire circuit, as the voltage drop over the sensor lines is taken into account in the measurement signal.

But with a 4-wire circuit, the dependency of the copper resistance of the cables on temperature goes directly into the measurement result, as the bridge excitation voltage U_{Bridge} changes:

$R_L(t) = R_{L20} * (1 + \alpha * (t – 20\ °C))$,

where R_{L20} is the line resistance at 20 °C and α is the temperature coefficient of the copper.

R_{L20} – calculation see page 10, α_{CU} = 0.00392 [1/K]

With a cable length of l = 109.36 yd and a temperature differential of 10°C, there is a line resistance of

$R_{L1}(t) = R_{L2}(t) = 16 * (1 + 0.00392 * 10) = 16.6\ \Omega$

This changes the bridge excitation voltage of

U_{Bridge} = 3.6 V (at 20 °C) to U_{Bridge} = 3.53 V.

This change in bridge excitation voltage directly at the transducer changes the measurement signal of the bridge by 2 % (= 100 % * (1 – 3.53 V / 3.6 V)).

This typical calculation shows that if long cables are involved, only 6-wire circuitry should be used.

3.2 Connecting the supply voltage

The power supply must meet the following requirements:

AED9301B DC voltage +18 V...+30 V

Current consumption 200 mA + current of control outputs OUT1...4 (at 80 Ω bridge resistance and 24 V power)

Calculating total current consumption (at 80 Ω bridge):

Current consumption for 18 V power supply: ≤250 mA + IOUT 1...4
Current consumption for 24 V power supply: ≤200 mA + IOUT 1...4
Current consumption for 30 V power supply: ≤170 mA + IOUT 1...4
$I_{OUT\ 1...4}$ = control outputs current

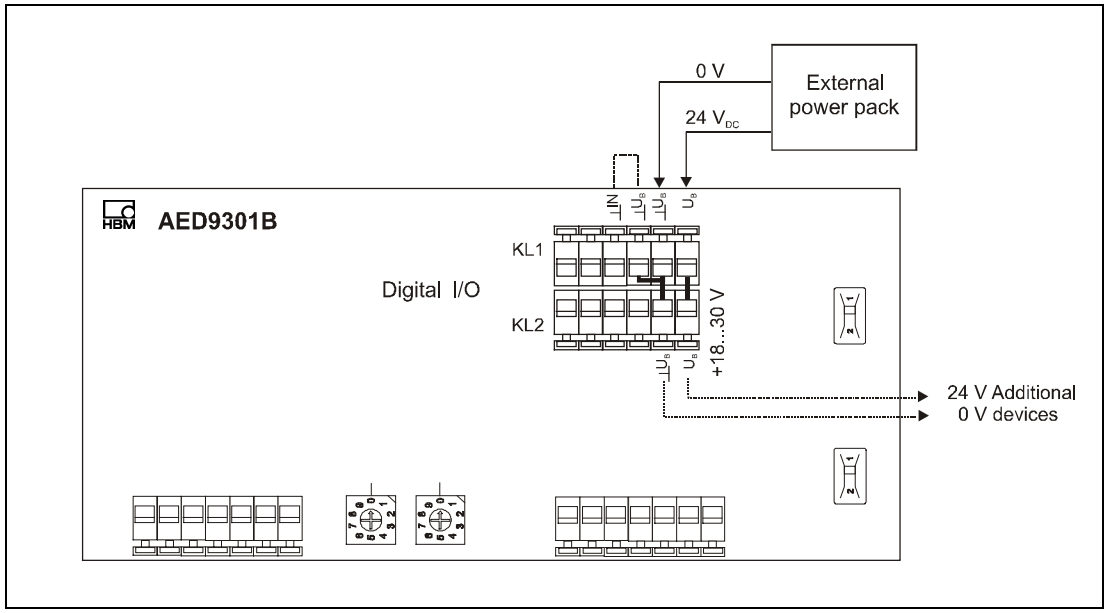


Fig. 3.2-1: Power supply connection

The AED supply voltage can be connected at terminals KL1 and KL2. The three ground terminals and the two voltage terminals are each interconnected internally. The supply voltage coming from the power pack is connected at terminal KL1; this supply voltage can be routed to other devices at terminal KL2.

Electrically isolated digital outputs OUT1...OUT4 are also supplied from this voltage. The potential separation occurs in the AED direction. Consequently the units controlled from OUT1...4 can also be fed from U_B (see Connection of digital inputs/outputs).

Control inputs IN1 and IN2 are initially electrically isolated from supply voltage U_B. The two grounds (ground U_B and ground IN) can be connected to terminal KL1, if required (see Connection of digital inputs/outputs).

3.3 Profibus connection

Profibus DP is fully standardized to IEC61158 / EN50170 for universal automation, so there is no difficulty in connecting components that conform to the standard.

In the case of the AED9301B, this is a Profibus DP Slave in accordance with DIN19245-3. It provides a simple and quickly implemented option for connecting electromechanical measurement sensors to automation systems such as SIEMENS SIMATIC S7 or to PCs.

The Profibus is electrically isolated from the measuring system and from the supply voltage, the transmission procedure is RS485. The maximum possible baud rate for RS485 is 12 Mbit/s. The node address can be set via two BCD-coded rotary switches *"S5"* and *"S4"*.

The Profibus connection KL3 is equipped with four terminals, so that it can be routed to the next bus node. The connection cables should be shielded, twisted-pair cables (see Profibus cable specification).

Bus termination should be activated at both ends of the Profibus line (at the AED switch *"S2 = on"*). This switch must be set to *"off"* for all the other bus nodes. The module can be disconnected from Profibus for diagnostic purposes (*"S3 = off"*). The factory default for this is *on*.

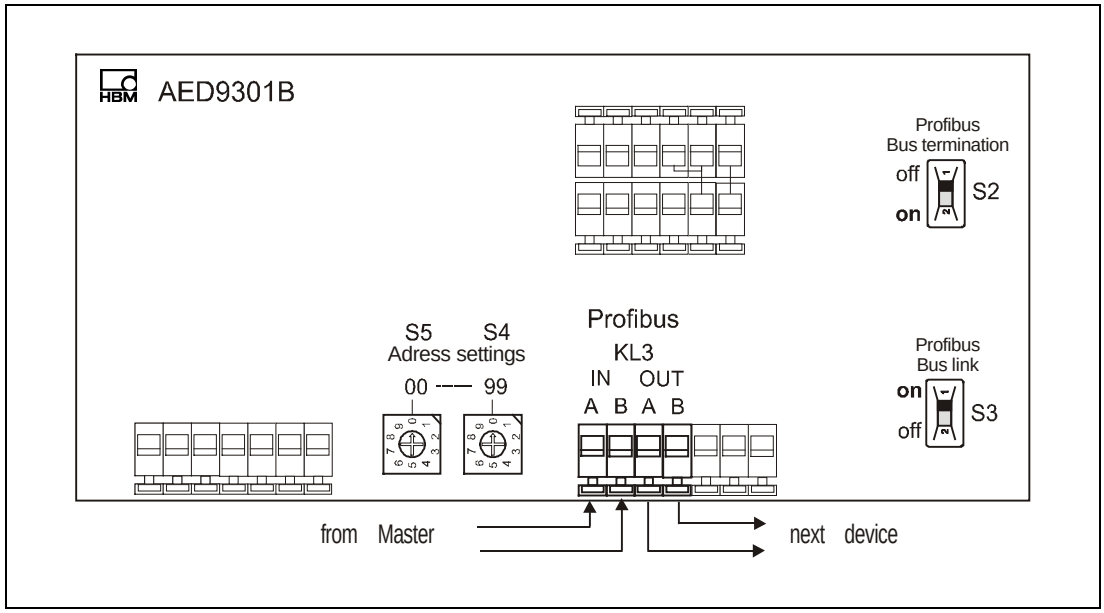


Fig. 3.3-1: Profibus connection via terminal KL3

Maximum cable length subject to bit rate:

Bit rate [kbit/s]	9.6	19.2	93.75	187.5	500	1500	12000
Max. cable length [m]	1200	1200	1200	1000	400	200	100

Setting the Profibus address

Address = S5 ∗ 10 + S4 (permissible address range: 3...99)

The address must be set in the deactivated state and read in by the AED when the supply voltage is applied. The address is set to 03 at the factory.

Light-emitting diode functions (LEDs)

The various Profibus states are indicated by 4 LEDs (Fig. 2-1):

LED1: Profibus power supply (green, on the right next to the bus termination)
the RS485 driver supply voltage is being applied if LED 1 shows a continuous green light

LED2: Profibus Data Exchange (green)
The *Data Exchange* state is indicated for cyclic data communication by green LED 2.

LED3: Profibus diagnostics (yellow)
The yellow LED 3 comes on when there is an internal error. The measurement data may be invalid.

LED4: Profibus error (red)
When there is a bus error, LED 4 shows red and stays on as long as the error persists.
Possible causes:
- Incorrect wiring (A and B may be transposed)
- Profibus Master not (yet) working

Installing Profibus:

1. Connect the feed lines in the deactivated state to the AED (see *Electrical connection* section). The Profibus line is routed from one device to the next via KL3.
2. Use *"S5"* and *"S4"* to set the node address.
3. Set the switch for connecting bus termination *("S2")*:
   Caution: Only set it to *on* for the first and last device, otherwise leave in the *off* position. If the first or last bus node is not an AED, you can usually connect bus termination via a slide switch on the Profibus connector housing.
4. Check that the bus link switch (*"S3"*) is set to *on*.
5. Activate supply voltage U_B.
6. Use the relevant tools to configure and assign parameters to the Profibus node.

Configuration and parameter assignment of the Profibus message with a configuration tool and GSD file is described in the aed_help_e, AD9301A; "Description of the Profibus communication". Also the linking the bus via a PC and the HBM Profibus Panel program.

The Profibus can be separated from the AED for diagnostic purposes (bus link (*S3*) to *"off"*).

3.4 Connecting digital inputs/outputs

At terminals KL1 and KL2 are the digital control inputs and control outputs together with the associated ground references.

The measuring amplifier is always electrically isolated from external supply voltage U_B and from the digital inputs and outputs

control inputs

Control inputs IN1 and IN2 are initially electrically isolated from supply voltage U_B and from the measuring ground, the reference potential is ground IN at terminal KL1 on the right next to the inputs.

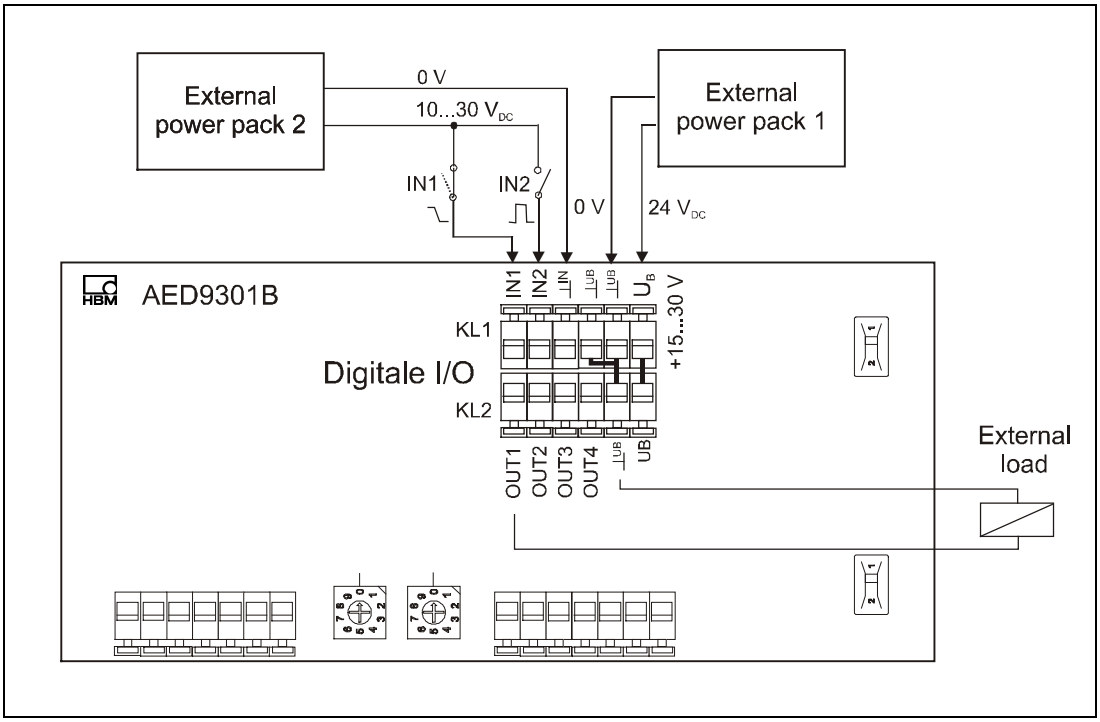


Fig. 3.4-1: Connection of digital I/Os, inputs and external power pack 1 electrically isolated

Logic level:

IN1:	Trigger:	quiescent level = low,	active edge = high-low edge
	Break Dosing:	quiescent level = low, (duration ≥20 ms)	activation = low-high-low-Puls
IN2:	Taring or Start dosing	quiescent level = low, (duration ≥20 ms)	activation = low-high-low-Puls

Unused inputs remain open. If the input circuit is also supplied via U_B, the ground of the inputs and the ground of the U_B must be connected.

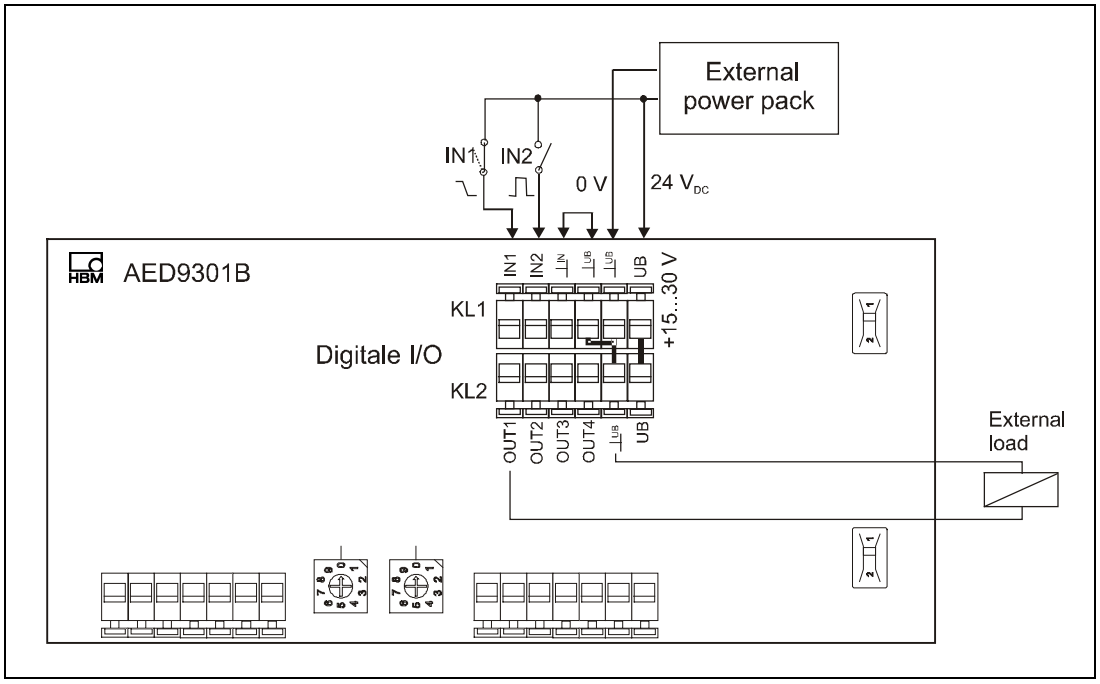


Fig. 3.4-2: Connection of digital inputs and outputs, inputs and external power pack not electrically isolated (IN1 = trigger)

Control outputs:

Digital outputs OUT1…4 are electrically isolated and are supplied via external supply voltage U_B. They are implemented as High side switches. Consequently, consumers must be connected to ground. The outputs are short-circuit-proof and can drive ohmic and inductive loads with currents up to approx. 0.5 A per output.

Logic level:	OUT inaktiv	→	voltage is Low (*H-side switches* deactivated)
	OUT aktiv	→	voltage is High (*H-side switches* activated)

The functions of the digital inputs and outputs differ in accordance with the type of measuring amplifier used (basic, plus)

The AD103C amplifier board has two inputs (IN1 and IN2) and 4 outputs (OUT1…4). The functions are defined using the commands **IMD**, **LIV** and **OMD** (also see aed_help_e, AD103C; “Description of the commands for signal processing” and “Description of the commands for the filling and dosing applications”).

Input functions:

IMD0: Input functions deactivated, possible to read in the status using the **POR** command.

IMD1: IN1 = external trigger for the trigger function (**TRC**),
IN2 = taring,

IMD2: IN1 = Stop filling,
IN2 = Start filling (dosing function)

Output functions:

IMD < 2 (no dosing mode):

LIV1 deactivated: control OUT1 via **POR** command

LIV2 deactivated: control OUT2 via **POR** command

LIV1 deactivated: limit value **LIV1** controls output **OUT1**

LIV2 deactivated: limit value **LIV2** controls output **OUT2**

LIV3 deactivated: limit value **LIV3** controls output **OUT3**

LIV4 deactivated: limit value **LIV4** controls output **OUT4**

IMD = 2 (Dosing mode, also see aed_help_e, AD103C; “Description of the commands for the filling and dosing applications”):

The following output functions are available, subject to the output mode command (**OMD**):

Outputs	**OMD0**	**OMD1**	**OMD2**
OUT1	Coarse Flow	Coarse Flow	Coarse Flow
OUT2	Fine flow	Fine flow	Fine flow
OUT3	Ready signal / emptying [1)]	Ready signal / emptying [1)]	Ready signal / emptying [1)]
OUT4	Tolerance+ overrun	Outside Tolerance ±	Alarm

[1)] for emptying time = 0 (**EPT**) → OUT3 ready signal is after actual value determination,
for emptying time > 0 (**EPT**) → OUT3 emptying control is over set time

3.5 Connecting the diagnostic bus

The diagnostic bus is used to analyze dynamic processes. The bus is set out as an RS485 2-wire bus (lines: TB/RB and TA/RA, GND).

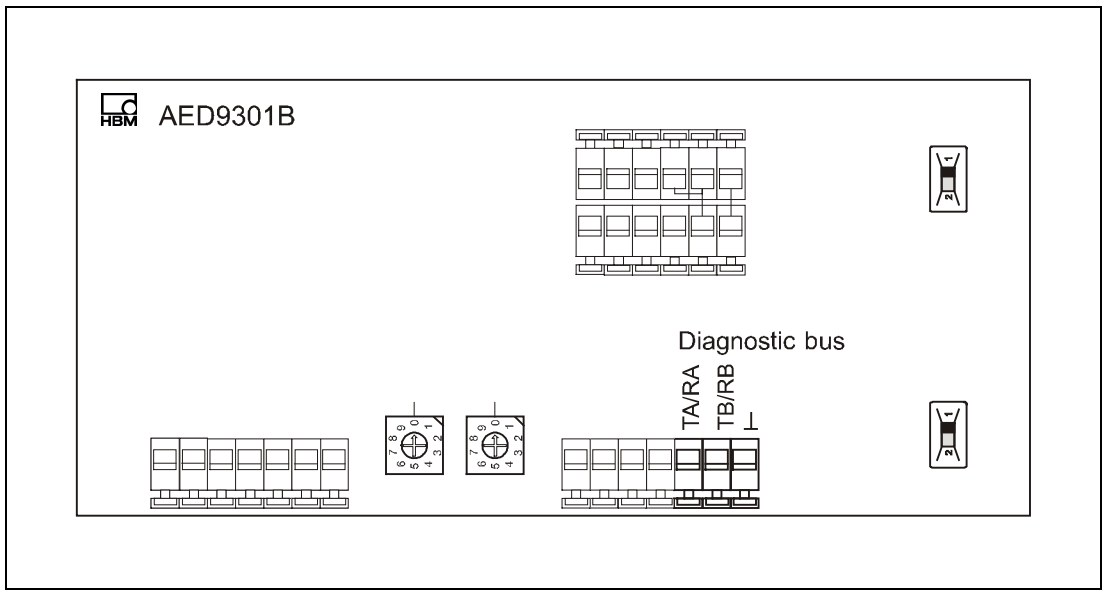


Fig. 3.5-1: Connecting the diagnostic bus via terminal KL3

The interfaces setting of the bus is defined and cannot be changed (38400 bit/s, 8E1).

External bus termination resistances are not necessary for this bus.

The HBM interface converter can be used to connect the RS485 bus to an (RS232) COM port of the PC.

The ground of the interface driver is related to the GNDext terminal. The interface driver of the master should be also connected to this GNDext.

Only a connecting cable with a screen grounded on two sides should be used as the interconnecting cable between the AED 9301B and the bus and the master (see also: AED9301B cable connection via a PG gland).

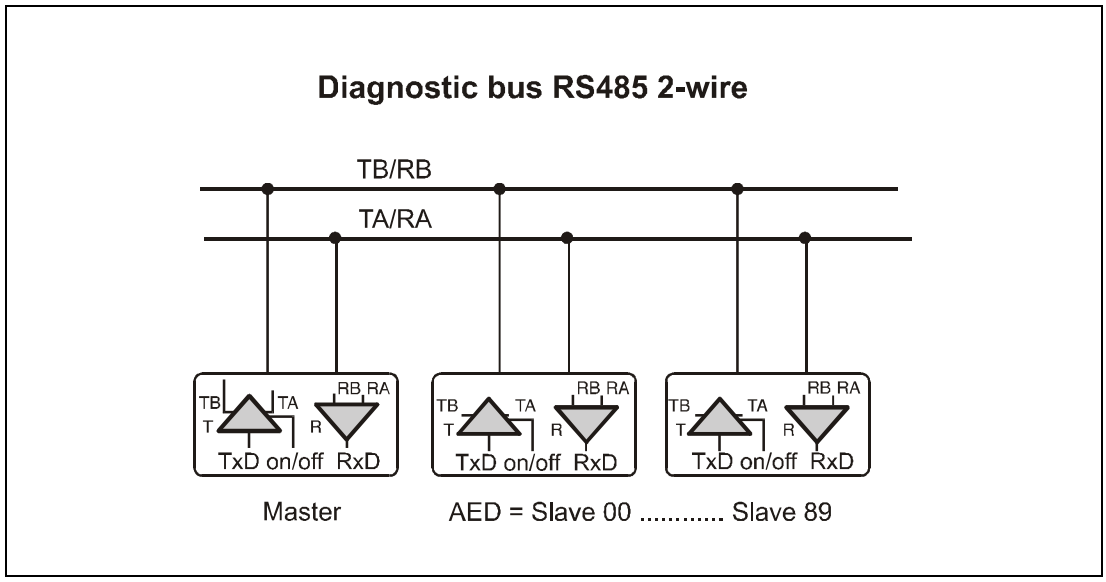


Fig. 3.5-2: Diagnostic RS485 bus

The functions and commands of the diagnostic channel are described in the help file aed_help_e Diagnosis. The address corresponds to the address of the AD103C amplifier, command **ADR** (00...89, factory setting: 31), see aed_help_e, Basic Commands). This address is independently from the CANOpen address.

The following functions can also be executed via this bus:

Parameters	Read only (changes are not possible)
Measured values	Reading individual measured values **MSV**?; (MSV?i not possible)
Results	Trigger results and dosing results can be read

The diagnostic functions can be executed using the HBM *AED_Panel32* program (as from Version V3.0.0).

The HBM display unit DWS2103 can be connected with this interface. Than all implemented functions and parameters are accessible. This is independent from the main communication channel.

3.6 AED9301B cable connection via PG glands

Only a connecting cable with a screen grounded on two sides should be used as the interconnecting cable between the AED 9301B and the transducer or Profibus DP. On the AED side, bring the screen extensively into contact at the PG gland. On the other side, connect the screen extensively to ground (housing). If there are vast differences between the ground potential of the AED9301B and its partner device, a potential equalization line must be provided in addition.

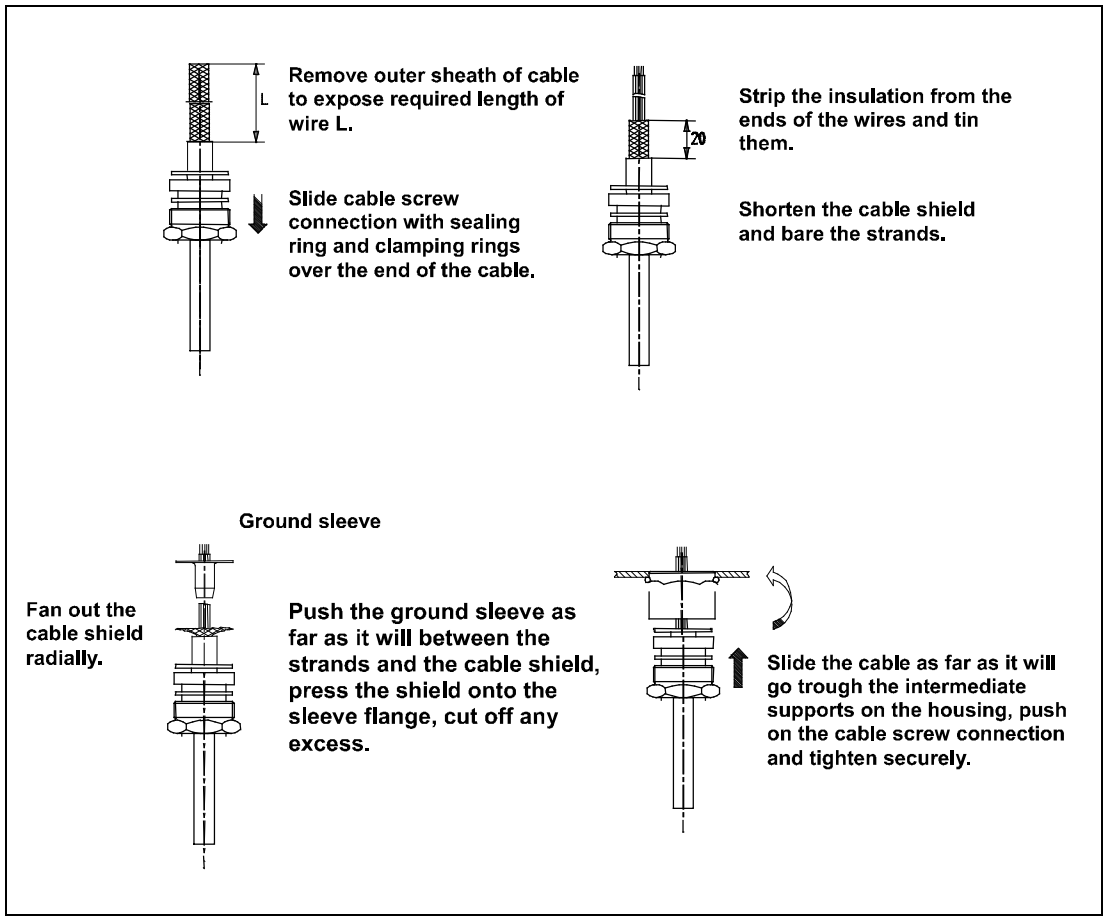


Fig. 3.6-1: Cable connection via a PG gland

Index

L

P

S

T

I1694-2.0 en

Hottinger Baldwin Messtechnik GmbH

Postfach 100151 D-64201 Darmstadt

Im Tiefen See 45 D-64293 Darmstadt

Tel.: +49/6151/803-0 Fax: +49/6151/8039100

E-mail: support@hbm.com · www.hbm.com

measurement with confidence