

AED9401A

Digital Transducer Electronics

Basic device

CANOpen / DeviceNet

Content

Typographical conventions.....	3
Important information.....	4
Safety information.....	5
1 Introduction and appropriate use	6
2 Mechanical construction	7
3 Electrical connections	8
3.1 Transducer connection.....	8
3.2 Connecting the supply voltage.....	13
3.3 Connecting CAN bus or DeviceNet.....	14
3.4 Connecting the diagnostic bus.....	17
3.5 Connecting digital inputs/outputs.....	19
3.6 AED9401A cable connection via a PG gland	22
Index.....	23

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 face 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 settings 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 field bus configuration tool. For more information, see the AED9401A help file `aed_help_e`, CANOpen and DeviceNet.

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 information

- 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 or are routed outside closed buildings (EN 61326-1).
- 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

AED9401A 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 an RS485, Profibus DP, CANOpen or DeviceNet interface 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 AED9401A digital transducer electronics, you can connect SG¹⁾ transducers in a full-bridge circuit directly to a CANOpen or a DeviceNet. This enables you to connect complete measurement chains to a field bus quickly and with little extra work.

The AED9401A basic device takes the AD103C amplifier board. It provides mechanical protection, shields the amplifier boards (EMC protection) and implements the CAN bus and DeviceNet link and full electrical isolation of all connections.

The AD103C amplifier is not among the components supplied with 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 functions of the AD103C amplifier and the communication are described in the help file `aed_help_e`.

The user manual has separate parts for the description of communication via DeviceNet or the CANOpen bus (see help file `aed_help_e`).

The additionally implemented diagnostic channel allows the dynamic processes to be analyzed (see help file `aed_help_e`).

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

¹⁾ **Strain Gage**

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
- an interface for CANOpen and DeviceNet (electrically isolated from the amplifier)
- digital inputs/outputs (electrically isolated from the amplifier)
- 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 CANOpen/DeviceNet connections, slide switches for bus disconnection, the slide switch for CANOpen/DeviceNet selection and termination resistor connection and the voltage stabilizer. The connection cables exit the casing via PG glands.

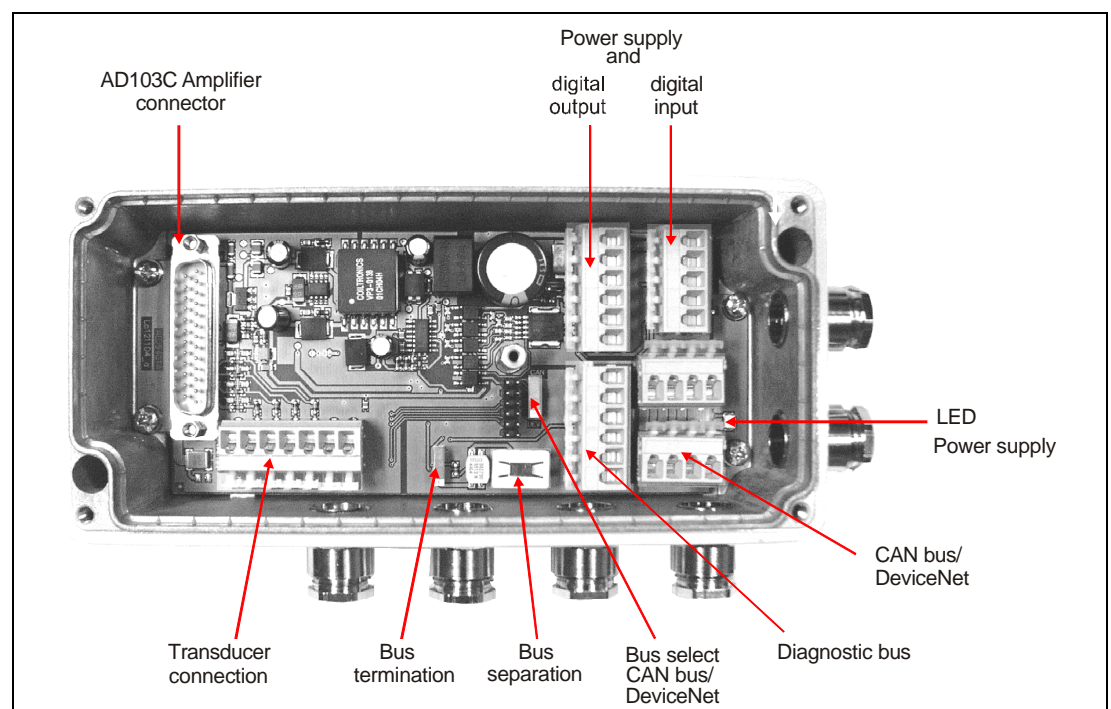


Fig. 2-1: Mechanical construction AED9401A (without amplifier)

3 Electrical connections

The AED9401A 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 AED9401A 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).

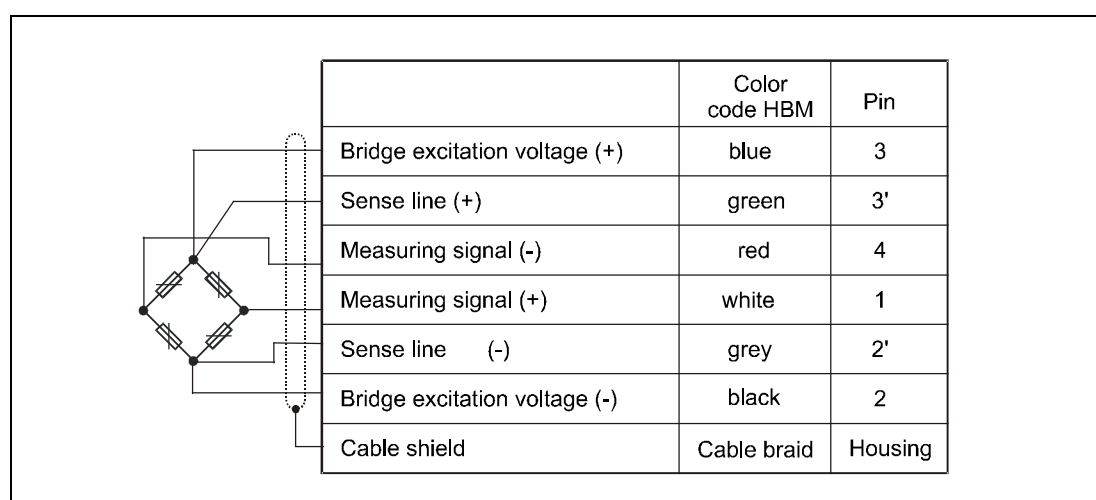


Fig. 3.1-1: Transducer connection in 6-wire circuitry (HBM color-coding)

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

The bridges are supplied with power in the AED9401A 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.

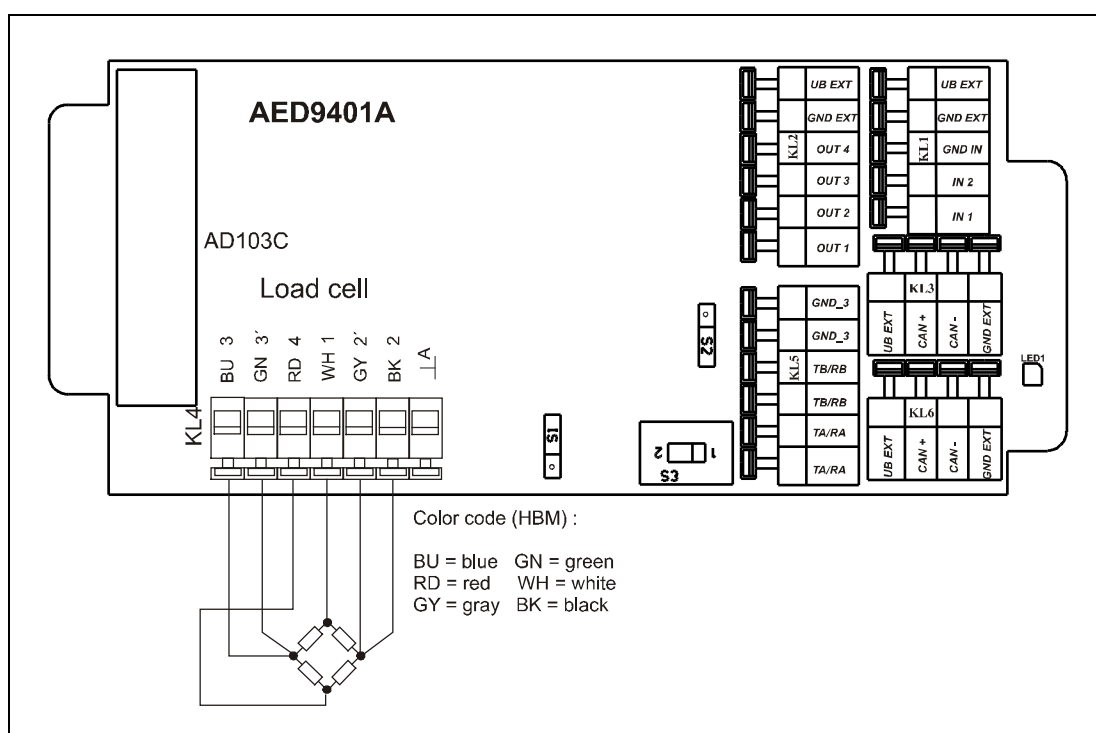


Fig. 3.1-2.: Transducer connection in the AED9401A basic device for a 6-wire connection

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

- Connection via a 6-core extension cable; sensor circuit bridged 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').

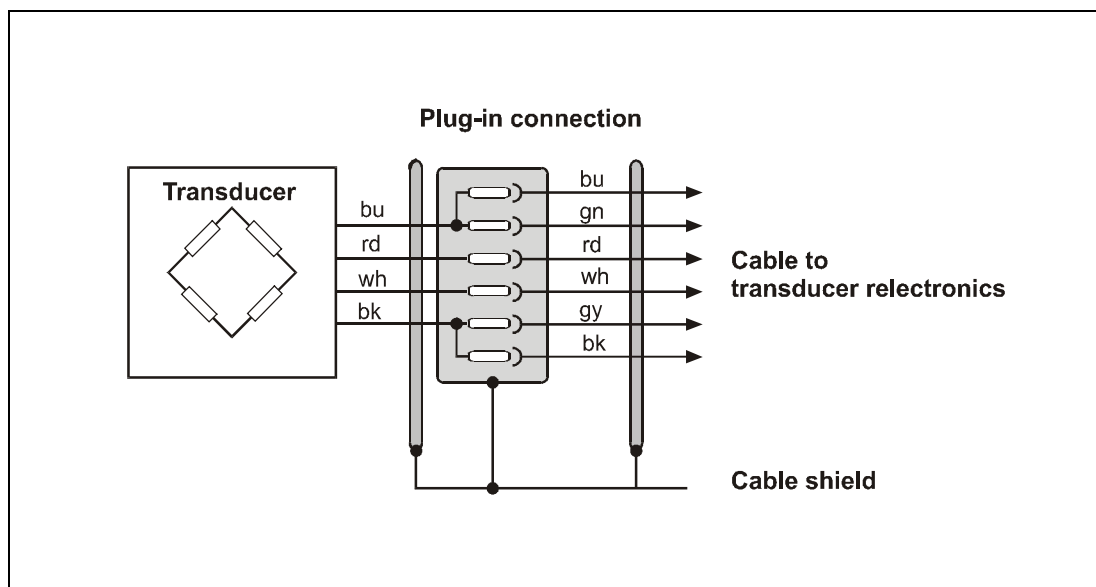


Fig. 3.1-3: Transducer connection in 4-wire circuitry via a 6-core cable extension

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.

6-wire circuit (standard mode of operation):

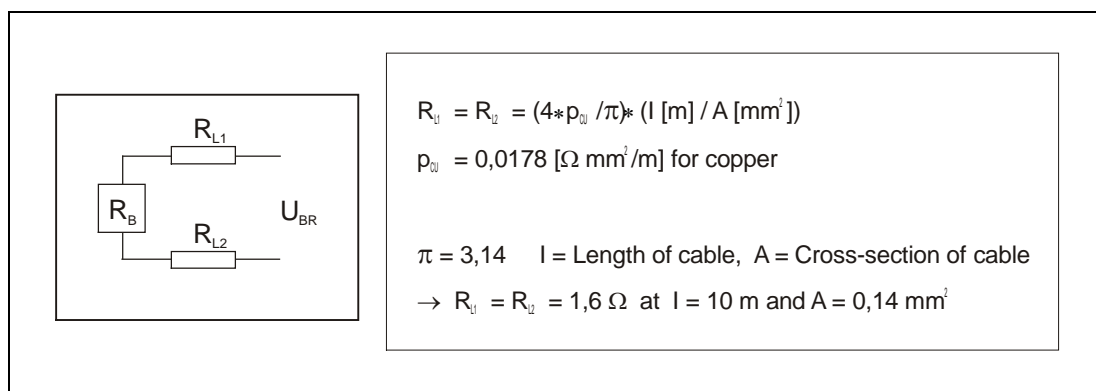
This will correct all the effects of the load cell cabling up to the sense points. Even changing the length of a cable after calibration will not make any difference to the measurement results.

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

4-wire circuit:

As correction through AUTOCAL can only ever take place up to sense 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, sense lines 2' and 3' are directly connected at connection terminals 2 and 3 in the AED.

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



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

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

For

$$R_B = 80 \, \Omega, R_{L1} = R_{L2} = 1.6 \, \Omega (l = 10 \, \text{m}) \text{ and } U_{BR} = 5 \, \text{V}$$

there is an excitation current of

$$I_{BR} = U_{BR} / (R_{L1} + R_{L2} + R_B) = 60 \, \text{mA}$$

and thus a voltage drop over the two line resistances totaling approx. 0.2 V

$$(U_{\text{Bridge}} = 4.8 \, \text{V}).$$

For

$$R_B = 80 \, \Omega, R_{L1} = R_{L2} = 16 \, \Omega (l = 100 \, \text{m}) \text{ and } U_{BR} = 5 \, \text{V}$$

there is an excitation current of

$$I_{BR} = U_{BR} / (R_{L1} + R_{L2} + R_B) = 45 \, \text{mA}$$

and thus a voltage drop over the two line resistances totaling approx. 1.4 V

$$(U_{\text{Bridge}} = 3.6 \, \text{V}).$$

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:

$$R_L(t) = R_{L20} * (1 + \alpha * (t - 20 \, ^\circ\text{C})),$$

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

$$R_{L20} - \text{calculation see page 10, } \alpha_{\text{CU}} = 0.00392 \, [1/\text{K}]$$

With a cable length of $l = 109.36 \, \text{yd}$ 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

$$U_{\text{Bridge}} = 3.6 \, \text{V (at } 20 \, ^\circ\text{C}) \text{ to } U_{\text{Bridge}} = 3.53 \, \text{V.}$$

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:

AED9401A DC voltage $U_{B \text{ ext}} = +18 \text{ V} \dots +30 \text{ V}_{\text{DC}}$

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

Calculating total current consumption (at 80 Ω bridge):

Current consumption for 18 V power supply: $\leq 250 \text{ mA} + \text{IOUT } 1 \dots 4$

Current consumption for 24 V power supply: $\leq 200 \text{ mA} + \text{IOUT } 1 \dots 4$

Current consumption for 30 V power supply: $\leq 170 \text{ mA} + \text{IOUT } 1 \dots 4$

IOUT 1...4 = control outputs current

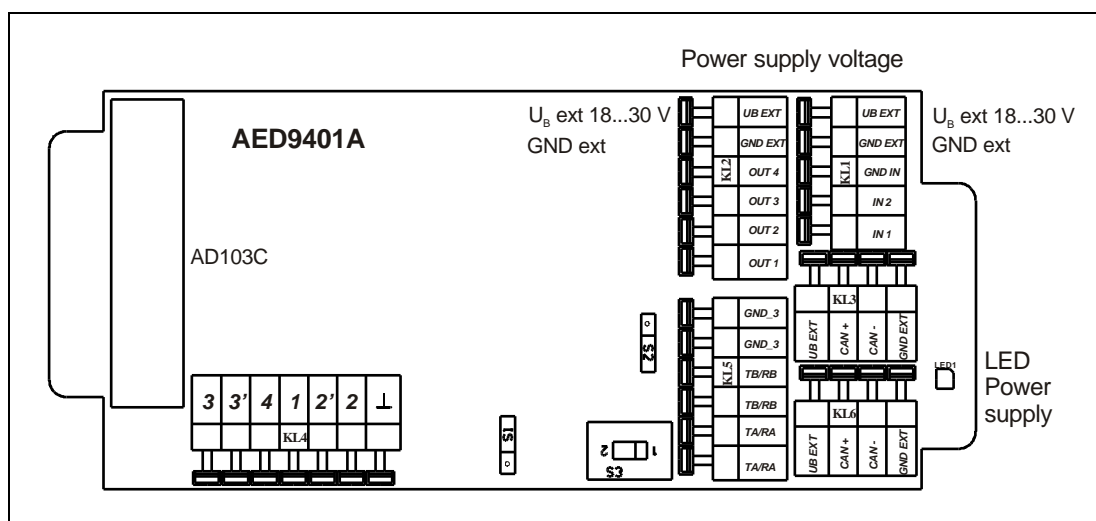


Fig. 3.2-1: Power supply connection

The AED supply voltage can be connected at terminals KL1 and KL2. The two 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).

The ground (GND in) of control inputs IN1 and IN2 relates to the ground of the external supply voltage (GND ext; also see Connection of digital inputs/outputs).

If the supply voltage is applied, LED1 will be on.

3.3 Connecting CAN bus or DeviceNet

The AED includes both the CANOpen and DeviceNet bus protocols. The two bus systems are connected via the same connection (KL3/KL6) in the basic device. These are identified by CANH (CAN+) or CANL (CAN-) in Figure 3.3-1. The assignments for terminals KL3 and KL6 are identical.

Selecting the bus:

Switch S2 is used to set the CANOpen or DeviceNet protocol before the supply voltage is activated (see Fig. 3.3-1).

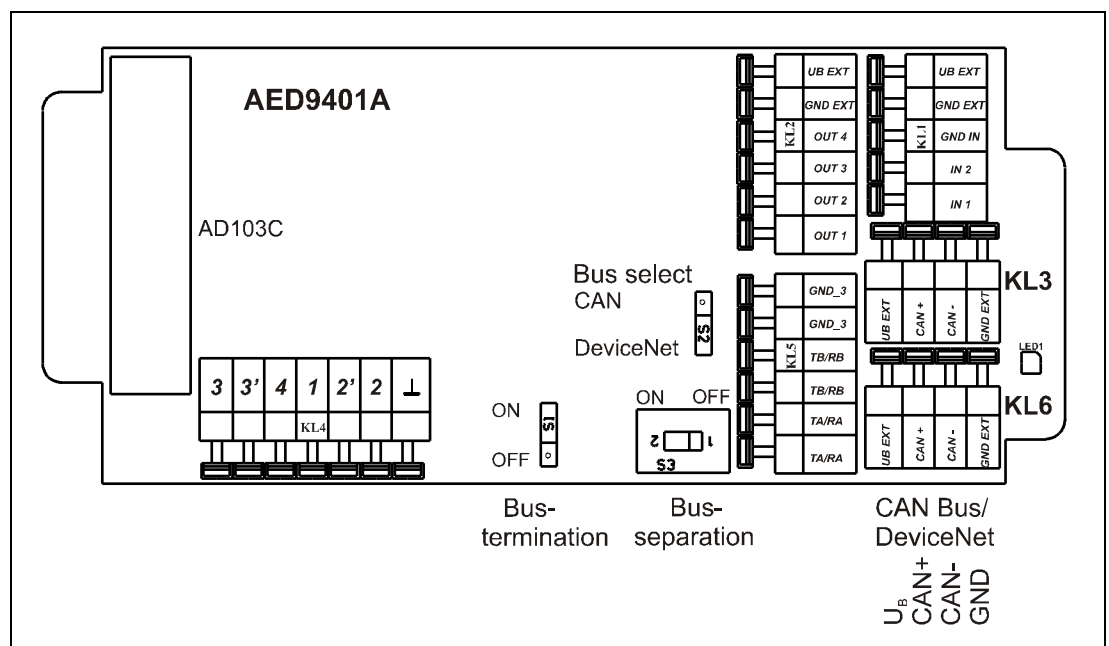


Fig. 3.3-1: CANOpen / DeviceNet connection via terminal KL3 / KL6

Bus termination

The bus termination switch (see Fig. 3.3-1) can be used to activate a differential resistance. Bus termination must only be activated at the ends of the bus cable (max. 2 termination resistances are active).

Bus disconnection:

Use the bus disconnection switch (see Fig. 3.3-1) to disconnect the AED from the bus. This will not disconnect the cable (KL3/KL6).

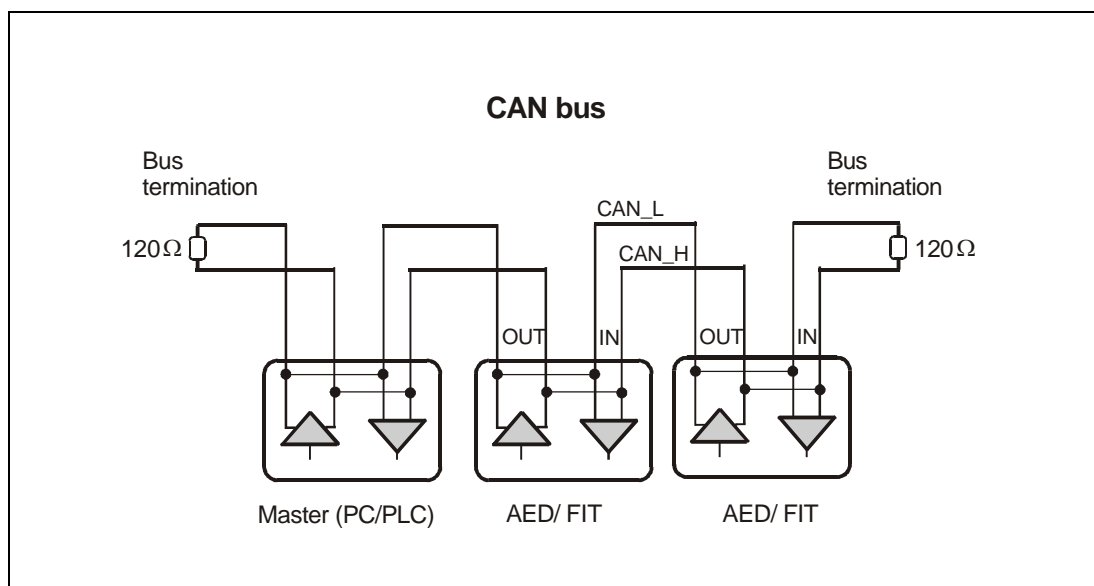


Fig. 3.3-2: Connection of the AED9401A to the CANOpen / DeviceNet



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 inter-connecting cable between the AED 9401A and the bus and the master (see also: AED9401A cable connection via a PG gland).

Bit rate and bus cable lengths

The table below gives the maximum cable lengths for the **CAN** bus, subject to the bit rate:

Bit rate [kbit/s]	10	20	50	125	250	500	800	1000
Max. cable length [m]	5000	2500	1000	500	250	100	50	25

The table below gives the maximum cable lengths for the **DeviceNet** bus, subject to the bit rate:

Bit rate [kbit/s]	125	250	500
Max. cable length [m]	500	250	100

The max. cable length is the total line length, calculated from the length of all the spur lines per node (bus nodes) and the line length between the nodes. The length of the spur lines per node is limited and depends on the bit rate being used (see secondary CAN bus documentation: *CiA DS102 V2.0* and DeviceNet: *DeviceNet Specification Volume 1, Appendix B, cable profiles*)

Setting the address

The address is set via the bus:

- CAN bus: 1...127 (default on delivery: 63)
- DeviceNet: 1...63 (default on delivery: 63)

Setting the bit rate

The bit rate is set with the field bus configuration tool via the bus; the factory default is 125 kbit/s.

3.4 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). This bus is independent of CANOpen or DeviceNet.

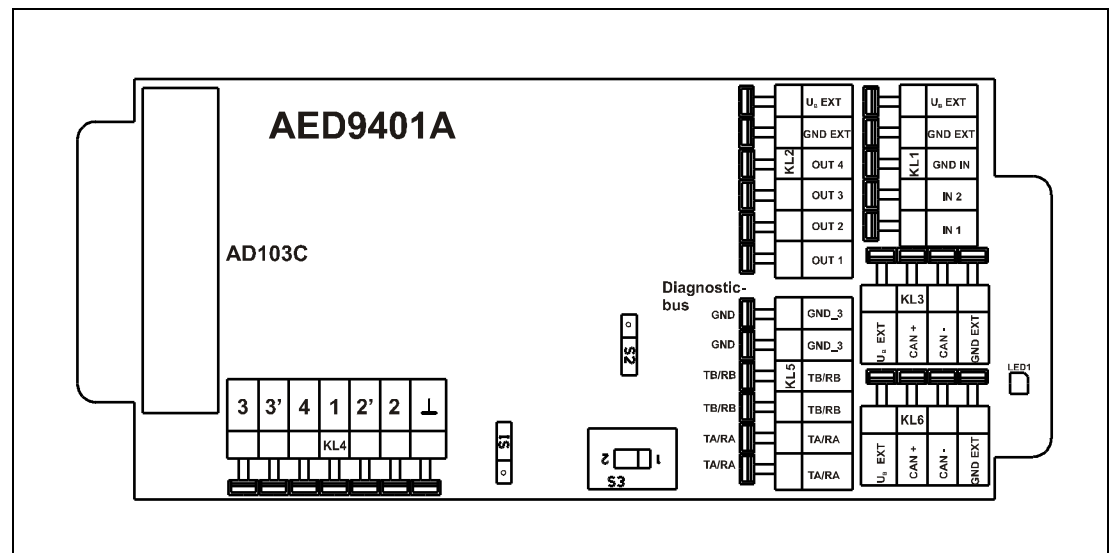


Fig. 3.4-1: Connecting the diagnostic bus via terminal KL5

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.

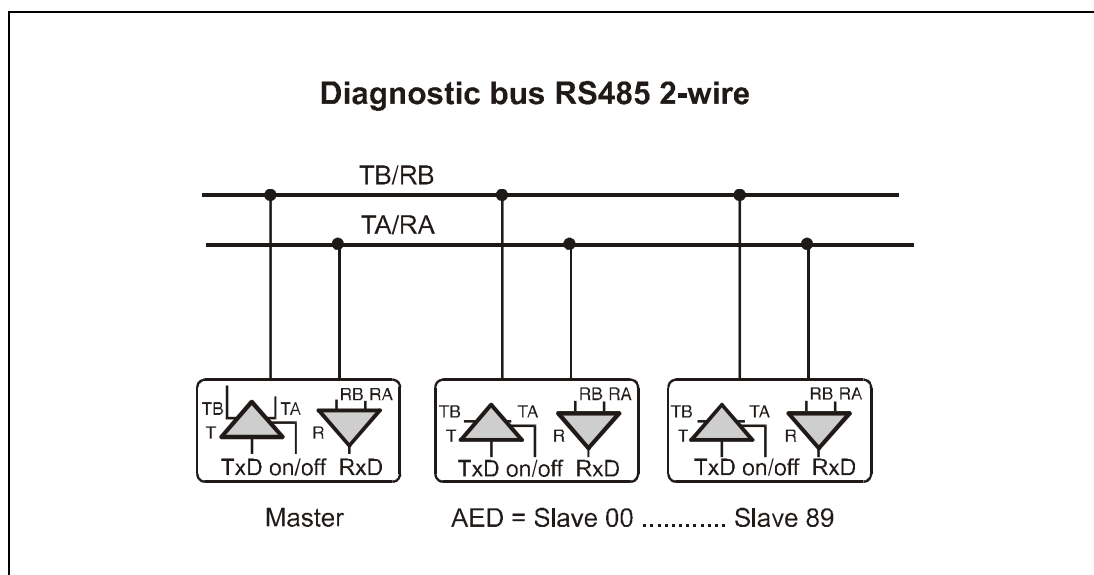


Fig. 3.4-2: Diagnostic RS485 bus



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 inter-connecting cable between the AED 9401A and the bus and the master (see also: AED9401A cable connection via a PG gland)

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>i</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.

3.5 Connecting digital inputs/outputs

The digital control inputs and control outputs together with the associated ground references and the power supply are at terminals KL1 and KL2.

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

Control inputs

The ground (GND in) of control inputs IN1 and IN2 relates to the ground of the external supply voltage (GND ext).

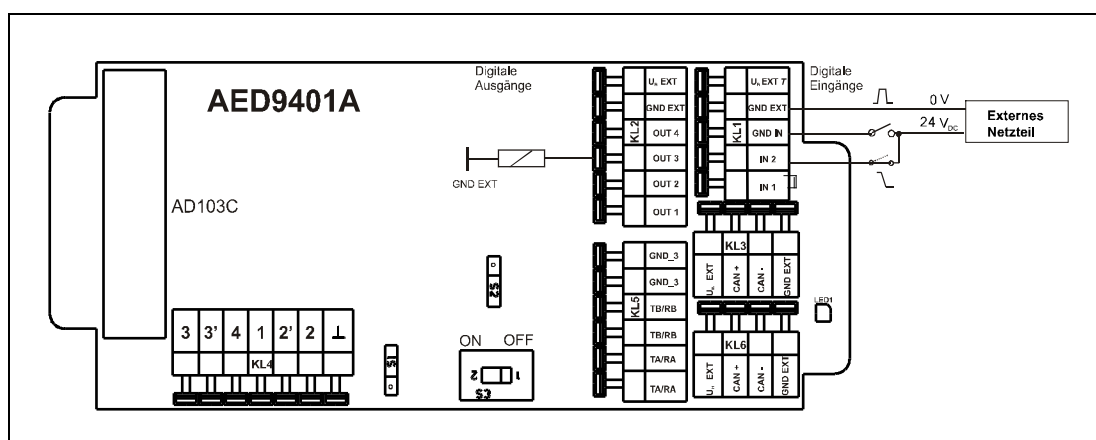


Fig. 3.5-1: Connecting digital inputs and outputs

Logic level of the inputs:

IN1: Trigger: or

Dosing break:

IN2: Tare or start dosing:

Quiescent level = Low, active edge = High Low **edge**

Quiescent level = Low, Activation = Low High Low **pulse** (duration ≥ 20 ms)

Quiescent level = Low, Activation = Low High Low **pulse** (duration ≥ 20 ms)



Unused inputs remain open.

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 inactive → voltage is Low ("H-side switches" deactivated)

 OUT active → voltage is High ("H-side switches" activated)

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 AD103C User Manual; Part 3, *Commands for Signal Processing* and Part 4, *Dosing Control*).

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 (**BRK**),
 IN2 = Start filling (Dosing Function, **RUN**)

Output functions:

IMD < 2 (no dosing mode):

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

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

LIV1 activated: Limit value **LIV1** controls output OUT1

LIV2 activated: Limit value **LIV2** controls output OUT2

LIV3 activated: Limit value **LIV3** controls output OUT3

LIV4 activated: 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 \pm	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

3.6 AED9401A cable connection via a PG gland

Only a connecting cable with a screen grounded on two sides should be used as the inter-connecting cable between the AED 9401A and the transducer or bus. 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 AED9401A and its partner device, a potential equalization line must be provided in addition.

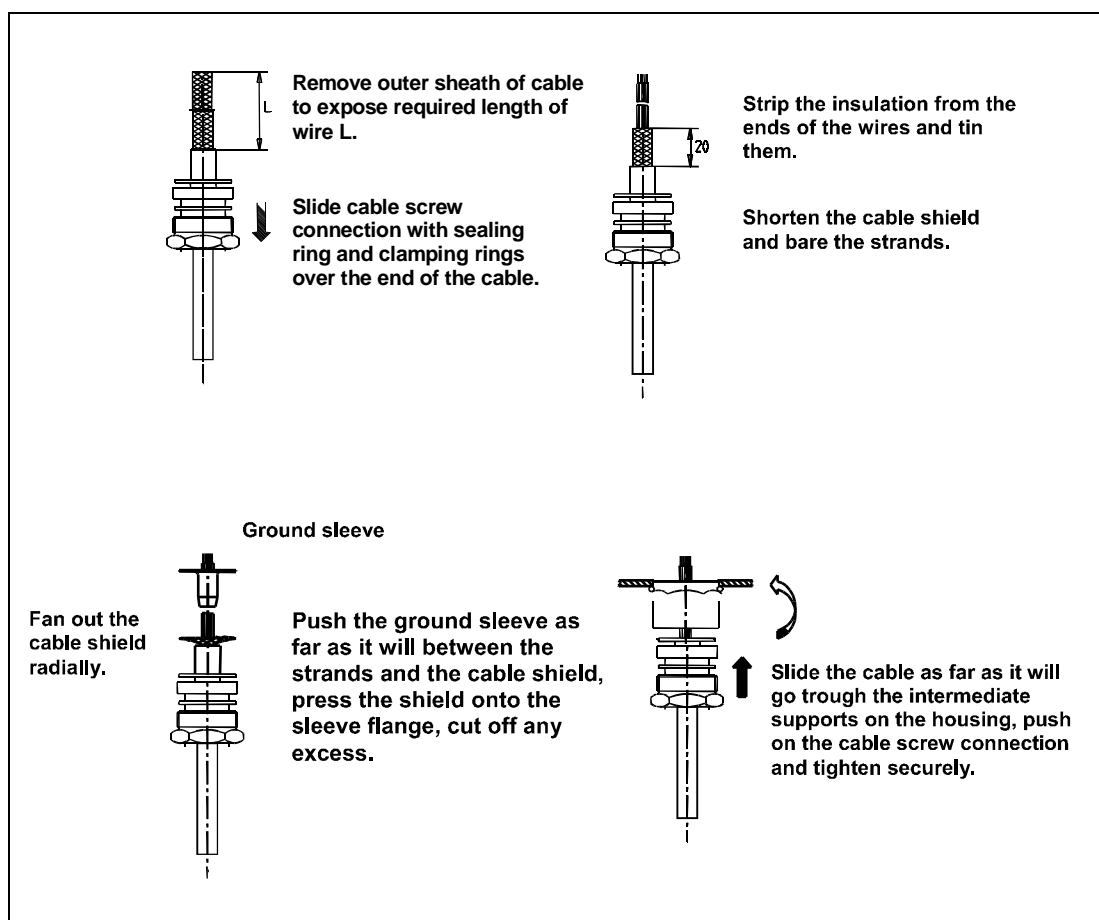


Fig. 3.6-1: Cable connection via a PG gland

Index

4

4-wire circuit	11, 12
4-wire connection.....	11

6

6-wire circuit	11, 12
6-wire connection.....	9, 11

A

Address CANOpen	16
Address DeviceNet	16

B

Bit rate CANOpen	15
Bit rate DeviceNet.....	15
Bridge excitation voltage	10, 11, 12
Bridge resistance	10, 11
Bus disconnection.....	14
Bus termination.....	14

C

Cable connection	
Cable connection - Digital inputs.....	19
Cable connection - Supply voltage.....	13
Cable length	15, 16
Cable length CANOpen.....	15
Cable length DeviceNet	15
Connecting CAN bus	14
Connecting DeviceNet	14
Connecting digital I/O.....	19
Connecting the diagnostic bus	17
Control inputs	19
Control outputs	20
Current consumption.....	13

D

Diagnostic bus	17
----------------------	----

I

Input functions	20
-----------------------	----

L

Load cell connection	11
Logic level control inputs.....	19
Logic level control outputs.....	20

O

Output functions.....	20
-----------------------	----

P

PG cable connection.....	22
--------------------------	----

S

Selecting bus	14
Selecting protocol	14

T

Transducer connection.....	8
----------------------------	---

Modifications reserved.
All details describe our products in general form only.
They are not to be understood as express warranty
and do not constitute any liability whatsoever.

I1695-2.0 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