User Manual

AED9501A

Digital Transducer
Electronics
Basic device
CANOpen/DeviceNet

I2331-1.2 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.

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 note

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.

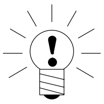
It is strictly forbidden to carry out any repairs and soldering work on the motherboards or to replace any components. Repairs may only be carried out by persons authorized thereto by Hottinger Baldwin Messtechnik GmbH.

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.
- 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 (+10...30 V) 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.
- 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 (EN61326−1).

Symbols pointing out notes on use and waste disposal as well as useful information:

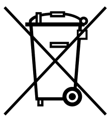
Symbol:  **NOTE**

Points out that important information about the product or its handling is being given.

Symbol: 

Meaning: **CE mark**

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).

Symbol: 

Meaning: **Statutory marking requirements for waste disposal**

National and local regulations regarding the protection of the environment and recycling of raw materials require old equipment to be separated from regular domestic waste for disposal. For more detailed information on disposal, please contact the local authorities or the dealer from whom you purchased the product.

1 Introduction and appropriate use

AED9501A digital transducer electronics are part of the AED component family that digitally conditions signals from mechanical measurement sensors and networks them with bus ca−pability. These include digital amplifier motherboards, basic boxes 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 digi−tal transducer electronics, you can connect SG[1)] transducers in a full−bridge cir-cuit to a computer or a PC. This enables you to configure complete measurement chains quickly and with little extra work.

AED9501A basic device can contain the AD103C amplifier board. It provides mechanical pro−tection, shields the amplifier board (EMC protection) and allows you to select the serial inter−faces CAN bus (factory default) or DeviceNet.

The AD103C amplifier mother board is not included in the scope of supply of the basic box and must be ordered separately.

All commands are described in the help file AED_Help_e.

The operating manual has separate parts for the description of communication via De−vice-Net or the CANOpen bus (see help file AED_help_e).

The additionally implemented diagnostic channel makes the analysis possible of dynamic procedures.

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

1) **S**train **G**ages

2 Mechanical construction

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

- mechanical protection (IP65)
- the power supply for the amplifier motherboard and transducer excitation
- total transducer bridge resistance $\geqq 80\ \Omega$
- a choice of serial interfaces CANOpen, DeviceNet
- diagnostic bus
- digital input IN1
- EMC−tested

The amplifier motherboard is designed as a plug−in board that can be plugged into the carrier board of the basic box via a 25 pin D−connector. The basic device contains terminals for the transducer, power pack and interface connections, slide switches for interface selection and the voltage stabilizer. The connection cables exit the casing via PG glands on the side.

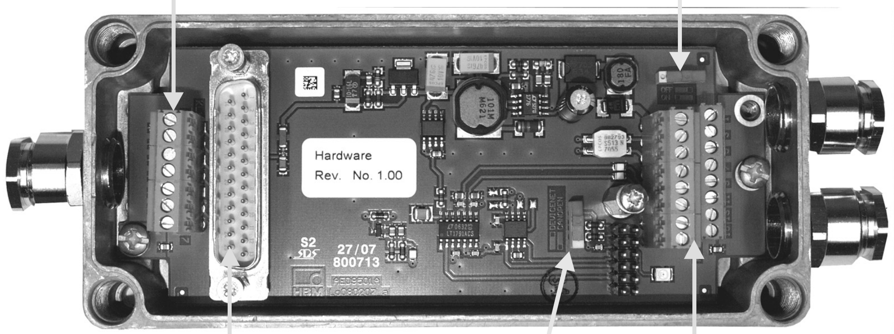


Fig. 2.1 Mechanical construction

NOTE

Please tighten the cover screws with a torque of approximately 1 Nm to ensure the specified IP degree of protection and maximum EMC protection.

3 Electrical connection

A connection diagram is attached inside the lid of the AED9501A basic device.

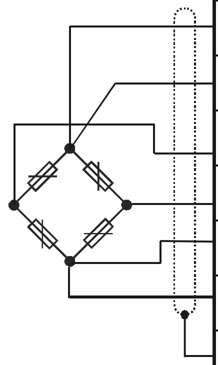
When making the connections, please ensure that the wires of the cable do not protrude beyond the connection terminals (risk that loops may form). Please make sure that the cable shielding is properly connected to the PG gland

3.1 Transducer connection

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

AED9501A with AD103C

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 strain gage transducers are supplied with power in the AED9501A basic device (5 V_{DC}).



	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: Transducer connection in 6−wire circuitry (HBM color−coding)

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

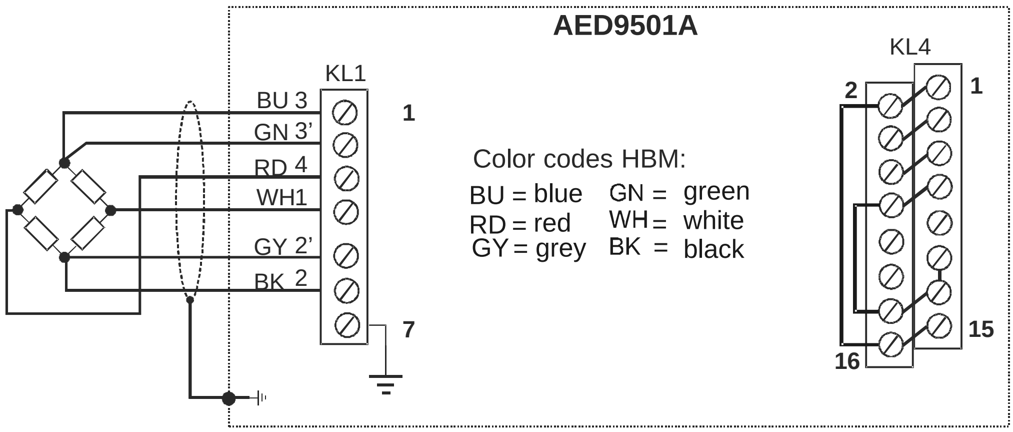


Fig.3.2: Transducer connection in the AED9501A basic device for a 6−wire connection

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.

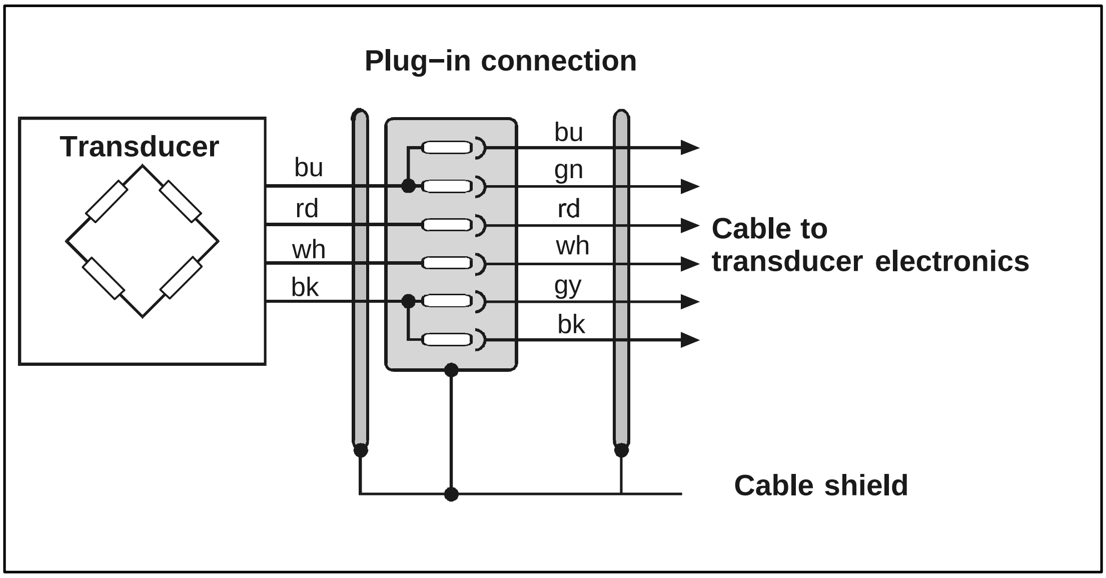


Fig.3.3: Transducer connection in 6−wire circuitry via a 6−core cable extension

- Connection without an extension cable; sensor circuit bridged at the transducer electronics.

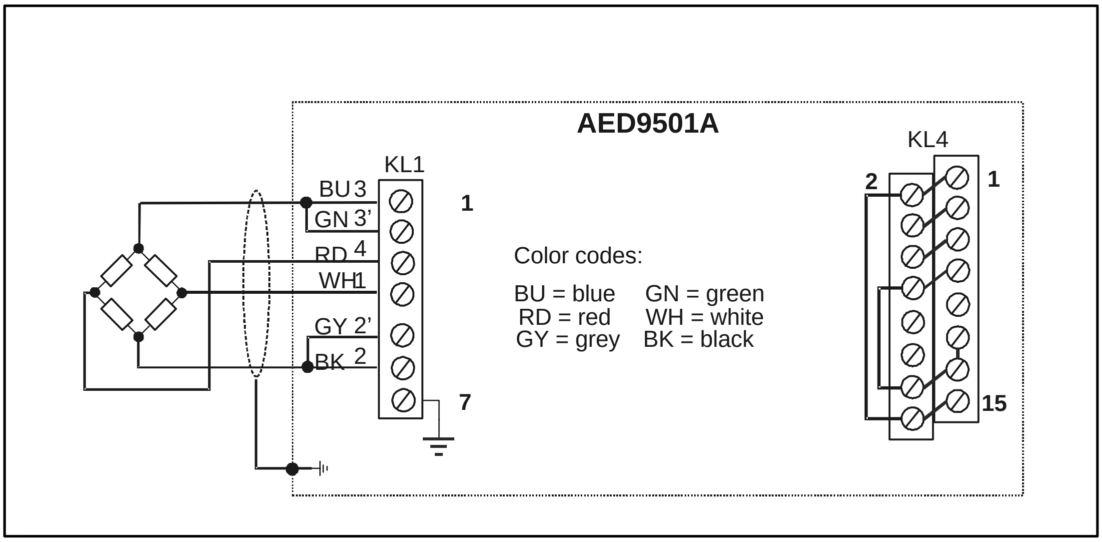


Fig.3.4: Transducer connection in 4−wire circuitry without a cable extension (jumpers 2 − 2' and 3 − 3')

Connection without an extension cable; sensor circuit at transducer electronics. When connecting several transducers, it is advisable to use an HBM VKK1(R)-4 or VKK2(R)-8 junction box. In general, the feed lines running to the AED should be shielded cables.

When connecting several transducers to the AED, the number of load cells that can be connected (and the resultant bridge resistance) must be taken into consideration with regard to the external supply voltage, so that the maximum power loss in the basic device is not exceeded.

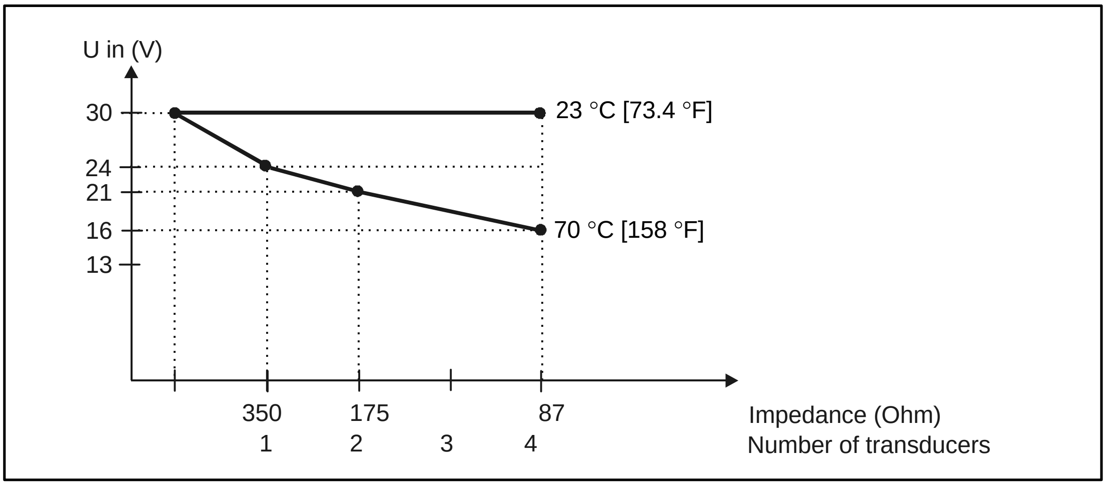


Fig.3.5: Maximum operating voltage for the AED9501A basic device, with regard to the number of transducers and the ambient temperature

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.

This is balanced out when connecting in 6−wire circuitry.

6−wire circuit (standard mode of operation):

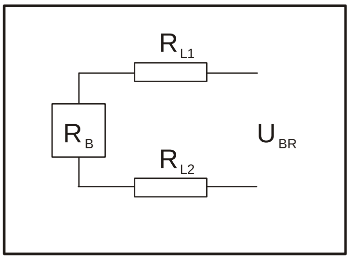
This will correct all the effects of the load cell cabling up to the feedback points. Even changing the length of a cable after calibration will not make any difference to the measurement results.

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. 3.2). For load cells with a 4−wire connection, the feedback bridges must be implemented directly at the load cell connection (Fig 3.3 or 3.4).

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 meas−urement errors when there are temperature changes, because the cable resistance and pos−sibly 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. 3.4).

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



$R_{L1} = R_{L2} = (4 \cdot r_{CU}/\pi) \cdot (l\ [m]\ /\ A\ [mm^2])$
$r_{CU} = 0.0178\ [\Omega mm^2/m]$ for copper

$\pi = 3.14$; l = length of cable; A = cross sect. of cable

$\rightarrow R_{L1} = R_{L2} = 1.6\ \Omega$ at $l = 10$ m and $A = 0.14\ mm^2$

Fig.3.6: Bridge equivalent circuit diagram

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:

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

For
$R_B = 80\ \Omega$, $R_{L1} = R_{L2} = 1{,}6\ \Omega$ (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
$R_B = 80\ \Omega$, $R_{L1} = R_{L2} = 16\ \Omega$ (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 ($U_{Bridge} = 3.6\ V = 80 * 0.045$).

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 tempera−ture goes directly into the measurement result, as the bridge excitation voltage U_{Bridge} chan-ges:

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

where R_{L20} is the line resistance at 20 °C and is the temperature coefficient of the cop−per.

R_{L20} – for calculation, see page 10, α_{CU}: = 0,00392 [1/K]

With a cable length of l = 100 m and a temperature differential of 10 °C, there is a line resis−tance of

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

This changes the bridge excitation voltage of

$U_{Bridgee} = 3.6$ 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 1.9 % (= 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:

AED9501A with AD103C	DC voltage	+10...+30 V
	Current consumption	≤ 200 mA (with 80 Ω bridge)

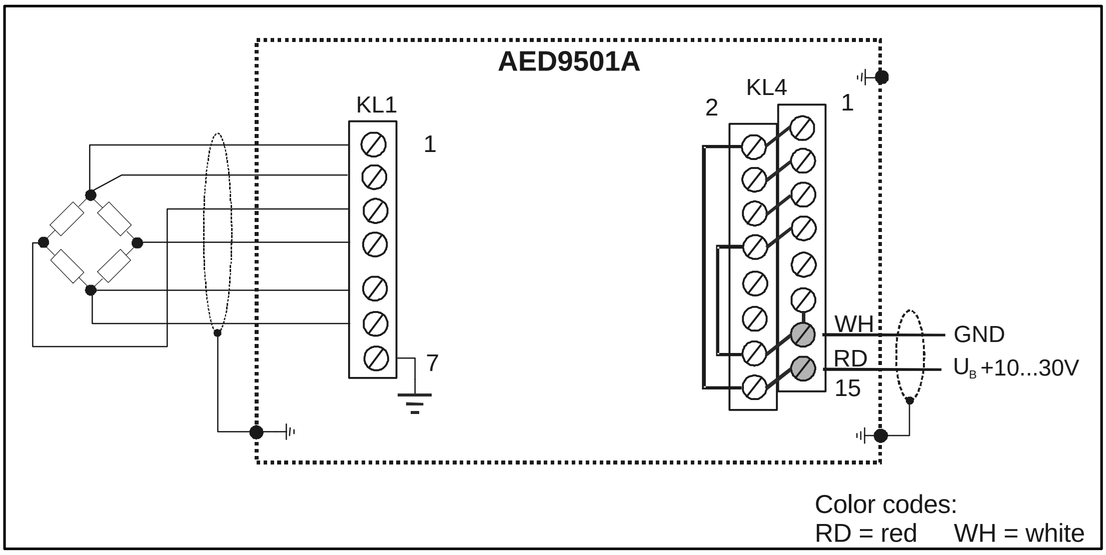


Fig.3.7: Power supply connection

The voltage feed must be shielded. It can be applied within the interface cable or be imple− mented as a separate cable.

When supplying several AEDs via one cable, the voltage drop over the cable must be taken into consideration. The voltage drop depends on the supply current required and on the line resistance.

3.3 Connecting CANOpen or DeviceNet

The AED includes both the CANOpen and DeviceNet bus protocols. The two bus systems are connected via the same connection (KL4) in the basic device. These are identified by CANH (CAN+) or CANL (CAN−) in Figure 3.8.

Selecting the bus:

Switch S2 is used to set the CANOpen or DeviceNet protocol before the supply voltage is activated (see Fig. 2.1).

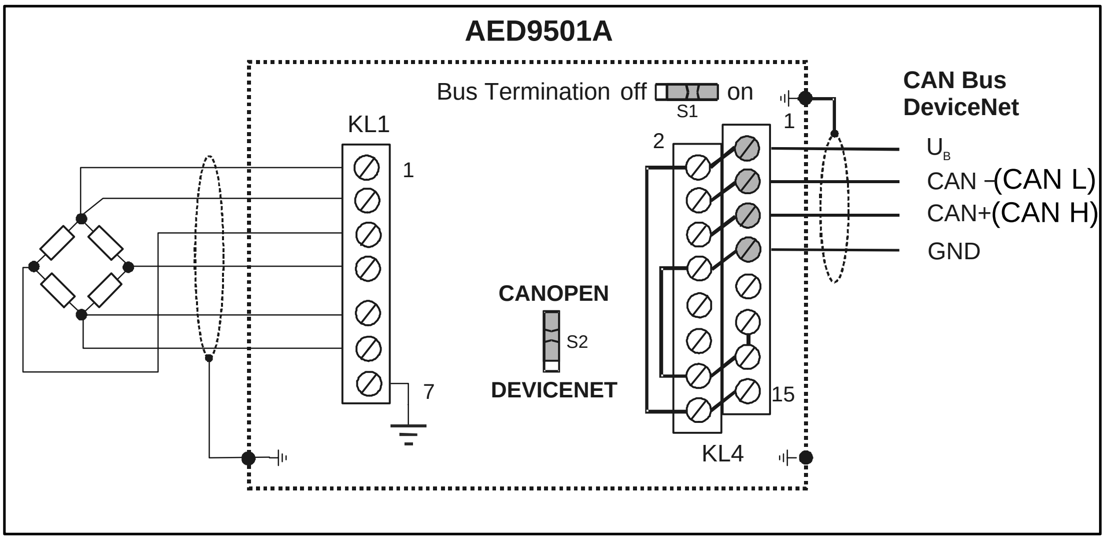


Fig.3.8: CANOpen / DeviceNet connection via terminal KL4

Bus termination:

The bus termination switch S1 (see Fig. 3.8) can be used to activate a differential resistor. Bus termination must only be activated at the end of the bus cable (max. 2 termination resistors are active).

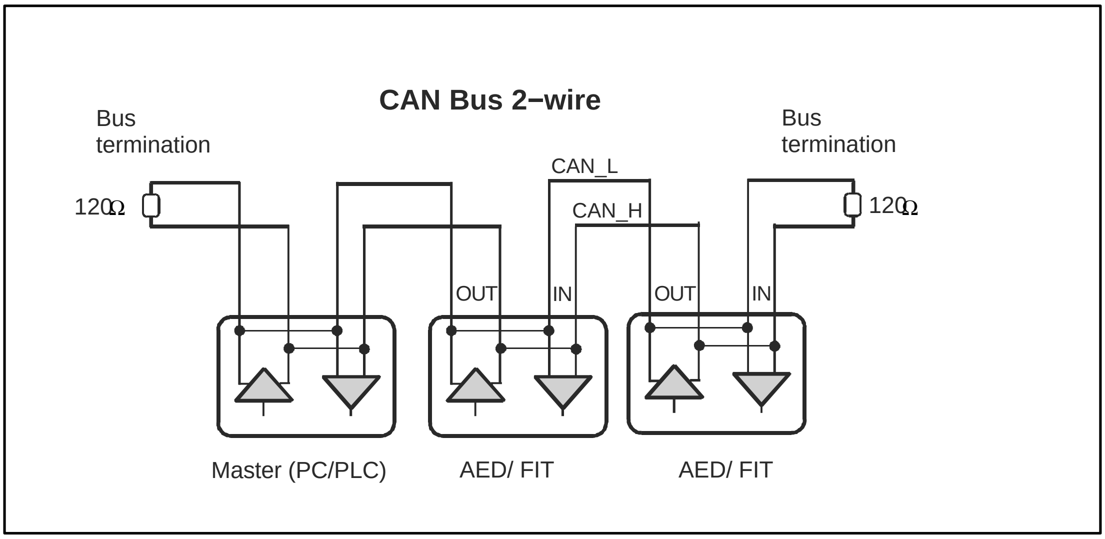


Fig.3.9: Connection of the AED9501A to the CANOpen / DeviceNet

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

Only a connecting cable with a screen grounded on two sides should be used as the inter−connecting cable between the AED 9501A and the bus and the master (see also: AED9501A cable connection via a PG gland)..

Baud rate and bus cable lengths

The table below gives the max. cable lengths for the CANOpen bus, subject to the baud rate:

Baud 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 max. cable lengths for the DeviceNet bus, subject to the baud rate:

Baud 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 baud rate being used (see secondary CANOpen docu−mentation: CiA DS102 V2.0 and DeviceNet: DeviceNet Specification Volume 1, Appendix B, cable profiles)

Setting the address

The address is set via the bus:

− CANOpen: 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.

3.4 Connecting the diagnostic bus

The diagnostic bus is used to analyze dynamic processes. The bus is set out as an RS-485 2-wire bus (lines: T/RB and T/RA, GND). This bus is independent of CANOpen or Device-Net.

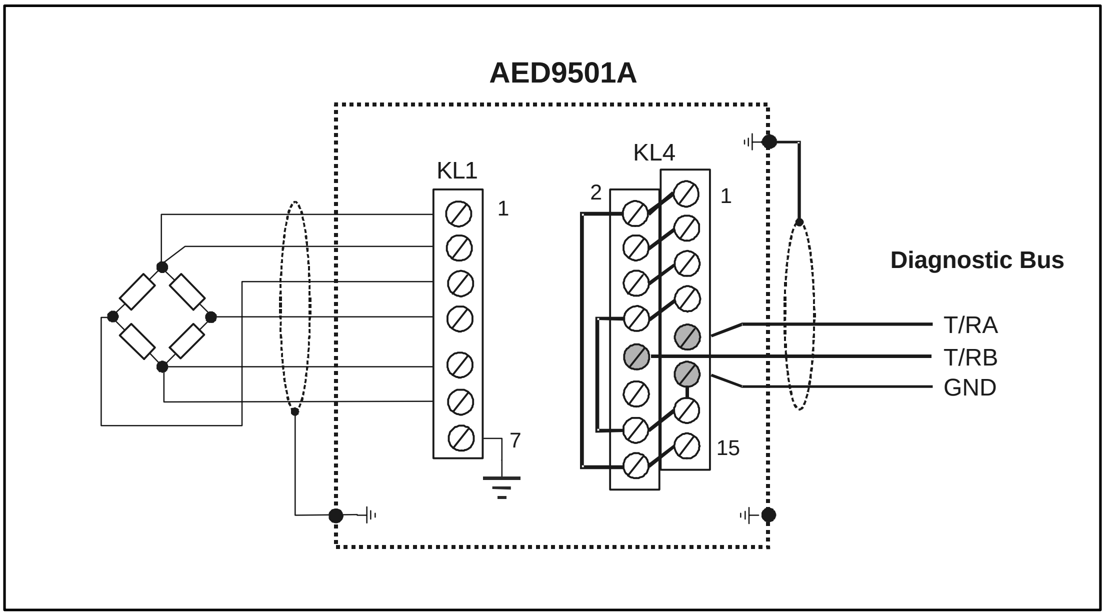


Fig.3.12: Connecting the diagnostic bus via terminal KL4

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

External bus termination resistances are not necessary for this bus.

The HBM interface converter can be used to connect the RS-485 bus to an (RS-232) COM port of the PC.

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

Only a connecting cable with a screen grounded on two sides should be used as the inter-connecting cable between the AED9501A and the bus and the master (see also: AED9501A cable connection via a PG gland)

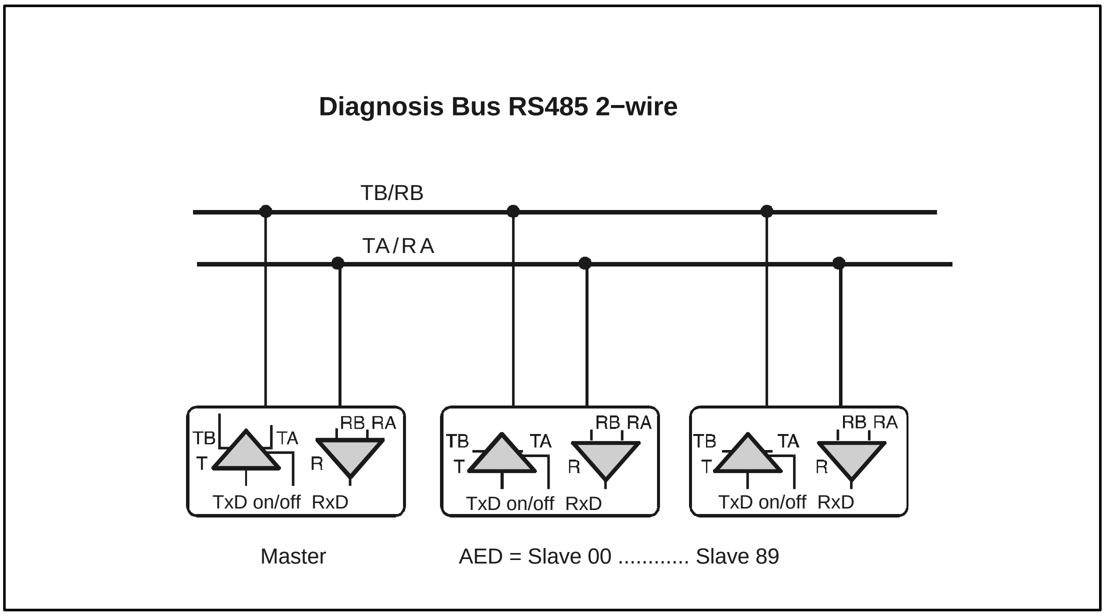


Fig. 3.11: Diagnostic RS-485 bus

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).

3.5 Digital input

Remote control

The IN1 control input ground is referenced to the ground of the external supply voltage.

The input has to be activated as external trigger using the **TRC** command (see commands for serial communication).

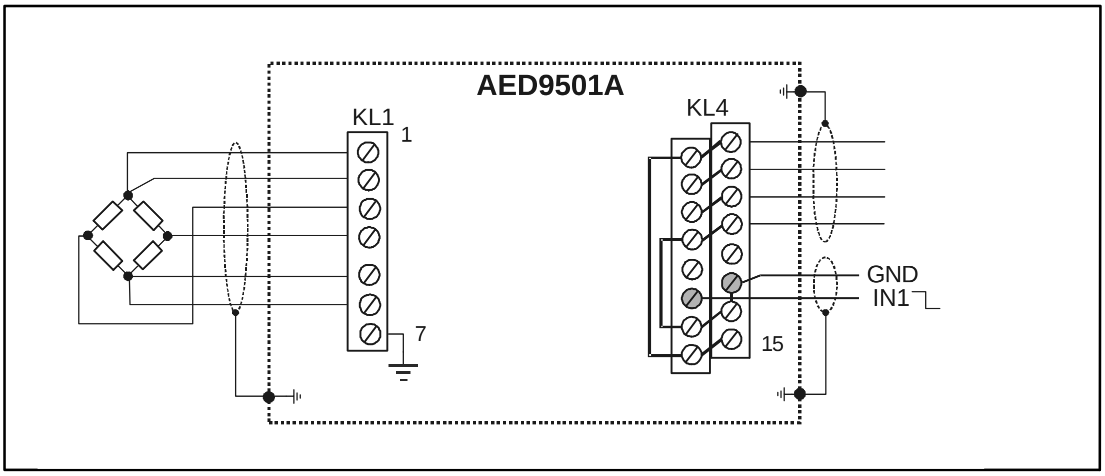


Fig. 3.12: Digital input IN1

Logic level of the inputs:

IN1:	Trigger:	Quiescent level =	Low
		Active edge =	High-Low
		High level:	2...30 V
		Low level:	0...1 V
		Input current:	≦ 3 mA (30 V_{UB})
		Input resistance:	10 kΩ

If the input is not required, the input remains unassigned. The GND of the digital input is connected to the GND of the supply voltage. The functions are defined using the command IMD (also see Commands for Signal Processing and 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)

IMD2: IN1 = Stop filling (BRK)

3.6 AED9501A cable connection via a PG gland

Only a connecting cable with a screen grounded on both sides (and metal connectors) should be used as the connecting cable between the AED9501A and its partner device. Bring the screen extensively into contact on both sides at the PG gland (and at the metal shell of the connector). If the partner device does not have a metal connector, connect the cable shielding extensively to ground. If there are vast differences between the ground po− tential of the AED9501A and its partner device, a potential equalization line must be provi- ded in addition.

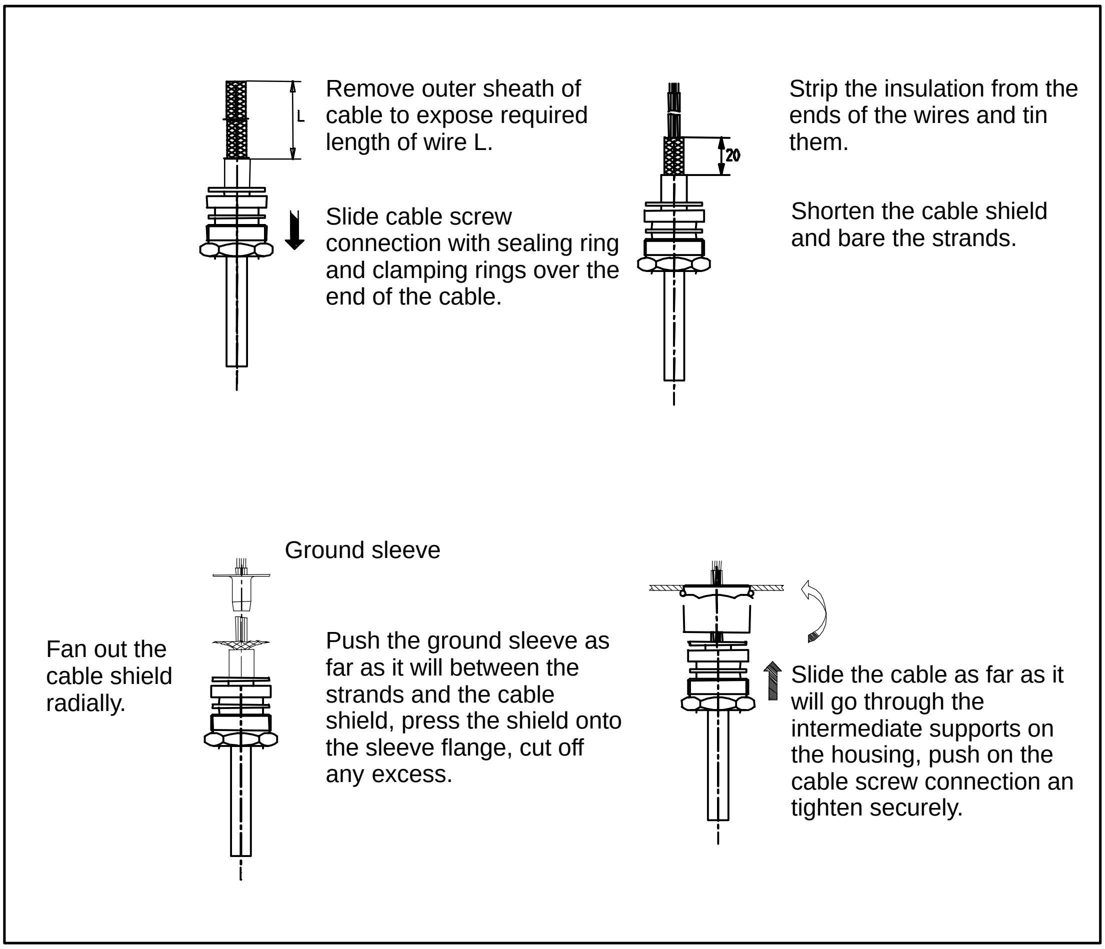


Fig. 3.13: Connecting the transducer, supply voltage and computer to the PG gland

4 Specifications

Type		**AED9501A**
Amplifier board		AD103C
Measurment signal input	mV/V	± 3, nominal ± 2
Strain gage transducer (1...4 full bridge, each 350 Ω), R_B		≥ 80...4000[1)]
Transducer connection		6 wire circuit
Length of transducer cable	m	≤ 100
Bridge excitation voltage	V_{DC}	5
CANOpen		
Protocol		CANOpen
Bit rate, max.	kbit/s	10...1000
Node address		1...127
Length of interface cable	m	5000...25
DeviceNet bus		
Protocol		DeviceNet
Bit rate, max.	kbit/s	125...500
Node address		1...63
Length of interface cable	m	1000...100
Diagnostic bus		
Protocol		ASCII/Binary
Baud rate, max.	kbit/s	38.4
Node address		0...89
Length of interface cable, max.	m	1000
Trigger input		
Input voltage range, LOW	V	0...1
Input voltage range, HIGH	V	2...30
Input current with High level = 30 V	mA	< 3
Power supply		
Operating voltage (DC)	V	10...30
Current consumption (without load cell)	mA	≤ 120[2)]
Temperature range		
Nominal temperature range	°C [°F]	−10...+40 [+14...+104]
Operating temperature range	°C [°F]	−20...+60 [−4...+140]
Storage temperature range	°C [°F]	−25...+85 [−13...+185]
Miscellaneous		
Dimensions (L x W x H)	mm	190 x 65 x 40
Weight, approx.	g	440 (without AD10x)
Degree of protection to DIN40050 (IEC529)		IP65

1) Depending on the external supply voltage

2) Calculating the total current consumption:

$$\text{Current consumption} = \leq 120\ \text{mA} + \frac{\text{Excitation voltage } U_B = 5\ \text{V}}{\text{Bridge resistance } R_B}$$

I2331−1.2 en

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