User Manual

AD101B

Digital Transducer Electronics

Amplifiers
Hardware and Functions

I1690-1.2 en

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 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 at the factory where they are safe from power failure and cannot be deleted or overwritten. They can be reset at any time by using the command **TDD**0. Further information can be found in the user manual AD101B, part 2, Commands for Serial Communication.

The production number set at the factory must not 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.

The AD101B is designed for an operating voltage = excitation voltage of **5 V_{DC}...10 V_{DC}**.

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 (5…10 V) with safe disconnection from the mains.
- When connecting additional devices, comply with the local safety requirements. [1)]
- 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.

[1)] Safety requirements for electrical measurement, control, regulatory and laboratory equipment

1 Introduction and appropriate use

AD101B 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 boxes and intelligent sensors with integrated signal processing. It is the task of these components to directly digitize and condition the measurement signals at the transducer location. Using digital transducer electronics, you can connect S.G.[1)] transducers in a full-bridge circuit directly to a computer or a P.C. This enables you to configure complete measurement chains quickly and with little extra work.

The AD101B amplifier motherboard can be operated independently of the AED9101B basic box. The basic box provides mechanical protection, shield the amplifier boards (EMC protection) and also give you the opportunity to select the serial interfaces (RS232, RS485).

The signal processing functions of limit value monitoring and fast-settling digital filters open up additional areas of application.

All commands are described in the user manual AD101B, part 2, Commands for Serial Communication.

The abbreviation **AED** is also used for AD101B transducer electronics in the following text.

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

2 Special features

- Operating voltage **5 V_{DC}…10 V_{DC}**
- Transducer excitation via external power supply.
- Measurement input ohmic full bridges
- Nominal sensitivity ±2 mV/V
- RS232 serial interfaces
- Digital filtering and scaling of the measurement signal
- Linearity error correction
- Power fail safe parameter storage
- Indestructible storage of factory defaults
- Choice of output speed for the measured values
- All settings made via the serial interface
- Automatic zero tracking (0.5 d/s, ± 2 %)
- Automatic initial zero setting (±2 %...±20 %)
- Trigger functions (level triggering, external triggering)
- Two Limit value switch

- When installing AD amplifier motherboards, try to avoid touching the components. It is essential to take action to prevent electrostatic discharge, as this may damage the electronics.
- Do not exceed the operating voltage range of 10 V_{DC}.
- The AED's external supply voltage must have low residual ripple (<1 mV), as this operating voltage is used simultaneously as the bridge excitation voltage.
- When using the AD101B amplifier motherboard outside the AED basic box, the primary device must implement EMC shielding.

3 Mechanical construction

AD amplifier motherboards are designed as plug-in boards and plug into the carrier board via a 25-pin sub-D connector.

Using an AED basic box (not supplied with the AD101B) extends the functionality by the following features:

- Mechanical protection (IP65) via the AED9101B basic box
- Overall bridge resistance (40) 80…4000 Ω via the power supply for the basic boxes
- Additional RS422 / RS485
- Electrical isolation for all digital inputs/outputs
- EMC protection (tested)

The basic device contains terminals for the transducer, power pack and PC connections, switches for interface selection and the voltage stabilizer. The connection cable exits the casing via PG glands (see the respective user manuals, part 1, Basic Boxes).

AED9101B basic box RS232 / RS485-2/4-wire / RS422 interface

4 Electrical configuration of the amplifier motherboard

The digital electronics circuit basically comprises the following function groups:

- Amplifier
- Analog/digital converter (A/D)
- Evaluating unit (µP)
- Power fail safe parameter storage (EEPROM)
- RS232 serial interface
- Digital inputs/outputs (HCMOS)
- power supply

The analog part is supplied with power via the external supply voltage 5 V_{DC}, which is used simultaneously as the bridge excitation voltage.

Do not exceed the operating voltage range of 10 V_{DC}.

The AED's external supply voltage must have low residual ripple (<1 mV), as this operating voltage is used simultaneously as the bridge excitation voltage.

4.1 Function

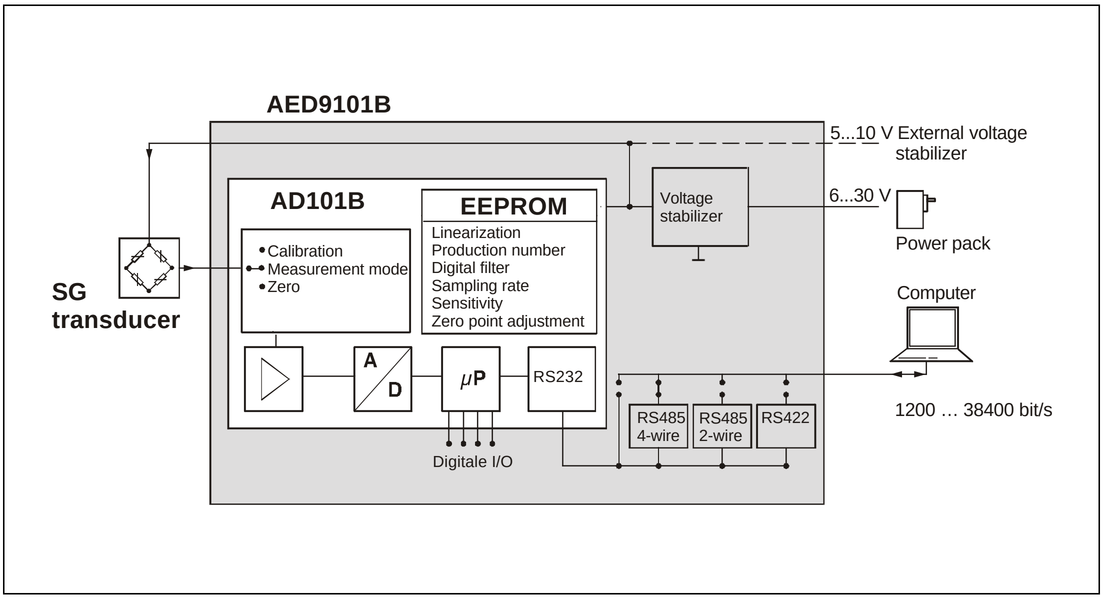


Fig. 4.1-1: Basic box with amplifier motherboard (in this example, AED9101B with AD101B)

The analog transducer signal is first amplified, then filtered and converted to a digital value in the analog/digital converter. The digitized measurement signal is processed in the microprocessor. The conditioned signal is forwarded to a computer via the serial interface. All the parameters can be stored power fail safe in the EEPROM.

The transducer electronics are adjusted by a calibration instrument at the factory to the absolute values 0 mV/V and +2 mV/V. From these measured values, the electronics use the commands **SZA** and **SFA** to determine a factory characteristic curve and subsequent measurement data is mapped over this characteristic curve. Depending on the output format (**COF**), the following measured values are returned:

Output format	Input signal	Meas. values for NOV = 0	Meas. values for NOV > 0	Status on delivery NOV = 0
Binary 2 chars. (integer)	0...2 mV/V	0...20000 digits	0…NOV	
Binary 4 chars. (long integer)	0...2 mV/V	0...5120000 digits	0…NOV	
ASCII	0...2 mV/V	0...1000000 digits	0…NOV	X

The unit of measurement mV/V reflects the ratio of the measurement voltage to the excitation voltage at the transducer bridge.

The factory default for the **SZA**/**SFA** characteristic curve should not be changed.

The two parameters **LDW** and **LWT** give you the opportunity to adapt the curve to meet your requirements (scale curve) and you can use the **NOV** command to standardize the measured values to the required scaling value (e.g. 3000 d).

4.2 Signal processing

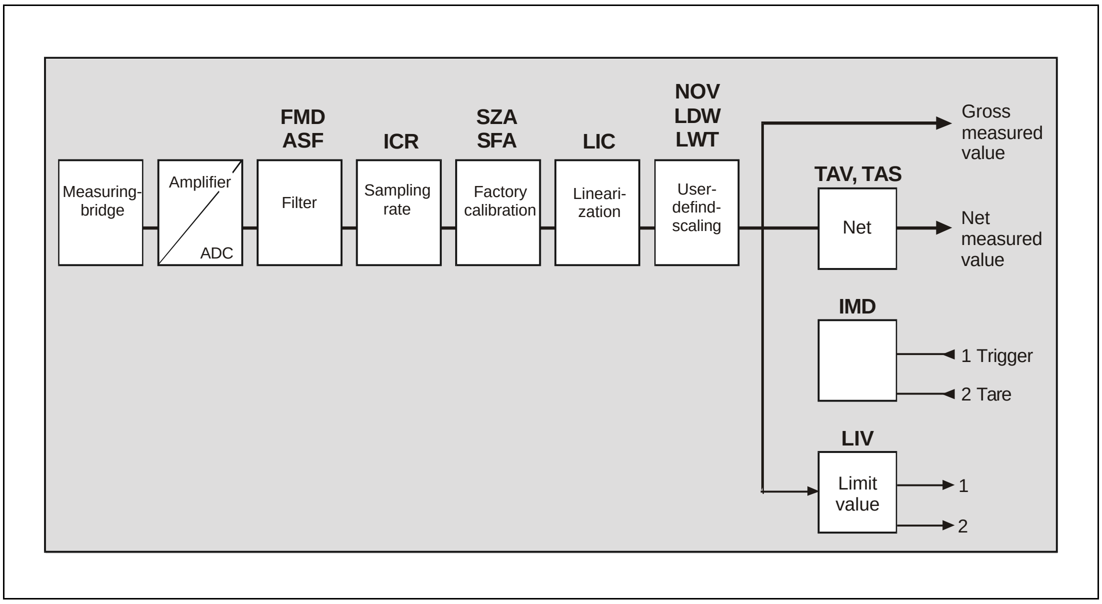


Fig. 4.2-1: Signal flow diagram for the AD101B measuring amplifier

After amplification and A/D conversion, the signal is filtered by adjustable digital filters (commands **FMD**, **ASF**). The commands **ASF** and **FMD** set the bandwidth for the measurement signal (digital filter). The command **ICR** can be used to modify the output rate (measured values per second) independently from the filter bandwidth.

Two types of digital filter are implemented in the AED and these are selected using the **FMD** command. With **FMD**0, filters are also available below the 1 Hz bandwidth. In filter mode **FMD**1, fast-settling filters with high damping in the stop band are activated.

The signal processing functions described below are executed at the set output rate, even if there is no communication via the serial interface.

Commands **SZA** and **SFA** are used to specify the factory characteristic curve.

Command (**LIC**) is available for linearization of the scale curve (with a third order polynomial). Polynomial parameters can be defined using the HBM PC software *AED_Panel32*.

As a user, you can set your own characteristic curve with the commands **LDW**, **LWT** and **NOV**, without modifying the default calibration (**SZA**/**SFA**). Gross/net selection is also available to you (**TAS, TAR** command). Command **ZSE** activates automatic initial zero setting. There is also an automatic zero tracking function (**ZTR**).

The current measured value is read out using the command **MSV**?. The format of the measured value (ASCII or binary) is set with the command **COF**. You can also use command **COF** to select automatic data output.

More detailed information on this topic can be found in the user manual AD101B, part 2, Commands for Serial Communication.

4.2.1 Triggering

The AD101B includes two trigger functions to support the functions in packing machines and checkweighers:

- Level triggering via an adjustable level
- External triggering via a digital trigger input (IN1)

Either the gross or the net measured value can be used as the trigger function input (depending on the tare function, **TAS**)

This special mode of measurement is activated via the **TRC** command. The determined measured value is read out using the command **MAV**?. For this mode of measurement, filter mode **FMD**1 must be set (fast-settling filters). The speed of measurement depends on the filter selected, the lockout time and the measurement time. The lockout time must match the settling time of the filter being used (**ASF**).

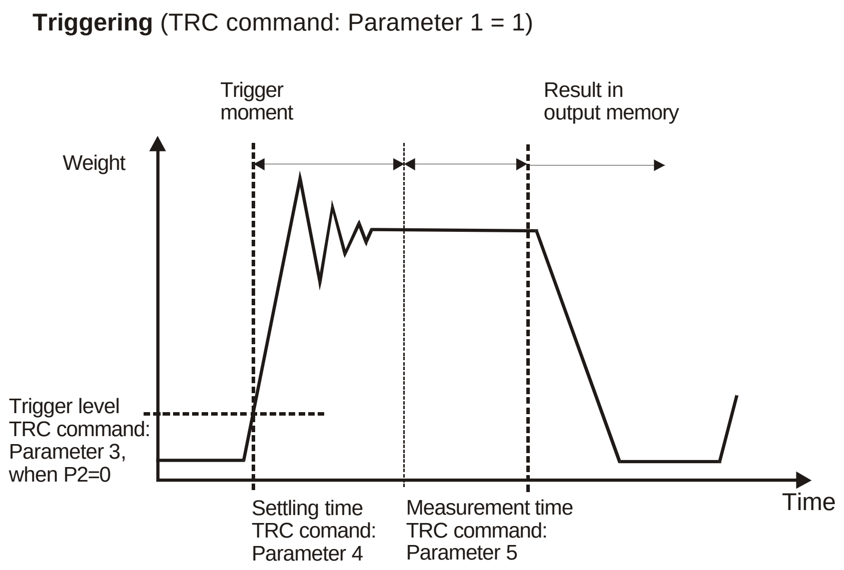


Fig. 4.2-2: Triggering

4.2.1.1 Level triggering

This mode of measurement is suitable for weighing procedures when the scale is unloaded between weighing operations.

The scale is not loaded. The product to be weighed is placed on the scale. This exceeds the trigger level and lockout time measurement begins. After the settling time, the actual weighing takes place. After this measurement time, the weight value is stored in the memory. The weighing procedure can only start again once the weight value is below the trigger level (unload the scale). In this mode of measurement, weighing must not be monitored by a fast external computer. The output memory will contain an invalid value until a new measured value has been calculated. Once the measured value memory has been read out using the **MAV**? command, this memory is reset to invalid.

The times for lockout time and measurement time depend on the selected filter **ASF**, **FMD** and the sampling rate. These are documented in the user manual AD101B, part 2, Commands for Serial Communication for the **ASF** and **TRC** commands. The times and the trigger level can be adjusted as required using the command **TRC**. The trigger level is on the user-defined characteristic curve (**NOV**).

4.2.1.2 External triggering

This external trigger has its quiescent level at 5 V (= High) and activates the measurement procedure with the Low/High edge (0 V→5 V).

The trigger edge starts lockout time measurement. After this settling time, the actual weighing takes place over the measurement time and the weight value determined is stored in the memory. The output memory will contain an invalid value until a new measured value has been calculated. Once the measured value memory has been read out using the **MAV**? command, this memory is reset to invalid.

The times (lockout time and measurement time) can be adjusted as required using the command **TRC**. The times depend on the sampling rate (**ICR**) and the filter settings (**ASF** and **FMD**).

A new trigger edge starts a new measurement procedure. It is not necessary to unload the scale here.

During a measurement run (waiting time plus measurement time) a trigger signal will be ineffective (no retriggering).

The moment of triggering can be read via the measurement status (**MSV**?).

4.2.2 Limit value outputs

Two limit values are available in the AD101B which are set via the **LIV** command. Limit value outputs are available as hardware outputs on the 25-pin connector as well as logical outputs in the measurement status. You can choose between the gross value, the net value or the trigger result as the input signal for limit value monitoring.

(see also the Electrical connection/digital inputs and outputs section)

More detailed information can be found in the user manual AD101B, part 2, Commands for Serial Communication.

4.2.3 Control inputs

You can use the command **IMD**1; to activate 2 inputs (IN1/2) as control inputs.

A Low/High edge (0 V→5 V) at input IN1 initiates an external triggering procedure (**TRC**, external triggering).

A Low level at input IN2 results in measured value taring. For the tare input, the Low level must be applied for at least 20 ms (debounce time).

(see also the Electrical connection/digital inputs and outputs section)

More detailed information can be found in the user manual AD101B, part 2, Commands for Serial Communication.

5 Electrical connections

5.1 Transducer connection

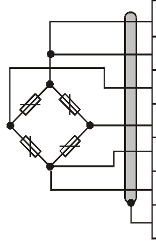
It is possible to connect SG transducers with a full bridge; RB = (40) 80...4000 Ω (external excitation voltage).
SG transducers must operate at a bridge excitation voltage of 5 V_{DC}...10 V_{DC}.

In principle, transducers with a bridge resistance >1000 Ω can also be connected. But this will increase the noise of the measurement signal (increased measurement ripple).

Make sure that a low-noise constant voltage source is used for the excitation voltage, as the quality of the power supply is directly adopted in the measurement result (see also the Specifications section).

(see user manual AED9101B, part 1, Basic Box)

5.1.1 Connecting in 6-wire circuitry



	Color code	**Female pin contact**
Bridge excitation voltage (+)	bu	9/21
Sense line (+)	gn	10
Measurement signal (+)	wh	24
Measurement signal (–)	rd	11
Bridge excitation voltage (–)	bk	12/13
Sense line (–)	gy	23
Cable shield	ye	Housing

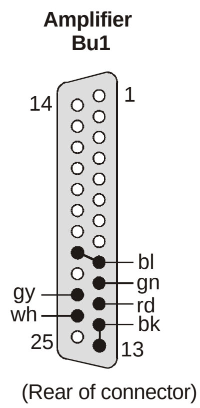


Fig. 5.1-1: Transducer connection (6-wire) to the AD101B amplifier motherboard

5.1.2 Connecting in 4-wire circuitry

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

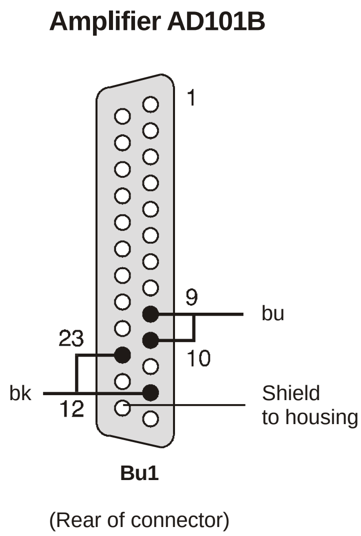


Fig. 5.1-2: Transducer connection of supply lines and sensor lines in 4-wire circuitry without a cable extension

Notes on type of connection, cable length and cable cross-section

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.

(see user manual AED9101, part 1)

5.2 Connecting the supply voltage

The power supply must meet the following requirements:

regulated DC voltage	+5 V...10 V
Residual ripple	<1 mV (peak to peak)
Current consumption AD101B	<90 mA (without SG bridge)

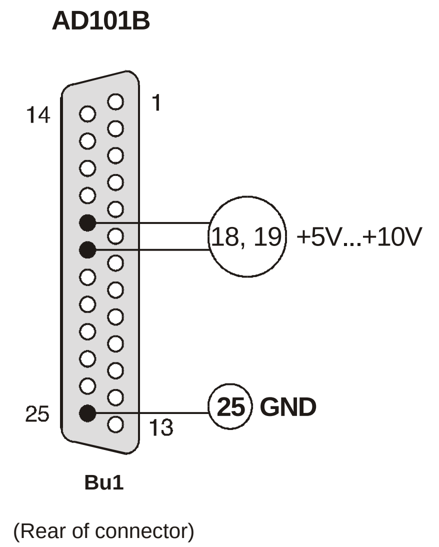


Fig. 5.2-1: Connecting the supply voltage to the amplifier motherboard

5.3 Connecting the serial interface

An RS232 interface is fitted as standard to the amplifier motherboard. Baud rates of 1200...38400 bit/s are available for this serial interface. In addition to the RxD (Receive Data) and TxD (Transmit Data) interface lines, there is also a DTR (Data Terminal Ready) control line available for triggering bus driver modules (e.g. LTC485). When the amplifier motherboard is installed in a basic box, the RS422 (factory default), RS485 and RS232 interfaces are directly available.

5.3.1 Interface pin assignment

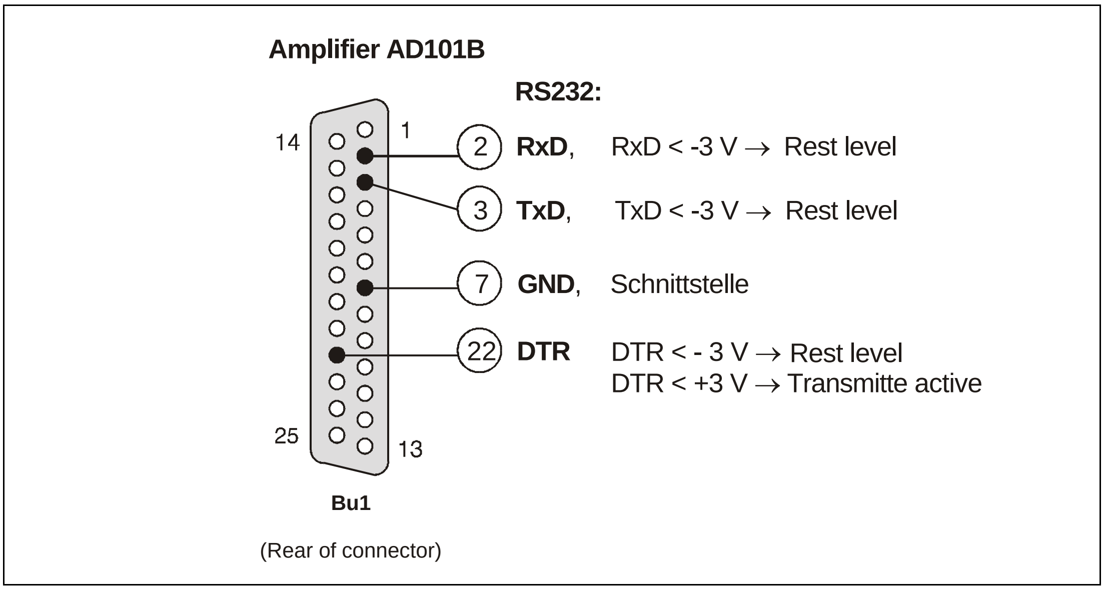


Fig. 5.3-1: Pin assignment for the RS232 interface at the amplifier motherboards

5.3.2 Connecting the AED to a computer via the RS232 interface

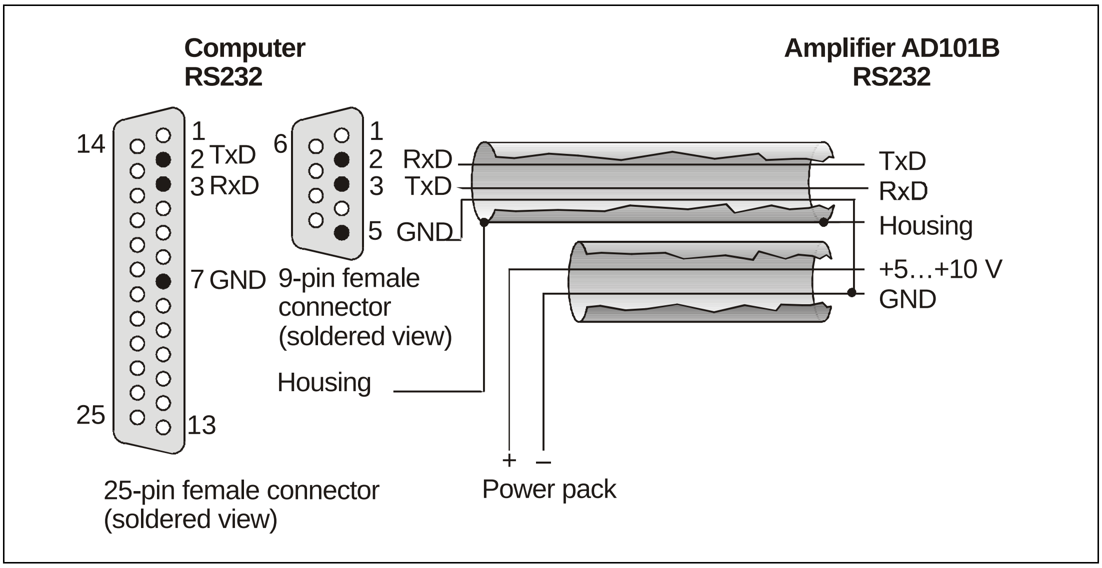


Fig. 5.3-2: Connecting an AED to a computer via RS232 and the supply voltage

Multi-channel measurements are only possible with appropriate bus drivers (RS485) (see user manual AED9101B).

5.4 Connecting digital inputs/outputs

5.4.1 Hardware connection, signal level

The AD101B has two digital inputs (IN1, IN2) and 2 control outputs (OUT1/2) that are triggered by various functions, depending on the selected mode of operation.

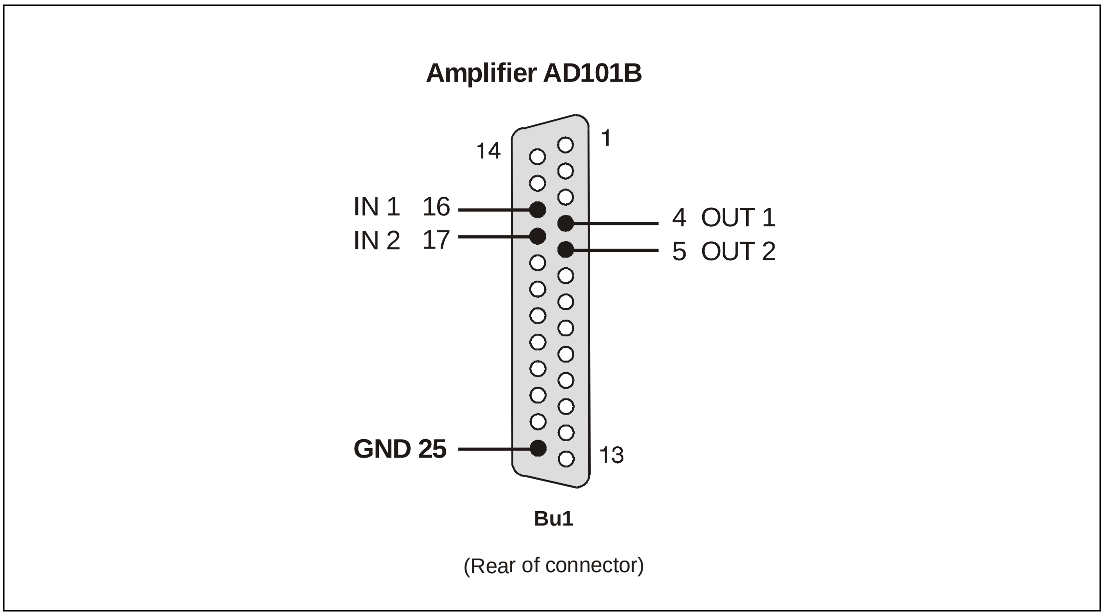


Fig. 5.4-1: Digital inputs and outputs of the amplifier motherboard

The signals at inputs IN1 and IN2 of the amplifier motherboard work at HCMOS level.

The levels at outputs OUT1/2 of the amplifier motherboard are HCMOS levels.

HCMOS level (electrical data)

High level	3.2...5 V
Low level	0…0.8 V related to GND
Output current	< 2 mA
Input current	< 10 μA

Logical assignment of inputs for IMD0

IN1 = POR?	IN1=Low --> POR,Parameter3 = 0 for query
IN2 = POR?	IN1=Low --> POR,Parameter4 = 0 for query

Logical assignment of inputs for IMD1

IN1 = Trigger	Quiescent level = High level Trigger start = Low/High edge
IN2 = Taring	Quiescent level = Highlevel Low = Taring (20 ms debounce time)

Logical assignment of outputs for IMD0

OUT1/2 Low level	POR,Parameter1/2 = 0
OUT1/2 High level	POR,Parameter1/2 = 1

Logical assignment of outputs for IMD1

Low level	Function/output = inactive
High level	Function/output = active

The AED9101B basic box does not have electrical isolation and only supports the control output IN1 (external trigger).

5.4.2 Function of limit value outputs, control inputs

The two OUT1/2 outputs of the amplifier motherboard can be used either as limit value outputs (**LIV** command) or as digital outputs that can be set with the command **POR**. The amplifier motherboard outputs can drive a standard TTL load.

Modes of operation IMD0 and IMD1

Inputs	**IMD0;**	**IMD1;**
IN1	Query via **POR**?	External trigger input
IN2	Query via **POR**?	Tare and select net value output

outputs	**Limit values (LIV) deactivated**	**Limit values (LIV) activated**
OUT1	Settings via **POR**	Settings via **LIV**1
OUT2	Settings via **POR**	Settings via **LIV**2

The AED9101B basic box does not have electrical isolation and only supports control input IN1 (external trigger).

6 Specifications

Type	Unit	AD101B
Accuracy class		0.015
Number of calibrated values as per EN45501 (R76) **Input sensitivity**	d µV/e	6000 1.0
Measuring range **Input signal range**	mV/V mV/V	±2.0 ±3.0
Measurement signal resolution, max.	bit	20 (at 1 Hz)
Sampling rate (depending on output format and baud rate)	Hz	600...4.7
Digital filter limit frequency, adjustable (-3 dB)	Hz	40...0.25
Bridge excitation voltage U_B	V_{DC}	5…10 (= supply voltage)
Measurement signal input; S.G. transducer (full bridge) **Transducer connection** **Input resistance (differential)**	Ω MΩ	≥40...4000 [1)] 6-wire circuit >15
Length of transducer cable	m	≤100, calibration incl. cable
Length of interface cable → RS232	m	≤15 (25-pin sub-D socket)
Calibration signal	mV/V	2 ±0.01 %
Temperature stability of the calibration signal	ppm/°C	≤2.5
Linearity deviation, related to the full scale	%	±0.01
Temperature influence per 10 K **on the zero point, related to the full scale** **on the sensitivity, related to the actual value**	 % %	 typ. ±0.005; max ±0.01 typ. ±0.005; max ±0.01
interface		RS232
Baud rate, adjustable	bit/s	1200...38400
Supply voltage	V_{DC}	5...10 residual ripple ≤10 mV (p.p.)
Current consumption (without load cell) [2)]	mA	≤80

1) Depending on the external supply voltage

2) $$\text{Current consumption} = \leq 80\ \text{mA} + \frac{\text{Excitation voltage } U_B}{\text{Bridge resistance } R_B}$$

Type	**Unit**	**AD101B**
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]
Dimensions (L * W * H)	mm	93 * 53 * 17
Weight	g	approx. 40
Degree of protection as per EN60529 (IEC 529)		IP00

Index

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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

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