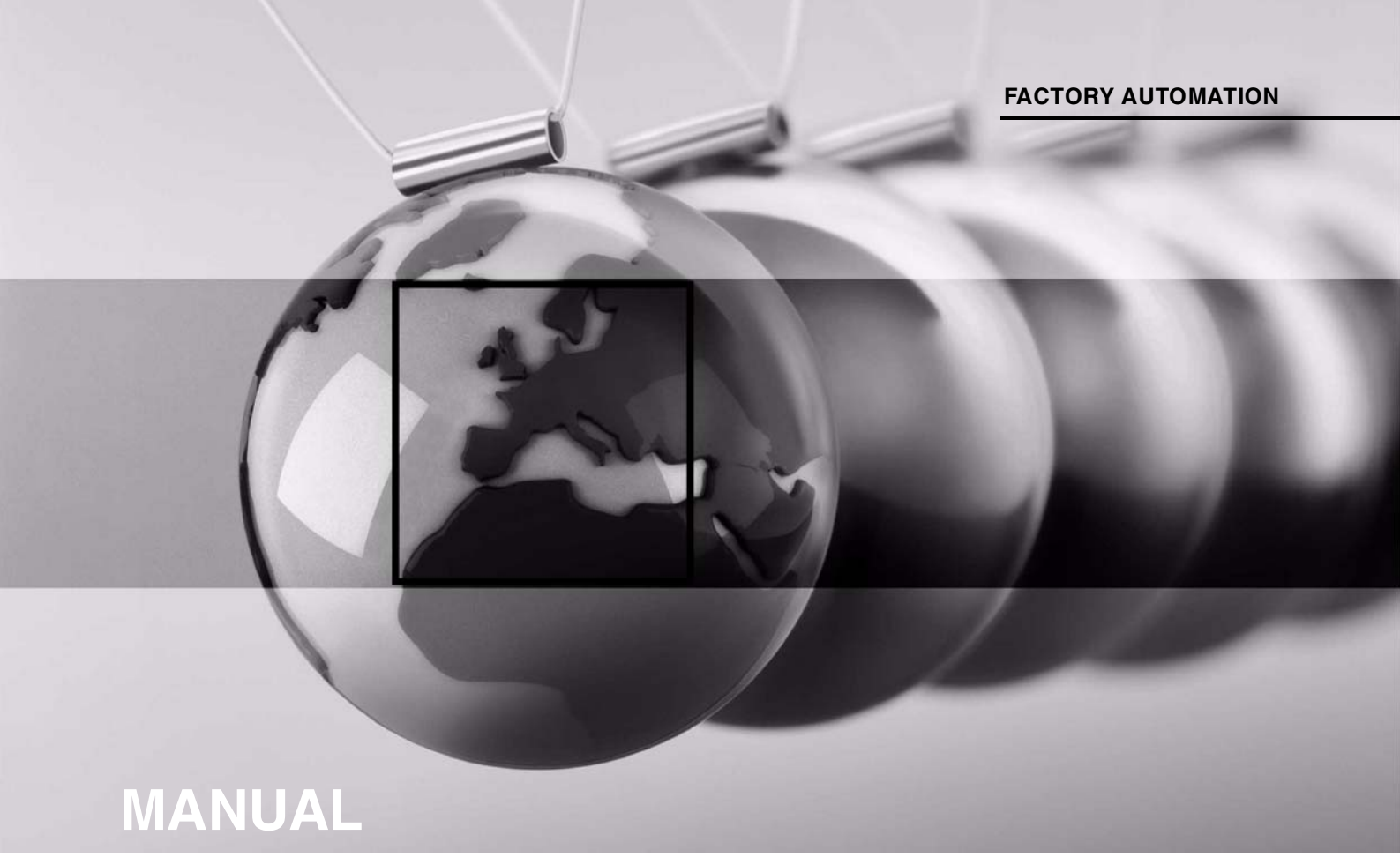

MANUAL

VBA-2E-G11-I/U/PT100-F
VBA-2E-G11-I/U/PT100-V1

AS-Interface Analog Module

A/D Spec 2.1

CE

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SENSING YOUR NEEDS

With regard to the supply of products, the current issue of the following document is applicable: The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

1 Introduction

Congratulations

You have chosen a device manufactured by Pepperl+Fuchs. Pepperl+Fuchs develops, produces and distributes electronic sensors and interface modules for the market of automation technology on a worldwide scale.

Before you install this device and put it into operation, please read the operating instructions thoroughly. The instructions and notes contained in this operating manual will guide you step-by-step through the installation and commissioning procedures to ensure trouble-free use of this product. By doing so, you:

- guarantee safe operation of the device
- can utilize the entire range of device functions
- avoid faulty operation and associated errors
- reduce costs from downtimes and incidental repairs
- increase the effectiveness and operating efficiency of your plant.

Store this operating manual somewhere safe in order to have it available for future work on the device.

After opening the packaging, please ensure that the device is intact and that the package is complete.

Symbols used

The following symbols are used in this manual:

Note!

This symbol draws your attention to important information.

Handling instructions

You will find handling instructions beside this symbol

Contact

If you have any questions about the device, its functions, or accessories, please contact us at:

Pepperl+Fuchs GmbH
Lilienthalstraße 200
68307 Mannheim
Telephone: +49 621 776-4411
Fax: +49 621 776-274411
E-Mail: fa-info@pepperl-fuchs.com

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2 Declaration of Conformity

All products were developed and manufactured under observance of the applicable European standards and guidelines.

Note!

A Declaration of Conformity can be requested from the manufacturer.

The product manufacturer, Pepperl+Fuchs GmbH, 68307 Mannheim, has a certified quality assurance system that conforms to ISO 9001.

ISO**9001**

3 Safety

3.1 Symbols relevant to safety

Danger!

This symbol indicates an imminent danger.

Non-observance will result in personal injury or death.

Warning!

This symbol indicates a possible fault or danger.

Non-observance may cause personal injury or serious property damage.

Caution!

This symbol indicates a possible fault.

Non-observance could interrupt devices and any connected facilities or systems, or result in their complete failure.

3.2 Intended Use

The VBA-2E-G11-I/U/PT100-* is an analog module for connecting 0 V ... 10 V or 0/4 mA ... 20 mA measurement sensors and Pt100 sensors to the AS-Interface network. Measured values are converted and data transmitted asynchronously as defined by AS-Interface profile 7.3. The measured values are converted internally at a resolution of 16 bits. The analog module features two analog inputs which can be current input, voltage input, or resistance thermometer input. The measurement sensors are powered either by the AS-Interface or by the auxiliary power source.

Read through these instructions thoroughly. Familiarize yourself with the device before installing, mounting, or operating.

Always operate the device as described in these instructions to ensure that the device and connected systems function correctly. The protection of operating personnel and plant is only guaranteed if the device is operated in accordance with its intended use.

3.3 General Safety Instructions

Only instructed specialist staff may operate the device in accordance with the operating manual.

User modification and or repair are dangerous and will void the warranty and exclude the manufacturer from any liability. If serious faults occur, stop using the device. Secure the device against inadvertent operation. In the event of repairs, return the device to your local Pepperl+Fuchs representative or sales office.

The connection of the device and maintenance work when live may only be carried out by a qualified electrical specialist.

The operating company bears responsibility for observing locally applicable safety regulations.

Store the not used device in the original packaging. This offers the device optimal protection against impact and moisture.

Ensure that the ambient conditions comply with regulations.

Note!

Disposal

Electronic waste is hazardous waste. When disposing of the equipment, observe the current statutory requirements in the respective country of use, as well as local regulations.

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4 Product Description

4.1 Displays and Controls

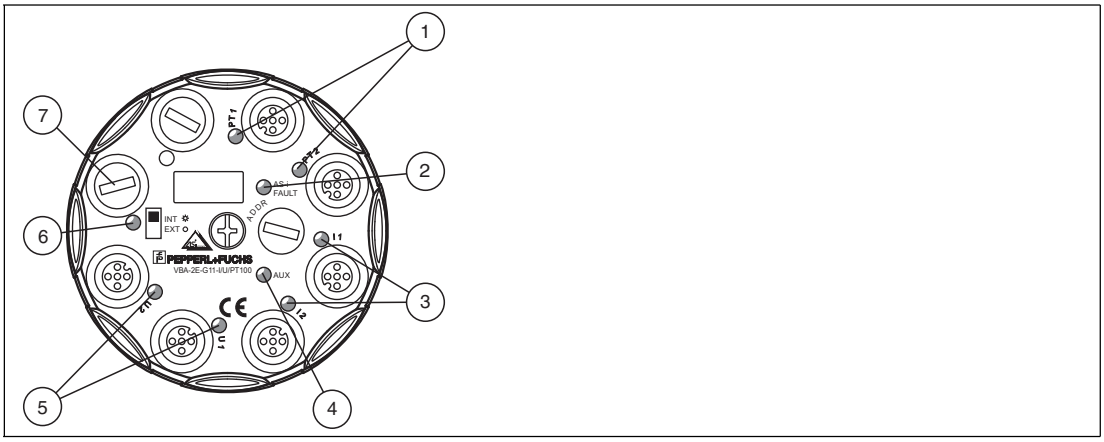


Figure 4.1 Display and control elements

The VBA-2E-G11-I/U/PT100-* analog module is equipped with the following displays and controls:

LED Indicator

②	AS-i/FAULT LED	Status indication; multicolor LED Green: normal mode Red: communication error Flashing yellow/red: address 0 Flashing green/red: peripheral fault
①	PT1 LED PT2 LED	Status of input signal; yellow LED Off: not active On: signal within measurement range Flashing: signal outside measurement range
③	I1 LED I2 LED	
⑤	U1 LED U2 LED	
④	AUX LED	Ext. auxiliary power source (U_{AUX}); dual LED (green/red) Green: voltage OK Red: voltage reversed
⑥	INT/EXT LED	Status indication, input supply; green LED Green: internal input supply Off: external input supply

Switch

⑦	INT/EXT switch	Set to INT: sensors powered via the AS-Interface (max. 140 mA) Set to EXT: sensors powered via an auxiliary power source (max. 600 mA)

In order to reach the switch, remove the blind plug ⑦

4.2 Connections

VBA-2E-G11-I/U/PT100-F

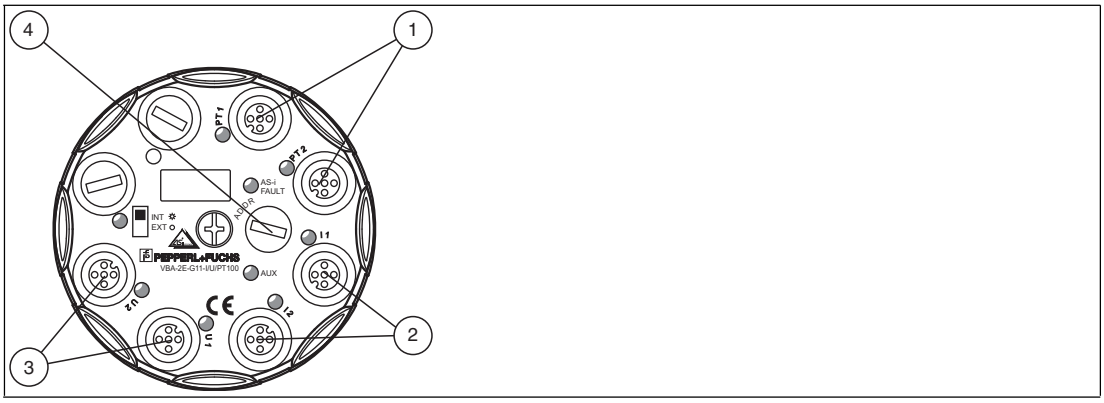


Figure 4.2 Connections VBA-2E-G11-I/U/PT100-F

The VBA-2E-G11-I/U/PT100-F analog module is equipped with the following connections:

1	Pt100 inputs	 5 : functional ground M12 round plug connector
2	Current inputs	
3	Voltage inputs	
4	Addressing socket	Low voltage switch socket, ∅ 1.3 mm

VBA-2E-G11-I/U/PT100-V1

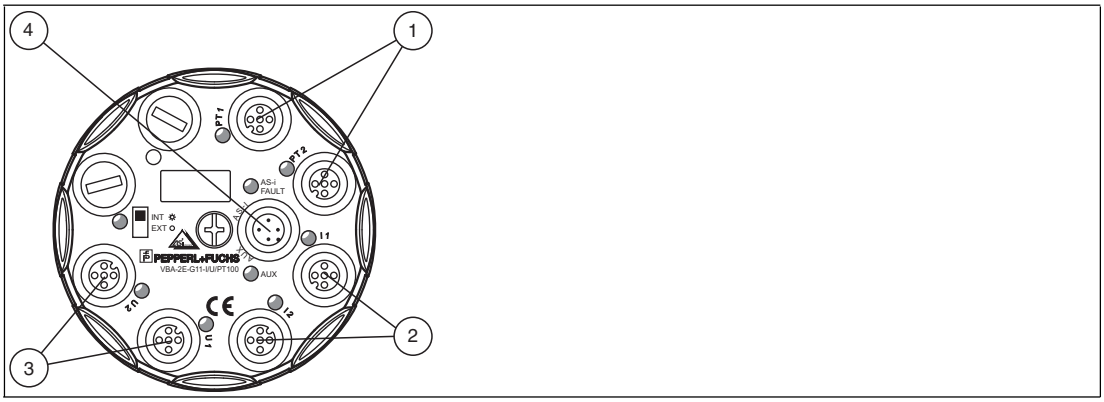
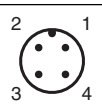


Figure 4.3 Connections VBA-2E-G11-I/U/PT100-V1

The VBA-2E-G11-I/U/PT100-V1 analog module is equipped with the following connections:

1	Pt100 inputs	 5 : functional ground M12 round plug connector
2	Current inputs	
3	Voltage inputs	
4	AS-Interface/U_{AUX}	 1: AS-Interface + 2: AUX - 3: AS-Interface - 4: AUX + M12 round plug connector

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Note!

Switching Off the Second Channel

Figure 4.4 Input PT2 bridge

Two bridges are plugged in at the PT100 input PT2 by default; these bridges are designed to switch off channel 2. Remove the bridges to use channels 1 and 2.

The bridges must be plugged in and disconnected only when the module is de-energized!

4.3 Automatic Detection of the Sensor Type

The VBA-2E-G11-I/U/PT100-* analog input module automatically detects which sensor type is connected. The types of sensors that can be connected are: 0 V ... 10 V measurement sensors, 0/4 mA ... 20 mA-measurement sensors, or Pt100 temperature sensors. The sensor type is automatically detected once switched on. Once the module has detected the sensor type, the corresponding module configuration is activated.

All input LEDs are illuminated during the first few seconds after switching on. During this time, the module evaluates the connected sensor type on the basis of various measured values. The signal values that ensure unambiguous detection of the type of sensor connected are:

- Voltage: 1 V ... 11.5 V
- Current: 1 mA ... 23 mA
- Pt100: -219 °C ... 884 °C

If the module cannot clearly establish which sensor type is connected, the last detected sensor type is provisionally activated. For example, the module may not detect which sensor type is connected if the signal values are not within the specified thresholds or if two different sensor types are simultaneously applied to one channel.

A specific sensor type is finally activated when the signal values measured are within the specified thresholds.

Note!

The Pt100 Input Is an Exception:

The Pt100 sensor type is only activated if a Pt100 temperature sensor is connected to the PT100 inputs before switching on. The Pt100 sensor type cannot be activated during operation or activated provisionally.

Note!

If you connect two different sensor types to one channel simultaneously, fault-free operation is not guaranteed. The module will not be damaged by this.

4.4 Pt100 temperature sensor

Pt100 temperature sensors are platinum resistance thermometers complying with standard IEC 751 / DIN EN 60751. In this standard, various values of the temperature sensor are defined. The nominal resistance of the Pt100 is 100 Ω, measured at 0 °C. Furthermore, as well as other values, the mean temperature coefficient α of 0°C to 100 °C is also defined. The mean temperature coefficient defines the mean change in resistance relative to the nominal resistance. The analog module calculates the corresponding temperature based on the measured resistance of the temperature sensor.

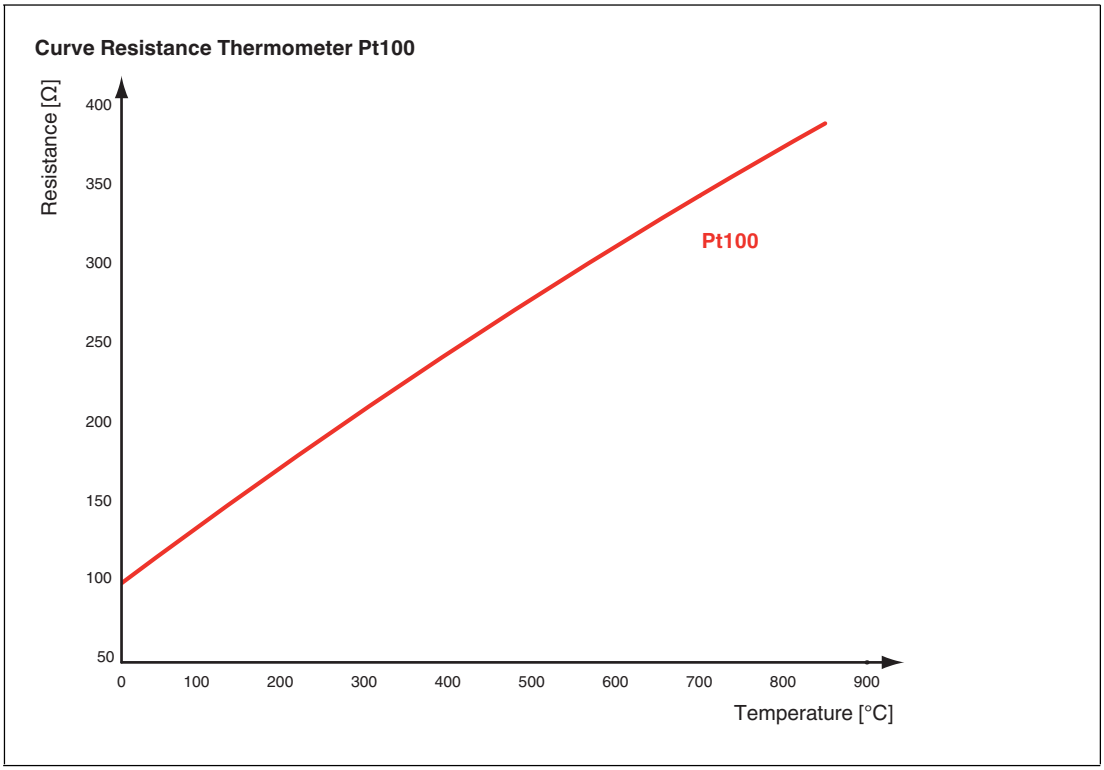


Figure 4.5 Curve Pt100

5 Installation

5.1 Storage and transport

For storage and transport purposes, package the unit using shockproof packaging material and protect it against moisture. The best method of protection is to package the unit using the original packaging. Furthermore, ensure that the ambient conditions are within allowable range.

5.2 Unpacking

Check the product for damage while unpacking. In the event of damage to the product, inform the post office or parcel service and notify the supplier.

Retain the original packaging in case the device must be stored or shipped again at a later date.

Should you have any questions, please direct them to Pepperl+Fuchs.

5.3 Mounting

Align the device as required and secure to a flat mounting surface by screwing it in place with two M4 mounting screws. When the central screw is tightened, the functional ground of the M12 round plug connector connects with the metal insert in the mounting base. Ensure that this metal insert is connected with the protective ground via the mounting screws. The mounting screws are not included.

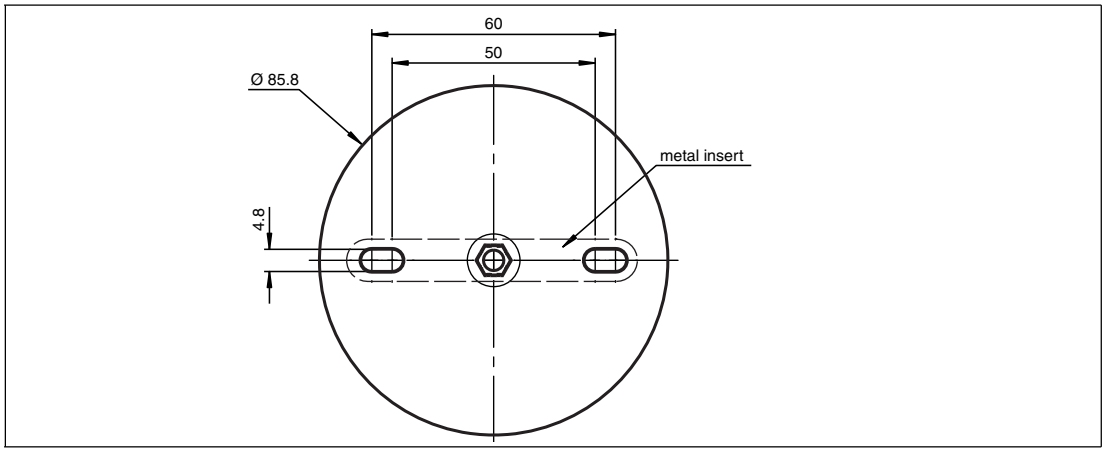


Figure 5.1

Screw a blind plug onto unused connections to ensure the relevant degree of protection. The recommended tightening torque for securing blind plugs is 0.4 Nm.

5.4 Connecting the AS-Interface

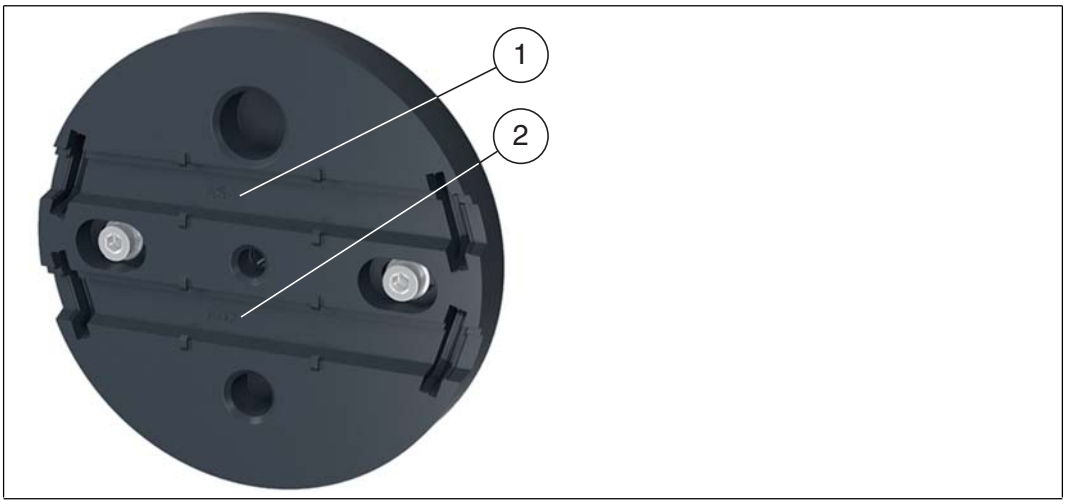
VBA-2E-G11-I/U/PT100-F

The VBA-2E-G11-I/U/PT100-F is connected with the AS-Interface network via the yellow flat cable. The external auxiliary power source U_{AUX} is connected to the module via the black flat cable where required.

Connecting to the AS-Interface

1. Open the module by unscrewing the central screw.
2. Place the yellow flat cable in the channel labeled AS-i.

3. If the module is to be powered via an external auxiliary power source U_{AUX}, place the black flat cable in the channel labeled AUX. Set the INT/EXT switch to EXT.
   If the module is to be powered solely by the AS-Interface, place the flat cable seal (VAZ-FK-S-BK-SEAL) in the channel labeled AUX. The flat cable seal ensures compliance with the protection class.



1. AS-i channel (yellow flat cable)
2. AUX channel (black flat cable)

3. Ensure the flat cable is positioned correctly.
4. Reattach the upper part of the module.
5. Tighten the central screw. The recommended tightening torque for this screw is 1.8 Nm.

   ↳ The AUX LED and the AS-i/FAULT LED illuminate in green when the module is connected to the AS-Interface and the external auxiliary power source U_{AUX}.

VBA-2E-G11-I/U/PT100-V1

The VBA-2E-G11-I/U/PT100-V1 is connected to the AS-Interface network and the external auxiliary power source U_{AUX} via the M12 connector. see chapter 4.2.

5.5 Connecting the Sensors

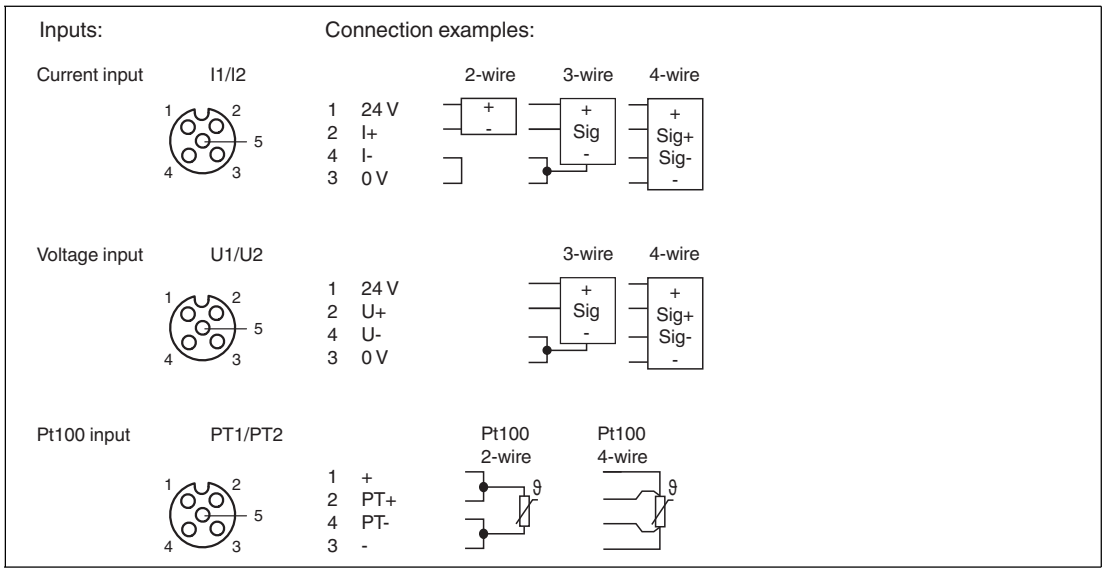


Figure 5.2

2-wire, 3-wire, and 4-wire sensors can be connected to the VBA-2E-G11-I/U/PT100-* module. Suitable for various connection scenarios → see Figure 5.2 on page 13. In order to obtain a sound measurement result, the difference in voltage between pins 3 and 4 on a 4-wire measurement (2 V) must not be exceeded.

Note!

Connection Instructions

Use shielded cables to connect the sensors.

Note!

Pin 5 of the M12 round plug connector is the functional ground. When the central screw is tightened, pin 5 connects with the metal insert in the mounting base. see chapter 5.3. This metal insert then makes contact with the mounting surface via the mounting screws.

6 Commissioning

6.1 Assigning an Address to the Module

To operate the VBA-2E-G11-I/U/PT100-* in an AS-Interface network, you must assign a suitable address to the AS-Interface slave. The AS-Interface VBP-HH1-V3.0 handheld device by Pepperl+Fuchs or an AS-Interface master can be used to assign addresses.

The VBA-2E-G11-I/U/PT100-* module is a standard slave as defined by specification 2.1. These modules can be assigned addresses 1 to 31. The default address on delivery is 0.

6.2 Slave Profile

The VBA-2E-G11-I/U/PT100-* has the profile

S-7.3.D

I/O	=	7
ID	=	3
ID1	=	F (programmable)
ID2	=	D

The data value is transmitted as defined by AS-Interface profile 7.3.

6.3 Parameterization

The following parameters can be set for the VBA-2E-G11-I/U/PT100-*. Program the parameters using an AS-Interface master, with the VAZ-SW-ACT32 AS-i Control Tool from Pepperl+Fuchs or with the VBP-HH1-V3.0 handheld device.

Parameter P0: 50/60 Hz Filter

Default value P0=1, active

With parameter P0, you activate the filter for 50/60 Hz power frequencies. With an activated filter, power frequency interference is suppressed. In this case, the conversion time is extended (see chapter 9.2).

Parameter P1: Second Channel

Default value P1=1, active

Parameter P1 is used to switch the second measuring channel on or off. If the second channel is switched off, this can considerably reduce the conversion time in the module. (see chapter 9.2)

Alternatively, it is possible to control the second channel via the bridges on input PT2. (see chapter 4.2)

Note!

The bridges on input PT2 override parameter P1.

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Parameter P2: Peripheral Fault

Default value P2=1, active

Parameter P2 is used to switch notification of a peripheral fault in the event of a measuring overrange on or off (see chapter 9). If notifications are activated, the AS-i/FAULT LED flashes in the event of a peripheral fault, and a notification is sent to the master.

A peripheral fault is always reported if:

- The power supply is overloaded.
- The external power supply is not available when the INT/EXT switch = EXT.

Parameter P3: Current Input 0 mA ... 20 mA

Default value P3=1, not active

Parameter P3=0 is used to set both input channels to current mode. Wire break detection is simultaneously deactivated. (see chapter 9.1)

7 Troubleshooting

7.1 Causes and Elimination of Peripheral Faults

A peripheral fault (P fault) is indicated by the color and flashing of the AS-i/FAULT LED. There are various causes of and solutions for correcting peripheral faults.

Cause	Solution
Sensor supply overload	■ Check sensor supply for short circuit
Measured values outside the measurement range	■ Check the connected measurement sensor/Pt100 temperature sensor for wire break/short circuit
Auxiliary power too low (switch set to EXT)	■ Check the auxiliary power source

If none of these potential solutions correct the peripheral fault, please contact Pepperl+Fuchs.

7.2 Cause and elimination of a channel fault

If channel 2 is not transferred and the LED at the connection of the relevant input of channel 2 is not illuminated, channel 2 is not activated.

Cause	Solution
Jumper plugged at PT100-input PT2	■ Remove jumper (see chapter 4.2)
Parameter P1=0	■ Change parameter P1 (see chapter 6.3)

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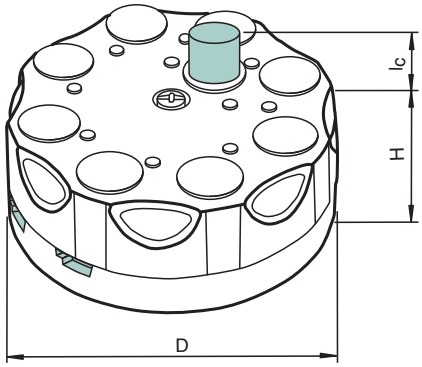
8 Appendix A

8.1 Dimensions



Type	D	H	l_c
VBA-2E-G11-I/U/PT100-F	85 mm	35 mm	-
VBA-2E-G11-I/U/PT100-V1	85 mm	35 mm	11 mm

8.2 Technical Data

General Data

Slave type	Standard slave
AS-Interface specification	V3.0
Required master specification	≥ V2.1
UL file number	E87056

Display/Controls

AS-i/FAULT LED	Status indication; multicolor LED Green: normal mode Red: communication error Flashing yellow/red: address 0 Flashing green/red: peripheral fault
ANALOG LED	Status of input signal; yellow LED Off: not active On: signal within measurement range Flashing: signal outside measurement range
AUX LED	Ext. auxiliary power source (U_{AUX}); dual LED (green/red) Green: voltage OK Red: voltage reversed
INT/EXT LED	Status indication, input supply; green LED Green: input supply from AS-Interface Off: input supply from auxiliary power source

Electrical Data

Auxiliary power (output)	20 VDC ... 30 VDC PELV
Rated operational voltage	26.5–31.6 V from AS-Interface
Rated operating current	≤ 60 mA (without sensors)/max. 200 mA
Protection class	III
Surge protection	U_{AUX}, U_e: Overvoltage category III, securely isolated power supplies (PELV)

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Input

Number/type	Two analog inputs Current: 4 mA ... 20 mA/4 mA ... 20 mA Voltage: 0 V ... 10 V Pt100: -200 °C ... 850 °C
Power supply	From AS-Interface (switch setting INT, basic setting) or from auxiliary power source U_{AUX} (switch setting EXT)
Current rating	≤ 140 mA from AS-Interface; overload and short-circuit proof ≤ 600 mA from external auxiliary power source U_{AUX}, overload and short-circuit proof
Input resistance	Current input: max. 70 Ω Voltage input: 100 kΩ
Measurement current	For Pt100: approx. 1 mA
Measurement accuracy	Voltage/current: 0.1% of end value Pt100: 0.1% of temperature displayed [°C] + 0.3 °C
Resolution	16 bit/1 µA (current input) or 16 bit/1 mV (voltage input) or 16 bit/0.1 °C (temperature input)
Temperature effect	Voltage/current: 20 ppm/K Pt100: (10 ppm of temperature displayed [°C] + 0.003 °C)/K

Programming Instructions

Profile	S-7.3.D
IO code	7
ID code	3
ID2 code	D
Data bit (function via AS-Interface)	The data value is transmitted as defined by AS-Interface profile 7.3.
Parameter bit (programmable via AS-i)	Function
P0	50/60 Hz filter P0=1, activated P0=0, deactivated
P1	Programming the second channel P1=1, channel 2 is programmed P1=0, channel 2 is not programmed
P2	Notification of peripheral fault in the event of a measuring overrange P2=1, peripheral fault is reported P2=0, peripheral fault is not reported
P3	P3=1, normal operation P3=0, both channels in current mode and without wire break detection

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Compliance with Standards and Directives

Directive conformity	
EMC Directive 2004/108/EC	EN 50295:1999
Standard conformity	
Noise immunity	EN 61000-6-2:2005, EN 61326-1:2006, IEC 62026-2:2008
Emitted interference	EN 61000-6-4:2007
Input	EN 61131-2:2007
Degree of protection	EN 60529:2000
Fieldbus standard	EN 50295:1999, IEC 62026-2:2008

Ambient conditions

Ambient temperature	-25 °C ... 70 °C (-13 °F ... 158 °F)
Storage temperature	-25 °C ... 85 °C (-13 °F ... 185 °F)

Mechanical Data

Device	**VBA-2E-G11-I/U/PT100-F**	**VBA-2E-G11-I/U/PT100-V1**
Connection	AS-Interface/U_{AUX}: insulation piercing technology, yellow flat cable/black flat cable Inputs: M12 round plug connectors	AS-Interface/U_{AUX}: M12 round plug connector Inputs: M12 round plug connectors
Degree of protection	IP68/IP69K	
Material		
Housing	PBT PC	
Mounting screw	Stainless steel 1.4305/AISI 303 (V2A)	
Mass	200 g	
Mounting	Mounting base	

9 Appendix B

9.1 Analog Input Module Measurement Ranges

Current Input Measurement Ranges

The measurement range of the current input can be set via AS-Interface parameter P3:

- P3=1, nominal range 4 mA ... 20 mA
- P3=0, nominal range 0 mA ... 20 mA

Current: 4 mA ... 20 mA

Input signal [mA]	Display on the master	Input LED	
> 23	32767	Flashing	Above threshold (peripheral fault)
20.001–23	20001–23000	On	Extended range [1)]
4 ... 20	**4000 ... 20000**	**On**	**Nominal range**
1 ... 3999	1000 ... 3999	On	Extended range [1)]
< 1	32767	Flashing	Below threshold (peripheral fault)

Table 9.1 Measurement range 1 mA ... 23 mA

[1)]: Measurement accuracy corresponds to the nominal range

Current: 0 mA ... 20 mA

Input signal [mA]	Display on the master	Input LED	
> 23	32767	Flashing	Above threshold (peripheral fault)
20.001 ... 23	20001 ... 23000	On	Extended range [1)]
0 ... 20	**0000 ... 20000**	**On**	**Nominal range**
< 0	0000	On	Below threshold

Table 9.2 Measurement range 0 mA ... 23 mA

[1)]: Measurement accuracy corresponds to the nominal range

Caution!

Maximum input current

At input currents > 80 mA, fault-free operation of all inputs is not guaranteed.

Voltage Input Measurement Ranges

Voltage: 0 V ... 10 V

Input signal [V]	Display on the master	Input LED	
> 11.5	32767	Flashing	Above threshold (peripheral fault)
10.001 ... 11.5	10001 ... 11500	On	Extended range [1)]
0 ... 10	**0000 ... 10000**	**On**	**Nominal range**
< 0	0000	On	Below threshold

Table 9.3 Measurement range 0 V ... 11.5 V

[1)]: Measurement accuracy corresponds to the nominal range

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Caution!
Maximum input voltage

The input voltage at the voltage input must not exceed 50 V.

Pt100 Input Measurement Ranges

Pt100: -200 °C ... 850 °C

Input signal [V]	Display on the master	Input LED	
> 884°C	32767	Flashing	Above threshold (peripheral fault)
850.1 °C ... 884 °C	8501 ... 8840	On	Extended range [1)]
-200 °C ... +850 °C (18.52 Ω ... +390.48 Ω)	**-2000 ... 8500**	**On**	**Nominal range**
-219.4 °C ... -200.1 °C	-2194 ... -2001	On	Extended range [1)]
< -219.4 °C	32767	Flashing	Below threshold (peripheral fault)

Table 9.4 Measurement range -219.4 °C ... 884 °C

[1)]: Measurement accuracy corresponds to the nominal range

9.2 Delay Times

The VBA-2E-G11-I/U/PT100-* needs a certain amount of time for the conversion and transmission of the analog measuring signals on the AS-Interface master. This period of time is mainly composed of the conversion time and the transmission time. The conversion time and transmission time depend on a number of factors.

Latency

Latency = delay of a signal under worst case conditions.

The analog-to-digital conversion in the analog module and the transmission via AS-Interface is not in sync. In the worst case, the transmission of a channel via AS-Interface starts just before the conversion of this channel is completed within the module. This gives rise to two scenarios:

1. The conversion time is longer than the transmission time

   Latency = Conversion time + Transmission time * (Number of channels +1)

2. The conversion time is shorter than the transmission time

   Latency = Conversion time * (Number of channels +1) + Transmission time

1st

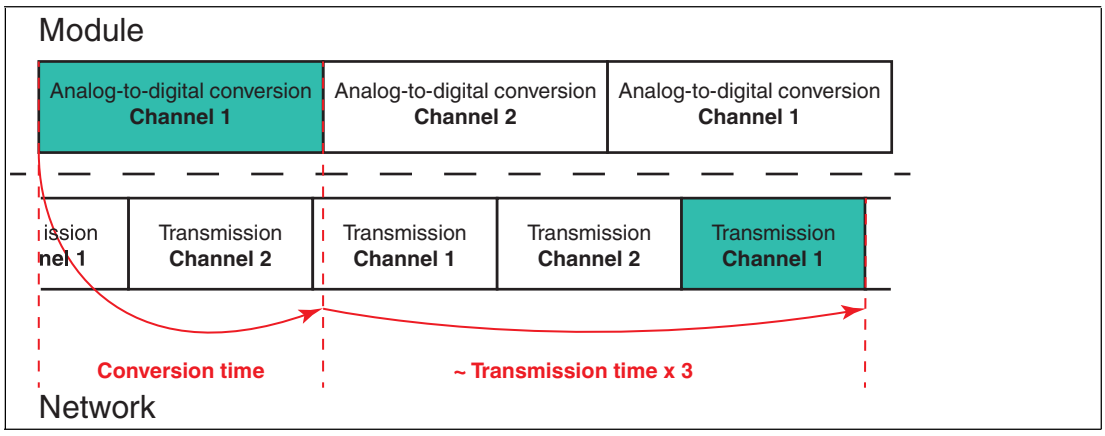

Figure 9.1 Conversion time > Transmission time

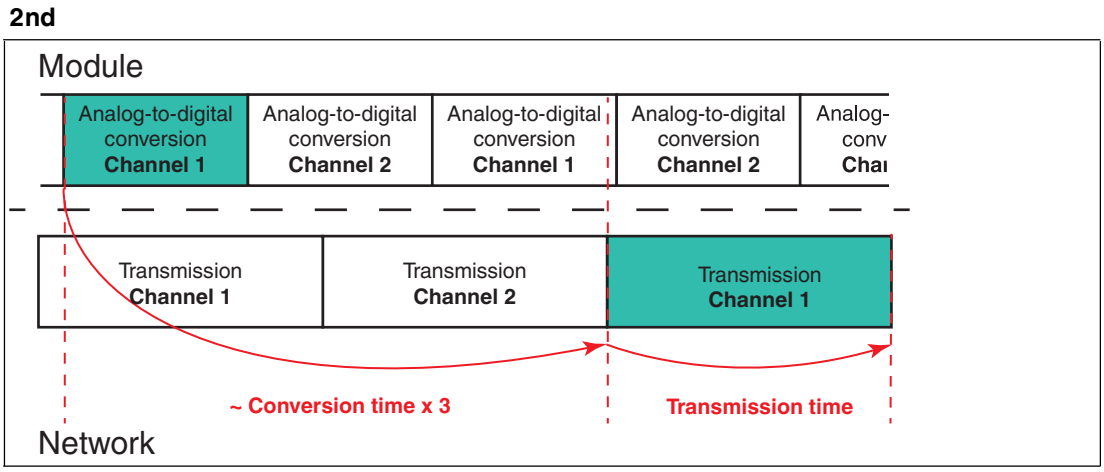

Figure 9.2 Conversion time < Transmission time

Conversion time

The conversion time is the time that the module requires to convert an analog signal into a digital value. The conversion time depends heavily on parameter P0

50/60 Hz filter inactive (P0=0)	10 ms
50/60 Hz filter active (P0=1)	70 ms

Table 9.5

Transmission time

The transmission time is based on the AS-Interface specification. The AS-Interface transmits data in 4-bit packets. At values greater than 4 bits, the quantity of data is divided into smaller values and then transmitted to a com unit over several cycles. If several channels are transmitted per slave, the number of cycles increases. The transmission time is the time required to fully transmit a digital data volume to the com unit. In the profile 7.3, seven frames are required per channel.

The duration of a cycle depends on the number of occupied addresses in the AS-interface network. An address is considered occupied if one of the following configurations apply:

- A standard address is assigned (e. g. **1**)
- An A- or B-Address is assigned (e. g. **1A** or **1B**)
- An A- and a B-Address are assigned (e. g. **1A** and **1B**)

When calculating the cycle time, each of these configurations assumed to be **one** occupied address.

Cycle time = 150µs * ([Number of occupied addresses] +2)

The transmission time is 7 cycles:

Transmission time = 150µs * ([Number of occupied addresses] +2) * 7

Example:

In a network, the addresses of 1A, 1B, 2A and 3 are assigned. For the calculation of the transmission time this corresponds to 3 occupied addresses. Thus we have:

Transmission time = 150µs * (**3** +2) * 7 = 5,25 ms

- 4 occupied addresses: Transmission time = 6,3 ms
- 31 occupied addresses: Transmission time = 35 ms

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FACTORY AUTOMATION – SENSING YOUR NEEDS

Worldwide Headquarters
Pepperl+Fuchs GmbH
68307 Mannheim · Germany
Tel. +49 621 776-0
E-mail: info@de.pepperl-fuchs.com

USA Headquarters
Pepperl+Fuchs Inc.
Twinsburg, Ohio 44087 · USA
Tel. +1 330 4253555
E-mail: sales@us.pepperl-fuchs.com

Asia Pacific Headquarters
Pepperl+Fuchs Pte Ltd.
Company Registration No. 199003130E
Singapore 139942
Tel. +65 67799091
E-mail: sales@sg.pepperl-fuchs.com

www.pepperl-fuchs.com

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