MANUAL

VBA-2A-G11-I-F
VBA-2A-G11-I-V1
VBA-2A-G11-IL-V1
VBA-4A-G11-I/U-F
AS-Interface Analog modules

A/D
Spec 2.1

CE

ECOLAB

UL

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SENSING YOUR NEEDS

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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:

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68307 Mannheim
Telephone: +49 621 776-4411
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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**

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3   Safety

3.1   Symbols relevant to safety

STOP

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-2A-G11-I-* features two analog current outputs (0–20 mA). These outputs are powered via the AS-Interface. The analog value is converted and data transmitted asynchronously as defined by AS-Interface profile 7.3. The rise time of the analog signals is approx. 2 ms. Depending on the design, the AS-Interface transmission line is connected via an M12 connector or via the AS-Interface flat cable.

The VBA-2A-G11-IL-V1 features two analog current outputs (0–20 mA). These outputs are powered via auxiliary power. The analog value is converted and data transmitted asynchronously as defined by AS-Interface profile 7.3. The rise time of the analog signals is approx. 2 ms. The AS-Interface transmission line and the auxiliary power are connected via an M12 connector.

The VBA-4A-G11-I/U-F features four analog outputs. The outputs can be configured either as current outputs (0–20 mA) or as voltage outputs (0–10 V). An automatic output detection function allows the outputs to be operated as current or voltage outputs, depending on the applied load. The outputs are configured as current outputs by default. Depending on the position of an internal slide switch, the outputs are powered via the AS-Interface or an auxiliary power source. The analog value is converted and data transmitted asynchronously as defined by AS-Interface profile 7.3. The rise time of the analog signals is approx. 2 ms. The AS-Interface transmission line is connected via the AS-Interface flat cable.

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.

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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

VBA-2A-G11-I-*
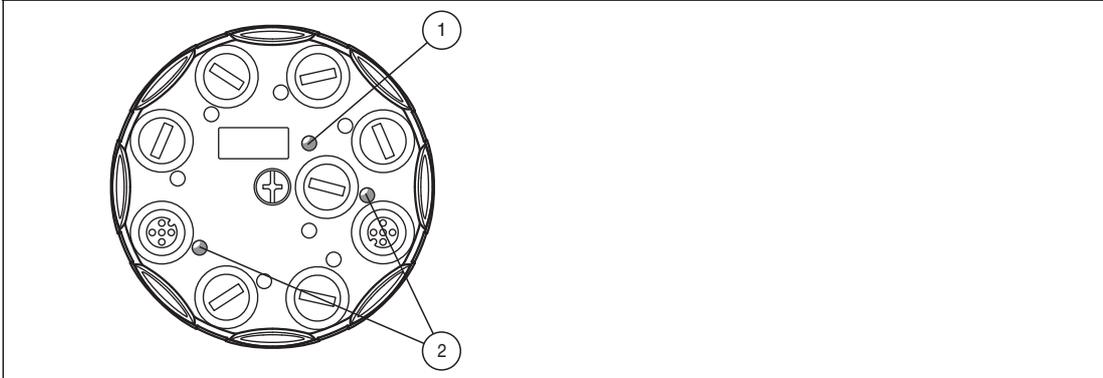

Figure 4.1   Indicators and operating means

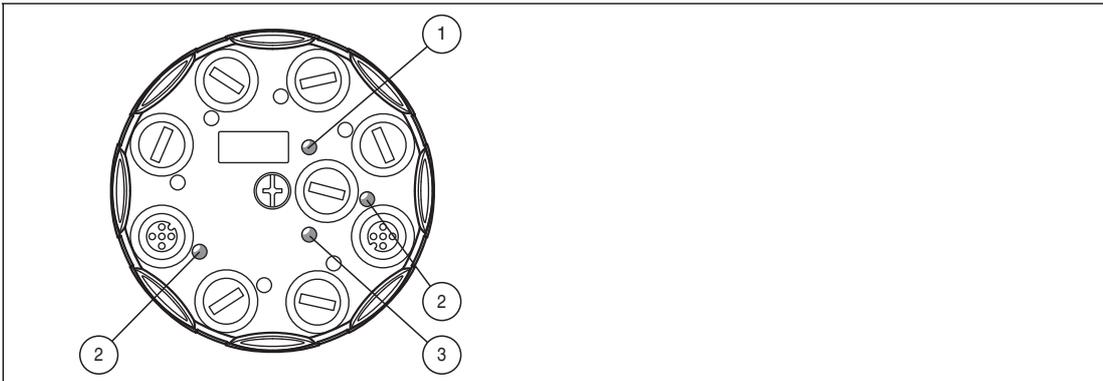**VBA-2A-G11-IL-V1**

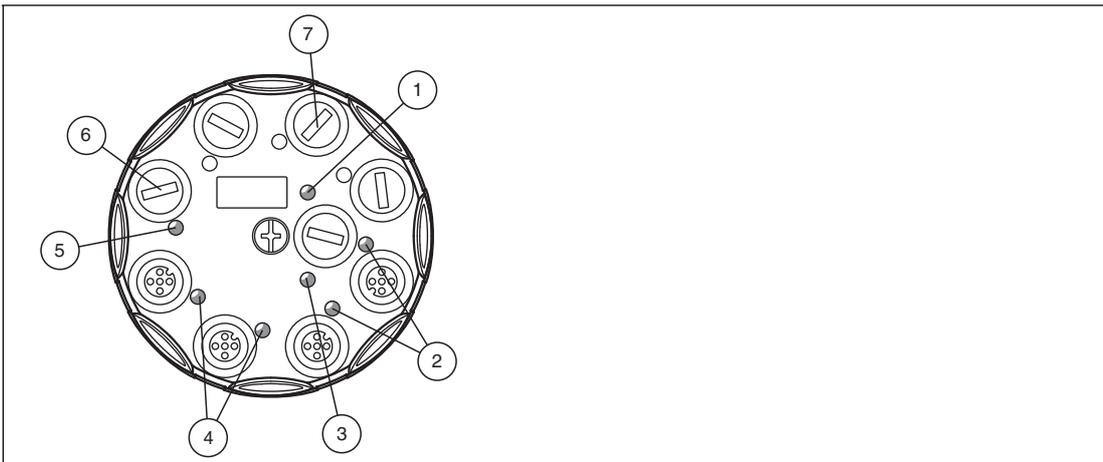Figure 4.2   Indicators and operating means

VBA-4A-G11-I/U-F

Figure 4.3   Indicators and operating means

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The analog output modules feature the following displays and controls:

LED Indicator

①	LED AS-i/FAULT	Status display; multi-colour LED Green: normal operation Red: communication fault Flashing yellow/red: address 0 Flashing green/red: peripheral fault
②	LED OUT1 LED OUT2	Status of output signal; yellow LED Yellow: Output value within range Yellow flashing: lead breakage (on current output) or output value out of range
③	LED AUX	ext. auxiliary voltage U_{AUX}; dual LED green/red green: voltage OK red: reverse voltage
④	LED OUT3 LED OUT4	Status of output signal; yellow LED Yellow: Output value within range Yellow flashing: lead breakage (on current output) or output value out of range
⑤	LED INT/EXT	status display input supply; LED green green: input supply from AS-Interface off: input supply from auxiliary voltage

Note!

Wire Break Detection

At a current output, a wire break is detected reliably when the current is > 10 µA.

Ranging from 1 µA to 10 µA, the wire break detection can not be guaranteed.

With a current = 0, the wire break detection is disabled.

Switches

⑥	INT/EXT switch	Set to INT: actuators powered via the AS-Interface (max. 120 mA) Set to EXT: actuators powered via an auxiliary power source (max. 700 mA)
⑦	Output configuration switch	: 4 x current outputs : 4 x voltage outputs : Automatic detection

To access the switch in question, remove the dummy plugs ⑥ or ⑦.

4.2 Connections

VBA-2A-G11-I-F
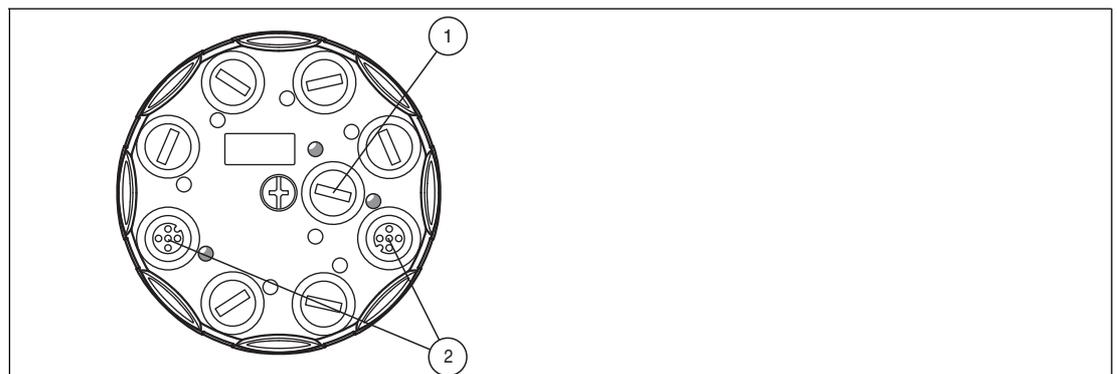
Figure 4.4   Connections

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VBA-2A-G11-I-V1
VBA-2A-G11-IL-V1
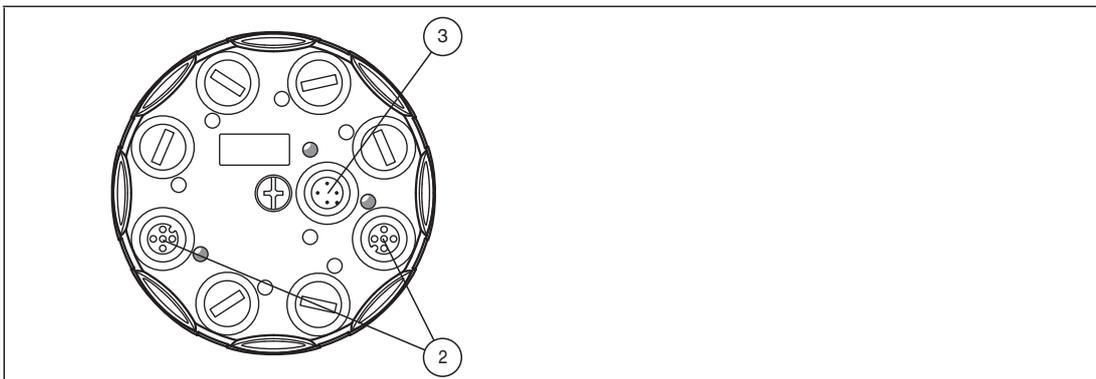
Figure 4.5　　　　Connections

VBA-4A-G11-I/U-F
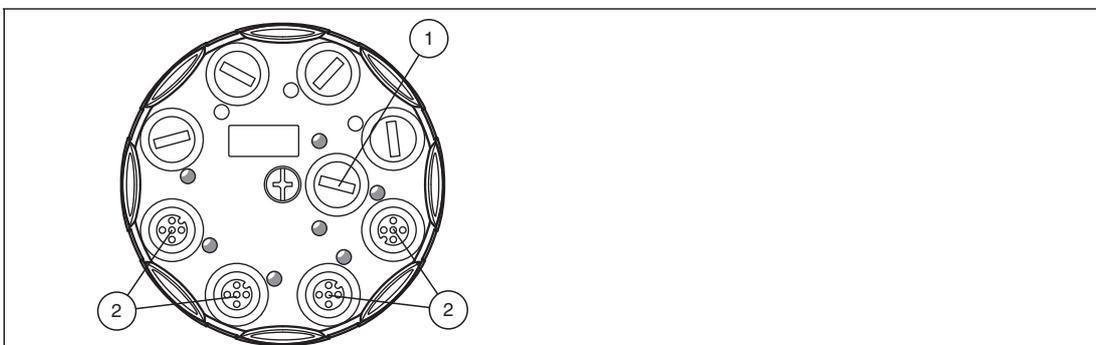
Figure 4.6　　　　Connections

The analog output modules feature the following connections:

①	Addressing socket [1]	Low voltage switch socket, ⌀ 1.3 mm
②	Analog outputs	5: Functional ground M12 circular connector
③	AS-Interface	**VBA-2A-G11-I-V1** 1: AS-Interface + 2: n.c. 3: AS-Interface - 4: n.c. M12 circular connector	**VBA-2A-G11-IL-V1** 1: AS-Interface + 2: AUX - 3: AS-Interface - 4: AUX +

Table 4.1　　[1]: Not for VBA-2A-G11-I-V1 & VBA-2A-G11-IL-V1

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4.3 Configuring the Outputs on the VBA-4A-G11-I/U-F

The outputs are configured either via parameter bits P1 and P3 or via the two DIP switches. If the outputs are configured via the parameter bits, the DIP switches must be set to the default position:

The DIP switches override parameter bits P1 and P3.

Three configurations are available:

4 x Current Outputs (Default Option)

Parameter bits: P1=1; P3=1

DIP switches:

4 x voltage outputs

Parameter bits: P1=0; P3=1

DIP switches:

Automatic Detection

Parameter bits: P1=1; P3=1->0

DIP switches:

A test signal records the input resistance of a connected actuator. If the measured input resistance value is > approx. 2 kΩ, the corresponding output is configured as a voltage output. If the measured input resistance value is < approx. 700 Ω, the corresponding output is configured as a current output. The output configuration detected is stored in the non-volatile memory of the module. The automatic detection process is initiated again each time the DIP switches or parameter bits are modified. When the OUT LED flashes rapidly, this indicates that automatic detection is in progress.

Note!

In the event that the AS-Interface system is restarted when configuring the switch parameters, ensure that P3 is not changed from 1 to 0.

Tip

Test Signal

The test signal is issued if DIP switch 2 is switched to the right.

The test signal is limited to 30 V or 20 mA for a maximum of 5 ms.

No test signal is issued if the module is restarted.

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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 circular connector connects with the metal insert in the mounting base. This metal insert can be used to generate a functional ground connection via the mounting screws, thereby improving electromagnetic compatibility (EMC). The mounting screws are not included.
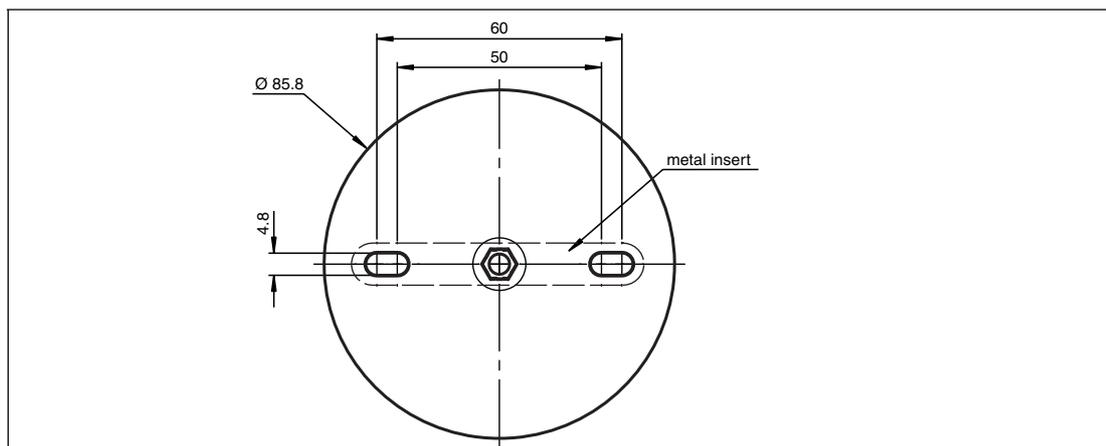
Figure 5.1

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

5.4 Connecting AS-Interface

VBA-2A-G11-I-F & VBA-4A-G11-I/U-F

The VBA-2A-G11-I-F and VBA-4A-G11-I/U-F modules are connected to the AS-Interface network via the yellow flat cable.

The VBA-4A-G11-I/U-F module can be connected to the external auxiliary power source U_{AUX} via the black flat cable if required.

Connecting to AS-Interface

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

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3. If the VBA-4A-G11-I/U-F module is to be powered via an external auxiliary power source U_{AUX}, insert the black flat cable into the port labeled AUX. Set the INT/EXT switch to EXT.
    If the VBA-4A-G11-I/U-F module is to be powered solely by AS-Interface, insert the flat cable seal (VAZ-FK-S-BK-SEAL) into the port labeled AUX. The flat cable seal ensures compliance with the protection class.
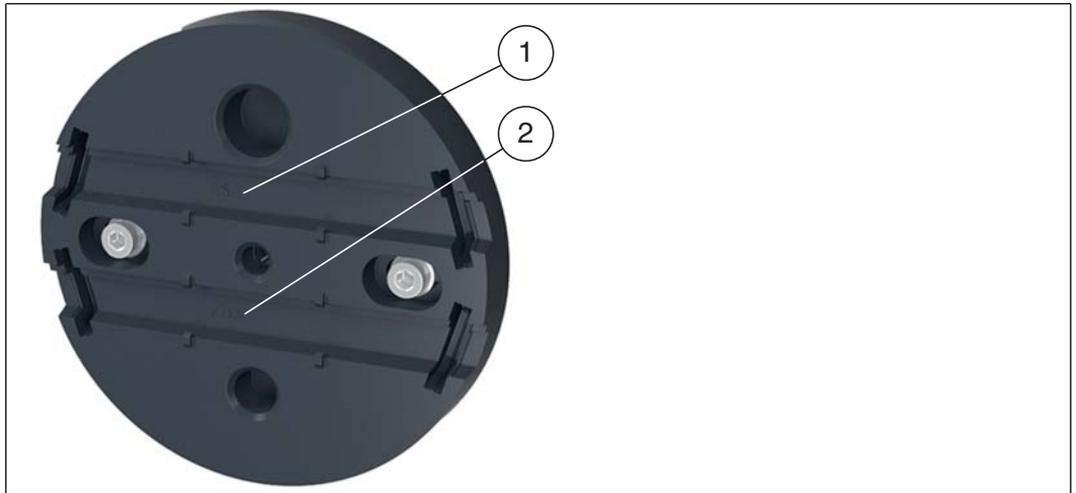
1. AS-i port (yellow flat cable)

2. AUX port (black flat cable) — VBA-4A-G11-I/U-F only

3. Ensure the flat cable is positioned correctly.

4. Reattach the upper part of the module.

5. Tighten the central screw. The recommend 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-2A-G11-I-V1 & VBA-2A-G11-IL-V1

The VBA-2A-G11-I-V1 and the VBA-2A-G11-IL-V1 modules are connected to the AS-Interface network via the M12 connector. See chapter 4.2.

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5.5 Connecting Actuators
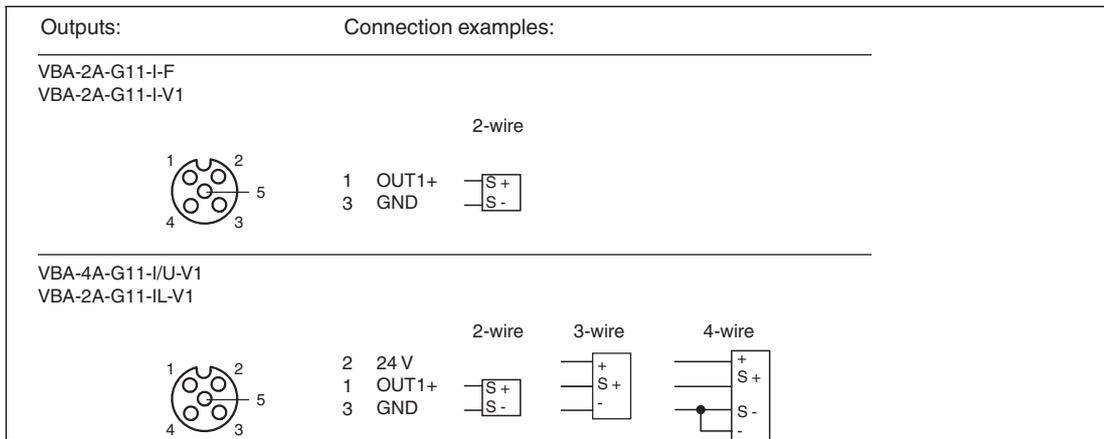
Figure 5.2

2-wire actuators can be connected to the VBA-2A-G11-F and VBA-2A-G11-V1 modules. 2-wire, 3-wire and 4-wire actuators can be connected to the VBA-4A-G11-V1 and the VBA-2A-G11-IL-V1 modules. For various connection scenarios → see Figure 5.2 on page 14.

Note!

Pin 5 of the M12 circular 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.

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6 Commissioning

6.1 Assigning an Address to the Module

To operate the analog output modules in an AS-Interface network, a suitable address must be assigned 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-2A-G11-I-F, VBA-2A-G11-I-V1VBA-2A-G11-IL-V1 and VBA-4A-G11-I/U-F modules are standard slaves 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 analog output modules offer the following profile:

		VBA-2A-G11-I-F **VBA-2A-G11-I-V1** **VBA-2A-G11-IL-V1**	**VBA-4A-G11-I/U-F**
I/O	=	7	7
ID	=	3	3
ID2	=	5	6
ID1	=	F (programmable)	F (programmable)

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

6.3 Parameterization

The following parameters can be configured: 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: Watchdog

Default value P0=1, active

Parameter P0 is used to activate the "watchdog" internal monitoring function. The watchdog function resets the output signals to zero if communication with the AS-Interface fails.

Parameter P1: Output Mode (VBA-4A-G11-I/U-F Only)

Default value P1=1

Parameter P1 is used to select the output mode for the analog outputs. This parameter switches between 4 current outputs and 4 voltage outputs, provided that the DIP switches are in the default position. see chapter 4.3.

Alternatively, the output mode can be selected using the DIP switches.

Parameter P2: Peripheral Fault

Default value P2=1, active

Parameter P2 is used to switch peripheral fault notifications on or off. 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 reported if:

- A wire break is detected at a current output
- The value range is above or below the relevant threshold see chapter 9.1.

A peripheral fault is **always** reported if:

- The actuator power supply is overloaded
- The external auxiliary power is not available when the INT/EXT switch = EXT
- the auxiliary power U_{AUX} is not connected (VBA 2A-G11-IL-V1 only).

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Note!

Wire Break Detection

At a current output, a wire break is detected reliably when the current is > 10 µA.

Ranging from 1 µA to 10 µA, the wire break detection can not be guaranteed.

With a current = 0, the wire break detection is disabled.

Parameter P3: Automatic Mode (VBA-4A-G11-I/U-F only)

Default value P3=1, active

Parameter P3 is used to configure the output mode by selecting automatic load detection or manual settings, provided that the DIP switches are in the default position. see chapter 4.3.

Alternatively, automatic mode can be configured using the DIP switches.

Tip

Mixed Operation

With automatic load detection, the module can simultaneously operate current and voltage outputs.

Configuration via Parameters/DIP Switches

DIP switches	Parameters		Output mode
	P1	P3	
	1 0 1 0	1 1 0 0	4 current outputs 4 voltage outputs Automatic mode Reserved
	x	x	4 voltage outputs
	x	x	Automatic mode
	x	x	Reserved

Note!

Wire Break Detection

At a current output, a wire break is detected reliably when the current is > 10 µA.

Ranging from 1 µA to 10 µA, the wire break detection can not be guaranteed.

With a current = 0, the wire break detection is disabled.

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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
Wire break at the current output	■ Check connection to the actuator
Analog value outside the value range	■ Check analog values
VBA-4A-G11-I/U-F & VBA-2A-G11-IL-V1 only:	
Actuator power supply overloaded	■ Check actuator supply for short circuit
Auxiliary power too low (VBA-4A-G11-I/U-V1: switch set to EXT)	■ Check auxiliary power

Note!

Wire Break Detection

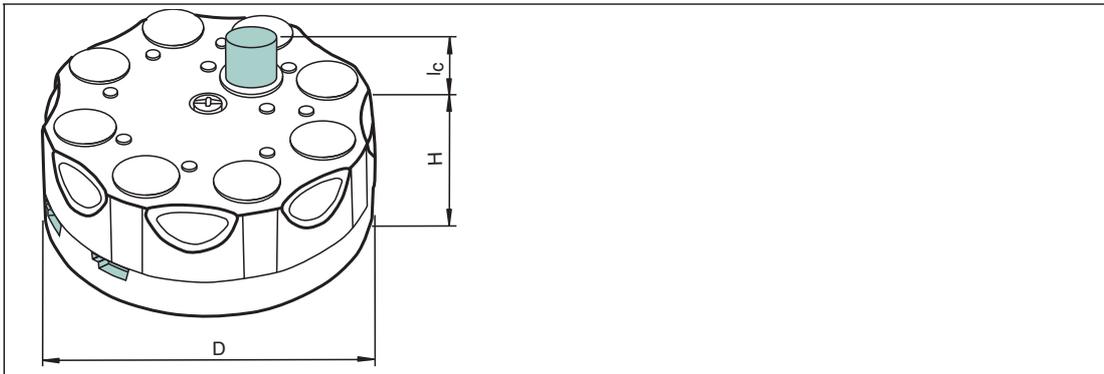At a current output, a wire break is detected reliably when the current is > 10 µA.

Ranging from 1 µA to 10 µA, the wire break detection can not be guaranteed.

With a current = 0, the wire break detection is disabled.

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

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8 Appendix A

8.1 Dimensions

Type	D	H	I_c
VBA-2A-G11-I-F	85 mm	35 mm	-
VBA-2A-G11-I-V1 VBA-2A-G11-IL-V1	85 mm	35 mm	11 mm
VBA-4A-G11-I/U-F	85 mm	35 mm	-

8.2 Technical Data

General specifications

Slave type	Standard slave
AS-Interface specification	V3.0
Required master specification	$\geq$ V2.1
UL File Number	E87056

Indicators/operating means

	VBA-2A-G11-I-*	VBA-2A-G11-IL-V1	VBA-4A-G11-I/U-F
LED AS-i/FAULT	Status display; multi-colour LED Green: normal operation Red: communication fault Flashing yellow/red: address 0 Flashing green/red: peripheral fault		
LED ANALOG	Status of output signal; yellow LED Yellow: 0 mA $\leq$ I $\leq$ 23 mA Yellow flashing: lead breakage or I > 23 mA		Status of output signal; yellow LED Yellow: Output value within range Yellow flashing: lead breakage (on current output) or output value out of range
LED AUX	-	ext. auxiliary voltage U_{AUX}; dual LED green/red green: voltage OK red: reverse voltage	
LED INT/EXT	-	-	status display output supply; LED green green: output supply from AS-Interface off: output supply from auxiliary voltage

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Electrical specifications

Gerät	VBA-2A-G11-I-*	VBA-2A-G11-IL-V1	VBA-4A-G11-I/U-F
Auxiliary voltage (output)	-	24 V DC ± 15 % PELV	
Rated operating voltage	26.5 ... 31.6 V from AS-Interface		
Rated operating current	$\leq$ 100 mA	$\leq$ 35 mA	$\leq$ 75 mA (without outputs) / max. 200 mA
Protection class	III		
Surge protection	U_e: Over voltage category III, safe isolated power supplies (PELV)	U_{AUX}, U_{in}: Over voltage category III, safe isolated power supplies (PELV)	

Output

Gerät	VBA-2A-G11-I-*	VBA-2A-G11-IL-V1	VBA-4A-G11-I/U-F
Number/Type	2 analog outputs (current), 0 ... 20 mA		4 analog outputs Current: 0 ... 20 mA Voltage: 0 ... 10 V
Supply	from AS-Interface	from AUX	from AS-Interface (switch position INT, basic setting) or auxiliary voltage U_{EXT} (switch position EXT)
Load	max. 600 Ω		voltage output: min. 1 kΩ current output: max. 600 Ω
Current loading capacity	-	$\leq$ 700 mA (signal current + actuator supply) from external bulk power supply U_{AUX}, overload and short-circuit protected	$\leq$ 120 mA (signal current + actuator supply) from AS-Interface; overload and short-circuit protected $\leq$ 700 mA (signal current + actuator supply) from external bulk power supply U_{AUX}, overload and short-circuit protected
Resolution	6 µA		Voltage output: 3 mV Current output: 6 µA
Accuracy	0.15 % of full-scale value		
Temperature influence	1 µA/K		1 µA/K or 0,3 mV/K
Short-circuit current	-		voltage output: max. 22 mA

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Programming instructions

Gerät	VBA-2A-G11-I-* VBA-2A-G11-IL-V1	VBA-4A-G11-I/U-F
Profile	S-7.3.5	S-7.3.6
IO code	7	7
ID code	3	3
ID2 code	5	6
Data bits (function via AS-Interface)	The transfer of the data value is based on AS-Interface Profile 7.3.	
Parameter bits (programmable via AS-i)	function	
P0	Watchdog: P0=1 (default), watchdog active P0=0, watchdog inactive	
P1	not used	Output mode: P1=1 (default), 4x current output P2=0, 4x voltage output
P2	Indication of peripheral fault: P2=1 (default), peripheral fault is reported P2=0, peripheral fault is not reported	
P3	not used	Automatic mode: P3=1 (default), manual setting of output mode P3=0, automatic load detection (mixed mode possible)

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
Protection degree	EN 60529:2000
Fieldbus standard	EN 50295:1999, IEC 62026-2:2008

Ambient conditions

Gerät	VBA-2A-G11-I-* VBA-2A-G11-IL-V1	VBA-4A-G11-I/U-F
Ambient temperature	-25 ... 70 °C (-13 ... 158 °F)	-25 ... 60 °C (-13 ... 140 °F)
Storage temperature	-25 ... 85 °C (-13 ... 185 °F)	-25 ... 85 °C (-13 ... 185 °F)

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Mechanical specifications

Connection	**VBA-2A-G11-I-V1**	AS-Interface: M12 round connector Outputs: M12 round connector
	VBA-2A-G11-IL-V1	AS-Interface/U_{AUX}: M12 round connector Outputs: M12 round connector
	VBA-2A-G11-I-F	cable piercing technique, AS-i flat cable Outputs: M12 round connector
	VBA-4A-G11-I/U-F	AS-Interface/U_{AUX}: cable piercing method, flat cable yellow/flat cable black Outputs: M12 round connector
Protection degree	IP68 / IP69K	
Material		
Housing	PBT PC	
Mounting screw	Stainless steel 1.4305 / AISI 303	
Mass	200 g	
Mounting	Mounting base	

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9 Appendix B

9.1 Value Ranges of the Analog Output Modules

Value Ranges for Current Outputs

Current: 0–20 mA

Data sent by master	Output signal [mA]	Output LED	
> 23000	23	⊓⎍⎍⎍⎍⎍⎍⎍	Above threshold (peripheral fault) [1]
20001–23000	20.001–23	On	Extended range [2]
0000–20000	**0–20**	**On**	**Nominal range**
< 0	0	⊓⎍⎍⎍⎍⎍⎍⎍	Below threshold (peripheral fault) [1]

Table 9.1   Value range 0–23 mA

[1]: Peripheral fault notifications can be managed via parameter P2. The output LED always flashes in the event that the value is above or below the relevant threshold. See chapter 6.3.

[2]: Accuracy corresponds to the nominal range
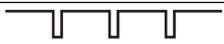
Value Ranges for Voltage Outputs

Voltage: 0–10 V

Data sent by master	Output signal [V]	Output LED	
> 11000	11.0	⊓⎍⎍⎍⎍⎍⎍⎍	Above threshold (peripheral fault) [1]
10001–11000	10.001–11.0	⎍_⎍_⎍_	Extended range [2]
0000–10000	**0–10**	**⎍_⎍_⎍_**	**Nominal range**
< 0000	0	⊓⎍⎍⎍⎍⎍⎍⎍	Below threshold (peripheral fault) [1]

Table 9.2   Value range 0–11 V

[1]: Peripheral fault notifications can be managed via parameter P2. The output LED always flashes in the event that the value is above or below the relevant threshold. See chapter 6.3.

[2]: Accuracy corresponds to the nominal range

9.2 Delay Times

When working with the analog output module, the AS-Interface requires a certain amount of time in which to transmit and convert the digital signals to the analog outputs. The conversion time and rise time in the module, and the transmission time in the AS-Interface network depends on a number of different factors.

Latency

Latency = delay of a signal under worst case conditions.

In the worst case, the transmission of a channel via AS-Interface starts just before the AS-Interface master has received a new data image.

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

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Conversion time

The conversion time is the time required by the module to convert a digital value into an analog signal. The conversion time is 0.7 ms.

Rise time

The rise time is the time required by the module to reach and maintain the target value at the analog output. For a resistive load, the rise time is

- At the current output: 1.5 ms
- At the voltage output: 2.5 ms

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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