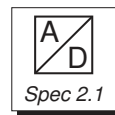
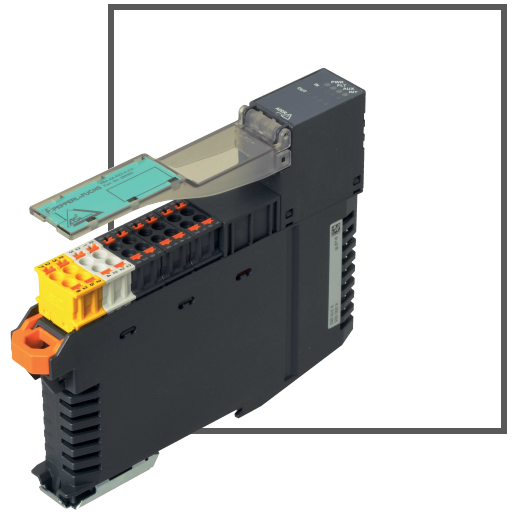


# MANUAL

## VBA-2A-KE5-IL/UL, VBA-4A-KE5-IJL/UJL AS-Interface Analog Modules



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"

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# 1 Introduction

## 1.1 Content of this Document

This document contains information required to use the product in the relevant phases of the product life cycle. This may include information on the following:

- Product identification
- Delivery, transport, and storage
- Mounting and installation
- Commissioning and operation
- Maintenance and repair
- Troubleshooting
- Dismounting
- Disposal



### **Note!**

For full information on the product, refer to the further documentation on the Internet at [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com).

The documentation comprises the following parts:

- This document
- Datasheet

In addition, the documentation may comprise the following parts, if applicable:

- EU-type examination certificate
- EU declaration of conformity
- Attestation of conformity
- Certificates
- Control drawings
- Instruction manual
- Other documents

## 1.2 Target Group, Personnel

Responsibility for planning, assembly, commissioning, operation, maintenance, and dismounting lies with the plant operator.

Only appropriately trained and qualified personnel may carry out mounting, installation, commissioning, operation, maintenance, and dismounting of the product. The personnel must have read and understood the instruction manual and the further documentation.

Prior to using the product make yourself familiar with it. Read the document carefully.



## 1.3 Symbols Used

This document contains symbols for the identification of warning messages and of informative messages.

### Warning Messages

You will find warning messages, whenever dangers may arise from your actions. It is mandatory that you observe these warning messages for your personal safety and in order to avoid property damage.

Depending on the risk level, the warning messages are displayed in descending order as follows:



#### ***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 the device and any connected systems and plants, or result in their complete failure.

### Informative Symbols



#### ***Note!***

This symbol brings important information to your attention.



#### **Action**

This symbol indicates a paragraph with instructions. You are prompted to perform an action or a sequence of actions.

## 2 Certificates and Approvals

### 2.1 UL Information

#### **Technical Data and Environmental Conditions**

This device is for indoor use only.

This device may be operated in altitudes up to 2000 m.

The ambient temperature range is from -25 °C to +70 °C.

The device must be installed in accordance with applicable national laws and regulations.

If the device is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The device must be installed in a switch cabinet or switch box that meets protection class IP54 as a minimum.

### 3 Product Description

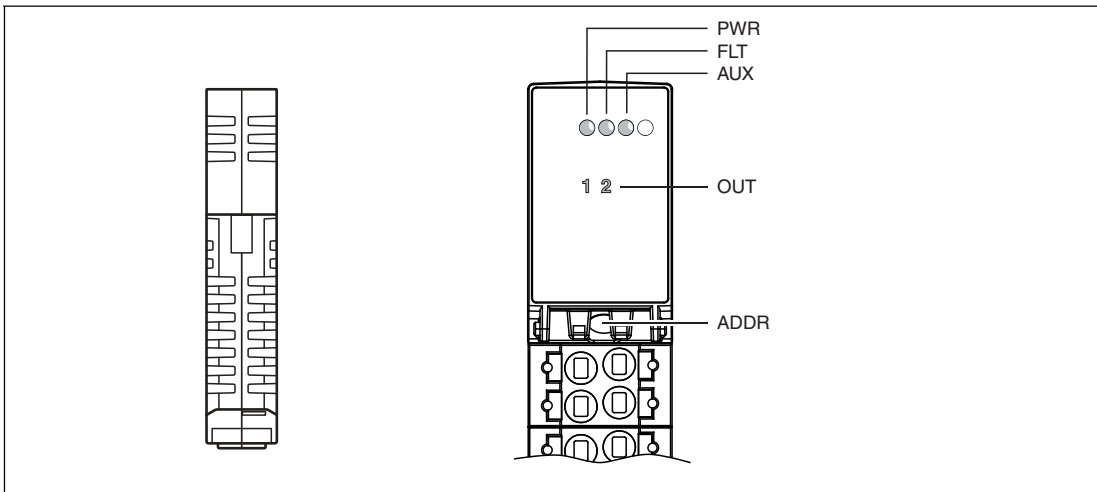
#### 3.1 Intended Use

The VBA-2A-KE5-IL/UL features two analog outputs. These outputs can be configured as current outputs (0 mA ... 20 mA) or as voltage outputs (0 V ... 10 V). The outputs are configured as current outputs by default. The outputs are supplied via the external auxiliary voltage. Analog value conversion and data transfer are provided asynchronously according to AS-Interface profile 7.3. The rise time of the analog signals is approximately 2 ms.

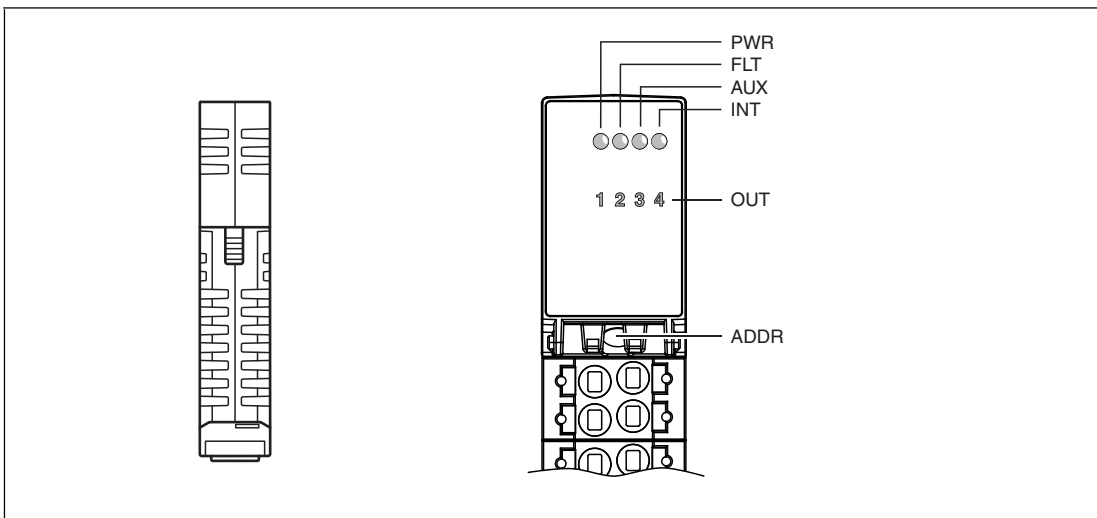
The VBA-4A-KE5-IJL/UJL features four analog outputs. These outputs can be configured as current outputs (0 mA ... 20 mA) or as voltage outputs (0 V ... 10 V). The module features automatic output detection, which allows outputs to be operated as a current or voltage output, depending on the applied load. The outputs are configured as current outputs by default. Depending on the position of an internal slide switch, the outputs are supplied via the AS-Interface or an auxiliary voltage source. Analog value conversion and data transfer are provided asynchronously according to AS-Interface profile 7.3. The rise time of the analog signals is approximately 2 ms.

#### 3.2 Displays and Operating Elements

##### VBA-2A-KE5-IL/UL



##### VBA-4A-KE5-IJL/UJL



The analog modules feature the following indicators and operating elements:



### LED Indicators

PWR LED	AS-Interface voltage; green LED <ul style="list-style-type: none"> <li>■ Green: OK status</li> <li>■ Flashing green: address 0 or peripheral fault</li> </ul>
FAULT LED	Fault indication; red LED <ul style="list-style-type: none"> <li>■ Red: communication error or address is 0</li> <li>■ Red flashing: peripheral fault</li> </ul>
AUX LED	External auxiliary voltage $U_{AUX}$ ; green/red dual LED <ul style="list-style-type: none"> <li>■ Green: voltage OK</li> <li>■ Red: voltage reversed</li> </ul>
LED INT (VBA-4A-KE5-IJL/UJL only)	Internal output voltage active; green LED <ul style="list-style-type: none"> <li>■ Green: internal output voltage from AS-Interface</li> <li>■ Off: output voltage from auxiliary voltage</li> </ul>
LED OUT1 ... OUT4 (OUT3, OUT4 only for VBA-4A-KE5-IJL/UJL)	Status of output signal; yellow LED <ul style="list-style-type: none"> <li>■ Yellow: output value within value range Continuously illuminated: output in current mode Continuously illuminated, briefly interrupted: output in voltage mode</li> <li>■ Flashing yellow: wire break (at current output) or output value outside of value range</li> </ul>



**Note!**

**Behavior of the LEDs**

LEDs OUT1 ... OUT4 are continuously lit up if the corresponding output is configured as a current output. For outputs in voltage mode, the corresponding OUT LED flashes, going out briefly and then illuminating for a longer period. See chapter 7.



**Note!**

**Wire Break Detection**

At a current output, a wire break is reliably detected if the set current > 10  $\mu$ A.  
 From 1  $\mu$ A to 10  $\mu$ A, wire break detection cannot be guaranteed.  
 If power = 0, wire break detection is deactivated.

**Switch**

INT/AUX switch  
(VBA-4A-KE5-IJL/UJL only)

- Set to INT:  
output voltage from AS-Interface (max. 100 mA)
- Set to AUX:  
Output voltage from auxiliary voltage (max. 600 mA)

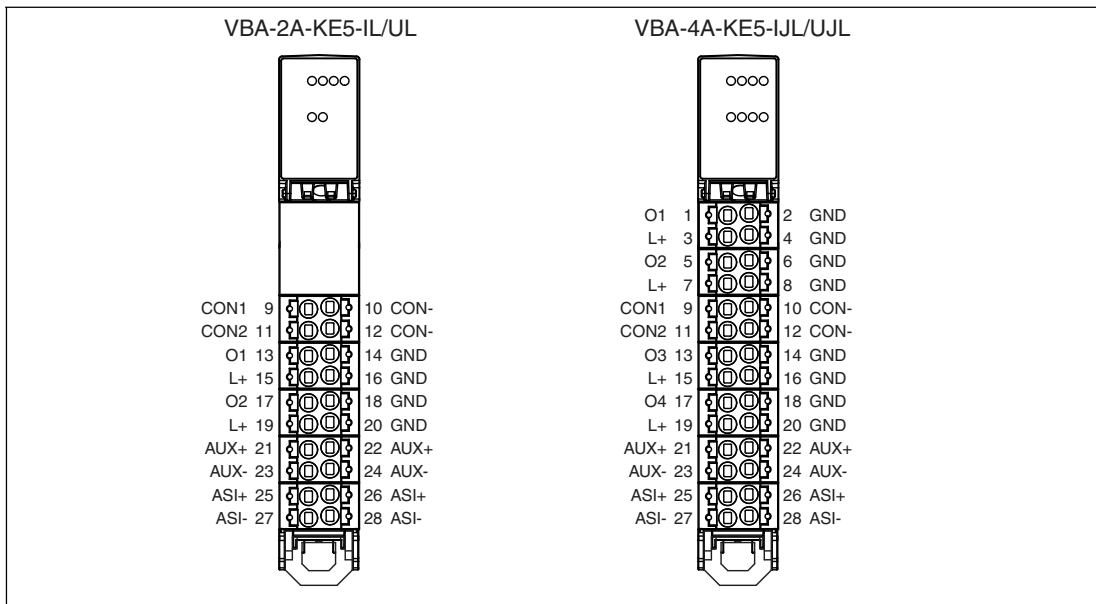


**Warning!**

Only use the switch when de-energized

Only adjust the INT/AUX switch if the module is not supplied via the AS-Interface or the AUX auxiliary voltage!

### 3.3 Connections



The analog output modules feature the following connections:

- ADDR      Addressing socket; extra-low-voltage switch socket, Ø 1.3 mm
- O1 ... O4    Analog outputs, U or I (O3 and O4 only for VBA-4A-KE5-IJL/UJL)
- L+          Actuator supply
- GND        Reference potential for outputs/actuators
- CON1, 2    Jumpers to the output configuration
- CON-
- ASI+        AS-Interface; both ASI+ terminals and both ASI- terminals are bridged in the terminal block.
- ASI-
- AUX+        Auxiliary voltage; both AUX+ terminals and both AUX- terminals are bridged in the terminal block.
- AUX-

### 3.4 Configuring the Output Function on the VBA-2A-KE5-IL/UL

Use the parameter bits P1 and P3 or the two jumpers CON1 and CON2 to configure the function of the outputs.



**Note!**

**Use of jumpers**

Jumpers on CON1 or CON2 override parameter bits P1 and P3.

If you configure the function of the outputs via the parameter bits, ensure that no jumpers are installed on CON1 or CON2.

Four configurations are available:

**2 x Current Outputs (Default Option)**

Parameter bits: P1=1; P3=1

Jumpers:



### O1 voltage output, O2 current output

Parameter bits: P1=0; P3=1

Jumpers:



### O1 current output, O2 voltage output

Parameter bits: P1=1; P3=0

Jumpers:



### 2 x voltage outputs

Parameter bits: P1=0; P3=0

Jumpers:



**Note!**

Never connect the CON1, CON2, and CON- connections with external potentials.  
Maximum permissible length of the jumper: ≤ 5 cm.

## 3.5

### Configuring the Output Function on the VBA-4A-KE5-IJL/UJL

Use the parameter bits P1 and P3 or the two jumpers CON1 and CON2 to configure the function of the outputs.



**Note!**

**Use of Jumpers**

Jumpers on CON1 or CON2 override parameter bits P1 and P3.

If you configure the function of the outputs via the parameter bits, ensure that no jumpers are installed on CON1 or CON2.

Three configurations are available:

#### 4 Current Outputs (Default Option)

Parameter bits: P1=1; P3=1

Jumpers:



#### 4 Voltage Outputs

Parameter bits: P1=0; P3=1

Jumpers:



### Automatic Detection

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

Jumpers:



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.

Automatic detection takes approx. 1 second and is indicated by OUT LEDs flashing in quick succession.

## 3.6 Resetting/Restarting Automatic Detection

Automatic detection can be restarted at any time during operation. Switching the supply off and on is not necessary. There are two options available:

1. Remove the jumper from CON2 and reconnect the jumper to CON-
2. Set and reset (0 -> 1 -> 0) the parameter bit P3. To do this, parameter P1 must be set to 1. There must be no jumpers installed on CON1 and CON2.



#### 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 the CON2 jumper is closed or if P3 is set to 0.

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.



#### Note!

Never connect the CON1, CON2, and CON- connections with external potentials.

Maximum permissible length of the jumper: ≤ 5 cm.

## 4 Installation

### 4.1 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.

### 4.2 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 contact Pepperl+Fuchs.

### 4.3 Mounting

Mount the module by snapping it onto a 35 mm DIN rail.

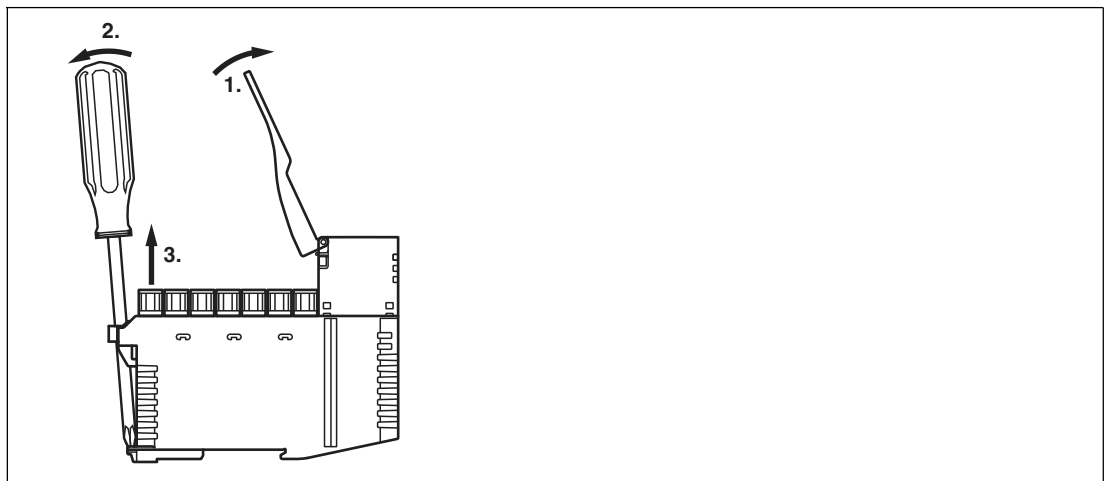


Figure 4.1 Unlocking terminals

1. Lift the label carrier upwards.
2. Guide a suitable screwdriver through the eye on the ejector and then:
  - Insert the blade of the screwdriver on the bottom of the foot bolt.
  - Then pull on the handle of the screwdriver in the direction indicated.
3. Remove the terminal block.

### 4.4 AS-Interface and AUX Auxiliary Voltage Connection

#### VBA-2A-KE5-IL/UL and VBA-4A-KE5-IJL/UJL

The analog module has a pair of terminals for looping through each of the ASI+, ASI-, AUX+, and AUX leads. Each pair of terminals is bridged in the terminal block. This ensures the connection is retained even if the terminal block is disconnected from the module.



#### **Warning!**

Note the permitted operating temperature

The permitted operating temperature of the cables connected to the terminal block must be at least +80 °C!

## 4.5 Connecting Actuators

You can connect 2-, 3-, and 4-wire sensors to the VBA-4E-KE5-IL. For various connection options, → see Figure 4.2 on page 14 and → see Figure 4.3 on page 14.

### Actuator supply via the module from AS-Interface (VBA-4A-KE5-IJL/UJL only) or auxiliary voltage AUX

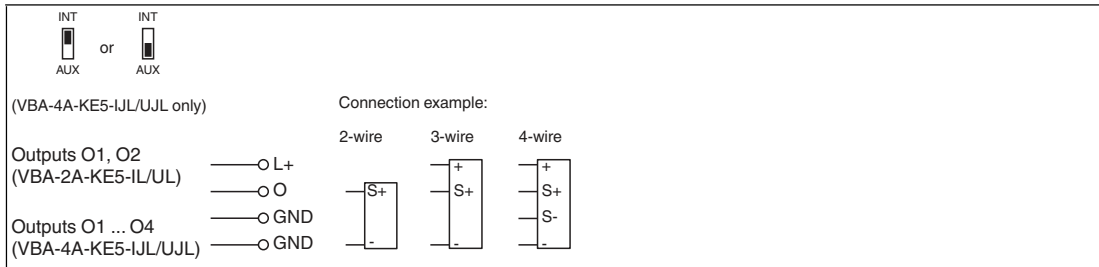


Figure 4.2 Connection of actuators with sensor supply via the module

### Sensor supply from external PELV power source EXT

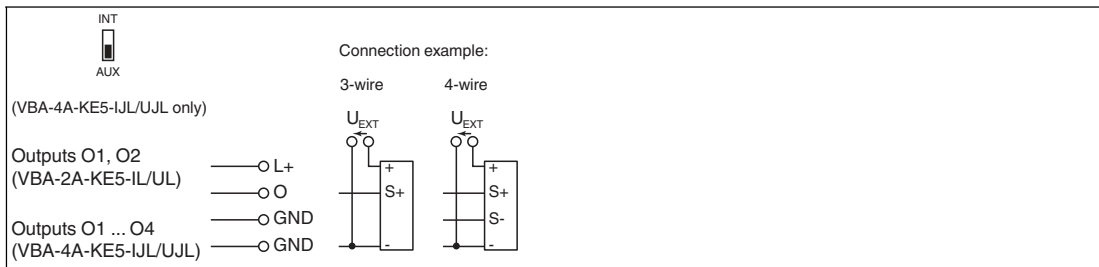


Figure 4.3 Connection of sensors with sensor supply from external power source PELV



#### Note!

Where power is supplied to the actuator from an external PELV EXT voltage source,  $U_{EXT}$  should have equal reference potential to the AUX auxiliary voltage.



#### Warning!

Note the permitted operating temperature

The permitted operating temperature of the cables connected to the terminal block must be at least +80 °C!

## 5 Commissioning

### 5.1 Assigning an Address to the Module

To operate the analog output modules in an AS-Interface network, assign a suitable address to the AS-Interface slave. The VBP-HH1-V3.0 AS-Interface handheld programming device by Pepperl+Fuchs or an AS-Interface master can be used to assign addresses.

VBA-2A-KE5-IL/UL and VBA-4A-KE5-IJL/UJL are standard slaves in line with specification 2.1. You can assign addresses 1 ... 31. The default address on delivery is 0.

### 5.2 Slave Profile

The analog output modules offer the following profile:

	VBA-2A-KE5-IL/UL	VBA-4A-KE5-IJL/UJL
Profile	= S-7.3.5	S-7.3.6
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.

### 5.3 Parameterization

The following parameters can be configured: Program the parameters using an AS-Interface master, with the VAZ-SW-ACT32 AS-i Control Tools 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 "0" if communication with the AS-Interface fails.

#### Parameter P1: Output Mode

Default value P1=1

Parameter P1 is used to select the output mode for the analog outputs.

**VBA-2A-KE5-IL/UL:** Parameter P1 selects current mode or voltage mode for output O1.

**VBA-4A-KE5-IJL/UJL:** Parameter P1 selects current mode or voltage mode for outputs O1 ... O4 collectively.



#### **Note!**

Jumpers on CON1 or CON2 override parameter bits P1 and P3.

If you configure the function of the outputs via the parameter bits, ensure that no jumpers are installed on CON1 or CON2. See chapter 3.4 and see chapter 3.5.

## Parameter P2: Peripheral Fault

Default value P2=1, active

Parameter P2 is used to switch peripheral fault messages on or off in the event of a wire break or if a value is outside the permissible value range. If messages are activated, the PWR and FAULT LEDs flash 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 7.1.

A peripheral fault is **always** issued independently of the parameter P2 if:

- The actuator power supply is overloaded. In this case, the outputs are also set to "0."
- The external auxiliary voltage is not available when the INT/AUX switch = AUX. This only applies to VBA-4A-KE5-IJL/UJL.
- The auxiliary voltage  $U_{AUX}$  is not connected. This only applies to VBA-2A-KE5-IL/UL.



### **Note!**

#### **Wire Break Detection**

At a current output, a wire break is reliably detected if the set current  $> 10 \mu\text{A}$ .

From  $1 \mu\text{A}$  to  $10 \mu\text{A}$ , wire break detection cannot be guaranteed.

If power = 0, wire break detection is deactivated.

## Parameter P3: Output Mode O2 or Automatic Mode

Default value P3=1

Parameter P3 is used to select the output mode for the analog outputs.

**VBA-2A-KE5-IL/UL:** Parameter P3 selects current mode or voltage mode for output O2.

**VBA-4A-KE5-IJL/UJL:** Parameter P3 activates automatic load detection (automatic mode) for outputs O1 ... O4.



### **Note!**

Jumpers on CON1 or CON2 override parameter bits P1 and P3.

If you configure the function of the outputs via the parameter bits, ensure that no jumpers are installed on CON1 or CON2. See chapter 3.4 and see chapter 3.5.



### **Tip**

#### **Mixed Operation**

When automatic load detection is activated, VBA-4A-KE5-IJL/UJL is able to operate the current and voltage outputs simultaneously.



**Configuration via Parameters/Jumpers**









Jumpers	Parameter		VBA-4A-KE5-IJL/UJL Output mode	VBA-2A-KE5-IL/UL Output mode
	P1	P3		
CON1 9  10 CON- CON2 11  12 CON-	1 0 1 0	1 1 0 0	4 current outputs 4 voltage outputs Automatic mode Reserved	2 current outputs O1 voltage output/O2 current output O1 current output/O2 voltage output 2 voltage outputs
CON1 9  10 CON- CON2 11  12 CON-	x	x	4 voltage outputs	O1 voltage output/O2 current output
CON1 9  10 CON- CON2 11  12 CON-	x	x	Automatic mode	O1 current output/O2 voltage output
CON1 9  10 CON- CON2 11  12 CON-	x	x	Reserved	2 voltage outputs

Table 5.1 Configuration of the Output Mode via Parameters/Jumpers



**Note!**

Never connect the CON1, CON2, and CON- connections with external potentials.  
Maximum permissible length of the jumper: ≤ 5 cm.

## 6 Troubleshooting

### 6.1 Causes and Elimination of a Peripheral Fault

A peripheral fault (P fault) is indicated by the PWR LED and the FAULT LED flashing alternately. There are various causes of and solutions for correcting peripheral faults.

Cause	Solution
Wire break at the current output	<ul style="list-style-type: none"> <li>■ Check connection to actuator</li> </ul>
Actuator with voltage input connected to output in current mode	<ul style="list-style-type: none"> <li>■ Correct actuator type</li> <li>■ Correct output mode. See chapter 3.4 or see chapter 3.5 and see chapter 5.3</li> </ul>
Analog value outside the value range	<ul style="list-style-type: none"> <li>■ Check analog values. See chapter 7.1</li> </ul>
Actuator power supply overloaded	<ul style="list-style-type: none"> <li>■ Check actuator supply for short circuit</li> </ul>
Auxiliary voltage missing (VBA-4A-KE5-IJL/UJL: AUX switch position)	<ul style="list-style-type: none"> <li>■ Check the auxiliary voltage</li> </ul>

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

### 6.2 Causes and Elimination of a Actuator Fault

The following causes may prevent connected actuators being activated with the correct signal values.

Cause	Solution
Actuator with voltage input connected to output in current mode	<ul style="list-style-type: none"> <li>■ Check the connection of the actuators. See chapter 3.3 and see chapter 4.5</li> <li>■ Correct output mode. See chapter 3.4 or see chapter 3.5 and see chapter 5.3</li> <li>■ For VBA-4A-KE5-IJL/UJL only: In automatic mode, a different output mode was already configured previously. See chapter 3.6 to reset the auto-detected configuration</li> </ul>
Actuator with current input connected to output in voltage mode	

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

## 7 Appendix A

### 7.1 Value Ranges of the Analog Output Modules

#### Value Ranges for Current Outputs

Current: 0 mA ... 20 mA



Data sent by master	Output signal [mA]	Output LED	
> 23000	23		Above threshold (peripheral fault) <sup>1)</sup>
20001 ... 23000	20.001 ... 23	on	Extended range <sup>2)</sup>
<b>0 ... 20000</b>	<b>0 ... 20</b>	<b>on</b>	<b>Nominal range</b>
< 0	0		Below threshold (peripheral fault) <sup>1)</sup>

Table 7.1 Value range 0 mA ... 23 mA

<sup>1)</sup>: Peripheral fault (P fault) messages can be managed via parameter P2. The output LED always flashes in the event that the value is above or below the relevant threshold. .

<sup>2)</sup>: Accuracy corresponds to the nominal range

#### Value Ranges for Voltage Outputs

Voltage: 0 V ... 10 V





Data sent by master	Output signal [V]	Output LED	
> 11000	11.0		Above threshold (peripheral fault) <sup>1)</sup>
10001 ... 11000	10.001 ... 11.0		Extended range <sup>2)</sup>
<b>0 ... 10000</b>	<b>0 ... 10</b>		<b>Nominal range</b>
< 0	0		Below threshold (peripheral fault) <sup>1)</sup>

Table 7.2 Value range 0 V ... 11 V

<sup>1)</sup>: Peripheral fault (P fault) messages can be managed via parameter P2. The output LED always flashes in the event that the value is above or below the relevant threshold. .

<sup>2)</sup>: Accuracy corresponds to the nominal range

## 7.2 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 depend on a number of different factors.

### Latency

Latency = the transit time of the signal in worst-case conditions.

In the worst-case scenario, the transfer of a channel via the AS-Interface network begins shortly before the AS-Interface master has received a new data image.

Latency = conversion time + rise time + transfer time \* (number of channels +1)

### 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 =  $150\mu\text{s} * ([\text{Number of occupied addresses}] + 2)$

The transmission time is 7 cycles:

Transmission time =  $150\mu\text{s} * ([\text{Number of occupied addresses}] + 2) * 7$

### 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 =  $150\mu\text{s} * (3 + 2) * 7 = 5,25 \text{ ms}$

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

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