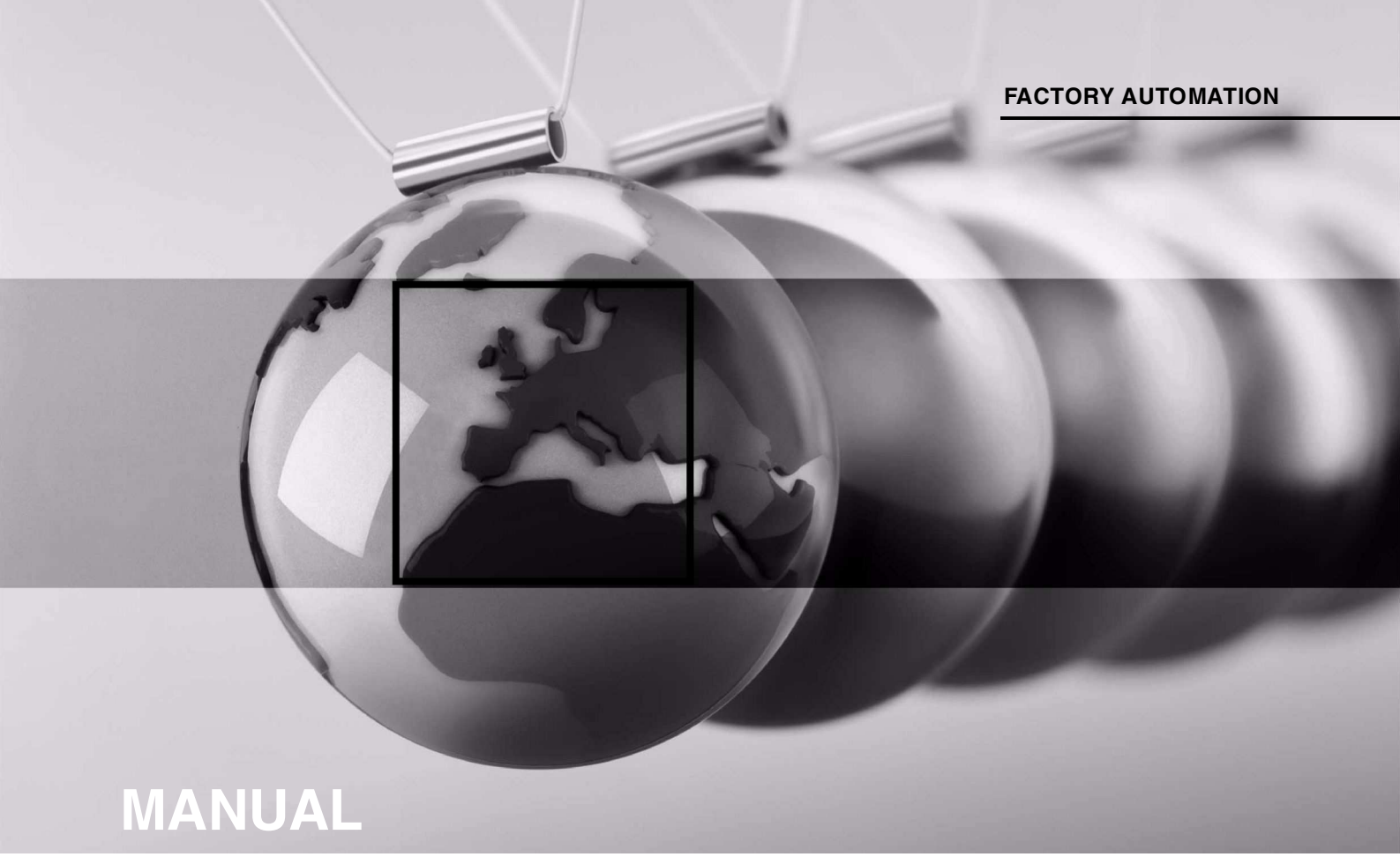
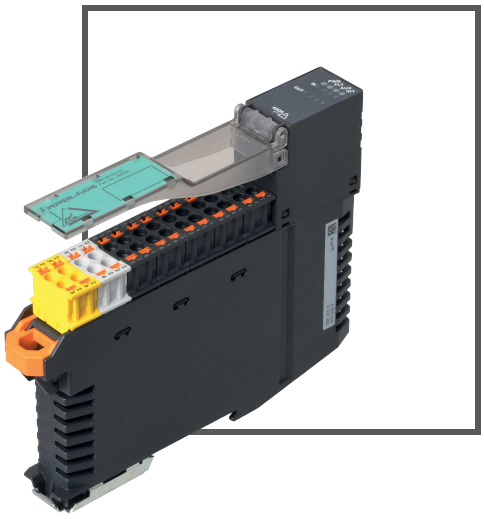


MANUAL

VBA-4E-KE5-IL

AS-Interface Analog Module



A/D Spec 2.1

PEPPERL+FUCHS
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

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.

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.

2018-07

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-4E-KE5-IL is an analog module for connecting up to four sensors 0/4 ... 20 mA to the AS-Interface network. Data conversion and data transfer are provided asynchronously according to AS-Interface profile 7.3. The data is converted internally at a 16 bit resolution. The analog module features four analog current inputs. Power is supplied to the sensors by the auxiliary voltage.

3.2 Displays and Operating Elements

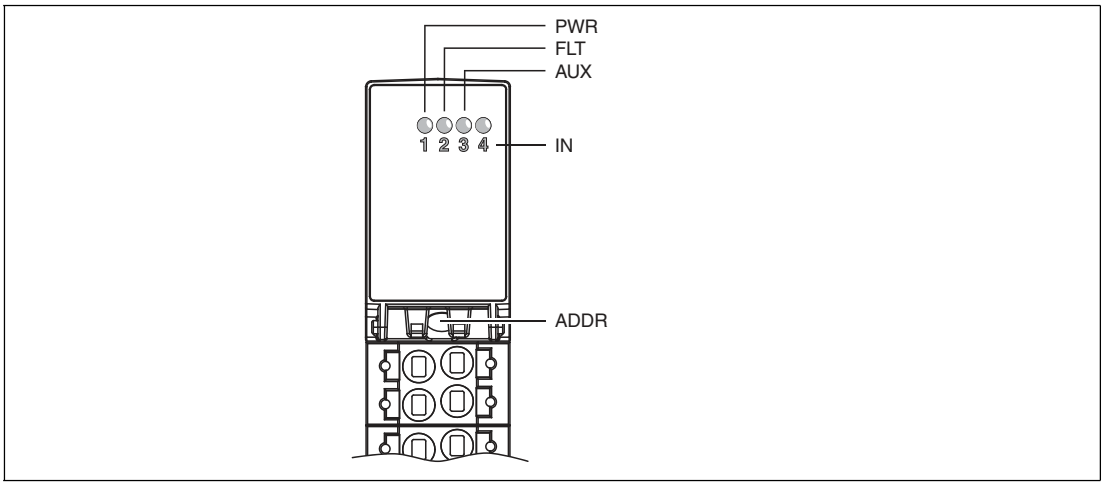


Figure 3.1 Indicators and Operating Elements

The VBA-4E-KE5-IL analog module is equipped with the following indicators and operating elements:

LED Indicators

PWR LED	AS-Interface voltage; green LED Green: voltage OK Green, flashing: address is 0 or peripheral fault
FAULT LED	Fault indication; red LED Red: communication fault or address is 0 Red, flashing: peripheral fault
AUX LED	Ext. auxiliary voltage U_{AUX}; dual green/red LED Green: voltage OK Red: voltage reversed
IN1 LED IN2 LED IN3 LED IN4 LED	Status input signal; yellow LED Yellow: input value within measuring range Yellow, flashing: wire break or input value outside of measuring range Off: channel is disabled

2018-07

3.3 Connections

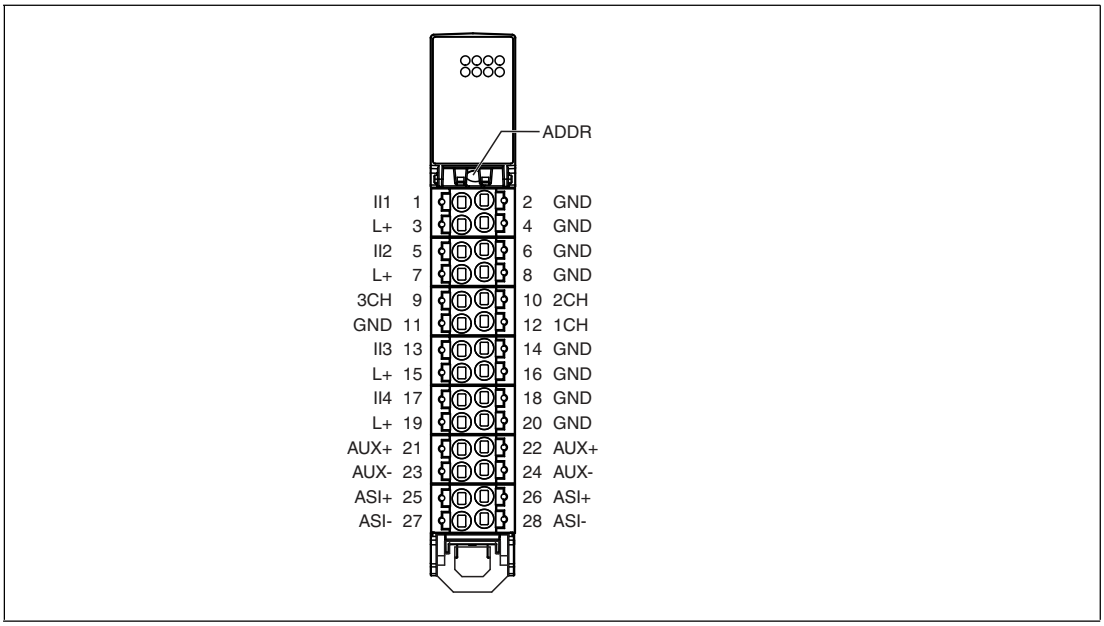


Figure 3.2 Connections

Abbreviation	Explanation
ADDR	Addressing socket; extra-low-voltage switch socket, Ø 1.3 mm
II1 ... II4	Current at analog inputs
L+	Sensor supply
GND	Reference potential for inputs and sensors
1CH, 2CH, 3CH	Jumpers for input configuration
ASI+ ASI-	AS-Interface; both ASI+ terminals and both ASI- terminals are bridged in the terminal block.
AUX+ AUX-	Auxiliary voltage; both AUX+ terminals and both AUX- terminals are bridged in the terminal block.

3.4 Automatic Activation of Input Channels

All input channels are deactivated by default. Wire break detection is activated (parameter bit P3 = 1). The measuring range is 4 mA ... 20 mA. The analog module checks the input signals to detect and automatically activate the connected inputs. This state is indicated by the four yellow LEDs IN1 ... IN4 illuminating in sequence until at least one connected input is detected. If no connected input is detected, the peripheral fault is set after 5 seconds. Automatic activation is still possible.

Activating an Input Channel

An input channel is activated if an input signal within a range of 1 mA ... 23 mA is present. Any activated inputs remain active after the module is restarted. The sequence and number of activated inputs can be chosen as required. To use the automatic activation, no jumpers may be installed between GND and 1CH, 2CH, or 3CH.

Note!

If wire break detection is disabled (parameter bit P3 = 0), automatic activation is switched off and all four input channels are activated. The measuring range is 0 mA ... 20 mA. The number of active input channels can be set by activating them manually using a jumper between GND and 1CH, 2CH, or 3CH. See chapter 3.6.

3.5 Resetting the Automatically Detected Sensor Types

Any sensor types saved through automatic detection are reset when the input configuration of the module is manually changed. For this, there are two available options:

1. Switch off the module power supply. Place or remove the jumper between 1CH, 2CH, or 3CH, and GND, then switch on the supply voltage again.
2. Change the status of parameter P3 (see chapter 5.3). In this case, it is not necessary to switch the supply voltage off and on.

Repeat this process if necessary to return to the required input configuration.

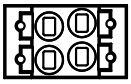
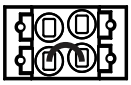
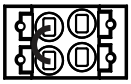
Note!

Any change made to the input configuration via a jumper between 1CH, 2CH, or 3CH, and GND is only detected once the supply voltage is switched on. Changes made via parameter P1 can also be implemented during ongoing operation. See chapter 5.3.

Do not connect the 1CH, 2CH, 3CH, and GND connections to external potentials. The length of the jumpers must not exceed 5 cm.

3.6 Manual Activation of the Input Channels

The number of active input channels can be determined using a jumper between the GND and 1CH, 2CH, and 3CH terminals.

Bridging terminals	Explanation
3CH 9  10 2CH GND 11 12 1CH	Automatic detection active (if parameter bit P3 = 1). See chapter 3.4 and see chapter 5.3.
3CH 9  10 2CH GND 11 12 1CH	Only input channel 1 active
3CH 9  10 2CH GND 11 12 1CH	Input channels 1 and 2 active
3CH 9  10 2CH GND 11 12 1CH	Input channels 1, 2, and 3 active

Note!

Any change made to the input configuration via a jumper between GND and 1CH, 2CH, or 3CH is only detected once the AS-Interface supply voltage is switched on.

Do not connect the 1CH, 2CH, 3CH, and GND connections to external potentials.

The length of the jumpers must not exceed 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 in compliance with EN 50022.

Unlocking Terminal Blocks

Proceed as follows to unlock and eject terminal blocks:

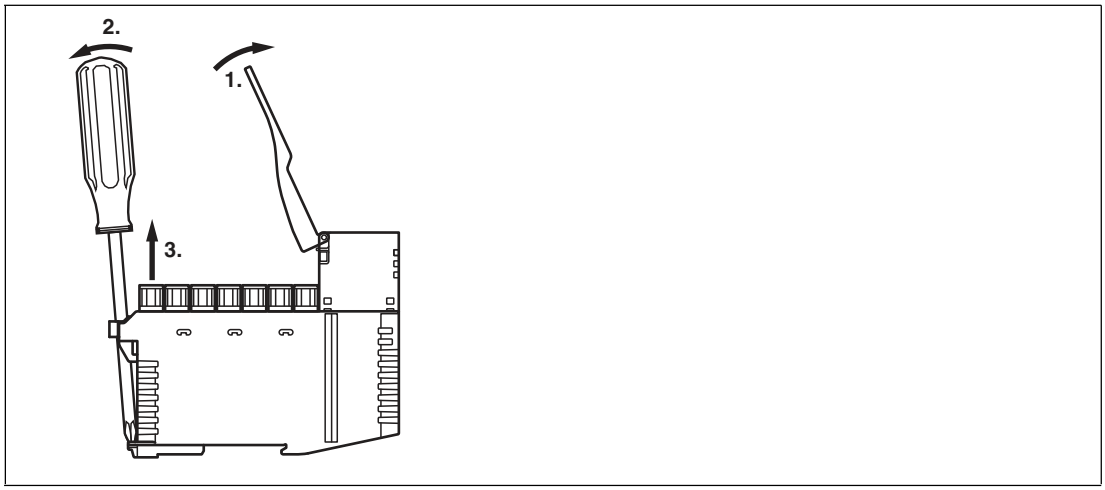


Figure 4.1 Unlocking terminals

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/Auxiliary Voltage Connection

Two terminals are always available for ASI+, ASI-, AUX+, and AUX- to make it easier to loop the leads through. Each of these pairs 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 the Sensors

You can connect 2- and 3-wire sensors to the VBA-4E-KE5-IL. For various connection options, → see Figure 4.2 on page 12 and → see Figure 4.3 on page 12.

Sensor Supply by Aux Auxiliary Voltage via the Module

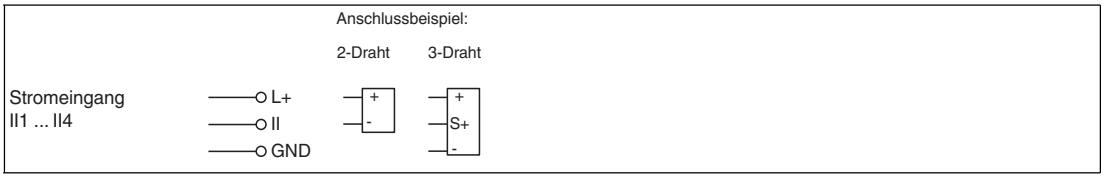


Figure 4.2 Connection of the sensors for sensor supply via the module

Sensor Supply from External PELV EXT Voltage Source

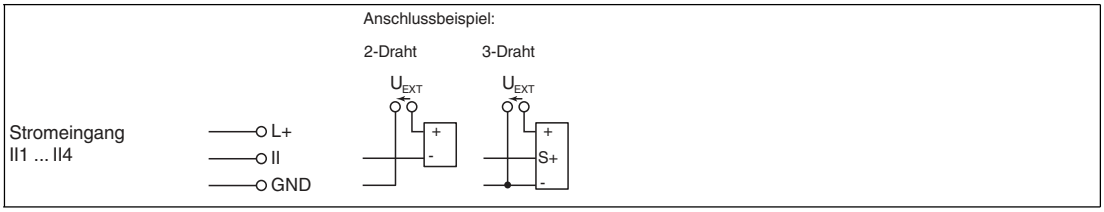


Figure 4.3 Connection of the sensors for sensor supply from external PELV voltage source

Note!

Where the sensor is supplied by an external PELV 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!

2018-07

5 Commissioning

5.1 Assigning an Address to the Module

To operate the VBA-4E-KE5-IL within an AS-Interface network, a suitable address must be assigned to the AS-Interface slave. The AS-Interface VBP-HH1-V3.0 handheld programming device by Pepperl+Fuchs, for example, or an AS-Interface master can be used to assign addresses.

The VBA-4E-KE5-IL is a standard slave as defined by specification 3.0 and requires a master that meets specification 2.1 or higher. You can assign addresses 1 ... 31. The default address on delivery is 0.

5.2 Slave Profile

The VBA-4E-KE5-IL has the profile

S-7.3.E

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

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

5.3 Parameterization

The following parameters can be set for the VBA-4E-KE5-IL. 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: 50/60 Hz Filter

Default value P0=1, active

With parameter P0, you activate the filter for 50/60 Hz line frequencies. With an activated filter, line frequency interference is suppressed. In this case, the conversion time is extended (see chapter 7.2).

Parameter P1: Not Used

Parameter P2: Peripheral Fault

Default value P2=1, active

Parameter P2 is used to switch peripheral fault messages in the event of a measuring overrange on or off (see chapter 7). If messages are activated, the PWR and FAULT LEDs flash in the event of a peripheral fault, and a message is sent to the master.

A peripheral fault is always output independently of the parameter P2, if:

- The power supply is overloaded.
- There is no external AUX power supply.
- No channel is activated. See chapter 3.4.

Parameter P3: Wire Break Detection

Default value P3=1, active

Parameter P3 is used to switch wire break detection on or off at the input channels. Where wire break detection is activated, automatic channel detection is also activated (see chapter 3.4). The measuring range is 4 mA ... 20 mA.

Parameter P3 = 0 is used to switch off wire break detection. All four input channels are then active. The measuring range is 0 mA ... 20 mA.

2018-07

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
Sensor supply overload	■ Check sensor supply for short circuit
Data outside the measuring range	■ Check connected sensors for wire break/short circuit ■ Disable wire break detection if a measuring range of 0 … 20 mA is required. See chapter 5.3
No input channel activated	■ Activate input channel (see chapter 3.4)
Auxiliary voltage too low	■ Check the auxiliary voltage

6.2 Causes and Elimination of a Channel Fault

If an input channel is not transferred and the corresponding IN LED does not light up, the channel is not activated.

Cause	Solution
Bridge is inserted between 1CH, 2CH, or 3CH, and GND	■ Remove the bridge, then reset the power supply (see chapter 3.6)
Incorrect input channels activated	■ A different input configuration was saved previously through automatic channel detection. To reset the input configuration see chapter 3.5

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

7 Appendix A

7.1 Analog Input Module Measuring Ranges

Current Input Measuring Ranges

The measuring 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	 1)	Above threshold (peripheral fault)
20.001 ... 23	20001 ... 23000	On	Extended range 2)
4 ... 20	**4000 ... 20000**	**On**	**Nominal range**
1 ... 3.999	1000 ... 3999	On	Extended range 2)
< 1	32767	 1)	Below threshold (peripheral fault)

Table 7.1 Measuring range 1 mA ... 23 mA

1): When channel is activated

2): Measurement accuracy corresponds to the nominal range

Current: 0 mA ... 20 mA

Input signal [mA]	Display on the master	Input LED	
> 23	32767		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 7.2 Measuring 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.

7.2 Delay Times

The module requires a certain amount of time to convert and transmit the analog measuring signals to the AS-Interface master. This time span (= latency) 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

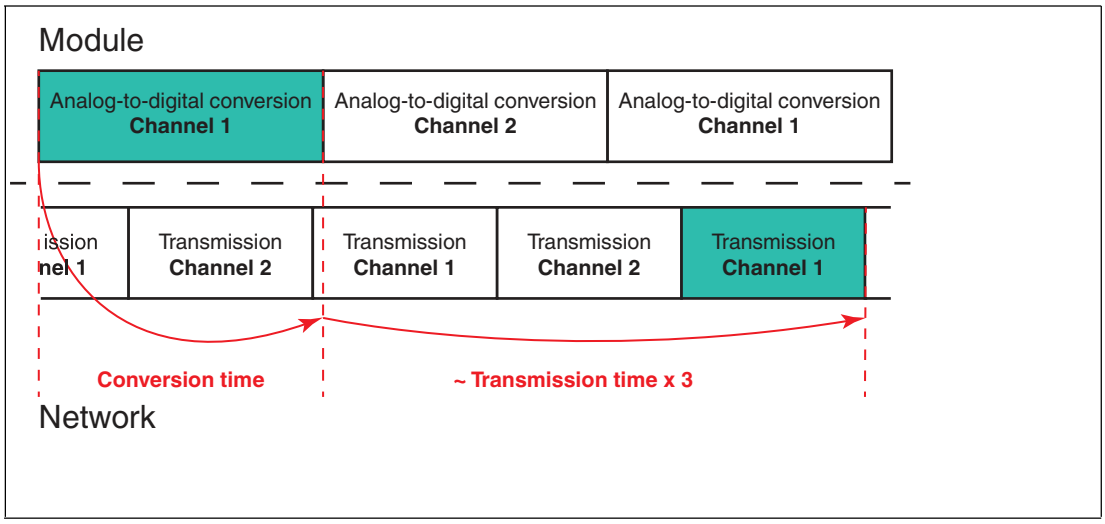


Figure 7.1 Conversion time > Transmission time

2nd

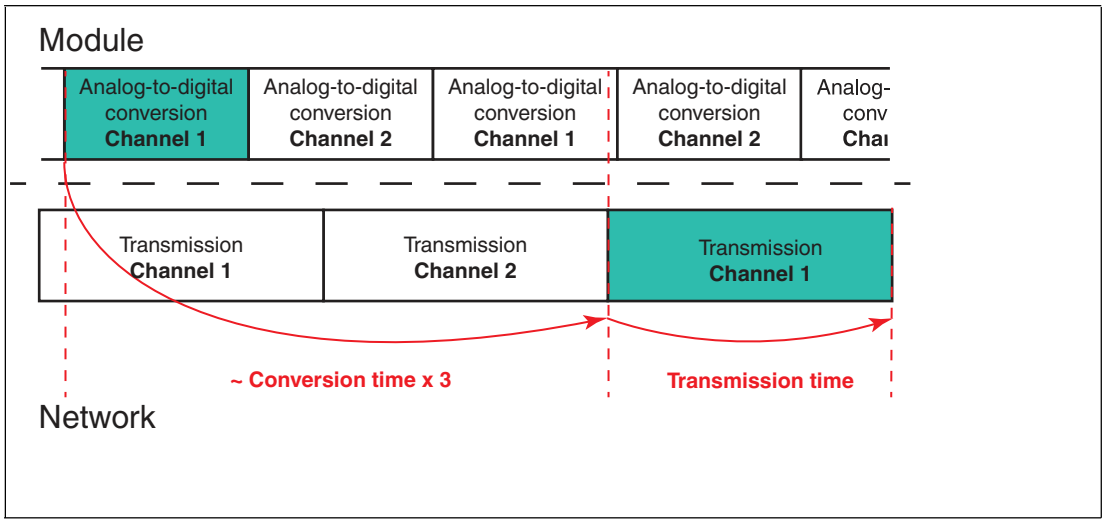


Figure 7.2 Conversion time < Transmission time

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 7.3

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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