MANUAL

AS-ɪ Sᴘᴇᴇᴅ Mᴏɴɪᴛᴏʀ

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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"

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AS-i Speed Monitor

30.9.2015

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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 installing this equipment and put into operation, read this manual carefully. This manual containes instructions and notes to help you through the installation and commissioning step by step. This makes sure bring such a trouble-free use of this product. This is for your benefit, since this:

- ensures the safe operation of the device
- helps you to exploit the full functionality of the device
- avoids errors and related malfunctions
- avoids costs by disruptions and any repairs
- increases the effectiveness and efficiency of your plant

Keep this manual at hand for subsequent operations on the device.

After opening the packaging please check the integrity of the device and the number of pieces of supplied.

Symbols used

The following symbols are used in this manual:

Information!

This symbol indicates important information.

Attention!

This symbol warns of a potential failure. Non-compliance may lead to interruptions of the device, the connected peripheral systems, or plant, potentially leading to total malfunctioning.

Warning!

This symbol warns of an imminent danger. Non-compliance may lead to personal injuries that could be fatal or result in material damages and destruction.

Contact

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

Pepperl+Fuchs GmbH

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68307 Mannheim

Telephone: +49 621 776-4411

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E-Mail: fa-info@pepperl-fuchs.com

30.9.2015

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2. Declaration of conformity

2.1 Declaration of conformity

This product was developed and manufactured under observance of the applicable European standards and guidelines.

Information!

A Declaration of Conformity can be requested from the manufacturer.

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

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3. Notes on Safety

This chapter contains user safety information.

Warning!

Please read this chapter carefully before using the Speed Monitor in combination with other machine safeguarding components on protected machinery.

3.1 Experienced staff

The 'AS-i Speed Monitor' must only be installed, operated, and maintained by qualified staff.

Qualified is a person who

• has a suitable technical education

• has been instructed in operating the machinery and has been informed about the valid safety guidelines by the machinery operator

• has access to the user manual.

3.2 Application area of the device

The AS-i Speed Monitor monitors the speeds and position of maximum two axes and depend on them it provides safe switching signals via AS-i and on local outputs.

3.2.1 Safety category

• SIL 3 according to EN 62 061

• PLe according to EN 13 849

• Cat 4 according to EN 954-1

Information!

Safety categories SIL 3, Cat. 4, PLe can be met for TTL and SSI encoders only if both connected encoders are monitoring the same axis and the speed monitor is configured for this mode.

3.3 Correct use

The AS-i Speed Monitor must only be used as defined in chap. <Application area of the device>. The AS-i Speed Monitor must only be used on the system, at which it was installed in accordance with this manual by adept personnel.

Information!

If used in a way differing from this description or if the device has been changed in any way – even during installation – any warranty claims with respect to Pepperl+Fuchs GmbH are invalid.

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3.4 Disposal

Information!

Electronic waste is hazardous waste. Please comply with all local ordinances when disposing this product!
The device does not contain batteries that need to be removed before disposing it.

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4. General Remarks

Please read this chapter carefully before working with the documentation and the "AS-i Speed Monitor".

4.1 Product information

This user manual is valid for the following Pepperl+Fuchs GmbH devices

4.1.1 AS-i Speed Monitor

AS-i Speed Monitor For sine /cosine encoder	**VBA-2E-KE4-ENC-S**
AS-i Speed Monitor For sine/cosine, SSI or TTL encoder	**VBA-2E2A-KE4-ENC/SSI-S**

4.2 Function of this manual

This manual instructs for the safe assembly, electrical installation, addressing, start-up as well as for the operation and for the maintenance of the Speed Monitor.

This manual does *not* provide instructions for operating machines, on which this module is built in. Please view the appropriate machine manual for corresponding information.

4.3 Target group

This manual is intended for designers, developers and operators of systems that will be safeguarded by one or more AS-i Speed Monitors. The manual is also targeted to people integrating AS-i Speed Monitors into machinery, performing the initial start-up, or maintaining them.

4.4 AS-i 3.0 specification

The AS-i Speed Monitor is designed according to the AS-i 3.0 specification.

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5. Product Description

This chapter is intended to inform the reader about the special characteristics of the AS-i Speed Monitor. It describes the design and the functionality of the devices.

Warning!

This chapter must be read before installation and operation of the device in conjunction with other safety components on protected machinery.

5.1 Technical data

The technical data are placed in the data sheet. Please view the current version on the web page: http://www.pepperl-fuchs.com.

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5.2 Safety relevant data (VBA-2E-KE4-ENC-S)

Identification data	Value	Standard
Safety category	4	EN 954-1 EN ISO 13849-1
Performance Level (PL)	e	EN ISO 13849-1
Safety Integrity Level (SIL)	3	EN 62061
Usage time (TM) [year]	20	EN ISO 13849-1
Max. power-on time [month]	12	EN 62061
PFH$_D$ [1/h]	2,77 x 10^{-09}	EN 61508, EN 62061

Tab. 5-1.

Max. system response time [ms] as a function of frequency limit

1015 Hz $<$ f$_{limit}$	**100 ms**
45 Hz $<$ f$_{limit}$ $<$ 1015 Hz	**140 ms**
f$_{limit}$ $<$ 45 Hz	**700 ms**

Frequency limit for 0-sequence
(1) f$_{in}$ = (f$_{limit}$ + 20Hz)∗100.5%

Frequency limit for safety code sequence
35 Hz $<$ f$_{limit}$ $<$ 900 Hz
(2) f$_{in}$ = (f$_{limit}$ - 20Hz)∗99.5%

980 Hz $<$ f$_{limit}$
(3) f$_{in}$ = (f$_{limit}$ - 100Hz)∗99.5%
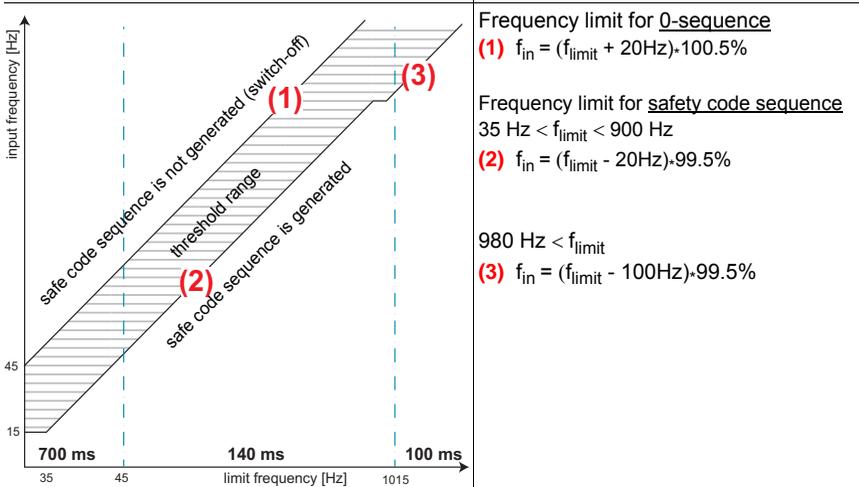
Tab. 5-2.

The diagram shows the function of the highest input frequencies at which the code sequence is reliably generated (lower curve) and the function of the lowest input frequencies at which the code sequence is reliably not generated (upper curve) as a function of the parameterized frequency limit.

5.3 Safety relevant data (VBA-2E2A-KE4-ENC/SSI-S)

Identification data	Value	Standard
Safety category	4	EN ISO 13849-1
Performance Level (PL)	e	EN ISO 13849-1
Safety Integrity Level (SIL)	3	EN 62061
Usage time (TM) [year]	20	EN ISO 13849-1
Max. power-on time [month]	12	EN 62061
PFH[1]$_D$ [1/h]	$5{,}08 \times 10^{-9}$	EN 62061, IEC 61508

Max. system response time [ms] depending on the frequency limit value	
AS-i input → local output	40 ms
Incremental encoder → local output	$\dfrac{2}{f_{Limit}} + t_{Filter} + 15$ ms
Incremental encoder → AS-i	$\dfrac{2}{f_{Limit}} + t_{Filter} + 20$ ms
SSI → local output	$t_{Watchdog} + t_{Filter} + 10$ ms
SSI → AS-i	$t_{Watchdog} + t_{Filter} + 15$ ms

Tab. 5-3.

1. The failure rates are specified for a maximum ambient temperature of 50° C.

Information!

Safety categories SIL 3, Cat. 4, PLe can be met for TTL and SSI encoders only if both connected encoders are monitoring the same axis and the speed monitor is configured for this mode.

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5.4 Front view and connections

5.4.1 VBA-2E-KE4-ENC-S
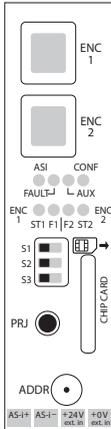
	ENC 1, ENC 2 Connection for encoder
	Chip Card Chip card
	S 1, S 2, S 3 Function selector switch
	PRJ Configuration push button
	ADDR Addressing port

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Connection to the AS-i Bus

AUX+$_{ext.in}$, AUX-$_{ext.in}$

Connection for external 24 V_{DC} PELV power supply

5.4.1.1 Mini IO socket plug

Pin	sin/cos
1	$\overline{sin}$
2	sin
3	n.c.
4	n.c.
5	cos
6	$\overline{cos}$
7	U_b
8	GND

```
7    8
5    6
3    4
1    2
```

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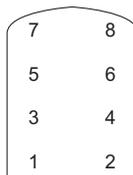
5.4.2   VBA-2E2A-KE4-ENC/SSI-S

ENC 1, ENC 2 Connection for encoder	
Chip Card Chip card	
PRJ Configuration push button	
ADDR Addressing port	
1.14$_{ext.out}$ 0V 1$_{ext.out}$ / 2.14$_{ext.out}$ 0V 2$_{ext.out}$ semiconductor output 1/2	

ASI+, ASI–

Connection to the AS-i Bus

AUX+$_{ext.in}$, AUX-$_{ext.in}$

Connection for external 24 V_{DC} PELV power supply

5.4.3   RJ45 socket plug

Pin	sin/cos	SSI	TTL
1	Ub_{in}	Ub_{in}	Ub_{in}
2	GND_{in}	GND_{in}	GND_{in}
3	–	CLK	–
4	sin	DATA	B
5	$\overline{sin}$	$\overline{DATA}$	$\overline{B}$
6	–	$\overline{CLK}$	–
7	cos	–	A
8	$\overline{cos}$	–	$\overline{A}$

Ub_{in}
power supply, encoder, positive pol

GND_{in}
power supply, encoder, negative pol

CLK, $\overline{CLK}$
clock line

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DATA, $\overline{\text{DATA}}$
data line

sin, $\overline{\text{sin}}$; cos, $\overline{\text{cos}}$; A, $\overline{\text{A}}$; B, $\overline{\text{B}}$
signal line

5.5   Operating elements

The operating elements are located on the front side beneath the transparent folding cover.

The addressing socket is and projecting buttons are accessible through holes even when the cover is closed.

To open the cover, for example to remove the chip card or set the switches, both encoders must be unplugged.

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5.5.1 Function selector switch (only with VBA-2E-KE4-ENC-S)

Off │ On		
S1	■ ■	**S1 - Off (RUN)**
S2	■ ■	normal operationing state
S3	■ ■	**S1 - On (Clear)**
		Factory setting mode
		S2, S3 (NC)
		Reserved

Off │ On
S1 ■
S2 ■ **NC**
S3 ■ **NC**
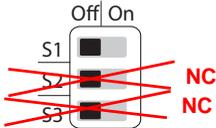
Information!

Function selection switches S2 and S3 currently have no function. In the future these will be used for selecting various options (e.g. encoder or resolver).

Mode for factory settings

The function selection switch S1 can be used to reset the device to its default settings.

☐ Disconnect AS-i voltage.

☐ Set the function selection switch S1 to the On position (Clear).

☐ Finally connect AS-i voltage again.

⟹ A run light on LEDs ST1, ST2, F1 and F2 appears for 5 s.

☐ During this time push and hold the projecting button as long as the running light stops flashing.

⟹ The device is reset to its factory default settings.

☐ Set the function selection switch S1 to the Off position (Run).

⟹ The device is in the normal operating state.

5.5.2 Projecting button

VBA-2E-KE4-ENC-S

The Projecting button can be used to store currently present frequencies. The stored values can then be loaded via software.

While values are being stored the **CONF** LED flashes.

The **CONF** LED goes out again as soon as the stored values have been loaded. Values stored using the Projecting button are deleted at **Power-on**.

Information!

The exact sequence of the parameterization is described in Sec. <Configuration>.

30.9.2015

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VBA-2E2A-KE4-ENC/SSI-S

By short pushing the Projecting button, the global reset of error condition can be triggered, in order to reset red-flashing configuration devices or an output that has shut down because of an overload.

- If no error is present, currently available frequencies and/or positions can be stored temporary for processing. These values can then be uploaded via software.
- The Projecting button can be used to reset the device to its default settings:

Mode for factory settings (VBA-2E2A-KE4-ENC/SSI-S)

☐ Disconnect AS-i voltage.

☐ Push and hold the Projecting button.

☐ Holding the button, connect the AS-i voltage again.

⟹ A running light on LEDs **ST1**, **ST2**, **F1** and **F2** appears for 5 seconds.

☐ After the running light is started, release the button and confirm the process with short pushing the button.

⟹ The device is set to the factory settings.

⟹ The device is in configuration mode.

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5.5.3 Chip card

The chip card is used for storing the device parameters, speeding up the time required to replace defective units. Exchanging the chip card moves all parameters from the old unit to the new one.

Unit replacement: Chip card "not blank" in a non-configured unit (unit in factory default state)

If a non-blank chip card is plugged into a configured unit, the data are copied to the unit.

Blank chip card in a configured unit

If a blank chip card is plugged into a configured unit, the data are copied to the chip card.

Data in the unit and the chip card are not the same

If the chip card and the unit are not blank and contain different data, there will be an error message (see Sec. <LEDs>).

Warning!

Verify the safety functions after replacing the unit!

5.5.4 Sensors

To VBA-2E-KE4-ENC-S only rotary and linear encoders may be connected.

To VBA-2E2A-KE4-ENC/SSI-S also angle or position encoder can be connected next to rotary or linear encoders.

Information!

Please note additional information in Sec. <Safety Requirements>.

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5.6 LED status display

5.6.1 VBA-2E-KE4-ENC-S

LED		Description
ASI	○	AS-i supply power not OK
	(1) 1 Hz	Periphery fault or address '0', configuration not validated
	(1)	AS-i supply power OK
FAULT	○	On-line
	(2)	Periphery fault or address '0', configuration not validated
	(2)	Off-line or address '0'
AUX	○	24 V_{DC} AUX missing
	(1)	24 V_{DC} AUX present
CONF	○	Normal operation
	(3) 2x 1 Hz	hip card is written
	(3)	Frequency stored via configuration button (see chap. <Projecting button>)
ST1, ST2	○	Encoder 1 / 2 *not* connected
	(3)	Error message
	(3)	Encoder 1 / 2 connected
F1, F2	○	No safe, low frequency or stop axis 1 / 2
	(3)	Error message
	(3)	Safe, low frequency or stop axis 1 / 2
ST1, F1, F2, St2	5 sec (3)	Switch S1 on 'clear'

Tab. 5-4. LEDs

(1) LED green   (2) LED red   (3) LED yellow

LED on   LED flashing   off

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LED flashing sample

LEDs	State					Process
ASI, FAULT, AUX, CONF	⊙	⊙	⊙	⊙	table 5-4	error encoder 1
ST1, F1, F2, ST2	☀	☀	◑	◑	2 Hz	
ASI, FAULT, AUX, CONF	⊙	⊙	⊙	⊙	table 5-4	error encoder 2
ST1, F1, F2, ST2	◑	◑	☀	☀	2 Hz	
ASI, FAULT, AUX, CONF	⊙	⊙	⊙	⊙	table 5-4	Data on chip card and device different
ST1, F1, F2, ST2	☀	☀	◑	◑	2 Hz	
ASI, FAULT, AUX, CONF	⊙	⊙	⊙	⊙	table 5-4	Chip card defective
ST1, F1, F2, ST2	◑	◑	☀	☀	2 Hz	
ASI, FAULT, AUX, CONF	⊙	⊙	⊙	⊙	table 5-4	Circuit or internal error
ST1, F1, F2, ST2	☀	☀	☀	☀	2 Hz	
ASI, FAULT, AUX, CONF	⊙	⊙	⊙	⊙	table 5-4	Factory reset
ST1, F1, F2, ST2	☀	☀	☀	☀	—	
ASI, FAULT, AUX, CONF	⊙	🟢	🔴	⊙	1 Hz	Configuration not validated
ST1, F1, F2, ST2	⊙	⊙	⊙	⊙	table 5-4	

Tab. 5-5.

Legend

☀	☀	Flashing in common mode
☀	☀	Flashing in push-pull mode
◑	◑	off
☀	☀	on
☀ ☀ ☀ ☀		Chaser lights
⊙	⊙	Standard view acc. to table 5-4

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5.6.2 VBA-2E2A-KE4-ENC/SSI-S

LED		Description
ASI		AS-i supply power not OK
	(1)	Address '0' or configuration not validated
	(1)	AS-i supply power OK
FAULT		On-line
	(2)	Configuration not validated
	(2)	Off-line or address '0'
AUX		24 VDC AUX missing
	(1)	24 VDC AUX present
CONF		Normal operation
	(3)	hip card is written
	(3)	Configuration operation
ST1, ST2		Encoder 1/2 not connected
	(3)	Encoder 1/2 connected
F1, F2		motion axis 1/2
	(3)	Encoder error
	(3)	stop axis 1/2
O1, O2		state output 1/2
	(3)	overload cut-off

Tab. 5-6. LEDs

(1) LED green   (2) LED red   (3) LED yellow

LED on   LED flashing   off

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LED flashing sample

State				Process
ST1	F1	F2	ST2	
🔆	🔆	⭘	⭘	error encoder 1
ST1	F1	F2	ST2	
⭘	⭘	🔆	🔆	error encoder 2
ST1	F1	F2	ST2	
🔆	🔆	⭘	⭘	Data on chip card and device different
ST1	F1	F2	ST2	
⭘	⭘	🔆	🔆	Chip card defective
ST1	F1	F2	ST2	
🔆	🔆	🔆	🔆	Circuit or internal error
ST1	F1	F2	ST2	
🔆	🔆	🔆	🔆	Factory reset
ASi	Fault	Aux	Conf	
🟢	🔴	⭘	⭘	Configuration not validated
ST1	F1	F2	ST2	
🔆	🔆	🔆	🔆	Incorrect double configuration

Tab. 5-7.

Legend		
🔆	🔆	Flashing in common mode
🔆	🔆	Flashing in push-pull mode
⭘	⭘	off
🔆	🔆	on
🔆 🔆 🔆 🔆		Chaser lights

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6. Installation

6.1 Installation

On mounting plate with 35 mm top-hat rail
Vertical monting position!
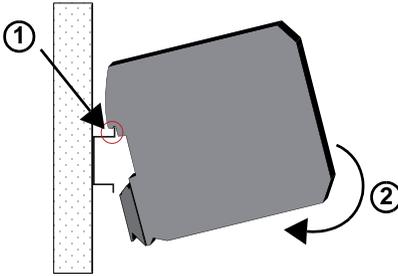
6.2 Electrical Installation

0,6 x 3,5 mm	0,6 Nm (5 lb$_f$·in)
7	0,2 ... 2,5 mm^2
7	0,2 ... 2,5 mm^2
AWG	24 ... 12
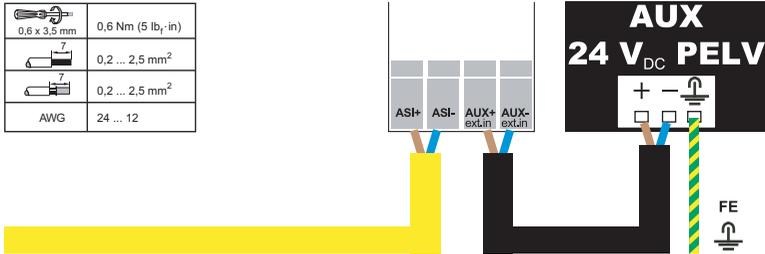
Ambient air temperature **0 °C … +55 °C**

Temperature rating for cable **60/75 ^{o}C**

Use copper conductors only
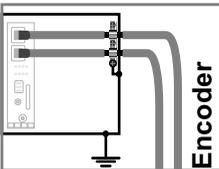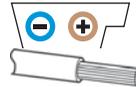
Connect encoder shield to cabinet ground!

30.9.2015

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Caution

The AS-i power supply for the AS-i components must have isolation per IEC 60742 and be able to handle momentary power interruptions of up to 20 ms. The power supply for the 24 V supply must also have isolation per IEC 60742 and be able to handle momentary power interruptions of up to 20 ms.

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7.   Maintenance

7.1   Controlling safe shutdowns

The plant safety engineer is responsible for verifying that the AS-i Speed Monitor works correctly as part of the safety system.

At least once a year it is necessary to verify the safe shutdown by initiating associated safety-related sensors or switchs:

Attention!

Press each safety-related AS-i slave and watch the reaction of the output circuits of the AS-i Safety Monitor.

Attention!

Check the maximum activated time and the total operating time. These values depend on the PFD value chosen for the total failure probability. Please refer to the information in chap. <Safety relevant data>.

After reaching the projected maximum operating time (three, six, or twelve months) the entire safety system must be checked for proper operation.

After reaching the projected total usage time (20 years) the device must be checked by the manufacturer concerning its proper operation.

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8. Configuration

Parameters are set similar to the AS-i Safety Monitor using the PC interface and reading back the data per text. Communication between the Speed Monitor and the PC is over AS-i.

8.1 Parameters

VBA-2E-KE4-ENC-S

Each channel uses the following parameters:

- AS-i Address
- Channel activated, channel not activated
- Detection of Safety Stop active, detection of Safety Stop not active
- Maximum allowed safe speed
- Detection of rotating direction.

VBA-2E2A-KE4-ENC/SSI-S

There are following parameters for each channel:

- AS-i Address
- Type of encoder
- Encoder parameters
- Filter settings
- safe coupling of encoder.

The function of the safe AS-i signals and the safety outputs can be freely configured via the ASIMON software.

○ *Information!*

For additional information, please refer to the separate documentation for the ASIMON software.

8.2 Setting parameters using AS-i Master with integrated Safety Monitor

○ *Information!*

Setting parameters using AS-i Master with integrated Safety Monitor is only possible with VBA-2E-KE4-ENC-S .

1. The Speed Monitor is connected to the AS-i circuit.
2. The non-safety slave is addressed.
3. The connected axes are brought to safe speed. If multiple Speed Monitors are connected, the Projecting button is actuated. The **CONF** LED flashes.
4. From the menu select "Speed Monitor." If multiple Speed Monitors are connected, you can select which device (AS-i address of the non-safety slave) is parameterized.
5. This menu is displayed

30.9.2015

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5.

```
SPEED MONITOR
PASSWORD
xxxx
OK            ESC
```

A 4-digit number can be entered. The factory default setting is password 0000. The password must be set to a different value in order to run the device.

6.   In the next menu item the addresses of the safety-limited speed (SLS) are assigned

```
ADDRESSES SLS
CH1 23
CH2 24
OK          ESC
```

First the previously set values are shown. These can be overwritten.

If the same address is entered for multiple channels, the results of these channels are overlaid. Only if all frequencies for these channels are within the range of the safety-limited speed is an SaW code sequence sent. This also makes it possible for example to combine Channel 1 and 2 into a single address.

Channels for which 0 is entered as an address are deactivated.

7.   In the next menu item the addresses of the safety stop are assigned.

```
ADDRESSES STOP
CH1 23
CH2 24
OK          ESC
```

First the previously set values are shown. These can be overwritten.

If the same address is entered for multiple channels, the results of these channels are overlaid. Only if all frequencies for these channels are within the range of the safety-limited speed is an SaW code sequence sent. This also makes it possible for example to combine Channel 1 and 2 into a single address.

Channels for which 0 is entered as an address are deactivated.

8.   After clicking on OK the following menu appears

Here the taught frequencies + 10% tolerance are shown.

```
FREQUENCY
CH1 23433
CH2 24355
OK          ESC
```

9.   The displayed values can be overwritten. To deactivate a channel, set the frequency to 0 or set no AS-i address.

10.   After clicking on OK the data are shown again.

```
ADDR FREQUENCY
CH1-12-23433
CH2-13-24355
OK          ESC
```

11.   After clicking on OK the following menu appears

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```
ADDR STOP
CH1-14
CH2-15
OK            ESC
```

12.   After clicking on OK the following menu appears

```
RELEASE WITH PASSWORD
WORD
XXXX
OK            ESC
```

Here you must enter the password. If a new password is entered, it is applied immediately.

13.   This releases the parameter set.

14.   The release procedure must be documented with date, name of the person releasing and the set parameters, and stored with the equipment documentation.

15.   Before first starting up check the function of the Speed Monitor.

8.3   Setting parameters using ASIMON software

For a detailled description of setting parameters using ASIMON software please consult the software manual.

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9. AS-i data

9.1 AS-i data for SaW slaves (VBA-2E-KE4-ENC-S)

A safety signal is output (code sequence generated) when the frequency falls below the set threshold.

	DiagsIv DO2	f < 25Hz	25Hz< f < f_{max}	f_{max} < f	f > f_{limit} (or other failure)
AS-i SaW sequence safe speed	0	SaW Code	SaW Code	0-sequence	F-sequence
	1	0-sequence	0-sequence		
AS-i SaW sequence stop	0	SaW Code			
	1	0-sequence			

Tab. 9-8.

Information!

f_{max} is the set upper limit for the safety frequency range, f_{limit} is the frequency limit of the unit (250 kHz).

Information!

0-sequence can be enforced in the diagnostic slave via the DO2.

The speed monitor offers the following settings for SaW slaves:

• Represent multiple signals as a collective message on just one SaW input slave

• Any number of safe signals acts on up to eight SaW input slaves (input slaves for each channel: safe speed, safe stop, right- and left-rotation).

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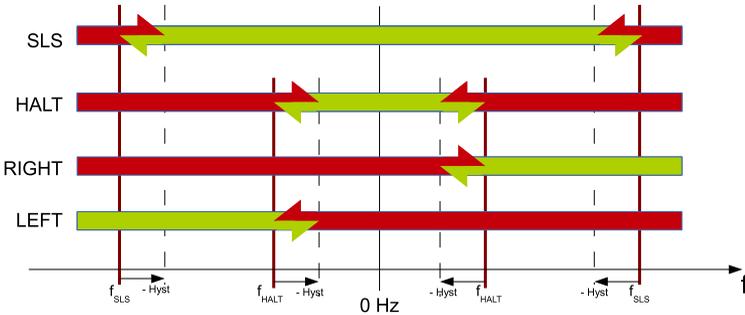
9.2 Examples:

- Safety speed axis 1 = e.g. Address 17
- Safety speed axis 2 = e.g. Address 17

Stopped is also the safety state.

Stopped is required separately:

- Safety stopped axis 1 = e.g. Address 18
- Safety stopped axis 2 = e.g. Address 18

Code sequence for safe speed and safe stop.

The rotation direction must also be monitored:

- Right rotation direction axis 1 = e.g. Address 19
- Right rotation direction axis 2 = e.g. Address 19

Code sequence for safe speed, safe stop and right rotation.

9.3 AS-i data of the diagnostic slave

The diagnostic slave provides 2 analog input data, the current frequency of the 2 axes, scaled in 10 Hz increments (0 … 20,000 corresponds to 0 … 200,000 Hz). For diagnostics all safety signals are also available in the diagnostic slave.

VBA-2E-KE4-ENC-S

DO3	DO2	DO1	DO0
reserved	mute SaW	S-7.5 data	S-7.5 data

DI3	DI2	DI1	DI0
S-7.5 data	S-7.5 data	f (axis 2) < SLS[1]	f (axis 1) < SLS[1]

1.   The input bits always refer to the PLC frequency; the stop frequency plays no role here. For a better diagnostics of short switch-offs, a turn-on and switch-off delay time (holding time) for this bit can be configured via the vendor object 23.

Analog Ch. 0:
frequency axis 1/10 Hz

Analog Ch. 1:
frequency axis 2/10 Hz

30.9.2015

PEPPERL+FUCHS

VBA-2E2A-KE4-ENC/SSI-S

DO3	DO2	DO1	DO0
reserved	free usable	S-7.5 data	S-7.5 data

DI3	DI2	DI1	DI0
S-7.5 data	S-7.5 data	ENC 2 OK	ENC 1 OK

Analog Ch. 0:

frequency axis 1/10 Hz

Analog Ch. 1:

frequency axis 2/10 Hz

9.3.1   Vendor objects (VBA-2E-KE4-ENC-S)

Vendor objects which can be read using the S-7.5 profile of the diagnostics slave:

Index (Vendor-Specific)	description	type	length in byte
1 (0x01)	Name of the safety representative who release the device	C-String	29 max.
2 (0x02)	Name of the configuration	C-String	27 max.
3 (0x03)	Date on which the configuration was loaded into the device.	C-String, YYYY-MM-DD hh:mm	17 max.
4 (0x04)	Date on which the configuration was released.	C-String, YYYY-MM-DD hh:mm	17 max.
20 (0x14)	Number of configurations which have been loaded into the device so far	uint16_t	2
21 (0x15)	Checksum/release code of the current configuration	uint16_t	2
22 (0x16)	0 : No frequency is stored 1 : A frequency was saved using the projecting button. Objects 40-43 contain valid data.	uint8_t	1
23 (0x17)	Holding time for bits DI1 and DI0 One value (in milliseconds) for rising and falling edge	2x uint16_t	4
30 (0x1E)	Frequency currently present on Axis 1	uint32_t	4
31 (0x1F)	Frequency currently present on Axis 2	uint32_t	4
32 (0x20)	Current rotation direction of Axis 1	uint8_t: 0: slow 1: counter-clockwise rotation 2: clockwise rotation	1
33 (0x21)	Current rotation direction of Axis 2	uint8_t: 0: slow 1: counter-clockwise rotation 2: clockwise rotation	1
35 (0x23)	Collector's item for all present actual speeds / directions (cumulated, objects 30-33)		10
40 (0x28)	Frequency of Axis 1 when projecting button is pressed	uint32_t	4
41 (0x29)	Frequency of Axis 2 when projecting button is pressed	uint32_t	4

Tab. 9-9.

Index (Vendor-Spe-cific)	description	type	length in byte
42 (0x2A)	Rotation direction of Axis 1 when projecting button is pressed	uint8_t: 0: slow 1: counter-clockwise rotation 2: clockwise rotation	1
43 (0x2B)	Rotation direction of Axis 2 when projecting button is pressed	uint8_t: 0: slow 1: counter-clockwise rotation 2: clockwise rotation	1
50 (0x32)	Projected limit frequency for STOP Axis 1	uint32_t	4
51 (0x33)	Projected limit frequency for PLC Axis 1	uint32_t	4
60 (0x3C)	Projected limit frequency for STOP Axis 2	uint32_t	4
61 (0x3D)	Projected limit frequency for PLC Axis 2	uint32_t	4
65 (0x41)	Collector's item for all configured speed limits (cumu-lated, objects 50, 51, 60, 61)		16
80 (0x50)	Instantaneous error status / cause for switch-off (see tab. <Bitmaps for error states>)	4 * uint_8	4
81 (0x51)	History error states / cause for switch-off (see tab. <Bitmaps for error states>)	4 * uint_8	4
82 (0x52)	Signal quality of error light, one byte for each axis (only for SIN/COS) 0: very gut (GREEN) 1: OK (YELLOW) 2: Borderline (RED) 3: Error detected 4: Encoder not connected	2 * uint_8	2
83 (0x53)	History of signal quality. Worst value of the error light since the last reset. "Encoder not connected" will be ignored.	2 * uint8_t	2
90 (0x5A)	Projected AS-i address for STOP Axis 1	uint8_t: 0: no address	1
91 (0x5B)	Projected AS-i address for PLC Axis 1	uint8_t: 0: no address	1
92 (0x5C)	Projected AS-i address for STOP Axis 2	uint8_t: 0: no address; 128: synchron. mode	1
93 (0x5D)	Projected AS-i address for PLC Axis 2	uint8_t: 0: no address; 128: synchron. mode	1
94 (0x5E)	Projected AS-i address for right rotation Axis 1	uint8_t: 0: no address	1
95 (0x5F)	Projected AS-i address for right rotation Axis 2	uint8_t: 0: no address	1
96 (0x60)	Projected AS-i address for left rotaton Axis 1	uint8_t: 0: no address	1
97 (0x61)	Projected AS-i address for left rotaton Axis 2	uint8_t: 0: no address	1

Tab. 9-9.

PEPPERL+FUCHS

Index (Vendor-Spe-cific)	description	type	length in byte
98 (0x62)	Collector's item for all safety addresses (cumulated, objects 90-97)		8
112 (0x70)	Current operating mode of speed monitor. 0: no configuration 1: Valid configuration, no release 2: Valid, released configuration	uint8_t: 0: no configuration 1: Valid configuration, no release 2: Valid, released con-figuration	1

Tab. 9-9.

Bitmaps for error states

Vendor-Object	description	byte 0	byte 1	byte 2	byte 3
80 (0x50) Read	current error	cause for switch-off Axis 1	Error Axis 1	cause for switch-off Axis 2	Error Axis 2
81 (0x51) Read	error history	cause for switch-off Axis 1	Error Axis 1	cause for switch-off Axis 2	Error Axis 2
81 (0x51) Write	reset history	write „0": reset now, auto reset off			
		write „1": reset automatically after each reading			
82 (0x52) Write	reset history error light	write „0": reset now, auto reset off			
		write „1": reset automatically after each reading			

Tab. 9-10. Bitmaps for error states

Error description	SAW	bit	byte
no error, frequency safe	code sequence		
frequency exceeded (STOP)	0-sequence	0	cause for switch-off
frequency exceeded (SLS)	0-sequence	1	cause for switch-off
diagnostic slave bit DO2 set	0-sequence	2	cause for switch-off
no encoder connected	0-sequence	3	cause for switch-off
configuration mode / n. validated[1]	0-sequence	4	cause for switch-off
no external 24 V supply[1]	0-sequence	5	cause for switch-off
input signals short-circuited to GND[1]	0-sequence	4	cause for switch-off
amplitude is too high	F-sequence	0	error
amplitude is too small	F-sequence	1	error
f_limit (250kHz) eceeded	F-sequence	2	error
safe coupling, axes not equal	F-sequence	3	error
internal error	F-sequence	4	error
wire break SIN- or COS-line	F-sequence	5	error

Tab. 9-11.

1. Peripheral fault

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9.4 Vendor objects (VBA-2E2A-KE4-ENC/SSI-S)

Index (Vendor-Specific)	description (read)	length (read)	description (write)	length (write)
10 (0x0A)	Device version	2		
21 (0x15)	Checksum / release code of the current configuration	2		
22 (0x16)	Number of configurations which have been loaded into the device so far	1		
70 (0x46)	Fieldbus bits outputs	2	Fieldbus bits inputs	2
80 (0x50)	Encoder diagnostics / error states	8		
81 (0x51)	Encoder diagnostics / error states history	2	Reset error states history	0/1
82 (0x52)	Signal quality of error light, one byte for each axis (only for SIN/COS) 0: very gut (GREEN) 1: OK (YELLOW) 2: Borderline (RED) 3: Error detected 4: Encoder not connected	2		
83 (0x53)	History of signal quality. Worst value of the error light since the last reset. "Encoder not connected" will be ignored.	2	Reset signal quality history	0/1
84 (0x54)	Power supply (min/max)	8	Reset power supply (min/max)	0/1
140 (0x8C)	Current speed	8		
150 (0x96)	Protocol version	2		
151 (0x97)	Chip card is written	1		

Tab. 9-12.

Bitmaps for error states

Vendor object	Description	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
80 (0x50) *Read*	Encoder diagnostics / error state		error encoder 1				error encoder 2		
81 (0x51) *Read*	Encoder diagnostics / error state history		error encoder 1				error encoder 2		

Tab. 9-13. Bitmaps for error states

General errors

Bit	Error description
0	EXT 24V missing
1	Configuration mode
2	Not used
3	Not used
4	Not configurated
5	No encoder connected
6	Not used
7	Not used

30.9.2015

PEPPERL+FUCHS

General errors

Bit	Error description
8	Frequency limit of 250 kHz exceeded
9	Internal error
10	Encoder power supply too low
11	Encoder power supply too high
12	No absolut position
13	Maximum position exceeded
14	Coupling error (speed)
15	Coupling error (position)

Encoder specific errors

Bit	Error description	
	SIN/COS	SSI
16	Earth fault	Valid bit not set
17	Not used	Monoflop time violated
18	Not used	Frame length too short
19	Not used	Frame length too long
20	Amplitude too high	No master recognised
21	Amplitude to small	Repeated frame data wrong
22	Cable break	Not used

10.   Safety Requirements

10.1   Encoder combinations and maximum achievable safety levels

Encoder combination			DC	Achievable safety level
1 encoder per axis	Sin/Cos (SIL3/PLe certified)	-	99%	SIL3, PLe, Cat.4[1]
	Sin/Cos (standard)	-	90%	SIL2, PLd, Cat.2[1]
	TTL (standard)	-	60%	PLc, Cat.1[1]
2 encoders coupled	Sin/Cos	Sin/Cos	99%	SIL3, PLe, Cat.4
	Sin/Cos	TTL		
	Sin/Cos	SSI		
	SSI	SSI		
	SSI	TTL		
	TTL	TTL		

Tab. 10-14.

1.   Fault exclusion for mechanical shaft breakage required.

Warning!

The maximum achievable safety level depends on the encoder, the circuitry and the operating mode of the speed monitor.

When using non-safety rated encoders the signal tracks must be generated independently. The two signal tracks may not be generated by a common processor or derived from each other by an electronic circuit.

- For the purpose of fault exclusion signal **and** inverted signal have to be connected.
- The rotary encoders must have a suitable performance level for the application.
- Please observe the information provided by the rotary encoder manufacturer.

30.9.2015

PEPPERL+FUCHS

10.2   Requirements for the sine/cosine encoder

- Incremental encoder.
- 1Vpp sine/cosine permissible (also from Hiperface or Endat 01 or Endat 02).
- For error exclusion the signal and symmetrical signal must be connected.

valid only for VBA-2E-KE4-ENC-S:

- The encoders are powered either externally or from the Speed Monitor. The Speed Monitor provides 5 V (max. 100 mA). The power source (internal/external) is determined by the connection wiring. If the encoder is powered externally, the connected voltages must not exceed 5.4 V, and if there is more than 5.4 V the current provided on each line may not exceed 44 mA.

valid only for VBA-2E2A-KE4-ENC/SSI-S:

- The encoder are powered externally. The encoder monitors the voltage (monitoring range configurable) and it must not exceed 30 V.

10.3   Anforderungen an den TTL-Drehgeber

- Inkrementalgeber.
- TTL-Signal mit einer Amplitude von ± 5 V
- Die Drehgeber werden extern versorgt. Die Spannung wird vom Drehzahlwächter überwacht (Überwachungsbereich konfigurierbar) und darf maximal 30 V betragen.

10.4   Requirements for the SSI encoder

- Absolute encoder.
- Mutliturn encoder as an absolute encoder:
  - the range of values of the SSI data must cover the full operating radius.
- Single-turn encoder as an angle encoder:
  - the range of value of the encoder indicates the current angle range.
- The encoder are powered externally. The encoder monitors the voltage (monitoring range configurable) and it must not exceed 30 V.

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