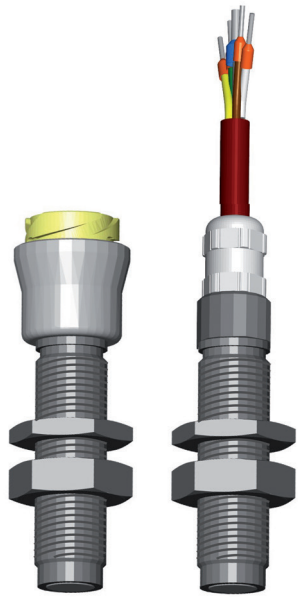
Instruction manual FA1...



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1 General information

Use for intended purpose

- The product may only be used for the applications specified in this document and in the technical documentation. Transportation with due care and attention, correct storage and installation as well as careful use and maintenance during operation of the product must be ensured to guarantee trouble-free and safe operation.
- The product must be used at all times in agreement with the technical specifications. In particular, compliance with the ambient conditions recommended in the technical documentation must be ensured.

Installation, assembly, repair and maintenance work

- Observe the relevant national regulations and observe the applicable standards and directives for special applications.
- Installation, assembly, repair and maintenance work must be carried out exactly according to the installation and maintenance instructions applicable to the individual products in order to guarantee their functional reliability and avoid installation errors and damage.
- Installation, assembly, repair and maintenance work must only be performed by qualified and authorised technical personnel in accordance with the relevant documentation, especially the safety and warning information contained therein.
- Make sure that no excess parts (screws, tools, etc) are left behind in or on products after performing installation, assembly, repair or maintenance work. Non-compliance with this requirement may cause malfunctions and/or damage to the products or the system.
- Make sure a function test is carried out on completion of installation, assembly, repair and maintenance work to ensure trouble-free operation of the products.

Suitable tools and equipment

Only suitable tools and equipment, especially materials provided by NORIS, are to be used for installation, assembly, repair and maintenance work. Damaged products or components are to be replaced only by genuine NORIS components or parts. NORIS shall accept no liability whatsoever for any damage incurred as the result of using unauthorised spare parts. This will invalidate the warranty. Keep the operating instructions in a place that is accessible to all users at any time.

Modification of products

NORIS shall accept no liability whatsoever if unauthorised modifications have been made to the products. This will also invalidate the warranty. Therefore, consult our technical staff before undertaking any modifications.

Shipping, appropriate storage and packaging

Products that are sent in for repair must be appropriately packaged to prevent damage (from impacts, moisture, static charge, etc). Make sure that products and all spare parts are stored correctly. Refer to the corresponding technical information for further information.

Disclaimer

We review the contents of our technical documentation at regular intervals to ensure it agrees with our products. Nevertheless, variations cannot be completely ruled out. NORIS therefore cannot guarantee complete agreement of the documentation contents with the hardware and software. Changes and corrections will be included in subsequent issues of the technical documentation.

2 General information on this instruction manual

2.1 Scope of validity

This instruction manual applies to the Series 11 and 12 sensors listed below:

Sensor type	Product revision
FAH11	B
FAH12	B
FAJ11	C
FAJ12	C
FAHZ11	D
FAHS11	A
FAHD13	A

Important information on the use of this instruction manual and supplementary information

Please note that the sensors are often adapted to customer-specific requirements. The connection cables, cable lengths, connectors etc. described in this instruction manual may vary in terms of the features on your specific product. Therefore always first refer to the information in the customer-specific drawing for installation, commissioning and operation.

2.2 Subject of the operating instructions

The subject of these operating instructions is the installation, commissioning, operation and maintenance of Series 11 and 12 speed sensors. This manual also contains important troubleshooting information.

2.3 Design and use of safety and warning notes

⚠ DANGER	**Warning about the type and source of danger that lead to serious injuries or even to death when disregarding the given precautions.** Folgen
⚠ CAUTION	**Warning about the type and source of danger that lead to minor physical injury when disregarding the given precautions.** Folgen
NOTICE	**Warning about the type and source of danger that lead to material damages when disregarding the given precautions.** Folgen

2.4 Scope of delivery

Note on customer-specific scope of delivery

The scope of delivery of your product may vary from the specifications below.

The scope of delivery is individually adapted to your specific requirements. In addition certain items are dependent on other factors, e.g. the number of retaining clips on the cable length, the size of the retaining clips on the calve diameter. Refer to the corresponding parts list for a detailed overview of the scope of delivery for your product.

The standard scope of delivery contains:

- Speed sensor, packed in an polyethylene bag.
- 2 nuts for fixing the sensor
- Thread protection

2.5 Accessories and spare parts

Available accessories

In addition to the installation material, further accessories are optionally available for these speed sensors.

Connector	Drawing No.	Order No.
Female connector DIN 43650-A	ZL-3A	311046
Female connector according VG95234	ZL4-1A-E	314015
Female connector Euro M12x1, shielded, straight with 2.0 m cable	ZL4-2A	522101
Female connector Euro M12x1, shielded, straight with 5.0 m cable	ZL4-2A	522102
Female connector Euro M12x1, shielded, straight with 10.0 m cable	ZL4-2A	522109
Female connector Euro M12x1, shielded, angled 90°, with 2.0 m cable	ZL4-2A	522105
Female connector Euro M12x1, shielded, angled 90°, with 5.0 m cable	ZL4-2A	522106
Female connector Euro M12x1, shielded, angled 90°, with 10.0 m cable	ZL4-2A	522111

1: List with available female connectors

Available spare parts

Available spare parts include installation material and connectors. For detailed information please contact our Service department or marketing team at sales@noris-group.com.

Type code

Type code structure									
FA	**H**	**Z**	**11**	**-02**	**15**	**-X03**	**-M10**	**-S0**	**Example: FAHZ11-0215-X03-M10-S0**
	Measuring principle								
		Measuring principle supplement							
			Construction type & material						
				Nominal length L1 and L2 of the sensor tube					
					Thread type				
						Electrical connection			
							Module version		
								Shielding	

Type code FAJ11[..]									
Measuring principle	**J**	Inductive-magnetic							J
Measuring principle supplement			Without code: 1 channel						J
Construction type & material			**11**	Sensor tube: brass					J
Nominal length				**-02**	L1 = 60 mm, L2 = 5 mm				J
				-03	L1 = 80 mm, L2 = 5 mm				J
				-04	L1 = 100 mm, L2 = 20 mm				
				-05	L1 = 120 mm, L2 = 40 mm				
					Other lengths up to 200 mm available on request				
Thread type					**13**	M14 x 1			
					22	M16 x 1.5			
					15	M18 x 1			J
					23	M18 x 1.5			J
					88	5/8‘‘ – 18 UNF			
Electrical connection						**-A**	DIN43650-A pin connector		J
						-C	MIL 14-5PN VG95234 pin connector		
						-E	Euro M12x1 pin connector		J
						-H1	DIN72585 Bajonette		
						-X03	Cable end with sheath length 0.5 m		
						-X05	Cable end with sheath length 2.0 m		J
						-X06	Cable end with sheath length 3.0 m		
						-X07	Cable end with sheath length 5.0 m		
						-X08	Cable end with sheath length 7.5 m		
						-X09	Cable end with sheath length 10.0 m		
Shielding								Without code: Shielding is attached to the sensor housing	J
							-S0	Shielding is not attached to the sensor housing	
FA	_	_	_ _	-_ _	_ _	-_ _	-_ _	_	**Example: FAJ11-0323-E-S0**

Type code FAH11[..] difference-hall principle										
Measuring principle	**H**	Difference-hall								X,Z
Measuring principle supplement			Without code: 1 output signal							X
		Z	2 output signals, galvanically connected							Z
		S	2 output signals, galvanically connected and status output (e. g. rotation direction detection)							
		D	2 output signals, galvanically isolated							
Construction type & material			**11**	Sensor tube: brass						X,Z
Nominal length				**-02**	L1 = 60 mm, L2 = 5 mm					X
				-03	L1 = 80 mm, L2 = 5 mm					X,Z
				-04	L1 = 100 mm, L2 = 20 mm					
				-05	L1 = 120 mm, L2 = 40 mm					Z
					Other lengths up to 200 mm available on request					
Thread type					**13**	M14 x 1 (only FAH11)				
					22	M16 x 1.5 (only FAH11)				
					15	M18 x 1				X
					23	M18 x 1.5				X,Z
					88	5/8‘‘ – 18 UNF (only FAH11)				
Electrical connection						**-A**	DIN43650-A pin connector (only FAH11)			X
						-C	MIL 14-5PN VG95234 pin connector (only FAH11)			
						-E	Euro M12x1 pin connector (only FAH11, on request for FAHZ11)			X,Z
						-H1	DIN72585 Bajonette (only FAH11)			
						-X03	Cable end with sheath length 0.5 m			
						-X05	Cable end with sheath length 2.0 m			X
						-X06	Cable end with sheath length 3.0 m			
						-X07	Cable end with sheath length 5.0 m			
						-X08	Cable end with sheath length 7.5 m			
						-X09	Cable end with sheath length 10.0 m			
Module version (Only for FAHD and FAHZ series)							**-M10**	Module m1		
							-M12	Module m1.25		
							-M15	Module m1.5		
								Without code module m2		Z
							-M25	Module m2.5		
							-M30	Module m3		
Shielding									Without code: Shielding is attached to the sensor housing	X,Z
								-S0	Shielding is not attached to the sensor housing	

Type code FAH11[..] difference-hall principle									
FA	_	_	_ _	-_ _	_ _	-_ _	-_ _	_	Example: FAHZ11-0323-X03-M12-S0

2: .

Preferred types

Features marked with an indicator letter at the end of the line in the table are preferred features. If you select a preferred feature for each placeholder (same indicator letter), the device is specified as preferred type. Preferred types are available quickly from stock. Other types will be delivered according to scheduled appointments.

Special types

If our standard types do not correspond with your expectation, we are pleased to develop a special solution together with you.

3 Product description

3.1 Scope of application

Series 11 and 12 speed sensors are mainly used in the following areas: Shipbuilding industry, transport technology and mechanical engineering. The sensors can be used for registering movements of any ferromagnetic components, such as

- gearwheels with various tooth shapes
- screw heads
- holes, apertures, grooves
- pulse bands on smooth shafts (accessories)

3.2 Measuring principle

Series FA**H...** sensors operate in accordance with the **differential Hall principle**:

Two closely spaced Hall elements are located on the sensor chip. The field of the magnet generates a constant voltage in the Hall elements. Ferromagnetic objects with an interrupted surface moving past the Hall elements cause the Hall voltage to change. When the moving part covers a Hall element and the other does not, a differential voltage is generated to provide a measuring signal. The frequency of this signal is proportional to the speed of movement (rotational speed). The difference-hall-effect principle is direction sensitive.

Series FA**J...** sensors operate in accordance with the **inductive-magnetic principle**:

The measuring element consists of a sensing coil and an iron core with a permanent magnet mounted. Ferromagnetic objects with an interrupted surface as they pass the sensor cause the constant field of the magnet to be changed and induce a voltage in the sensing coil. The frequency of this signal is proportional to the speed of movement (rotational speed). The inductive-magnetic principle is direction-insensitive.

3.3 Peculiarities and differences

The next table shows the features and differences between the sensors of the construction type 11 and 12.

FAH11	FAH12
Robust housing: IP66/68	Robust and high quality housing: IP68 pressure-tight and individually tested at 5 bar (for details see technical data)
Sensor tube: Brass	Sensor tube: Stainless steel
Measuring principle: Difference-hall-effect principle, 1 measuring channel Installation mode: Direction-sensitive	Measuring principle: Difference-hall-effect principle, 1 measuring channel Installation mode: Direction-sensitive

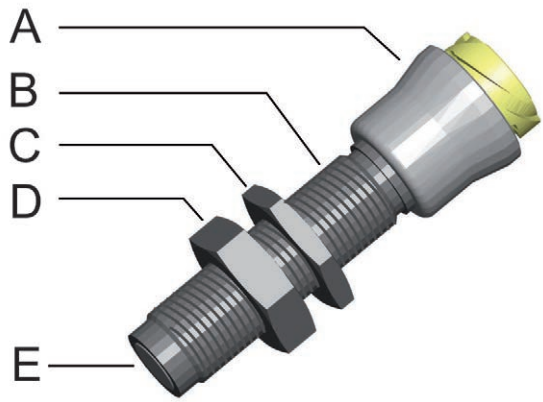
FAJ11	FAJ12
Robust housing: IP66/68	Robust and high quality housing: IP68 pressure-tight and individually tested at 5 bar (for details see technical data)
Sensor tube: Brass	Sensor tube: Stainless Steel
Measuring principle: Inductive magnetic, 1 measuring channel Installation mode: Direction independent	Measuring principle: Inductive magnetic, 1 measuring channel Installation mode: Direction independent

FAHZ11	FAHS11
Robust housing: IP66/68	Robust housing: IP66/68
Sensor tube: Brass	Sensor tube: Brass
Measuring principle: Difference-hall-effect principle, 2 measuring channels Installation mode: Direction-sensitive	Measuring principle: Difference-hall-effect principle, 2 measuring channels and 1 additional channel for rotation direction detection Installation mode: Direction-sensitive

FAHD11	
Robust housing: IP66/68	
Sensor tube: Brass	
Measuring principle: Difference-hall-effect principle, 2 galvanically isolated measuring channels Installation mode: Direction-sensitive	

3.4 Speed sensor design

3.4.1 General structure



1: FAx1x Design

A Connecting plug (see connection variants)
With integrated operating status LED for type FA12

B Threaded tube

C Counter nut

D Nut for fixation

E Sensor head (measuring area)
Type series FAx11: Sensor tube: Brass
Type series FAx12: Sensor tube: Stainless steel

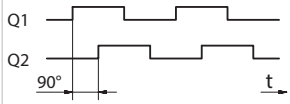
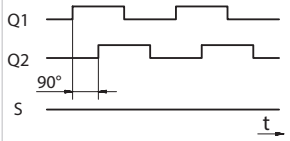
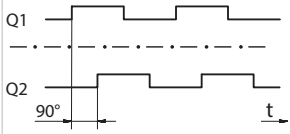
3.4.2 Connection variants

Information on customer-specific connections

Series 11 and 12 speed sensors are available with different connections. The connection variants are defined by the type code of the appropriate sensor type. Refer to the customer drawing for your connection variant.

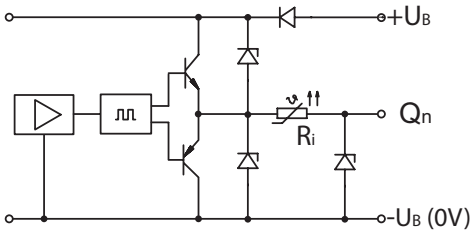
- **Standard:** e. g. Euro M18x1 or cable end (see preferred types in type code).

3.4.3 Signal types

Type	Measuring principle	Signal outputs	Signal form
FAH11	Difference-hall	One square wave signal	
FAJ11	Induct.-magnetic	One square wave signal	
FAHZ11	Difference-hall	Two square wave signals, Q2 to Q1 is 90° phase shift	
FAHS11	Difference-hall	Two square wave signals + one status signal	
FAHD11	Difference-hall	Two square wave signals, galvanically isolated	

Type	Measuring principle	Signal outputs	Signal form
FAH12	Difference-hall	One square wave signal	
FAJ12	Induct.-magnetic	One square wave signal	

3.4.4 Elementary circuit diagram



Push-pull output stage

Note:
NPN- and PNP-inputs can be connected.

4 Technical data FA11

4.1 General technical data

Electrical connection	
Supply voltage	*See specific technical data*
Nominal voltage	*See specific technical data*
Current consumption	*See specific technical data*
Reverse voltage protection	Yes
Over voltage protection	Yes
Connection	*See specific technical data*
Recommended cable length	< 100 m
Used cable cross section	0.33 mm², shielded

Electrical output	
Measuring channels	*See specific technical data*
Output signals and signal form	*See specific technical data*
Output stage	Push-pull amplifier
Continuous short circuit prot.	Yes
Galvanic separation	*See specific technical data*
Output level ULow	*See specific technical data*
Output level UHigh	*See specific technical data*
Output current (Sink)	*See specific technical data*
Output PNP (Load)	*See specific technical data*
Internal resistance	*See specific technical data*
Rise time	≥ 10 V/µs

Signal acquisition	
Measuring principle	Type FA**H**[..]: Difference-hall Type FA**J**[..]: Inductive magnetic
Frequency range	*See specific technical data*
Scan type	Non-contacting

Signal acquisition	
Scan object - distance	0.2 ... 3 mm; recommended: 1.0 ± 0.5 mm
Scan object	*See specific technical data*
Phase-shift	*See specific technical data*

Environmental influences	
Operating temperature	-40 ... +120 °C
Storage temperature	Recommended: -25 ... +70 °C; max.: -40 ... +105 °C (max. limit values within 30 days per year @ relative humidity 5...95%)
Protection class	*See specific technical data*
Vibration resistance	DIN IEC 60068-T2-6, 10 g @ 5...2000 Hz (Sinus) DIN EN 61373, 30 g @ 20...500 Hz (Random)
Shock resistance	DIN IEC 60068-T2-27, 1000 m/s² @ 6 ms
Climatic test	DIN IEC 60068-T2-1/-2/-30
EMI - ESD	IEC 61000-4-2, Lev. 3
EMI - Burst	IEC 61000-4-4, Lev. 3
EMI - Surge	IEC 61000-4-5, Lev. 2
EMI - HF immunity	IEC 61000-4-3, 10 V/m IEC 61000-4-6 (RF - conducted), 10 Veff IEC 60553 (AF - conducted), 3 Veff
Emitted interference	CISPR 16-1, CISPR 16-2 EMC2
Insulation voltage	500 VAC, 50 Hz @ 1 min

Mech. Quantities	
Material	Sensor tube: Brass Adapter: Chromatised aluminium
Mounting	Screw-in thread (see type code)
Length	L1 = 60 ... 200 mm
Installation position	Any
Installation mode	*See specific technical data*
Weight	100 ... 300 g (depending on connection and length)
Pressure resistance	5 bar (measuring tip)

4.2 Specific technical data

	Difference-hall principle FAH type	Inductive-magnetic principle FAJ type
Scan object	Ferromagnetic materials, Tooth wheel: Module m1 to m3; tooth face > 7 mm (spur gear DIN867) Hole: Ø ≥ 5 mm, web ≥ 2 mm, depth ≥ 4 mm Groove: Ø ≥ 4 mm, web ≥ 2 mm, depth ≥ 4 mm	Ferromagnetic materials, Tooth wheel: Module ≥ m1.5; tooth face width ≥ 5 mm (spur gear DIN867) Hole: Ø ≥ 5 mm, web ≥ 2 mm, depth ≥ 4 mm Groove: Ø ≥ 4 mm, web ≥ 2 mm, depth ≥ 4 mm
Frequency range	0.2 ... 20,000 Hz	See diagram; 5 Hz...10,000 Hz depending from module and scan distance; under optimal conditions up to 15 kHz
Installation mode	Direction-sensitive	Direction independent

Sensors with one signal output

	FAH11	FAJ11
Supply voltage	9 ... 32 VDC	
Nominal voltage	24 VDC	
Current consumption	< 10 mA (without output current PNP)	< 6 mA (without output current PNP)
Connection	DIN 43650A, Mil14-5PN, Euro M12x1, DIN 72585 or cable end (see customer drawing)	
Measuring channels	1 measuring channel	
Output level ULow	≤ 0.8 V @ 24 VDC, 10 mA, 24 °C	
Output level UHigh	≥ UB-1.5 V @ 24 VDC, 10 mA, 24 °C	
Internal resistance	45 Ω	
Output current (Sink)	max. -50 mA	
Output PNP (Load)	max. 50 mA	
Protection class	Housing: IP66/IP68 Connection Type A: IP65; Typ C, E, H, X: IP67	Housing: IP66/IP68 Connection Type A: IP65; Typ C, E, H, X: IP67
Approvals	CE, ABS, BV, DNV-GL, LR	

Sensors with two signal outputs and status signal output

FAHS11	
Supply voltage	9 ... 32 VDC
Nominal voltage	15 VDC
Current consumption	< 20 mA (without output current PNP)
Connection	Cable end, see customer drawing
Measuring channels	2 measuring channels and 1 additional channel for rotation direction detection
Output level ULow	Per channel: ≤ 0.8 V @ 24 VDC, 10 mA, 24 °C
Output level UHigh	Per channel: ≥ UB-1.6 V @ 24 VDC, 10 mA, 24 °C
Internal resistance	45 Ω
Output current (Sink)	Per channel: max. -50 mA
Output PNP (Load)	Per channel: max. 50 mA
Phase-shift	90° ± 10% @ m1.5...m3 | 90° ± 15% @ m1...m1.25
Protection class	Housing: IP66/IP68 Connection Type X: IP67
Approvals	CE, ABS, BV, DNV-GL

Sensors with two signal outputs

	FAHZ11	FAHD11
Supply voltage	9 ... 32 VDC	2 x 9 ... 32 VDC
Nominal voltage	15 VDC	2 x 15 VDC
Current consumption	< 20 mA (without output current PNP)	2 x < 10 mA (without output current PNP)
Connection	Cable end, customized connections acc. customer drawing	
Measuring channels	2 measuring channels	2 galvanically isolated measuring channels
Output level ULow	Per channel: ≤ 0.8 V @ 15 VDC, 10 mA, 24 °C	
Output level UHigh	Per channel: ≥ UB-1.6 V @ 15 VDC, 10 mA, 24 °C	
Internal resistance	50 Ω	
Output current (Sink)	Per channel: max. -50 mA	
Output PNP (Load)	Per channel: max. 50 mA	

	FAHZ11	FAHD11
Phase-shift	90° ± 10% @ m1.5...m3 | 90° ± 15% @ m1...m1.25	
Protection class	Housing: IP66/IP68 Connection Type X: IP67	
Approvals	CE, ABS, BV, DNV-GL	

5 Technical data FA12

5.1 General technical data

Electrical connection	
Supply voltage	9...32 VDC
Nominal voltage	24 VDC
Current consumption	See specific technical data
Reverse voltage protection	Yes
Over voltage protection	Yes
Connection	DIN 43650A, Mil14-5PN, Euro M12x1, DIN 72585 or cable end (see customer drawing)
Recommended cable length	< 100 m
Used cable cross section	0.33 mm², shielded

Electrical Output	
Measuring channels	1 measuring channel
Output signals and signal form	Square wave signal
Output stage	Push-pull amplifier
Continuous short circuit prot.	Yes
Output level ULow	≤ 0.8 V @ 24 VDC, 10 mA, 24 °C
Output level UHigh	≥ UB-1.5 V @ 24 VDC, 10 mA, 24 °C
Output current (Sink)	max. -50 mA
Output PNP (Load)	max. 50 mA
Internal resistance	45 Ω
Rise time	≥ 10 V/µs

Signal acquisition	
Measuring principle	See specific technical data
Frequency range	See specific technical data
Scan type	Non-contacting
Scan object - distance	Siehe spezifische technische Daten
Scan object	Siehe spezifische technische Daten

Environmental influences	
Operating temperature	-40 ... +120 °C (status LED near cable connection up to 100 °C)
Storage temperature	Recommended: -25 ... +70 °C; max.: -40 ... +105 °C (max. limit values within 30 days per year @ relative humidity 5...95%)
Protection class	Housing: IP66/IP68

Environmental influences	
Vibration resistance	DIN IEC 60068-T2-6, 10 g @ 5…2000 Hz (Sinus) DIN EN 61373, 30 g @ 20…500 Hz (Random)
Shock resistance	DIN IEC 60068-T2-27, 1000 m/s² @ 6 ms
Climatic test	DIN IEC 60068-T2-1/-2/-30
EMI - ESD	IEC 61000-4-2, Lev. 3
EMI - Burst	IEC 61000-4-4, Lev. 3
EMI - Surge	IEC 61000-4-5, Lev. 2
EMI - HF immunity	IEC 61000-4-3, 10 V/m IEC 61000-4-6 (RF - conducted), 10 Veff IEC 60553 (AF - conducted), 3 Veff
Emitted interference	CISPR 16-1, CISPR 16-2 EMC2
Insulation voltage	500 VAC, 50 Hz @ 1 min

Mech. Quantities	
Material	Sensor tube: Stainless steel Adapter: Chromatised aluminium
Mounting	Male thread M18x1 | M18x1.5 | 5/8" - 18 UNF
Length	L1 = 60 ... 200 mm
Installation position	Any
Installation mode	See specific technical data
Weight	100 ... 300g (depending on connection and length)
Pressure resistance	5 bar (measuring tip)

Other	
Approvals	CE, ABS, BV, DNV-GL, LR

5.2 Specific technical data

	Difference-hall principle FAH type	Inductive-magnetic principle FAJ type
Scan object	Ferromagnetic materials, Tooth wheel: Module m1 to m3; tooth face > 7 mm (spur gear DIN867) Hole: Ø ≥ 5 mm, web ≥ 2 mm, depth ≥ 4 mm Groove: Ø ≥ 4 mm, web ≥ 2 mm, depth ≥ 4 mm	Ferromagnetic materials, Tooth wheel: Module ≥ m1.5; tooth face width ≥ 5 mm (spur gear DIN867) Hole: Ø ≥ 5 mm, web ≥ 2 mm, depth ≥ 4 mm Groove: Ø ≥ 4 mm, web ≥ 2 mm, depth ≥ 4 mm
Frequency range	0.2 ... 20,000 Hz	See diagram; 5 Hz...10,000 Hz depending from module and scan distance; under optimal conditions up to 15 kHz
Installation mode	Direction-sensitive	Direction independent

	FAH12	FAJ12
Measuring principle	Difference-hall-effect principle	Inductive magnetic
Current consumption	< 15 mA (without output current PNP)	< 7 mA (without output current PNP)

6 Installation

6.1 Information on avoiding faults and damage

Protective Cap

NOTICE

Ensure that you remove the protective cap only when mounting the sensor. Otherwise the sensor may be damaged.

At delivery the sensor is equipped with a protective cap to protect the measurement area and the electronic parts against mechanical and electrical hazard.

NOTICE

Ensure that the measurement area is not soiled.

A soiled measurement area may lead to signal loss or even damage the sensor. Also note the recommendations in the maintenance section.

Sensor mounting

When mounting the sensor make sure that the screw connections are tightened appropriately. Therefore note the instructions in section "Installing the speed sensor [▶ 28]".

NOTICE

Use appropriate tools and do not apply excessive force to secure the sensor.

The sensor may otherwise be damaged.

Scanning distance

Observe the permissible scanning distance.

NOTICE

Make sure that the specified scanning distance is maintained.

Signal distortion and signal loss may occur or the sensor or the scanning object may even be damaged if the scanning distance is too small. Signal distortion and signal loss may also occur if the scanning distance is too great.

Connection and securing connectors

When installing the speed sensor, the data and information on the customer drawings always have priority over the information in this instruction manual.

NOTICE

Do not touch electronical parts of the sensor (connector pins, open cable end, etc.) without appropriate measures to ground your body (e. g. ESD wristband).

Otherwise electrostatic discharge may damage the sensors' electronic components.

NOTICE

Do not loosen the cable gland.

Otherwise humidity and dust may damage the sensors' electronic components.

NOTICE

The connections are to be made and connectors secured exactly as described on the technical drawings and in this manual.

Incorrect wiring and incorrectly or inappropriately tightened screw connections can result in signal loss or damage to the sensor or connection.

Cable installation

NOTICE

Make sure that the connection cable is installed correctly.

Incorrectly installed connection cables can result in signal loss or damage to the sensor.

NOTICE

Note the minimum cable bending radius when laying the cable.

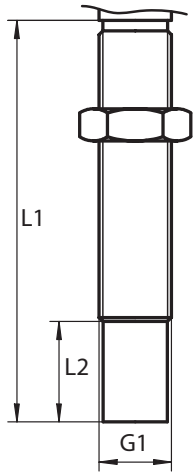
Otherwise the connection cable may be damaged.

READ

You will find further information on cable installation under Connection and cable Installation.

6.2 Preparing for installation

6.2.1 Dimensions



Explanation to the illustration
Please note the possible combination of L1 and L2 for the nominal length in the type code.

L1: 60, 80, 100, 120 mm (up to 200 mm available on request)
L2: 5, 20, 40 mm
G1: M14x1; M16x1.5; M18x1; M18x1.5; 5/8“ – 18 UNF (see type code)

6.2.2 Checking the scanning object

NOTICE

To ensure trouble-free operation, the scanning object must not be damaged.

Damaged scanning objects can result in signal distortion, signal loss or even damage to the sensor.

Make sure that the scanning object is in perfect condition.

A. Check that the scanning object is undamaged (e.g. no scratches, material unevenness, etc.).

➡ If this is not the case, you must first rectify these faults before you continue with the installation of the sensor.

6.2.3 Checking the installation holes

Check the hole before you install the sensor.

NOTICE

A faulty hole can result in signal distortion, signal loss or even damage to the sensor.

Therefore, carry out the following procedure:

A. Check the installation tapped hole for the sensor tube.

⇨ The hole must be without sharp edges and there must be no roughness on the surface of the hole.

HINT

B. Fit the sensor carefully in the installation hole for testing purposes.

➡ The check is finished. You can now continue with the installation.

6.2.4 Preparing tools and ressources

For installation prepare the following tools:

- Proper screw-wrenches according to the thread
- Torque wrench

6.3 Mounting speed sensors

6.3.1 Mounting speed sensors with inductive-magnetic principle, type FAJxx

Mount the sensor according to the following instructions:

► **Prerequisite:** The system is switched off.

► **Prerequisite:** The bore holes and the scanning object have been checked before mounting the sensor.

A. Remove the thread protection.

B. Screw the sensor carefully into the appropriate mounting bore hole and position the sensor exactly to the scanning object.

⇨ The mounting of the sensor is not direction sensitive.

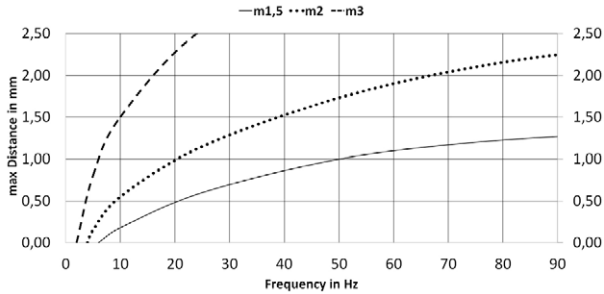
C. Maintain the distance to the scanning object.

HINT

D. If the scanning object is not visible: screw the speed sensor clockwise to the end stop (until the sensor touches the scanning object). **NOTICE! Attention: The scanning object must stand still!!!** Now screw the sensor anti-clockwise according to its thread type to get the correct scanning distance (e. g. with thread type M18x1 one rotation correlates 1 mm, with thread type M18x1.5 one rotation correlates 1.5 mm, etc.).

⇨ The cover ration of sensor and scanning object should amount min. 2:3.

E. With modules > m2 the recommended scanning distance has to be increased to get a valid output signal (see also the following diagram).



2: FAJ Diagram max. scanning distance - frequency

NOTICE

A too close scanning distance may lead to signal distortion, signal loss or may even damage the sensor.

Thus, maintain the recommended scanning distance (> 0.2 mm).

F. Fix the sensor with screw nut and counter screw nut.

⇨ Screw the nuts with the correct torque (see next table).

NOTICE

Do not use disproportionately force to fix the screws. This may damage the sensor.

This will invalidate the manufacturer's warranty.

➡ The mounting is finished.

Thread	Material	Screw nut type	Torque
M18x1	Brass		30-35 Nm
			20-25 Nm
	Stainless steel		30-35 Nm
			20 Nm
M18x1,5	Stainless steel		35-40 Nm
			25-30 Nm

Thread	Material	Screw nut type	Torque
M16x1,5	Brass	- - -	20-25 Nm
M14x1	Brass	- - -	20-25 Nm
M14x1,5	Stainless steel	- - -	30-35 Nm
5/8“-18UNF	Brass	- - -	25-30 Nm

6.3.2 Mounting speed sensors with differential Hall principle, type FAHxx

Mount the sensor according to the following instructions:

- **Prerequisite:** The system is switched off.
- **Prerequisite:** The bore holes and the scanning object have been checked before mounting the sensor.

A. Remove the thread protection.

B. Screw the sensor carefully into the appropriate mounting bore hole and position the sensor exactly to the scanning object.

C. Maintain the recommended distance to the scanning object "(see Section Technical Data) [▶ 17]".

NOTICE

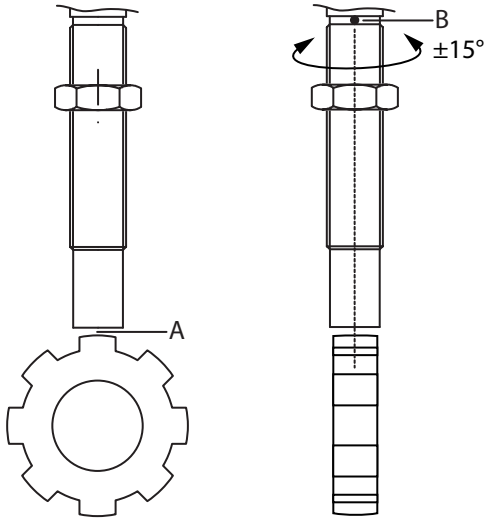
A too close scanning distance may lead to signal distortion, signal loss or may even damage the sensor.

Thus, maintain the recommended scanning distance (> 0.2 mm).

HINT

D. If the scanning object is not visible: screw the speed sensor clockwise to the end stop (until the sensor touches the scanning object). **NOTICE! Attention: The scanning object must stand still!!!** Now screw the sensor anti-clockwise according to its thread type to get the correct scanning distance (e. g. with thread type M18x1 one rotation correlates 1 mm, with thread type M18x1.5 one rotation correlates 1.5 mm, etc.).

E. The mounting of this sensor type is direction sensitive. Note the position of the marking. Now screw the sensor clockwise or anti-clockwise (note the shortest screw direction) that the marking of the sensor is positioned in direction of rotation of the scanning object (see next Fig., Pos. B).



⇨ The cover ration of sensor and scanning object should amount min. 2:3.

F. Fix the sensor with screw nut and counter screw nut.

⇨ Screw the nuts with the correct torque (see next table).

NOTICE

Do not use disproportionately force to fix the screws. This may damage the sensor.

This will invalidate the manufacturer's warranty.

➡ The mounting is finished.

Thread	Material	Screw nut type	Torque
M18x1	Brass		30-35 Nm
			20-25 Nm
	Stainless steel		30-35 Nm
			20 Nm
M18x1,5	Stainless steel		35-40 Nm
			25-30 Nm

Thread	Material	Screw nut type	Torque
M16x1,5	Brass	- - -	20-25 Nm
M14x1	Brass	- - -	20-25 Nm
M14x1,5	Stainless steel	- - -	30-35 Nm
5/8“-18UNF	Brass	- - -	25-30 Nm

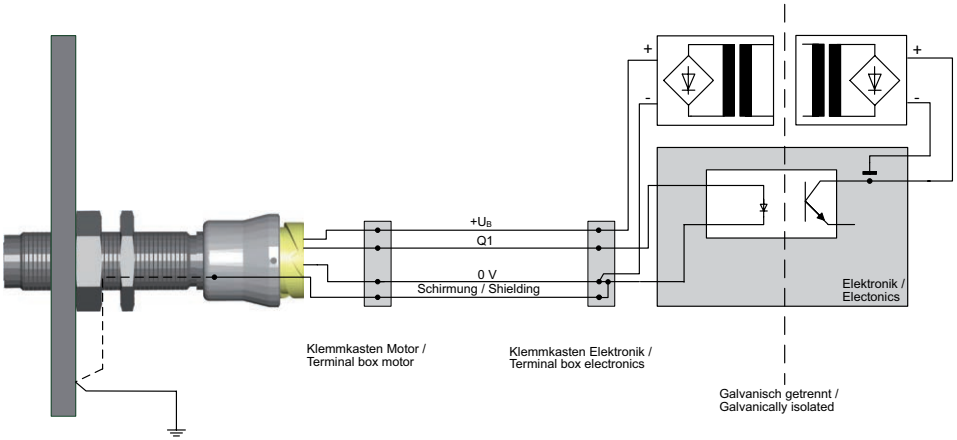
6.4 Connection and cable laying

6.4.1 Connection concept

In general: The connection concepts mentioned in this section are recommendations from the manufacturer. Variations for the individual application make quite sense and have to be discussed individually according to local environmental conditions. Thus, each connection concept can only be a reasonable compromise for the current conditions of the application.

6.4.1.1 Connection concept for strong electromagnetic fields

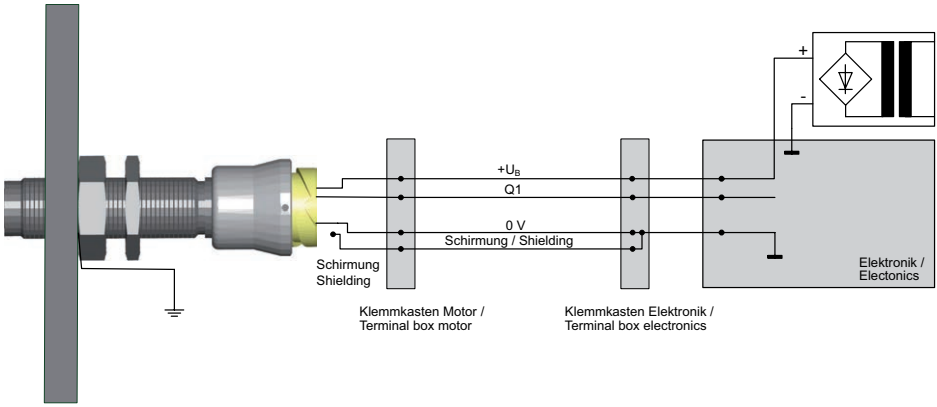
The signal inputs and the supply voltage of the sensor and the processing electronic are galvanically isolated. The connections must be shielded to an adequate extent and conduct well.



3: Concept with connected shielding at both sides, type FAx1x

6.4.1.2 Connection concept for weak electromagnetic fields

The signal inputs and the supply voltage of the sensor and the processing electronic are not galvanically isolated. The shielding is not consistent and not connected to the sensor. This connection type has to be ordered separately (see type code).



4: Concept with connected shielding at one side, type FAx1x...-S0

6.4.2 Important information on connection and cable installation

NOTICE

Refer to the information on the customer drawings as well as the information and technical data on the corresponding sensor type as provided in this instruction manual. The connection instructions provided in this section apply to speed sensors types mentioned in the Section “Scope of Application”. Make sure your body is correctly earthed (!electrostatic discharge!) before you touch the sensor connections.

The cabling, connector or the sensor may otherwise be damaged.

- Sensors must be connected to the system with no interruptions.
- The connections must be shielded to an adequate extent and conduct well.
- Unshielded wires have to be kept as short as possible.
- Cable connections must be uninterrupted, i.e. no terminals between sensor and system.
- Cable connections must be direct, i.e. shortest route without cable loops.
- Shielded cables must be used, as specified in the corresponding technical drawings (see technical drawing for sensor).
- Maintain the minimum bending radius to avoid damaging the connecting cables.

- Observe the maximum permissible cable length.
- Do not install the cable in the vicinity of electromagnetic fields or power lines. Signal and control lines have to be laid separately from each other to avoid coupling tracks (optimum is 20 cm or more). If the local separation of sensor and motor lines is not possible, then a plate or a metal tube has to be used for separation.
- In the cabinet the lines has to be laid near the cabinet housing (earth) or on the mounting plates to avoid crosstalk of the signals.
- Avoid tension, pressure and torsion stress on the cables.
- Make sure that no sharp-edged objects can come in contact with the connection cables.
- Extensive cable shielding is required.
- The speed sensor is always a part of the motor or machine unit. Therefore make sure that the equipotential bonding or the sensor is part of the overall shielding concept.
- Make sure that no compensating current flows via the cable shielding due to the potential differences between the motor/machine and electrical ground connections. Therefore take suitable precautions, e. g. equipotential bonding lines with large cable cross section (minimum 10 mm^2). Note that the shielding can be placed several times. Also in the switchgear cabinet it can be connected several times with the cabinet housing.

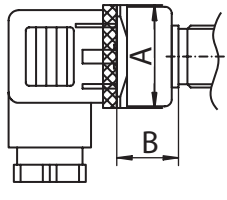
6.4.3 Connection variants for type FA11

Speed sensors type FA11 are available with different connections.

Connectors for type FA11

Connection type	FAH11	FAHZ11	FAHS11	FAHD11	FAJ11
DIN 43650-A	X	-	-	-	X
MIL 14-5PN	X	-	-	-	X
EURO M12x1	X	On request	-	-	X
DIN 72585	X	-	-	-	X

FA...-A: Connector DIN43650 A

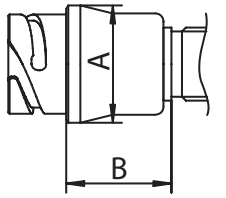


A: Diameter 30 mm
B: Length 18 mm
1: $+U_B$
2: $-U_B$ (0V)
3: Signal Q
PE: Shielding

Note:
On delivery supplied with female connector.

Protection class: IP65

FA...-C: Connector MIL 14-5PN

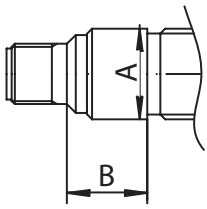


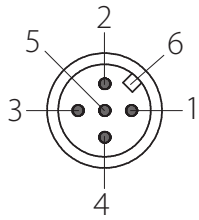
A: Diameter 29 mm
B: Length 26 mm
1: Shielding
2: $-U_B$ (0V)
3: Signal Q
4: Signal Q
5: $+U_B$
6: Coding nib

Note:
On delivery without any female connector (accessories set ZL4-1A)

Protection class: IP67

FA...-E: Connector Euro M12x1



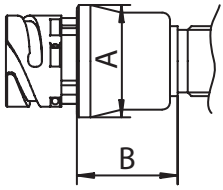


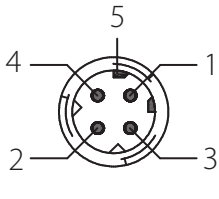
Protection class: IP67

A: Diameter 18 mm
B: Length 16 mm
1: $+U_B$
2: not used
3: $-U_B$ (0V)
4: Signal Q
5: Shielding
6: Coding nib

Note:
On delivery without any female connector (accessories set ZL4-2A)

FA...-H1: Connector DIN72585 Bajonette





Protection class: IP67

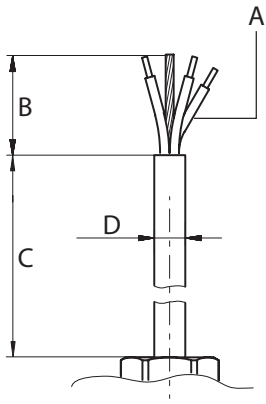
A: Diameter 29 mm
B: Length 26 mm
1: $+U_B$
2: $-U_B$ (0V)
3: Signal Q
4: Shielding
5: Coding nib

Note:
On delivery without any female connector

Cable -X connection variant for type FA11

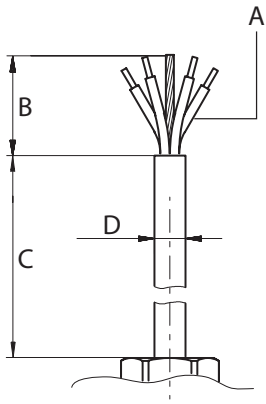
Connection type -X	FAH11	FAHZ11	FAHS11	FAHD11	FAJ11
Cable with 3 wires	X	-	-	-	X
Cable with 4 wires	-	X	-	-	-
Cable with 6 wires	-	-	X	X	-

Connection cable type -X for sensors with 3 connecting wires



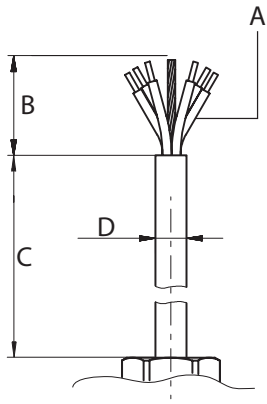
Explanation to the left illustration
A) 3 x 0.33 mm²
B) 80 ± 10 mm
C) Length K1 ± 5 %
D) Diameter 4.6 ± 0.5 mm
Protection class: IP67

Connection cable type -X for sensors with 4 connecting wires



Explanation to the left illustration
A) Wires 4 x 0.33 mm² halogen-free
B) Length 80 ±10 mm
C) Length K1 ± 5% (K1 see customer drawing)
D) Diameter 7 ±0.5 mm
Protection class: IP67

Connection cable type -X for sensors with 6 connecting wires



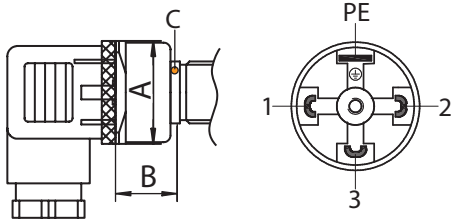
Explanation to the left illustration

A) Wires 6 x 0.33 mm² halogen-free
B) Length 80 ±10 mm
C) Length K1 ± 5% (K1 see customer drawing)
D) Diameter 7 ±0.5 mm
Protection class: IP67

6.4.4 Connection variants for type FA12

Connection type	FAH12	FAHJ12
DIN 43650-A	X	X
MIL 14-5PN	X	X
EURO M12x1	X	X
DIN 72585	X	X
Cable -X	X	X

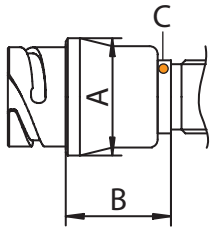
FA...-A: Connector DIN43650 A

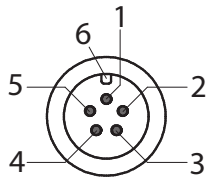


A: Diameter 30 mm
B: Length 18 mm
C: Status LED
1: $+U_B$
2: $-U_B$ (0V)
3: Signal Q
PE: Shielding

Note:
On delivery supplied with female connector.

FA...-C: Connector MIL 14-5PN

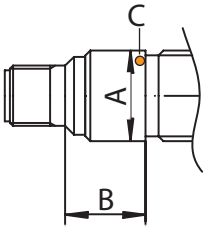


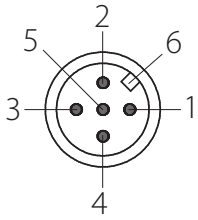


A: Diameter 29 mm
B: Length 26 mm
C: Status LED
1: Shielding
2: $-U_B$ (0V)
3: Signal Q
4: Signal Q
5: $+U_B$
6: Coding nib

Note:
On delivery without any female connector (accessories set ZL4-1A).

FA...-E: Connector Euro M12x1



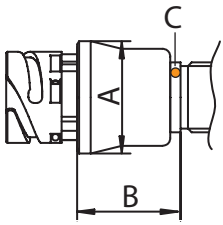


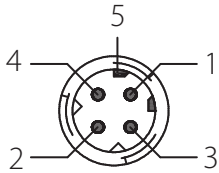
Optionally with degree of protection IP69K

A: Diameter 18 mm
B: Length 16 mm
C: Status LED
1: $+U_B$
2: not used
3: $-U_B$ (0V)
4: Signal Q
5: Shielding
6: Coding nib

Note:
On delivery without any female connector (accessories set ZL4-2A)

FA...-H: Connector DIN72585 Bajonette

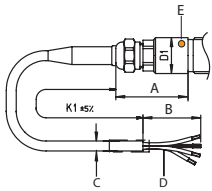




A: Diameter 29 mm
B: Length 26 mm
C: Status LED
1: $+U_B$
2: not used
3: $-U_B$ (0V)
4: Signal Q
5: Shielding
6: Coding nib

Note:
On delivery without any female connector (accessories set ZL4-5)

FA...-X: Cable end



A: Approx. 40 mm
B: 80 ± 10 mm
C: Ø 5 ± 0.5 mm
D: 3 x 0.33 mm²
D1: Approx. 18 mm
E: Status-LED
K1: Cable sheath ± 5 %

Brown: $+U_B$
Green: $-U_B$ (0V)
White: Signal Q
Shielding

7 Commissioning

7.1 Tools and equipment

Have the following tools and equipment ready for commissioning:

- Multimeter
- 2-channel oscilloscope

NOTICE

Make sure that the tools and equipment are in perfect working order.

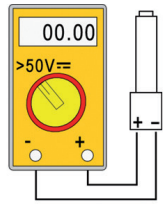
Otherwise the results of the measurements described below may be falsified.

7.2 Checking the operating voltage

You require the following tools and equipment:

- Multimeter

Check that the operating voltage $U_{nominal}$ corresponds to specifications:



5: Checking operating voltage

A. Switch to the measuring range for direct voltage.

B. Connect multimeter [+] to sensor [+] and multimeter [-] to sensor [-].

C. Switch on the operating voltage.

➡ **Result:** The multimeter shows $U_{nominal}$.

➡ **Result:** $U_{nominal}$ is within the predefined tolerance (see Technical Data).

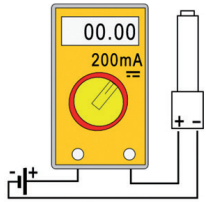
➡ Pay attention to reverse polarity.

7.3 Checking the power consumption

You require the following tools and equipment:

- Multimeter
- Simulator (load)

Check whether the power consumption I_B is within the predefined tolerance:



6: Checking power consumption

► **Prerequisite:** You simulate the load for this measurement.

A. Switch the measuring range to direct current.

B. Connect the multimeter in series in the power supply line [+].

C. Set to 200 mA, it may be necessary to reduce the range.

➡ **Result:** Power consumption I_B is within the predefined tolerance (see Technical Data).

7.4 Checking operation

You require the following tools and equipment:

- Oscilloscope

Check whether the output signal is a perfect square wave signal:

A. Connect oscilloscope [-] to sensor [-].

B. Connect oscilloscope [+] to sensor [Q].

C. Perform this measurement **without** and **with** the electronic evaluator connected.

➡ **Result:** The output signal is in both cases a distinct square wave signal with no interference.

➡ **Please note:** Without connected evaluator the power consumption is not in the specified tolerance range while testing with the oscilloscope. If the sensor is not connected to the electronic evaluator, the outlet lines Q[..] to the negative pole must be terminated with a 2.2 kΩ resistor in order to achieve a distinct output signal.

HINT

Electrical interference can often be reduced by increasing or decreasing the scanning distance. Therefore observe the minimum scanning frequency.

7.5 Checking the phase angle

Checking the phase angle is relevant for sensors with 2 or more output signals.

You require the following tools and equipment:

- 2-channel oscilloscope

Check whether the measured phase angle of the signals agrees with the specification.

A. Connect oscilloscope [-] to sensor [-].

B. Connect oscilloscope channel [-1] to sensor [Q1].

C. Connect oscilloscope channel [+2] to sensor [Q2].

⇨ Perform this measurement with the electronic evaluator connected.

➡ **Result:** The output signal is a distinct square wave signal with phase shift as specified on the customer drawing.

7.6 Checking the shielding

You require the following tools and equipment:

- Multimeter

Check whether the volume resistance is < 2 Ω:

A. Unplug the sensor connector.

B. Connect multimeter [-] to the sensor housing. Connect multimeter [+] to the connector shielding connection (check against customer drawing) [-].

C. Start the continuity check.

➡ **Result:** Volume resistance < 2 Ω.

8 Maintenance

Speed sensors contain no moving parts and are therefore classified as 'maintenance-free devices' by the manufacturer. Nevertheless, bear in mind that speed sensors are part of a system and are therefore subject to various ambient factors (heat, cold, motor abrasion, etc.). They are therefore included in the servicing concept as part of system maintenance. Connections and cabling. their installation as well as downstream processing and evaluation components in particular are to be included in the maintenance concept.

The manufacturer recommends to check the speed sensors at regular intervals as part of system maintenance. The sensors should be cleaned if soiled. If on inspection the speed sensors is found to be damaged, replacement is recommended even if the damage does not directly cause failure or signal loss. Damaged connections and cabling should also be replaced immediately. Function tests should then be carried out to ensure trouble-free operation. This preventative maintenance avoids failures and consequential damage.

9 De-installation and disposal

De-installation of sensors

NOTICE

If the sensor is removed for maintenance purposes, the protective cap should be replaced on the sensor head immediately after removal.

The sensor may otherwise be damaged.

Disposal of defective sensors

Electric devices should not be disposed of together with normal waste. Dispose of the sensors in accordance with local requirements for electronic equipment.

10 Troubleshooting

10.1 Recommended procedure

When troubleshooting the system, it is essential to precisely identify the source of faults. Faults are often suspected in the wrong place. Targeted fault localisation is therefore indispensable.

HINT

A reliable method is the **exclusion procedure**:

1. Temporarily replace suspect components by new components.
2. Temporarily interchange signal paths in order to locate the fault. If the fault migrates, the cause of the fault can be clearly determined in most cases.

10.2 Considerations for troubleshooting

Questions that can help you to quickly limit the scope of troubleshooting

1. **What kind of fault is it?**

   Is no measuring signal applied?

   Is the sensor defective?

   Is the signal distorted, faulty or weak?

2. **Can the sensor be clearly identified as the cause of the fault (continue with Question 4) or could the fault be attributed to conditions on site or in the system, e.g. faulty cabling (continue with Question 3)?**

   if possible, try replacing the sensor by a new fully functional sensor to rule out the sensor as the cause of fault.

3. **Is the installation and/or cabling on site OK? (If so, continue with Question 4)**

   Further questions concerning installation and cabling:

   Have you checked whether the installation is correct (correct installation direction, correct scanning distance, correct screw connection, operating voltage supply, etc.)?

   Is the cabling uninterrupted (no terminal connections, etc.)?

   Are the cables damaged (abraded, breaks, kinks, etc.)?

   Is the shielding correct? Is the system shielding concept coherent?

   Is the connector OK (e.g. no pushed-in contact pins) or the plug connection OK?

   Is the connector adequately sealed?

   Is the sensor head clean (no metal chips)?

4. **Are there signs of mechanical damage on the sensor? If so, what kind of damage is it? (If not, continue with Question 5)**

If there is external damage on the sensor, it is recommended to replace the sensor to ensure reliable operation of the system and to avoid subsequent failure or consequential damage.

5. **Have you checked the sensor technically?**

   A simple basic function test can already provide an indication as to whether the sensor is functioning correctly or not. Such function tests are described in this instruction manual (see "Commissioning [▶ 43]").

10.3 Frequent causes of fault

General causes of fault

- Is the correct type of sensor installed? Is it suitable for the rotor module?
- Do the sensor operating conditions conform to the specification (environmental influences, scope of application)?

Electrical causes of fault

- Does the power source supply sufficient current?
- Is the sensor connected correctly (cable break, loose screws, etc.)?
- Is the load too high (output signal unclear)?
- Is the scanning frequency overshot or undershot?

Mechanical causes of fault

Check rotor:

- Is the rotor made from ferromagnetic material?
- Is the rotor in good working order (no burrs, no deformation, not covered)?
- Is the rotor running correctly (bearing play)?
- Does the rotor have a radial run-out error?

Check sensor

- Is the sensor installed in the correct position?
- Is the distance from the sensor to the rotor correct?
- Is the resonance within the predefined tolerance (fit of locknut)?

11 Service

Do you have any questions or do you require help with the installation, commissioning or maintenance? Contact our Service representatives:

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