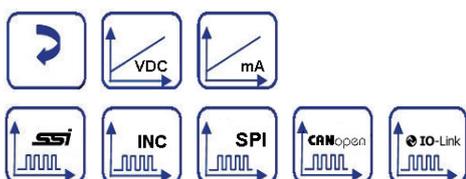
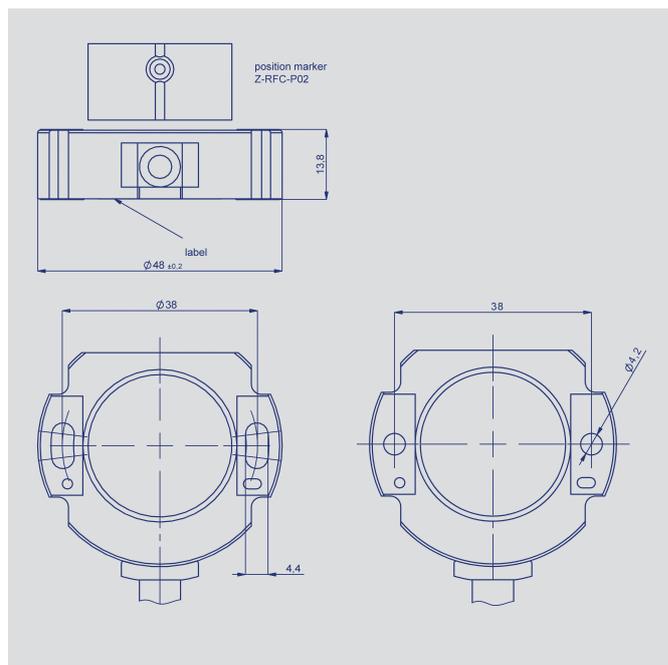
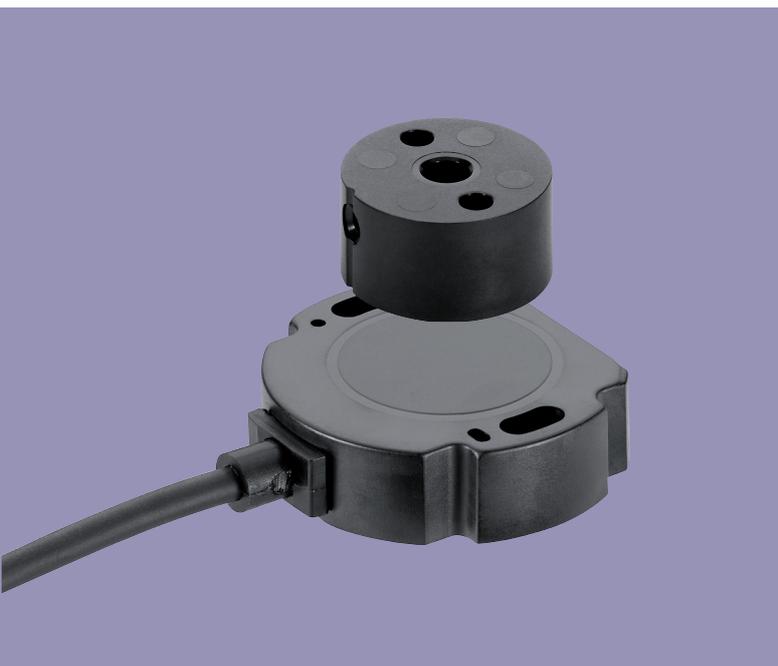


**NOVOHALL
Rotary Sensor
touchless technology**

Series RFC-4800



Special features

- Touchless hall technology
- Electrical range up to 360°
- 2-part, mechanically decoupled
- High protection class, IP67, IP69
- Resolution up to 14 bit
- Wear-free
- Temperature range -40 °C to +125 °C
- Single and multi-channel versions
- Optimized for use in industrial and mobile applications with highest EMC requirements such as ISO pulses and high interferences to ISO 11452 and ECE-Standard
- Suitable for safety-relevant applications according to DIN EN ISO 13849
- Interfaces:
Voltage, current, SSI, incremental, CANopen, SPI, IO-Link
- Customized versions

The two-part design consisting of sensor and magnetic position marker offers great flexibility when mounting. The absence of shaft and bearing makes the assembly much less sensitive to axial and radial application tolerances - separate couplings are obsolete.

Measurements can be made transmissively through any non-ferromagnetic material.

The sensor is perfectly suitable for use in harsh environmental conditions through the completely encapsulated electronics.

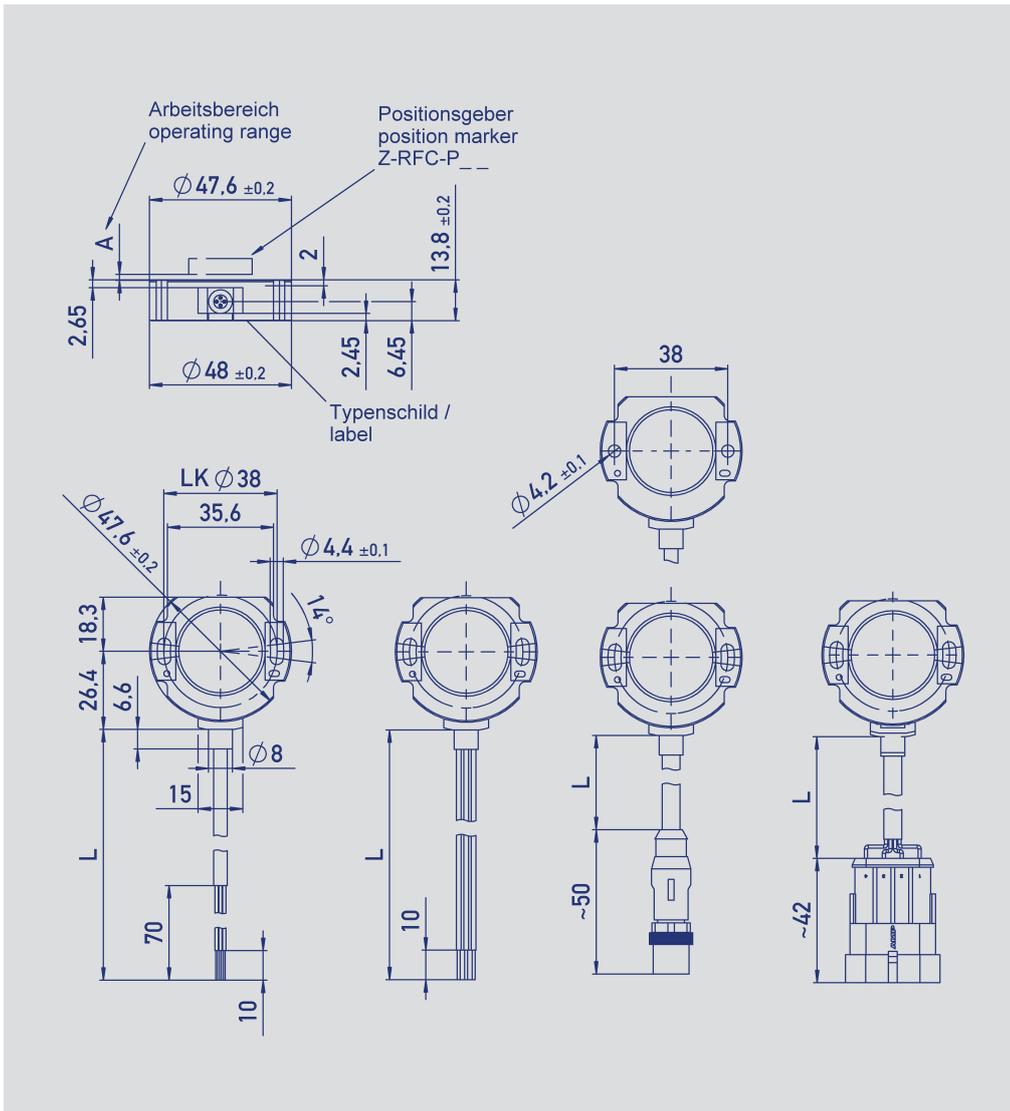
Applications

- Manufacturing Engineering
Textile machinery
Packaging machinery
Sheet metal and wire machinery
- Automation technology
- Medical engineering
- Mobile working machines
Industrial trucks
Construction machinery
Agricultural and forestry machinery
- Marine applications

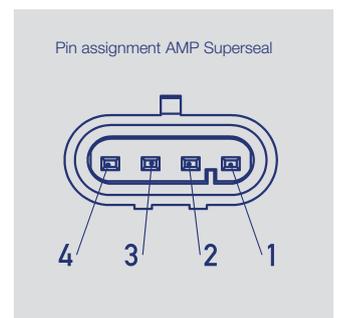
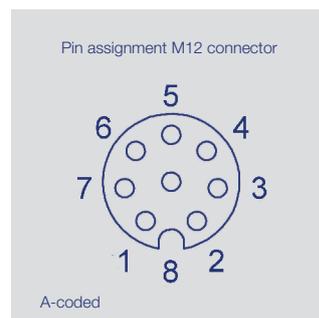
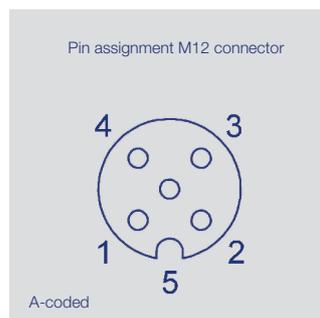
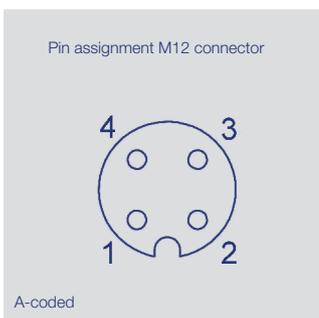
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Drawings



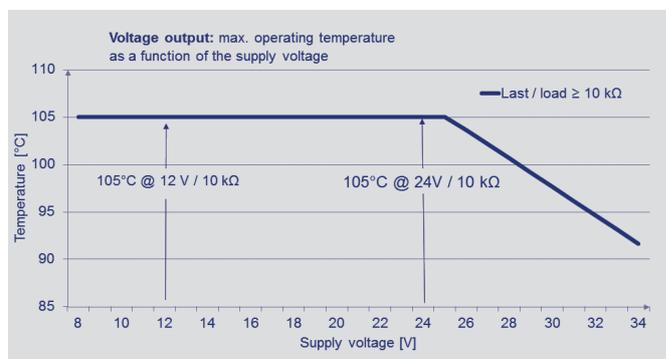
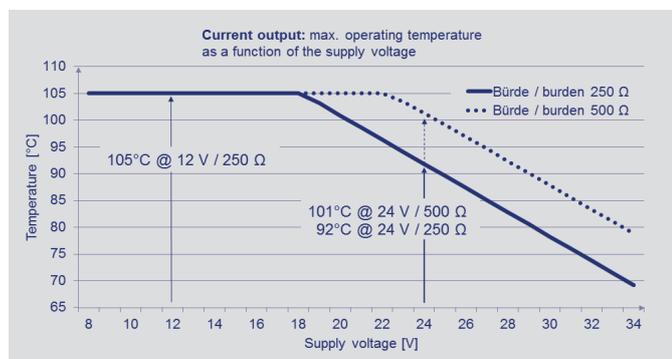
CAD data see
www.novotechnik.de/en/download/cad-data/



Mechanical Data

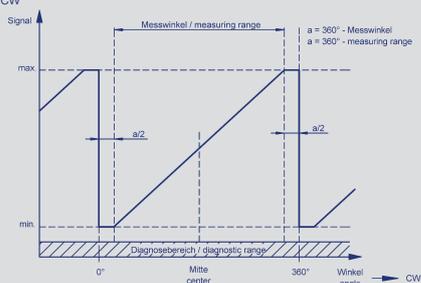
Description		
Housing	high grade, temperature resistant plastic	
Electrical connection	Cable 4 x 0.5 mm ² , AWG 20, TPE, shielded (analog voltage / current CE, CANopen) Cable 4 x 0.5 mm ² , AWG 20, TPE, unshielded (analog voltage / current mobil) Cable 5 x 0.14 mm ² , AWG 26, PUR, shielded (SPI) Cable 8 x 0.25 mm ² , AWG 24, TPE, shielded (SSI, Incremental, CANopen IN/OUT) Wire 0.5 mm ² , AWG 20, PVC (analog voltage / current mobile, Incremental Open Collector) Connector M12x1, 4-pin / 5-pin / 8-pin with cable L=0.15 m Connector AMP-Superseal, 4-pin with cable L = 0.15 m	
Mechanical Data		
Dimensions	see dimension drawing	
Mounting	with 2 lens flange head screws M4 (enclosed in delivery)	
Fastening torque of mounting screws	250	Ncm
Mechanical travel	360 continuous	°
Maximum operational speed	mechanically unlimited	
Weight (without connection)	approx. 50	g
Vibration IEC 60068-2-6	5 ... 2000 Amax = 0.75 amax = 20	Hz mm g
Shock IEC 60068-2-27	50 (6 ms)	g
Life	mechanically unlimited	
Protection class DIN EN 60529	IP67 / IP68 / IP69 (with M12 connector: IP67)	

Temperature diagram

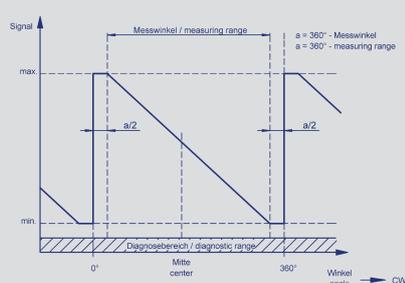


Output Characteristics

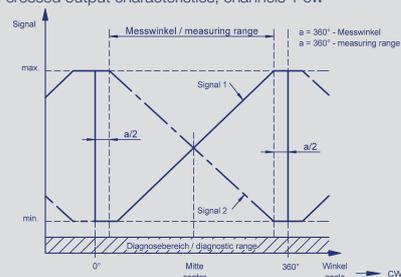
One-channel, cw



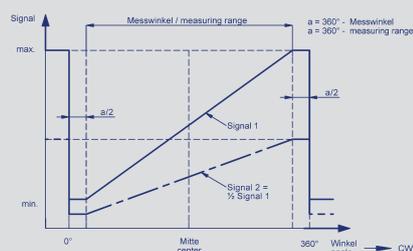
One-channel, ccw



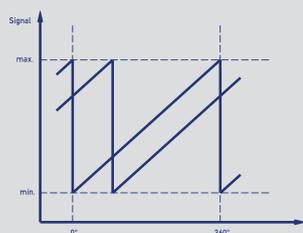
Two channels, crossed output characteristics, channels 1 cw



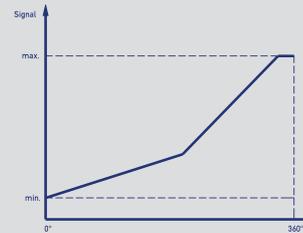
On request: Two channels, signal 2 = 0.5 x signal 1



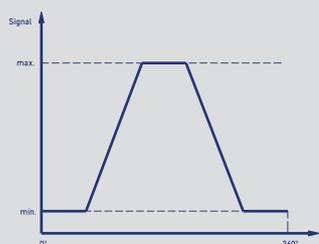
On request: 2 offset output characteristics



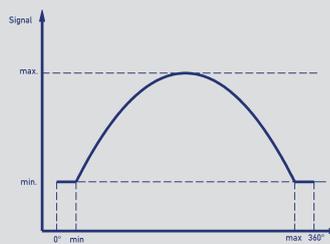
On request: Different gradients



On request: Trapezoid output characteristic



On request: Parabolic output characteristic



Technical Data - Analog Versions for Industrial Applications

Technical Data - Versions for Industrial Applications

Design optimized for use in machine and plant engineering. High reliability, simple interface to PLC, high variety.

Type Designations	RFC-48 _ _ - _ _ - 2 _ _ - _ _ _ ratiometric	RFC-48 _ _ - _ _ - 1 1 _ - _ _ _ voltage	RFC-48 _ _ - _ _ - 1 2 _ - _ _ _ current	
Electrical Data				
Output signal	ratiometric to supply voltage 0.25 ... 4.75 V (5 ... 95 %) 0.5 ... 4.5 V (10 ... 90 %) (load ≥ 5 k Ω)	0.1 ... 10 V (load ≥ 10 k Ω)	4 ... 20 mA (burden ≤ 500 Ω)	
Number of channels	1 / 2	1	1	
Diagnosis	activated (in case of error output signal is outside of the plausible signal range)			
Update rate	typical 3.4			kHz
Resolution	12			bit
Measuring range	0 ... 30 up to 0 ... 360, in 10°-steps			
Independent linearity	≤ 0.5			\pm % FS
Repeatability	typical ≤ 0.1			°
Hysteresis at measuring range < 360°	typical ≤ 0.1			°
Hysteresis at measuring range 360°	typical ≤ 0.25 (lower hysteresis on request)			°
Temperature error at measuring range 30 up to 170°	typical $\pm 0,7$	typical $\pm 1,0$	typical $\pm 1,2$	% FS
Temperature error at measuring range 180 up to 360°	typical $\pm 0,35$	typical $\pm 0,5$	typical $\pm 0,6$	% FS
Supply voltage U_b	5 (4.5 ... 5.5)	24 (18 ... 30)	24 (13 ... 30)	VDC
Current consumption (w/o load)	typical 12 per channel			mA
Reverse voltage	yes, supply lines and outputs			
Short circuit protection	yes (vs. GND and supply voltage)			
Insulation resistance (500 VDC)	≥ 10			M Ω
Cross-section cable	0.5 (AWG 20)			
Environmental Data				
Operating temperature	-40 ... +125 -25 ... +85 with M12 connector	-40 ... +105 * -25 ... +85 with M12 connector	-40 ... +105 * -25 ... +85 with M12 connector	°C °C
The max. operating temperature depends on supply voltage U_b and load resp. burden (see page 4)				
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	99 (per channel)	46	40	years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us			
EMC compatibility	EN 61000-4-2 Electrostatic discharge (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Electrical fast transients (burst) 1 kV EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff. EN 55016-2-3 Radiated disturbances			



Connection assignment

One-channel versions

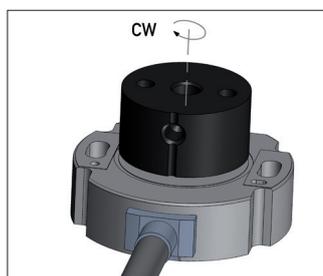
Signal	Cable code 2 _ _	Connector M12 code 501
Supply voltage U_b	GN	pin 1
Signal output	WH	pin 2
GND	BN	pin 3
Not assigned	YE	pin 4

Cable shielding connect to GND.

Redundant versions

Signal	Cable code 2 _ _	Connector M12 code 501
Supply voltage U_b	GN	pin 1
Signal output 1	WH	pin 2
GND	BN	pin 3
Signal output 2	YE	pin 4

Cable shielding connect to GND.



When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.

Ordering Specifications - Analog Versions - Voltage - Current
for Industrial Applications

Ordering specifications

Preferred types printed in bold:

- Delivery time up to 25 pcs. within 10 working days EXW
- Best low-volume pricing

Supply voltage Ub

- 1: 24 V
- 2: 5 V

Output signal supply voltage Ub = 24 V

- 1: 0.1 ... 10 V (only one-channel)
- 2: 4 ... 20 mA (only one-channel)

Output signal supply voltage Ub = 5 V

- 1: 0.25 ... 4.75 V ratiometric to supply voltage Ub (5 ... 95 %)
- 2: 0.5 ... 4.5 V ratiometric to supply voltage Ub (10 ... 90 %)

Output characteristics

- 1: Rising cw
 - 2: Rising ccw
 - 3: Crossed output channel 1 rising cw (partly redundant)
- Other output characteristics on request

Electrical connections

- 201: Cable 4-pole, 0,5 m shielded
 - 202: Cable 4-pole, 1 m shielded**
 - 206: Cable 4-pole, 3 m shielded**
 - 210: Cable 4-pole, 5 m shielded
 - 220: Cable 4-pole, 10 m shielded
 - 501: M12 connector 4-pin, with cable, L = 0.15 m, shielded**
- Cable versions and assembled connectors on request

R F C - 4 8 5 1 - 6 3 6 - 2 1 1 - 2 0 2

Series

Mechanical version

- 4851: Elongated hole mounting for easy adjustment**
 - 4852: Round hole mounting
 - 4853: Elongated hole mounting, without diagnostic function**
 - 4854: Round hole mounting, without diagnostic function
- Other versions f.e. with internal shielding against magnetic fields on request

Measuring range

- 03: Angle 0° ... 30° min.
 - ...
 - 06, 12, 18, 24, 36**
 - ...
 - 36: Angle 0° ... 360° max.
- Other angles on request

Number of channels

- 6: Single output 1 x supply voltage Ub / 1 x output**
- 7: partly redundant 1 x supply voltage Ub / 2 x output (only at supply voltage Ub = 5 V)**

**Technical Data -
Analog Versions
- Voltage
- Current**
for Mobile Applications



Technical Data - Versions for Mobile Applications

These versions are optimized for the high requirements in mobile applications. Tested to the highest requirements as ISO-pulses and high interferences to ISO 11452.

Type Designations	RFC-48_--_--2_--_-- ratiometric	RFC-48_--_--3_--_-- voltage	RFC-48_--_--32_--_-- current	
Electrical Data				
Output signal	ratiometric to supply voltage Ub 0.25 ... 4.75 V (5 ... 95 %) 0.5 ... 4.5 V (10 ... 90 %) (load ≥ 5 k Ω)	0.25 ... 4.75 V 0.5 ... 4.5 V (load ≥ 10 k Ω)	4 ... 20 mA (burden @ Ub > 13 V: $\leq 500 \Omega$ burden @ Ub ≤ 13 V: $\leq 250 \Omega$)	
Number of channels	1 / 2			
Diagnosis	activated (in case of error output signal is outside of the plausible signal range)			
Update rate	typical 3.4			kHz
Resolution	12			bit
Measuring range	0 ... 30 up to 0 ... 360, in 10°-steps			°
Independent linearity	$\leq 0,5$			$\pm\%$ FS
Repeatability	typical $\leq 0,1$			°
Hysteresis at measuring range < 360°	typical $\leq 0,1$			°
Hysteresis at measuring range 360°	typical $\leq 0,25$ (lower hysteresis on request)			°
Temperature error at measuring range 30 and 170°	typical $\pm 0,7$	typical $\pm 1,0$	typical $\pm 1,2$	% FS
Temperature error at measuring range 180 and 360°	typical $\pm 0,35$	typical $\pm 0,5$	typical $\pm 0,6$	% FS
Supply voltage Ub	5 (4.5 ... 5.5)	12/24 (8 ... 34)	12/24 (8 ... 34)	VDC
Current consumption (w/o load)	typical 12 per channel			mA
Reverse voltage	yes, supply lines and outputs			
Short circuit protection	yes (vs. GND and supply voltage)			
Insulation resistance (500 VDC)	≥ 10			M Ω
Cross-section cable / lead wires	0.5 (AWG 20)			mm ²
Environmental Data				
Operating temperature	-40 ... +125 -25 ... +85 with M12 connector	-40 ... +105 * -25 ... +85 with M12 connector	-40 ... +105 * -25 ... +85 with M12 connector	°C °C
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	99 (per channel)	44 (per channel)	40 (per channel)	years
MTTFd (DIN EN ISO 13849-1 parts count method, w/o load, wc)	198 (per channel)	88 (per channel)	80 (per channel)	years
Functional safety	Suitable for safety-relevant applications according to ISO 13849 after customer validation. Further safety data (DCavg...) and support for functional safety are available on request.			
EMC compatibility	ISO 10605 Packaging and Handling + Component Test 8 kV, 15 kV ISO 11452-2 Radiated EM HF-Fields, Absorber Hall 100 V/m ISO 11452-5 Radiated EM HF-Fields, Stripline 200 V/m CISPR25 Radiated emission class 5 ISO 7637-2 Pulses on supply lines (1, 2a, 2b, 3a, 3b, 4, 5) Level 4 ISO 7637-3 Transient disturbances Level 4 EN 13309 Construction machinery Emission and immunity according to ECE - R10 (E1)			

Connection assignment

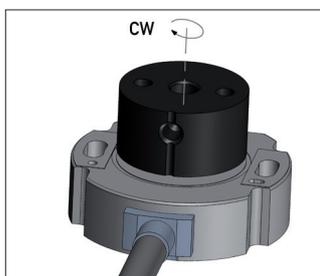
One-channel versions

Signal	Lead wires code 4 __	Cable code 2 __	Connector code 551 / 552
Supply voltage Ub	RD	GN	pin 1
Signal output	BU	WH	pin 2
GND	BK	BN	pin 3
Not assigned	-	YE	pin 4

Redundant versions

Signal	Lead wires code 4 __	Cable code 2 __	Connector code 551 / 552
Supply voltage Ub 1	RD	GN	pin 1
Signal output 1	BU	WH	pin 2
GND 1	BIK	BN	pin 3
Signal output 2	BU/WH	YE	pin 4
Supply voltage Ub 2	RD/WH	-	-
GND 2	BK/WH	-	-

When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.



Ordering Specifications - Analog Versions for Mobile Applications

Ordering specifications

Preferred types printed in bold:

- Delivery time up to 25 pcs. within 10 working days EXW
- Best low-volume pricing

Supply voltage

- 2: Supply voltage $U_b = 5\text{ V}$ (4.5 ... 5.5 V)
3: Supply voltage $U_b = 12/24\text{ V}$ (8 ... 34 V)

Output signal Supply voltage $U_b = 5\text{ V}$

- 1: **0.25 ... 4.75 V ratiometric to supply voltage U_b** (5 ... 95 %)
2: 0.5 ... 4.5 V ratiometric to supply voltage U_b (10 ... 90 %)

Output signal supply voltage $U_b = 12/24\text{ V}$

- 2: 4 ... 20 mA
4: 0.5 ... 4.5 V
5: **0.25 ... 4.75 V**

Output characteristics

- 1: Rising cw
2: Rising ccw
3: **Crossed output channel 1 rising cw (partly redundant)**
4: **Crossed output channel 1 rising cw (fully redundant)**
Other output characteristics on request

Electrical connections

- 251: Cable 4-pole, 0,5 m unshielded, one-channel and partly redundant
252: **Cable 4-pole, 1 m unshielded, one-channel and partly redundant**
256: **Cable 4-pole, 3 m unshielded, one-channel and partly redundant**
260: Cable 4-pole, 5 m unshielded, one-channel and partly redundant
270: Cable 4-pole, 10 m unshielded, one-channel and partly redundant
401: **Lead wires 3 x L = 0,5 m, single**
411: **Lead wires 4 x L = 0,5 m, partly redundant**
421: **Lead wires 6 x L = 0,5 m, fully redundant**
551: **M12 connector 4-pin, with cable L = 0.15 m unshielded, one-channel and partly redundant**
552: Connector AMP Superseal, 4-pin, with cable L = 0.15 m, unshielded, one-channel and partly redundant
Cable versions and assembled connectors on request

R F C - 4 8 5 1 - 6 3 6 - 2 1 1 - 2 5 2

Series

Measuring range

- 03: Angle 0° ... 30° min.
...
06, 12, 18, 24, 36
...
36: Angle 0° ... 360° max.
Other angles on request

Number of channels

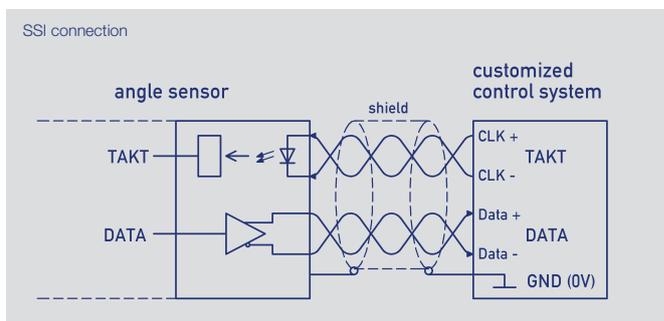
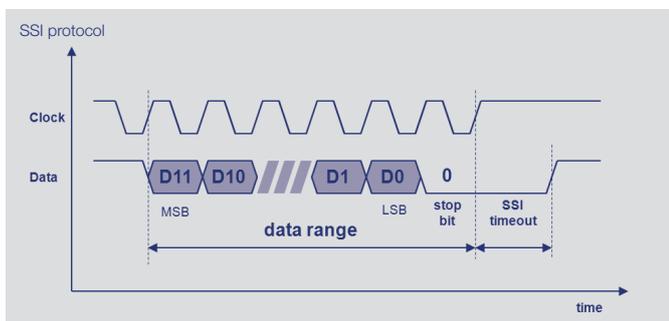
- 6: one-channel 1x supply voltage U_b / 1 x output
7: partly redundant 1 x supply voltage U_b / 2 x output
8: fully redundant 2 x supply voltage U_b / 2 x output

Mechanical version

- 4851: **Elongated hole mounting for easy adjustment**
4852: Round hole mounting
4853: **Elongated hole mounting, without diagnostic function**
4854: Round hole mounting, without diagnostic function
Further versions f.e. with internal shielding against magnetic fields on request.

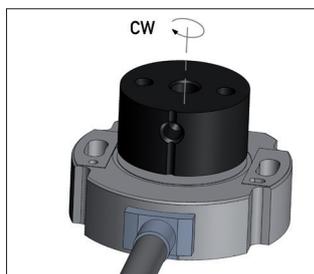
Technical Data SSI Interface

Type Designations	RFC-48 _-212-41 _- _- _- Supply voltage 5 VDC	RFC-48 _-212-44 _- _- _- Supply voltage 24 VDC
Electrical Data		
Protocol	SSI 13 bit (12 bit data + 1 stop bit)	
Inputs	RS422 compatible, CLK lines via optocoupler galvanically isolated	
Monoflop time (tm)	16	µs
Coding	Gray	
Update rate (internal)	2 000	kHz
Resolution across 360°	12	bit
Measuring range	360°	
Maximum operational speed position marker	30 000, higher speeds on request	
Independent linearity	typical 0,5	±% FS
Repeatability	≤ 0.2	°
Hysteresis	≤ 0.7, lower hysteresis on request	°
Temperature error	0.375	±% FS
Supply voltage Ub	5 (4.5 ... 5.5)	24 (18 ... 30)
Current consumption (w/o load)	typical 27	typical 10
Reverse voltage	yes, supply lines	
Short circuit protection	yes (ouput vs. supply voltage and GND)	yes (output vs. GND)
Ohmic load at outputs	≥ 120	Ω
Max. clock rate	1	MHz
Insulation resistance (500 VDC)	≥ 10	
Cross-section cable	0.25 (AWG 24)	
Environmental Data		
Operating temperature	-40 ... +85 (-25 ... +85 with M12 connector)	
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	141	102
Functional safety	If you need assistance in using our products in safety-related systems, please contact us	
EMC compatibility	EN 61000-4-2 Electrostatic discharge (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Electrical fast transients (burst) 1 kV EN 61000-4-6 Conducted disturbances, induced by RF fields 10 V eff. EN 61000-4-8 Power frequency magnetic fields 30 A/m EN 55016-2-3 Noise radiation class B	



Connection assignment

Signal	Cable code 4 _- _-	Connector M12 code 531
Supply voltage Ub	WH	pin 1
GND	BN	pin 2
Clock input SSI Clk-	GN	pin 3
Clock input SSI Clk+	YE	pin 4
Signal output SSI Data-	GY	pin 5
Signal output SSI Data+	PK	pin 6
Not assigned	BU	pin 7
Not assigned	RD	pin 8



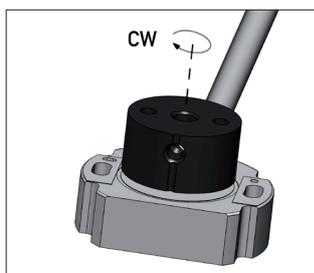
When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.

Technical Data Incremental Interface for Industrial Applications

Type Designations	RFC-48__-2__-5__-__-__ Supply voltage 5 VDC	RFC-48__-2__-530-__-__ Supply voltage 24 VDC, TTL	RFC-48__-2__-534-__-__ Supply voltage 24 VDC, HTL	
Electrical Data				
Outputs	A+ / A- B+ / B- Z+ / Z-			
Level	RS-422, TTL-compatible	RS-422, TTL-compatible	HTL-compatible, Push-Pull	
Length Z-pulse	90 electrical, between 2 edges A / B			°
Pulses per revolution	1024, other resolutions see page 12			ppr
Counts per revolution (after quadrature)	4096			
Option Low Speed				
- Minimum edge separation	8			µs
- Minimum input frequency of counter input	32			kHz
- Maximum operational speed	1 800			min ⁻¹
Option High Speed				
- Minimum edge separation	0.5			µs
- Minimum input frequency of counter input	500			kHz
- Maximum operational speed	29 000, higher speeds on request			min ⁻¹
Measuring range	360			°
Independent linearity	typical 0.5			±% FS
Repeatability	≤ 0.2			°
Hysteresis	≤ 0.7, lower hysteresis on request			°
Temperature error	0.375			±% FS
Supply voltage Ub	5 (4.5 ... 5.5)	24 (18 ... 30)	24 (18 ... 30)	VDC
Current consumption (w/o load)	typical 20	typical 10	typical 10	mA
Reverse voltage	yes, supply lines			
Short circuit protection	yes, all outputs vs. GND and supply voltage	yes, all outputs vs. GND	yes, all outputs vs. GND and supply voltage	
Ohmic load at output	≥ 120 per channel A / B / Z	≥ 120 per channel A / B / Z	≥ 750 per channel A / B / Z	Ω
Insulation resistance (500 VDC)	≥ 10			MΩ
Cross-section cable	0.25 (AWG 24)			mm ²
Environmental Data				
Operating temperature	-40 ... +85 (-25 ... +85 with M12 connector)			°C
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	183	122	122	years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us			
EMC compatibility	EN 61000-4-2 Electrostatic discharge (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Electrical fast transients (burst) 1 kV EN 61000-4-6 Conducted disturbances, induced by RF fields 10 V eff. EN 61000-4-8 Power frequency magnetic fields 30 A/m EN 55016-2-3 Radiated disturbances			

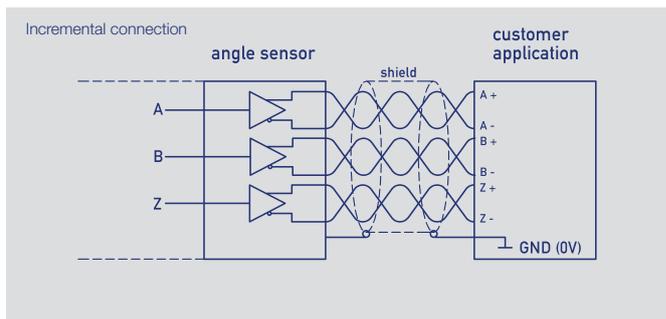
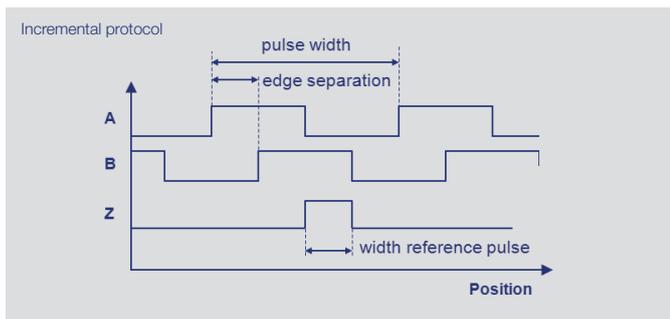
Connection assignment

Signal	Cable code 4 __	Connector M12 code 531
Supply voltage Ub	WH	pin 1
GND	BN	pin 2
A-	GN	pin 3
A+	YE	pin 4
B-	GY	pin 5
B+	PK	pin 6
Z+	BU	pin 7
Z-	RD	pin 8



When the marking of the position marker is pointing away from the cable, the output is in the vicinity of the reference pulse (Z).
Rotational direction CW:
A leads before B.

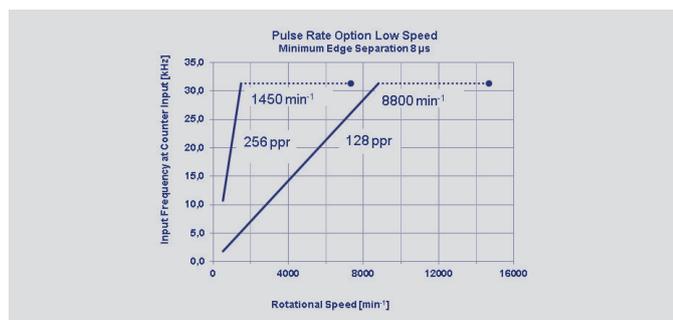
Technical Data Incremental Interface



Electrical Data

Pulses per revolution	1024	512	256	128	ppr	
Counts per revolution (after quadrature)	4096	2048	1024	512		
Option Low Speed						
- Minimal edge separation	8				μs	
- Minimum input frequency of counter input	32	32	32*	32*	kHz	
- Maximum operational speed	1800	3600	7200	14400	min^{-1}	
Option High Speed						
- Minimal edge separation	0,5				μs	
- Minimum input frequency of counter input	500	500	500*	105*	kHz	
- Maximum operational speed	29000	higher speeds on request				min^{-1}

*) The requirement for the minimum input frequency of counter input is reduced at lower speed (see below charts).

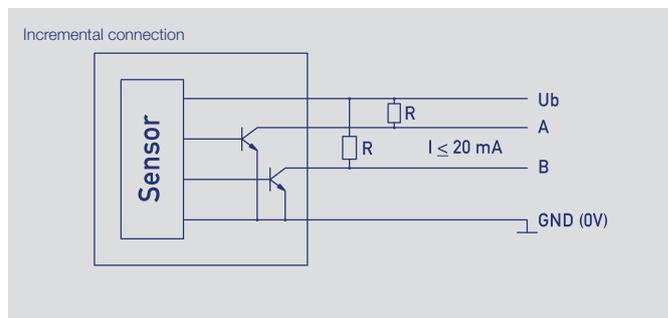
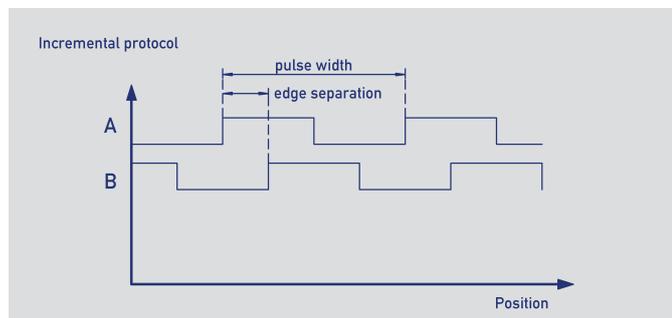


*) max. 120.000 U/min, limited by max. operational speed of position marker

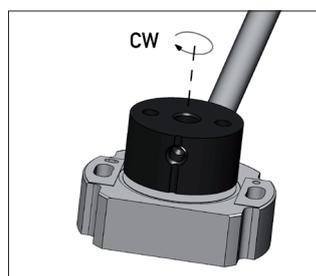
Technical Data Incremental Interface for Mobile Applications

Type Designations	RFC-48_ _-2_ _-556- _ _ _ _				Supply voltage 12/24 VDC, open collector
Electrical Data					
Outputs	A- B-				
Level	Open collector				
Pulses per revolution	1024	512	256	128	ppr
Counts per revolution (after quadrature)	4096	2048	1024	512	
Minimum edge separation	8				μs
Minimum input frequency of counter input	32	32	32*	32*	kHz
Maximum operational speed	580	3500	7200	14400	min ⁻¹
Measuring range	360				°
Independent linearity	typical 0.5				±% FS
Repeatability	≤ 0.2				°
Hysteresis	≤ 0.7, lower hysteresis on request				
Temperature error	0.375				±% FS
Supply voltage Ub	12/24 (9 ... 34)				VDC
Current consumption (w/o load)	typical 10				mA
Overvoltage protection	60 (temporary / 10 min.)				VDC
Reverse voltage	yes, supply lines				
Short circuit protection	yes, all outputs vs. GND and supply voltage Ub				
Load outputs vs. supply voltage Ub	20 per channel				mA
Insulation resistance (500 VDC)	≥ 10				MΩ
Cross-section cable / lead wires	0.5 (AWG 20)				mm ²
Environmental Data					
Operating temperature	-40 ... +85 (-25 ... +85 with M12 connector)				°C
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	83				years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us				
EMC compatibility	ISO TR 10605 Packaging and Handling + Component Test 8 kV, 15 kV ISO 11452-2 Radiated EM RF fields, absorber hall 100 V/m ISO 11452-5 Radiated EM RF fields, stripline 200 V/m ISO 7637-2 Pulses on supply lines (1) Level 3, (2a, 2b, 3a, 3b, 4, 5) Level 4 CISPR 25 Radiated emission class 5				

*) The requirements for the minimum input frequencies of counter input is reduced at lower speed (see page 12).



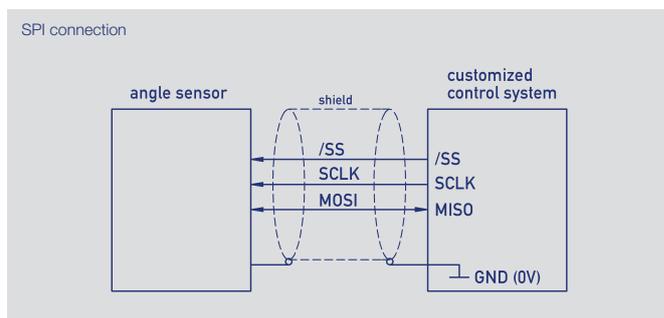
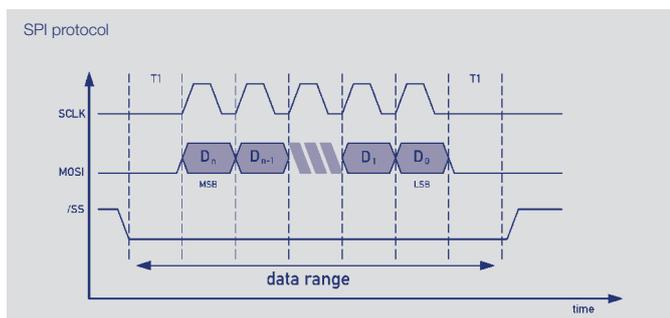
Connection assignment			
Signal	Lead wires code 4 _ _	Cable code 2 _ _	Connector M12 code 551
A-	BU	GN	pin 1
Supply voltage Ub	RD	WH	pin 2
GND	BK	BN	pin 3
B-	BU/WH	YE	pin 4



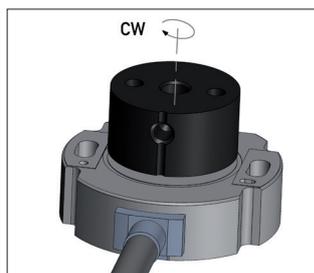
Rotational direction CW:
A leads before B

Technical Data SPI Interface

Type Designations	RFC-48__-2__-8__-__-__	
	Supply voltage 5 VDC	
Electrical Data		
Protocol	SPI	
Coding	Binary code	
Level SCLK, MOSI, /SS	TTL level (s. application note SPI protocol)	
Update rate internal	5	kHz
Resolution across 360°	14	bit
Measuring range	360	°
Independent linearity	≤ 0.5	±% FS
Repeatability	≤ 0.1	°
Hysteresis	≤ 0.1	°
Temperature error	±0.625	% FS
Supply voltage Ub	5 (4.5 ... 5.5)	VDC
Current consumption (w/o load)	typical 15	mA
Reverse voltage	yes, supply lines	
Short circuit protection	yes (vs. GND and supply voltage)	
Max. clock rate	400	kHz
Insulation resistance (500 VDC)	≥ 10	MΩ
Cross-section cable	0.14 (AWG 26)	mm²
Environmental Data		
Operating temperature	-40 ... +85	°C
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	272	years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us	
EMC compatibility	EN 61000-4-2 electrostatic discharge (ESD) 4 kV, 8 kV EN 61000-4-3 electromagnetic fields 10 V/m EN 61000-4-4 electrical fast transients (Burst) 1 kV EN 61000-4-6 conducted disturbances, induced by RF fields 10 V eff. EN 61000-4-8 Power frequency magnetic fields 30 A/m EN 55011/EN 55022/A1 Radiated disturbances class B	



Connection assignment	
Signal	Cable code 302
Supply voltage Ub	GN
GND	BN
MOSI / MISO	YE
SCLK	GY
/SS (slave select)	WH



When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.

Ordering Specifications - Digital Versions - SSI - Incremental - SPI

Ordering specifications

Preferred types printed in bold:

- Delivery time up to 25 pcs. within 10 working days EXW
- Best low-volume pricing

Supply voltage U_b / Interface
4: Synchronous-Serial Interface (SSI)
5: Incremental Interface A / B / Z
8: Serial Peripheral Interface (SPI)

Interface parameters for SSI Interface

- 11: 5 V (4.5 ... 5.5 V) Supply voltage, output RS422 comp., Gray code, rising cw**
- 12: 5 V (4.5 ... 5.5 V) Supply voltage, output RS422 comp., Gray code rising ccw
- 41: 24 V (18 ... 30 V) Supply voltage, output RS422 comp., Gray code, rising cw**
- 42: 24 V (18 ... 30 V) Supply voltage, output RS422 comp., Gray code rising ccw

Interface parameters for Incremental Interface

Low Speed Mode (minimum edge separation 8 μ s)

- 15: 5 V (4.5 ... 5.5 V) supply voltage, output RS422, TTL-compatible**
- 35: 24 V (18 ... 30 V) supply voltage, output RS422, TTL-compatible**
- 39: 24 V (18 ... 30 V) supply voltage, output HTL-compatible, Push-Pull**
- 56: 12/24 V (9 ... 34 V) supply voltage, output low side, open collector**

High Speed Mode (minimal edge separation 0,5 μ s)

- 10: 5 V (4.5 ... 5.5 V) supply voltage, output RS422, TTL-compatible
- 30: 24 V (18 ... 30 V) supply voltage, output RS422, TTL-compatible
- 34: 24 V (18 ... 30 V) supply voltage, output HTL-compatible, Push-Pull
- UWV signals instead of ABZ signals for motor commutation on request
- Absolute position at Power On (Power on Burst) on request

Interface parameters for SPI Interface

- 31: 5 V (4.5 ... 5.5 V) Supply voltage, Binary code, rising cw**

Electrical connections

SSI / Incremental:

- 432: Cable 8-pole, 1.0 m, shielded**
- 436: Cable 8-pole, 3.0 m, shielded**
- 440: Cable 8-pole, 5.0 m, shielded
- 450: Cable 8-pole, 10.0 m, shielded
- 531: Connector M12x1 8-pole with cable, L = 0.15 m, shielded**

Incremental Open Collector:

- 252: Cable 4-pole, 1 m, unshielded**
- 256: Cable 4-pole, 3 m, unshielded**
- 260: Cable 4-pole, 5 m, unshielded
- 270: Cable 4-pole, 10 m, unshielded
- 411: Lead wires 4 x L = 0.5 m**
- 551: Connector M12x1 4-pin with cable, L = 0.15 m, unshielded**

SPI

- 302: Cable 5-pole 1.0 m, shielded**
- Cable versions and assembled connectors on request

R F C - 4 8 0 2 - 2 1 2 - 4 4 1 - 4 3 2

Series

Resolution SSI Interface

- 12: 12 bit**
- Other resolutions on request

Resolution Incremental Interface

- 12: 1024 ppr - 4096 counts (after quadrature)**
- 11: 512 ppr - 2048 counts (after quadrature)
- 10: 256 ppr - 1024 counts (after quadrature)
- 09: 128 ppr - 512 counts (after quadrature)
- Other resolutions on request

Resolution SPI Interface

- 14: 14 bit**

Interface

- 2: Digital Interface**

Mechanical version

- 4801: Elongated hole
- 4802: Round hole mounting**

Technical Data



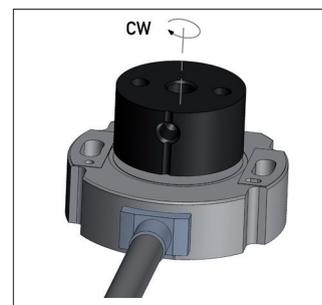
Type Designations	RFC-48 _ _ - 214 - 6 _ _ _ - _ _ _ _ CANopen	
Electrical Data		
Measured variables	Position and speed	
Measuring range	360	°
Measurement range speed	0 ... 1600	min-1
Number of channels	1 / 2 see ordering specifications	
Output signal / protocol	CANopen protocol to CiA DS-301 V4.2.0, Device profile DS-406 V3.2 Encoder Class C2, LSS services to CiA DS-305 V1.1.2	
Programmable parameter	Position, speed, cams, working areas, rotating direction, scale, offset, node-ID, baud rate	
Diagnosis	activated (in case of error output signal is outside of the plausible signal range)	
Node-ID	1 ... 127 (default 127)	
Baud rate	50 ... 1000 see ordering specifications	kBaud
Resolution across 360° (position)	14	bit
Resolution speed	$360/2^{14} \approx 0,022$	°/ms
Update rate	1	kHz
Independent linearity	≤ 0.5	±% FS
Repeatability	≤ 0.36	°
Hysteresis	≤ 0.36	°
Temperature error	0.2	±% FS
Supply voltage Ub	12/24 (8 ... 34)	VDC
Current consumption (w/o load)	< 100	mA
Reverse voltage	yes, supply lines	
Short circuit protection	yes, output vs.GND and supply voltage Ub (up to 40 VDC)	
Overvoltage protection	< 45 (permanent)	VDC
Insulation resistance (500 VDC)	≥ 10	MΩ
Cross-section cable	0.5 (AWG 20) (4-pole) resp. 0.25 (AWG 24) (8-pole)	
Bus termination internal	120, optionally, see ordering specifications	Ω
Environmental Data		
Operation temperature	-40 ... +105 (-25 ... +85 with M12 connector)	°C
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	one-channel: 71 / two-channel: 58	years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us	
EMC compatibility	ISO TR 10605 Packaging and Handling + Component Test 8 kV ISO 11452-2 Radiated EM RF fields, Absorberhall 100 V/m ISO 11452-5 Radiated EM RF fields, Stripline 200 V/m CISPR 25 Radiated emission class 3 ISO 7637-2 Pulses on supply lines (1, 2a, 2b, 3a, 3b, 4 (24 V systems), 5) Level 5 ISO 7637-3 Transient emission Level 4	

Connection assignment

Signal	Cable Code 2 _ _	Connector M12 Code 511
CAN_SHLD	Shield	pin 1
Supply voltage Ub	WH	pin 2
GND	BN	pin 3
CAN_H	YE	pin 4
CAN_L	GN	pin 5

Cable shielding connect to GND.

Signal	Cable Code 432
CAN_SHLD	Shield
Supply voltage Ub	WH and RD
GND	BN and BU
CAN_H IN	YE
CAN_L IN	GN
CAN_H OUT	PK
CAN_L OUT	GY



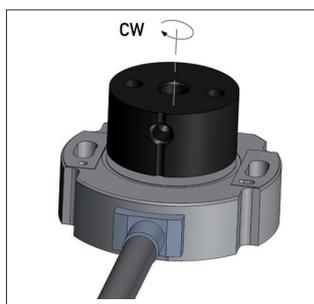
When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.

Type Designations	RFC-48 _ _ - 214 - A _ _ - _ _ _ IO-Link	
Electrical Data		
Measured variables	Position (other process data such as speed, revolution counter or cams on request)	
Measuring range	360	°
Number of channels	1	
Output signal / protocol	IO-Link Spec V1.1 to IEC 61131-9, Smart Sensor Profile	
Programmable parameter	Zero point offset, averaging, rotating direction	
Diagnosis	activated (in case of error output signal is outside of the plausible signal range)	
Resolution across 360° (Position)	14	bit
Update rate	1	kHz
Transfer rate	COM 3 (230.4 kB)	
Frame type	2.2	
Minimum cycle time	1	ms
Independent linearity	0.5	±% FS
Repeatability	0.36	°
Hysteresis	0.36	°
Temperature error	0.2	±% FS
Supply voltage U_b	24 (18 ... 30)	VDC
Current consumption (w/o load)	< 100	mA
Reverse voltage	yes, supply lines	
Short circuit protection	yes, output vs. GND and U_b (up to 40 VDC)	
Overvoltage protection	< 35 (permanent)	VDC
Insulation resistance (500 VDC)	≥ 10	MΩ
Cross-section cable	0.5 (AWG 20)	mm ²
Environmental Data		
Operation temperature	-40 ... +105 (-25 ... +85 with M12 connector)	
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	single channel: 76	Jahre
Functional safety	If you need assistance in using our products in safety-related systems, please contact us	
 npatibility	EN 61000-4-2 Electrostatic discharge (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Electrical fast transients (burst) 2 kV EN 61000-4-6 Conducted disturbances, induced by RF fields 10 V eff. EN 55016-2-3 Radiated disturbances	

Connection assignment

Signal	Cable code 2 _ _	Connector M12 code 551
Supply voltage U_b	BN	pin 1
Do not connect*	GN	pin 2
GND	WH	pin 3
C/Q	YE	pin 4

*) Alternatively on GND



When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.

Ordering
Specifications



Ordering specifications

Preferred types printed in bold:

- Delivery time up to 25 pcs. within 10 working days EXW
- Best low-volume pricing

Interface

6: CANopen Interface

A: IO-Link

Interface parameters CANopen 6 _ _

1: 1 x position, 1 x speed

2: 2 x position, 2 x speed

5: 1 x position, 1 x speed with bus termination 120 Ω

6: 2 x position, 2 x speed with bus termination 120 Ω

Interface parameters IO-Link A _ _

11: 1 x position, rising cw

Other process data such as speed, revolution counter or cams on request

Baud rate

1: Baud rate 1000 kBaud

2: Baud rate 800 kBaud

3: Baud rate 500 kBaud

4: Baud rate 250 kBaud

5: Baud rate 125 kBaud

7: Baud rate 50 kBaud

Electrical connections CANopen

202: Cable 4-pole 1.0 m, shielded

432: Cable 8-pole, 1.0 m shielded (CAN IN/OUT)

511: Connector M12x1, 5-pin, with cable, L= 0.15 m, shielded

Electrical connections IO-Link

252: Cable 4-pole, 1.0 m, unshielded

256: Cable 4-pole, 3.0 m, unshielded

260: Cable 4-pole, 5.0 m, unshielded

270: Cable 4-pole, 10.0 m, unshielded

551: Connector M12x1, 4-pin, with cable, L= 0.15 m, unshielded

Cable versions and assembled connectors on request

R F C - 4 8 5 2 - 2 1 4 - 6 1 5 - 5 1 1

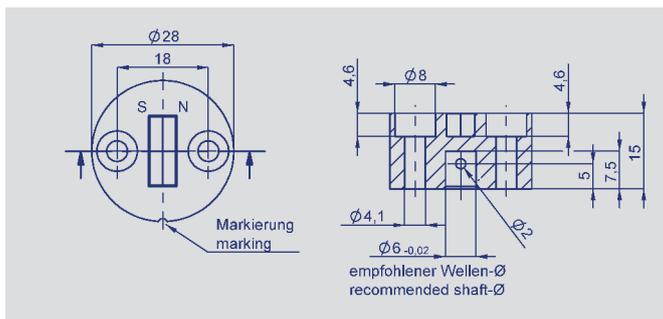
Series

Mechanical version

4851: Elongated hole

4852: Round hole mounting

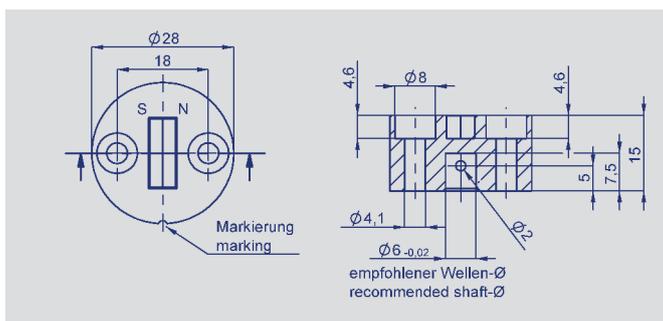
Position Markers



Z-RFC-P41

Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both included in delivery).

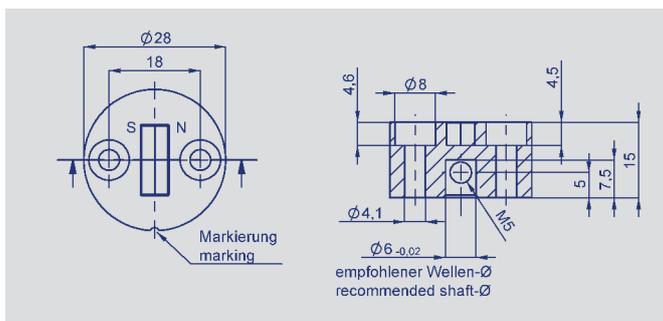
- max. permitted radial offset ± 3 mm
- packaging unit:
1 pc. P/N 400105037
25 pcs. P/N 400105038



Z-RFC-P02

Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both are included in delivery).

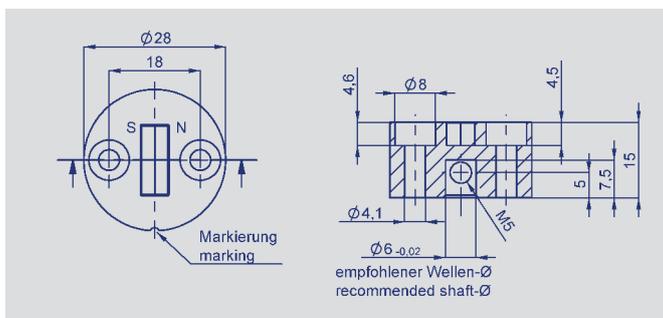
- max. permitted radial offset ± 3 mm
- packaging unit:
1 pc. P/N 400005661
25 pcs. P/N 400056080



Z-RFC-P47

Position marker for fixation with threaded pin M5 (included in delivery).

- max. permitted radial offset ± 3 mm
- packaging unit:
1 pc. P/N 400105039
25 pcs. P/N 40005040

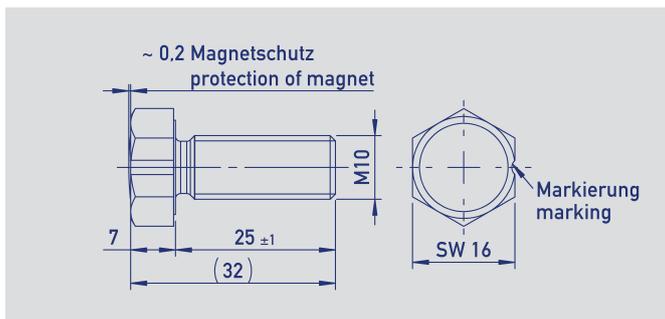


Z-RFC-P08

Position marker for fixation with threaded pin pin M5 (included in delivery).

- max. permitted radial offset ± 3 mm
- packaging unit:
1 pc. P/N 400056070
25 pcs. P/N 400056084

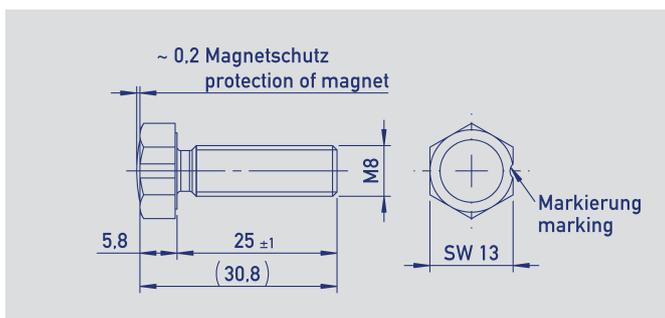
Position Markers



Z-RFC-P18

Screw position marker
M10 x 25 mm, similar DIN 933,
Aluminum anodized,
magnet potted

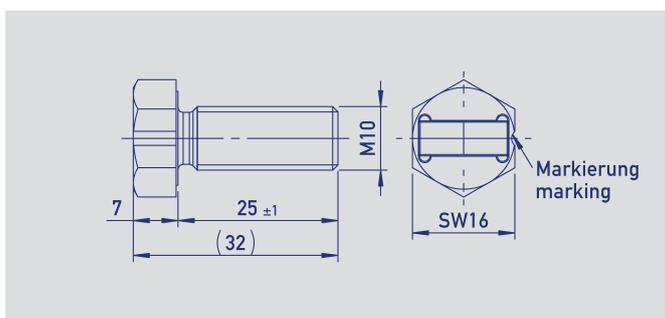
- max. permitted radial offset ± 3 mm
- packaging unit:
1 pc. P/N 400104756
25 pcs. P/N 400104757



Z-RFC-P19

Screw position marker
M8 x 25 mm, similar DIN 933 /
ISO 4017

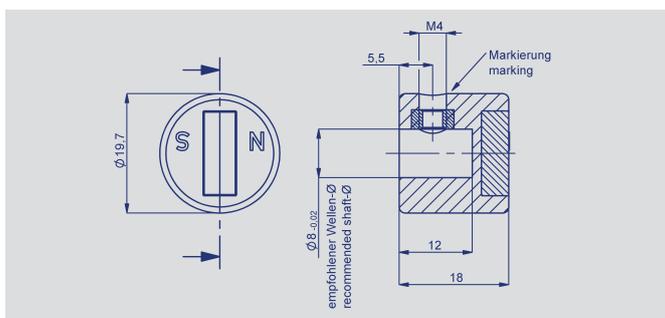
- Aluminum anodized,
magnet potted
- max. permitted radial offset $\pm 1,5$ mm
 - packaging unit:
1 pc. P/N 400104754
25 pcs. P/N 400104755



Z-RFC-P20

Screw position marker
M10 x 25 mm, similar DIN 933,
Aluminum anodized

- max. permitted radial offset ± 3 mm
- packaging unit:
1 pc. P/N 400104758
25 pcs. P/N 400104759

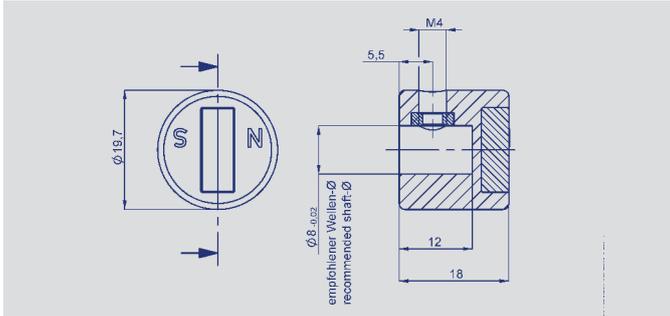


Z-RFC-P43

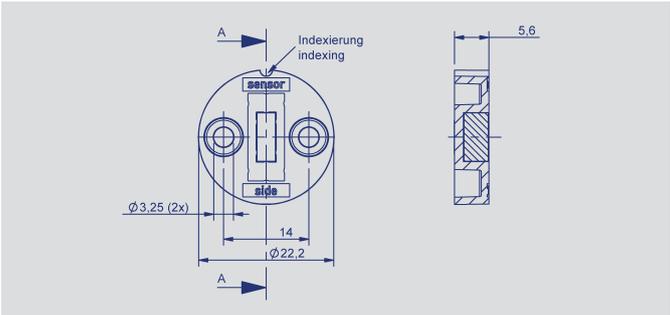
Position marker for fixation with
threaded pin M4
(included in delivery)

- max. permitted radial offset ± 3 mm
- packaging unit:
1 pc. P/N 400105041
25 pcs. P/N 400105042

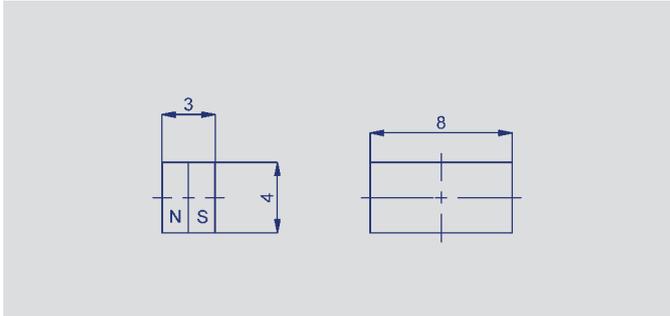
Position Markers



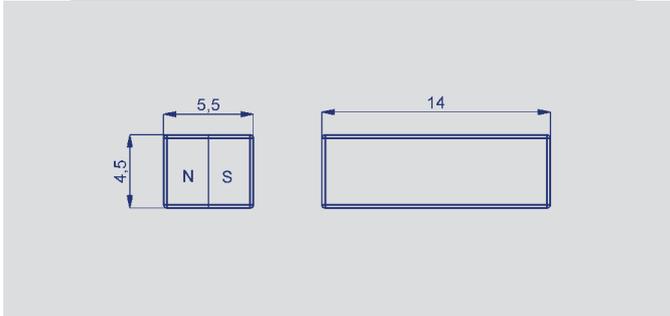
Z-RFC-P23
Position marker for fixation with threaded pin M4 (included in delivery)
 • max. permitted radial offset ± 3 mm
 • packaging unit:
 1 pc. P/N 400056074
 25 pcs. P/N 400056085



Z-RFC-P30
Position marker for frontal fixation with 2 fillister screws M3x8 (included in delivery)
 • max. permitted radial offset ± 1.5 mm
 • packaging unit:
 1 pc. P/N 400056086
 25 pcs. P/N 400056087

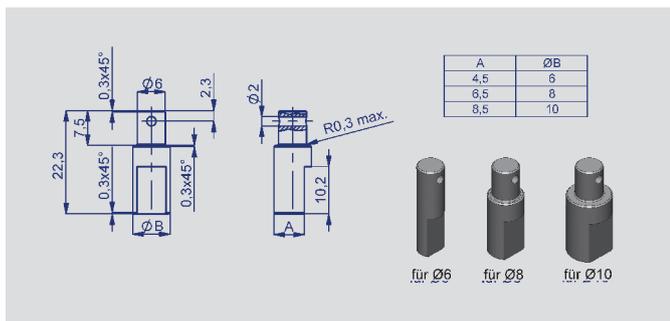


Z-RFC-P03
Magnet for direct application onto customer's shaft
 • max. permitted radial offset ± 1.5 mm
 • packaging unit:
 1 pc. P/N 40005658
 50 pcs. P/N 400056081



Z-RFC-P04
Magnet for direct application onto customer's shaft
 • max. permitted radial offset ± 3 mm
 • packaging unit:
 1 pc. P/N 40005659
 50 pcs. P/N 400056082

Position Markers



Shaft adapter for Z-RFC-P41 and Z-RFC-P02

Fixation at position marker with locking pin

- Z-RFC-S01: Ø 6 mm, P/N 400056206
- Z-RFC-S02: Ø 8 mm, P/N 400056207
- Z-RFC-S03: Ø 10 mm, P/N 400056208

Working distances (mm)

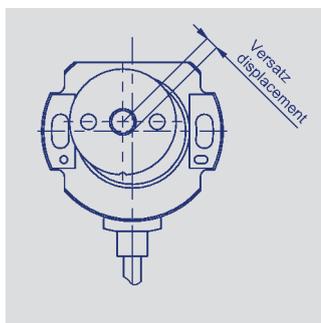
Interface	Z-RFC- P02 / P08	P03	P04	P18	P19	P20	P23	P30	P41 / P47	P 43
One channel										
RFC-4853/4854: Analog * / SPI	0 ... 4	0 ... 1.5	0 ... 4	0 ... 4.5	0 ... 2.2	0 ... 4	0 ... 4	0 ... 1.5	0 ... 2.7	0 ... 2.7
SSI / Incremental	0 ... 1.4	-	0 ... 1.4	-	-	0 ... 1.4	0 ... 1.4	-	-	-
RFC-4851/4852: Analog / CANopen / IO-Link	2.3 ... 5	0.7 ... 2.2	2.3 ... 5	0 ... 4.5	0 ... 2.2	2.3 ... 5	2.3 ... 5	0.7 ... 2.2	0 ... 2.7	0 ... 2.7
Partly / Fully redundant										
RFC-4851/4852: Analog / CANopen	1.9 ... 4.5	0.3 ... 1.8	1.9 ... 4.5	0 ... 4	0 ... 1.7	1.9 ... 4.5	1.9 ... 4.5	0.3 ... 1.8	0 ... 2.3	0 ... 2.3
RFC-4853/4854: Analog *	0 ... 4	0 ... 1.5	0 ... 4	0 ... 4	0 ... 1.7	0 ... 4	0 ... 4	0 ... 1.5	0 ... 2.3	0 ... 2.3

*) without diagnostic function

Mounting instructions Z-RFC-P03 / Z-RFC-P04

- In general, we recommend mounting on not magnetizable materials, otherwise the stated working distances can change
- If the shaft is magnetizable please keep sufficient distance
- When the magnet is mounted in the shaft, the shaft may not be magnetizable
- If the magnet is axially fixed on a magnetizable shaft the working distances reduces by approximately 20 %

Lateral magnet offset

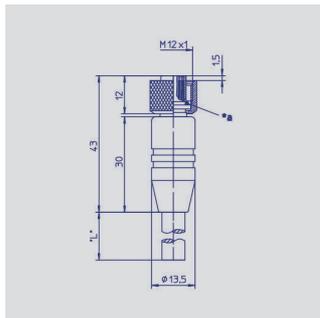


Lateral magnet offset will cause additional linearity error. The angle error, which is caused by radial displacement of sensor and position marker depends on the used position marker or magnet.

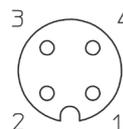
Additional linearity error (°) at radial displacement

Interface	Z-RFC-P02 / P04 / P08 / P20 / P23			Z-RFC-P41 / P43 / P47			Z-RFC-P03 / P30			Z-RFC-P18			Z-RFC-P19		
	0.5 mm	1 mm	2 mm	0.5 mm	1 mm	2 mm	0.5 mm	1 mm	2 mm	0.5 mm	1 mm	2 mm	0.5 mm	1 mm	2 mm
One channel															
Analog / SPI / CANopen / IO-Link	0.4	1.1	3.5	0.4	1.1	3.5	1.4	3.7	-	0.7	1.3	3.3	1.3	2.6	-
SSI / Incremental	0.4	0.7	2.2	-	-	-	-	-	-	-	-	-	-	-	-
Partly / Fully redundant															
Analog / CANopen	0.7	1.8	5.2	0.7	1.8	5.2	2.5	6.4	-	1.1	2.0	4.6	2.3	4.5	-

Connector System M12



Pin assignment
1 = Brown
2 = White
3 = Blue
4 = Black



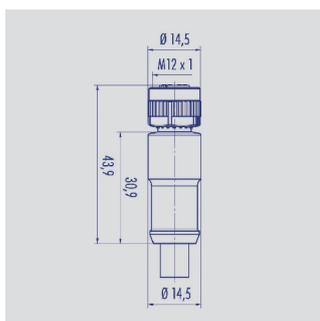
M12x1 mating female connector, 4-pin, straight, A-coded, with molded cable, shielded, IP67, open ended

Connector housing Plastic PA

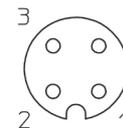
Cable sheath PUR; Ø = max. 6 mm, -25 °C...+80 °C (moved) -50 °C...+80 °C (fixed)

Wires PP, 0.34 mm²

Length	Type	P/N
2 m	EEM 33-32	400005600
5 m	EEM 33-62	400005609
10 m	EEM 33-97	400005650



Pin assignment
1 = Brown
2 = White
3 = Blue
4 = Black



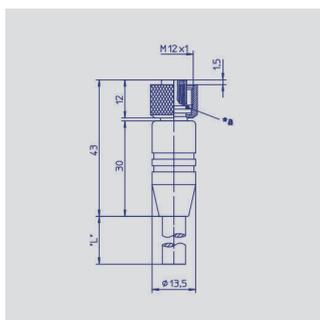
M12x1 mating female connector, 4-pin, straight, A-coded, with molded cable, not shielded, IP67, open ended

Connector housing Plastic PA

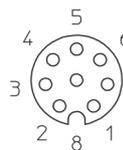
Cable sheath PUR; Ø = max. 6 mm, -40 °C...+85 °C

Wires PP, 0.34 mm²

Length	Type	P/N
2 m	EEM 33-35	400056135
5 m	EEM 33-36	400056136
10 m	EEM 33-37	400056137



Pin assignment
1 = White
2 = Brown
3 = Green
4 = Yellow
5 = grau
6 = rosa
7 = Blue
8 = Red



M12x1 mating female connector, 8-pin, straight, A-coded, with molded cable, shielded, IP67, open ended

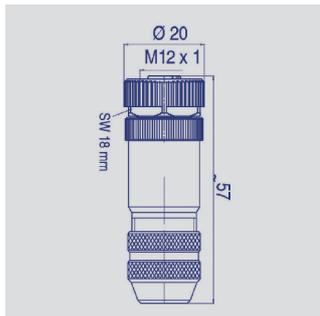
Connector housing Plastic PA

Cable sheath PUR; Ø = max. 8 mm, -25 °C...+80 °C (moved) -50 °C...+80 °C (fixed)

Wires PP, 0.25 mm²

Length	Type	P/N
2 m	EEM 33-86	400005629
5 m	EEM 33-90	400005635
10 m	EEM 33-92	400005637

Connector System M12

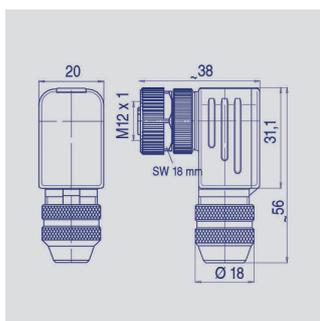


Pin assignment



M12x1 mating female connector, 5-pin, straight, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN bus

Connector housing	Metal -40 °C...+85 °C
For wire gauge	6...8 mm, max. 0.75 mm ²
Type	EEM 33-73, P/N 400005645

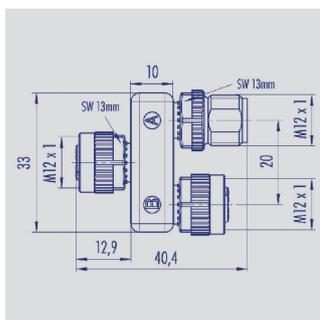


Pin assignment

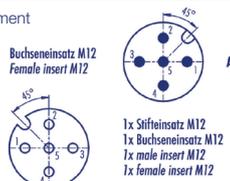


M12x1 mating female connector, 5-pin, angled, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN bus

Connector housing	Metal -40 °C...+85 °C
For wire gauge	6...8 mm, max. 0.75 mm ²
Type	EEM 33-75, P/N 400005646
It is possible to turn and fix the contact carrier in 90° positions.	



Pin assignment

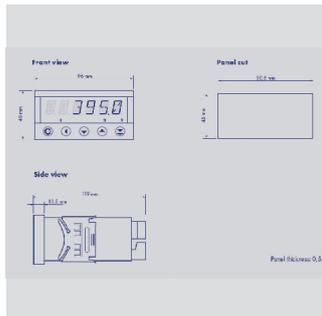


M12x1 splitter / T-connector, 5-pin, A-coded, IP68, 1:1 connection, female - male - female, CAN-Bus

Connector housing	PUR
Operating temperature	-25 °C... +85 °C
Type	EEM 33-45, P/N 400056145

Multifunctional Measuring Device with Display

Series MAP4000



Special features

- Supply voltage 10...30 VDC, 80...250 V DC or AC
- high accuracy
- direct connection of potentiometric and standardized signals
- adjustable supply voltage for sensors 5 ... 24 V
- Temperature coefficient 100 ppm/K
- optional RS 232, RS 485, analog output, limited switch
- complete data see separate data sheet MAP-4000

Ordering specifications

Number comparator relays

- 0: none
- 2: 2 relays
- 4: 4 relays

Analog output

- 0: no analog output
- 1: analog output present

Interface

- 0: ni interface
- 1: RS 232
- 2: RS 485

M A P - 4 0 1 0 - 0 0 0 - 1 0 1

Series

Supply voltage

- 00: 10...30 V AC/DC
- 10: 80...250 V AC

Display colour

- 1: Red

Data storage (only with interface)

- 0: not storage
- 1: RTC storage
- 2: FAST storage

Adjustable Excitation voltage (5...24 V/Max. 1,2 W)

- 1: Excitation present

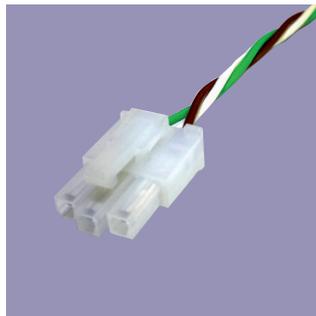
Connecting Options on request

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- M12 connector**
- Customized lengths
 - 3-, 4-, 6- and 8-pole versions
 - Protection class IP68
 - Ordering codes of standard versions see ordering specifications



- Molex Mini Fit jr.**
- Customized length and lead wires
 - 3-, 4- and 6-pole versions
 - on request



- Tyco AMP Super Seal**
- Pin- and bushing housing
 - Customized lengths
 - 3-, 4- and 6-pole versions
 - Protection class IP67
 - on request



- Molex Mini Fit**
- Customized length and lead wires
 - 3-, 4-, 6- and 8-pole versions
 - on request



- Deutsch DTM 04**
- Pin- and bushing housing
 - Customized lengths
 - 3-, 4- and 6-pole versions
 - Protection class IP67
 - on request



- ITT Cannon Sure Seal connector**
- customized lengths
 - 3-, 4- and 6-pole versions
 - protection class IP67
 - on request

The specifications contained in our datasheets are intended solely for informational purposes. The documented specification values are based on ideal operational and environmental conditions and can vary significantly depending on the actual customer application. Using our products at or close to one or more of the specified performance ranges can lead to limitations regarding other performance parameters. It is therefore necessary that the end user verifies relevant performance parameters in the intended application. We reserve the right to change product specifications without notice.