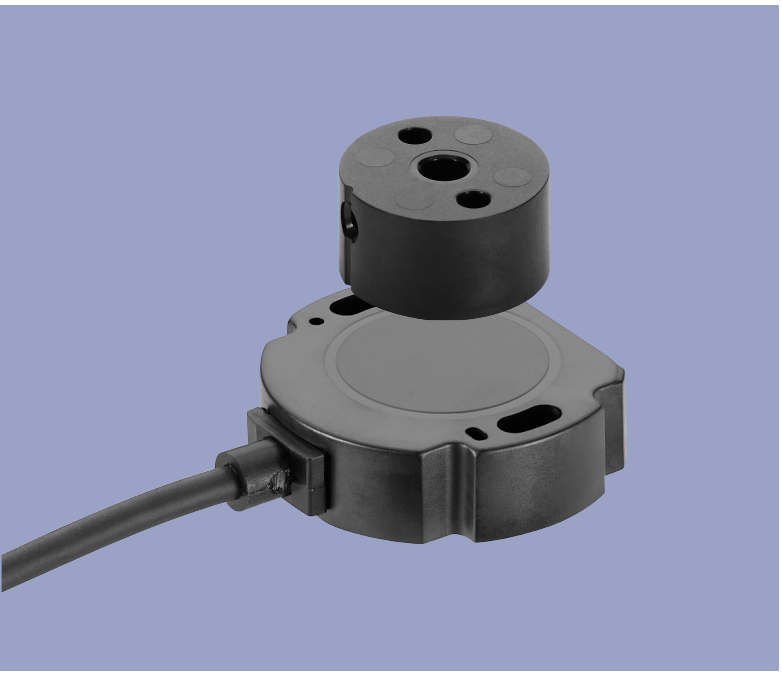
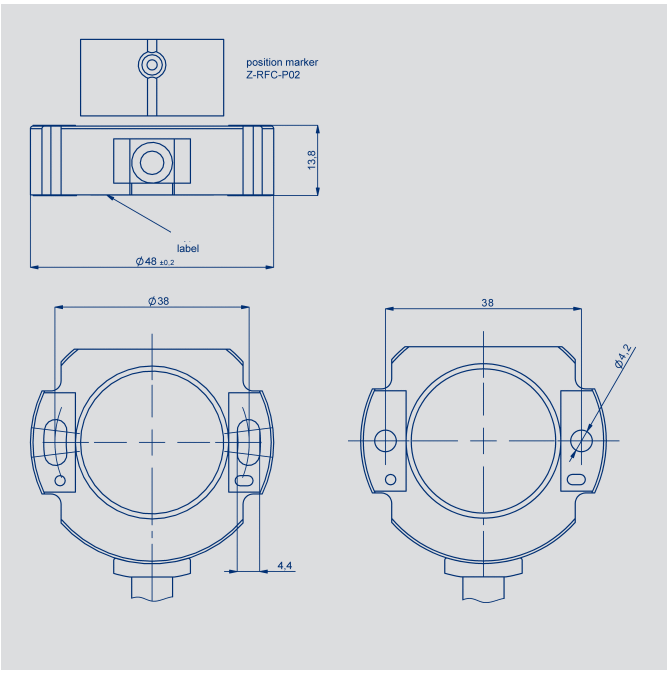
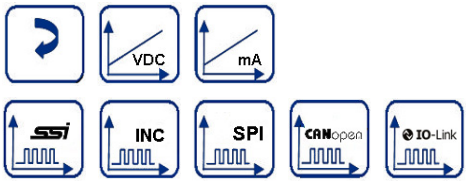
novotechnik
Siedle Group

NOVOHALL
Rotary Sensor
touchless technology
transmissive

Series RFC-4800







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.

Special features

- Touchless hall technology
- Electrical range up to 360°
- 2-part, mechanically decoupled
- High protection class, IP67, IP6K9K
- 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
- Interfaces:
  Voltage, current, SSI, incremental, CANopen, SPI, IO-Link
- Customized versions

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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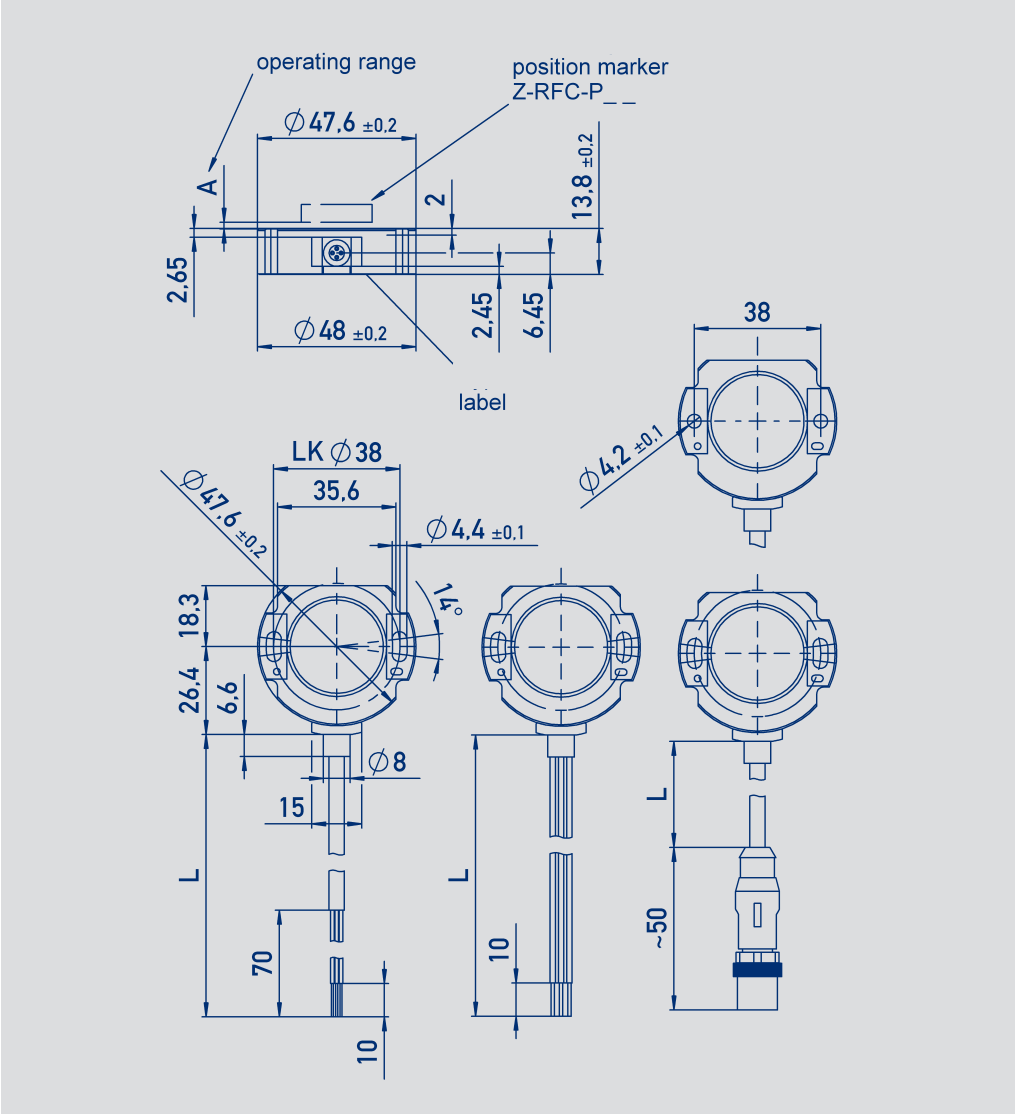
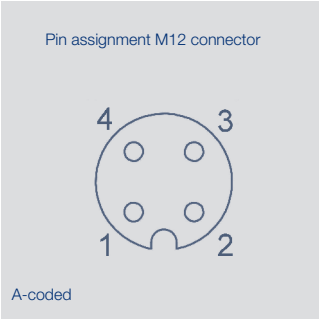
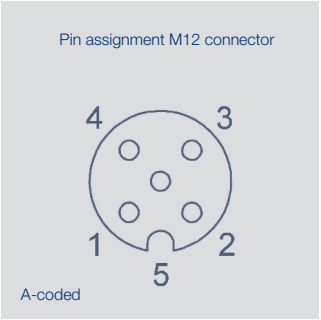
Contents

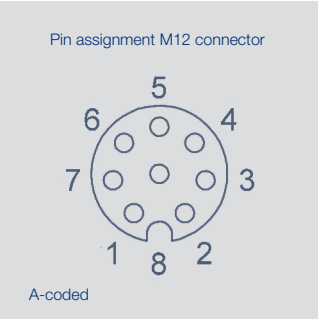
Drawings



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





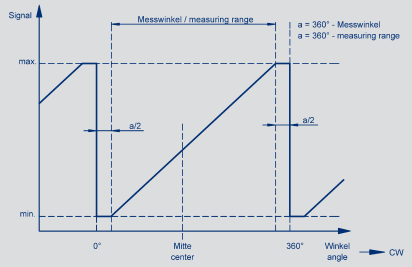


Mechanical Data

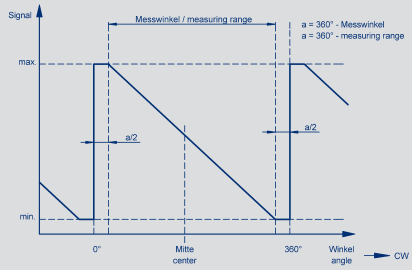
Description		
Housing	high grade, temperature resistant plastic	
Electrical connection	Cable 4x 0.14 mm², AWG 26, TPE, shielded (analog voltage / current CE) Cable 4x 0.14 mm², AWG 26, TPE, unshielded (analog voltage / current mobile) Cable 4x 0.5 mm², AWG 20, TPE, shielded (CANopen) Cable 5x 0.14 mm², AWG 26, PUR, shielded (SPI) Cable 8x 0.25 mm², AWG 24, TPE, shielded (SSI, Incremental, CANopen IN/OUT) Wire 0.5 mm², AWG 20, PVC (analog voltage / current mobile, Incremental Open Collector) Connector M12x1, 4-pin / 5-pin / 8-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 / IP6K9K (M12 connector: IP67)	

Output Characteristics

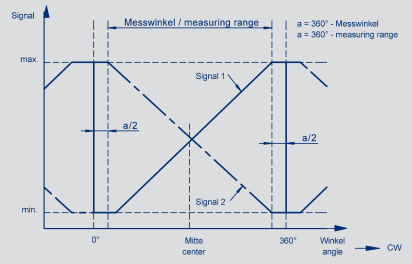
One-channel, cw



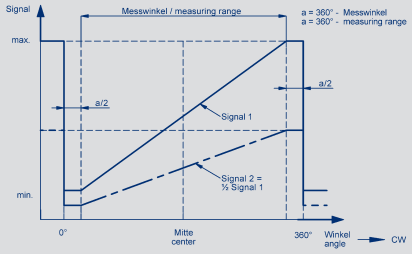
One-channel, ccw



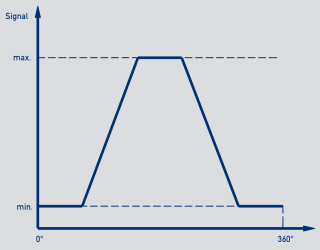
Two channels, crossed output characteristics, channels 1 cw



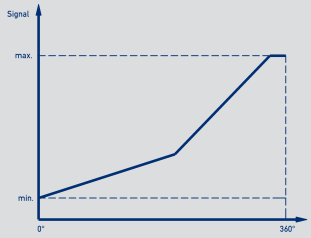
On request: Two channels, signal 2 = 0.5 x signal 1



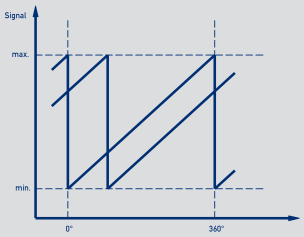
On request: Trapezoid output characteristic



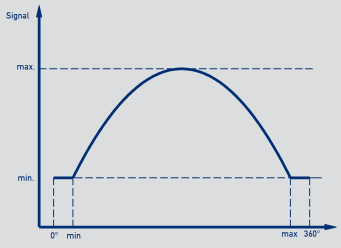
On request: Different gradients



On request: 2 offset output characteristics



On request: Parabolic output characteristic



Technical Data - Analog Versions - Voltage - Current
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-4801- _ _ _ - 2 _ _ - _ _ _ ratiometric**	**RFC-4801- _ _ _ - 1 1 _ - _ _ _ voltage**	**RFC-4801- _ _ _ - 1 2 _ - _ _ _ current**	
Electrical Data				
Output signal	ratiometric to supply voltage 0.25 ... 4.75 V 0.5 ... 4.5 V (load ≥1 kΩ)	0.1 ... 10 V (load ≥10 kΩ)	4 ... 20 mA (burden max. 500 Ω)	
Number of channels	1 / 2	1	1	
Update rate	typical 5			kHz
Resolution	12			bit
Measuring range	0 ... 30 up to 0 ... 360, in 10°-steps			°
Independent linearity	≤ 0.5			±% FS
Repeatability	≤ 0.1			°
Hysteresis	≤ 0.1			°
Temperature error at measuring range 30 up to 170°	±0,825	±1,24	±1,24	% FS
Temperature error at measuring range 180 up to 360°	±0,41	±0,66	±0,66	% FS
Supply voltage Ub	5 (4,5 ... 5,5)	24 (18 ... 30)	24 (18 ... 30)	VDC
Current consumption (w/o load)	typical 15 (typical 8 on request) per channel			mA
Reverse voltage	yes, supply lines and outputs			
Short circuit protection	yes (vs. GND and supply voltage)			
Insulation resistance (500 VDC)	≥ 10			MΩ
Cross-section cable	AWG 26, 0.14			mm^2
Environmental Data				
Operating temperature	-40 ... +125 -25 ... +85 with M12 connector	-40 ... +125 -25 ... +85 with M12 connector	-40 ... +105 (+125, if supply voltage ≤ 28 V) -25 ... +85 with M12 connector	°C °C
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	290 (one-channel) 288 (per channel, partly redundant)	98 (one-channel)	111 (one-channel)	years years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us			
EMC compatibility CE	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 3 A/m EN 55011/EN 55022/A1 Radiated disturbances class B			

Connection assignment

One-channel versions

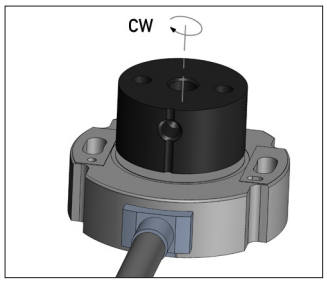
Signal	Cable code 2 _ _	Connector M12 code 501
Supply voltage Ub	GN	pin 1
Signal output	WH	pin 2
GND	BN	pin 3
Not assigned	YE	pin 4

Cable shielding connect to GND.

Redundant versions

Signal	Cable code 2 _ _	Connector M12 code 501
Supply voltage Ub	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 (18 ... 30 V)
2: 5 V (4.5 ... 5.5 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
2: 0.5 ... 4.5 V ratiometric to supply voltage Ub

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	0	1	–	6	3	6	–	2	1	1	–	2	0	2

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)

Series

Mechanical version
4801: Elongated hole mounting for easy adjustment
4802: Round hole mounting

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

Technical Data - Versions for Mobile Applications
These versions are optimzed for the high requirements in mobile applications. Tested to the highest requirements as ISO-pulses and high interferences to ISO 11452.

Type Designations	**RFC-4801- _ _ _ -2 _ _ - _ _ _ ratiometric**	**RFC-4801- _ _ _ -3 _ _ - _ _ _ voltage**	**RFC-4801- _ _ _ -32 _ _ - _ _ _ current**	
Electrical Data				
Output signal	ratiometric to supply voltage Ub 0.25 ... 4.75 V 0.5 ... 4.5 V (load ≥1 kΩ)	0.25 ... 4.75 V 0.5 ... 4.5 V (load ≥10 kΩ)	4 ... 20 mA (burden max. 250 Ω)	
Number of channels	1 / 2	1 / 2	1	
Update rate	typical 5			kHz
Resolution	12			bit
Measuring range	0 ... 30 up to 0 ... 360, in 10°-steps			°
Independent linearity	≤ 0,5			±% FS
Repeatability	≤ 0,1			°
Hysteresis	≤ 0,1			°
Temperature error at measuring range 30 and 170° Temperature error at measuring range 180 and 360°	±0.825 ±0.41	±1.24 ±0.66	±1.24 ±0.66	% FS % FS
Supply voltage Ub	5 (4.5 ... 5.5)	12/24 (9 ... 34)	12/24 (9 ... 34)	VDC
Current consumption (w/o load)	typical 15 (typical 8 on request) per channel			mA
Reverse voltage	yes, supply lines and outputs			
Short circuit protection	yes (vs. GND and supply voltage)			
Insulation resistance (500 VDC)	≥ 10			MΩ
Cross-section cable Cross-section wire	AWG 26, 0.14 AWG 20, 0.5			mm^2 mm^2
Environmental Data				
Operating temperature	-40 ... +125 -25 ... +85 with connector M12	-40 ... +125 -25 ... +85 with connector M12	-40 ... +105 (+125, if supply voltage ≤ 28 V) -25 ... +85 with connector M12	°C °C
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	290 (one-channel) 288 (per channel, partly redundant) 290 (per channel, fully redundant)	91 (one-channel) 101 (per channel, partly redundant)	109 (one-channel)	years years years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us			
EMC compatibility	ISO 11452-2 Radiated EM RF fields 100 V/m ISO 11452-4 BCI (Bulk current injection) 100 mA CISPR25 Radiated emission class 5 SAE J1113-2 Conducted immunity level 2 SAE J1113-13 Packaging and handling 4-20 kV SAE J1113-22 Radiated magnetic field 80 µT SAE J1113-26 AC power line electric field 15 kV EN61000-4-2 Immunity to static discharge (ESD) 4 kV, 8 kV, 15 kV EN 55011/EN 55022/A1 Radiated disturbances class B	ISO 11452-5 Radiated EM RF fields 300 V/m ISO 11452-2 Radiated EM RF fields 100 V/m ISO 7637-2 Pulse 1a, 2a, 3a, 3b, 4, 5 CISPR25 Radiated emission class 5 ISO 7637-3 Transient transmission (on/off) Level 3 ISO TR10605 Packaging and Handling + Component test 8 kV/15 kV		

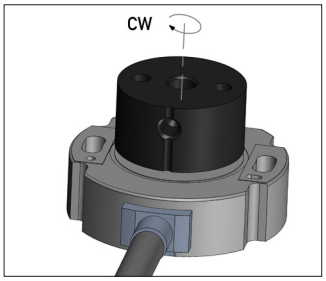
Connection assignment

One-channel versions

Signal	**Lead wires code 4 _ _**	**Cable code 2 _ _**	**Connector M12 code 551**
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 M12 code 551**
Supply voltage Ub 1	RD	GN	pin 1
Signal output 1	BU	WH	pin 2
GND 1	BlK	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 Ub = 5 V (4.5 ... 5.5 V)
3: Supply voltage Ub = 12/24 V (9.0 ... 34.0 V)

Output signal Supply voltage Ub = 5 V
1: 0.25 ... 4.75 V ratiometric to supply voltage Ub
2: 0.5 ... 4.5 V ratiometric to supply voltage Ub

Output signal supply voltage Ub = 12/24 V
2: 4 ... 20 mA (only one-channel)
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
Cable versions and assembled connectors on request

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

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 Ub / 1 x output
7: partly redundant 1 x supply voltage Ub / 2 x output
8: fully redundant 2 x supply voltage Ub / 2 x output (only at supply voltage Ub = 5 V)

Series

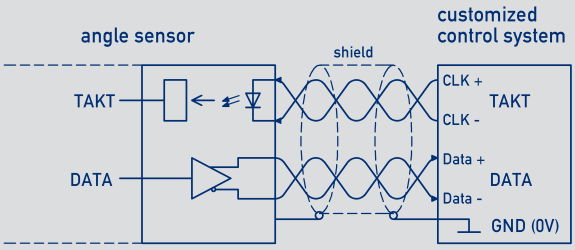
Mechanical version
4801: Elongated hole mounting for easy adjustment
4802: Round hole mounting

Technical Data
SSI Interface

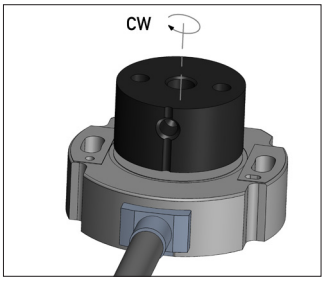
Type Designations	RFC-48_ _-214-41 _-_ _ _ Supply voltage 5 VDC	RFC-48 _ _-214 - 44 _-_ _ _ Supply voltage 24 VDC	
Electrical Data			
Protocol	SSI 13 bit (12 bit data + 1 stop bit)		
Inputs	RS422 compatible, CLK lines via optocoupler galvanically isolated		
Monoflop time (tm)	16		µs
Coding	Gray		
Update rate (internal)	2 000		kHz
Resolution across 360°	12		bit
Measuring range	360		°
Maximum operational speed position marker	30 000, higher speeds on request		min-1
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)	VDC
Current consumption (w/o load)	typical 27	typical 10	mA
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		MΩ
Cross-section cable	AWG 24, 0.25		mm²
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)	141	102	years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us		
EMC compatibility CE	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		

SSI protocol

SSI connection



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



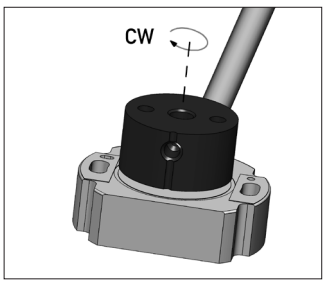
When the marking of the position marker is pointing towards the cable, the sensor output is near the electrical center position.

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 - Minimum input frequency of counter input - Maximum operational speed	 8 32 1 800			 µs kHz min^{-1}
Option High Speed - Minimum edge separation - Minimum input frequency of counter input - Maximum operational speed	 0.5 500 29 000, higher speeds on request			 µs kHz 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	AWG 24, 0.25			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 CE	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

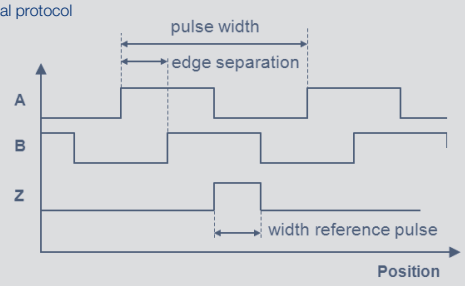
Signal	Cable code 4 _ _	Connector M12 code 531
Supply voltage Ub	WH	pin 1
GND	BN	pin 2
A-	GN	pin 3
A+	YE	pin 4
B-	GY	pin 5
B+	PK	pin 6
Z+	BU	pin 7
Z-	RD	pin 8



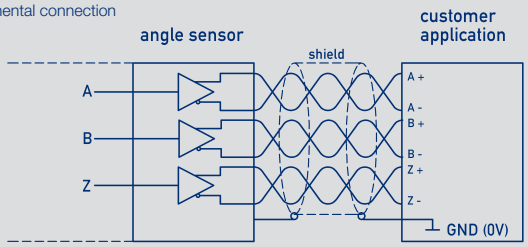
When the marking of the position marker is pointing away from the cable, the output is in the vicinity of the reference pulse (Z).
Rotational direction CW:
A leads before B.

Technical Data
Incremental Interface

Incremental protocol

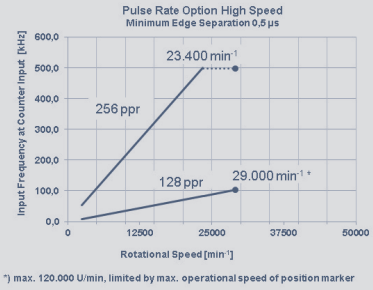


Incremental connection



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).

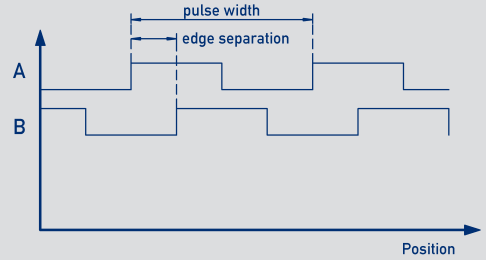


Technical Data
Incremental Interface
for Mobile Applications

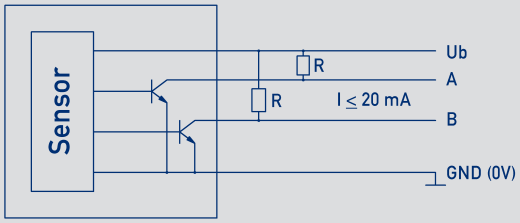
Type Designations	RFC-48_ _-2 _ _-556- _ _ _ Supply voltage 12/24 VDC, open collector				
Electrical Data					
Outputs	A- B-				
Level	Open collector				
Pulses per revolution	1024	512	256	128	ppr
Counts per reveolution (after quadrature)	4096	2048	1024	512	
Minimum edge separation	8				µs
Minimum input 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	AWG 20, 0.5				mm^2
Environmental Data					
Operating temperature	-40 ... +85				°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 Pulse 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).

Incremental protocol

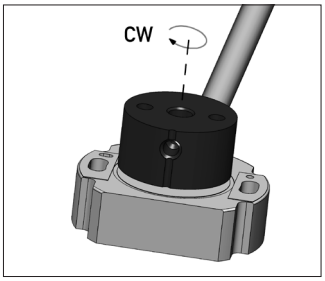


Incremental connection



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

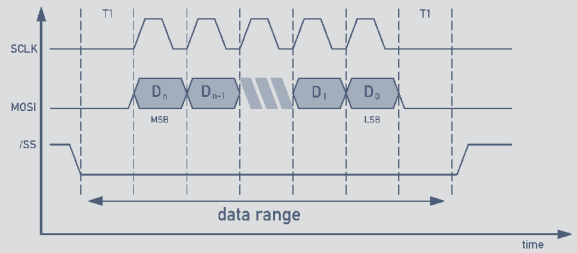


Rotational direction CW:
A leads before B

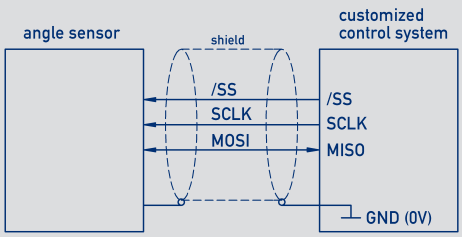
Technical Data
SPI Interface

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	AWG 26, 0.14	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 CE	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	

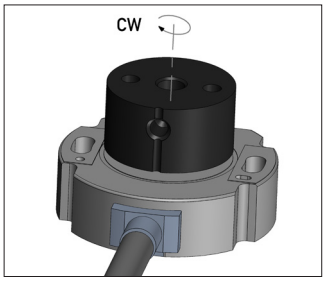
SPI protocol



SPI connection



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 Ub / Interface
4: Synchronous-Serial Interface (SSI)
5: Incremental Inrface 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 µs)
15: 5V (4.5 ... 5.5 V) supply voltage, output RS422, TTL- compatible
35: 24V (18 ... 30 V) supply voltage, output RS422, TTL-compatible
39: 24V (18 ... 30 V) supply voltage, output HTL-compatible, Push-Pull
56: 12/24V (9 ... 34 V) supply voltage, output low side, open collector
High Speed Mode (minimal edge separation 0,5 µs)
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
UVW 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 and assembled connectors on request

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

Series

Mechanical version
4801: Elongated hole
4802: Round hole mounting

Interface
2: Digital Interface

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

Technical Data

CANopen®

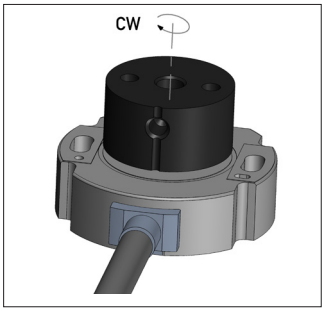
Type Designations	RFC-48 _ _- 214 - 6 _ _ - _ _ _ CANopen	
Electrical Data		
Measured variables	Position and speed	
Measuring range	360	°
Measurement range speed	0 ... 1600	min-1
Number of channels	1 / 2 see ordering specifications	
Output signal / protocol	CANopen protocol to CiA DS-301 V4.2.0, Device 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	
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	AWG 20, 0.5	mm^2
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 Pulse 1, 2a, 2b, 3a, 3b, 4 (24 V systems), 5 Level 5 ISO 7637-3 Transient transmission 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.

Technical Data

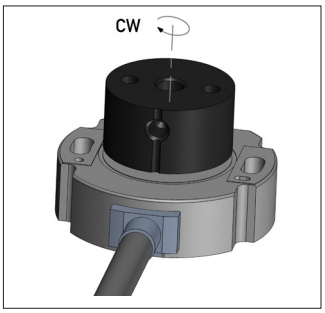
IO-Link

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	
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 Ub	24 (18 ... 30)	VDC
Current consumption (w/o load)	< 100	mA
Reverse voltage	yes, supply lines	
Short circuit protection	yes, output vs. GND and Ub (up to 40 VDC)	
Overvoltage protection	< 35 (permanent)	VDC
Insulation resistance (500 VDC)	≥ 10	MΩ
Cross-section cable	AWG 20, 0.5 (4 pole) or AWG 24, 0.25 (8 pole)	mm^2
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)	single channel: 76	Jahre
Functional safety	If you need assistance in using our products in safety-related systems, please contact us	
EMC compatibility CE	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 Ub	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

CANopen®
IO-Link

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= 0.15m, shielded

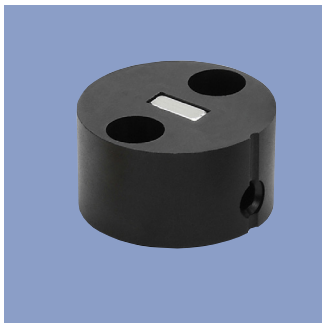
Elektrical connections IO-Link
252: Cable 4-pole, 1.0 m, unshielded
256: Cable 4-pole, 3.0 m, unshielded
260: Cable 4-pole, 5.0 m, unshielded
270: Cable 4-pole, 10,. m, unshielded
551: Connector M12x1, 4-pin, with cable, L= 0.15m, unshielded
Cable versions and assembled connectors on request

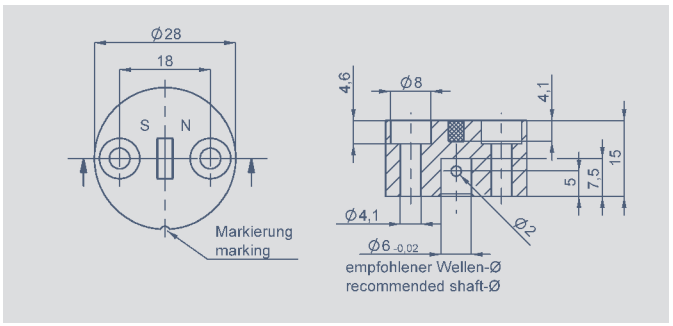
R	F	C	–	4	8	5	2	–	2	1	4	–	6	1	5	–	5	1	1

Series

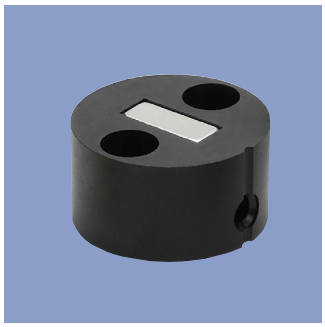
Mechanical version
4851: Elongated hole
4852: Round hole mounting

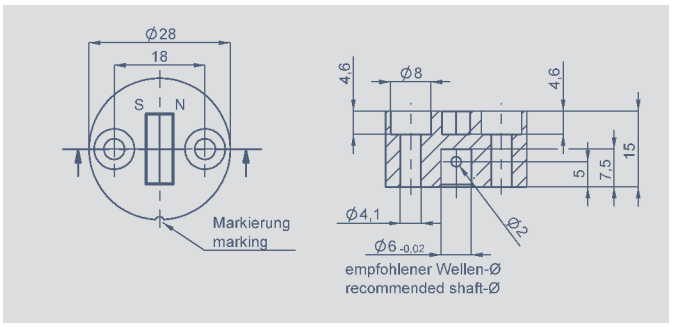
Position Markers



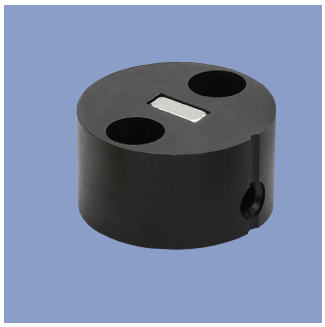


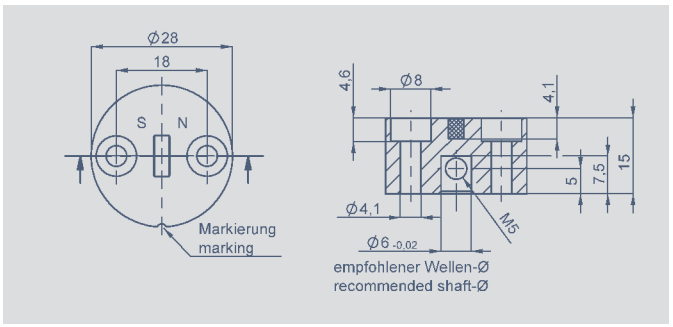
Z-RFC-P01
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both are included in delivery).
Not recommended for new designs.
- max. permitted radial offset ±1.5 mm
- packaging unit:
  1 pc. P/N 005660
  25 pcs. P/N 056079



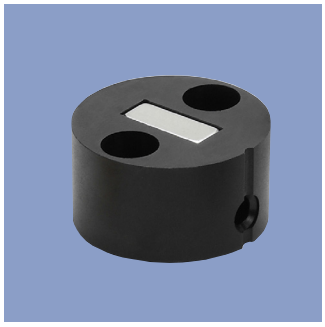


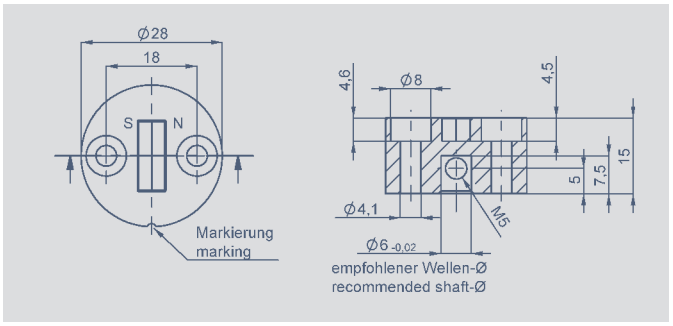
Z-RFC-P02
Position marker for frontal fixation with 2 cylinder head screws M4x20 (with microencapsulation) or with locking pin (both are included in delivery).
- max. permitted radial offset ±3 mm
- packaging unit:
  1 pc. P/N 005661
  25 pcs. P/N 056080





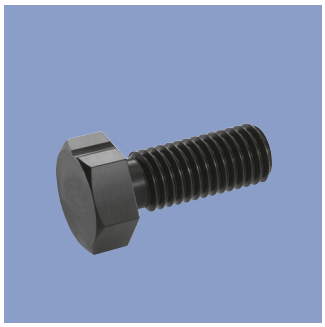
Z-RFC-P07
Position marker for fixation with threaded pin M5 (included in delivery).
Not recommended for new designs.
- max. permitted radial offset ±1,5 mm
- packaging unit:
  1 pc. P/N 056069
  25 pcs. P/N 056083

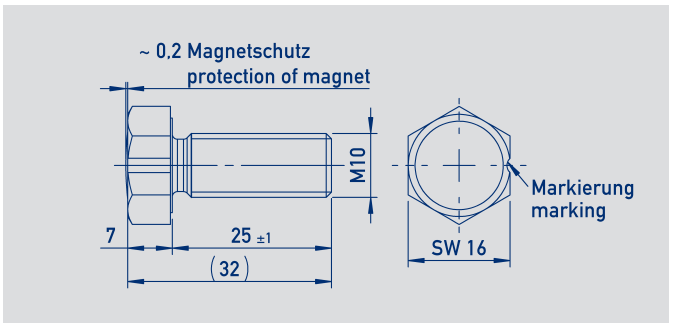




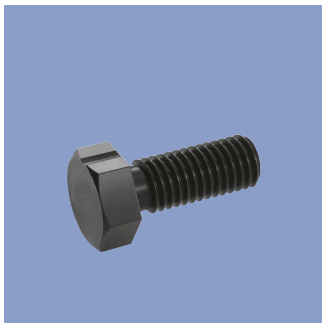
Z-RFC-P08
Position marker for fixation with threaded pin pin M5 (included in delivery).
- max. permitted radial offset ±3 mm
- packaging unit:
  1 pc. P/N 056070
  25 pcs. P/N 056084

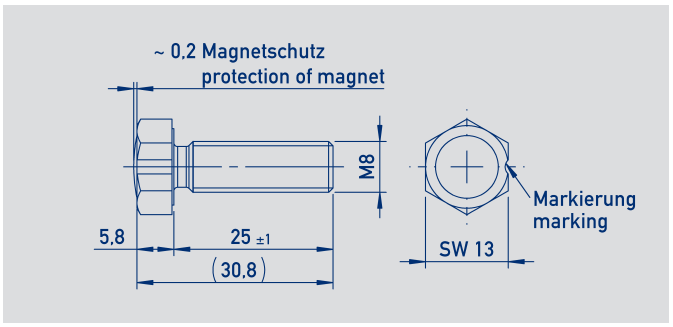
Position Markers



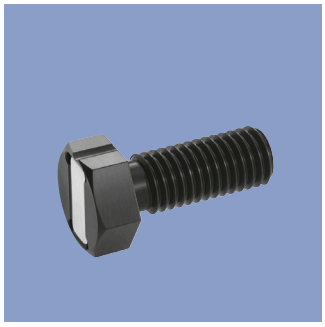


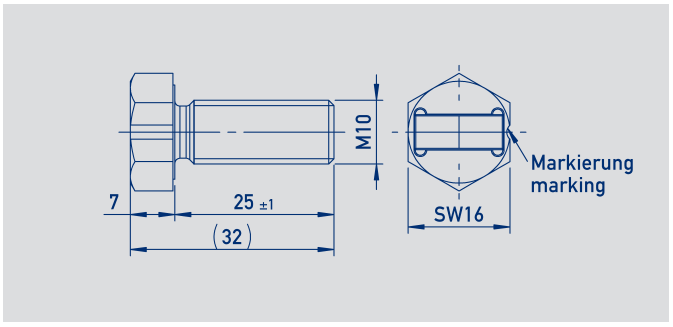
Z-RFC-P18
Screw position marker
M10 x 25 mm, similar DIN 933,
Aluminum anodized,
magnet potted
- max. permitted radial offset ±3 mm
- packaging unit:
  1 pc. P/N 104756
  25 pcs. P/N 104757



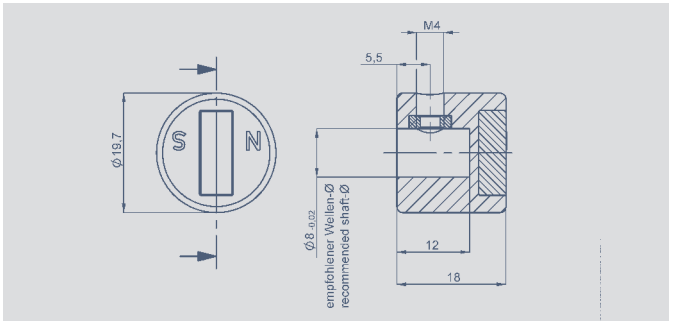


Z-RFC-P19
Screw position marker
M8 x 25 mm, similar DIN 933 / ISO 4017
Aluminum anodized,
magnet potted
- max. permitted radial offset ±1,5 mm
- packaging unit:
  1 pc. P/N 104754
  25 pcs. P/N 104755



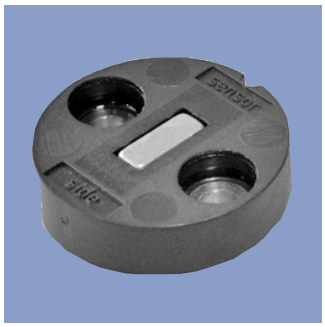


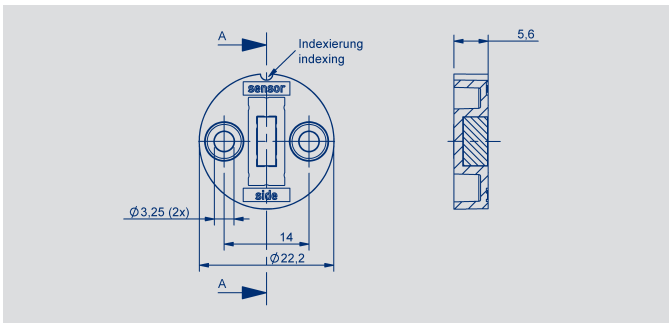
Z-RFC-P20
Screw position marker
M10 x 25 mm, similar DIN 933,
Aluminum anodized
- max. permitted radial offset ±3 mm
- packaging unit:
  1 pc. P/N 104758
  25 pcs. P/N 104759



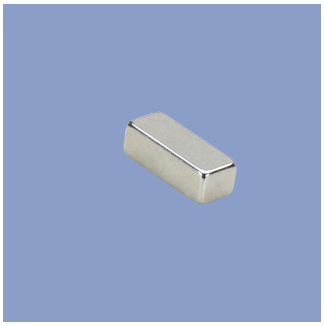
Z-RFC-P23
Position marker for fixation with threaded pin M4
(included in delivery)
- max. permitted radial offset ±3 mm
- packaging unit:
  1 pc. P/N 056074
  25 pcs. P/N 056085

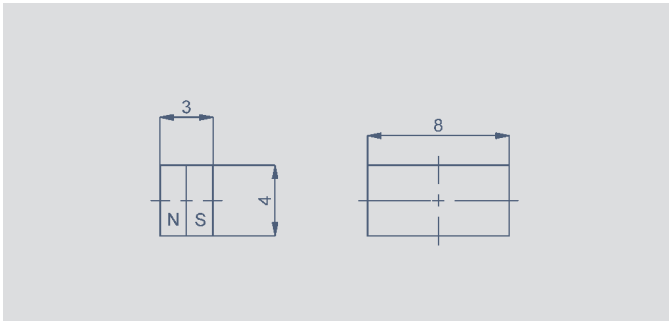
Position Markers



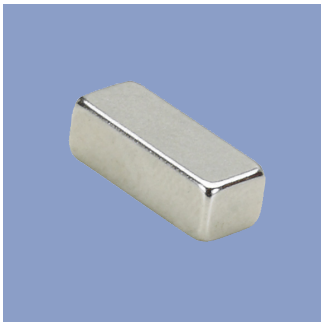


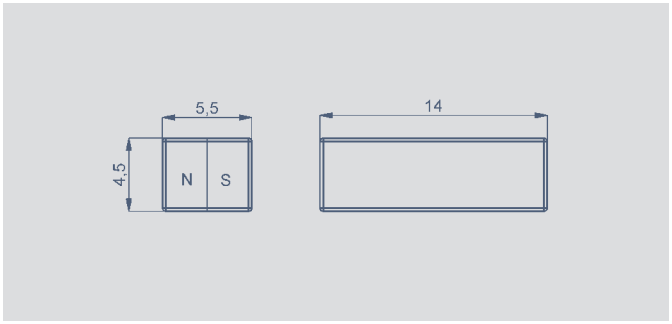
Z-RFC-P30
Position marker for frontal fixation with 2 fillister screws M3x8 (included in delivery)
- max. permitted radial offset ±1.5 mm
- packaging unit:
  1 pc. P/N 056086
  25 pcs. P/N 056087



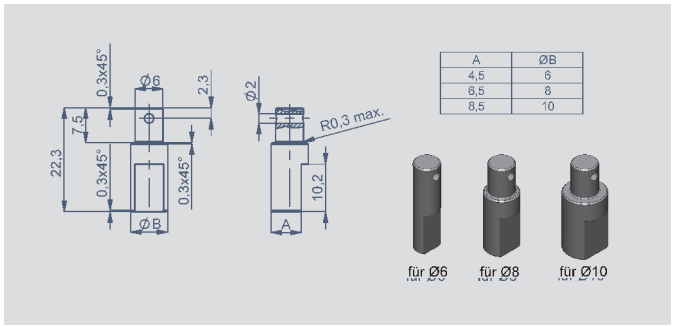


Z-RFC-P03
Magnet for direct application onto customer's shaft
- max. permitted radial offset ±1,5 mm
- packaging unit:
  1 pc. P/N 005658
  50 pcs. P/N 056081





Z-RFC-P04
Magnet for direct application onto customer's shaft
- max. permitted radial offset ±3 mm
- packaging unit:
  1 pc. P/N 005659
  50 pcs. P/N 056082



Shaft adapter for Z-RFC-P01 and Z-RFC-P02
Fixation at position marker with locking pin
- Z-RFC-S01: Ø 6 mm, P/N 056206
- Z-RFC-S02: Ø 8 mm, P/N 056207
- Z-RFC-S03: Ø 10 mm, P/N 056208

Position Markers

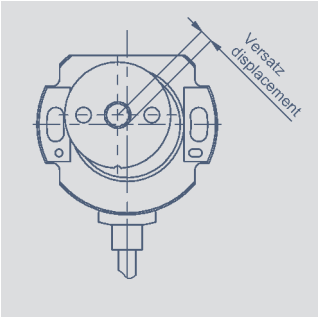
Working distances (mm)

Interface	Z-RFC- _ _ _ P01	P02	P03	P04	P07	P08	P18	P19	P20	P23	P30
Analog / SPI single	0 ... 1.5	0 ... 4	0 ... 1.5	0 ... 4	0 ... 1.5	0 ... 4	0 ... 4.5	0 ... 2.2	0 ... 4	0 ... 4	0 ... 1.5
Analog redundant	0 ... 1.5	0 ... 4	0 ... 1.5	0 ... 4	0 ... 1.5	0 ... 4	0 ... 4	0 ... 1.7	0 ... 4	0 ... 4	0 ... 1.5
SSI / Incremental	-	0 ... 1.4	-	0 ... 1.4	-	0 ... 1.4	-	-	0 ... 1.4	0 ... 1.4	-
CANopen / IO-Link single	0.7 ... 2.2	2.3 ... 5	0.7 ... 2.2	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
CANopen redundant	0.3 ... 1.8	1.9 ... 4.5	0.3 ... 1.8	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

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

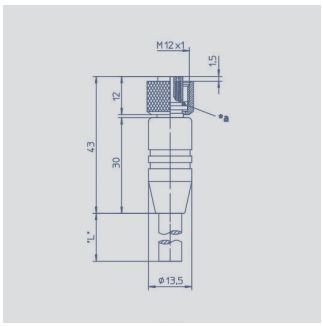


Lateral magnet offset will cause additional linearity error.
The angle error, which is caused by radial displacement of sensor and position marker depends on the used position marker or magnet.

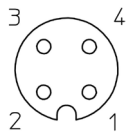
Additional linearity error (°) at radial displacement

Interface	Z-RFC-P02 / P04 / P08 / P20 / P23			Z-RFC-P01 / P03 / P07 / 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
Analog / SPI / CANopen / IO-Link single	0.4	1.1	3.5	1.4	3.7	-	0.7	1.3	3.3	1.3	2.6	-
Analog / CANopen redundant	0.7	1.8	5.2	2.5	6.4	-	1.1	2.0	4.6	2.3	4.5	-
SSI / Incremental	0.4	0.7	2.2	-	-	-	-	-	-	-	-	-

Connector System M12



Pin assignment

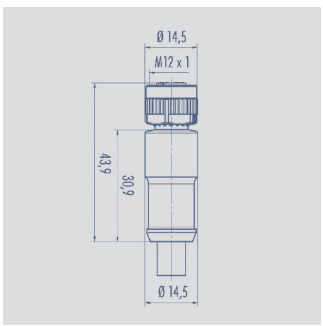


1 = Brown
2 = White
3 = Blue
4 = Black

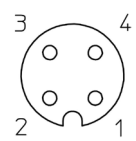
M12x1 mating female connector, 4-pin, straight, A-coded, with molded cable, shielded, IP67, open ended

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	005600
5 m	EEM 33-62	005609
10 m	EEM 33-97	005650



Pin assignment

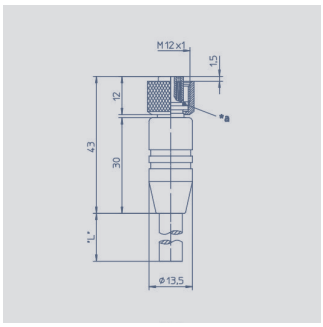


1 = Brown
2 = White
3 = Blue
4 = Black

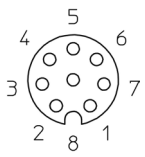
M12x1 mating female connector, 4-pin, straight, A-coded, with molded cable, not shielded, IP67, open ended

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	056135
5 m	EEM 33-36	056136
10 m	EEM 33-37	056137



Pin assignment

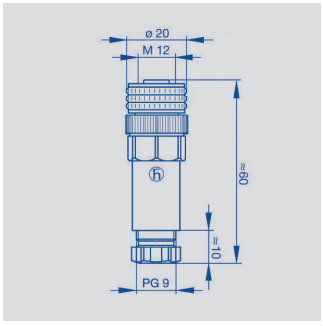


1 = White
2 = Brown
3 = Green
4 = Yellow
5 = grau
6 = rosa
7 = Blue
8 = Red

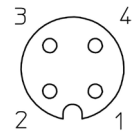
M12x1 mating female connector, 8-pin, straight, A-coded, with molded cable, shielded, IP67, open ended

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	005629
5 m	EEM 33-90	005635
10 m	EEM 33-92	005637



Pin assignment

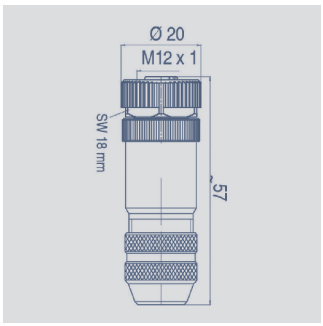


M12x1 mating female connector, 4-pin, straight, A-coded, with coupling nut, screw termination, IP67, not shielded

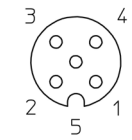
Connector housing	Plastic PBT -25 °C...+90 °C
For wire gauge	6...8 mm, max. 0,75 mm²

Type EEM 33-88, P/N 005633

Connector System M12



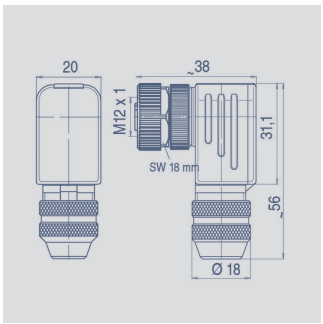
Pin assignment



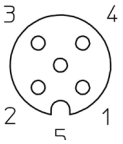
M12x1 mating female connector, 5-pin, straight, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN bus

Connector housing	Metal -40 °C...+85 °C
For wire gauge	6...8 mm, max. 0.75 mm²

Type EEM 33-73, P/N 005645



Pin assignment

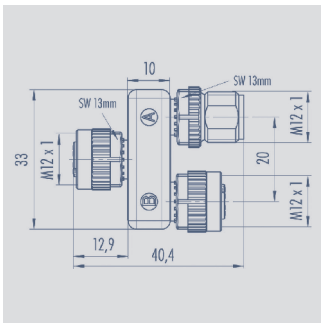


M12x1 mating female connector, 5-pin, angled, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN bus

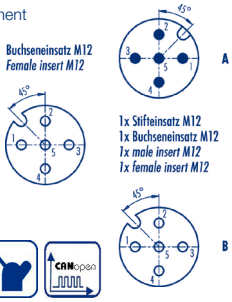
Connector housing	Metal -40 °C...+85 °C
For wire gauge	6...8 mm, max. 0.75 mm²

Type EEM 33-75, P/N 005646

It is possible to turn and fix the contact carrier in 90° positions.



Pin assignment

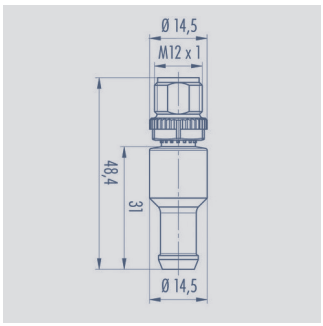


M12x1 splitter / T-connector, 5-pin, A-coded, IP68,1:1 connection, female - male - female, CAN-Bus

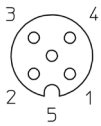
Connector housing	PUR
Operating temperature	-25 °C... +85 °C

Type EEM 33-45, P/N 056145

Connector System M12



Pin assignment

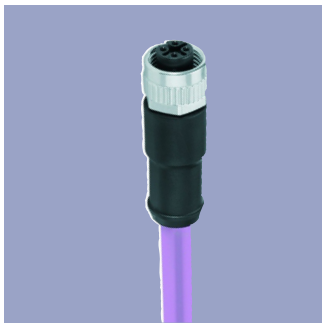


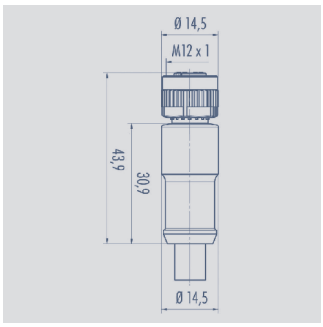
1 = n. c.
2 = n. c.
3 = n. c.
4 = ┐ Widerstand
5 = ┘ 120 Ω

M12x1 terminating resistor, 5-pin, A-coded, IP67, 120 Ω resistance, CAN-Bus

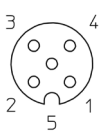
Connector housing	PUR
Operating temperature	-25 °C... +85 °C

Type EEM 33-47, P/N 056147





Pin assignment

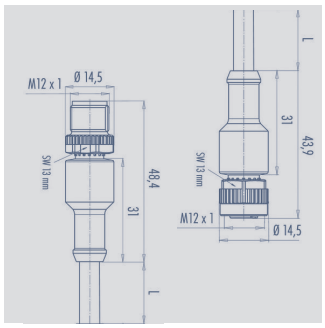


1 = Shield
2 = Red (0,34 mm²)
3 = Black (0,34 mm²)
4 = White (0,25 mm²)
5 = Blue (0,25 mm²)

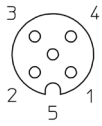
M12x1 mating female connector, 5-pin, straight, A-coded, with molded cable, IP67, shielded, open ended, CAN-Bus

Connector housing	PUR
Cable sheath	PUR Ø = max. 7.2 mm, -25 °C...+85 °C (moved)
Wiires	PP 2x 0.25 mm² + 2 x 0.34 mm²

Length	Type	P/N
2 m	EEM 33-41	056141
5 m	EEM 33-42	056142
10 m	EEM 33-43	056143



Pin assignment



M12x1 mating female connector, 5-pin, straight, A-coded, with molded cable, IP68, CAN-Bus

Connector housing	PUR
Cable sheath	PUR; Ø 7.2 mm -25 °C... +85 °C (fixed)

Length	Type	P/N
5 m	EEM 33-44	056144

IP67 Protection class IP67 DIN EN 60529

IP68 Protection class IP68 DIN EN 60529

CAN-bus

Very good Electromagnetic Compatibility (EMC) and shield systems

Very good resistance to oils, coolants und lubricants

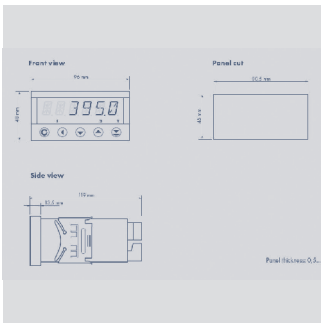
UL - approved

Suited for applications in dragchains

Note: The protection class is valid only in locked position with its plugs. The application of these products in harsh environments must be checked in particular cases.

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 sensoren 5... 24 V
- Temperature coefficient 100 ppm/K
- optional RS 232, RS 485, analog output, limited switch

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

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

Data storage (only with interface)
0: not storage
1: RTC storage
2: FAST storage

Display colour
1: Red

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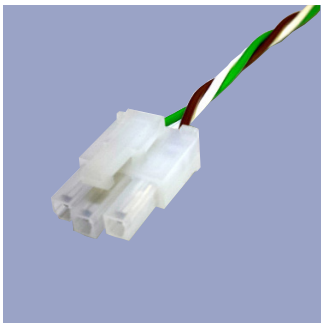
Connecting Options
on request

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.