



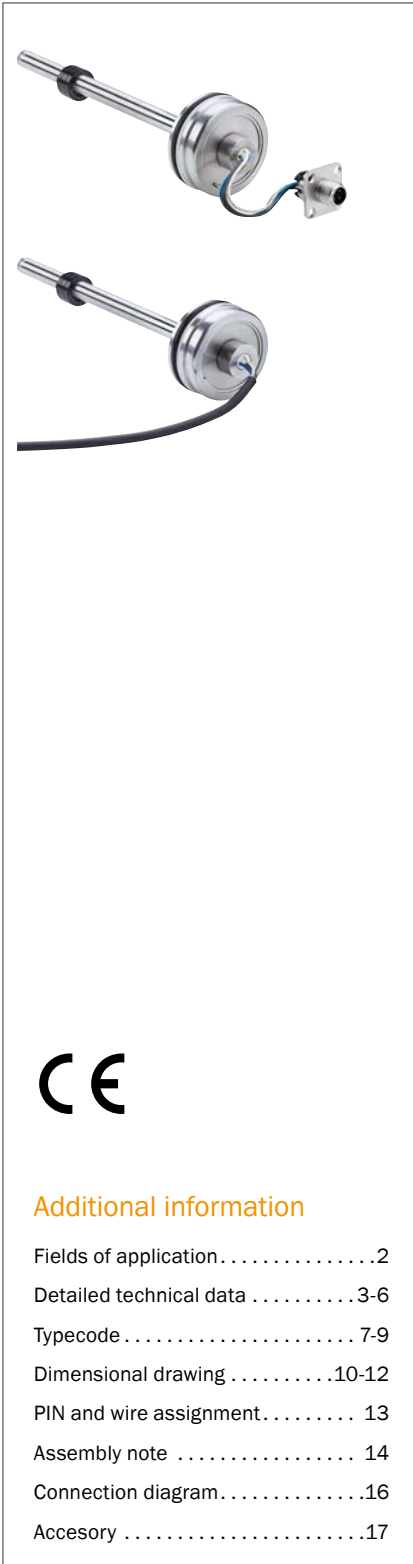
MAX48A

INTEGRATED CYLINDER POSITION MEASUREMENT
FOR MOBILE MACHINES

Linear encoders

SICK
Sensor Intelligence.

INTEGRATED CYLINDER POSITION MEASUREMENT FOR MOBILE MACHINES



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Product description

The MAX48A linear encoder is designed for position measurements in mobile hydraulic applications in hydraulic cylinders and controls hydraulic components of self-driving mobile machines. The magnetostriction technology provides highly reliable, wear- and maintenance-free absolute position detection. The pressure-resistant housing protects the encoder in the hydraulic cylinder

from influences during operation, such as fluid temperatures, vibrations, hydraulic oil, electrical and magnetic fields. MAX48A with 48 mm housing, axial cable entry and rugged stainless-steel housing can be easily installed in the existing cylinder construction. The diagnostic functions of the MAX® can be used to examine the operating cycles of hydraulic cylinders.

At a glance

- Measuring range: 50 to 2,500 mm (1 mm steps), typical resolution 0.1 mm
- Analog, CANopen, SAE J1939 and PWM interfaces are available
- Pressure-resistant housing, designed for hydraulic operating pressure of up to 400 bar
- High operating temperature (electronics) up to +105 °C
- Fluid temperature (hydraulic oil) up to max. +95 °C
- Compact dimensions: 10 mm installation space, 30 mm damping zone
- Position magnet does not need a spacer disk

Your benefits

- Magnetostriction: Reliable, safe and wear-free
- 100% mechanical and electrically compatible with existing cylinder constructions
- Space-saving installation: Better utilization of the piston stroke in tight installation space of the cylinder
- Extremely stable signal behavior and very good EMC properties: Resistant to extreme electrical influences, such as radiated or coupled faults in the on-board power supply
- Status monitoring: Monitoring of piston strokes, operating hours and max. oil temperature provides a statement about the cost-optimized operation of the machine
- Favorable cost-benefit ratio

→ www.sick.com/MAX48

For more information, simply enter the link or scan the QR code and get direct access to technical data, CAD design models, operating instructions, software, application examples, and much more.



Fields of application

Mobile work equipment

- Steering cylinder and spring systems
- Lifting and press cylinders on garbage trucks
- Stroke, swivel and tilt cylinders on telescopic handlers
- Support cylinders on work platforms
- Cutting system adjustment, steering assistance
- Loading crane monitoring, boom cylinders
- Gripper monitoring field on container cranes

Detailed technical data

General notes

Note	Accessories not included with delivery, please order separately.
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Performance

	Analog	PWM	Digital
Measured values	Position		Position, speed
Measuring range			
Position (F.S.)	50 ... 2,500 mm ¹⁾		
Speed	-		0 ... 1,000 mm/s
Unusable range			
Nullzone	30 mm		
Dampingzone	30 mm, 36 mm, 63 mm (depending on type)		
Switch-on time	< 250 ms		
Measuring frequency (internal)	2 ms		1 ms
Transmission rate (cycle time)	Continuous analog output signal	Depending on type, PWM frequency	-CANopen (0 ... 65,535 ms) Factory setting: 0 ms (transmission stopped) -SAE J1939: 20 ms
Setting point tolerance			
(Zero point and F.S.)	≤ ± 1 mm		
Resolution	Typ. 0.1 mm (noise-free)		
Hysteresis	± 0.1 mm		
Repeatability	Typ. ± 0.2 mm		
Linearity (in the operational status)	Typ. ± 0.25 mm (measuring range 50 to 500 mm) Typ. ± 0.04% F.S. (measuring range from 500 to 2,500 mm)		
Temperature drift			
Self-heating of the electronics (Warm-up phase)	Typ. ≤ ± 0.25 mm (2 min)		
Operational status (Hydraulic oil at operating temperature)	Typ. ≤ ± 0.005 % x F.S. x ΔT (ΔT 40°C) ²⁾		
MTTFd	69 years (EN ISO 13849-1) ^{3) 4)}		

¹⁾ F.S. = Full Scale (Measuring range)

²⁾ Increase in oil temperature by 40°C during operation.

³⁾ This product is a standard product and does not constitute a safety component as defined in the Machinery Directive. Calculation based on nominal load of components, average ambient temperature of electronic 60°C, frequency of use 8760 h/a.

⁴⁾ Every second failure of an electronic component is regarded as a dangerous failure.

Interfaces

	Analog	PWM	Digital
Communication interface detail	Voltage / current	PWM	CANopen / SAE J1939
Voltage output	0.25 ... 4.75 V 0.50 ... 4.50 V 0.50 ... 9.50 V 1.00 ... 9.00 V 9.50 ... 0.50 V 9.00 ... 1.00 V 4.75 ... 0.25 V 4.50 ... 0.50 V	-	
Current output	4.00 ... 20.00 mA 20.00 ... 4.00 mA	-	
Bus protocol	-		CANopen CiA DS-301
Device profile	-		CANopen CiA DS-406
Network Management Protocol	-		SAE J1939-81
Application Layer	-		SAE J1939-71
Puls width	-	05% ... 95% 10% ... 95% 15% ... 85% 20% ... 80% 25% ... 75%	-
Frequency	-	250 Hz 300 Hz 400 Hz 500 Hz	-

Electrical data

	Analog	PWM	Digital
Connection type	M12 connector, 4-pin Connecting cable, 3-wire		M12 connector, 5-pin
Supply voltage	12 V DC 8 ... 16 V DC ¹⁾ 24 V DC 8 ... 36 V DC	-	
Residual ripple	< 1% P-P		
Power consumption	12 V DC ≤ 0.75 W ¹⁾ 24 V DC ≤ 1.25 W ²⁾ 24 V DC ≤ 0.75 W	-	
Current consumption	12 V DC ≤ 60 mA ¹⁾ 24 V DC ≤ 50 mA ²⁾ 24 V DC ≤ 30 mA	-	
Load resistance	Voltage signal RL ≥ 10 kΩ Current signal 100 Ω ≤ RL ≤ 500 Ω Bustermiation -	- - -	120 Ω
Switch-on current	12 V DC Typ. 2.5 A/ 50 μs 24 V DC Typ. 5.0 A/ 50 μs	-	

	Analog	PWM	Digital
Over voltage protection			
12 V DC	≤ 18 V at all poles during the switch-on process (60 s) ≤ 24 V to GND during the switch-on process (60 s)		
24 V DC	≤ 36 V at all poles during the switch-on process (60 s) ≤ 48 V to GND during the switch-on process (60 s)		
Reverse polarity protection	≤ 36 V (at all poles) (ISO 16750-2)		
Insulation resistance	$R_{iso} \geq 10 \text{ M}\Omega$, 60 s (ISO 16750-2)		
Dielectric strength	500 V DC (0 V against housing) (ISO 16750-2)		

¹⁾ Valid for voltage outputs 0.50 ... 4.50 V; 4.50 ... 0.50 V; 0.25 ... 4.75 V; 4.75 ... 0.25 V

²⁾ Valid for current output 4 ... 20 mA; 20 ... 4 mA

Mechanical data

	Analog	PWM	Digital
Dimensions			
Construction size	48f7 mm (for installation in drill hole 48H8)		
∅ pressure pipe	10 mm		
∅ O-ring	∅ 40.87 mm x 3.53 mm		
∅ support ring	∅ 48 mm x ∅ 42.6 mm x 1.4 mm		
M12 flange type L	Construction DM 24x24 mm - hole pattern 17 mm (EN 61076-2-101)		
M12 connector (stranded wires)	60 ... 280 mm (depending on type)		
Connecting cable / stripped wires	∅ 5.0 mm / ∅ 1.4 mm 300 ... 10.000 mm (depending on type) 3 x 0.38 mm ² (AWG22)		
Material			
Electronics enclosure	Stainless steel 1.4305, AISI 303		
Pressure pipe	Stainless steel 1.4404, AISI 316L		
O-ring	NBR 70		
Support ring	PTFE		
Connection inlay	Glass fiber reinforced polyamide, nickel-/gold-plated brass contacts		
M12 flange	Nickel-plated brass with O-ring (NBR)		
Connecting cable / stranded wire	PUR / PVC		

Ambient data

	Analog	PWM	Digital
EMC	EU Directive 2014/30/EU CE marking		
Generic standards	EN 61000-6-2 and EN 61000-6-3		
Agricultural and forestry machinery	ISO 14982		
Construction machinery	EN 13309/ISO 13766		
Transient pulses	ISO 7637-2		
ESD (air and contact discharge)	EN 61000-4-2, ISO/TR 10605		
Enclosure rating			
Housing without electrical connection	IP67 (EN 60529)		
Housing with connecting cable	IP67 (EN 60529)		
M12 connector	IP69k (ISO 20653)		

¹⁾ Considered self-heating caused by continuously electrical operation with applied supply voltage.

²⁾ Due to permissible temperature loads of O-ring seals, hydraulic oil and the temperature-dependent signal quality of the position magnet.

³⁾ Relative Humidity 55 %

⁴⁾ Due to the dry storage of the O-ring when not installed (not wetted by hydraulic oil).

For details of applied tests and descriptive standards, please see document 8021473.

	Analog	PWM	Digital
Temperature			
Operating temperature range (electronics)	-40 °C ... +105 °C ¹⁾		
Ambient temperature (fluid)	-30 °C ... +95 °C ²⁾		
Storage temperature range	-20 °C ... +65 °C ³⁾⁴⁾		
Permissible relative humidity	90 % (Condensation not permitted)		
Resistance to shocks	Fall test in acc. with IEC 60068-2-31 100 g, 11 ms (Single shock in acc. with IEC 60068-2-27) 50 g, 11 ms (Continuous shocks, 1,000 shocks per spatial axis in acc. with IEC 60068-2-27)		
Resistance to vibration			
Sinus	20 g, 24 h / spatial axis, 55 ... 2,000 Hz (IEC 60068-2-6)		
Sine over noise	18 g (r.m.s), 36 h / spatial axis, 10 ... 2,000 Hz (IEC 60068-2-80)		
Random noise (resonance points excluded)	20 g (r.m.s), 48 h / spatial axis, 10 ... 2,000 Hz (IEC 60068-2-64)		
Nominal operating pressure (P_N)	400 bar		
Max. overload operation pressure (P_N x 1.2)	480 bar		
Max. test pressure in cylinder (P_N x 1.5)	600 bar		

¹⁾ Considered self-heating caused by continuously electrical operation with applied supply voltage.

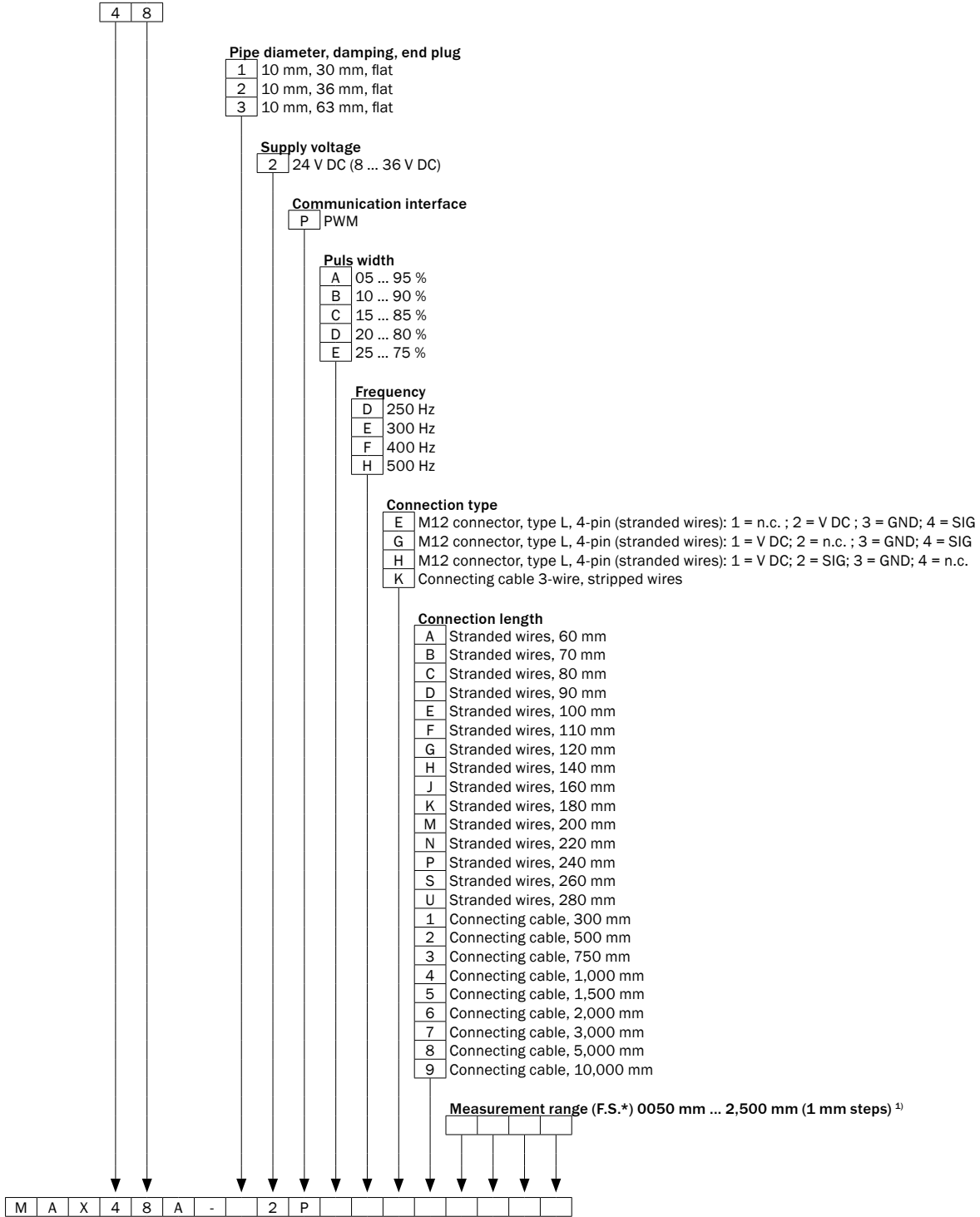
²⁾ Due to permissible temperature loads of O-ring seals, hydraulic oil and the temperature-dependent signal quality of the position magnet.

³⁾ Relative Humidity 55 %

⁴⁾ Due to the dry storage of the O-ring when not installed (not wetted by hydraulic oil).

For details of applied tests and descriptive standards, please see document 8021473.

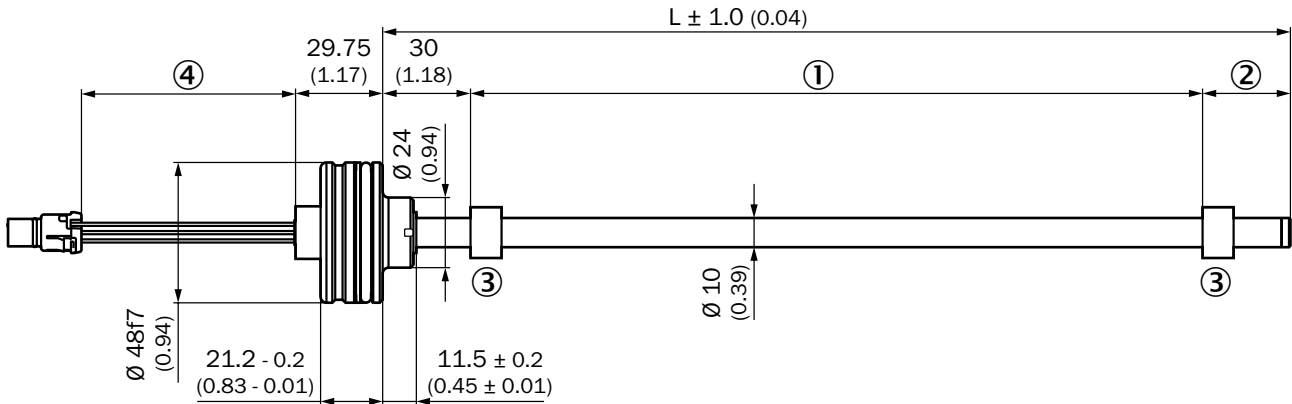
PWM



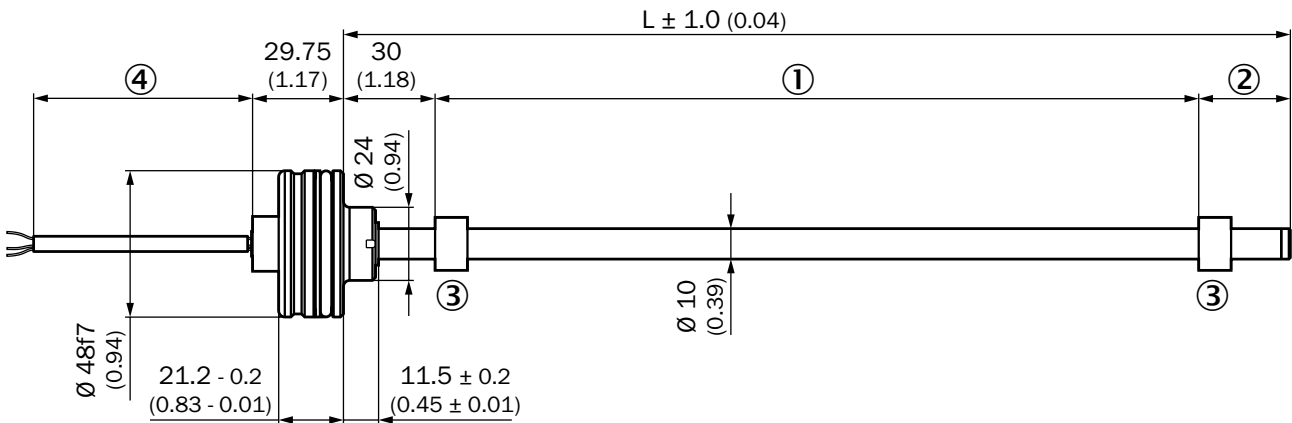
* Full Scale (measuring range end value)

Dimensional drawing

MAX48A

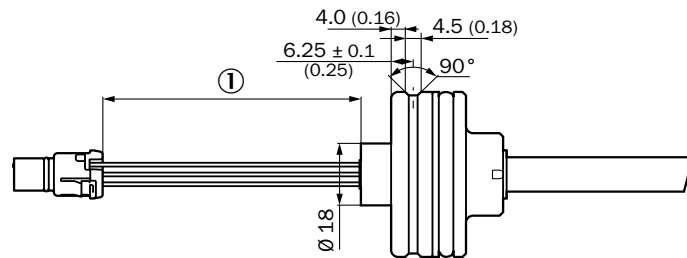


- ① Measuring range
- ② Damping zone
- ③ Position magnet
- ④ Stranded wires length



- ① Measuring range
- ② Damping zone
- ③ Position magnet
- ④ Connecting cable length

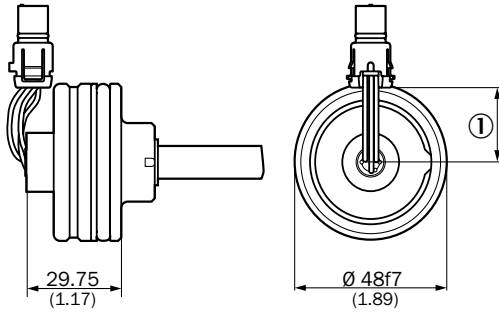
MAX48A Housing



- ① Stranded wires length

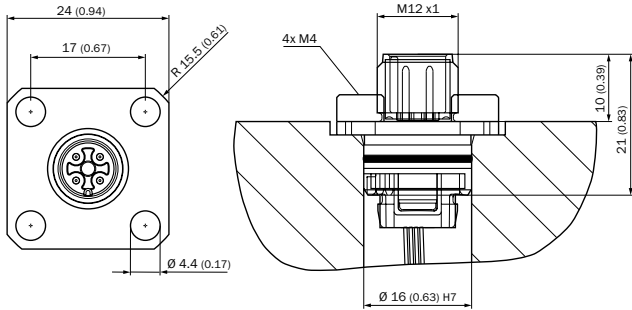
Encoder with electrical connection

M12 connector (Analog/ PWM/ Digital interface)

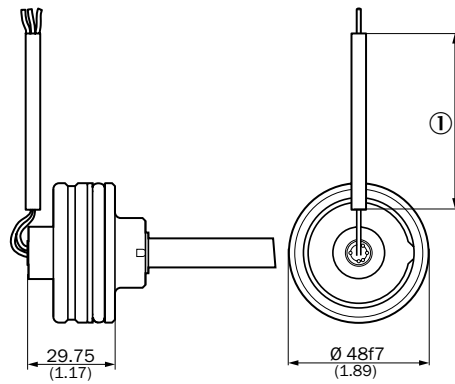


① Stranded wires length (depending on type)

M12 connector type L/ flange - radial seal



Connecting cable 3-wire (Analog/ PWM interface)

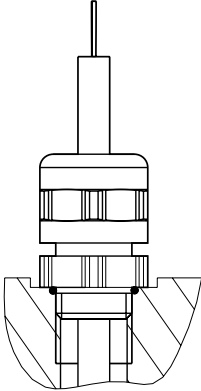


① Connecting cable length (depending on type)

Wire color	Terminal
brown	V DC
blue	GND
black	SIG (V)

Wire color	Terminal
brown	V DC
blue	GND
white	SIG (mA)

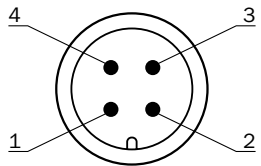
Cable fitting mount



PIN and wire assignment

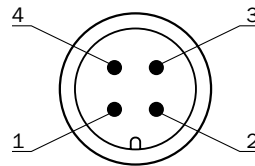
M12 (4-pin for Analog/ PWM interface)

PIN assignment G (Type L)



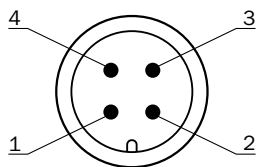
- ① V DC
- ② N.C.
- ③ GND
- ④ Signal

PIN assignment H (Type L)



- ① VDC
- ② Signal
- ③ GND
- ④ N. C.

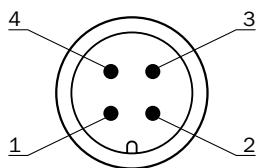
PIN assignment E (Type L)



- ① N. C.
- ② VDC
- ③ GND
- ④ Signal

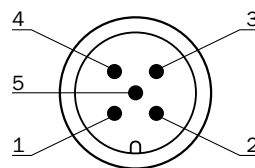
M12 connector (5-pin for Digital interface)

PIN assignment S (Type L)



- ① VDC
- ② N.C.
- ③ GND
- ④ CAN_H
- ⑤ CAN_L

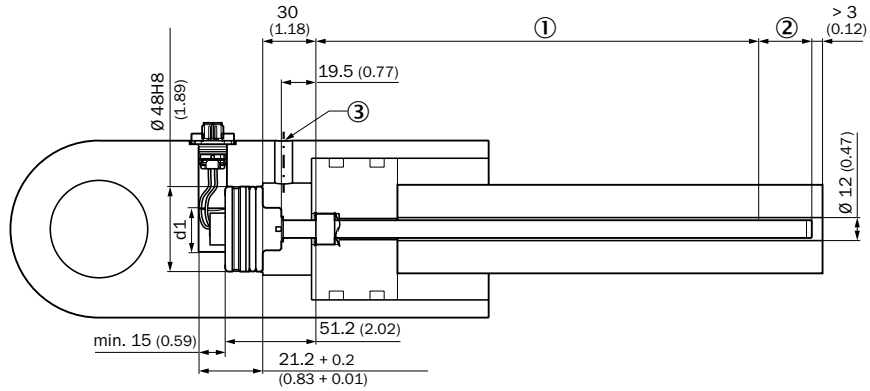
PIN assignment F (Type L)



- ① N.C.
- ② VDC
- ③ GND
- ④ CAN_H
- ⑤ CAN_L

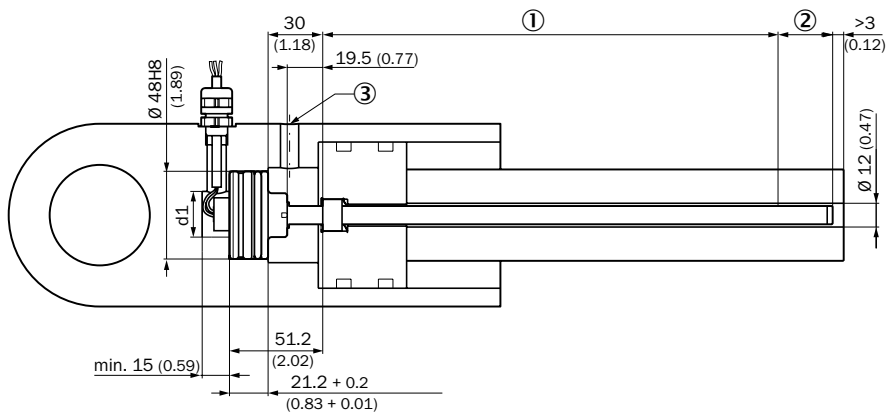
Assembly note

IN-cylinder assembly



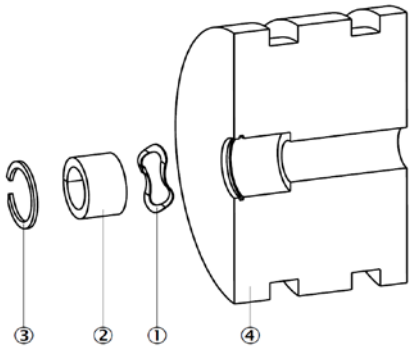
- ① Measuring range
- ② Damping zone
- ③ Hydraulic port

Please observe the information in the operating instructions (8021473) ($d: 32 \leq d \leq 40$).



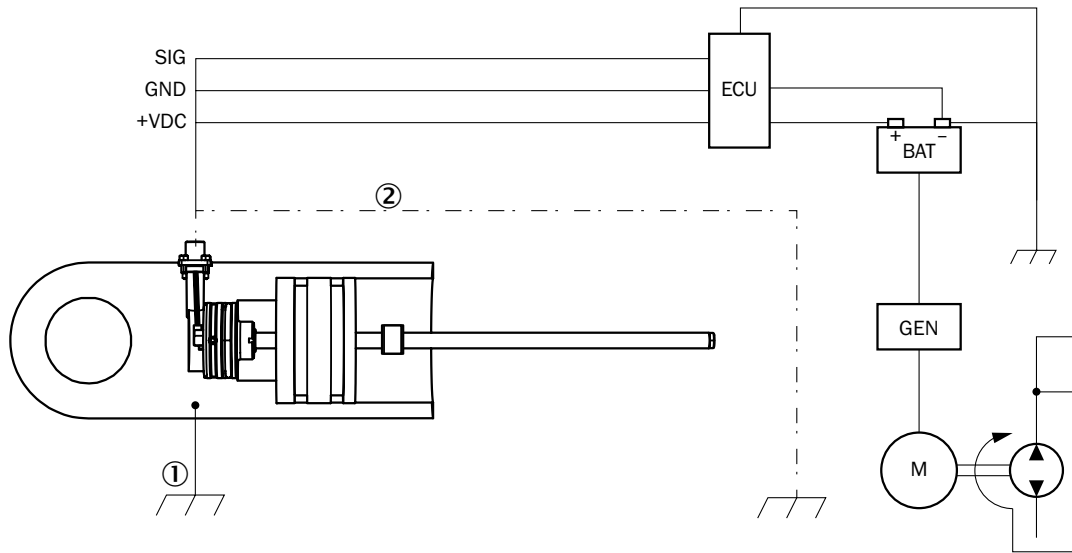
- ① Measuring range
- ② Damping zone
- ③ Hydraulic port

Please observe the information in the operating instructions (8021473) ($d: 32 \leq d \leq 40$).

Installation of the position magnet

- ① Corrugated spring washer
- ② Position magnet
- ③ Circlip
- ④ Piston

Connection diagram



- ① Chassis GND
- ② Cable shielding (optional)

Accessories

Mounting systems

Flanges



Flange plates

Figure	Brief description	Packaging unit	Type	Part no.
	Flange for M12 male connector, type L square flange (24 mm x 24 mm) with axial seal, nickel-plated brass	1	BEF-FA-M12L-01	2117510
		5	BEF-FA-M12L-05	2117511
		10	BEF-FA-M12L-10	2117512

Dimensional drawings → [page 18](#)

Other mounting accessories

Others

Figure	Brief description	Packaging unit	Type	Part no.
	Circlip for installing the position magnets in the piston of the hydraulic cylinder, stainless steel 1.4300 / SAE 302	1	BEF-MK-SR-01	2116437
		5	BEF-MK-SR-05	2116438
		10	BEF-MK-SR-10	2116439
		50	BEF-MK-SR-50	2116440
	Corrugated spring washer for installing the position magnets in the piston of the hydraulic cylinder, stainless steel 1.4568 / SAE 631	1	BEF-MK-WF-01	2116431
		5	BEF-MK-WF-05	2116432
		10	BEF-MK-WF-10	2116433
		50	BEF-MK-WF-50	2116435

Dimensional drawings → [page 18](#)

Connection systems

Plug connectors and cables


Other connectors and cables

Figure	Brief description	Packaging unit	Type	Part no.
	Head A: M12 Cable: shielded Cable gland with M12 x 1.5 connection thread, terminal insert Polyamide V0 to UL94, O-ring NBR, moulded seal NBR	1	BEF-EA-M12-S	2117513

Dimensional drawings → [page 18](#)

Further accessories

Magnets

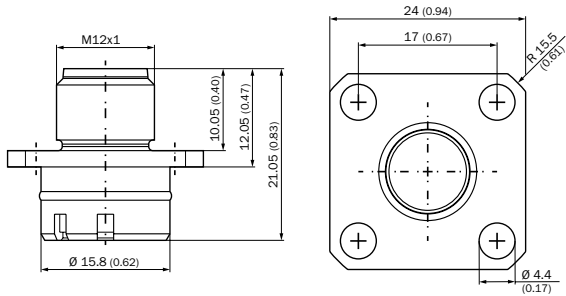
Figure	Brief description	Packaging unit	Type	Part no.
	Position magnet for magnorestrictive linear encoder, Ø 17.4 mm	1	MAG-O-174-01	2112714
		5	MAG-O-174-05	2112713
		10	MAG-O-174-10	2115045
		50	MAG-O-174-50	2112711

Dimensional drawings → [page 18](#)

Dimensional drawings for accessories (Dimensions in mm (inch))

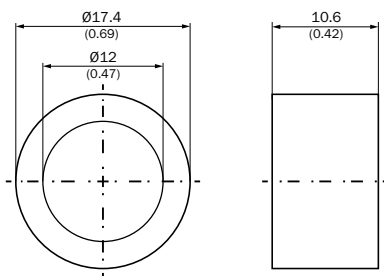
Flanges

Square flange type L (BEF-FA-M12L-xx)

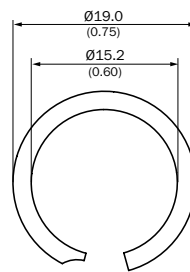


Other mounting accessories

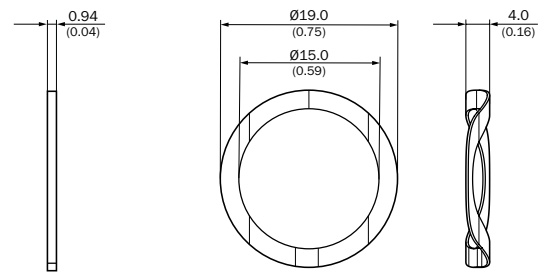
Position magnet (MAG-0-174-xx)



Circlip (BEF-MK-SR-xx)

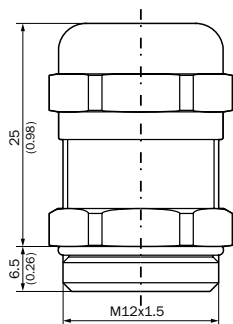


Spring washer (BEF-MK-WF-xx)



Plug connectors and cables

Cable gland (BEF-EA-M12-S)



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Detailed addresses and further locations → www.sick.com