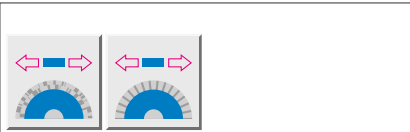


RUGGED DESIGN MEASURES DISTANCES UP TO 50 M - THE HEAVY-DUTY WIRE DRAW ENCODER



Product description

With wire draw lengths from 2 m to 50 m, the HighLine series of wire draw encoders have enormous range. Thanks to guide rollers, the HighLine series enables flexible measurement paths - even around obstacles. Their rugged housing

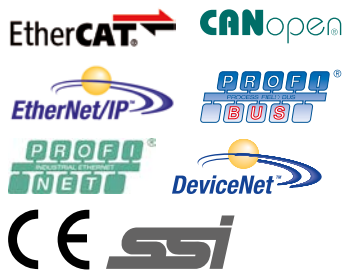
and dirt-resistant brush assemblies allow the encoder to be used in the toughest of environments, including dust, shock and vibration, which ensure a long service lifetime.

At a glance

- Measuring lengths: 2 m to 50 m
- Modular measuring system with a wide selection of interfaces/measuring lengths
- Very rugged system (dirt scraper, integrated brushes)
- High-quality winding mechanism and wire input
- High enclosure rating
- High resistance to shock and vibrations
- Extremely high resolution possible
- Expandable using external accessories

Your benefits

- Reliable solution for use in harsh ambient conditions
- Long service life due to rugged industrial housing
- Quick and easy installation without the need for precise linear guidance
- Low integration and maintenance costs
- Customization option reduces storage costs
- Quick and easy commissioning thanks to analog interface and option to use low-cost interface card



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Fields of application

- Positioning of storage and retrieval systems
- Positioning grippers and trolleys with cranes
- Automated guided systems
- Elevators
- Lifting platforms
- Presses

Detailed technical data

BTF

Performance

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
Measuring range	0 m ... 2 m	0 m ... 3 m	0 m ... 5 m	0 m ... 10 m	0 m ... 20 m	0 m ... 30 m	0 m ... 50 m
Reproducibility	Max. 0.2 mm ¹⁾	Max. 0.3 mm ¹⁾	Max. 0.5 mm ¹⁾	Max. 1 mm ¹⁾	Max. 2 mm ¹⁾	Max. 3 mm ¹⁾	Max. 5 mm ¹⁾
Linearity	Max. ± 2 mm ^{1) 2)}	Max. ± 3 mm ^{1) 2)}		Max. ± 6 mm ^{1) 2)}	Max. ± 10 mm ^{1) 2)}	Max. ± 15 mm ^{1) 2)}	Max. ± 24 mm ^{1) 2)}
Hysteresis	Max. 1 mm ¹⁾	Max. 1.5 mm ¹⁾	Max. 2 mm ¹⁾	Max. 4 mm ¹⁾	Max. 6 mm ¹⁾	Max. 8 mm ¹⁾	Max. 10 mm ¹⁾
Resolution (wire draw + encoder)							
Analog	4 ... 20 mA = 0.02 mm; 0 ... 10 V = 0.02 mm ^{3) 4)}		4 ... 20 mA = 0.03 mm; 0 ... 10 V = 0.03 mm ^{3) 4)}		-		
SSI	0.025 (ATM60) ^{3) 4)} 0.02 (AHM36) ^{3) 4)}		0.05 mm (ATM60) ^{3) 4)} 0.04 mm (AHM36) ^{3) 4)}				0.1 mm (ATM60) ^{3) 4)} 0.06 mm (AHM36) ^{3) 4)}
CANopen	0.02 mm (ATM60) ^{3) 4)} 0.01 mm (AHM36) ^{3) 4)}		0.04 mm (ATM60) ^{3) 4)} 0.02 mm (AHM36) ^{3) 4)}				0.06 mm (ATM60) ^{3) 4)} 0.03 mm (AHM36) ^{3) 4)}
DeviceNet	0.02 mm ^{3) 4)}		0.04 mm ^{3) 4)}				0.06 mm ^{3) 4)}
PROFIBUS	0.02 mm ^{3) 4)}		0.04 mm ^{3) 4)}				0.06 mm ^{3) 4)}
EtherNet/IP	0.001 mm ^{3) 4)}						0.002 mm ^{3) 4)}
PROFINET	0.001 mm ^{3) 4)}						0.002 mm ^{3) 4)}
EtherCAT®	0.001 mm ^{3) 4)}						0.002 mm ^{3) 4)}

¹⁾ Value applies to wire draw mechanics.

²⁾ Value applies under consideration of the exact length of the measuring wire per revolution (located on the wire draw mechanism's label).

³⁾ The values shown here are rounded.

⁴⁾ Sample calculation based on the BTF08 with PROFINET: 200 mm (length of wire draw per revolution - see mechanical data):
262,144 (steps per revolution) = 0.001 mm (resolution from the combination wire draw + encoder)

Interfaces

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
Encoder	Absolute encoder						
Electrical interface	See type code						
Connection type	See type code						
Clock frequency							
Analog	32 kHz				-		
SSI	1 MHz (ATM60) 2 MHz (AHM36)						
Address setting							

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
CANopen	0 ... 63 (ATM60) 0 ... 127 (AHM36)						
DeviceNet	0 ... 63, DIP switch or protocol						
PROFIBUS	0 ... 127, DIP switch						
EtherNet/IP	Via DHCP / DEC switches						
PROFINET	Via DCP						
Protocol							
CANopen	Communication profile DS 301 V4.0 (ATM60) Communication profile DS 301 V4.02 (AHM36)						
DeviceNet	DeviceNet Specification Release 2.0						
PROFIBUS	PROFIBUS DP V0 (A3M60), profile for encoders (07hex) - Class 2 (ATM60 PROFIBUS)						
EtherNet/IP	EtherNet/IP IEC 61784-1						
PROFINET	PROFINET IO / RT Class B						
EtherCAT®	EtherCAT, CoE (CiA DS-301)						
Bus termination							
CANopen	Via DIP switches (ATM60) Via external terminator (AHM36)						
DeviceNet	Via DIP switches						
PROFIBUS	Via DIP switches						
Set (electronic adjustment)							
Analog	Teach-in functionality						
SSI	Via SET cable (ATM60) H active (L = 0 - 3 V; H = 4.0 - U _s V) (AHM36)						
CANopen	Via PRESET pushbutton or protocol						
DeviceNet	Via PRESET pushbutton or protocol						
PROFIBUS	Via PRESET pushbutton or protocol						
EtherNet/IP	Via PRESET pushbutton or protocol						
PROFINET	Via PRESET pushbutton or protocol						
EtherCAT®	Via PRESET pushbutton or protocol						
Encoder profile							
CANopen	Device profile DSP 406 V 2.0 (ATM60) CiA DS-406, V3.2. - Class C2 (AHM36)						
DeviceNet	Generic Profile						
PROFIBUS	Encoder profile version 1.1 Class 1 and Class2 (A3M60), profile for encoders (07hex) - Class 2 (ATM60 PROFIBUS)						
EtherNet/IP	0 x 22						
PROFINET	V4.1 class3						
EtherCAT®	CiA DS-406						

Electrical data

		BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m	
Initialization time									
	Analog	≤ 2 ms ¹⁾					-		
	SSI	Approx. 1,050 ms (ATM60) ¹⁾ 100 ms (AHM36) ¹⁾							
	CANopen	Approx. 12 s (ATM60) ¹⁾ 2 s (AHM36) ¹⁾							
	DeviceNet	Approx. 12 s ¹⁾							
	PROFIBUS	Approx. 1 s (A3M60), approx. 12 s (ATM60 PROFIBUS) ¹⁾							
	EtherNet/IP	Approx. 12 s ¹⁾							
	PROFINET	Approx. 12 s ¹⁾							
	EtherCAT®	Approx. 12 s ¹⁾							
Supply voltage									
	Analog	18 V ... 33 V					-		
	SSI	4.5 V DC ... 32 V DC (AHM36) 10 V ... 32 V (ATM60)							
	CANopen	10 V ... 32 V (ATM60) 10 V ... 30 V (AHM36)							
	DeviceNet	10 V ... 32 V							
	PROFIBUS	10 V ... 32 V							
	EtherNet/IP	10 V ... 30 V							
	PROFINET	10 V ... 30 V							
	EtherCAT®	10 V ... 30 V							
Code type									
	SSI	Gray (ATM60) Gray, binary (AHM36)							
Power consumption									
	Analog	2 W					-		
	SSI	0.8 W (ATM60) 1.5 W (AHM36)							
	CANopen	2 W (ATM60) 1.5 W (AHM36)							
	DeviceNet	2 W							
	PROFIBUS	1,5 W (A3M60) 2 W (ATM60 PROFIBUS)							
	EtherNet/IP	3 W							
	PROFINET	3 W							
	EtherCAT®	3 W							

¹⁾ Valid positional data can be measured once this time has elapsed.

²⁾ 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 devices, average ambient temperature 40 °C, frequency of use 8760 h/a. All electronic failures are considered hazardous. For more information, see document no. 8015532.

³⁾ This value relates to the connected encoder only.

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
MTTFd: mean time to dangerous failure							
SSI	150 years (ATM60) ^{2) 3)} 230 years (AHM36) ^{2) 3)}						
CANopen	150 years (ATM60) ^{2) 3)} 270 years (AHM36) ^{2) 3)}						
DeviceNet	150 years ^{2) 3)}						
PROFIBUS	60 years (A3M60) ^{2) 3)} 150 years (ATM60 PROFIBUS) ^{2) 3)}						
EtherNet/IP	80 years ^{2) 3)}						
PROFINET	80 years ^{2) 3)}						
EtherCAT®	80 years ^{2) 3)}						

¹⁾ Valid positional data can be measured once this time has elapsed.

²⁾ 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 devices, average ambient temperature 40 °C, frequency of use 8760 h/a. All electronic failures are considered hazardous. For more information, see document no. 8015532.

³⁾ This value relates to the connected encoder only.

Mechanical data

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
Mass (incl. encoder)							
Analog	1.7 kg	1.9 kg	3.2 kg	3.9 kg	5.4 kg	-	
SSI	1.8 kg (ATM60)	2 kg (ATM60)	3.3 kg (ATM60)	4 kg (ATM60)	5.5 kg (ATM60)	6.7 kg (ATM60)	17 kg (ATM60)
	1.42 kg (AHM36)	1.62 kg (AHM36)	2.92 kg (AHM36)	3.62 kg (AHM36)	5.12 kg (AHM36)	6.32 kg (AHM36)	16.62 kg (AHM36)
CANopen	1.89 kg (ATM60)	2.09 kg (ATM60)	3.39 kg (ATM60)	4.09 kg (ATM60)	5.59 kg (ATM60)	6.79 kg (ATM60)	17.09 kg (ATM60)
	1.42 kg (AHM36)	1.62 kg (AHM36)	2.92 kg (AHM36)	3.62 kg (AHM36)	5.12 kg (AHM36)	6.32 kg (AHM36)	16.62 kg (AHM36)
DeviceNet	1.89 kg	2.09 kg	3.39 kg	4.09 kg	5.59 kg	6.79 kg	17.09 kg
PROFIBUS	1.58 kg (A3M60)	1.78 kg (A3M60)	3.08 kg (A3M60)	3.78 kg (A3M60)	5.28 kg (A3M60)	6.48 kg (A3M60)	16.78 kg (A3M60)
	1.89 kg (ATM60)	2.09 kg (ATM60)	3.39 kg (ATM60)	4.09 kg (ATM60)	5.59 kg (ATM60)	6.79 kg (ATM60)	17.09 kg (ATM60)
	PROFIBUS)	PROFIBUS)	PROFIBUS)	PROFIBUS)	PROFIBUS)	PROFIBUS)	PROFIBUS)
EtherNet/IP	1.5 kg	1.7 kg	3 kg	3.7 kg	5.2 kg	6.4 kg	16.7 kg
PROFINET	1.5 kg	1.7 kg	3 kg	3.7 kg	5.2 kg	6.4 kg	16.7 kg
EtherCAT®	1.5 kg	1.7 kg	3 kg	3.7 kg	5.2 kg	6.4 kg	16.7 kg
Mass (mechanism)	1.3 kg	1.5 kg	2.8 kg	3.5 kg	5 kg	6.2 kg	16.5 kg
Measuring wire material	Highly flexible steel wire, 1.4401 stainless steel V4A						
Mass (measuring wire)	7.1 g/m				2.6 g/m		7.1 g/m
Material, wire draw mechanism housing	Aluminum (anodized), zinc die cast		Aluminum (anodized), plastic				Aluminum (anodized), zinc die cast
Wire draw lengths per revolution	200 mm ¹⁾		334.1 mm ¹⁾		332.4 mm ¹⁾		491.5 mm ¹⁾
Spring return force	6 N ... 14 N ²⁾		15 N ... 20 N ²⁾	10 N ... 20 N ²⁾			18 N ... 37 N ²⁾
Service life of wire draw mechanism	1 mio. cycles ³⁾						
Actual wire draw length	2.2 m	3.2 m	5.2 m	10.2 m	20.2 m	30.2 m	50.2 m
Measuring wire diameter	1.35 mm				0.81 mm		1.35 mm
Wire acceleration	40 m/s ²		70 m/s ²	40 m/s ²	30 m/s ²	15 m/s ²	18 m/s ²
Traversing speed	4 m/s						
Integrated encoder							
Analog	ACM60					-	
SSI	ATM60 SSI						
	AHM36 SSI						
CANopen	ATM60 CANopen						
	AHM36 CANopen						
DeviceNet	ATM60 DeviceNet						
PROFIBUS	A3M60, ATM60 PROFIBUS						
EtherNet/IP	AFM60 EtherNet/IP						
PROFINET	AFM60 PROFINET						
EtherCAT®	AFM60 EtherCAT®						

¹⁾ The data shown here are average values. The exact lengths are listed on the label for the wire draw mechanism.

²⁾ These values were measured at an ambient temperature of 25 °C. There may be variations at other temperatures.

³⁾ A cycle is made up of a wire intake and outtake.

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
Number of steps per revolution							
SSI	8,000 (ATM60) 8,192 (AHM36)		6,680 (ATM60) 8,192 (AHM36)				4,900 (ATM60) 8,192 (AHM36)
CANopen	8,192 (ATM60) 16,384 (AHM36)						
DeviceNet	8,192						
PROFIBUS	8,192						
EtherNet/IP	262,144						
PROFINET	262,144						
EtherCAT®	262,144						
Article number encoder							
Analog	6045312 6045313					-	
SSI	1034293 (ATM60)		1034294 (ATM60)		1034295 (ATM60)		1034296 (ATM60)
	1068330 (AHM36)						
CANopen	1030025 (ATM60) 1065999 (AHM36)						
DeviceNet	1030018						
PROFIBUS	1051018 (A3M60) 1030014 (ATM60)						
EtherNet/IP	1055331						
PROFINET	1059040						
EtherCAT®	1059061						
Integrated mechanics	MRA-F080-102D2	MRA-F080-103D2	MRA-F130-105D2	MRA-F130-110D2	MRA-F130-120D1	MRA-F130-130D1	MRA-F190-150D2
Article number mechanics	6028625	6030125	6028626	6028627	6028628	6028629	6028630

¹⁾ The data shown here are average values. The exact lengths are listed on the label for the wire draw mechanism.

²⁾ These values were measured at an ambient temperature of 25 °C. There may be variations at other temperatures.

³⁾ A cycle is made up of a wire intake and outtake.

Ambient data

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
EMC	According to EN 61000-6-2 and EN 61000-6-3						
Enclosure rating (encoder)							
Analog	IP 65					-	
SSI	IP 67 (ATM60) IP 66 / IP 67, on the housing side (as per IEC 60529) (AHM36) IP 66 / IP 67, on the shaft side (as per IEC 60529) (AHM36)						
CANopen	IP 67 (ATM60) IP 66 / IP 67, on the housing side (as per IEC 60529) (AHM36) IP 66 / IP 67, on the shaft side (as per IEC 60529) (AHM36)						
DeviceNet	IP 67						
PROFIBUS	IP 67						
EtherNet/IP	IP 67						
PROFINET	IP 67						
EtherCAT®	IP 67						

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
Enclosure rating (mechanism)	IP 64						IP 31
Resistance to shocks (as per EN 60068-2-27)							
Analog	50 g, 6 ms					-	
SSI	10 g, 6 ms (ATM60) 100 g, 6 ms (AHM36)						
CANopen	100 g, 6 ms						
DeviceNet	100 g, 6 ms						
PROFIBUS	100 g, 6 ms						
EtherNet/IP	100 g, 6 ms						
PROFINET	100 g, 6 ms						
EtherCAT®	100 g, 6 ms						
Resistance to vibrations (as per EN 60068-2-6)							
SSI	20 g, 10 Hz ... 2,000 Hz (ATM60, AHM36)						
CANopen	20 g, 10 Hz ... 2,000 Hz						
DeviceNet	20 g, 10 Hz ... 2,000 Hz						
PROFIBUS	30 g, 10 Hz ... 2,000 Hz						
EtherNet/IP	30 g, 10 Hz ... 2,000 Hz						
PROFINET	30 g, 10 Hz ... 2,000 Hz						
EtherCAT®	30 g, 10 Hz ... 2,000 Hz						
Analog	4 g, sine 5 Hz ... 100 Hz					-	
Operating temperature range (encoder)							
Analog	-30 °C ... +80 °C					-	
SSI	-20 °C ... +85 °C (ATM60) -40 °C ... +100 °C (AHM36)						
CANopen	-20 °C ... +85 °C (ATM60 CANopen) -40 °C ... +85 °C (AHM36 CANopen)						
DeviceNet	-20 °C ... +85 °C						
PROFIBUS	-10 °C ... +70 °C (A3M60) -20 °C ... +85 °C (ATM60 PROFIBUS)						
EtherNet/IP	-30 °C ... +85 °C						
PROFINET	-30 °C ... +85 °C						
EtherCAT®	-30 °C ... +85 °C						
Operating temperature range (mechanical)	-30 °C ... +70 °C						

	BTF08 0 m ... 2 m	BTF08 0 m ... 3 m	BTF08 0 m ... 5 m	BTF13 0 m ... 10 m	BTF13 0 m ... 20 m	BTF13 0 m ... 30 m	BTF19 0 m ... 50 m
Operating temperature range (combination)							
Analog	-30 °C ... +70 °C					-	
SSI	-20 °C ... +70 °C (ATM60) -30 °C ... +70 °C (AHM36)						
CANopen	-20 °C ... +70 °C (ATM60 CANopen) -30 °C ... +70 °C (AHM36 CANopen)						
DeviceNet	-20 °C ... +70 °C						
PROFIBUS	-10 °C ... +70 °C (A3M60) -20 °C ... +70 °C (ATM60 PROFIBUS)						
EtherNet/IP	-30 °C ... +70 °C						
PROFINET	-30 °C ... +70 °C						
EtherCAT®	-30 °C ... +70 °C						
Relative humidity/condensation							
SSI	90% (ATM60, AHM36) ¹⁾						
CANopen	98% (ATM60) ¹⁾ 90% (AHM36) ¹⁾						
DeviceNet	98% ¹⁾						
PROFIBUS	95% ¹⁾ (A3M60) 98% ¹⁾ (ATM60)						
EtherNet/IP	90% ¹⁾						
PROFINET	90% ¹⁾						
EtherCAT®	90% ¹⁾						

¹⁾ Condensation of optical surfaces not permitted.

PRF

Performance

	PRF08 0 m ... 2 m	PRF08 0 m ... 3 m	PRF13 0 m ... 5 m	PRF13 0 m ... 10 m	PRF13 0 m ... 20 m	PRF13 0 m ... 30 m	PRF19 0 m ... 50 m
Measuring range	0 m ... 2 m	0 m ... 3 m	0 m ... 5 m	0 m ... 10 m	0 m ... 20 m	0 m ... 30 m	0 m ... 50 m
Reproducibility	Max. 0.2 mm ¹⁾	Max. 0.3 mm ¹⁾	Max. 0.5 mm ¹⁾	Max. 1 mm ¹⁾	Max. 2 mm ¹⁾	Max. 3 mm ¹⁾	Max. 5 mm ¹⁾
Linearity	Max. ± 2 mm ^{1) 2)}	Max. ± 3 mm ^{1) 2)}		Max. ± 6 mm ^{1) 2)}	Max. ± 10 mm ^{1) 2)}	Max. ± 15 mm ^{1) 2)}	Max. ± 24 mm ^{1) 2)}
Hysteresis	Max. 1 mm ¹⁾	Max. 1.5 mm ¹⁾	Max. 2 mm ¹⁾	Max. 4 mm ¹⁾	Max. 6 mm ¹⁾	Max. 8 mm ¹⁾	Max. 10 mm ¹⁾
Resolution (wire draw + encoder)	0.1 mm ^{3) 4)}		0.2 mm ^{3) 4)}				0.4 mm ^{3) 4)}

¹⁾ Value applies to wire draw mechanics.

²⁾ Value applies under consideration of the exact length of the measuring wire per revolution (located on the wire draw mechanism's label).

³⁾ The values shown here are rounded.

⁴⁾ Sample calculation based on the PRF08 with HTL Push Pull: 200 mm (length of wire draw per revolution - see mechanical data); 2,000 (steps per revolution) = 0.1 mm (resolution from the combination wire draw + encoder)

Interfaces

Encoder	Incremental encoders
Electrical interface	See type code
Connection type	See type code

Electrical data

Maximum output frequency	≤ 600 kHz
Reference signal, position	Electric, logically gated with A and B
Reference signal, number	1 electric, logically gated with A and B
Maximum load current	≤ 30 mA
Initialization time	≤ 32 ms, 30 ms, at mechanical zero pulse width ^{1) 1)}
Supply voltage	4.5 V ... 32 V
Power consumption	0.7 W
MTTFd: mean time to dangerous failure	300 years ^{2) 3)}

¹⁾ Valid positional data can be measured once this time has elapsed.

²⁾ 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 devices, average ambient temperature 40 °C, frequency of use 8760 h/a. All electronic failures are considered hazardous. For more information, see document no. 8015532.

³⁾ This value relates to the connected encoder only.

Mechanical data

	PRF08 0 m ... 2 m	PRF08 0 m ... 3 m	PRF13 0 m ... 5 m	PRF13 0 m ... 10 m	PRF13 0 m ... 20 m	PRF13 0 m ... 30 m	PRF19 0 m ... 50 m
Mass (incl. encoder)	1.6 kg	1.8 kg	3.1 kg	3.8 kg	5.3 kg	6.5 kg	16.8 kg
Measuring wire material	Highly flexible steel wire, 1.4401 stainless steel V4A						
Mass (measuring wire)	7.1 g/m				2.6 g/m		7.1 g/m
Material, wire draw mechanism housing	Aluminum (anodized), zinc die cast		Aluminum (anodized), plastic				Aluminum (anodized), zinc die cast

¹⁾ The data shown here are average values. The exact lengths are listed on the label for the wire draw mechanism.

²⁾ These values were measured at an ambient temperature of 25 °C. There may be variations at other temperatures.

³⁾ A cycle is made up of a wire intake and outtake.

⁴⁾ The fitted DFS60 encoders are programmed with the specified number of lines and interface ex-works. Separate programming devices are available for the DFS60 encoders and can be used to adjust the electrical interface (TTL/HTL) and the number of lines (up to a maximum of 10,000 lines) in accordance with the customer's requirements.

	PRF08 0 m ... 2 m	PRF08 0 m ... 3 m	PRF13 0 m ... 5 m	PRF13 0 m ... 10 m	PRF13 0 m ... 20 m	PRF13 0 m ... 30 m	PRF19 0 m ... 50 m
Wire draw lengths per revolution	200 mm ¹⁾		334.1 mm ¹⁾		332.4 mm ¹⁾		491.5 mm ¹⁾
Spring return force	6 N ... 14 N ²⁾		15 N ... 20 N ²⁾				18 N ... 37 N ²⁾
Service life of wire draw mechanism	1 mio. cycles ³⁾						
Actual wire draw length	2.2 m	3.2 m	5.2 m	10.2 m	20.2 m	30.2 m	50.2 m
Measuring wire diameter	1.35 mm				0.81 mm		1.35 mm
Wire acceleration	40 m/s ²		70 m/s ²	40 m/s ²	30 m/s ²	15 m/s ²	18 m/s ²
Traversing speed	4 m/s						
Integrated encoder	DFS60 programmable						
Pulses per revolution	2,000 ⁴⁾		1,670 ⁴⁾		1,662 ⁴⁾		1,225 ⁴⁾
Article number encoder	-						
Integrated mechanics	MRA-F080- 102D2	MRA-F080- 103D2	MRA-F130- 105D2	MRA-F130- 110D2	MRA-F130- 120D1	MRA-F130- 130D1	MRA-F190- 150D2
Article number mechanics	6028625	6030125	6028626	6028627	6028628	6028629	6028630

¹⁾ The data shown here are average values. The exact lengths are listed on the label for the wire draw mechanism.

²⁾ These values were measured at an ambient temperature of 25 °C. There may be variations at other temperatures.

³⁾ A cycle is made up of a wire intake and outtake.

⁴⁾ The fitted DFS60 encoders are programmed with the specified number of lines and interface ex-works. Separate programming devices are available for the DFS60 encoders and can be used to adjust the electrical interface (TTL/HTL) and the number of lines (up to a maximum of 10,000 lines) in accordance with the customer's requirements.

Ambient data

	PRF08 0 m ... 2 m	PRF08 0 m ... 3 m	PRF13 0 m ... 5 m	PRF13 0 m ... 10 m	PRF13 0 m ... 20 m	PRF13 0 m ... 30 m	PRF19 0 m ... 50 m
EMC	According to EN 61000-6-2 and EN 61000-6-3						
Enclosure rating (encoder)	IP 67						
Enclosure rating (mechanism)	IP 64						IP 31
Resistance to shocks (according to EN 60068-2-27)	60 g, 6 ms						
Resistance to vibration (according to EN 60068-2-6)	20 g, 10 Hz ... 2,000 Hz						
Operating temperature range (encoder)	-40 °C ... +100 °C						
Operating temperature range (mechanical)	-30 °C ... +70 °C						
Operating temperature range (combination)	-30 °C ... +70 °C						
Relative humidity/condensation	90% ¹⁾						

¹⁾ Condensation of optical surfaces not permitted.

Type code

HighLine absolute

Size	
0	8
1	3
1	9

80 mm (only in conjunction with measuring lengths 02 and 03)
 130 mm (only in conjunction with measuring lengths 05, 10, 20, 30)
 190 mm (only in conjunction with measuring length 50)

Electrical interface

A	SSI
C	CANopen ¹⁾
D	DeviceNet ¹⁾
E	EtherCAT®
H	HIPERFACE® (on request)
K	SSI + SinCos (on request)
L	SSI + incremental HTL (on request)
I	EtherNet/IP
N	PROFINET
P	PROFIBUS ¹⁾
R	SSI + incrementally programmable (on request)
S	SSI + SinCos programmable (on request)
T	SSI + incremental TTL (on request)

Connection type

A	Male connector, M23, 12-pin, radial (only in combination with interface A)
B	Male connector, 3 x M12, axial (only in combination with the electrical interfaces E, I, N, and P with axial outlet)
C	Male connector, M12, 8-pin, radial (only in combination with interface A)
H	Male connector for fieldbus adapters (in combination with the electrical interfaces C, D, and P with radial outlet) ¹⁾
K	Cable, 8-wire, universal, 1.5 m (on request)
L	Cable, 8-wire, universal, 3.0 m (on request)
M	Cable, 8-wire, universal, 5.0 m (on request)
N	Male connector, 1 x M12, 8-pin, universal (only in combination with interface A)
Q	Male connector, 1 x M12, 5-pin, universal (only in combination with interface C)

Measuring length

0	2	2 meter
0	3	3 meter
0	5	5 meter
1	0	10 meter
2	0	20 meter
3	0	30 meter
5	0	50 meter

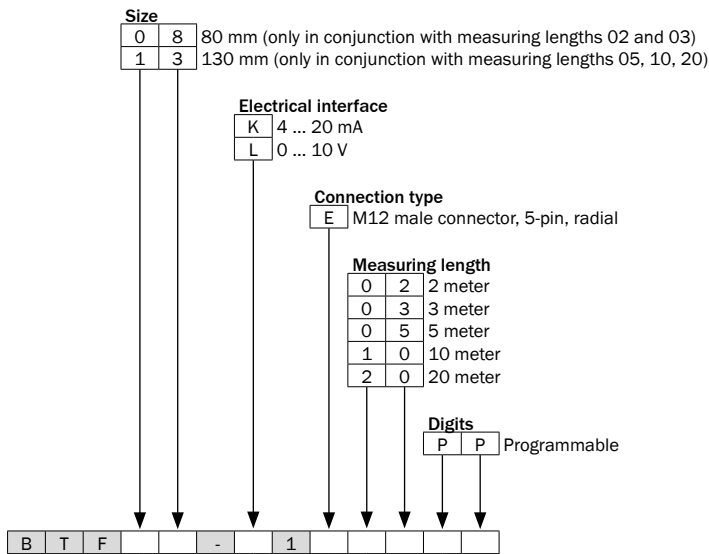
Interface / measuring length

4	0	A = SSI with connection type A / measuring length 2 m, 3 m
2	0	A = SSI with connection type A / measuring length 5 m, 10 m, 20 m, 30 m
1	0	A = SSI with connection type A / measuring length 50 m
4	1	A = SSI with connection type N / measuring length 2 m, 3 m
2	4	A = SSI with connection type N / measuring length 5 m, 10 m
2	5	A = SSI with connection type N / measuring length 20 m, 30 m
1	7	A = SSI with connection type N / measuring length 50 m
4	1	C = CANopen with connection type H; D = DeviceNet; P = PROFINET / measuring length 2 m, 3 m
2	5	C = CANopen with connection type H; D = DeviceNet; P = PROFINET / measuring length 5 m, 10 m, 20 m, 30 m
1	7	C = CANopen with connection type H; D = DeviceNet; P = PROFINET / measuring length 50 m
8	2	C = CANopen with connection type Q / measuring length 2 m, 3 m
4	9	C = CANopen with connection type Q / measuring length 5 m, 10 m, 20 m, 30 m
3	3	C = CANopen with connection type Q / measuring length 50 m
9	9	I = EtherNet/IP; E = EtherCAT®; N = PROFINET / measuring length 2 m, 3 m
9	9	I = EtherNet/IP; E = EtherCAT®; N = PROFINET / measuring length 5 m, 10 m, 20 m, 30 m
9	9	I = EtherNet/IP; E = EtherCAT®; N = PROFINET / measuring length 50 m



¹⁾ Please order fieldbus adapter for CANopen, DeviceNet, and PROFIBUS with radial outlet separately.

HighLine analog



Ordering information

Measuring range	Electrical interface	Connection type	Type	Part no.
0 m ... 2 m	4 mA ... 20 mA, analog	1 x M12 male connector, 5-pin, radial	BTF08-K1EM02PP	1060964
	0 V to 10 V analog		BTF08-L1EM02PP	1060965
	SSI	M23 male connector, 12-pin, radial	BTF08-A1AM0240	1034299
		Male connector, 1 x M12, 8-pin, universal	BTF08-A1NM0241	1068884
	CANopen	Male connector, 1 x M12, 5-pin, universal	BTF08-C1QM0282	1068885
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF08-C1HM0241	1034317
	DeviceNet	Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF08-D1HM0241	1034311
	PROFIBUS	3 x M12 male connectors, 5-pin, axial	BTF08-P1BM0241	1060966
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF08-P1HM0241	1034305
	PROFINET	3 x M12 male connectors, 4-pin, axial	BTF08-N1BM0299	1060967
	EtherNet/IP		BTF08-I1BM0299	1060968
	EtherCAT®		BTF08-E1BM0299	1060969

¹⁾ Order adapter separately.

Measuring range	Electrical interface	Connection type	Type	Part no.
0 m ... 3 m	4 mA ... 20 mA, analog	1 x M12 male connector, 5-pin, radial	BTF08-K1EM03PP	1060970
	0 V to 10 V analog		BTF08-L1EM03PP	1060973
	SSI	M23 male connector, 12-pin, radial	BTF08-A1AM0340	1034892
		Male connector, 1 x M12, 8-pin, universal	BTF08-A1NM0341	1068886
	CANopen	Male connector, 1 x M12, 5-pin, universal	BTF08-C1QM0382	1068887
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF08-C1HM0341	1034895
	DeviceNet	Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF08-D1HM0341	1034894
	PROFIBUS	3 x M12 male connectors, 5-pin, axial	BTF08-P1BM0341	1060975
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF08-P1HM0341	1034893
	PROFINET	3 x M12 male connectors, 4-pin, axial	BTF08-N1BM0399	1060976
	EtherNet/IP		BTF08-I1BM0399	1060978
	EtherCAT®		BTF08-E1BM0399	1060980
0 m ... 5 m	4 mA ... 20 mA, analog	1 x M12 male connector, 5-pin, radial	BTF13-K1EM05PP	1060982
	0 V to 10 V analog		BTF13-L1EM05PP	1060983
	SSI	M23 male connector, 12-pin, radial	BTF13-A1AM0520	1034300
		Male connector, 1 x M12, 8-pin, universal	BTF13-A1NM0524	1068888
	CANopen	Male connector, 1 x M12, 5-pin, universal	BTF13-C1QM0549	1068889
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-C1HM0525	1034318
	DeviceNet	Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-D1HM0525	1034312
	PROFIBUS	3 x M12 male connectors, 5-pin, axial	BTF13-P1BM0525	1060985
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-P1HM0525	1034306
	PROFINET	3 x M12 male connectors, 4-pin, axial	BTF13-N1BM0599	1060986
	EtherNet/IP		BTF13-I1BM0599	1060987
	EtherCAT®		BTF13-E1BM0599	1060988

¹⁾ Order adapter separately.

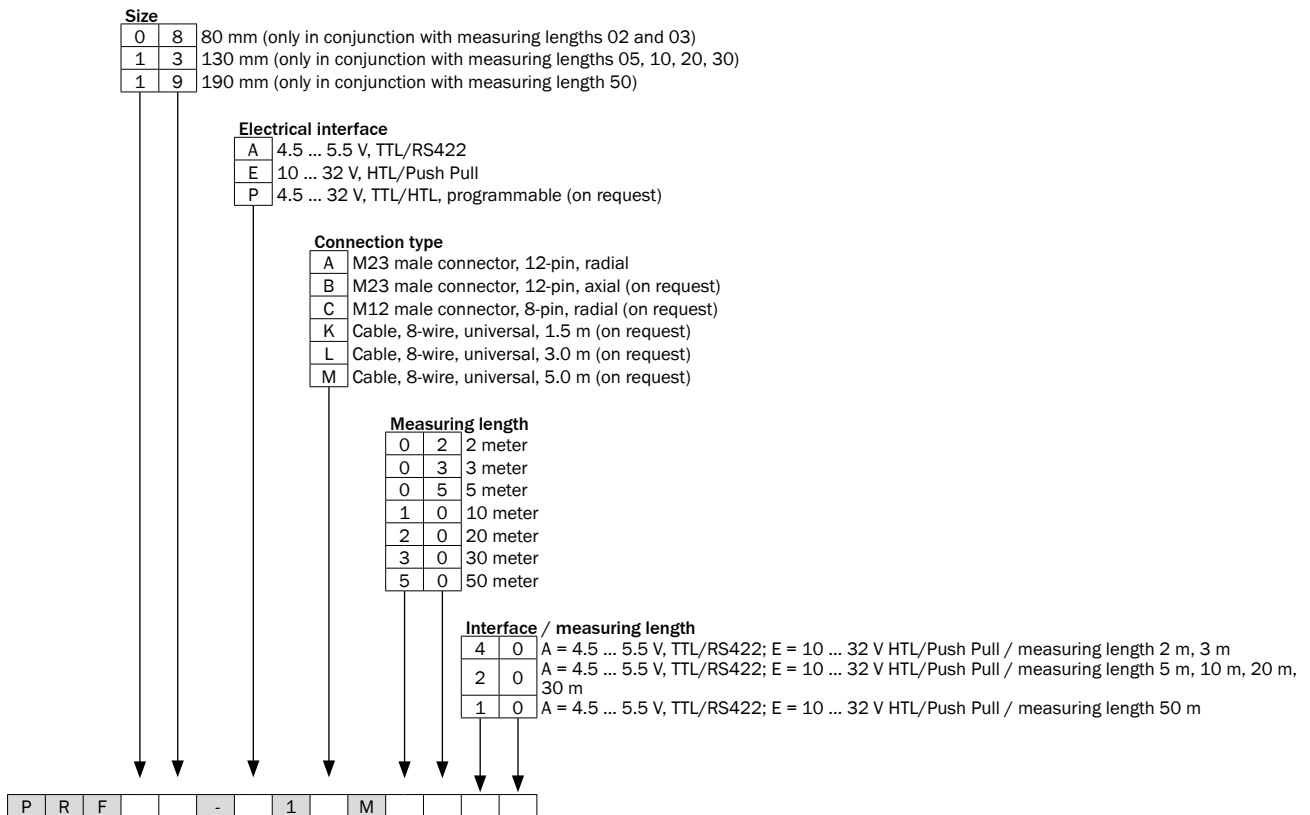
Measuring range	Electrical interface	Connection type	Type	Part no.
0 m ... 10 m	4 mA ... 20 mA, analog	1 x M12 male connector, 5-pin, radial	BTF13-K1EM10PP	1060989
	0 V ... 10 V analog		BTF13-L1EM10PP	1060990
	SSI	M23 male connector, 12-pin, radial	BTF13-A1AM1020	1034301
		Male connector, 1 x M12, 8-pin, universal	BTF13-A1NM1024	1068890
	CANopen	Male connector, 1 x M12, 5-pin, universal	BTF13-C1QM1049	1068891
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-C1HM1025	1034319
	DeviceNet	Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-D1HM1025	1034313
	PROFIBUS	3 x M12 male connectors, 5-pin, axial	BTF13-P1BM1025	1060991
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-P1HM1025	1034307
	PROFINET	3 x M12 male connectors, 4-pin, axial	BTF13-N1BM1099	1060992
	EtherNet/IP		BTF13-I1BM1099	1060993
	EtherCAT®		BTF13-E1BM1099	1060994
	0 m ... 20 m	4 mA ... 20 mA, analog	1 x M12 male connector, 5-pin, radial	BTF13-K1EM20PP
0 V ... 10 V analog		BTF13-L1EM20PP		1060996
SSI		M23 male connector, 12-pin, radial	BTF13-A1AM2020	1034302
		Male connector, 1 x M12, 8-pin, universal	BTF13-A1NM2025	1068892
CANopen		Male connector, 1 x M12, 5-pin, universal	BTF13-C1QM2049	1068893
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-C1HM2025	1034320
DeviceNet		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-D1HM2025	1034314
PROFIBUS		3 x M12 male connectors, 5-pin, axial	BTF13-P1BM2025	1060997
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-P1HM2025	1034308
PROFINET		3 x M12 male connectors, 4-pin, axial	BTF13-N1BM2099	1060998
EtherNet/IP			BTF13-I1BM2099	1060999
EtherCAT®			BTF13-E1BM2099	1061000
0 m ... 30 m		SSI	M23 male connector, 12-pin, radial	BTF13-A1AM3020
	Male connector, 1 x M12, 8-pin, universal		BTF13-A1NM3025	1068894
	CANopen	Male connector, 1 x M12, 5-pin, universal	BTF13-C1QM3049	1068896
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-C1HM3025	1034321
	DeviceNet	Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-D1HM3025	1034315
	PROFIBUS	3 x M12 male connectors, 5-pin, axial	BTF13-P1BM3025	1061003
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF13-P1HM3025	1034309
	PROFINET	3 x M12 male connectors, 4-pin, axial	BTF13-N1BM3099	1061004
	EtherNet/IP		BTF13-I1BM3099	1061005
EtherCAT®	BTF13-E1BM3099		1061006	

¹⁾ Order adapter separately.

Measuring range	Electrical interface	Connection type	Type	Part no.
0 m ... 50 m	SSI	M23 male connector, 12-pin, radial	BTF19-A1AM5010	1034304
		Male connector, 1 x M12, 8-pin, universal	BTF19-A1NM5017	1068897
	CANopen	Male connector, 1 x M12, 5-pin, universal	BTF19-C1QM5033	1068898
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF19-C1HM5017	1034322
	DeviceNet	Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF19-D1HM5017	1034316
	PROFIBUS	3 x M12 male connectors, 5-pin, axial	BTF19-P1BM5017	1061009
		Bus adapter with cable screw fixings or round connectors, radial ¹⁾	BTF19-P1HM5017	1034310
	PROFINET		BTF19-N1BM5099	1061010
	EtherNet/IP	3 x M12 male connectors, 4-pin, axial	BTF19-I1BM5099	1061011
	EtherCAT®		BTF19-E1BM5099	1061012

¹⁾ Order adapter separately.

HighLine incremental



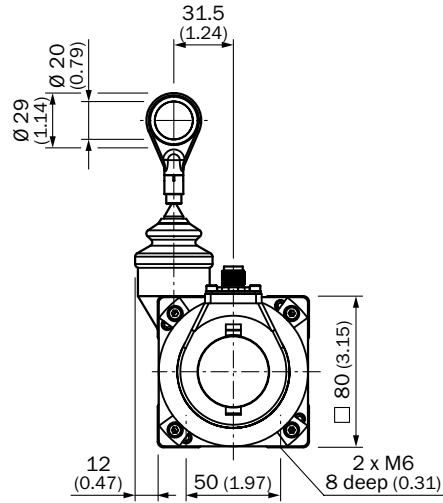
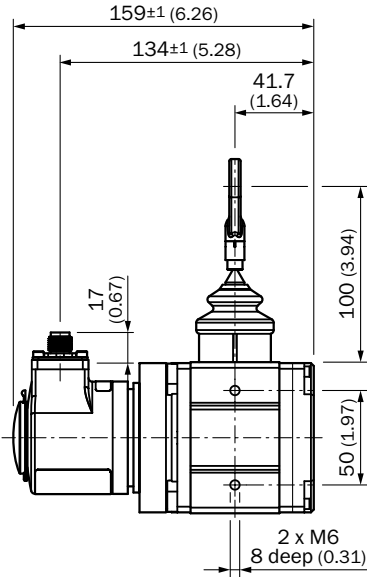
Ordering information

- Connection type: M23 male connector, 12-pin, radial

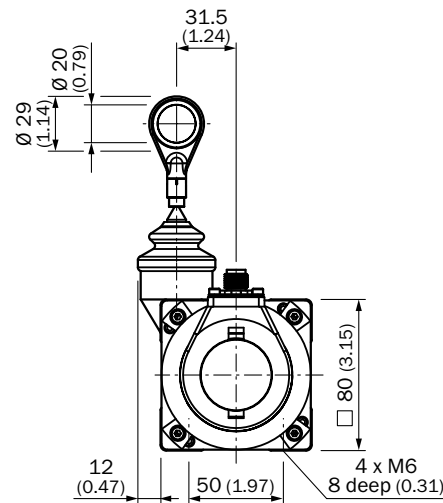
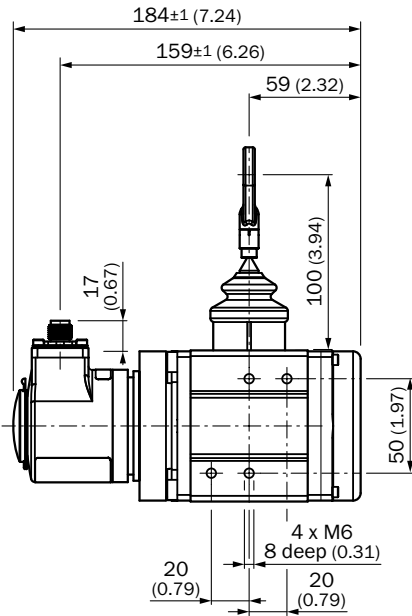
Measuring range	Electrical interface	Type	Part no.
0 m ... 2 m	4.5 V...5.5 V, TTL/RS422	PRF08-A1AM0240	1034323
	10 V ... 32 V, HTL/Push Pull	PRF08-E1AM0240	1034335
0 m ... 3 m	4.5 V...5.5 V, TTL/RS422	PRF08-A1AM0340	1034896
	10 V ... 32 V, HTL/Push Pull	PRF08-E1AM0340	1034898
0 m ... 5 m	4.5 V...5.5 V, TTL/RS422	PRF13-A1AM0520	1034324
	10 V ... 32 V, HTL/Push Pull	PRF13-E1AM0520	1034336
0 m ... 10 m	4.5 V...5.5 V, TTL/RS422	PRF13-A1AM1020	1034325
	10 V ... 32 V, HTL/Push Pull	PRF13-E1AM1020	1034337
0 m ... 20 m	4.5 V...5.5 V, TTL/RS422	PRF13-A1AM2020	1034326
	10 V ... 32 V, HTL/Push Pull	PRF13-E1AM2020	1034338
0 m ... 30 m	4.5 V...5.5 V, TTL/RS422	PRF13-A1AM3020	1034327
	10 V ... 32 V, HTL/Push Pull	PRF13-E1AM3020	1034339
0 m ... 50 m	4.5 V...5.5 V, TTL/RS422	PRF19-A1AM5010	1034328
	10 V ... 32 V, HTL/Push Pull	PRF19-E1AM5010	1034340

Dimensional drawings (dimensions in mm)

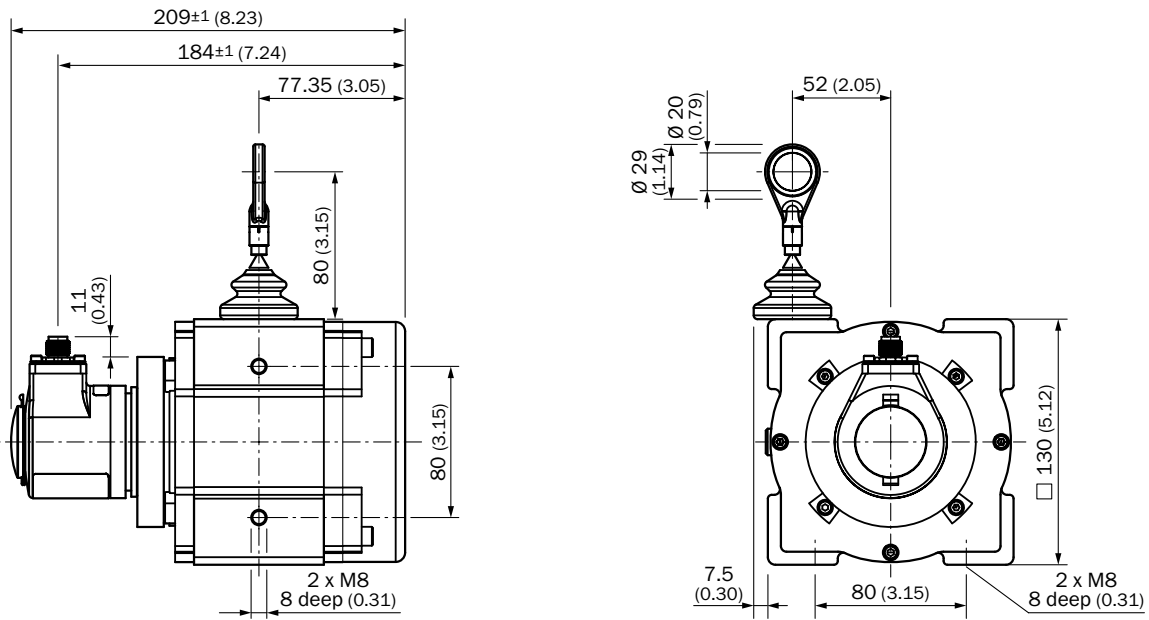
BTF08 up to 2 m
Analog



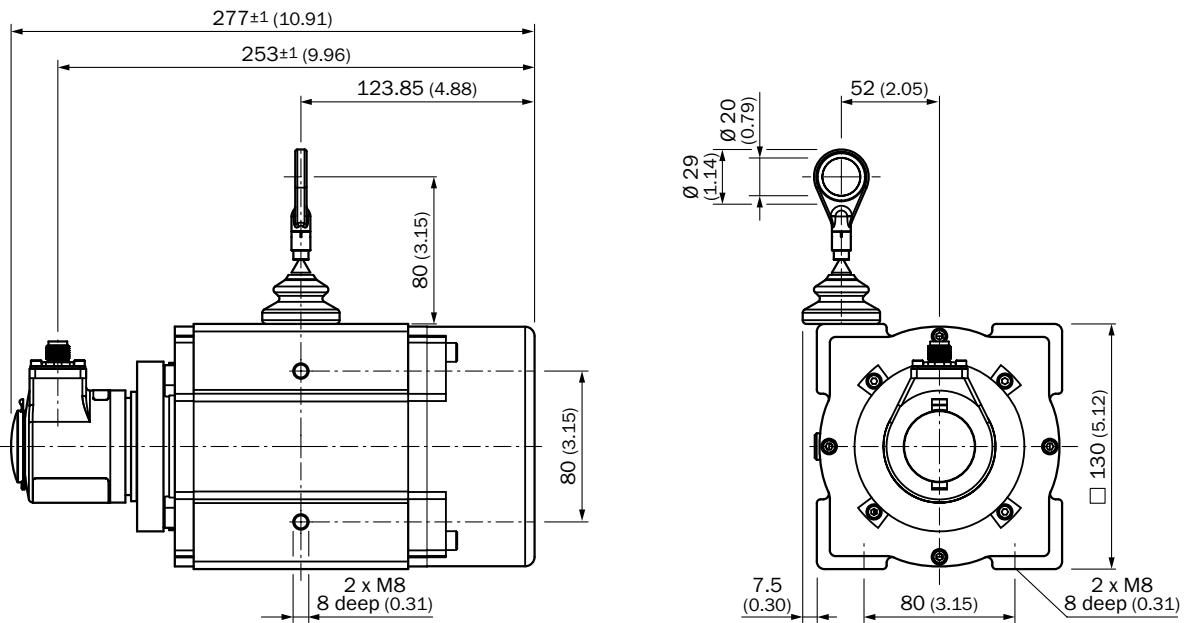
BTF08 up to 3 m
Analog



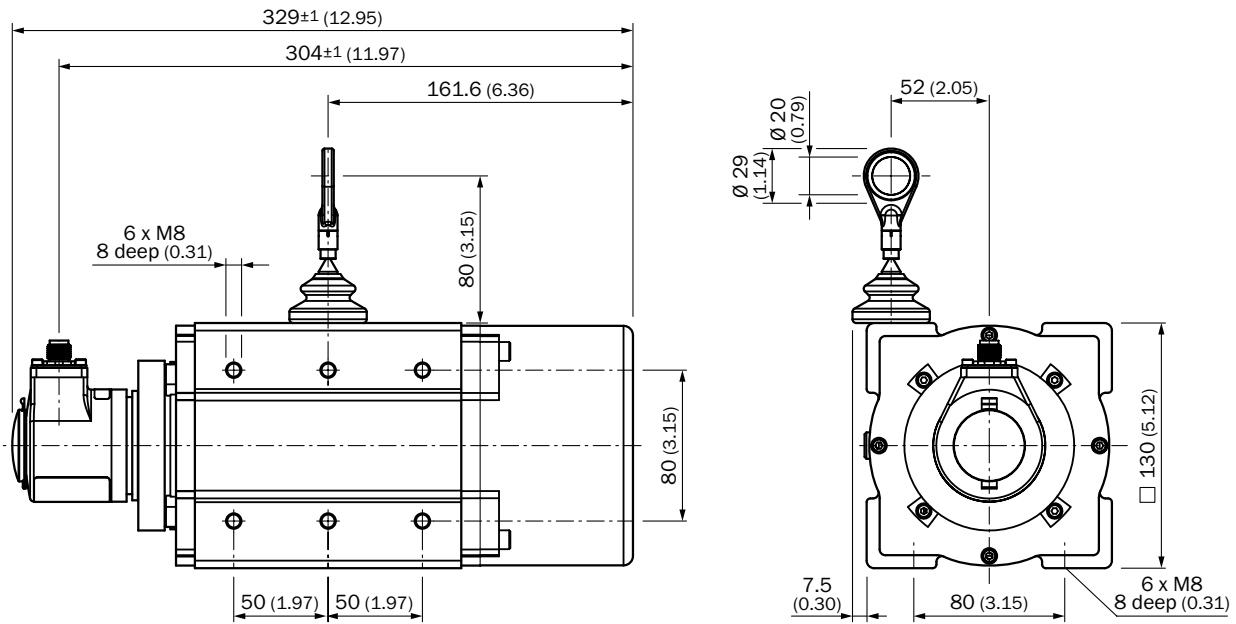
BTF13 up to 5 m
Analog



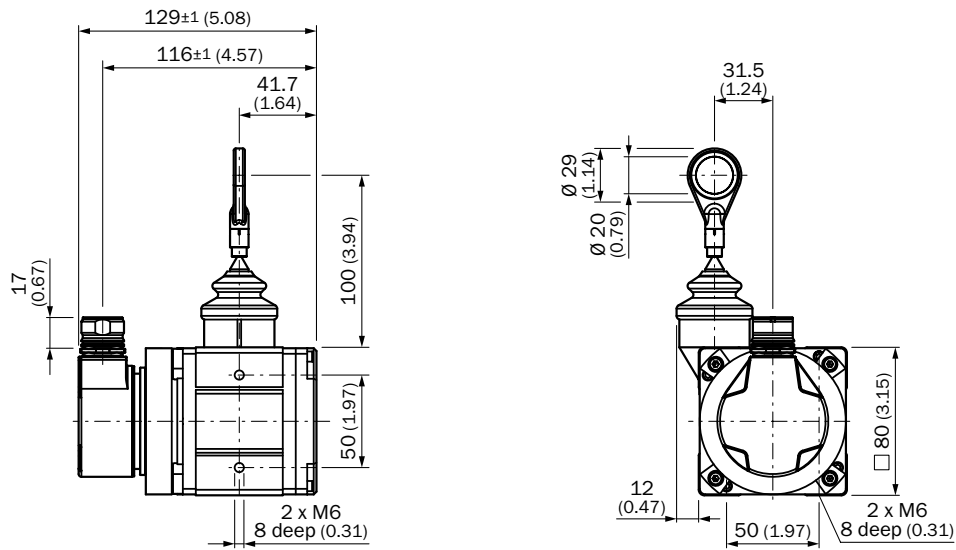
BTF13 up to 10 m
Analog



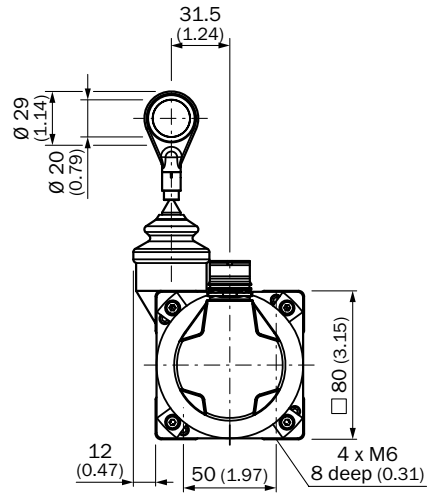
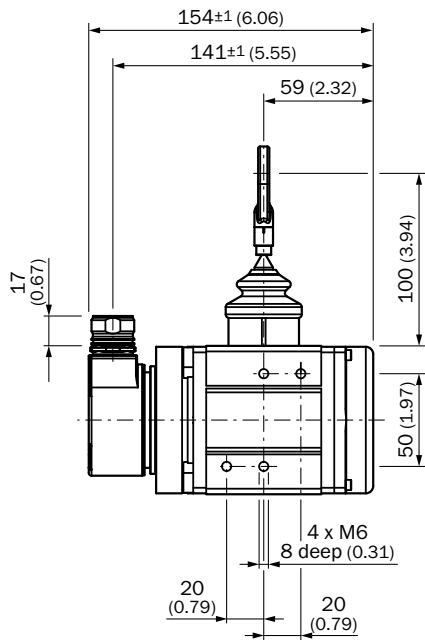
BTF13 up to 20 m
Analog



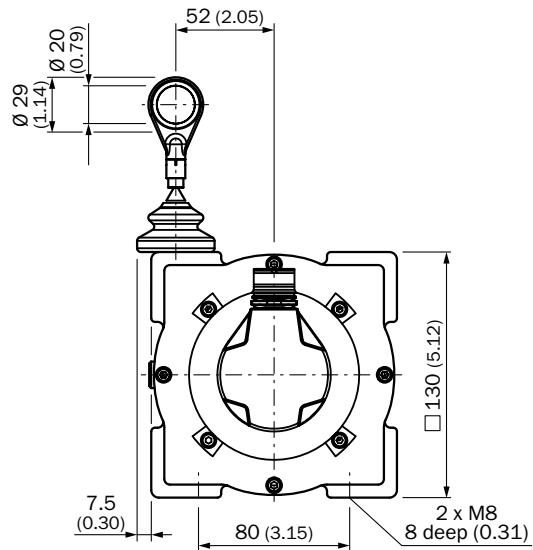
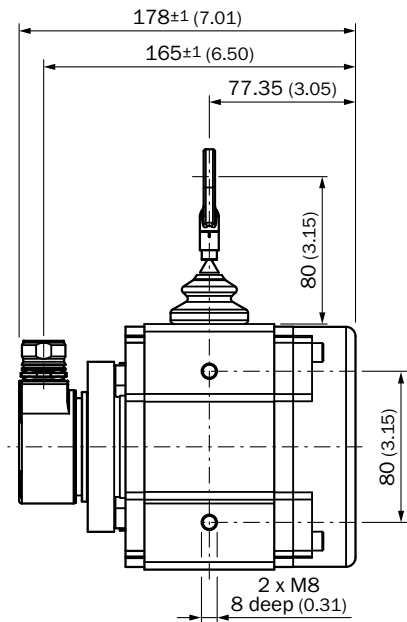
BTF08 up to 2 m
SSI



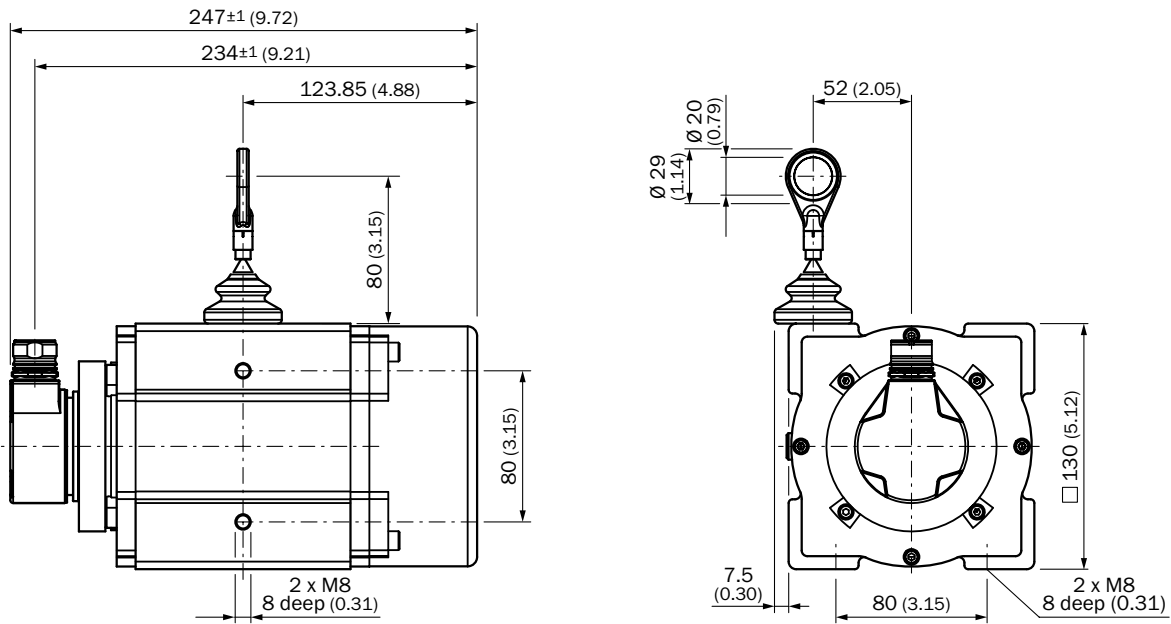
BTF08 up to 3 m
SSI



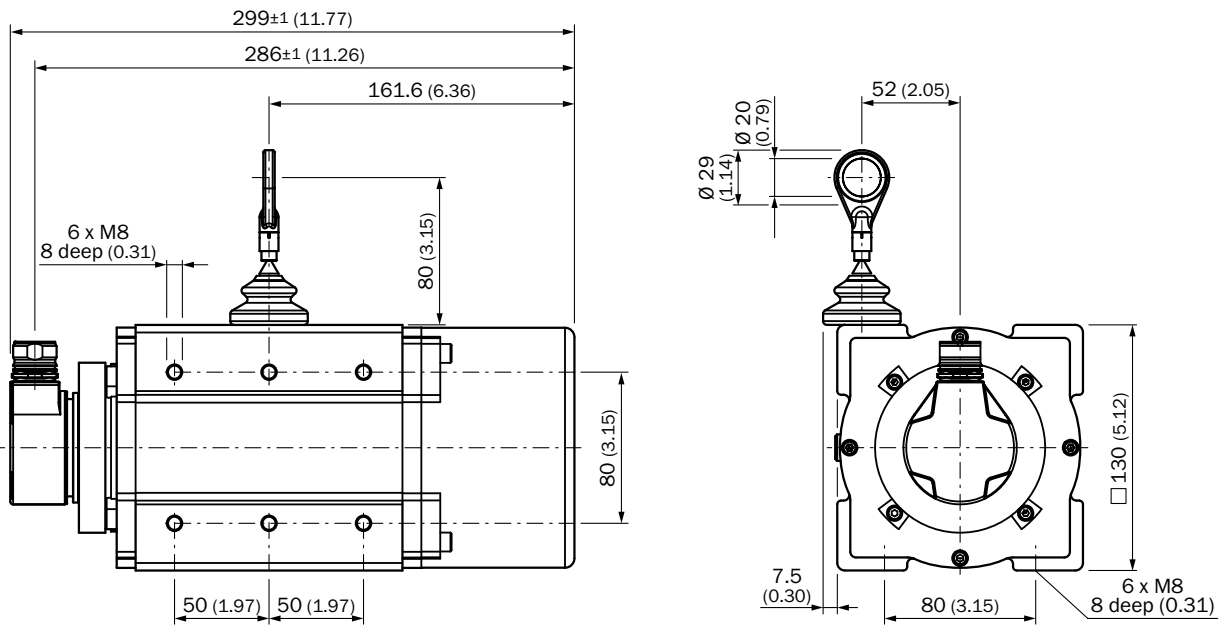
BTF13 up to 5 m
SSI



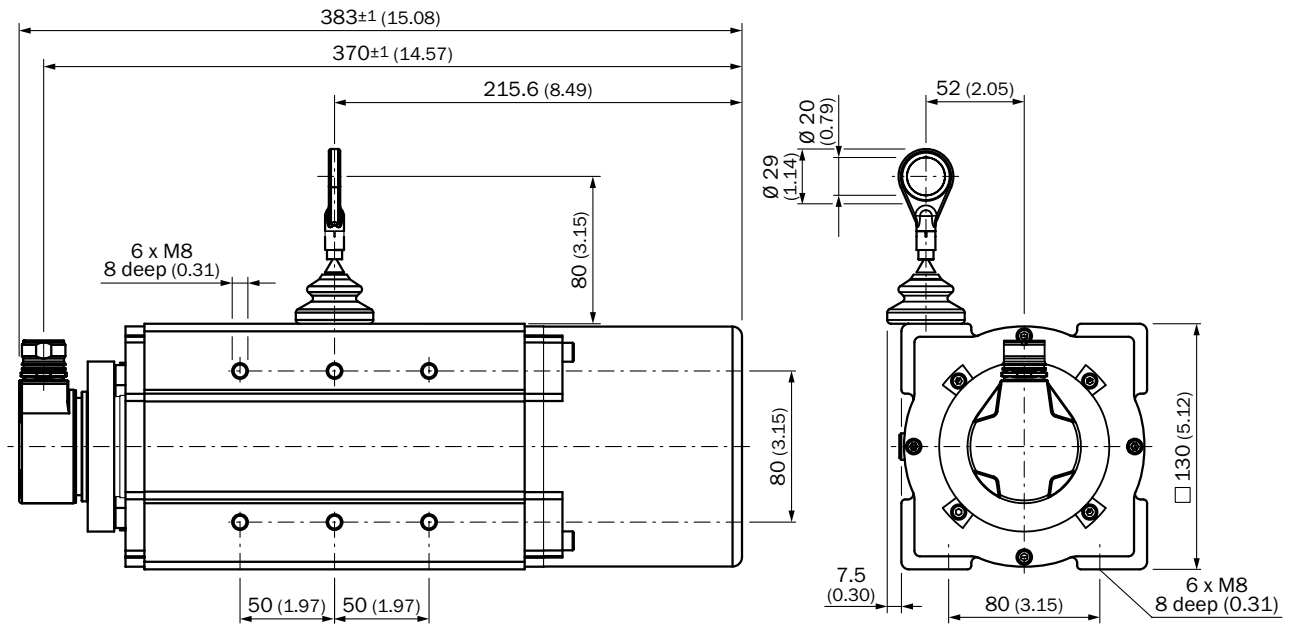
BTF13 up to 10 m
SSI



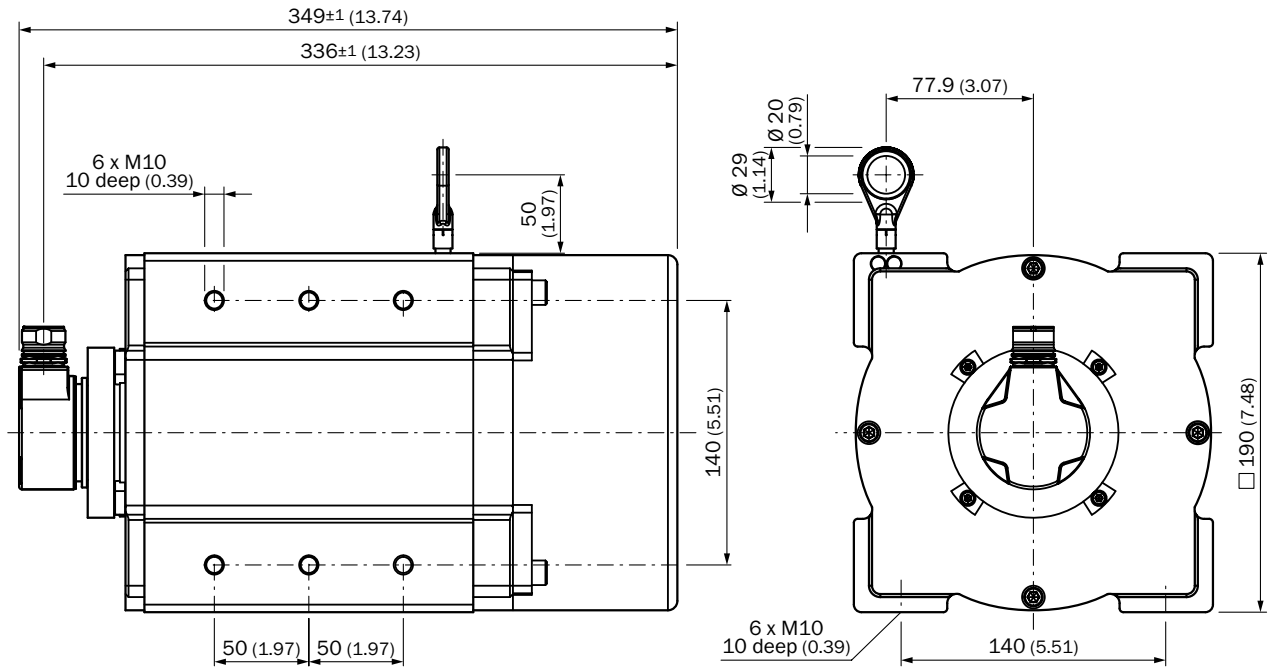
BTF13 up to 20 m
SSI



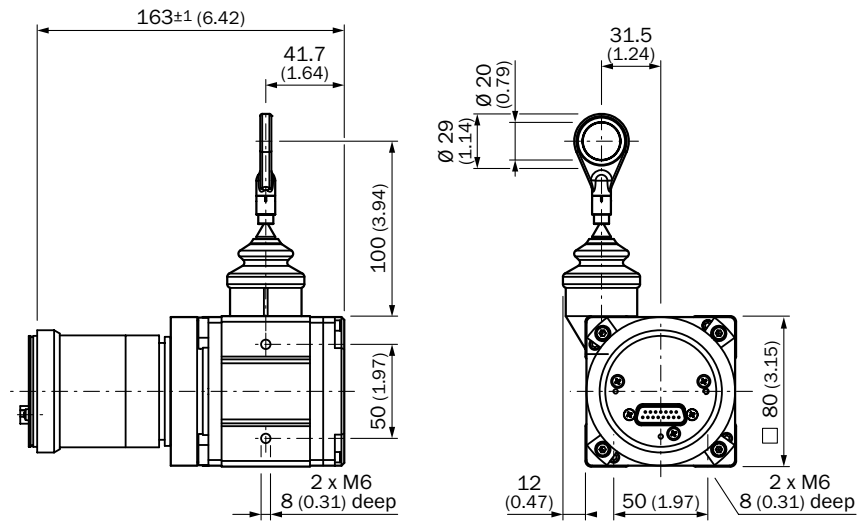
BTF13 up to 20 m
SSI



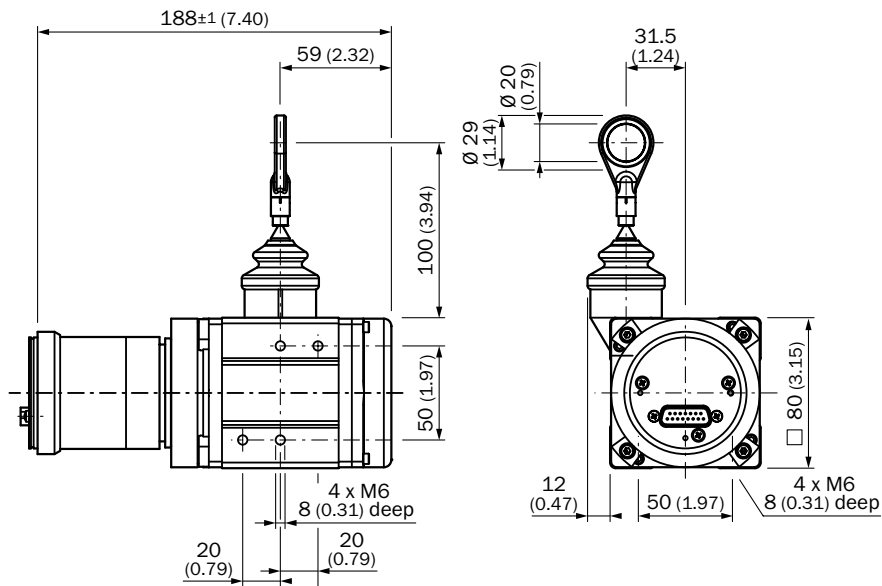
BTF19 up to 50 m
SSI



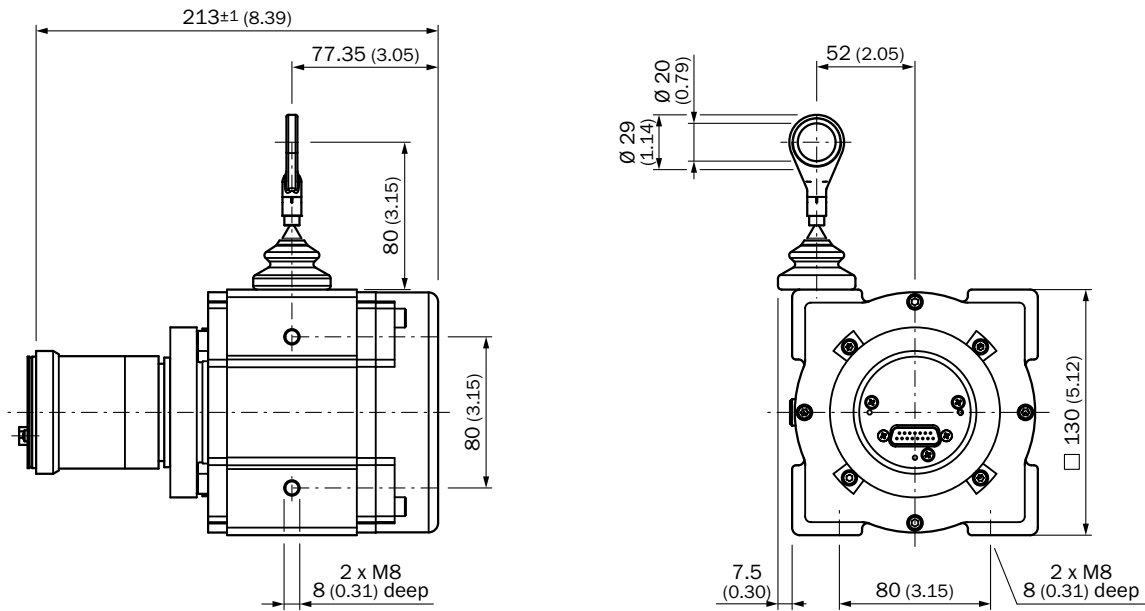
BTF08 up to 2 m
CANopen, PROFIBUS, DeviceNet (ATM60)



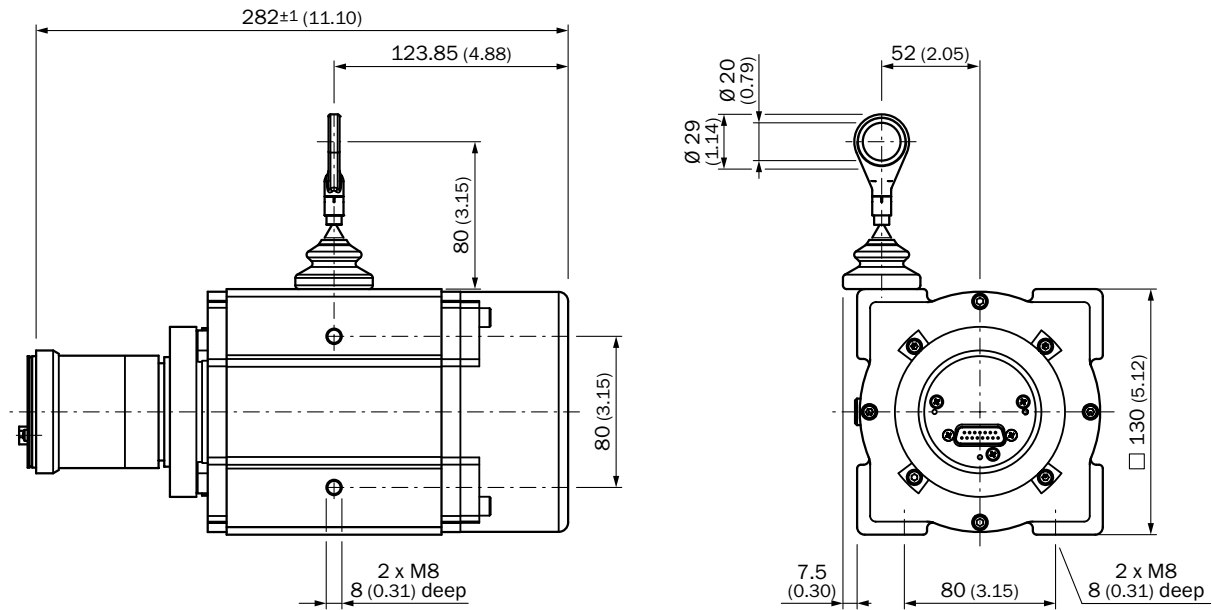
BTF08 up to 3 m
CANopen, PROFIBUS, DeviceNet (ATM60)



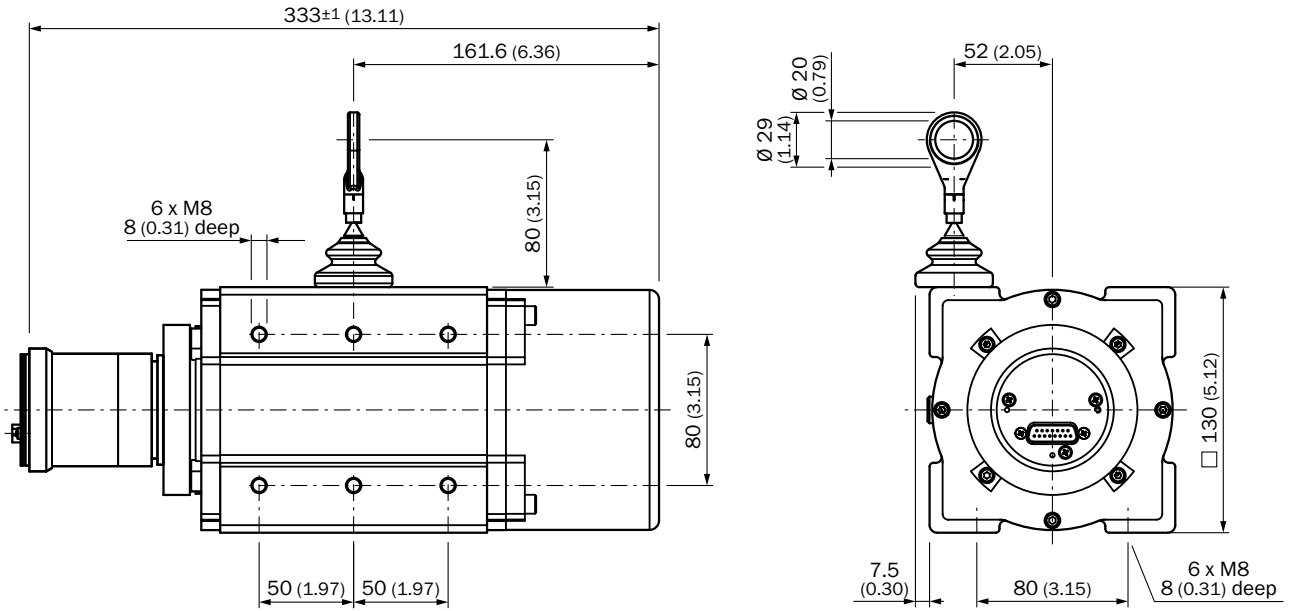
BTF13 up to 5 m
CANopen, PROFIBUS, DeviceNet (ATM60)



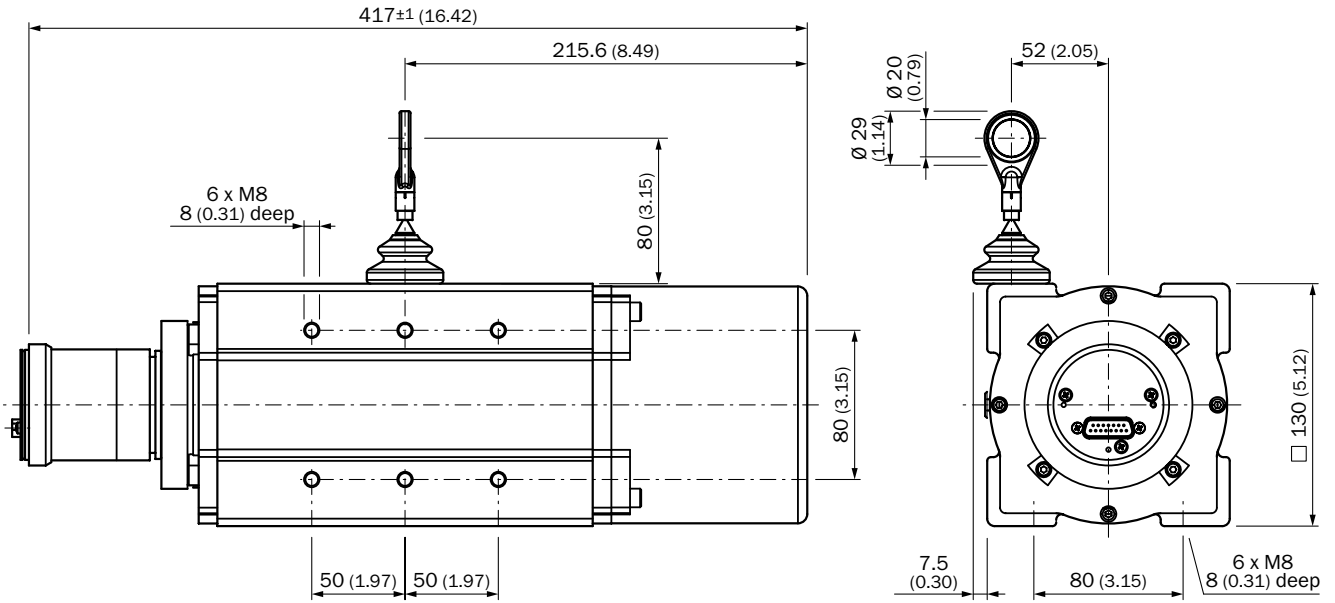
BTF13 up to 10 m
CANopen, PROFIBUS, DeviceNet (ATM60)



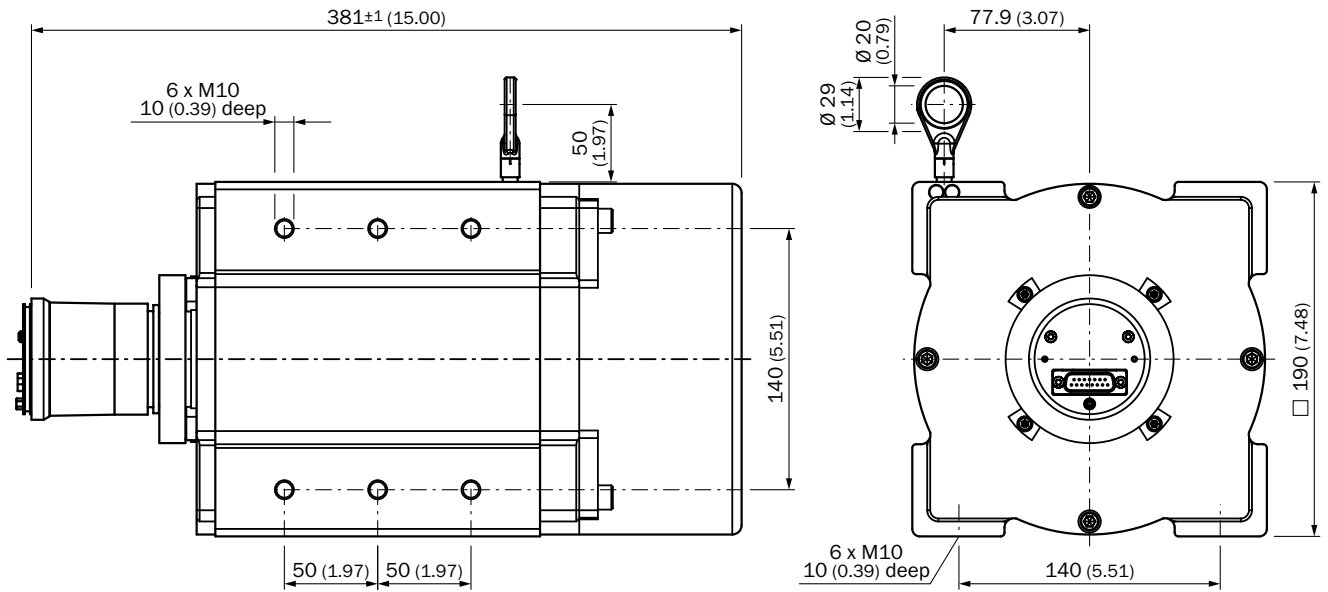
BTF13 up to 20 m
CANopen, PROFIBUS, DeviceNet (ATM60)



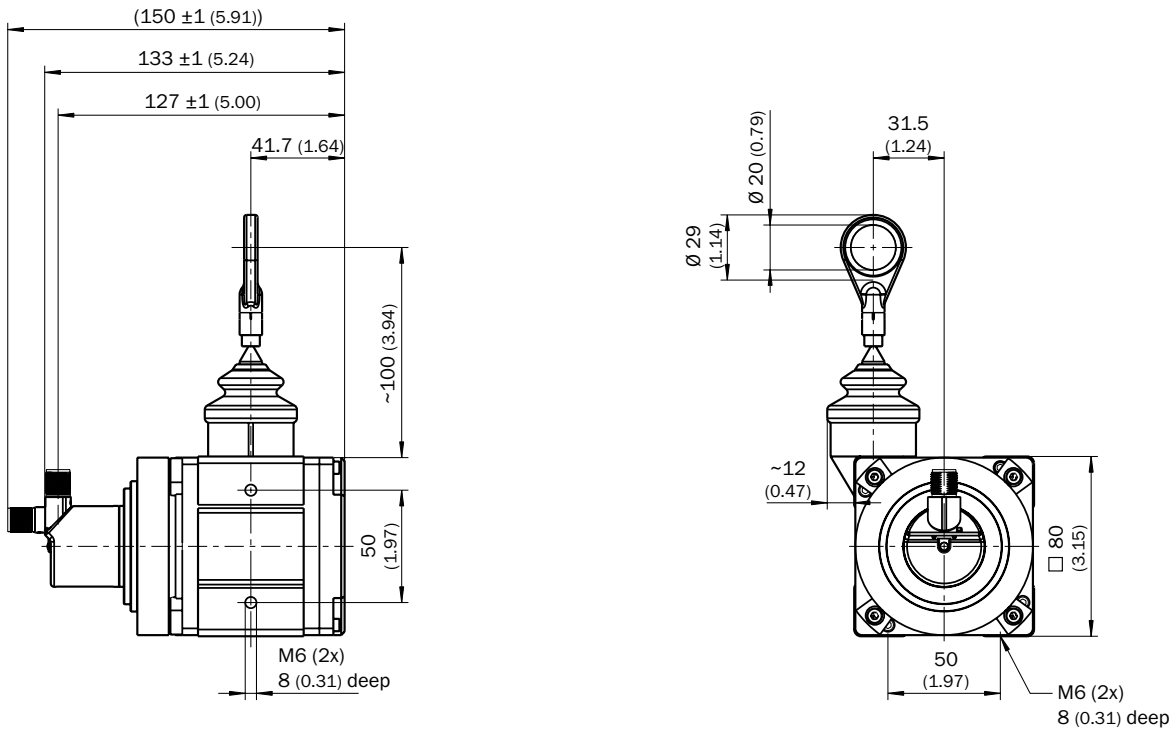
BTF13 up to 30 m
CANopen, PROFIBUS, DeviceNet (ATM60)



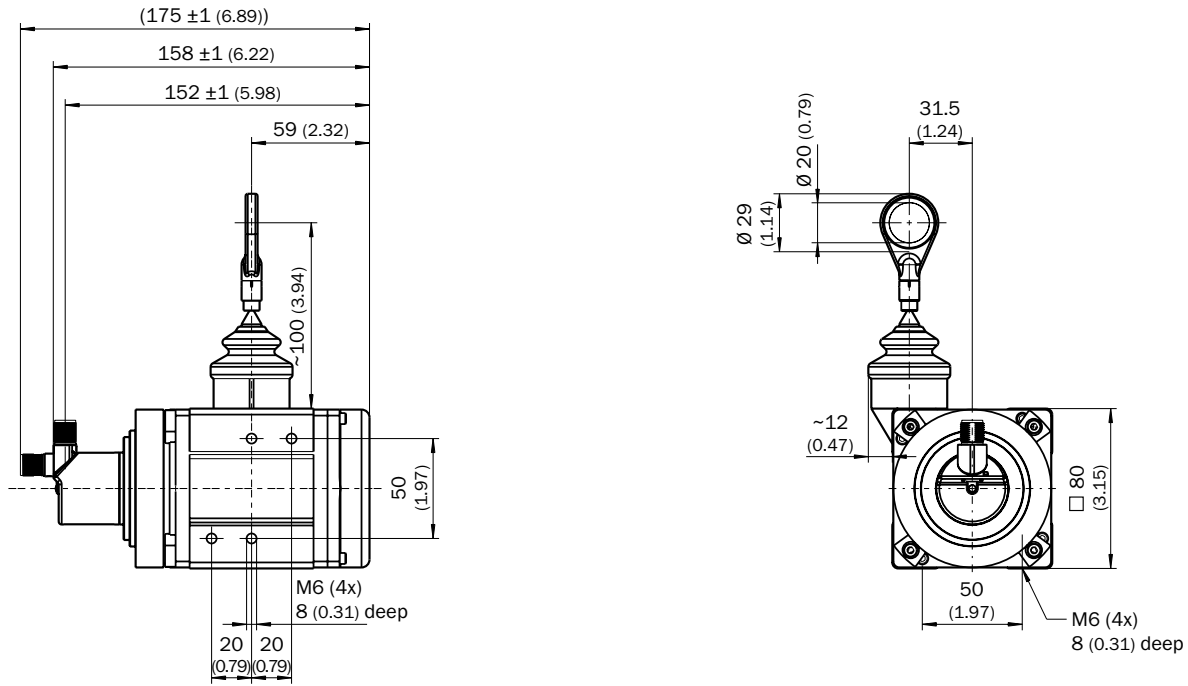
BTF19 up to 50 m
CANopen, PROFIBUS, DeviceNet (ATM60)



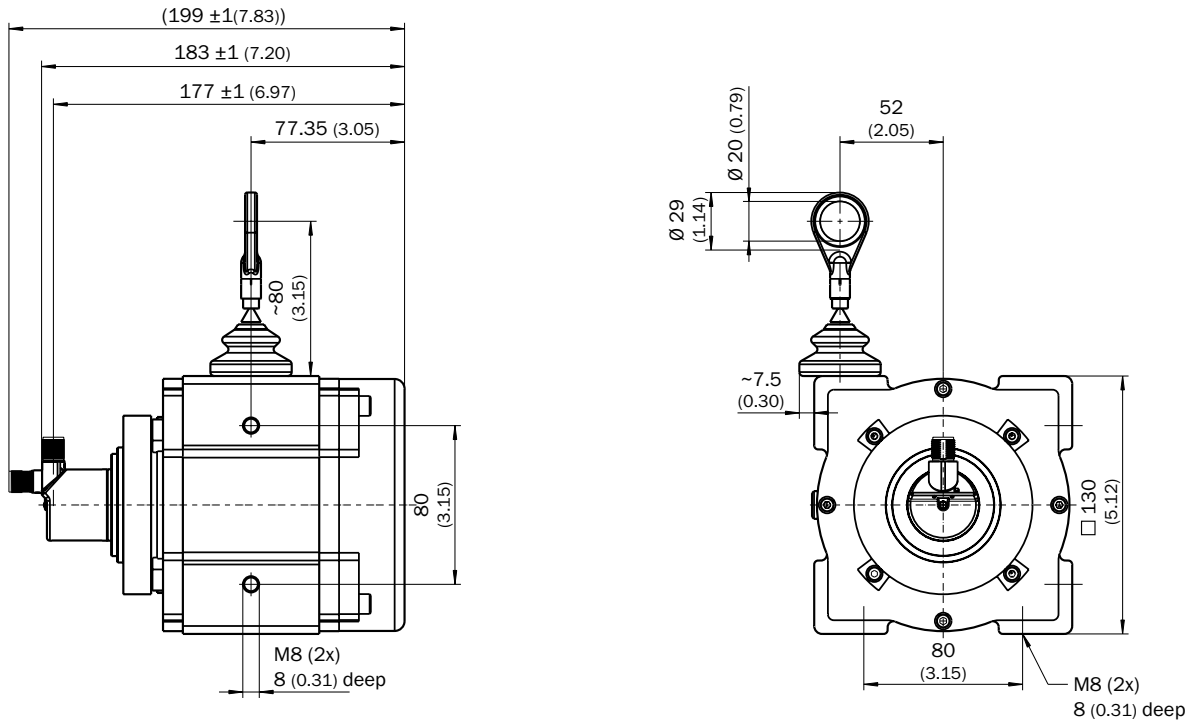
BTF08 up to 2 m
CANopen, SSI (AHM36)



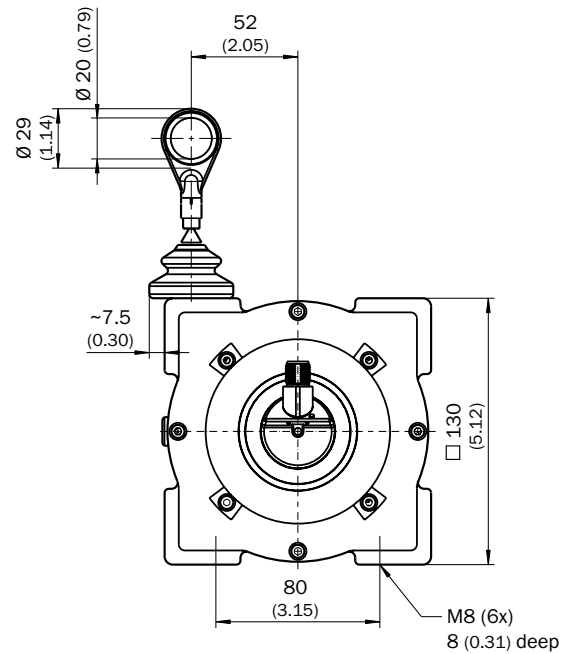
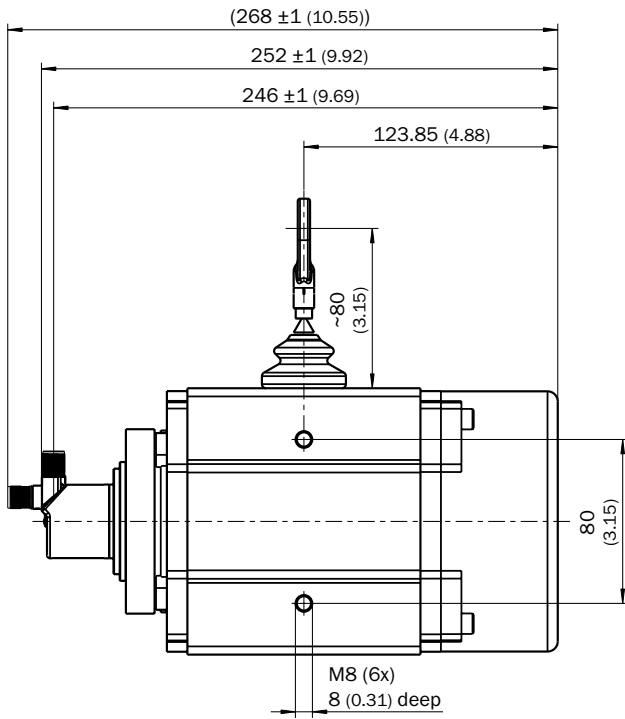
BTF08 up to 3 m
CANopen, SSI (AHM36)



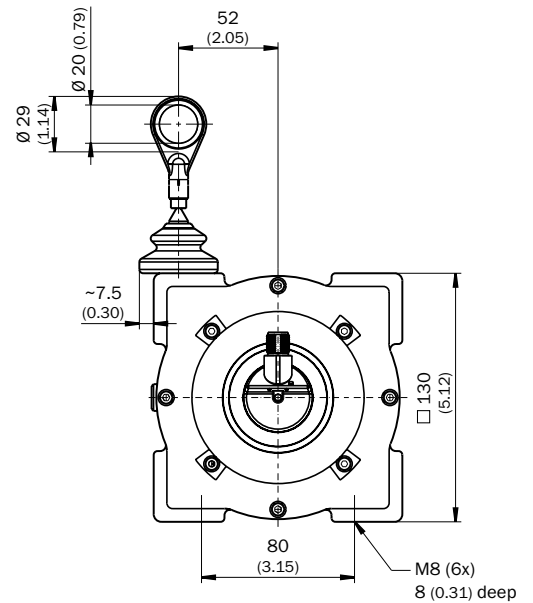
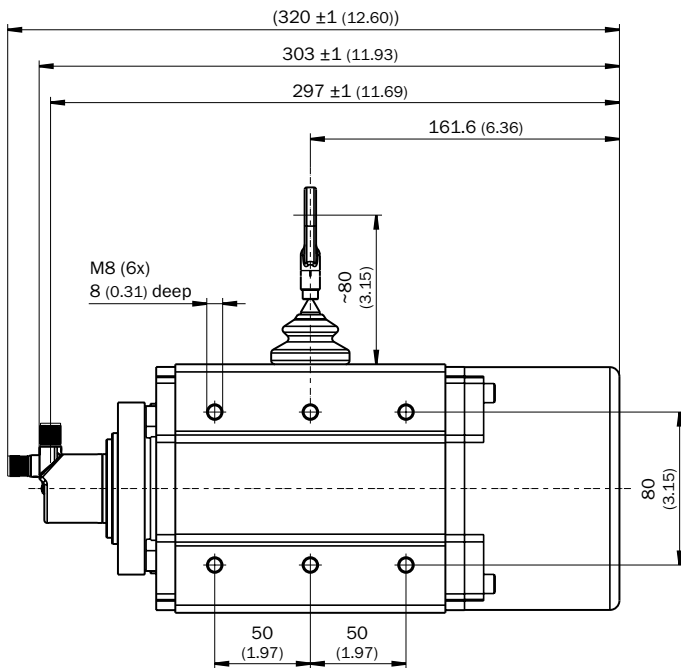
BTF13 up to 5 m
CANopen, SSI (AHM36)



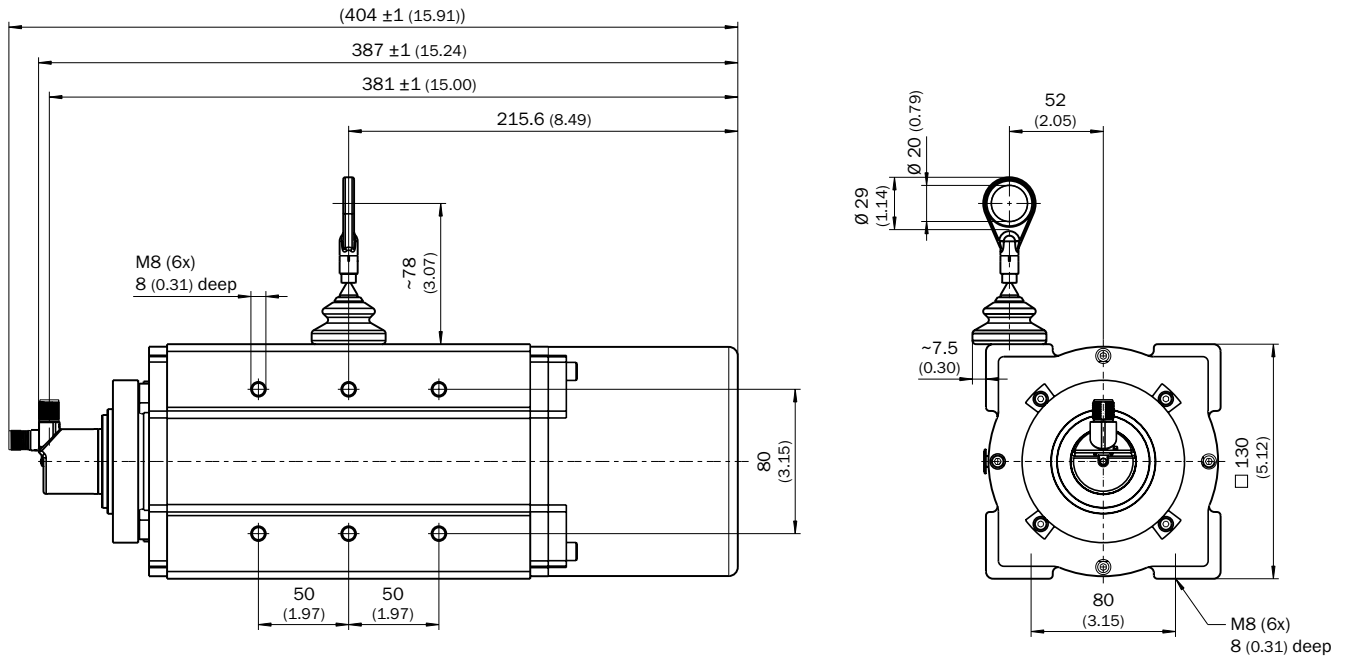
BTF13 up to 10 m
CANopen, SSI (AHM36)



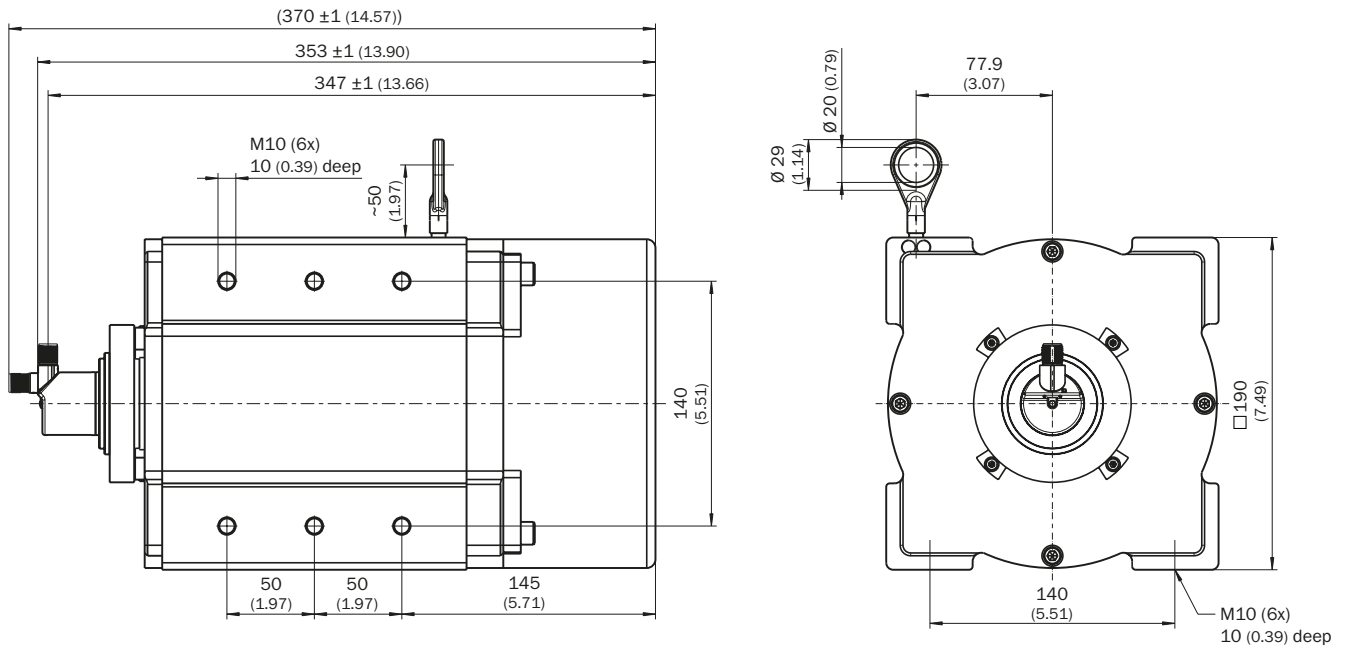
BTF13 up to 20 m
CANopen, SSI (AHM36)



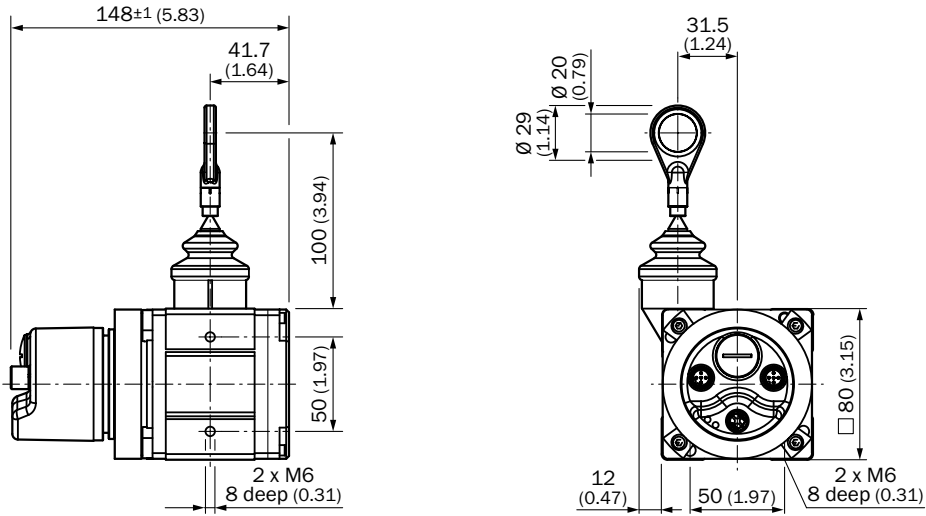
BTF13 up to 30 m
CANopen, SSI (AHM36)



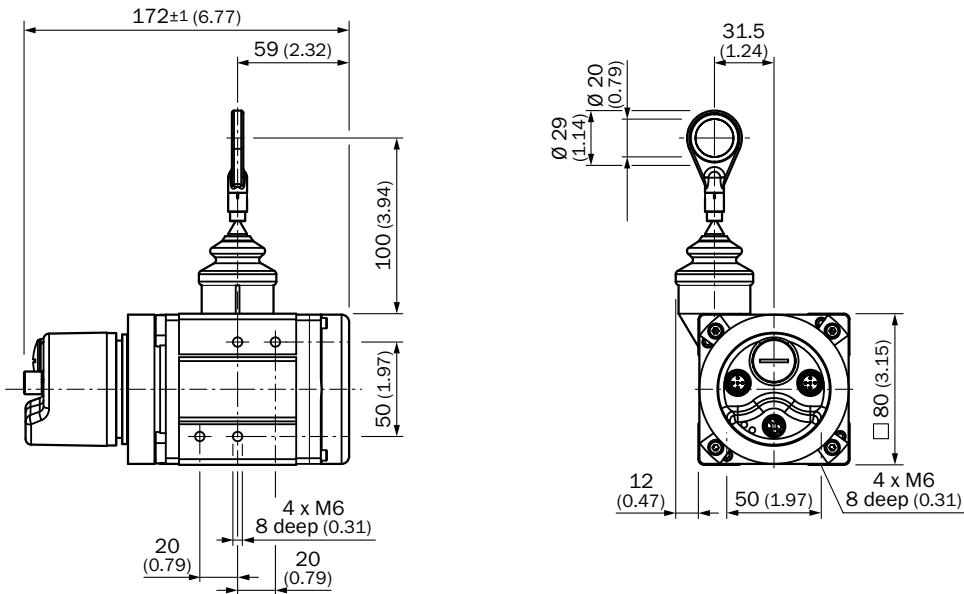
BTF19 up to 50 m
CANopen, SSI (AHM36)



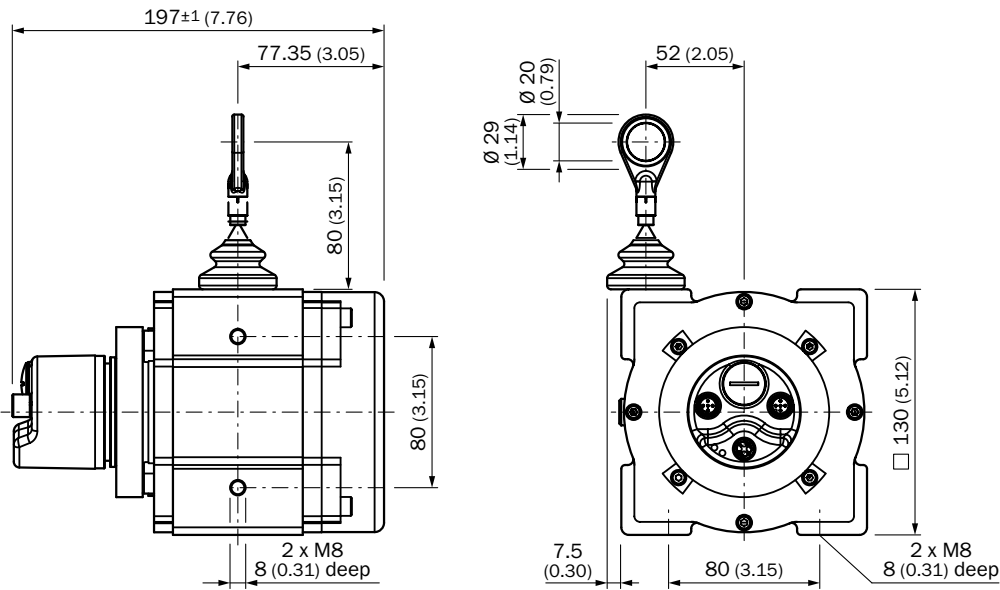
BTF08 up to 2 m
PROFIBUS (A3M60)



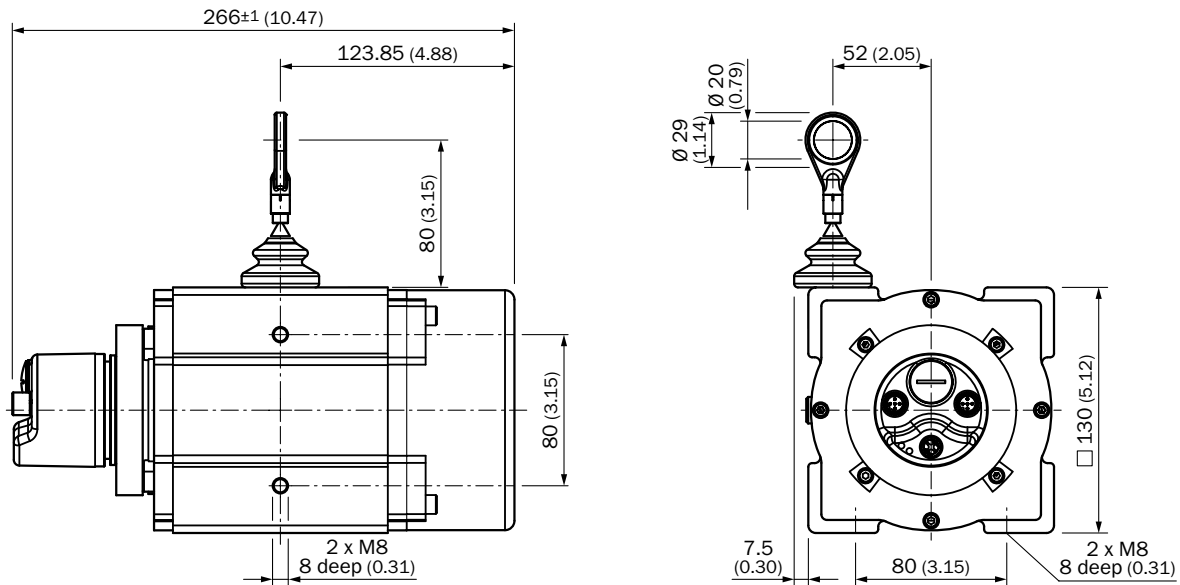
BTF08 up to 3 m
PROFIBUS (A3M60)



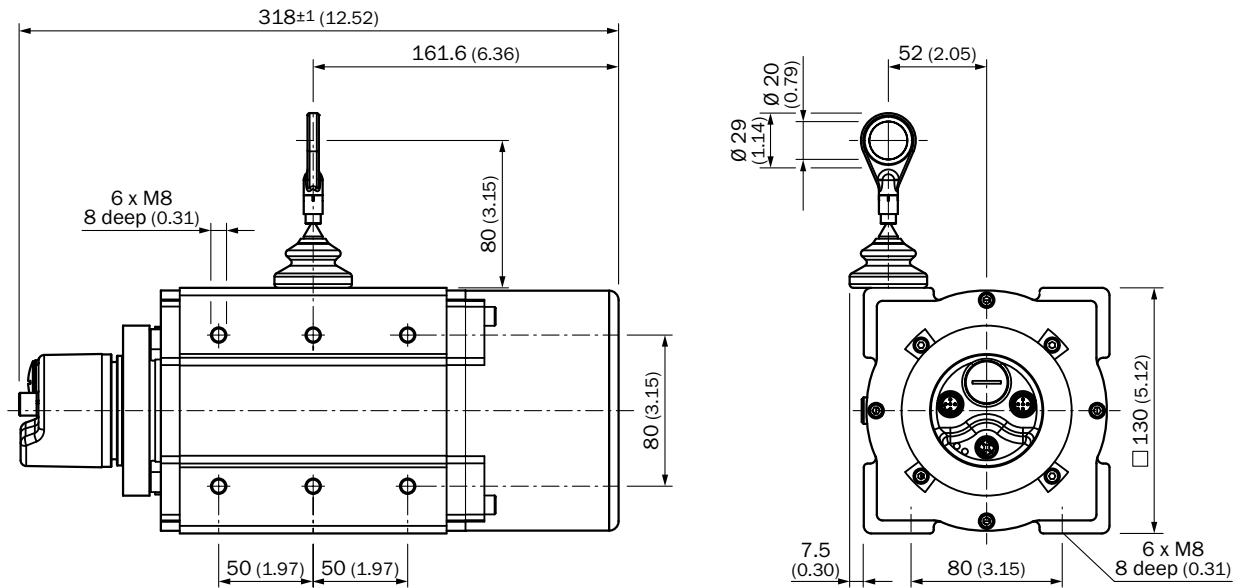
BTF13 up to 5 m
PROFIBUS (A3M60)



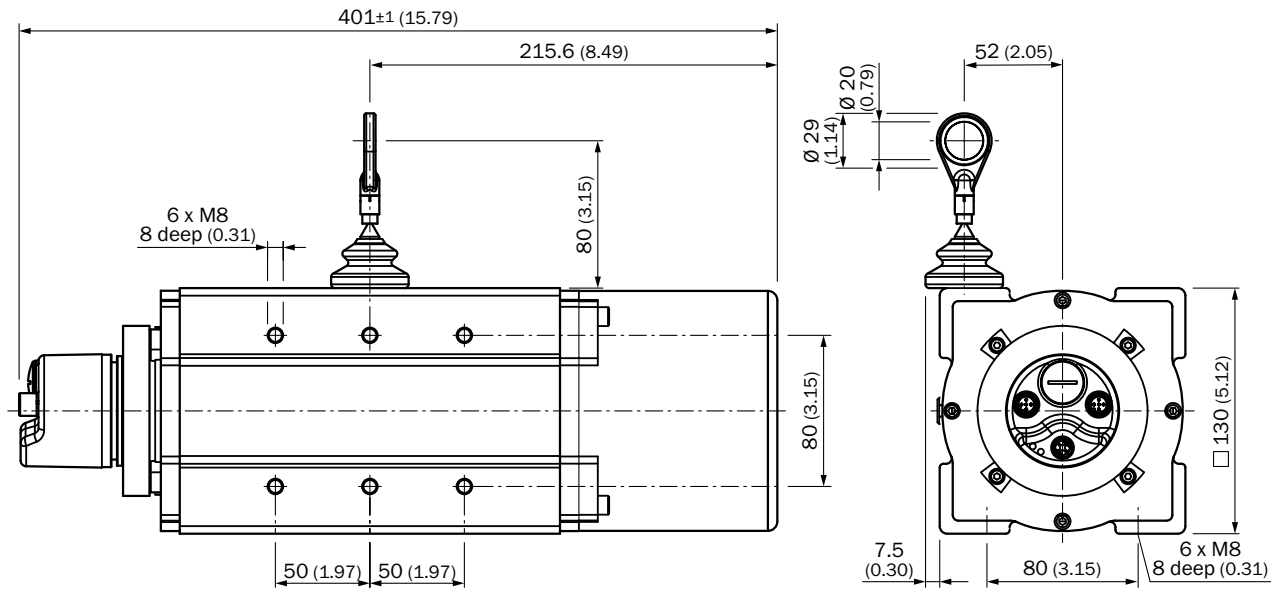
BTF13 up to 10 m
PROFIBUS (A3M60)



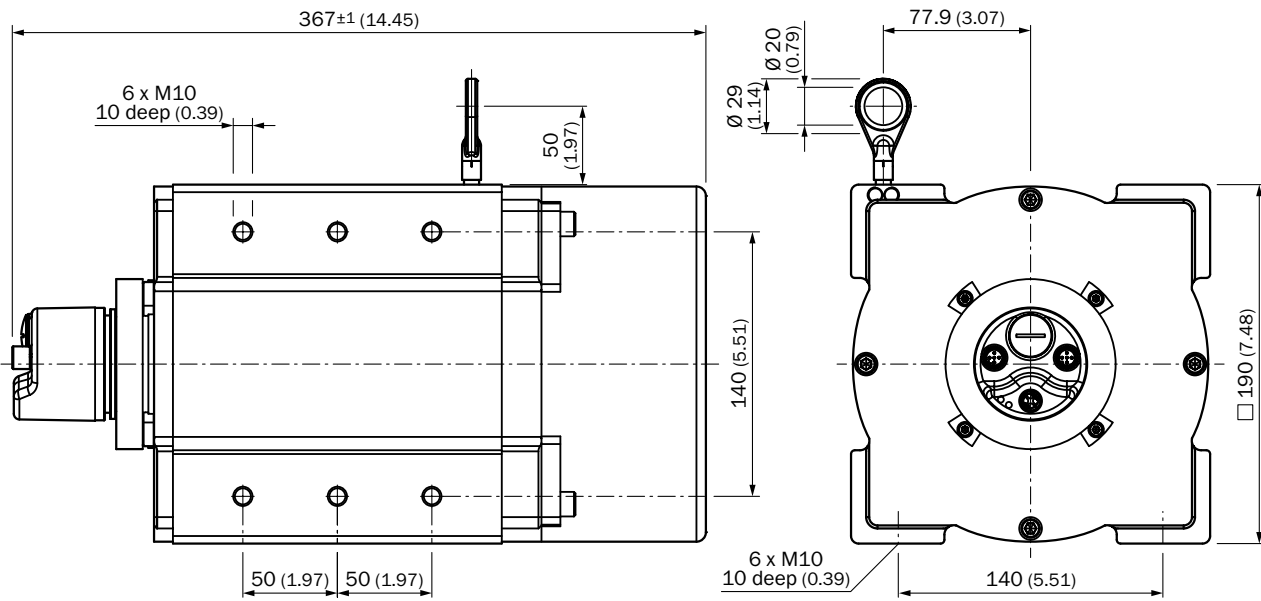
BTF13 up to 20 m
PROFIBUS (A3M60)



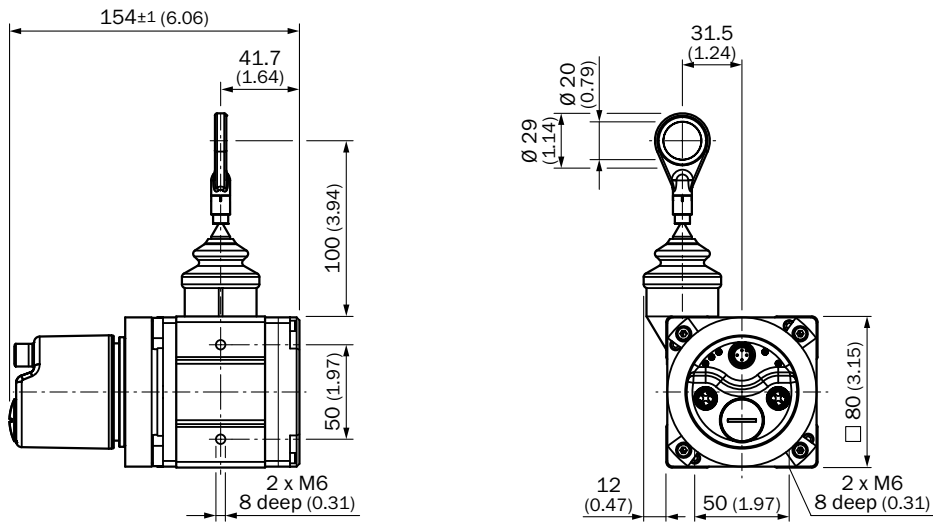
BTF13 up to 30 m
PROFIBUS (A3M60)



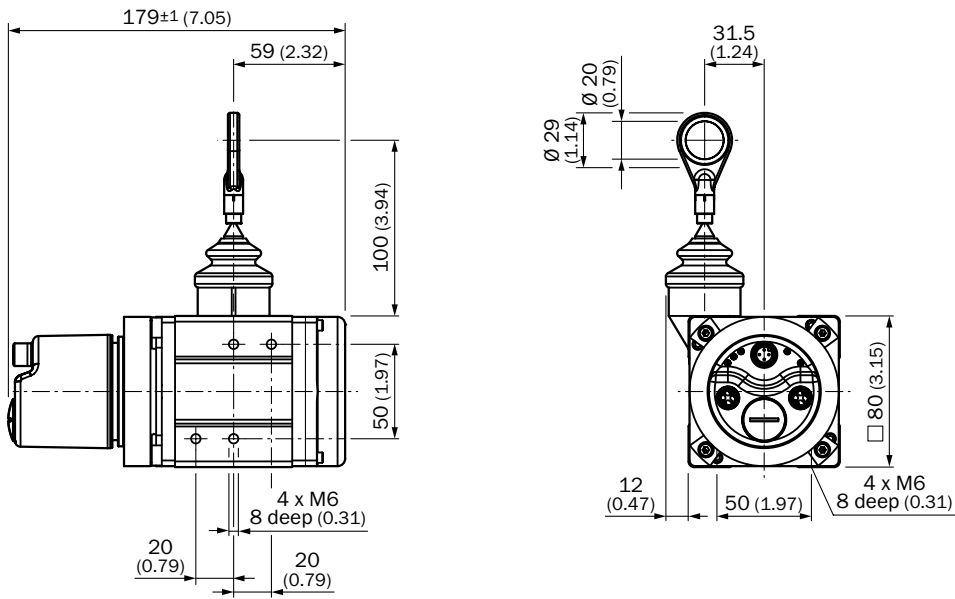
BTF19 up to 50 m
PROFIBUS (A3M60)



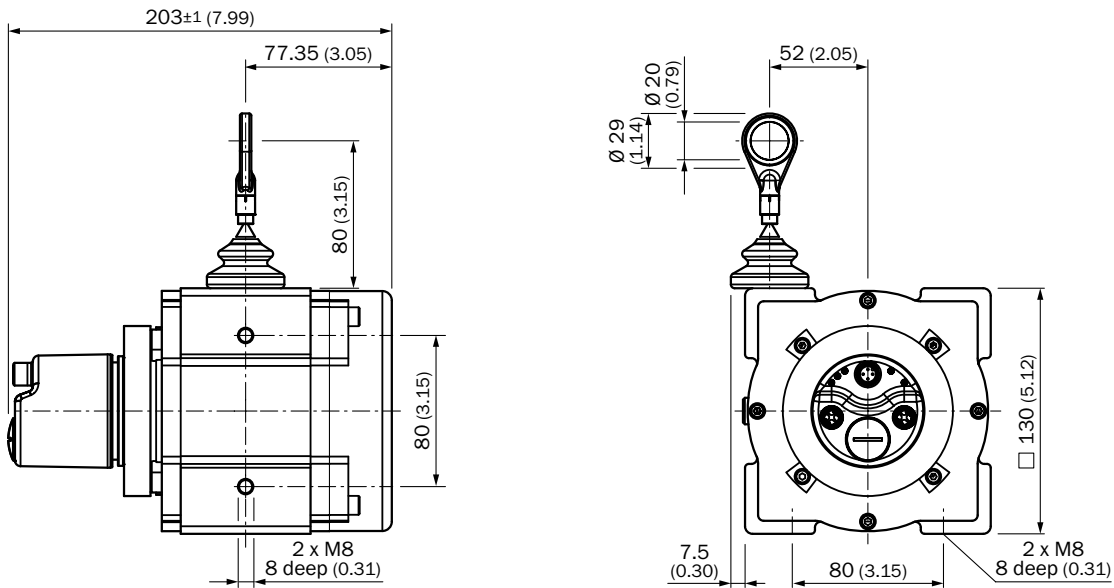
BTF08 up to 2 m
EtherNet/IP, EtherCAT®, PROFINET



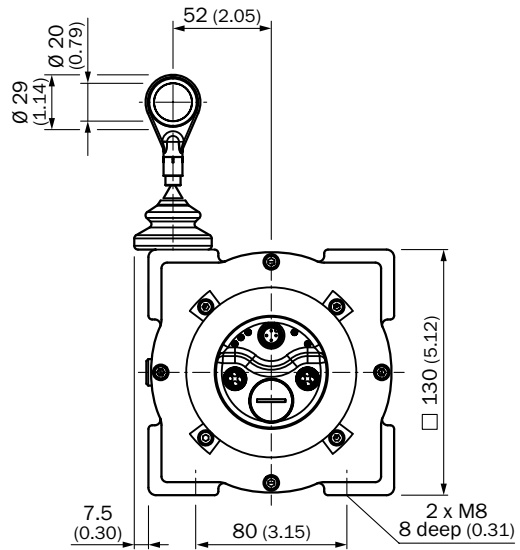
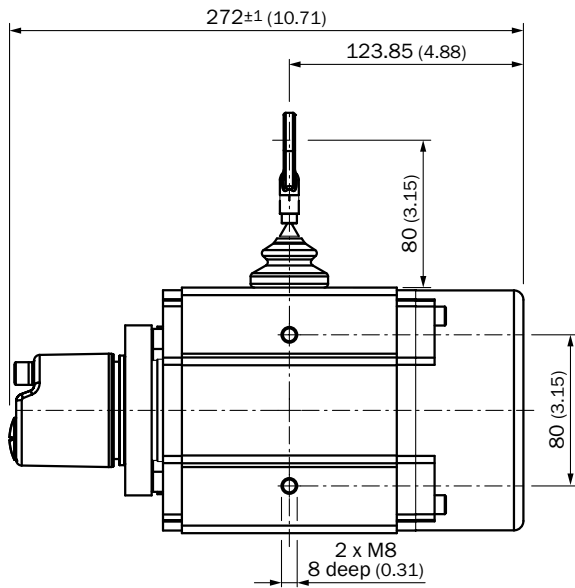
BTF08 up to 3 m
 EtherNet/IP, EtherCAT®, PROFINET



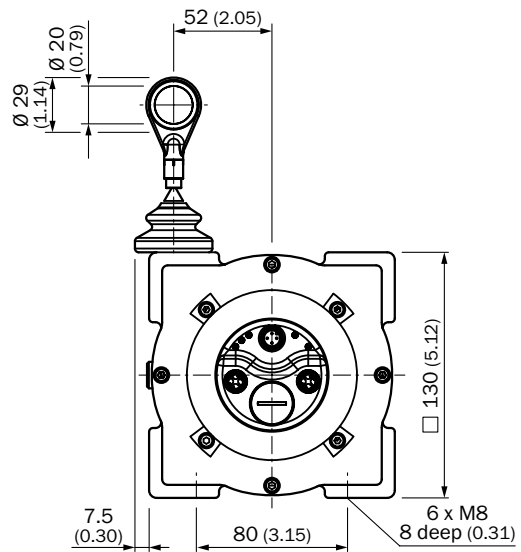
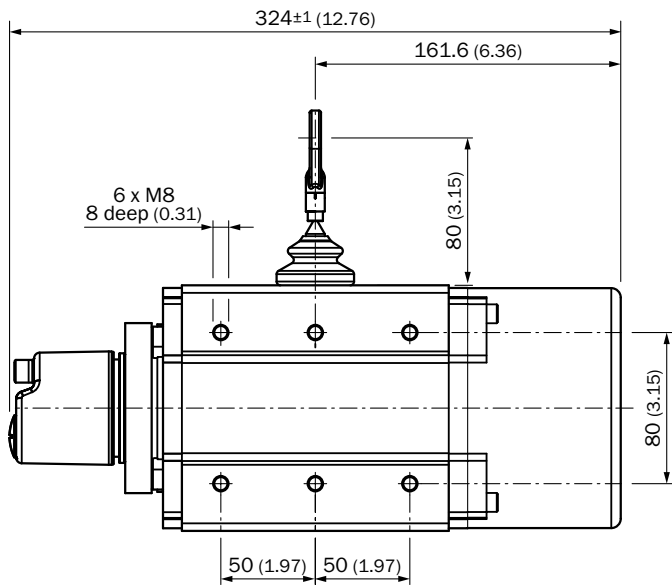
BTF13 up to 5 m
 EtherNet/IP, EtherCAT®, PROFINET



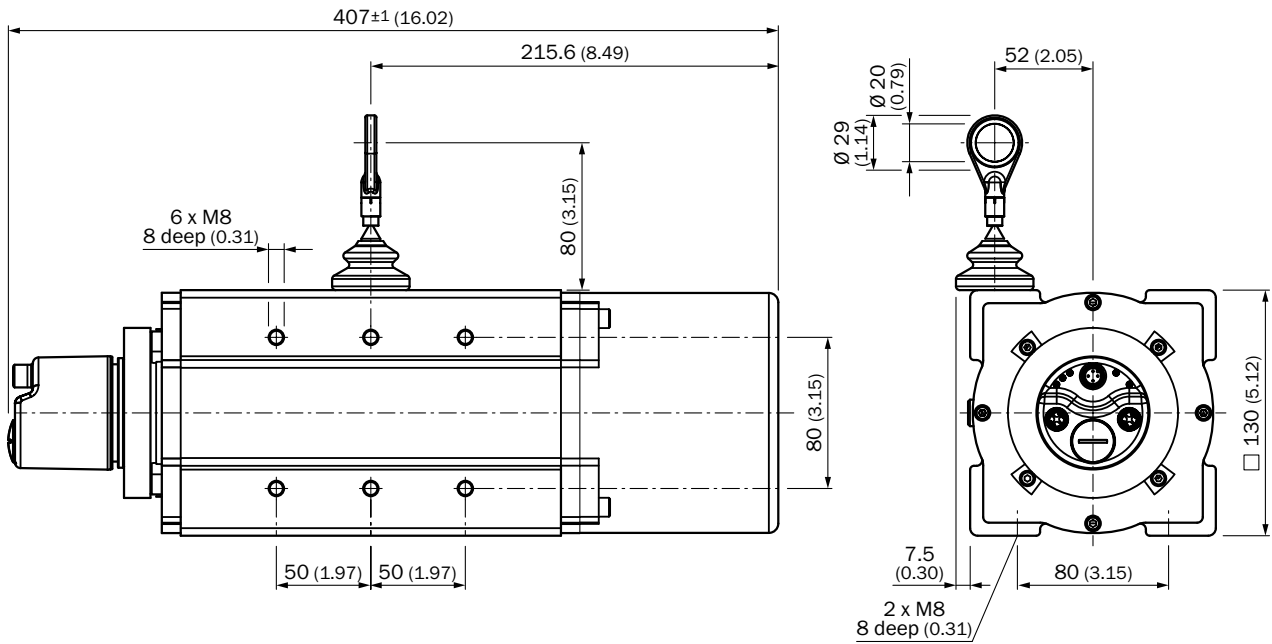
BTF13 up to 10 m
 EtherNet/IP, EtherCAT®, PROFINET



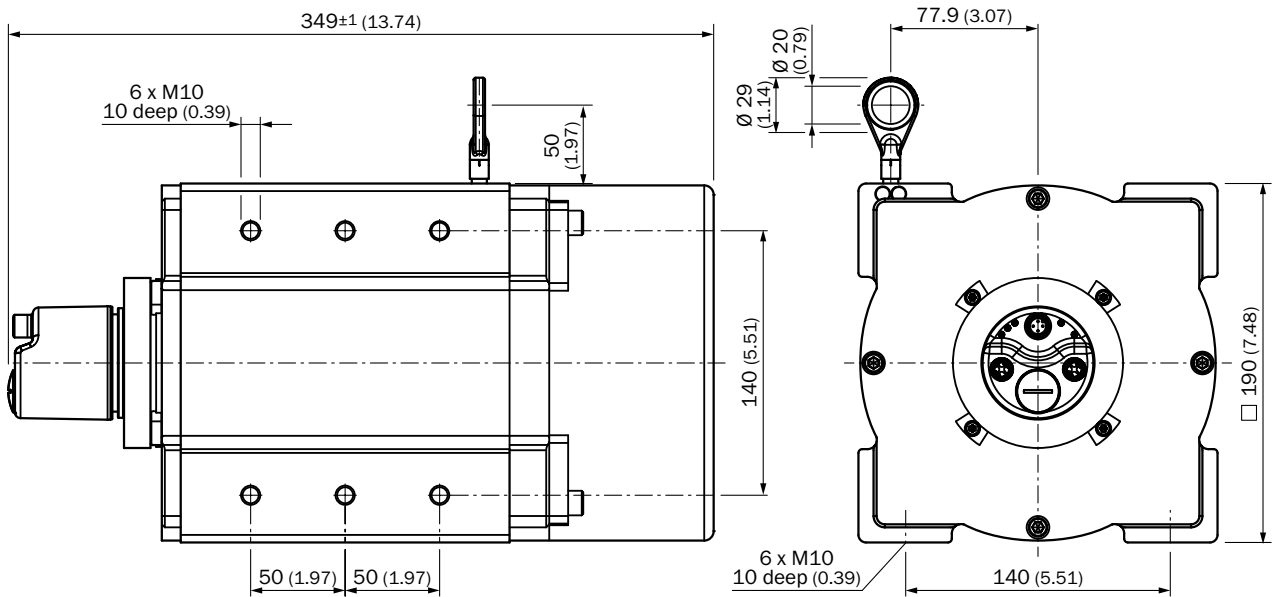
BTF13 up to 20 m
 EtherNet/IP, EtherCAT®, PROFINET



BTF13 up to 30 m
 EtherNet/IP, EtherCAT®, PROFINET

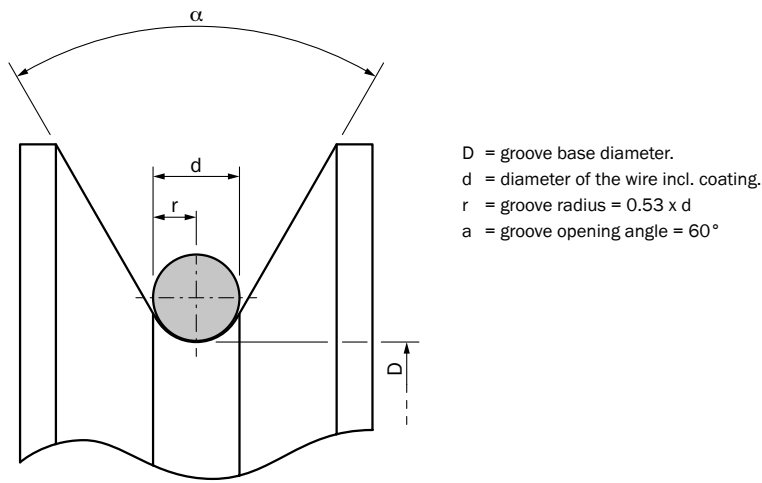


BTF19 up to 50 m
 EtherNet/IP, EtherCAT®, PROFINET



Deflection roller design

With the aid of deflection rollers, it is possible to guide the measuring wire of wire draw encoders over edges and around corners without significantly affecting the life time of the wire draw encoder. In this case, it must be considered that the designs of the deflection roller and of the measuring wire must be compatible in order to avoid damage to the system.



- The groove radius should not be too small – **recommendation: 0.53 x diameter of the wire cable**
- The groove opening angle should be neither too small nor too large – **recommendation: 60°**
- In order to ensure the longest possible system life, the deflection roller material should be neither too soft nor too hard – **recommended material: polyamide**
- The groove base diameter of the deflection roller should not be too small – **see table for recommendations**

EcoLine

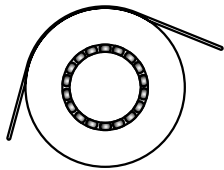
Length	Measuring wire, PA-sheathed	Diameter of the measuring wire	Structure of the measuring wire (strands x cords)	Min. groove base diameter
1.25 m	PA12	0.45 mm	7 x 7	25 mm
3 m	-	0.55 mm	1 x 19	40 mm
5 m	-	0.55 mm	1 x 19	40 mm
10 m	-	0.55 mm	1 x 19	40 mm

HighLine

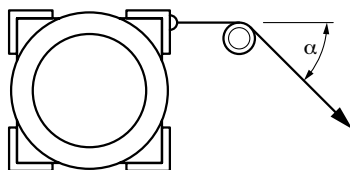
Length	Measuring wire, PA-sheathed	Diameter of the measuring wire	Structure of the measuring wire (strands x cords)	Min. groove base diameter
2 m	-	1.35 mm	7 x 19	35 mm
3 m	-	1.35 mm	7 x 19	35 mm
5 m	-	1.35 mm	7 x 19	35 mm
10 m	-	1.35 mm	7 x 19	35 mm
20 m	-	0.81 mm	7 x 7	35 mm
30 m	-	0.81 mm	7 x 7	35 mm
50 m	-	1.35 mm	7 x 19	35 mm

Installation of deflection rollers

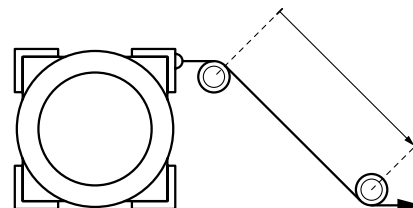
General notes on the installation of deflection rollers



The deflection roller should always be installed in a way which ensures that running is smooth. The deflection roller should ideally have an integrated ball bearing.



The smaller the deflection angle (α) achieved by a deflection roller, the less wear will appear on the measuring wire and therefore the longer the service life of the wire draw mechanism.



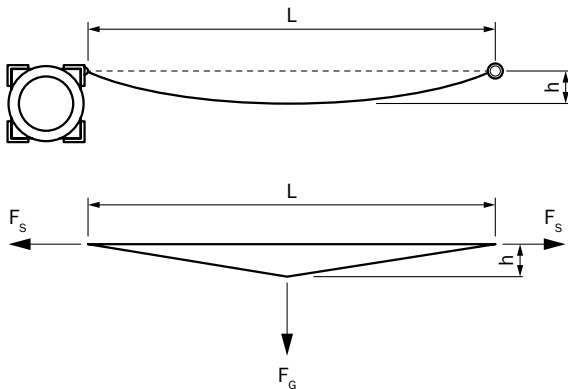
If two or more deflection rollers are needed, then the deflection rollers should always be installed at a distance from one another. The requisite distance between the deflection rollers must be accurately defined on site, accounting for specific customer requirements.

Wire sag

If the measuring wire is pulled out in a horizontal direction, this creates sag that becomes more pronounced as the wire length increases. This has particular implications for applications with obstacles that could get in the way of the moving measuring wire. However, the change in length that results from the sag, and the measurement error this leads to, are negligible.

Calculating the wire sag

The mass of the free-hanging measuring wire creates weight-related force, and this causes the wire to bend into a hyperbolic-shaped line. The tension force in the measuring wire acts against the sag. As the measurement length increases, so too does the tension force as a result of the spring drive. We can imagine the hyperbola shape in a simplified format that looks approximately like a triangle.



The weight-related force of the measuring wire can be calculated using **Formula A**.

The spring rate of the spring drive is calculated using **Formula B**.

Formula C determines the sag of the measuring wire (the results of Formula A and Formula B are required in order to calculate the wire sag).

Formula D is used for calculating the measurement error.

The values found in real life will differ from the theoretical values that are calculated, as the measuring wire itself demonstrates a certain amount of resistance against the sag.

Formula A

$$F_G = 0.5 \times m_L \times g \times L$$

F_G = weight-related force of the measuring wire [N]

m_L = length-related mass of the measuring wire [Kg/m]

g = gravitational acceleration 9.81 [m/s²]

L = free length of the measuring wire [m]

Formula B

$$c = \frac{F_{S \max} - F_{S \min}}{L_{\max}}$$

c = spring rate of the spring drive [N/m]

$F_{S \max}$ = maximum tensile force in the wire [N]

$F_{S \min}$ = minimum tensile force in the wire [N]

Formula C

$$h = \frac{L^2 \times g \times m_L}{8 \times (c \times L + F_{\min})}$$

h = wire sag [mm]

c = spring rate of the spring drive [N/m]

$F_{S \min}$ = minimum tensile force in the measuring wire [N]

g = gravitational acceleration 9.81 [m/s²]

m_L = length-related mass of the measuring wire [Kg/m]

L = free length of the measuring wire [m]

Formula D

$$f = \sqrt{L^2 + 4h^2} - L$$

f = measurement error [m]

h = wire sag [m]


L = free length of the measuring wire [m]

Recommended accessories






Mounting systems

Flanges

Flange plate

Figure	Brief description	Type	Part no.
	Flange adapter for HighLine wire draw mechanisms, adaption of face mount flange with centering hub 20 mm to 50 mm servo flange	BEF-FA-020-050WDE	2073776

Other mounting accessories

Figure	Brief description	Type	Part no.
	Joint ball for insertion in wire end ring with 20 mm diameter	Joint ball for BTF/PRF/MRA wire draw	5318683
	Additional brush attachment for wire draw mechanism MRA-F080 (2 m and 3 m from the HighLine series)	MRA-F080-B	6045341
	Wire draw deflection pulley for wire draw mechanism MRA-F080 (2 m and 3 m from HighLine series)	MRA-F080-R	6028632
	Additional brush attachment for wire draw mechanism MRA-F130 (5 m, 10 m, 20 m and 30 m from HighLine series)	MRA-F130-B	6038562
	Wire draw deflection pulley for wire draw mechanism MRA-F130 (5 m, 10 m, 20 m and 30 m from HighLine series)	MRA-F130-R	6028631

Wire draw mechanism

Wire draw mechanism for face mount flange encoder

Figure	Brief description	Measuring length	Type	Part no.
	HighLine wire draw mechanism for 60 series face mount flange with 10 mm shaft	2.0 m	MRA-F080-402D2	6029788
		5.0 m	MRA-F130-405D2	6029789
		10.0 m	MRA-F130-410D2	6029790
		20.0 m	MRA-F130-420D1	6029791
		30.0 m	MRA-F130-430D1	6029792
		50.0 m	MRA-F190-450D2	6029793

Wire draw mechanism for servo flange encoder

Figure	Brief description	Measuring length	Type	Part no.
	HighLine wire draw mechanism for 60 series servo flange With 6 mm shaft	2.0 m	MRA-F080-102D2	6028625
		3.0 m	MRA-F080-103D2	6030125
		5.0 m	MRA-F130-105D2	6028626
		10.0 m	MRA-F130-110D2	6028627
		20.0 m	MRA-F130-120D1	6028628
		30.0 m	MRA-F130-130D1	6028629
		50.0 m	MRA-F190-150D2	6028630

Connectivity








Adapters and distributors

T-piece







Figure	Brief description	Type	Part no.
	CANopen, T-piece	DSC-1205T000025KM0	6030664

Plug connectors and cables

Connecting cables with female connector







Figure	Brief description	Length of cable	Type	Part no.
	Head A: female connector, M12, 5-pin, angled Head B: cable Cable: for power supply, PUR, halogen-free, shielded, 3 x 0.34 mm ² , Ø 4.2 mm	5 m	DOL-1202-W05MC	6042067
		10 m	DOL-1202-W10MC	6042068
	Head A: female connector, M12, 4-pin, straight Head B: cable Cable: for power supply, suitable for drag chain, PUR, halogen-free, unshielded, 4 x 0.34 mm ² , Ø 4.7 mm	2 m	DOL-1204-G02MC	6025900
		5 m	DOL-1204-G05MC	6025901
		10 m	DOL-1204-G10MC	6025902
		25 m	DOL-1204-G25MC	6034751
	Head A: female connector, M12, 4-pin, straight Head B: cable Cable: for power supply, suitable for drag chain, PVC, unshielded, 4 x 0.25 mm ² , Ø 5.0 mm	5 m	DOL-1204-G05M	6009866
	Head A: female connector, M12, 4-pin, angled Head B: cable Cable: for power supply, suitable for drag chain, PUR, halogen-free, unshielded, 4 x 0.34 mm ² , Ø 4.7 mm	2 m	DOL-1204-W02MC	6025903
		5 m	DOL-1204-W05MC	6025904
		10 m	DOL-1204-W10MC	6025905
		25 m	DOL-1204-W25MC	6034754
	Head A: female connector, M12, 5-pin, straight Head B: cable Cable: for power supply, suitable for drag chain, PUR, halogen-free, shielded, 5 x 0.34 mm ² , Ø 5.9 mm	5 m	DOL-1205-G05MAC	6036384
		10 m	DOL-1205-G10MAC	6036385
		20 m	DOL-1205-G20MAC	6036386
	Head A: female connector, M12, 5-pin, straight, A-coded Head B: cable Cable: suitable for drag chain, PUR, halogen-free, shielded, 5 x 0.34 mm ² , Ø 5.9 mm	1.5 m	DOL-1205-G1M5ACSCCO	6049451
		3 m	DOL-1205-G03MACSCCO	6049452
		5 m	DOL-1205-G05MACSCCO	6049453
		10 m	DOL-1205-G10MACSCCO	6049454
	Head A: female connector, M12, 5-pin, angled, A-coded Head B: cable Cable: suitable for drag chain, PUR, halogen-free, shielded, 5 x 0.34 mm ² , Ø 5.9 mm	1.5 m	DOL-1205-W1M5ACSCCO	6049455
		3 m	DOL-1205-W03MACSCCO	6049456
		5 m	DOL-1205-W05MACSCCO	6049457
		10 m	DOL-1205-W10MACSCCO	6049458

¹⁾ Warning! Only in combination with electrical interfaces U, V, W and M.

Figure	Brief description	Length of cable	Type	Part no.
	Head A: female connector, M23, 12-pin, straight Head B: cable Cable: SSI, suitable for drag chain, PUR, shielded, 4 x 2 x 0.25 mm ² + 2 x 0.5 mm ² + 2 x 0.14 mm ² , Ø 7.8 mm	1.5 m	DOL-2312-G1M5MA1	2029200
		3 m	DOL-2312-G03MMA1	2029201
		5 m	DOL-2312-G05MMA1	2029202
		10 m	DOL-2312-G10MMA1	2029203
		20 m	DOL-2312-G20MMA1	2029204
		30 m	DOL-2312-G30MMA1	2029205
	Head A: female connector, M12, 5-pin, straight Head B: cable Cable: PROFIBUS, suitable for drag chain, PUR, halogen-free, shielded, 2 x 0.34 mm ² , Ø 8.0 mm	5 m	DOL-1205-G05MQ	6026006
		10 m	DOL-1205-G10MQ	6026008
		12 m	DOL-1205-G12MQ	6032636
		15 m	DOL-1205-G15MQ	6032637
		20 m	DOL-1205-G20MQ	6032638
		30 m	DOL-1205-G30MQ	6032639
	Head A: female connector, M12, 5-pin, angled, B-coded Head B: cable Cable: PROFIBUS, suitable for drag chain, PUR, shielded, 2 x 0.64 mm ² , Ø 7.8 mm	5 m	DOL-1205-W05MQ	6041423
		10 m	DOL-1205-W10MQ	6041425
	Head A: female connector, M12, 5-pin, straight Head B: cable Cable: CANopen, suitable for drag chain, shielded, 2 x 0.34 mm ² + 2 x 0.25 mm ² + 1 x 0.34 mm ² , Ø 6.7 mm A-coded	2 m	DOL-1205-G02MY	6053041
		5 m	DOL-1205-G05MY	6053042
		10 m	DOL-1205-G10MY	6053043
	Head A: female connector, M23, 12-pin, straight Head B: cable Cable: incremental, PUR, shielded, 4 x 2 x 0.25 mm ² + 2 x 0.5 mm ² + 1 x 0.14 mm ² , Ø 7.8 mm ¹⁾	2 m	DOL-2312-G02MLD1	2062202
		7 m	DOL-2312-G07MLD1	2062203
		10 m	DOL-2312-G10MLD1	2062204
		15 m	DOL-2312-G15MLD1	2062205
		20 m	DOL-2312-G20MLD1	2062206
		25 m	DOL-2312-G25MLD1	2062207
		30 m	DOL-2312-G30MLD1	2062208
	Head A: female connector, M23, 12-pin, straight Head B: cable Cable: incremental, suitable for drag chain, PUR, shielded, 4 x 2 x 0.25 mm ² + 2 x 0.5 mm ² + 1 x 0.14 mm ² , Ø 7.8 mm ¹⁾	1.5 m	DOL-2312-G1M5MD1	2062240
		3 m	DOL-2312-G03MMD1	2062243
		5 m	DOL-2312-G05MMD1	2062244
		10 m	DOL-2312-G10MMD1	2062245
		20 m	DOL-2312-G20MMD1	2062246
		30 m	DOL-2312-G30MMD1	2062247

¹⁾ Warning! Only in combination with electrical interfaces U, V, W and M.

Connecting cables with male connector

Figure	Brief description	Length of cable	Type	Part no.
	Head A: male connector, M12, 5-pin, straight, B-coded Head B: cable Cable: PROFIBUS, suitable for drag chain, PUR, halogen-free, shielded, 2 x 0.34 mm ² , Ø 8.0 mm Wire shielding: AL-PT foil, total shield, tin-plated C shield	5 m	STL-1205-G05MQ	6026005
		10 m	STL-1205-G10MQ	6026007
		12 m	STL-1205-G12MQ	6032635
	Head A: male connector, M12, 5-pin, angled, B-coded Head B: cable Cable: PROFIBUS, suitable for drag chain, PUR, shielded, 2 x 0.64 mm ² , Ø 7.8 mm	5 m	STL-1205-W05MQ	6041426
		10 m	STL-1205-W10MQ	6041427
	Head A: male connector, M12, 4-pin, straight, D-coded Head B: cable Cable: EtherNet/IP, PUR, halogen-free, shielded, 2 x 2 x 0.14 mm ² , Ø 6.4 mm	2 m	STL-1204-G02ME90	6045284
		5 m	STL-1204-G05ME90	6045285
		10 m	STL-1204-G10ME90	6045286
	Head A: male connector, M12, 4-pin, angled, D-coded Head B: cable Cable: EtherNet/IP, PUR, halogen-free, shielded, 2 x 2 x 0.14 mm ² , Ø 6.4 mm	2 m	STL-1204-W02ME90	6047912
		5 m	STL-1204-W05ME90	6047913
		10 m	STL-1204-W10ME90	6047914
		25 m	STL-1204-W20ME90	6047915
	Head A: male connector, M12, 4-pin, straight, D-coded Head B: cable Cable: PROFINET, EtherCAT, PVC, shielded, 4 x 0.34 mm ² , Ø 6.5 mm	2 m	STL-1204-G02MZ90	6048247
		5 m	STL-1204-G05MZ90	6048248
		10 m	STL-1204-G10MZ90	6048249
	Head A: male connector, M12, 4-pin, angled, D-coded Head B: cable Cable: PROFINET, EtherCAT, PVC, shielded, 4 x 0.34 mm ² , Ø 6.5 mm	2 m	STL-1204-W02MZ90	6048256
		5 m	STL-1204-W05MZ90	6048257
		10 m	STL-1204-W10MZ90	6048258
		25 m	STL-1204-W25MZ90	6048259

Female connectors (ready to assemble)









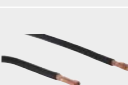

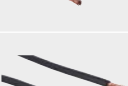


Figure	Brief description	Type	Part no.
	Head A: female connector, M12, 4-pin, straight, unshielded, for power supply, for cable diameter 4 mm ... 6 mm Head B: -	DOS-1204-G	6007302
	Head A: female connector, M12, 5-pin, straight, unshielded, for cable diameter 4 mm ... 6 mm Head B: -	DOS-1205-G	6009719
	Head A: female connector, M12, 4-pin, angled, unshielded, for power supply, for cable diameter 3 mm ... 6.5 mm Head B: -	DOS-1204-W	6007303
	Head A: female connector, M23, 12-pin, straight, shielded, for cable diameter 5.5 mm ... 10.5 mm Head B: - Operating temperature: -20 °C ... +130 °C	DOS-2312-G	6027538
	Head A: female connector, M23, 12-pin, straight, shielded, for cable diameter 5.5 mm ... 10.5 mm Head B: - Operating temperature: -40 °C ... +125 °C	DOS-2312-G02	2077057
	Head A: female connector, M23, 12-pin, angled, shielded, for cable diameter 4.2 mm ... 6.6 mm Head B: - Operating temperature: -20 °C ... +130 °C	DOS-2312-W01	2072580
	Head A: female connector, M12, 5-pin, straight, B-coded, shielded, PROFIBUS, for cable diameter 4 mm ... 9 mm Head B: -	DOS-1205-GQ	6021353
	Head A: female connector, M12, 5-pin, angled, B-coded, shielded, PROFIBUS, for cable diameter 4 mm ... 8 mm Head B: -	DOS-1205-WQ	6041429

Figure	Brief description	Type	Part no.
	Head A: female connector, M12, 5-pin, straight, shielded, CANopen, DeviceNet, for cable diameter 4.5 mm ... 7 mm Head B: -	DOS-1205-GA	6027534
	Head A: female connector, M12, 4-pin, straight, D-coded, shielded, EtherNet/IP, for cable diameter 4 mm ... 8 mm Head B: -	DOS-1204-GE	6048153
	Head A: female connector, M12, 4-pin, angled, D-coded, shielded, EtherNet/IP, for cable diameter 4 mm ... 8 mm Head B: -	DOS-1204-WE	6048154
	Head A: female connector, M12, 4-pin, straight, D-coded, shielded, PROFINET, EtherCAT, for cable diameter 4 mm ... 8 mm	DOS-1204-GZ	6048263
	Head A: female connector, M12, 4-pin, angled, D-coded, shielded, PROFINET, EtherCAT, for cable diameter 4 mm ... 8 mm	DOS-1204-WZ	6048264

Cables (ready to assemble)

Figure	Brief description	Length of cable	Type	Part no.
	Head A: cable Head B: cable Cable: suitable for drag chain, PUR, shielded, 2 x 0.25 mm ² , Ø 8.0 mm	By the meter	LTG-2102-MW	6021355
	Head A: cable Head B: cable Cable: suitable for drag chain, PUR, halogen-free, shielded, 4 x 2 x 0.15 mm ² , Ø 5.6 mm		LTG-2308-MWENC	6027529
	Head A: cable Head B: cable Cable: PUR, shielded, 4 x 2 x 0.25 mm ² + 2 x 0.5 mm ² + 1 x 0.14 mm ² , Ø 7.5 mm		LTG-2411-MW	6027530
	Head A: cable Head B: cable Cable: suitable for drag chain, PUR, halogen-free, shielded, 4 x 2 x 0.25 mm ² + 2 x 0.5 mm ² + 2 x 0.14 mm ² , Ø 7.8 mm		LTG-2512-MW	6027531
	Head A: cable Head B: cable Cable: suitable for drag chain, PUR, halogen-free, shielded, UV and saltwater-resistant, 4 x 2 x 0.25 mm ² + 2 x 0.5 mm ² + 2 x 0.14 mm ² , Ø 7.8 mm		LTG-2612-MW	6028516

Other plug connectors and cables

Figure	Brief description	Type	Part no.
	A3M60 accessories sales set comprising: Female cable connector supply voltage M12 angled (6007303) Female cable connector M12 angled (6041429) Male cable connector M12 angled (6041428)	DOS-3XM12-W	2058177
	Head A: female connector, M12, 4-pin, D-coded Head B: female connector, RJ45, 8-pin Cable: shielded Switch cabinet feedthrough	Feedthrough female connector Ethernet RJ45	6048180
	Head A: male connector, M12, 4-pin, straight, B-coded Cable: PROFIBUS terminator	STE-END-Q	6021156

Male connectors (ready to assemble)

Figure	Brief description	Type	Part no.
	Head A: male connector, M12, 5-pin, straight, unshielded, for cable diametes 4 mm ... 6 mm Head B: -	STE-1205-G	6022083
	Head A: male connector, M12, 5-pin, straight, B-coded, shielded, for cable diameter 4 mm ... 9 mm Head B: -	STE-1205-GQ	6021354
	Head A: male connector, M23, 12-pin, straight, shielded, for cable diameter 5.5 mm ... 10.5 mm Head B: - Operating temperature: -20 °C ... +130 °C	STE-2312-G	6027537
	Head A: male connector, M23, 12-pin, straight, for cable diameter 5.5 mm ... 10.5 mm Head B: - Operating temperature: -40 °C ... +125 °C	STE-2312-G01	2077273
	Head A: male connector, M12, 5-pin, angled, B-coded, shielded, PROFIBUS, for cable diameter 4 mm ... 8 mm Head B: -	STE-1205-WQ	6041428
	Head A: male connector, M12, 5-pin, straight, A encoded, shielded, CANopen, DeviceNet, for cable diameter 4 mm ... 8 mm Head B: -	STE-1205-GA	6027533
	Head A: male connector, RJ45, 8-pin, straight, shielded, EtherNet/IP, for cable diameter 4.5 mm ... 8 mm Head B: -	STE-0J08-GE	6048150
	Head A: male connector, M12, 4-pin, straight, D-coded, shielded, EtherNet/IP, for cable diameter 4 mm ... 8 mm Head B: -	STE-1204-GE01	6048151
	Head A: male connector, M12, 4-pin, angled, D-coded, shielded, EtherNet/IP, for cable diameter 4 mm ... 8 mm Head B: -	STE-1204-WE	6048152
	Head A: male connector, RJ45, 4-pin, straight, shielded, PROFINET, EtherCAT, for cable diameter 4.5 mm ... 8 mm	STE-0J04-GZ	6048260
	Head A: male connector, M12, 4-pin, straight, D-coded, shielded, PROFINET, EtherCAT, for cable diameter 4 mm ... 8 mm	STE-1204-GZ	6048261
	Head A: male connector, M12, 4-pin, angled, D-coded, shielded, PROFINET, EtherCAT, for cable diameter 4 mm ... 8 mm	STE-1204-WZ	6048262

Connection cables with female and male connector

Figure	Brief description	Length of cable	Type	Part no.
	Head A: female connector, M23, 12-pin, straight Head B: male connector, D-Sub, 9-pin, straight Cable: shielded, 4 x 2 x 0.08 mm ²	0.5 m	DSL-3D08-G0M5AC3	2046580
	Head A: female connector, M12, 5-pin, straight Head B: male connector, M12, 5-pin, straight Cable: CANopen, suitable for drag chain, PUR, halogen-free, shielded, 2 x 0.34 mm ² + 2 x 0.25 mm ² + 1 x 0.34 mm ² , Ø 6.7 mm, A-coded	2 m	DSL-1205-G02MY	6053044
		5 m	DSL-1205-G05MY	6053045
		10 m	DSL-1205-G10MY	6053046

Connection cables with male and male connector

Figure	Brief description		Type	Part no.
	Head A: male connector, M12, 4-pin, straight, D-coded Head B: male connector, M12, 4-pin, straight, D-coded Cable: EtherNet/IP, PUR, halogen-free, shielded, 2 x 2 x 0.14 mm ² , Ø 6.4 mm	2 m	SSL-1204-G02ME90	6045222
		5 m	SSL-1204-G05ME90	6045277
		10 m	SSL-1204-G10ME90	6045279
	Head A: male connector, M12, 4-pin, angled, D-coded Head B: male connector, M12, 4-pin, straight, D-coded Cable: EtherNet/IP, PUR, halogen-free, shielded, 2 x 2 x 0.14 mm ² , Ø 6.4 mm	2 m	SSL-1204-H02ME90	6047908
		5 m	SSL-1204-H05ME90	6047909
		10 m	SSL-1204-H10ME90	6047910
	Head A: male connector, M12, 4-pin, straight, D-coded Head B: male connector, RJ45, 8-pin, straight Cable: EtherNet/IP, PUR, halogen-free, shielded, 2 x 2 x 0.14 mm ² , Ø 6.4 mm	2 m	SSL-2J04-G02ME60	6047916
		5 m	SSL-2J04-G05ME60	6047917
		10 m	SSL-2J04-G10ME60	6047918
	Head A: male connector, M12, 4-pin, angled, D-coded Head B: male connector, RJ45, 8-pin, straight Cable: EtherNet/IP, PUR, halogen-free, shielded, 2 x 2 x 0.14 mm ² , Ø 6.4 mm	2 m	SSL-2J04-H02ME	6047911
		5 m	SSL-2J04-H05ME	6045287
		10 m	SSL-2J04-H10ME	6045288
	Head A: male connector, M12, 4-pin, angled, D-coded Head B: male connector, M12, 4-pin, straight Cable: PROFINET, EtherCAT, PVC, shielded, 4 x 0.34 mm ² , Ø 6.5 mm	2 m	SSL-1204-F02MZ90	6048250
		5 m	SSL-1204-F05MZ90	6048251
		10 m	SSL-1204-F10MZ90	6048252
	Head A: male connector, M12, 4-pin, straight, D-coded Head B: male connector, M12, 4-pin, straight Cable: PROFINET, EtherCAT, PVC, shielded, 4 x 0.34 mm ² , Ø 6.5 mm	2 m	SSL-1204-G02MZ90	6048241
		5 m	SSL-1204-G05MZ90	6048242
		10 m	SSL-1204-G10MZ90	6048243
	Head A: male connector, RJ45, 4-pin, straight, D-coded Head B: male connector, M12, 4-pin, angled Cable: PROFINET, EtherCAT, PVC, shielded, 4 x 0.34 mm ² , Ø 6.5 mm	2 m	SSL-2J04-F02MZ	6048253
		5 m	SSL-2J04-F05MZ	6048254
		10 m	SSL-2J04-F10MZ	6048255
	Head A: male connector, M12, 4-pin, straight, D-coded Head B: male connector, RJ45, 4-pin, straight Cable: PROFINET, EtherCAT, PVC, shielded, 4 x 0.34 mm ² , Ø 6.5 mm	2 m	SSL-2J04-G02MZ60	6048244
		5 m	SSL-2J04-G05MZ60	6048245
		10 m	SSL-2J04-G10MZ60	6048246

Other accessories

Spare parts

Figure	Brief description	Type	Part no.
	Spare mounting set for HighLine wire draw mechanisms for fitting encoders with servo flange	MRA-F-K	6028633

Programming and configuration tools

Figure	Brief description	Type	Part no.
	Programming unit ¹⁾ USB, for programmable SICK encoders AFS60, AFM60, DFS60, VFS60, DFV60 and wire draw encoders with programmable encoders.	PGT-08-S	1036616
	Programming unit display for programmable SICK DFS60, VFS60, DFV60, AFS/AFM60, AHS/AHM36 encoders, and wire draw encoders with DFS60, AFS/AFM60, and AHS/AHM36. Compact dimensions, low weight, and intuitive operation.	PGT-10-Pro	1072254

¹⁾ Can be used with programmable incremental and absolute encoders in conjunction with the corresponding adapter cables.

→ For additional accessories, please see page K-668 onwards

