

HIGH-RESOLUTION, PROGRAMMABLE ENCODER FOR SOPHISTICATED APPLICATIONS



Product description

The DFS60 is a high-resolution incremental encoder with a diameter of 60mm. It offers a wide variety of mechanical and electric interfaces and can also be programmed by the customer if required. Programming of the output signal and zero pulse is a unique feature

for the market. The high enclosure rating, wide temperature range and large ball bearing distance ensure extreme robustness, making the DFS60 the ideal encoder for industrial applications in harsh environments

At a glance

- Compact installation depth
- High resolution up to 16 bits
- Optionally programmable: Output voltage, zero pulse position, zero pulse width and number of pulses
- Connection: Radial or axial cable outlet, M23 or M12 connector, axial or radial
- Electrical interfaces: 5V & 24V TTL/RS-422, 24 V HTL/push pull
- Mechanical interfaces: face mount or servo flange, blind or through hollow shaft
- Remote zero set possible

Your benefits

- Reduced storage costs and downtime due to customer-specific programming
- Variety of different mechanical and electrical interfaces enable the encoder to be optimally adjusted to fit the installation situation
- Excellent concentricity even at high speeds
- High resolution of up to 16 bits ensures precise measurements
- Permanent and safe operation due to a high enclosure rating, temperature resistance and a long bearing lifetime
- Programmability via the PGT-08 programming software and the PGT-10-Pro display programming tool allow the encoder to be adapted flexibly and quickly according to customer needs
- Programmable zero pulse position simplifies installation



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→ www.sick.com/DFS60

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

- Applications in factory and logistics automation for measuring of position, speed and distance: e.g. in printing machines, textile machines, wood processing, packaging machinery

Detailed technical data

Performance

	Eco	Basic	Advanced
Pulses per revolution	100 ... 2048 ¹⁾ (depending on type)	1 ... 10000 ¹⁾ (depending on type)	1 ... 65536 ¹⁾ (depending on type)
Pulses per revolution Sin/Cos 1,0 V_{PP}	-	1024	-
Measuring step	90° electronically/ppr		
Measuring step deviation at non binary number of lines			
Pulses 1 ... 99	-	± 0.08°	± 0.04°
Pulses 100 ... 10,000	± 0.2°	± 0.01°	± 0.008°
Pulses > 10,000	-		± 0.002°
Measuring step deviation at binary number of lines			
Pulses 1 ... 64	-	± 0.05°	± 0.03°
Pulses 128 ... 8,192	± 0.15°	± 0.008°	± 0.008°
Pulses 16,384 ... 65,536	-		± 0.0015°
Error limits	± 0.3°	± 0.05°	± 0.03°

¹⁾ See maximum revolution range.

Electrical data

	Eco	Basic	Advanced
Electrical interface	4,5 V ... 5,5 V, TTL/RS422, 10 V ... 32 V HTL/Push pull, 10 V ... 32 V, TTL/RS422		
	-	4,5 V ... 32 V, HTL/Push pull, 0-SET 4,5 V ... 32 V, TTL/RS422, 0-SET 4,5 V ... 32 V, TTL/HTL programmable ¹⁾ 4,5 V ... 32 V, TTL/HTL programmable, 0-SET ¹⁾	
	-	4,5 V ... 5,5 V, Sin/Cos 1,0 V _{SS}	-
Initialization time			
4.5 V ... 5.5 V, TTL/RS422	40 ms		
10 V ... 32 V, HTL/Push pull	40 ms		
10 V ... 32 V, TTL/RS422	40 ms		
4.5 V ... 32 V, HTL/Push pull, 0-SET	30 ms		
4.5 V ... 5.5 V, TTL/RS422, 0-SET	30 ms		
4.5 V ... 32 V, TTL/RS422, 0-SET	30 ms		
4.5 V ... 32 V, TTL/HTL programmable	-	32 ms ²⁾ 30 ms	
4.5 V ... 32 V, TTL/HTL programmable, 0-SET	-	32 ms ²⁾ 30 ms	
4,5 V ... 5,5 V, Sin/Cos 1,0 V _{PP}	-	40 ms	-
0-SET function	-	H-active (L = 0 - 3 V, H = 4,0 - Us V)	

	Eco	Basic	Advanced
Connection type	Cable, 8-wire, universal, 1.5 m Cable, 8-wire, universal, 3 m Cable, 8-wire, universal, 5 m Cable, 8-wire, universal, 10 m Male connector, M12, 8-pin, radial Male connector, M12, 8-pin, axial Male connector, M23, 12-pin, radial Male connector, M23, 12-pin, axial		
Operating current	40 mA (without load)		
Power consumption			
4.5 V ... 5.5 V, TTL/RS422	≤ 0.5 W (without load)		
10 V ... 32 V, HTL/Push pull	≤ 0.5 W (without load)		
10 V ... 32 V, TTL/RS422	≤ 0.5 W (without load)		
4.5 V ... 32 V, HTL/Push pull, 0-SET		≤ 0.7 W (without load)	
4.5 V ... 5.5 V, TTL/RS422, 0-SET		≤ 0.7 W (without load)	
4.5 V ... 32 V, TTL/RS422, 0-SET		≤ 0.7 W (without load)	
4.5 V ... 32 V, TTL/HTL programmable	-	≤ 0.7 W (without load)	
4.5 V ... 32 V, TTL/HTL programmable, 0-SET	-	≤ 0.7 W (without load)	
Load resistance			
4.5 V ... 5.5 V, Sin/Cos 1.0 V _{PP}	-	≤ 120 Ω	
Load current	≤ 30 mA		
Output frequency			
TTL/RS422	≤ 300 kHz	≤ 600 kHz	≤ 820 kHz
HTL/Push pull	≤ 300 kHz	≤ 600 kHz	≤ 820 kHz
HTL/Push pull, 0-SET	≤ 300 kHz	≤ 600 kHz	≤ 820 kHz
TTL/RS422, 0-SET	≤ 300 kHz	≤ 600 kHz	≤ 820 kHz
TTL/HTL programmable	-	≤ 600 kHz	≤ 820 kHz
TTL/HTL programmable, 0-SET	-	≤ 600 kHz	≤ 820 kHz
Sin/Cos 1,0 V _{PP}	-	≤ 200 kHz	-
Reference signal, number	1		
Reference signal, position	90°, electric, logically gated with A and B	90°, electric, logically gated with A and B 90°, electronically, gated with Sinus and Cosinus	90°, electric, logically gated with A and B
Reverse polarity protection			
4.5 V ... 5.5 V, TTL/RS422	-		
10 V ... 32 V, HTL/Push pull	✓		
10 V ... 32 V, TTL/RS422	✓		
4.5 V ... 32 V, HTL/Push pull, 0-SET	-	✓	
4.5 V ... 32 V, TTL/RS422, 0-SET	-	✓	
4.5 V ... 32 V, TTL/HTL programmable	-	-	-
4.5 V ... 5.5 V, Sin/Cos 1.0 V _{PP}	-	✓	
4.5 V ... 32 V, TTL/HTL programmable, 0-SET	-	✓	✓
Short-circuit protection of the outputs			
4.5 V ... 5.5 V, TTL/RS422	✓ ³⁾		
10 V ... 32 V, HTL/Push pull	✓ ³⁾		
10 V ... 32 V, TTL/RS422	✓ ⁴⁾		
4.5 V ... 32 V, HTL/Push pull, 0-SET	✓ ³⁾		
4.5 V ... 32 V, TTL/RS422, 0-SET	✓ ⁴⁾		

	Eco	Basic	Advanced
4.5 V ... 32 V, TTL/HTL programmable	-	✓ ^{5) 6)}	
4.5 V ... 5.5 V, Sin/Cos 1.0 V _{PP}	-	✓ ³⁾	-
4.5 V ... 32 V, TTL/HTL programmable, 0-SET	-	✓ ^{5) 6)}	
MTTFd: mean time to dangerous failure	300 years (EN ISO 13849-1) ⁷⁾		

¹⁾ Only with devices with M23 connector in connection with electrical interfaces M, U, V and W.

²⁾ With mechanical zero pulse width.

³⁾ Short-circuit opposite to another channel, US or GND permissible for maximum 30 s.

⁴⁾ Short-circuit opposite to another channel or GND permissible for maximum 30 s.

⁵⁾ Programming TTL with $\geq 5,5$ V: short-circuit opposite to another channel or GND permissible for maximum 30 s.

⁶⁾ Programming HTL or TTL with $< 5,5$ V: short-circuit opposite to another channel, US or GND permissible for maximum 30 s.

⁷⁾ 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 40°C, frequency of use 8760 h/a. All electronic failures are considered hazardous. For more information, see document no. 8015532.

Mechanical data

	Eco	Basic	Advanced
Mechanical interface	Solid shaft, face mount flange Solid shaft, Servo flange Blind hollow shaft Through hollow shaft		
Shaft diameter	Solid shaft, face mount flange 10 mm x 19 mm Solid shaft, Servo flange 6 mm x 10 mm Blind hollow shaft, Through hollow shaft 6 mm 8 mm 3/8" 10 mm 12 mm 1/2" 14 mm 15 mm 5/8"		
Weight	Blind hollow shaft, Through hollow shaft 0.2 kg Solid shaft 0.3 kg		
Shaft material	Stainless steel		
Flange material	Aluminum		
Housing material	Aluminum die cast		
Start up torque	Blind hollow shaft, Through hollow shaft 0.8 Ncm (+20 °C) Solid shaft 0.5 Ncm (+20 °C)		
Operating torque	Blind hollow shaft, Through hollow shaft 0.6 Ncm (+20 °C) Solid shaft 0.3 Ncm (+20 °C)		
Permissible shaft movement, axial static/dynamic	Blind hollow shaft, Through hollow shaft ± 0.5 mm / ± 0.2 mm		± 0.5 mm / ± 0.01 mm
Permissible shaft movement, radial static/dynamic	Blind hollow shaft, Through hollow shaft ± 0.3 mm / ± 0.1 mm		± 0.3 mm / ± 0.05 mm
Permissible shaft loading radial/axial			

	Eco	Basic	Advanced
Solid shaft	80 N (radial) 40 N (axial)		
Operating speed			
Blind hollow shaft, Through hollow shaft	≤ 6,000 min ⁻¹ ¹⁾		
Solid shaft	≤ 9,000 min ⁻¹ ¹⁾		
Moment of inertia of the rotor	40 gcm ² / 6.2 gcm ² (depending on type)		40 gcm ² / 6.2 gcm ² (depending on type)
Bearing lifetime	3.6 x 10 ¹⁰ revolutions		
Angular acceleration	≤ 500,000 rad/s ²		

¹⁾ Take into account self-heating of 3.3 K per 1,000 rpm when designing the operating temperature range.

Ambient data

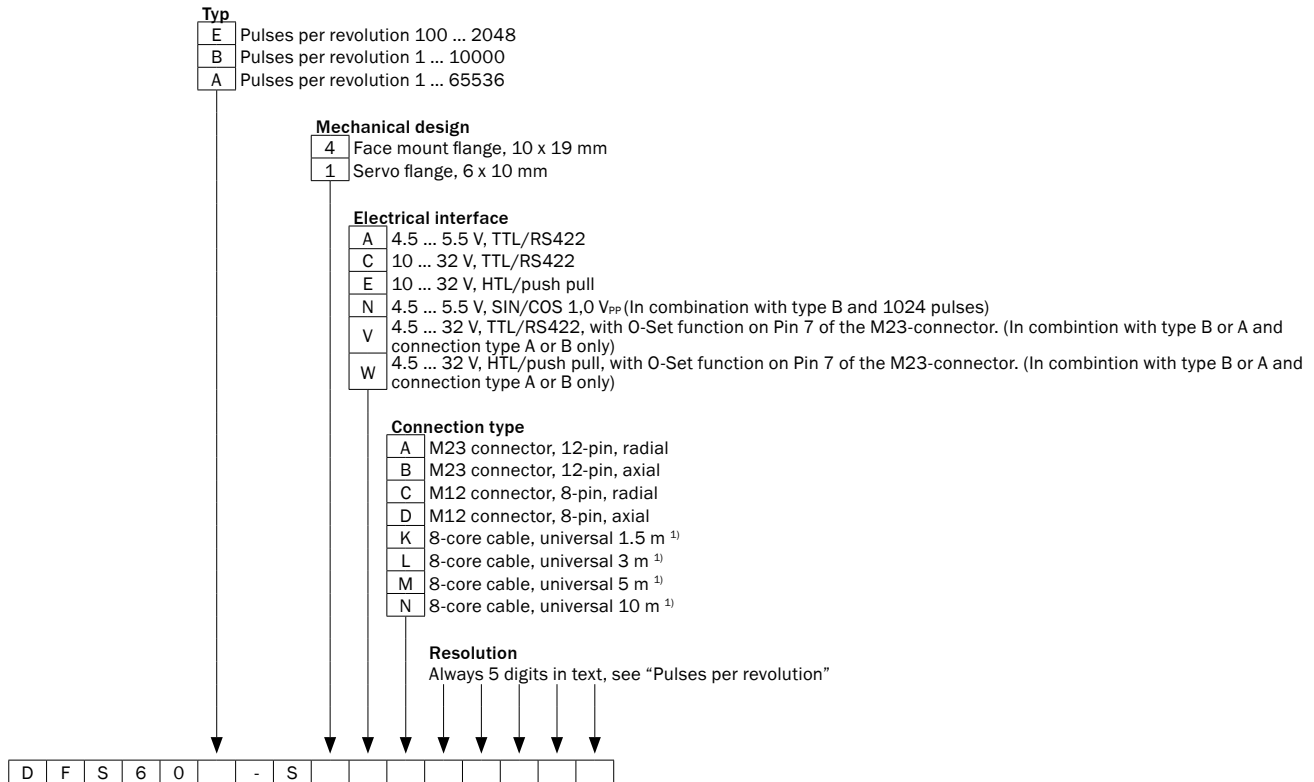
	Eco	Basic	Advanced
EMC			
4,5 V ... 5,5 V, TTL/RS422	According to EN 61000-6-2 and EN 61000-6-3		
10 V ... 32 V, HTL/Push pull	According to 61000-6-2 and EN 61000-6-4		
10 V ... 32 V, TTL/RS422	According to EN 61000-6-2 and EN 61000-6-4		
4,5 V ... 32 V, HTL/Push pull, 0-SET	-	According to EN 61000-6-2 and EN 61000-6-3	
4,5 V ... 32 V, TTL/RS422, 0-SET	-	According to EN 61000-6-2 and EN 61000-6-3	
4,5 V ... 32 V, TTL/HTL programmierbar	-	According to EN 61000-6-2 and EN 61000-6-3	
4,5 V ... 5,5 V, Sin/Cos 1,0 V _{SS}	-	According to EN 61000-6-2 and EN 61000-6-3	-
4,5 V ... 32 V, TTL/HTL programmierbar, 0-SET	-	According to EN 61000-6-2 and EN 61000-6-3	
Enclosure rating			
shaft side	IP65		
Housing side, connector outlet	IP67, Through hollow shaft IP65 (according to IEC 60529)		
Housing side, cable outlet	IP67, Through hollow shaft IP65 (according to IEC 60529)		
Permissible relative humidity	90 % (condensation of the optical scanning not permitted)		
Operating temperature range			
	0 °C ... +85 °C	-40 °C ... +100 °C ²⁾ -30 °C ... +100 °C ³⁾	
Storage temperature range	-40 °C ... +100 °C, without package		
Resistance to shocks	50 g, 6 ms (according to EN 60068-2-27)	70 g, 6 ms (according to EN 60068-2-27)	100 g, 6 ms (according to EN 60068-2-27)
Resistance to vibration	20 g, 10 Hz ... 2,000 Hz (according to EN 60068-2-6)		
	30 g, 10 Hz ... 2,000 Hz (according to EN 60068-2-6)		

¹⁾ With mating connector fitted.

²⁾ Stationary position of the cable.

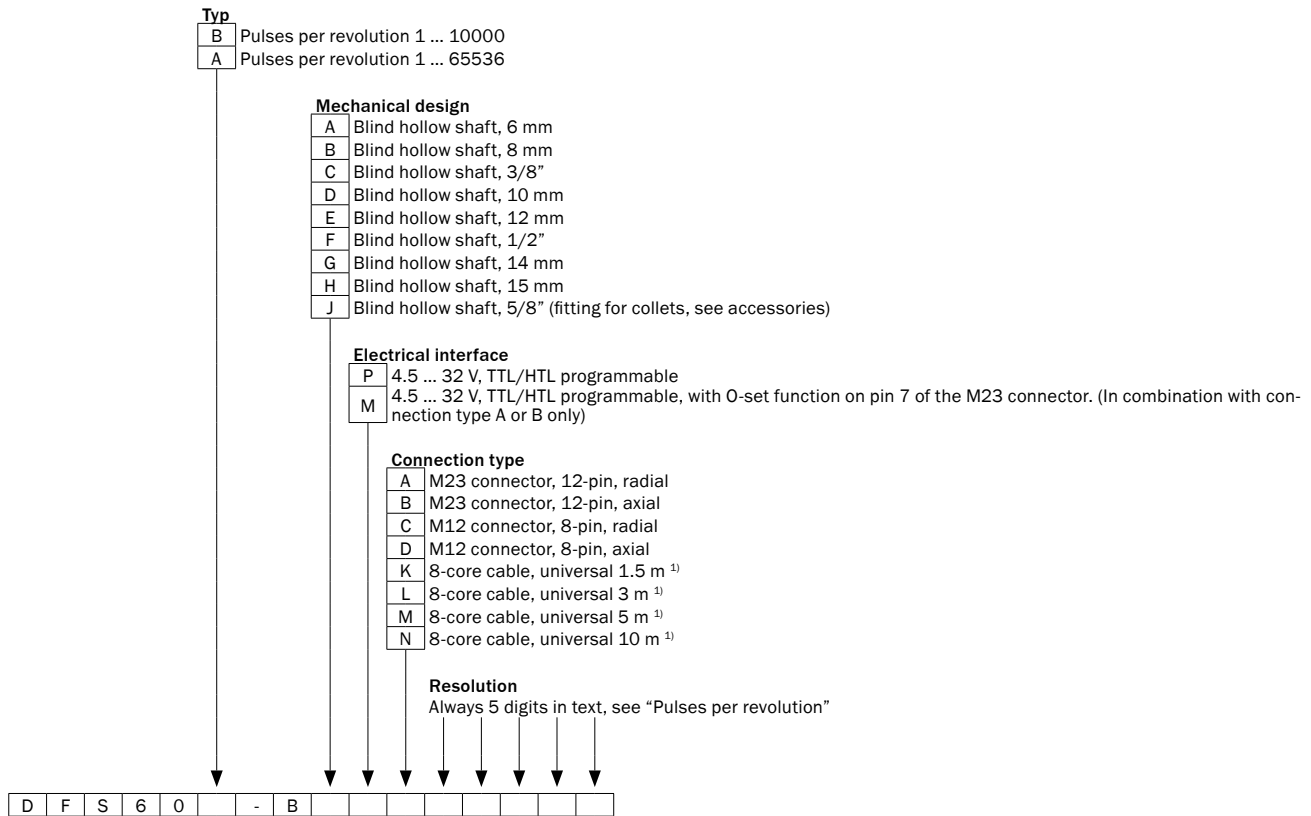
³⁾ Flexible position of the cable.

Solid shaft, not programmable



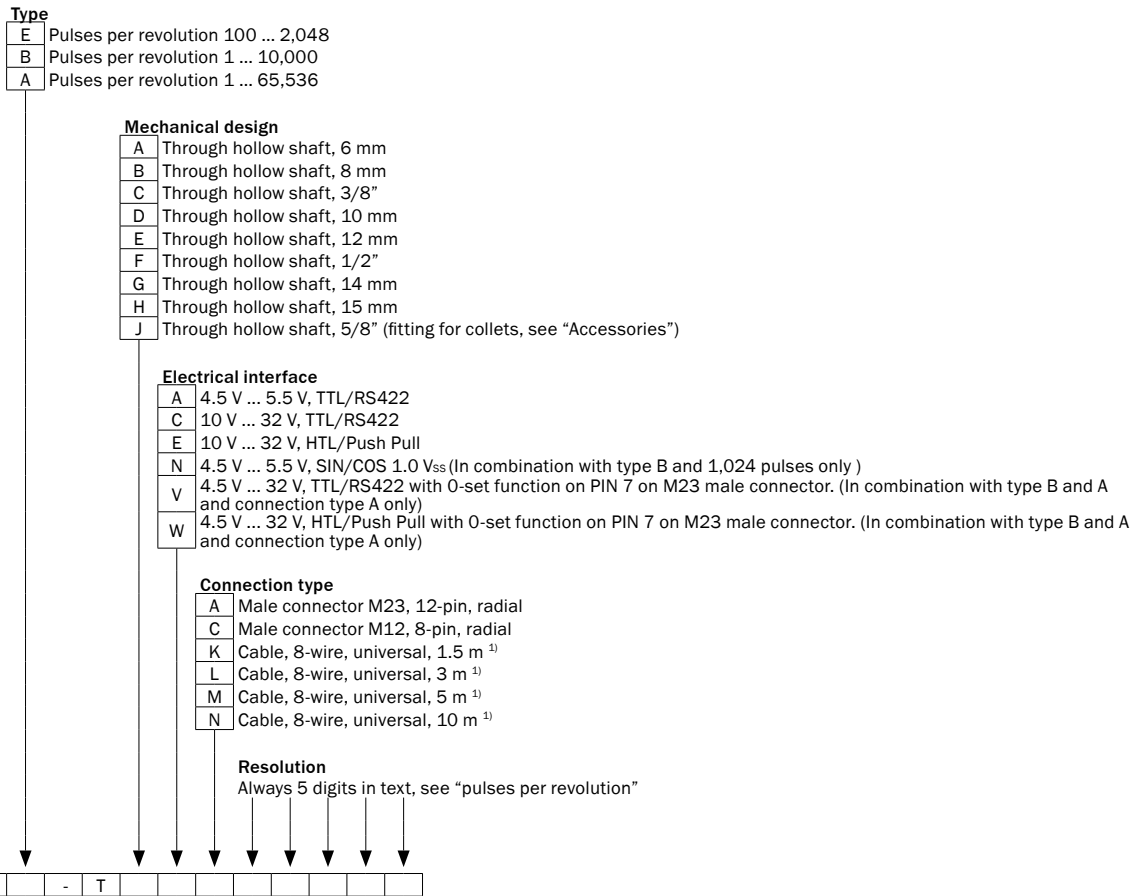
¹⁾ The universal cable outlet is positioned in such a way that kink-free laying in radial or axial direction is possible.

Blind hollow shaft, programmable



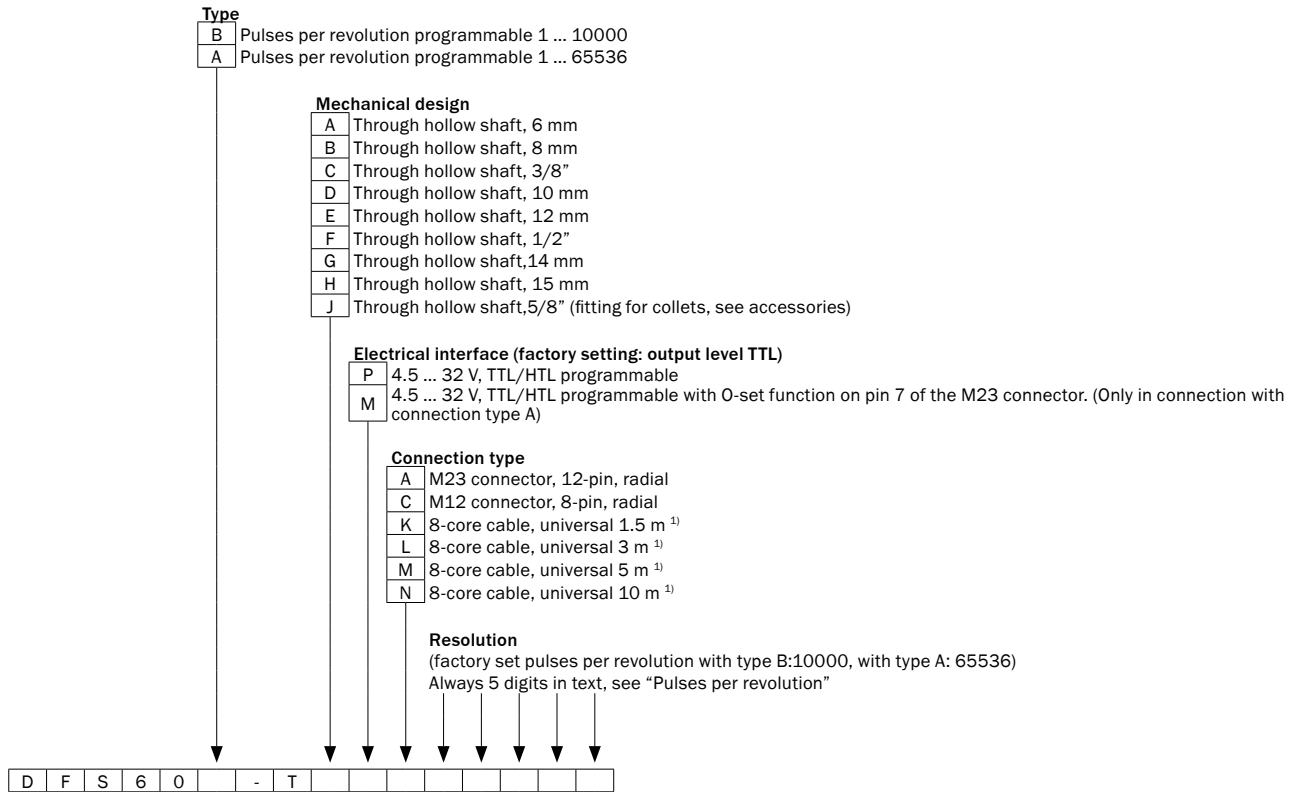
¹⁾ The universal cable outlet is positioned in such a way that kink-free laying in radial or axial direction is possible.

Through hollow shaft, not programmable



¹⁾ The universal cable outlet is positioned so that it is possible to lay it without bends in a radial and axial direction.

Through hollow shaft, programmable



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¹⁾ The universal cable outlet is positioned in such a way that kink-free laying in radial or axial direction is possible.

Pulses per revolution¹⁾

	E	B ²⁾	A ²⁾
Pulses per revolution	00100	00100	00100
	00200	00200	00200
	00250	00250	00250
	00256	00300	00300
	00314	00314	00314
	00360	00360	00360
	00500	00500	00500
	00512	00512	00512
	00720	00720	00720
	01000	01000	01000
	01024	01024	01024
	01250	01250	01250
	02000	02000	02000
	02048	02048	02048
		02500	02500
		03600	03600
		04000	04000
		04096	04096
		05000	05000
		07200	07200
		08192	08192
		10000	10000
			16384
			32768
			65536

¹⁾The electrical interface N (Sin/Cos 1.0 V_{pp}) can only be ordered with 1024 pulses per revolution.

²⁾others on request

Programmable functions

Pulses per revolution from 1 ... 65536 using programming tools PGT-08-S or PGT-10-Pro

Zero pulse width electrically 90°, 180°, 270° using programming tools PGT-08-S or PGT-10-Pro

Zero pulse width mechanically 1° ... 359° using programming tool PGT-10-Pro

Level of the output voltage TTL/HTL using programming tools PGT-08-S or PGT-10-Pro

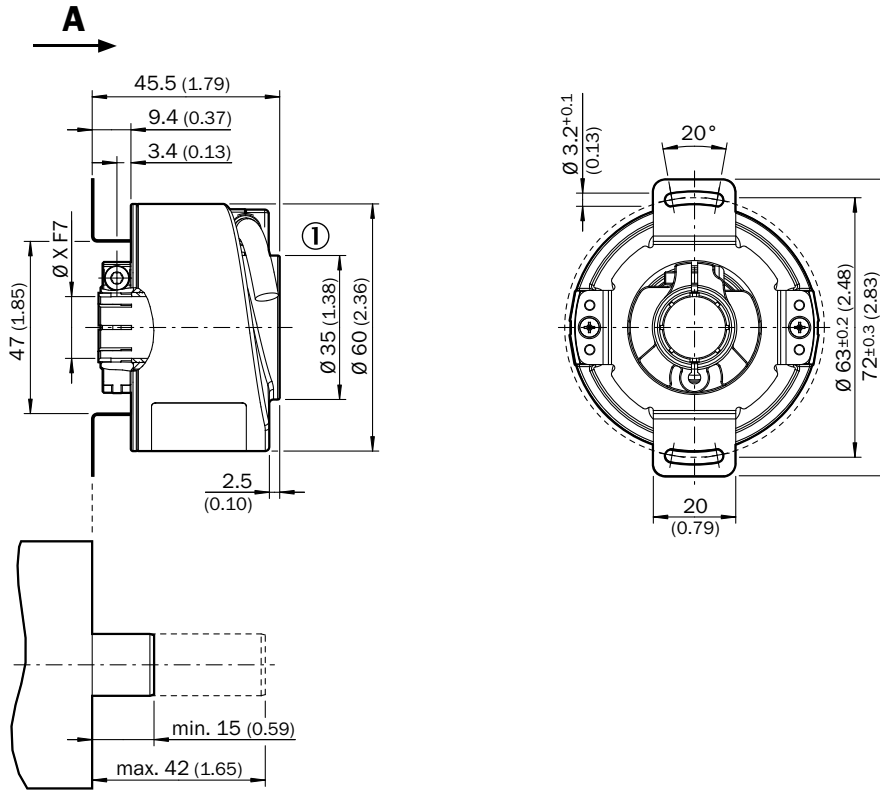
Counting direction CW/CCW using Programming-Tools PGT -08-S or PGT -10-Pro

0-SET function using programming tools PGT-08-S or PGT-10-Pro

0-SET function via PIN 7 of the M23 connector by applying U_s for at least 250 ms.

Dimensional drawings (Dimensions in mm (inch))

Blind hollow shaft, cable outlet

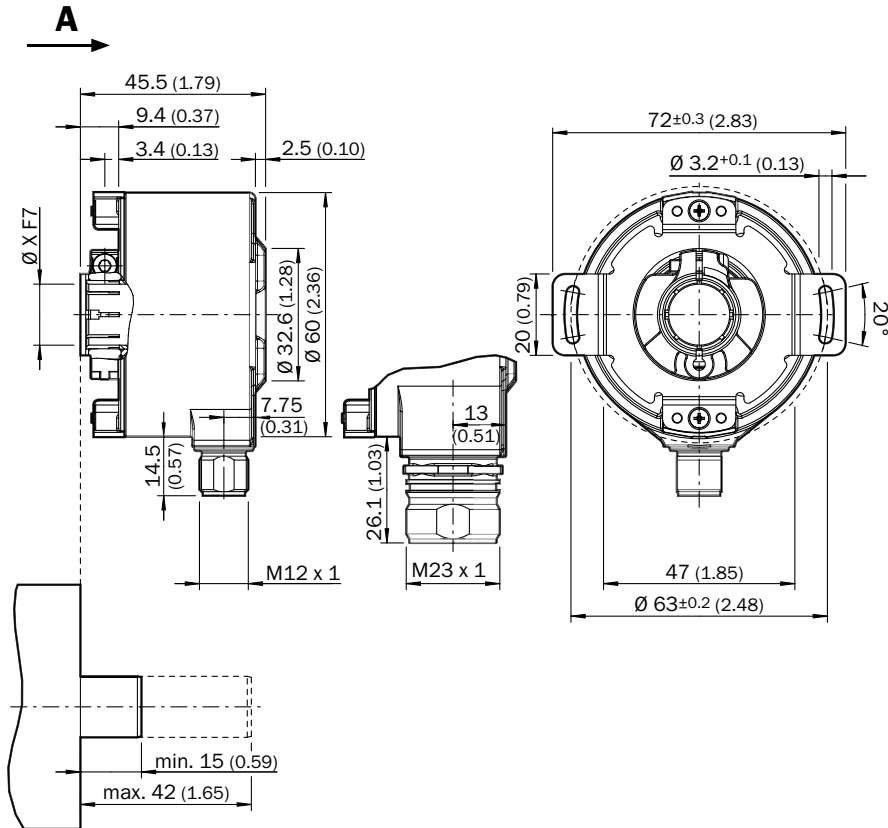


General tolerances according to DIN ISO 2768-mk

① Cable diameter = 5.6 mm +/- 0.2 mm bend radius = 30 mm

Type	Shaft diameter XF7	Shaft diameter xj7
Blind hollow shaft		
DFS60x-BAxxxxxxxx	6 mm	Provided by customer
DFS60x-BBxxxxxxxx	8 mm	
DFS60x-BCxxxxxxxx	3/8"	
DFS60x-BDxxxxxxxx	10 mm	
DFS60x-BExxxxxxxx	12 mm	
DFS60x-BFxxxxxxxx	1/2"	
DFS60x-BGxxxxxxxx	14 mm	
DFS60x-BHxxxxxxxx	15 mm	
DFS60x-BJxxxxxxxx	5/8"	

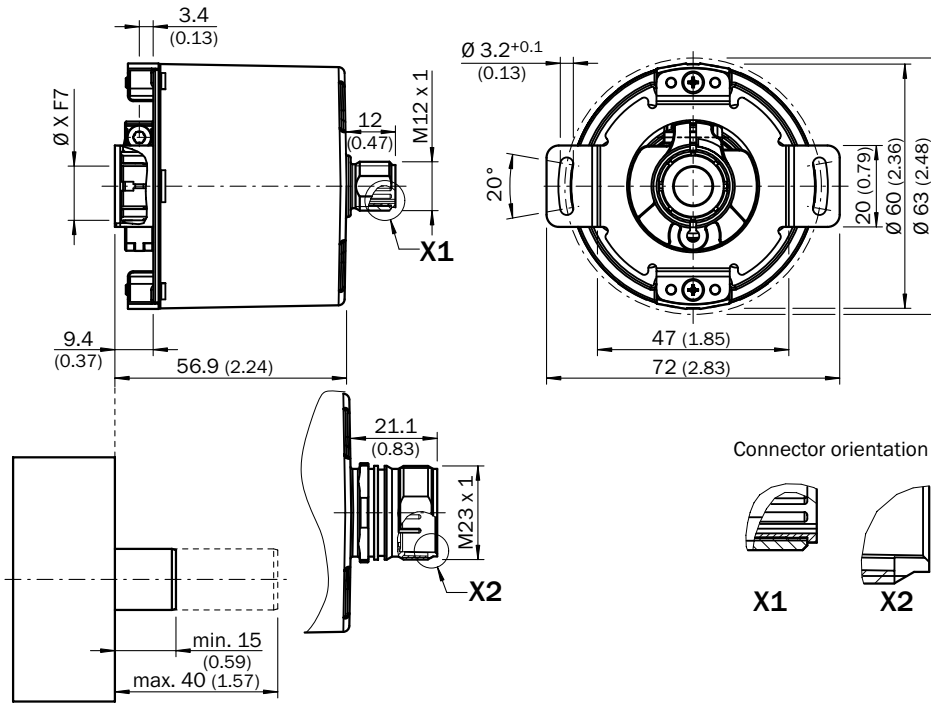
Blind hollow shaft, radial connector outlet M12 and M23



General tolerances according to DIN ISO 2768-mk

Type Blind hollow shaft	Shaft diameter XF7	Shaft diameter xj7
DFS60x-BAxxxxxxxx	6 mm	Provided by customer
DFS60x-BBxxxxxxxx	8 mm	
DFS60x-BCxxxxxxxx	3/8"	
DFS60x-BDxxxxxxxx	10 mm	
DFS60x-BExxxxxxxx	12 mm	
DFS60x-BFxxxxxxxx	1/2"	
DFS60x-BGxxxxxxxx	14 mm	
DFS60x-BHxxxxxxxx	15 mm	
DFS60x-BJxxxxxxxx	5/8"	

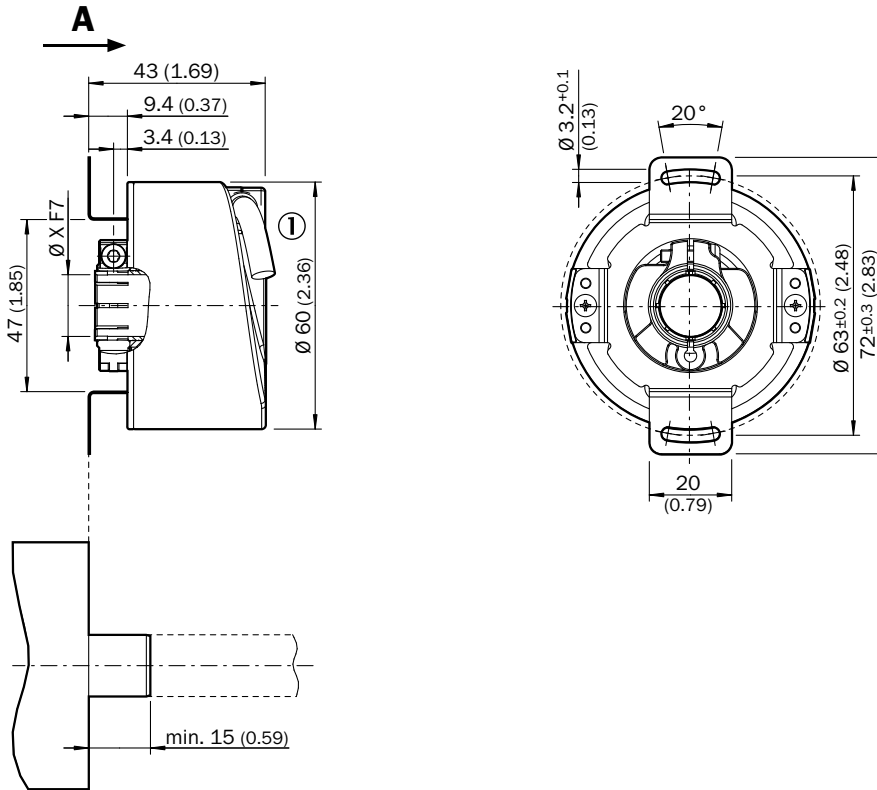
Blind hollow shaft, axial connector outlet M12 and M23



General tolerances according to DIN ISO 2768-mk

Type	Shaft diameter XF7	Shaft diameter xj7
Blind hollow shaft		
DFS60x-BAxxxxxxxx	6 mm	Provided by customer
DFS60x-BBxxxxxxxx	8 mm	
DFS60x-BCxxxxxxxx	3/8"	
DFS60x-BDxxxxxxxx	10 mm	
DFS60x-BExxxxxxxx	12 mm	
DFS60x-BFxxxxxxxx	1/2"	
DFS60x-BGxxxxxxxx	14 mm	
DFS60x-BHxxxxxxxx	15 mm	
DFS60x-BJxxxxxxxx	5/8"	

Through hollow shaft, cable outlet

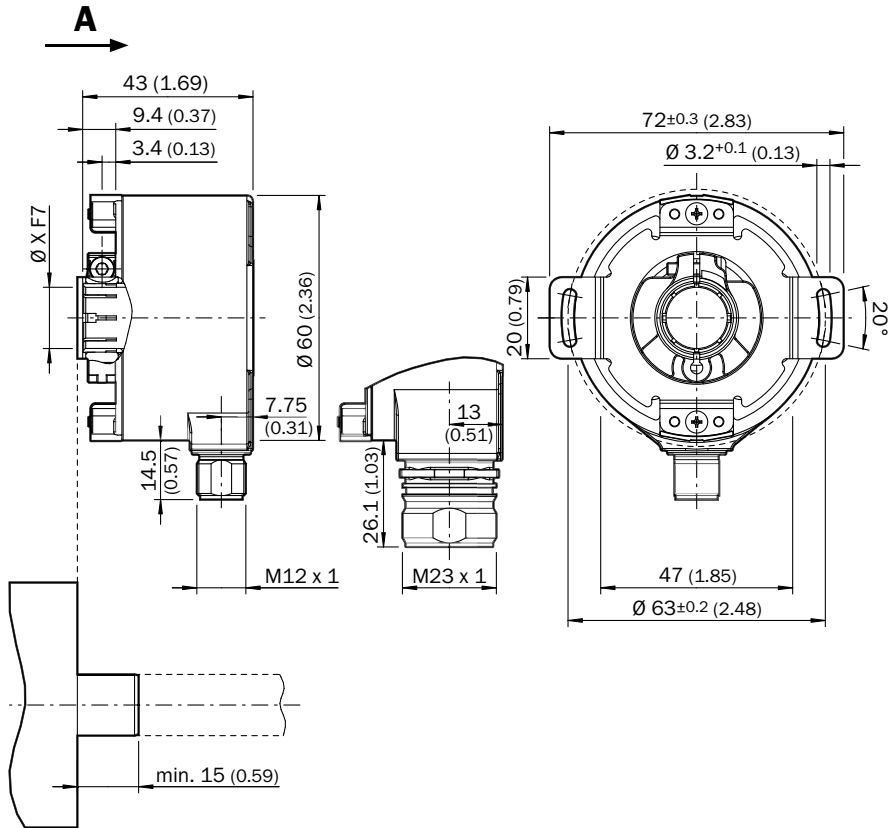


General tolerances according to DIN ISO 2768-mk

① Cable diameter = 5.6 mm +/- 0.2 mm bend radius = 30 mm

Type Through hollow shaft	Shaft diameter XF7	Shaft diameter xj7
DFS60x-TAxxxxxxx	6 mm	Provided by customer
DFS60x-TBxxxxxxx	8 mm	
DFS60x-TCxxxxxxx	3/8"	
DFS60x-TDxxxxxxx	10 mm	
DFS60x-TExxxxxxx	12 mm	
DFS60x-TFxxxxxxx	1/2"	
DFS60x-TGxxxxxxx	14 mm	
DFS60x-THxxxxxxx	15 mm	
DFS60x-TJxxxxxxx	5/8"	

Through hollow shaft, radial connector outlet M12 and M23

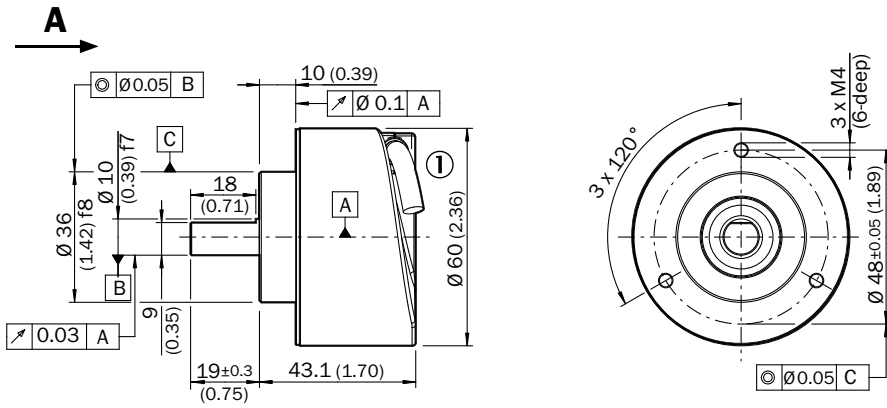


General tolerances according to DIN ISO 2768-mk

① Cable diameter = 5.6 mm +/- 0.2 mm bend radius = 30 mm

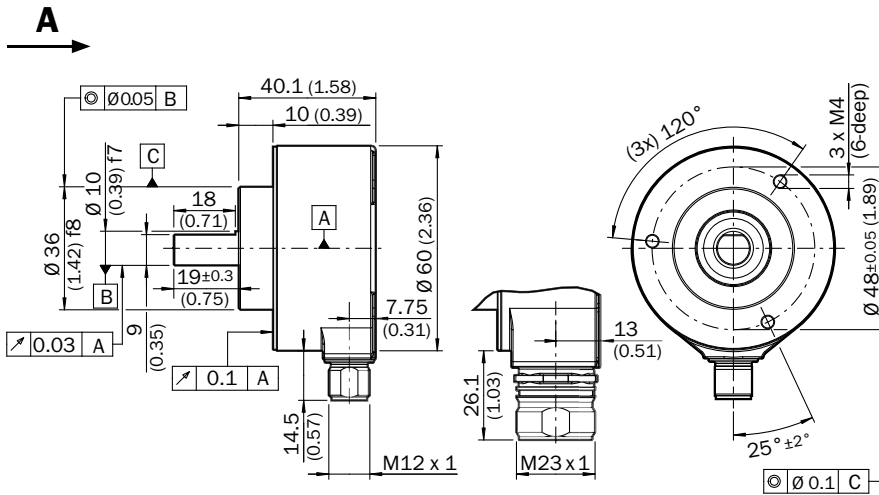
Type Through hollow shaft	Shaft diameter XF7	Shaft diameter xj7
DFS60x-TAxxxxxxx	6 mm	Provided by customer
DFS60x-TBxxxxxxx	8 mm	
DFS60x-TCxxxxxxx	3/8"	
DFS60x-TDxxxxxxx	10 mm	
DFS60x-TExxxxxxx	12 mm	
DFS60x-TFxxxxxxx	1/2"	
DFS60x-TGxxxxxxx	14 mm	
DFS60x-THxxxxxxx	15 mm	
DFS60x-TJxxxxxxx	5/8"	

Face mount flange, cable outlet



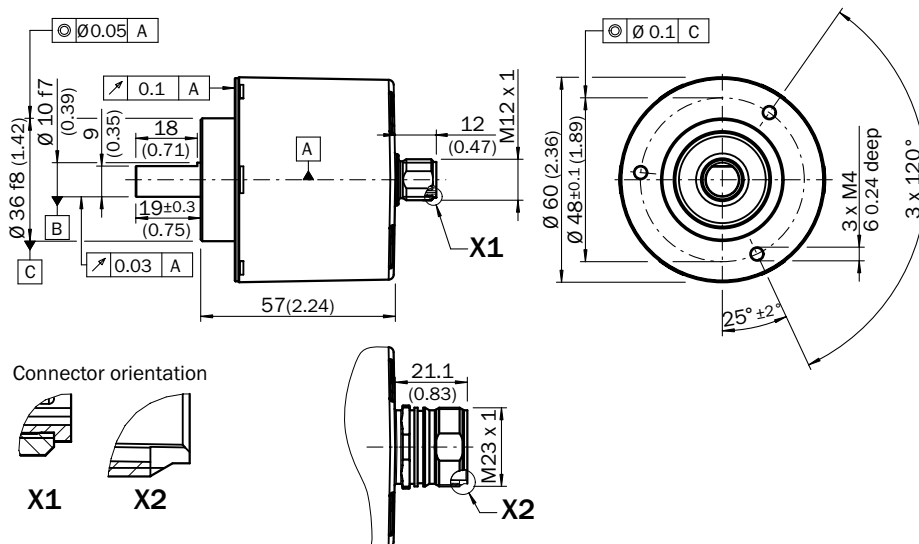
General tolerances according to DIN ISO 2768-mk
 ① Cable diameter = 5.6 mm +/- 0.2 mm bend radius = 30 mm

Face mount flange, radial connector outlet M12 and M23



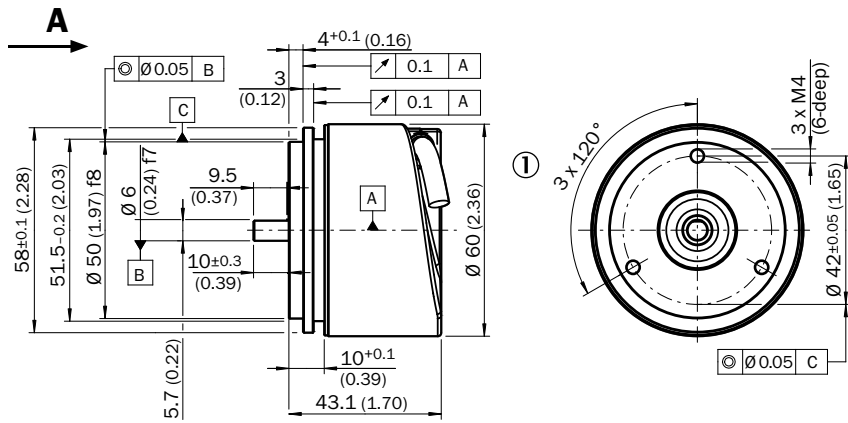
General tolerances according to DIN ISO 2768-mk

Face mount flange, axial connector outlet M12 and M23



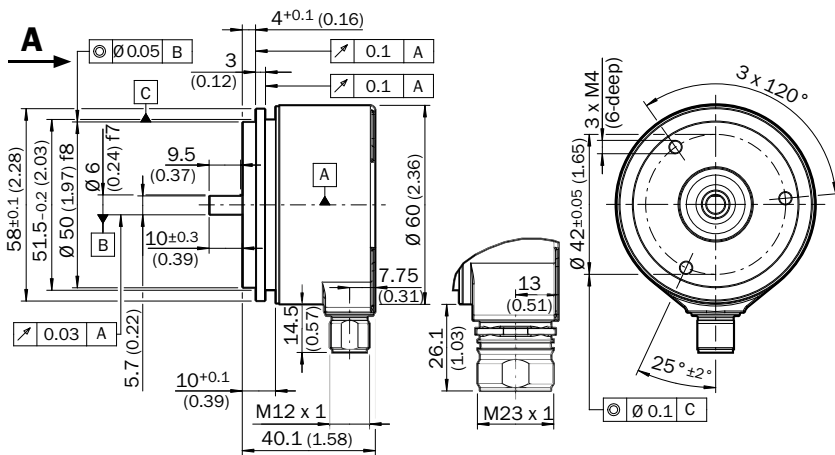
General tolerances according to DIN ISO 2768-mk

Servo flange, cable outlet



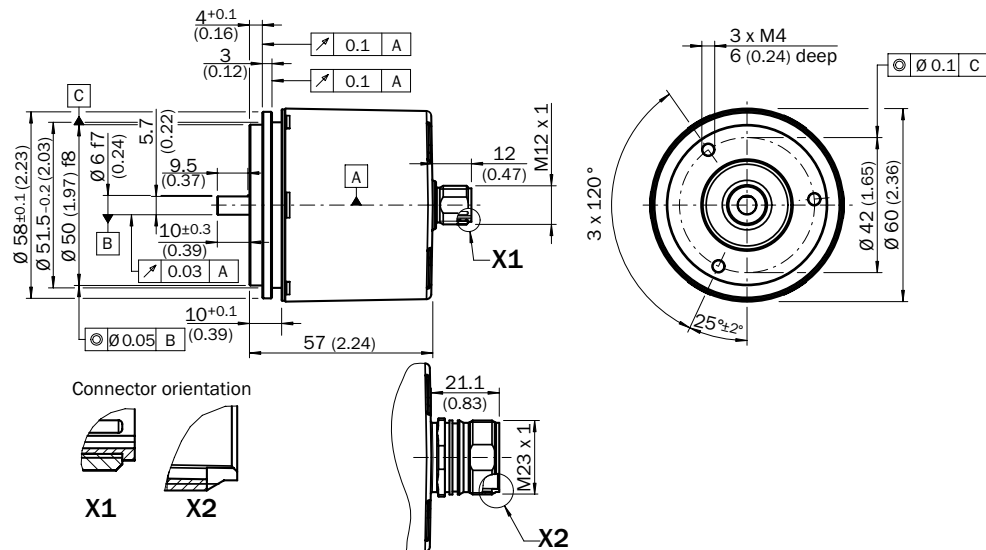
General tolerances according to DIN ISO 2768-mk
 ① Cable diameter = 5.6 mm +/- 0.2 mm bend radius = 30 mm

Servo flange, radial connector outlet M12 and M23



General tolerances according to DIN ISO 2768-mk

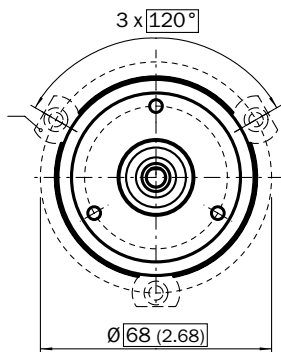
Servo flange, axial connector outlet M12 and M23



General tolerances according to DIN ISO 2768-mk

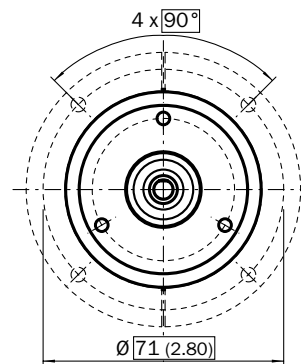
Proposed fitting

Proposed customer fitting for servo clamp small (part no. 2029166)



All dimensions in mm (inch)

Proposed customer fitting for servo clamp half-shell (part no. 2029165)

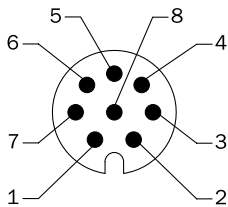


All dimensions in mm (inch)

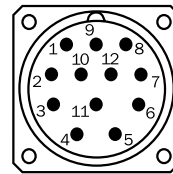
PIN assignment

Cable, 8-wire

View of M12 male device connector on encoder



View of M23 male device connector on encoder

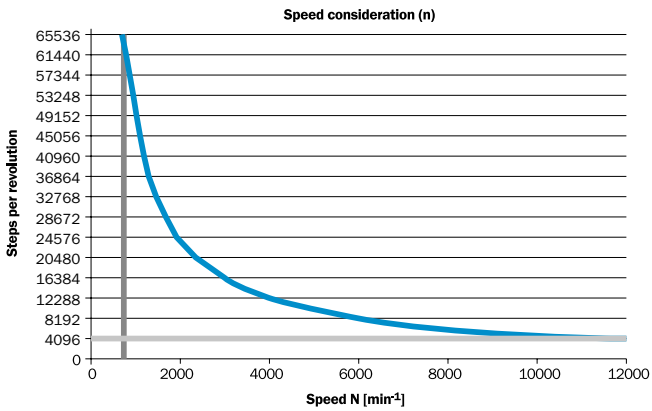


PIN, 8-pin, M12 male connector	PIN, 12-pin, M23 male connector	Color of the wires for encoders with cable outlet	TTL/HTL signal	Sin/cos 1.0 V _{SS}	Explanation
1	6	Brown	\bar{A}	COS-	Signal wire
2	5	White	A	COS+	Signal wire
3	1	Black	\bar{B}	SIN-	Signal wire
4	8	Pink	B	SIN+	Signal wire
5	4	Yellow	\bar{Z}	\bar{Z}	Signal wire
6	3	Violet	Z	Z	Signal wire
7	10	Blue	GND	GND	Ground connection of the encoder
8	12	Red	+U _s	+U _s	Supply voltage (volt-free to housing)
-	9	-	n.c.	n.c.	Not assigned
-	2	-	n.c.	n.c.	Not assigned
-	11	-	n.c.	n.c.	Not assigned
-	7 ¹⁾	-	O-SET ¹⁾	n.c.	Set zero pulse ¹⁾
Screen	Screen	Screen	Screen	Screen	Screen connected to housing on encoder side. Connected to ground on control side.

¹⁾ For electrical interfaces only: M, U, V, W with O-SET function on PIN 7 on M23 male connector. The O-SET input is used to set the zero pulse on the current shaft position. If the O-SET input is connected to U_s for longer than 250 ms after it had previously been unassigned for at least 1,000 ms or had been connected to the GND, the current position of the shaft is assigned to the zero pulse signal "Z".

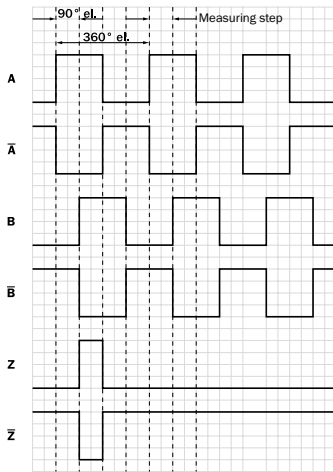
Maximum revolution range

Maximum revolution range



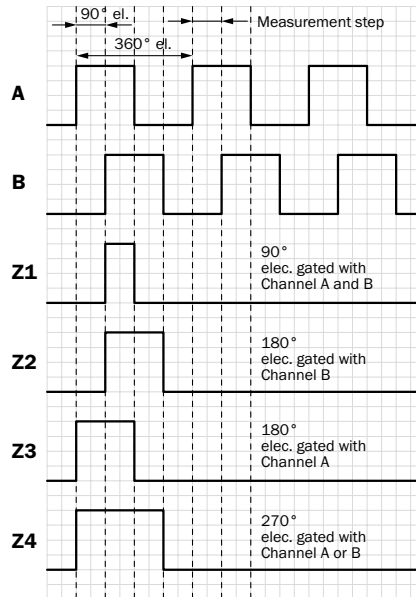
Signal outputs

Signal outputs



CW with view on the encoder shaft in direction "A", compare dimensional drawing.

Electrical zero pulse width can be configured to 90°, 180°, or 270°. Width of the zero pulse in relation to a pulse period.



CW with view on the encoder shaft in direction "A", compare dimensional drawing.