HEIDENHAIN

Functional Safety

Product Information

ECN 1123
EQN 1135

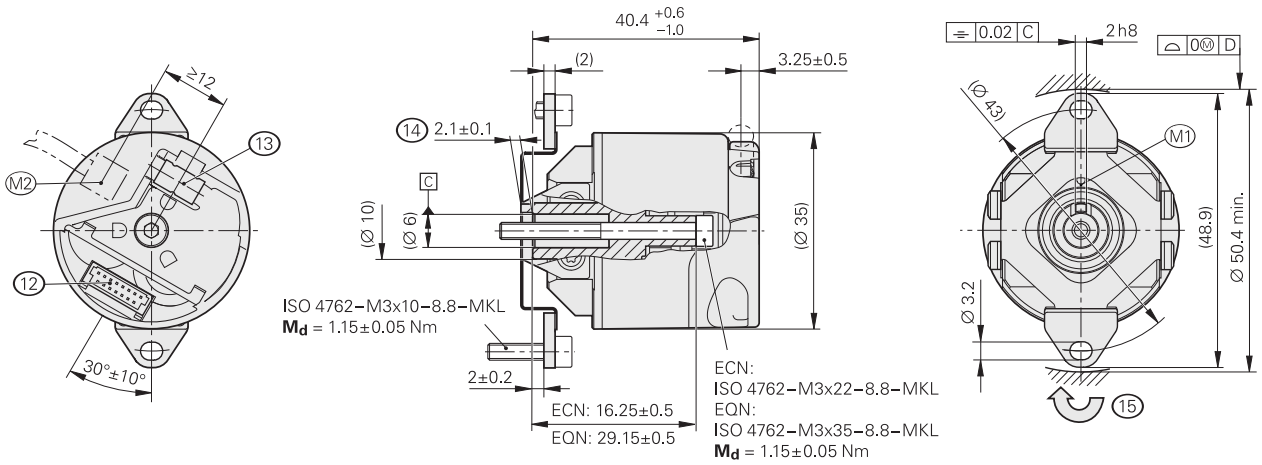
Absolute Rotary Encoders with Interlocking Hollow Shaft for Safety-Related Applications

11/2015

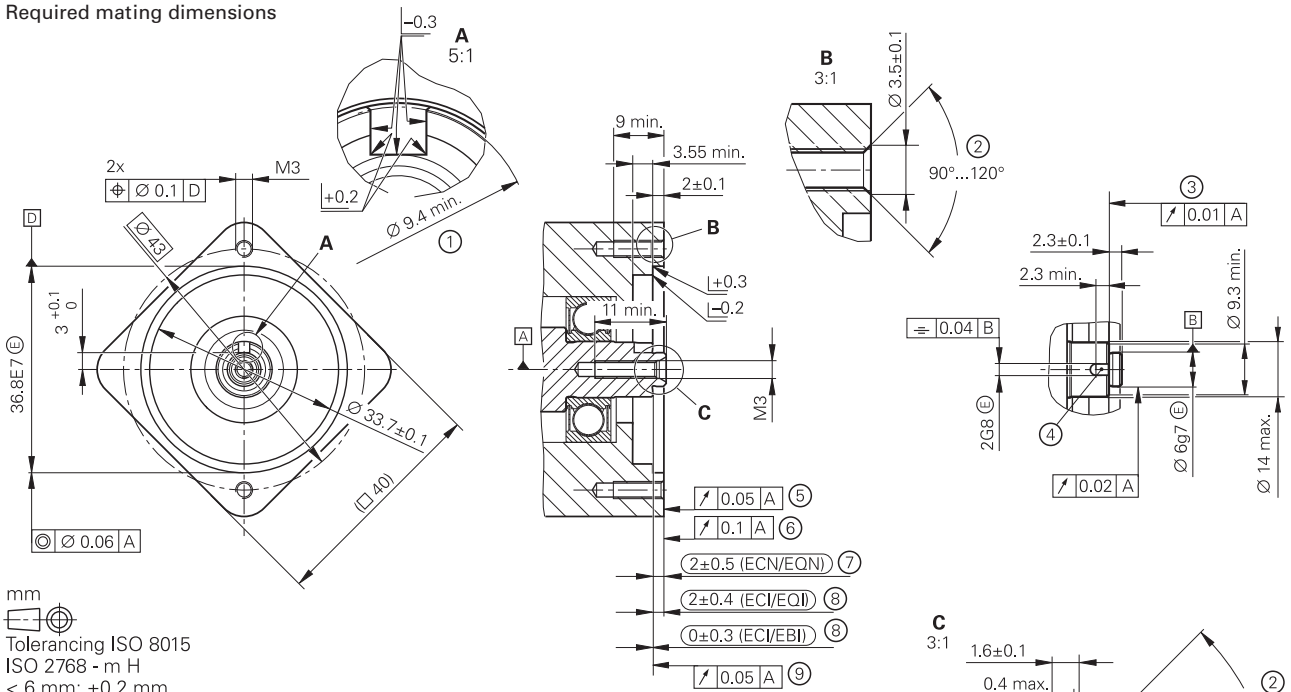
ECN 1123, EQN 1135

Rotary encoders for absolute position values with safe singleturn information

- **Mounted stator coupling, 75A**
- **Blind hollow shaft Ø 6 mm for axial clamping (1KA)**

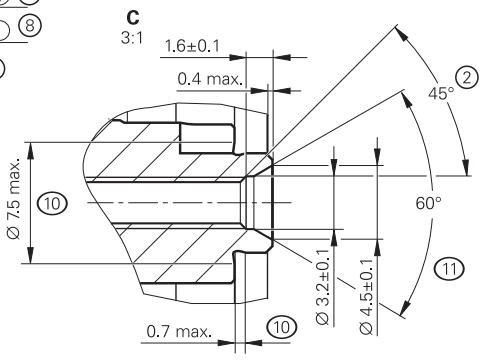


Required mating dimensions



mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm



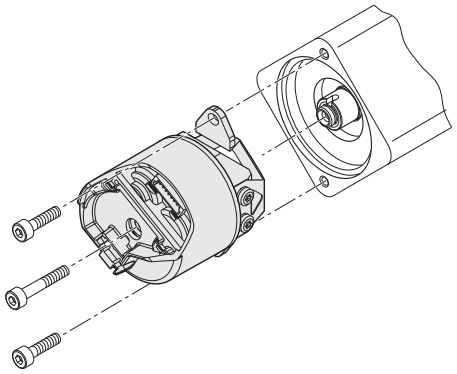
A = Bearing of mating shaft
M1 = Measuring point for operating temperature
M2 = Measuring point for vibration
1 = Contact surface of slot
2 = Chamfer is obligatory at start of thread for materially bonding anti-rotation lock
3 = Shaft; ensure full-surface contact!
4 = Slot required only for ECN/EQN and ECI/EQI with WELLA1 = 1KA
5 = Flange surface ECI/EQI FS; ensure full-surface contact!
6 = Coupling surface of ECN/EQN
7 = Maximum permissible deviation between shaft and flange surfaces. Compensation of mounting tolerances and thermal expansion, for which ±0.15 mm of dynamic axial motion is permitted
8 = Maximum permissible deviation between shaft and flange surfaces. Compensation of mounting tolerances and thermal expansion
9 = Flange surface of ECI/EBI; ensure full-surface contact!
10 = Undercut
11 = Possible centering hole
12 = PCB connector, 15-pin
13 = Cable outlet for cables with crimp sleeve, diameter 4.3 ±0.1 – 7 long
14 = Positive fit element. Ensure correct engagement in slot 4, e.g. by measuring the device overhang
15 = Direction of shaft rotation for output signals as per the interface description

Specifications	ECN 1123 – Singleturn	EQN 1135 – Multiturn
These data apply for	ID 743586-01	ID 743587-01
Functional safety For applications up to	As single-encoder system for monitoring functions • SIL 1 according to EN 61508 (further basis for testing: EN 61800-5-2) • Category 2, PL c according to EN ISO 13849-1:2008 As single-encoder system for closed-loop functions • SIL 2 according to EN 61508 (further basis for testing: EN 61800-5-2) • Category 3, PL d according to EN ISO 13849-1:2008 Safe in the singleturn range	
PFH	≤ 15 x 10^{-9} (probability of a dangerous failure per hour)	
Safe position [1]	*Encoder:* ± 1.75° (safety-related measuring step: SM = 0.7°) *Mechanical coupling:* ± 2° (fault exclusion for loosening of shaft and stator coupling, designed for accelerations of ≤ 300 m/s^2)	
Interface	EnDat 2.2	
Ordering designation	EnDat 22	
Position values/revolution	8 388 608 (23 bits)	
Revolutions	-	4096 (12 bits)
Calculation time t_{cal} Clock frequency	≤ 7 µs ≤ 8 MHz	
System accuracy	± 60"	
Electrical connection	15-pin PCB connector (with connection for external temperature sensor [3])	
Cable length	≤ 100 m (see EnDat description in the *Interfaces of HEIDENHAIN Encoders* catalog)	
Voltage supply	DC 3.6 V to 14 V	
Power consumption [2] (maximum)	*At 3.6 V:* ≤ 600 mW *At 14 V:* ≤ 700 mW	*At 3.6 V:* ≤ 700 mW *At 14 V:* ≤ 800 mW
Current consumption (typical)	*At 5 V:* 85 mA (without load)	*At 5 V:* 105 mA (without load)
Shaft	Blind hollow shaft Ø 6 mm with positive locking element (1KA)	
Speed	≤ 12 000 rpm	
Starting torque [4] at 20 °C	≤ 0.001 Nm	≤ 0.002 Nm
Moment of inertia	*Rotor:* 0.4 × 10^{-6} kgm^2 ; *Stator:* 1.0 × 10^{-5} kgm^2	
Angular acceleration	*Rotor:* ≤ 1 × 10^5 rad/s^2 ; *Stator:* ≤ 1 × 10^4 rad/s^2	
Axial motion of measured shaft	≤ ± 0.5 mm	
Natural frequency of stator coupling	≥ 1000 Hz	
Vibration 55 to 2000 Hz **Shock** 6 ms	≤ 200 m/s^2 (EN 60 068-2-6); 10 Hz to 55 Hz constant over distance 3.2 mm peak to peak ≤ 2000 m/s^2 (EN 60 068-2-27)	
Operating temperature	–40 °C to 110 °C	
Trigger threshold of error message for excessive temperature	125 °C (measuring accuracy of internal temperature sensor: ± 5 K)	
Relative humidity	≤ 93 % (40 °C/21 d according to EN 60068-2-78) without condensation	
Protection EN 60 529	IP 40 (see *Insulation* under *General mechanical information* in the *Encoders for Servo Drives* catalog; contamination through ingress of liquids must be avoided)	
Mass	≈ 0.1 kg	

1) Further tolerances possible in subsequent electronics after position value comparison (contact subsequent electronics manufacturer)
2) See *General electrical information* in the *Interfaces of HEIDENHAIN Encoders* catalog
3) See *Temperature measurement in motors* in the *Encoders for Servo Drives* catalog.
4) Note the maximum torque when designing the mechanical fault exclusion (page 4)

Mounting

The blind hollow shaft of the rotary encoder is slid onto the motor's drive shaft and fastened with a central screw. It is particularly important to ensure that the positive-locking element of the encoder shaft securely engages the corresponding slot in the measured shaft. The stator is connected without a centering collar to a flat surface with two clamping screws. Use screws with materially bonding anti-rotation locking (see *Mounting accessories*).



Conditions required on the motor side for a safe mechanical connection:

	Mating shaft	**Mating stator**
Material	Steel	Aluminum
Tensile strength R_m	≥ 600 N/mm²	≥ 220 N/mm²
Shear strength τ_m	-	≥ 150 N/mm²
Interface pressure P_G	≥ 500 N/mm²	≥ 200 N/mm²
Surface roughness R_Z	≤ 10 µm	≤ 10 µm
Coefficient of expansion α_{therm}	(10 to 17) × 10^{-6} K^{-1}	≤ 25 × 10^{-6} K^{-1}
Torque to be absorbed [1]	≤ 0.51 Nm + $\alpha_R \times J_R$	≤ 0.55 Nm + $\alpha_S \times J_S$

1) Relative to the encoder-shaft rotational axis; where α_R, α_S: angular acceleration of rotor/stator (according to the application) and J_R, J_S: moment of inertia of rotor/stator (see *Specifications*)

Mounting accessories

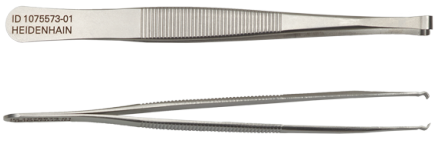
Screws
Screws (central screw, mounting screws) are not included in delivery. They can be ordered separately.

	Screws [1]		**Lot size**
Central screw for ECN 1123	ISO 4762-**M3×22**-8.8-**MKL**	ID 202264-65	10 or 100 pieces
Central screw for EQN 1135	ISO 4762-**M3×35**-8.8-**MKL**	ID 202264-66	
Mounting screw for flange	ISO 4762-**M3×10**-8.8-**MKL**	ID 202264-87	20 or 200 pieces

1) With coating for materially bonding anti-rotation lock

Please note the information on screws from HEIDENHAIN in the catalog titled *Encoders for Servo Drives*, chapter *General mechanical information* under *Rotary encoders with functional safety*.

Mounting aid
The mounting aid serves to plug and unplug the PCB connector. It prevents damage to the cable because the strain is applied only to the connector. The wires themselves must not be strained.



ID 1075573-01

For further mounting information and mounting aids see the Mounting Instructions and the *Encoders for Servo Drives* catalog.

Electrical Connection – Cable

Cables inside the motor housing			
Complete with PCB connector (15-pin) and M12 flange socket (male), 8-pin; individual TPE wires with net sleeve and wires for temperature sensor		TPE 10×0.16 mm² [1]	ID 1117412-xx
With one PCB connector (15-pin); Ø 3.7 mm EPG (with shield crimping Ø 4.5 mm) and wires for temperature sensor		EPG (1×4×0.06 mm²) [1] TPE 2×0.16 mm²	ID 1108078-xx

1) Individual wires with net sleeve; shield required at motor
Note for safety-related applications: Provide bit error rate as per specification 533095!

PUR connecting cable Ø 6 mm; [(4×0.14 mm²) + (4×0.34 mm²); A_P = 0.34 mm²		**M12** connector, 8-pin	**M23** connector, 9-pin
Complete with connector (female) and M12 coupling (male), 8 pins each, or M23 coupling (male), 9-pin		ID 368330-xx	ID 745796-xx
Complete with 8-pin M12 connector (female) and 15-pin D-sub connector (female)		ID 533627-xx	-
Complete with 8-pin M12 connector (female) and 15-pin D-sub connector (male)		ID 524599-xx	-
With one 8-pin M12 connector (female)		ID 634265-xx [1]	-

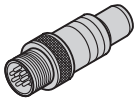
A_P: Cross section of power supply lines

1) Connecting element must be suitable for the maximum clock frequency used.
Note for safety-related applications: Provide bit error rate as per specification 533095!

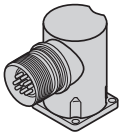
Electrical connection – pin layout

Pin layout

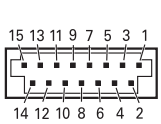
8-pin coupling or flange socket M12



9-pin M23 right-angle socket



15-pin PCB connector



	Voltage supply				Absolute position values				Other signals [1]	
M12	**8**	**2**	**5**	**1**	**3**	**4**	**7**	**6**	**/**	**/**
M23	**3**	**7**	**4**	**8**	**5**	**6**	**1**	**2**	**/**	**/**
	13	**11**	**14**	**12**	**7**	**8**	**9**	**10**	**5**	**6**
	U_P	Sensor **U_P**	**0 V**	Sensor **0 V**	**DATA**	**$\overline{\text{DATA}}$**	**CLOCK**	**$\overline{\text{CLOCK}}$**	**T+** [2]	**T-** [2]
	Brown/ Green	Blue	White/ Green	White	Gray	Pink	Violet	Yellow	Brown	[3]

1) Only with adapter cables inside the motor
2) Connections for external temperature sensor; evaluation optimized for KTY 84-130 (see *Temperature measurement in motors* in the *Encoders for Servo Drives* catalog); connection in the M23 flange socket
3) **White** with M23 flange socket; **green** with M12 flange socket

Cable shield connected to housing; **Up** = Power supply
Sensor: The sensor line is connected in the encoder with the corresponding power line
Vacant pins or wires must not be used!
Note for safety-oriented applications: Only HEIDENHAIN cables complete with connectors are qualified for use. Exchange connectors or modify cables only after consultation with HEIDENHAIN Traunreut.

HEIDENHAIN

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This Product Information supersedes all previous editions, which thereby become invalid. The basis for ordering from HEIDENHAIN is always the Product Information valid when the contract is made.

Related documents: Adhere to the information in the following documents to ensure the correct and intended operation of the encoder:
- Catalog: *Position Encoders for Servo Drives:* 208922-xx
- Mounting Instructions for *ECN 1123, EQN 1135:* 749296-xx
- Technical Information: *Safety-Related Position Measuring Systems:* 596632
- For implementation in a safe control or inverter: *Specification*: 533095

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