HEIDENHAIN

Functional Safety

Product Information

ECN 1123
EQN 1135

Absolute Rotary Encoders with 1KA Positive-Locking Hollow Shaft for Safety-Related Applications

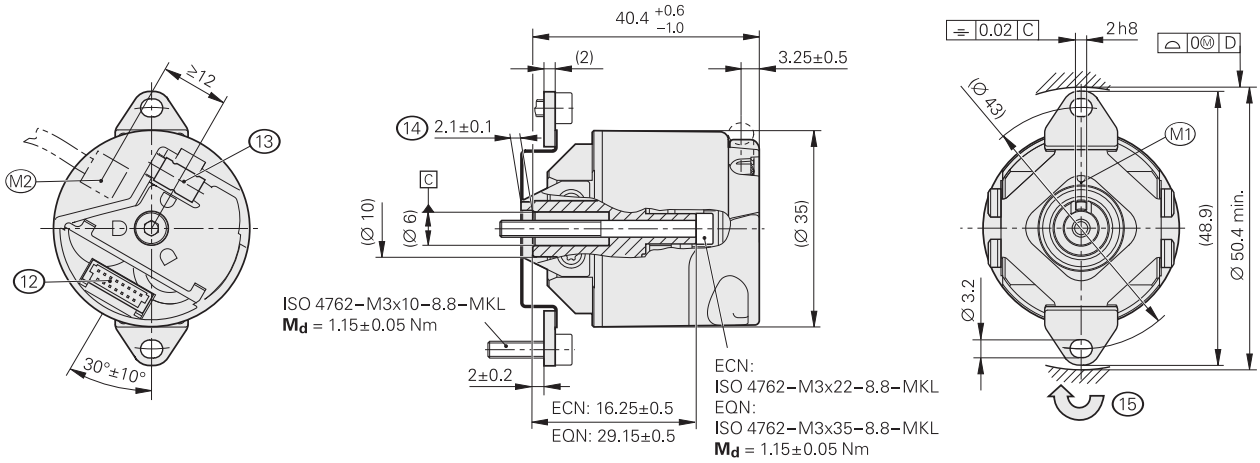
06/2018

ECN 1123, EQN 1135

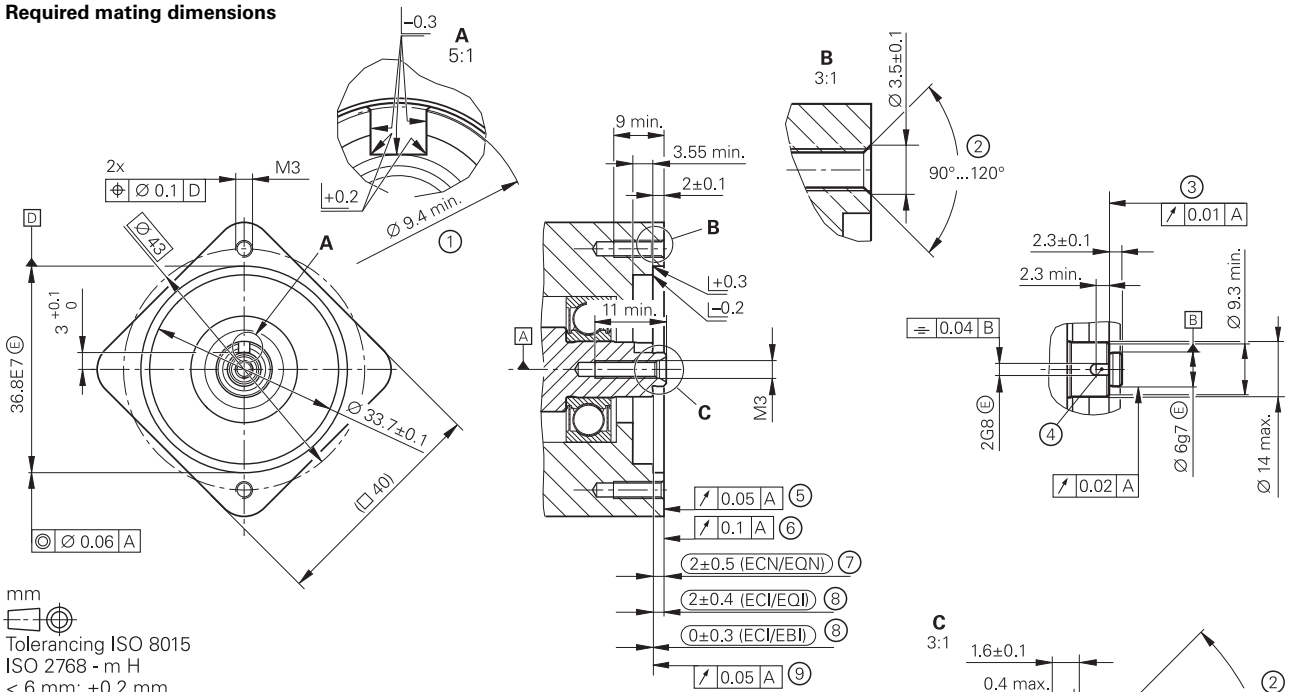
Rotary encoders for absolute position values with safe singleturn information

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

Functional Safety



Required mating dimensions



mm

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

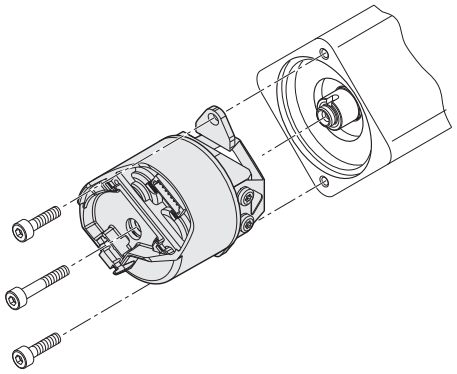
A = Bearing of mating shaft
M1 = Measuring point for operating temperature
M2 = Measuring point for vibration
1 = Contact surface of slot
2 = Chamfer is obligatory at start of thread for materially bonding anti-rotation lock
3 = Shaft surface; ensure full-surface contact!
4 = Slot required only for ECN/EQN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

Specifications	ECN 1123 – Singleturn	EQN 1135 – Multiturn
ID number	743586-01	743587-01
Functional safety for applications up to	As single-encoder system for monitoring functions: • SIL 1 as per EN 61508 (further basis for testing: EN 61800-5-2) • Category 2, PL c as per EN ISO 13849-1:2015 As single-encoder system for closed-loop functions: • SIL 2 as per EN 61508 (further basis for testing: EN 61800-5-2) • Category 3, PL d as per EN ISO 13849-1:2015 Safe in singleturn operation	
PFH	≤ $15 \cdot 10^{-9}$ (probability of 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 coupling and stator coupling; designed for accelerations of ≤ 300 m/s²)	
Interface	EnDat 2.2	
Ordering designation	EnDat22	
Position values per rev.	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* brochure)	
Supply voltage	DC 3.6 V to 14 V	
Power consumption [2] (max.)	*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:* $0.4 \cdot 10^{-6}$ kgm²; *stator:* $1.0 \cdot 10^{-5}$ kgm²	
Angular acceleration	*Rotor:* ≤ $1 \cdot 10^{5}$ rad/s²; *stator:* ≤ $1 \cdot 10^{4}$ rad/s²	
Axial motion of measured shaft	≤ ±0.5 mm	
Natural frequency of stator coupling	≥ 1000 Hz	
Vibration 55 Hz to 2 000 Hz **Shock** 6 ms	≤ 200 m/s² (EN 60068-2-6); 10 Hz to 55 Hz constant over 3.2 mm peak to peak ≤ 2000 m/s² (EN 60068-2-27)	
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 as per EN 60068-2-78); condensation excluded	
Protection EN 60529	IP40 (see *Insulation* under *General mechanical information* in the *Encoders for Servo Drives* brochure; contamination from the ingress of liquid must be prevented)	
Mass	≈ 0.1 kg	

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

Mounting

The blind hollow shaft of the rotary encoder is slid onto the measured 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 lock (see *Mounting accessories*).



The following material properties and conditions must be complied with when planning and executing customer-side installation:

	Mating stator	**Mating shaft**
Material	Aluminum	Steel
Tensile strength R_a	≥ 220 N/mm^2	≥ 600 N/mm^2
Yield strength $R_{p0.2}$ or yield point R_e	-	≥ 400 N/mm^2
Shear strength τ_a	130 N/mm^2	≥ 390 N/mm^2
Interface pressure P_G	≥ 250 N/mm^2	≥ 660 N/mm^2
Modulus of Elasticity E (at 20 °C)	70 kN/mm^2 to 75 kN/mm^2	200 kN/mm^2 to 215 kN/mm^2
Coefficient of thermal expansion α_{therm} (at 20 °C)	≤ 25 · 10^{-6} K^{-1}	10 · 10^{-6} K^{-1} to 17 · 10^{-6} K^{-1}
Surface roughness R_Z	≤ 16 µm	
Friction values	Mounting surfaces must be clean and free of grease. Use screws and washers in the condition as delivered.	
Tightening process	Use a signaling torque tool as per DIN EN ISO 6789; accuracy ±6 %	
Mounting temperature	15 °C to 35 °C	

When designing the mechanical fault exclusion for the shaft connection, use the following maximum torque M_{max}:
M_{max} = 1.0 Nm

The mechanical design on the customer side must ensure that the maximum torque M_{max} occurring in the application can be transmitted.

Mounting accessories

Screws
Screws are not included in delivery. They can be ordered separately.

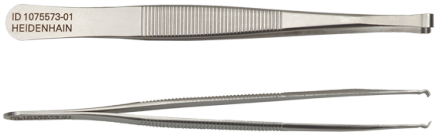
	Screws [1]		Lot size
Central screw for ECN 1123	ISO 4762-**M3×22**-8.8-**MKL**	ID 202264-65	10 or 100
Central screw for EQN 1135	ISO 4762-**M3×35**-8.8-**MKL**	ID 202264-66	
Mounting screw for flange	ISO 4762-**M3×10**-8.8-**MKL**	ID 202264-87	20 or 200

1) With coating for materially bonding anti-rotation lock

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

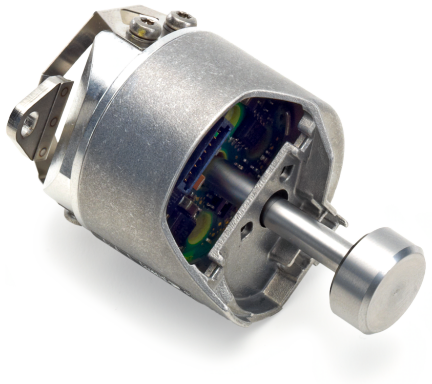
Mounting aid
To avoid damage to the cable, use the mounting aid to connect and disconnect the cable assembly. The pulling force must be applied only to the connector of the cable assembly, and not to the wires.

ID 1075573-01



Mounting aid
This tool is for turning the encoder shaft from the rear, thereby making it easy to find the positive-locking connection between the encoder shaft and the measured shaft.

ID 821017-03



Output cables inside the motor housing		
Complete with 15-pin PCB connector and 8-pin M12 flange socket (male); TPE single wires in braided sleeve and wires for temperature sensor		TPE 10 × 0.16 mm² [1) 2)] ID 1117412-xx
One 15-pin PCB connector and free cable end (unstripped); Ø 3.7 mm EPG (with shield crimp sleeve: Ø 4.3 mm) and wires for temperature sensor		EPG 1 × (4 × 0.06 mm²) + 4 × 0.06 mm² [2)] TPE 2 × 0.16 mm² ID 1108078-xx

1) Single wires with braided sleeve
2) Shield connection required on the motor side
Note for safety-related applications: Document the bit error rate in accordance with Specification 533095!

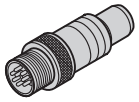
PUR adapter cables and connecting cables Ø 6 mm; 2 × (2 × 0.09 mm²) + 2 × (2 × 0.16 mm²); A_P = 0.16 mm²		**8-pin M12 connector**
Adapter cable with 8-pin M12 connector (female) and 15-pin D-sub connector (male) for IK 215, PWM 21, EIB 741, etc.		ID 1036526-xx
Adapter cable with 8-pin angled M12 connector (female) and 15-pin D-sub connector (male) for IK 215, PWM 21, EIB 741, etc.		ID 1133855-xx
Connecting cable with 8-pin M12 connector (female) and 8-pin M12 coupling (male)		ID 1036372-xx
Connecting cable with 8-pin angled M12 connector (female) and 8-pin M12 coupling (male)		ID 1036386-xx
Connecting cable with 8-pin M12 connector (female) and free cable end (unstripped)		ID 1129581-xx [1)]
Connecting cable with 8-pin angled M12 connector (female) and free cable end (unstripped)		ID 1133799-xx [1)]

A_P: Cross section of power supply lines
1) Use connecting elements for 8 MHz signal transmission
Note for safety-related applications:
- Document the bit error rate in accordance with Specification 533095!
- CE compliance of the complete system must be documented!

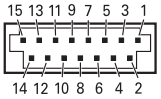
Electrical connection – pin layout

Pin layout

8-pin M12 coupling or flange socket



15-pin PCB connector



	Power supply				Serial data transfer				Other signals [1]	
M12	**8**	**2**	**5**	**1**	**3**	**4**	**7**	**6**	**/**	**/**
	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	Green

1) Only for encoder cables within the motor housing
2) Connections for external temperature sensor; evaluation optimized for KTY 84-130 (see *Temperature measurement in motors* in the *Encoders for Servo Drives* brochure)

Cable shield connected to housing; **Up** = Power supply
Sensor: The sense line is connected in the encoder with the corresponding power line.
Vacant pins and wires must not be used!
Note for safety-related applications: Only completely assembled HEIDENHAIN cables are qualified. Do not modify cables or exchange their connectors without first consulting with HEIDENHAIN Traunreut!

HEIDENHAIN

DR. JOHANNES HEIDENHAIN GmbH
Dr.-Johannes-Heidenhain-Straße 5
83301 Traunreut, Germany
☏ +49 8669 31-0
FAX +49 8669 5061
E-mail: info@heidenhain.de

www.heidenhain.de

750816 · 05 · A · 01 · 05/2018 · PDF

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

Further information: Adhere to the information in the following documents to ensure the correct and intended operation of the encoder:

- *Encoders for Servo Drives* brochure: 208922-xx
- Mounting instructions for *ECN 1123, EQN 1135:* 816487-xx
- *Safety-Related Position Measuring Systems* Technical Information document: 596632
- For implementation in a safe control or inverter, refer to Specification 533095