HEIDENHAIN

Functional Safety

Product Information

ECN 1123
EQN 1135

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

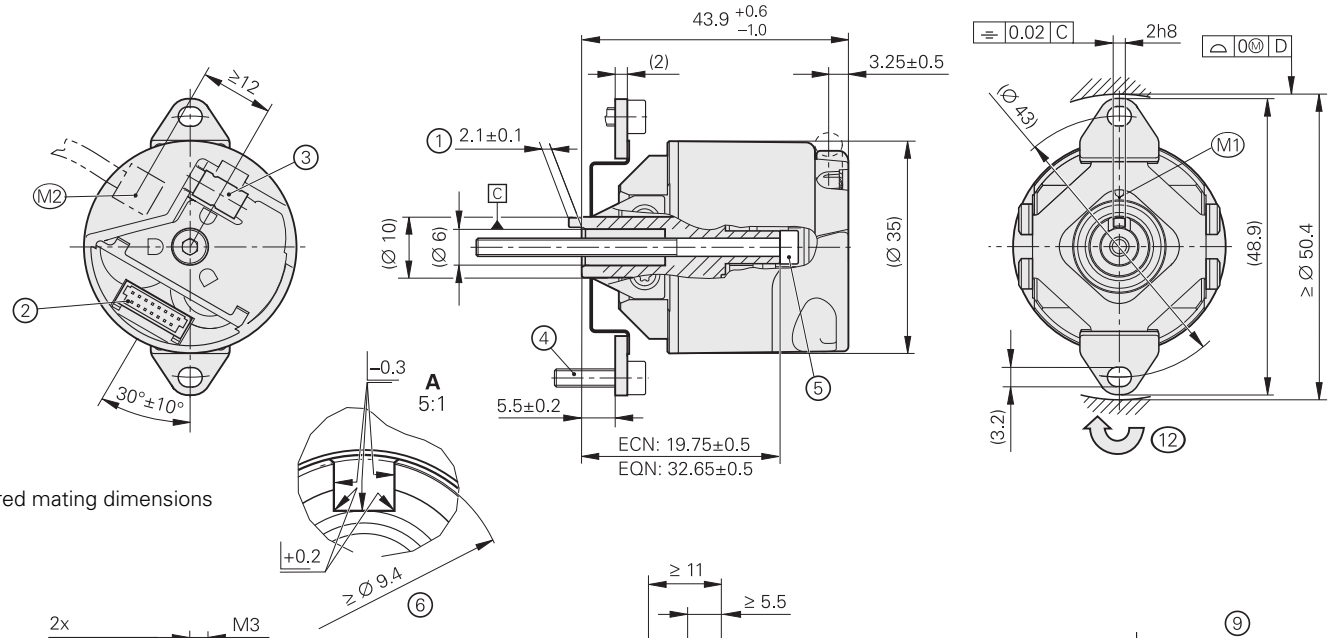
03/2018

ECN 1123, EQN 1135

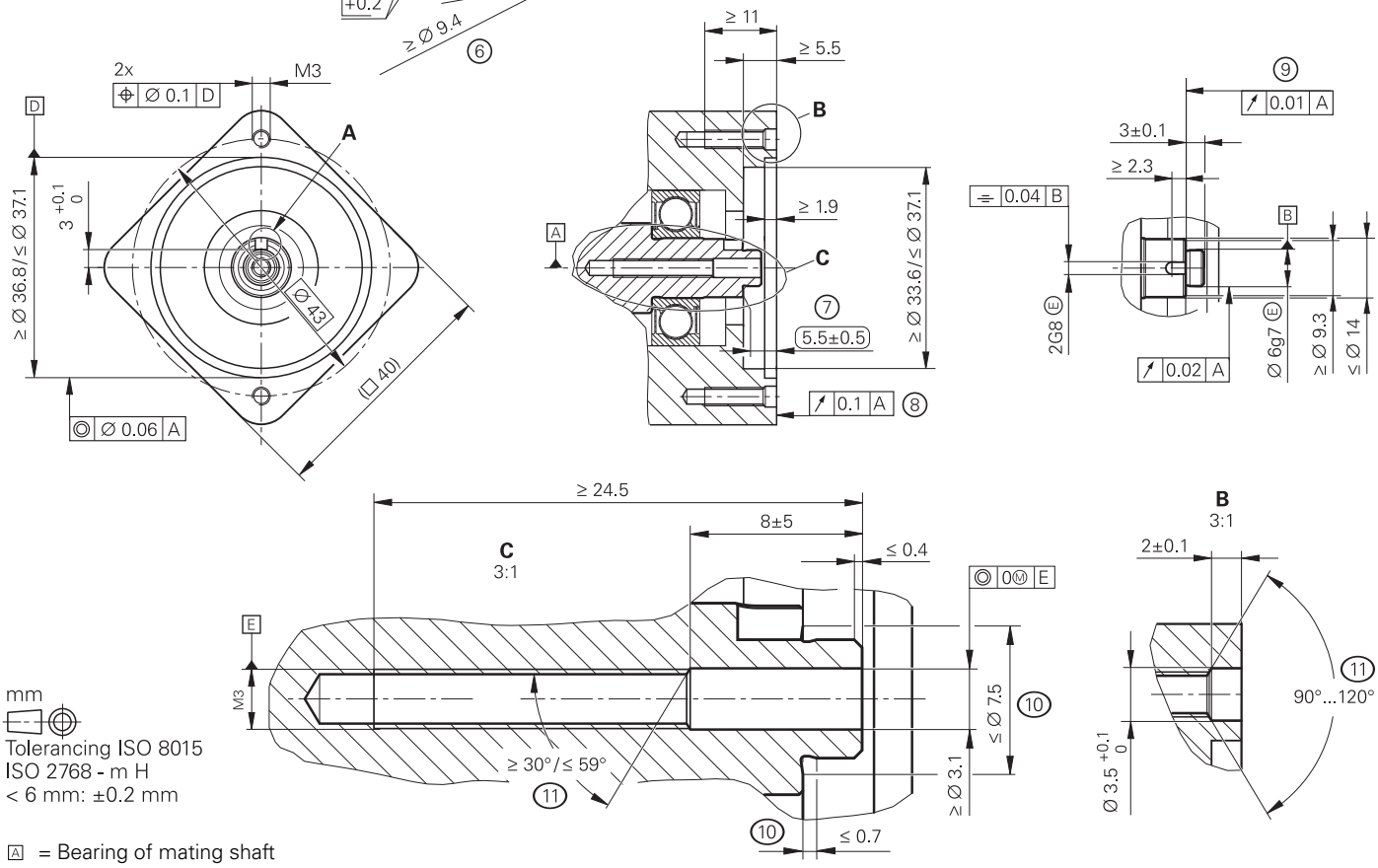
Rotary encoders for absolute position values with safe singleturn information

- **75A mounted stator coupling**
- **1KC blind hollow shaft for axial clamping**

Functional Safety



Required mating dimensions



mm

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

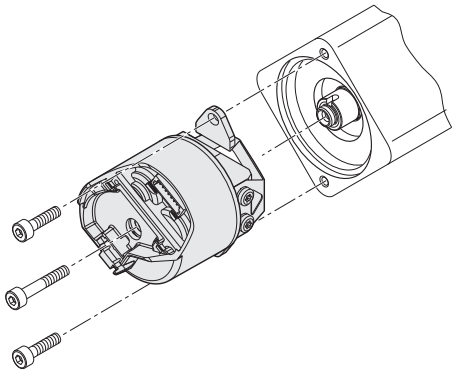
Ⓐ = Bearing of mating shaft
M1 = Measuring point for operating temperature
M2 = Measuring point for vibration
1 = Positive-locking element; ensure correct engagement in slot (e.g., by measuring the device overhang)
2 = 15-pin PCB connector
3 = Cable gland with crimp sleeve: Ø 4.3 ±0.1 mm; length: 7 mm
4 = Screw ISO 4762 M3x12 – 8.8 – MEC; tightening torque: 1.15 ±0.05 Nm
5 = Screw ISO 4762: for ECN: M3x40 – 8.8 – MEC; for EQN: M3x50 – 8.8 – MEC; tightening torque: 1.15 ±0.05 Nm
6 = Contact surface of slot
7 = Maximum permissible deviation between shaft surface and coupling surface; compensation for mounting tolerances and thermal expansion, of which ±0.15 mm of dynamic axial motion is permitted
8 = Coupling surface
9 = Shaft surface. Ensure that there is full-surface contact!
10 = Undercut
11 = Chamfer at start of thread is obligatory for materially bonding anti-rotation lock
12 = Direction of shaft rotation for output signals as per the interface description

Specifications	ECN 1123 – Singleturn	EQN 1135 – Multiturn
ID number	743586-03	743587-03
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 the singleturn range	
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 and stator coupling; designed for accelerations of ≤ 300 m/s²)	
Interface	EnDat 2.2	
Ordering designation	EnDat22	
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* 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 (1KC)	
Speed	≤ 12 000 rpm	
Starting torque at 20 °C	≤ 0.001 Nm	≤ 0.002 Nm
Moment of inertia	$0.4 \cdot 10^{-6}$ kgm²	
Angular acceleration	≤ $0.8 \cdot 10^{5}$ 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 distance 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 manufacturer of the 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

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 rotary encoder shaft securely engages the corresponding slot in the measured shaft. Mounting on the stator side is performed without a centering collar on a flat surface with two clamping screws. In each case, use screws with materially bonding anti-rotation lock (see *Mounting accessories*).



Requirements on the motor side for safe mechanical coupling:

	Mating shaft	**Mating stator**
Material	Steel	Aluminum
Tensile strength R_m	≥ 600 N/mm 2	≥ 220 N/mm 2
Shear strength τ_m	-	≥ 130 N/mm 2
Interface pressure P_b	≥ 500 N/mm 2	≥ 200 N/mm 2
Surface roughness R_z	≤ 20 µm	≤ 10 µm
Coefficient of thermal expansion α_{therm}	$10 \cdot 10^{-6}\,K^{-1}$ to $17 \cdot 10^{-6}\,K^{-1}$	$\leq 25 \cdot 10^{-6}\,K^{-1}$

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

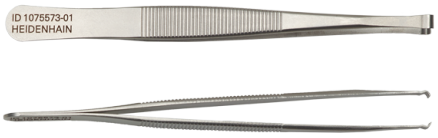
	Screws [1]		Batch size
Central screw for ECN 1123	ISO 4762-**M3×40**-8.8-**MEC**	ID 202264-82	10 or 100
Central screw for EQN 1135	ISO 4762-**M3×50**-8.8-**MEC**	ID 202264-81	
Mounting screw for stator coupling	ISO 4762-**M3×12**-8.8-**MEC**	ID 202264-69	20 or 200

1) With coating for material-bonding anti-rotation lock

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

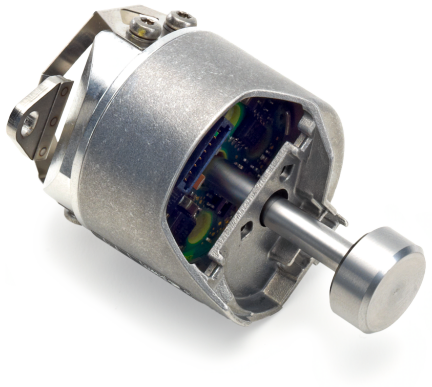
Mounting aid
This mounting aid is used for plugging and unplugging the PCB connector. It prevents damage to the cable by virtue of the fact that strain is applied only to the connector. The wires are not permitted to be pulled.

ID 1075573-01



Mounting aid
This mounting aid allows the shaft of the rotary encoder to be turned from the rear of the device. By this means, the positive-locking connection between the rotary encoder and the measured shaft can be found easily.

ID 821017-03



Electrical connection – Cables

Output cables inside the motor housing		
Complete with 15-pin PCB connector and 8-pin M12 flange socket (male); individual TPE wires with braided sleeve and wires for temperature sensor		TPE 10 × 0.16 mm² [1) 2)] ID 1117412-xx
One 15-pin PCB connector, Ø 3.7 mm, EPG (with shield crimp sleeve, Ø 4.5 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) Individual 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*!

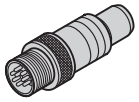
PUR connecting cable Ø 6 mm; [2 × (2 × 0.09 mm²) + 2 × (2 × 0.16 mm²)] A_P = 0.16 mm²		**8-pin M12 connector**
Complete with connector (female) and coupling (male)		ID 1036372-xx
Complete with right-angle connector (female) and coupling (male)		ID 1036386-xx
Complete with connector (female) and 15-pin D-sub connector (male) for IK 215, PWM 21, EIB 741, etc.		ID 1036526-xx
Complete with right-angle connector (female) and 15-pin D-sub connector (male) for IK 215, PWM 21, EIB 741, etc.		ID 1133855-xx
Complete with connector (female)		ID 1129581-xx [1)]
Complete with right-angle connector (female)		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!

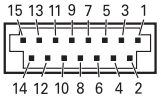
Electrical connection – Pin layout

Pin layout

Coupling or 8-pin M12 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	Sense **U_P**	**0 V**	Sense **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
Sensing: The sense line is connected in the encoder to the corresponding power supply line.
Vacant pins and wires must not be used!
Note for safety-related applications: Only completely assembled HEIDENHAIN cables are qualified for this. Do not modify cables or exchange their connectors without first consulting 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 document edition valid when the order is made.

Related documents: 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
- *ECN 1123, EQN 1135 Mounting Instructions*: 816487-xx
- *Safety-Related Position Measuring Systems Technical Information:* 596632
- For implementation in a safe control or inverter: *Specification 533095*

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