HEIDENHAIN

ECI 1319
EQI 1331

Absolute Rotary Encoders
without Integral Bearing

With additional measures:
suitable for safety-related
applications with up to SIL 3

For HMC 2 connection
technology

Functional
Safety

ECI 1319, EQI 1331

**Rotary encoders for absolute position values with safe singleturn information**
- **Robust inductive scanning principle**
- **Mounting-compatible with photoelectric rotary encoders with a 07B stator coupling**
- **0YA mounting flange**
- **Blind hollow shaft for axial clamping Ø 12.7 mm (44C) or Ø 12 mm (44A)**
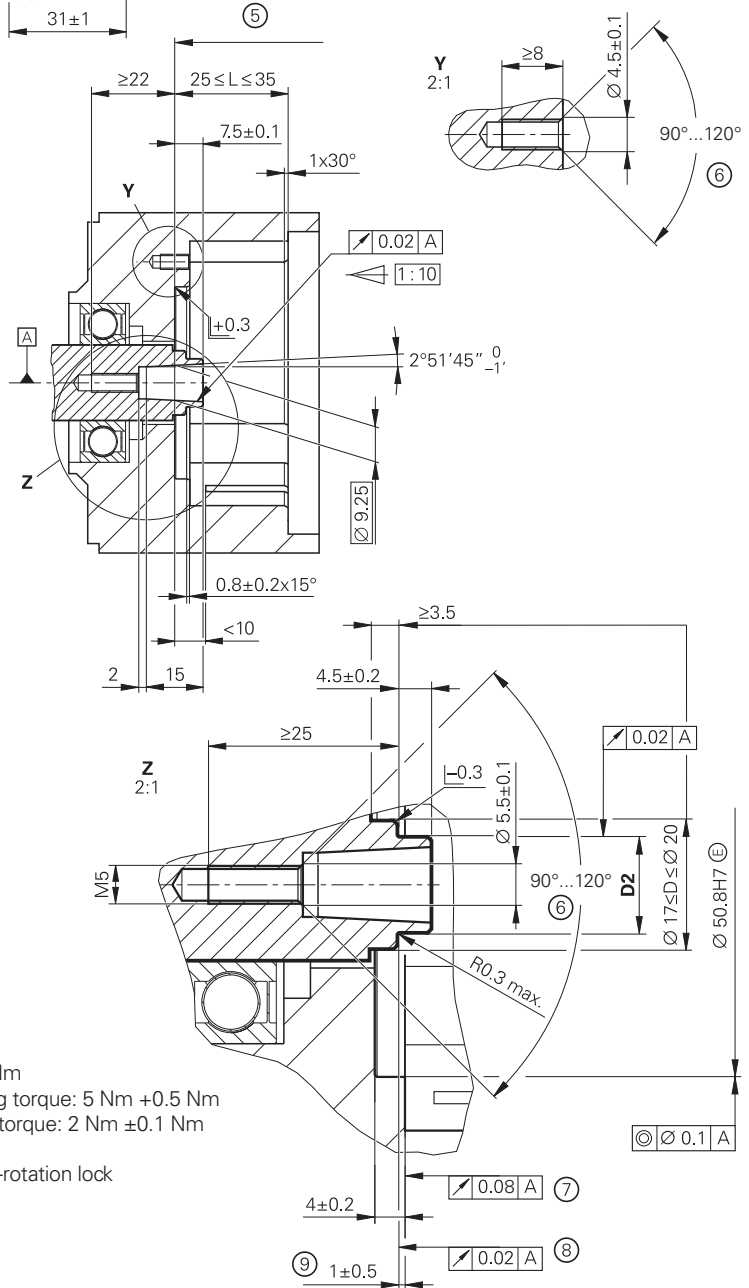- **Cost-optimized mating dimensions upon request**

Functional Safety
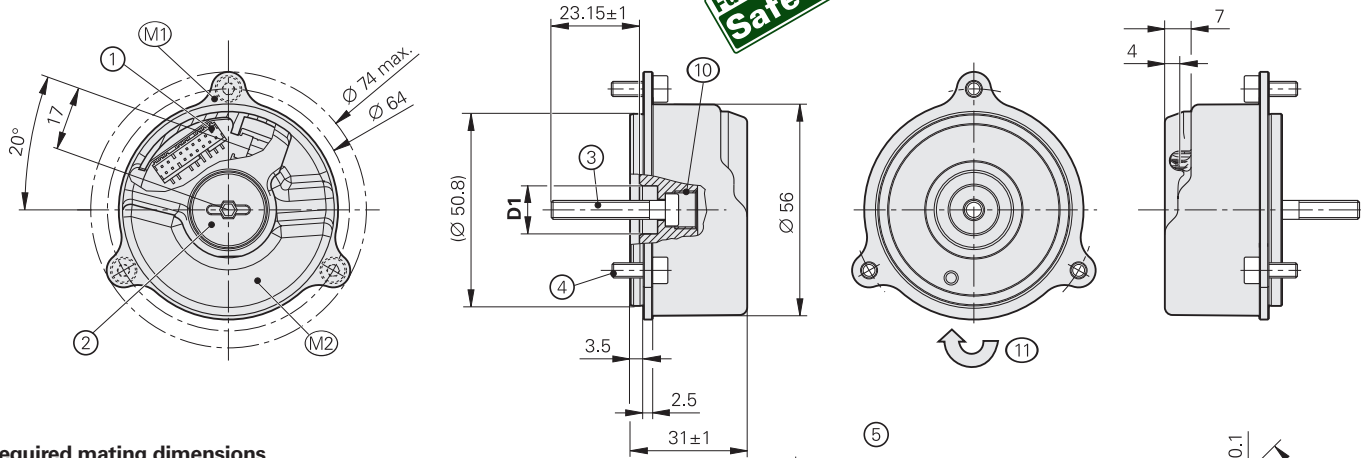
Required mating dimensions
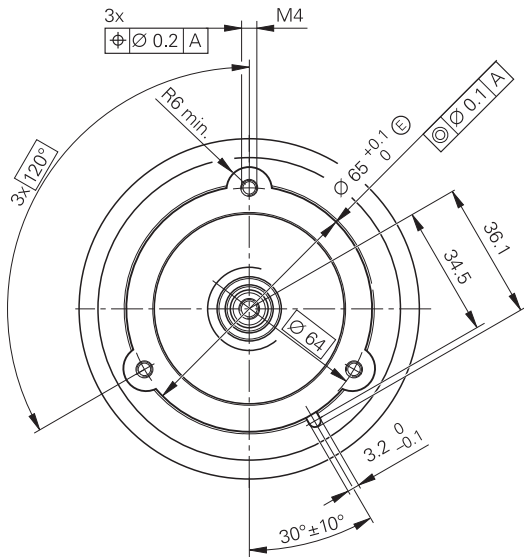
D1	D2
Ø 12G6 Ⓔ	Ø 12h6 Ⓔ
Ø 12.7G6 Ⓔ	Ø 12.7h6 Ⓔ

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; see also D 741714
1 = 16-pin (12+4-pin) PCB connector
2 = Screw plug: widths A/F 3 and 4; tightening torque: 5 Nm +0.5 Nm
3 = Screw: DIN 6912 – M5x30 – 08.8 – MKL, width A/F 4; tightening torque: 5 Nm +0.5 Nm
4 = Screw: ISO 4762 – M4x10 – 8.8 – MKL, width A/F 3, tightening torque: 2 Nm ±0.1 Nm
5 = Functional diameter of taper for ECN/EQN 13xx
6 = Chamfer at start of thread is obligatory for material bonding anti-rotation lock
7 = ExI/resolver flange surface; ensure full-surface contact!
8 = Shaft surface; ensure full-surface contact!
9 = Mounting clearance between shaft surface and flange surface;
compensation of mounting tolerances and thermal expansion
ECI/EQI: dynamic motion permitted over entire range
ECN/EQN: no dynamic motion permitted
10 = M10 back-off thread
11 = Direction of shaft rotation for ascending position values

Specifications	ECI 1319 singleturn	EQI 1331 multiturn
Functional safety for applications with up to	As a single-encoder system for monitoring and 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 With additional measures as per Document 1277016, suitable for safety-related applications with up to SIL 3 or Category 4, PL e Safe in the singleturn range	
PFH[1]	*SIL 2:* $\leq 15 \cdot 10^{-9}$ (probability of dangerous failure per hour) *SIL 3:* $\leq 2 \cdot 10^{-9}$	
Safe position[2]	*Encoder:* ±1.06° (safety-related measuring step SM = 0.35°) *Mechanical coupling:* 0° (fault exclusion for the loosening of the shaft coupling and stator coupling; designed for accelerations at the stator: ≤ 400 m/s^2; at the rotor: ≤ 600 m/s^2)	
Interface	EnDat 3	
Ordering designation	E30–R2	
Position values per revolution	524 288 (19 bits)	
Revolutions	–	4096 (12 bits)
XEL.time HPFout data rate	≤ 11 µs at 12.5 Mbit/s ≤ 8.2 µs at 25 Mbit/s	
Propagation time	14 µs (typical)	
System accuracy	±65″	
Electrical connection	16-pin PCB connector (12+4; with separate connection option for external temperature sensor)[3]	
Cable length	*At 12.5 Mbit/s:* ≤ 100 m; *at 25 Mbit/s:* ≤ 40 m	
Supply voltage	DC 4 V to 14 V (recommended: 12 V)	
Current consumption (typical)	*At 12 V:* ≤ 45 mA (without communication)	*At 12 V:* ≤ 50 mA (without communication)
Power consumption[4] (maximum)	*At 4 V:* ≤ 850 mW *At 14 V:* ≤ 900 mW	*At 4 V:* ≤ 950 mW *At 14 V:* ≤ 1000 mW
Shaft	Blind hollow shaft for axial clamping Ø 12.7 mm (44C) or Ø 12 mm (44A)	
Shaft speed	≤ 15000 rpm	≤ 12000 rpm
Moment of inertia of rotor	$2.45 \cdot 10^{-6}$ kgm^2	$2.6 \cdot 10^{-6}$ kgm^2
Angular acceleration of rotor	$\leq 1 \cdot 10^5$ rad/s^2	
Axial motion of measured shaft	$\leq \pm 0.5$ mm	
Vibration 55 Hz to 2000 Hz[5] **Shock** 6 ms	*Stator:* ≤ 400 m/s^2; *rotor:* ≤ 600 m/s^2 (EN 60068-2-6) ≤ 2000 m/s^2 (EN 60068-2-27)	
Operating temperature	–40 °C to 115 °C	
Trigger threshold for temperature exceedance error message	130 °C (measuring accuracy of internal temperature sensor: ±1 K)	
Relative humidity	≤ 93 % (40 °C/21 d as per EN 60068-2-78); condensation excluded	
Protection rating EN 60529	IP20	
Mass	≈ 0.13 kg	
ID number	*44C shaft:* 1286377-01; *44A shaft:* 1286377-06	*44C shaft:* 1286378-01; *44A shaft:* 1286378-06

[1] For use at ≤ 2000 m above sea level
[2] Further tolerances may arise in subsequent electronics after position value comparison (contact mfr. of subsequent electronics)
[3] See *Temperature measurement in motors* in the *Encoders for Servo Drives* brochure
[4] See *General electrical information* in the *Interfaces of HEIDENHAIN Encoders* brochure or at *www.heidenhain.de*
[5] 10 Hz to 55 Hz, 4.9 mm constant peak to peak

Mounting

The blind hollow shaft of the rotary encoder is seated onto the measured shaft and fastened with a central screw. Mounting on the stator side is performed via a centering diameter with three mounting screws. Use screws with material bonding anti-rotation lock (see *Mounting accessories*).

Further information:

For the customer-side mounting design, the materials specifications for steel apply to the customer-side shaft, and for the customer side stator, the materials specifications for aluminum.

Also pay attention to the other material properties in the *Encoders for Servo Drives* brochure (ID 208922-xx).
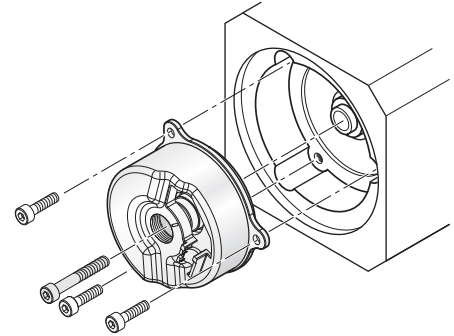
Mounting accessories

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

ECI 1319/EQI 1331	Screws[1]		Quantity
Central screw for shaft fastening	DIN 6912-**M5×30**-08.8-**MKL**	ID 202264-76	10 or 100
Mounting screw for flange	ISO 4762-**M4×10**-8.8-**MKL**	ID 202264-85	30 or 300

[1] With coating for material bonding anti-rotation lock

Please note the information on screws from HEIDENHAIN in the *Encoders for Servo Drives* brochure, under *Screws with material bonding anti-rotation lock* in the chapter *General mechanical information*.

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

ID 1075573-01
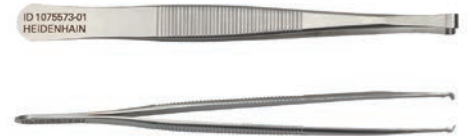
EnDat 3 adapter (SA 1210)
Adapter for connecting an encoder with EnDat 3 (E30-R2) to the PWM 21

ID 1317260-01

For further mounting information and mounting aids, refer to the relevant mounting instructions and the *Encoders for Servo Drives* brochure. The quality of mounting can be tested with the PWM 21 and the ATS software. For selecting the software, please contact HEIDENHAIN.
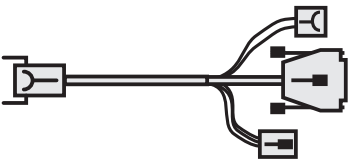
Integrated temperature evaluation

This rotary encoder features a temperature sensor integrated into the encoder electronics and an evaluation circuit for an external temperature sensor. In both cases, the respective digitized temperature value is transmitted purely serially via the EnDat protocol. Please bear in mind that neither the temperature measurement nor the transmission of the temperature value is safe in terms of functional safety. With regard to the internal temperature sensor (FID 0x21 SENSOR_TEMP_INT), the rotary encoder supports the two-stage cascaded signaling of a temperature exceedance. It consists of an EnDat warning and an EnDat error message. In compliance with the EnDat specification, when the temperature reaches the warning threshold for temperature exceedance of the internal temperature sensor, an EnDat warning is issued (HPF.STATUS.W "collective warning bit"). In addition, bit 26 (W10) "Temperature warning threshold exceeded" is set in the LPF with the FID=ERRMSG. This warning threshold for the internal temperature sensor is stored in the parameter SET.tempWarnLevel and can be individually adjusted. A device-specific default value is saved here before shipping. The temperature measured by the internal temperature sensor is higher by a device-specific and application-specific amount than the temperature at measuring point M1, as shown in the dimension drawing.

The encoder features a further, albeit non-adjustable trigger threshold for the EnDat error message (HPF.STATUS.F "collective error bit"). In addition, bit 8 (A8) "Permissible ambient conditions exceeded" is set in the LPF with the FID=ERRMSG. This trigger threshold may vary depending on the encoder model and is stated in the specifications. HEIDENHAIN recommends adjusting the warning threshold based on the application such that this threshold is sufficiently below the trigger threshold for the "Temperature exceeded" EnDat error message. Compliance with the operating temperature at measuring point M1 is required for adherence to the encoder's intended and proper use.
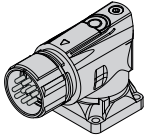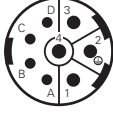
Electrical connection
Cables

ETFE output cable inside the motor housing $\varnothing$ 1.8 mm 2 x 0.15 mm^2, without shield; $A_P = 0.15$ mm^2		
12-pin PCB connector (female), with strain relief ($\varnothing$ 6.2 mm) and 8-pin M23 SpeedTEC rotatable angle flange socket (male, for communication)		ID 1275042-xx
12-pin PCB connector (female), with strain relief $\varnothing$ 6.2 mm and 2 x ETFE twisted single wires (communication)		ID 1302701-xx[1]

ETFE cable inside the motor 2 x 0.15 mm^2 for temperature sensor		
4-pin PCB connector (female) with heat shrink tubing and 2-pin connector (male, for temperature sensor)		ID 1302763-xx

PUR adapter cable $\varnothing$ 11 mm with external shield (testing cable for the PWM 21); 4 × 1.5 mm^2 (power wires) 2 × 0.75 mm^2 (shielded brake wires) 2 × 0.25 mm^2 (shielded communication wires); $A_P = 0.25$ mm^2		
8-pin M23 SpeedTEC straight connector (female) and 3-pin connector (female, for power) and 4-pin connector (male, for brake) and 15-pin D-sub connector (male, for communication)		ID 1275291-xx

[1] Connecting elements must be suitable for the maximum data rate used.
Please comply with the *General electrical information* chapter in the *Interfaces of HEIDENHAIN encoders* brochure.
SpeedTEC is a registered trademark of TE Connectivity Industrial GmbH.

Electrical connection

Pin layout of ECI, EQI

8-pin M23 SpeedTEC HMC 2 angle flange socket	16-pin (12+4) PCB connector

	Encoder			
	Power supply / Serial data transfer		**Other signals**	
M23	A	B	/	/
12	2b	5a	/	/
4	/	/	1a	1b
2	/	/	2	1
	P_SD+[1]	**P_SD–**[1]	**T+**[2]	**T–**[2]
	Violet	Yellow	Brown	Green

	Motor					
	Brake		**Power**			
M23	C	D	1	4	3	2
	Brake +	**Brake –**	**U**	**V**	**W**	**PE**

[1] Supply voltage and data: P_SD+ contains U_P (power supply); P_SD– contains 0 V
[2] Connections for external temperature sensor; evaluation optimized for a KTY 84-130, PT 1000, and other sensors
(see *Temperature measurement in motors* in the *Encoders for Servo Drives* brochure)

Vacant pins or wires must not be used!

SpeedTEC is a registered trademark of TE Connectivity Industrial GmbH.

📖 **Further information:**

Comply with the requirements described in the following documents to ensure correct and intended operation:
- Brochure: *Encoders for Servo Drives* — ID 208922-xx
- Brochure: *Cables and Connectors* — ID 1206103-xx
- Brochure: *Interfaces of HEIDENHAIN Encoders* — ID 1078628-xx
- Product Information document: *HMC 2* — ID 1305512-xx
- Technical Information document: *EnDat 3* — ID 1305415-xx
- Mounting Instructions: *ECI 1319, EQI 1331* — ID 1327848
- EnDat 3 Application Conditions for Functional Safety — ID 3000003-xx
- Supplementary Application Conditions for EnDat 3 for Step Monitoring (SIL 3, PLe) — ID 1277016-xx
- EnDat Application Notes — ID 722024-xx

For information about EnDat 3, visit **www.endat.de**.
For brochures and Product Information documents, visit **www.heidenhain.de**.