



HEIDENHAIN



**Functional
Safety**

Product Information

ECI 1319 **EQI 1331**

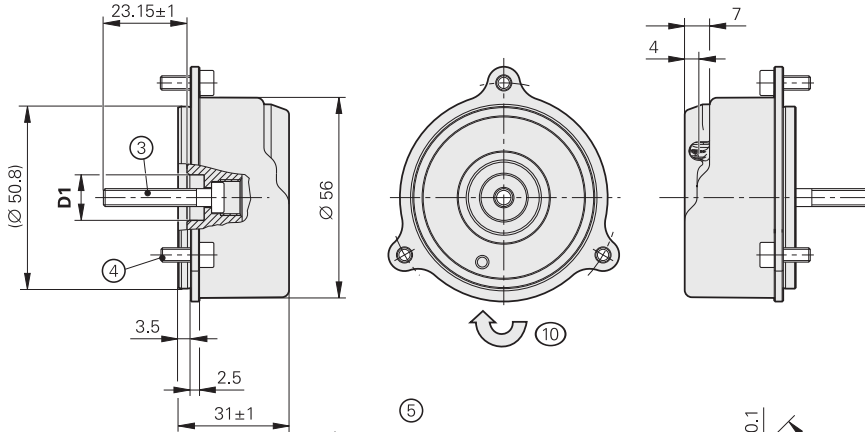
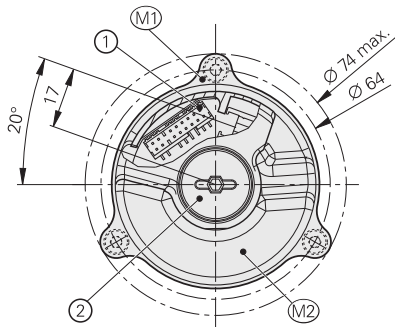
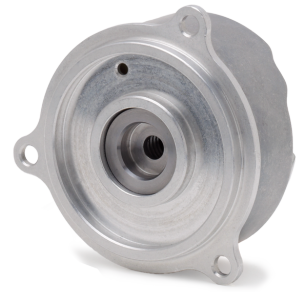
Absolute Rotary Encoders without
Integral Bearing

With Additional Measures Suitable
for Safety-Related Applications up
to SIL 3

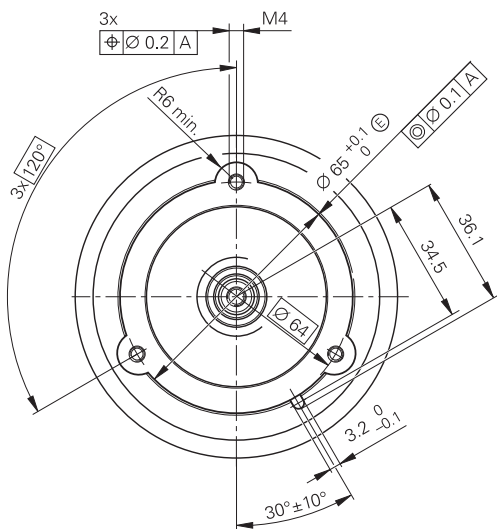
ECI 1319, EQI 1331

Rotary encoders for absolute position values with safe singleturn information

- Rugged inductive scanning principle
- Mounting-compatible to photoelectric rotary encoders with 07B stator coupling
- 0YA mounting flange
- Blind hollow shaft for axial clamping $\varnothing 12.7$ mm (44C) or $\varnothing 12$ mm (44A)
- Cost-optimized mating dimensions upon request



Required mating dimensions



D1	D2
$\varnothing 12G6$ E	$\varnothing 12h6$ E
$\varnothing 12.7G6$ E	$\varnothing 12.7h6$ E

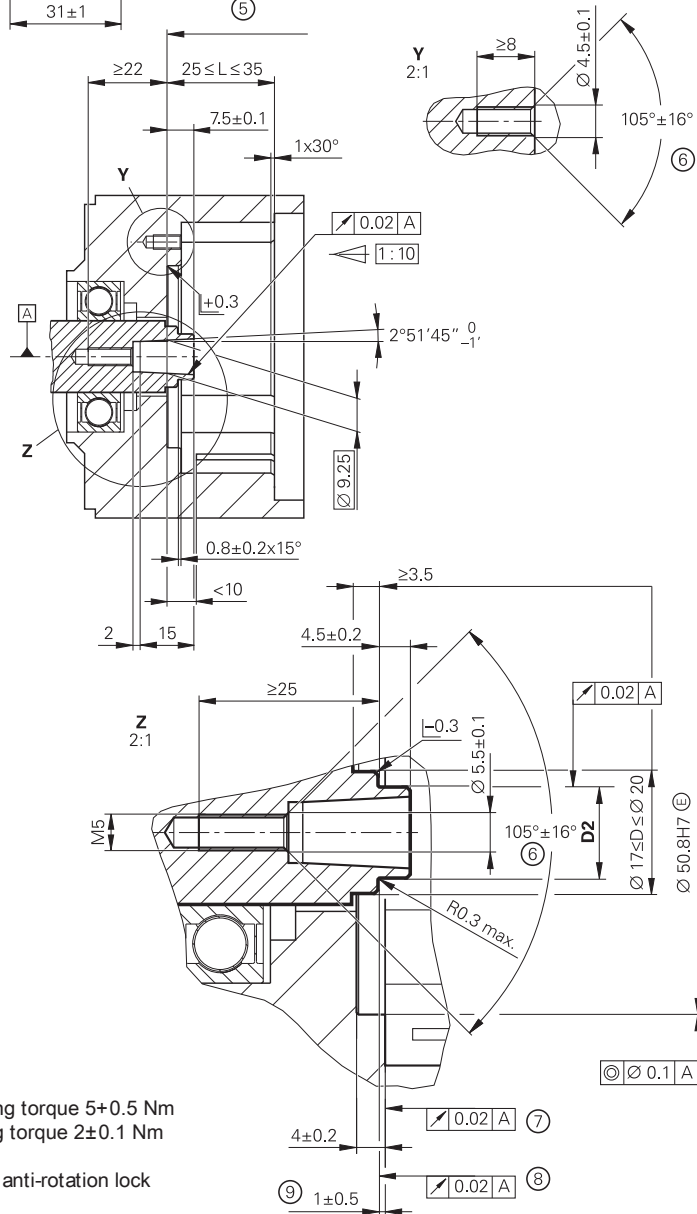
mm

 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 = PCB connector, 12-pin and 4-pin
- 2 = Screw plug, widths A/F 3 and 4, tightening torque 5 ± 0.5 Nm
- 3 = Screw ISO 6912 - M5x30 - 08.8 - MKL width A/F 4, tightening torque 5 ± 0.5 Nm
- 4 = Screw ISO 4762 - M4x10 - 8.8 - MKL width A/F 3, tightening torque 2 ± 0.1 Nm
- 5 = Functional diameter of taper for ECN/EQN 13xx
- 6 = Chamfer is obligatory at start of thread for materially bonding anti-rotation lock
- 7 = Flange surface ExI/resolver; ensure full-surface contact!
- 8 = Shaft; ensure full-surface contact!
- 9 = Maximum permissible deviation between shaft and flange surfaces Compensation of mounting tolerances and thermal expansion.

ECI/EQI: Dynamic motion permitted over entire range. ECN/EQN: no dynamic motion permitted

10 = Direction of shaft rotation for output signals as per the interface description



Specifications	ECI 1319 – Singletum	EQI 1331 – Multitum
These data apply for	ID 810661-02 (shaft 44C) ID 810661-03 (shaft 44A) ID 810661-06 (shaft 44C, collective package)	ID 810662-01 (shaft 44A) ID 810662-03 (shaft 44C) ID 810662-06 (shaft 44C, collective package)
Functional safety For applications up to	As single-encoder system for monitoring and closed-loop functions: <ul style="list-style-type: none"> • 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 With additional measures according to document 1000344 suited for safety-related applications up to SIL 3 or Category 4, PL e Safe in singletum range	
PFH	SIL 2: $\leq 15 \times 10^{-9}$ (probability of dangerous failure per hour) SIL 3: $\leq 2 \times 10^{-9}$	
Safe position ¹⁾	Encoder: $\pm 0.88^\circ$ (safety-related measuring step SM = 0.35°) Mechanical coupling: 0° (fault exclusion for loosening of shaft and stator coupling, designed for accelerations on stator of: $\leq 400 \text{ m/s}^2$; on the rotor: $\leq 600 \text{ m/s}^2$)	
Interface	EnDat 2.2	
Ordering designation	EnDat 22	
Position values/revolution	524 288 (19 bits)	
Revolutions	-	4096 (12 bits)
Calculation time t_{cal} Clock frequency	$\leq 5 \mu\text{s}$ $\leq 16 \text{ MHz}$	
System accuracy	$\pm 65''$	
Electrical connection	Via PCB connector, encoder: 12-pin; temperature sensor: ²⁾ 4-pin	
Cable length	$\leq 100 \text{ m}$ (see EnDat description in the catalog <i>Interfaces of HEIDENHAIN Encoders</i>)	
Voltage supply	3.6 V to 14 V DC	
Power consumption ³⁾ (maximum)	At 3.6 V: $\leq 620 \text{ mW}$ At 14 V: $\leq 680 \text{ mW}$	At 3.6 V: $\leq 730 \text{ mW}$ At 14 V: $\leq 830 \text{ mW}$
Current consumption (typical)	At 5 V: 95 mA (without load)	At 5 V: 115 mA (without load)
Shaft*	Blind hollow shaft for axial clamping $\varnothing 12.7 \text{ mm}$ (44C) or $\varnothing 12 \text{ mm}$ (44A)	
Spindle speed	$\leq 15\,000 \text{ min}^{-1}$	$\leq 12\,000 \text{ min}^{-1}$
Moment of inertia of rotor	$2.45 \times 10^{-6} \text{ kgm}^2$	$2.6 \times 10^{-6} \text{ kgm}^2$
Angular acceleration of rotor	$\leq 1 \times 10^5 \text{ rad/s}^2$	
Axial motion of measured shaft	$\leq \pm 0.5 \text{ mm}$	
Vibration 55 to 2000 Hz ⁴⁾ Shock 6 ms	Stator: $\leq 400 \text{ m/s}^2$; Rotor: $\leq 600 \text{ m/s}^2$ (EN 60 068-2-6) $\leq 2000 \text{ m/s}^2$ (EN 60 068-2-27)	
Operating temperature	-40 °C to 115 °C	
Threshold sensitivity Error message for exceeded temperature	130 °C (measuring accuracy of internal temperature sensor: $\pm 1 \text{ K}$)	
Relative humidity	$\leq 93 \%$ (40 °C/21 d as per EN 60068-2-78); without condensation	
Protection EN 60 529	IP 20 (see <i>Insulation</i> under <i>General mechanical information</i> in the <i>Encoders for Servo Drives</i> catalog)	
Weight	$\approx 0.13 \text{ kg}$	

* Please select when ordering

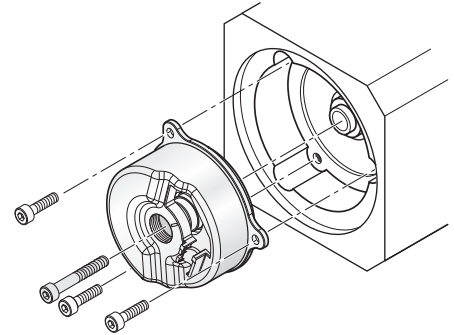
- 1) Further tolerances may occur in the subsequent electronics after the position value comparison (contact the manufacturer of the subsequent electronics)
- 2) See *Temperature measurement in motors* in the *Position Encoders for Servo Drives* brochure
- 3) See *General electrical information* in the catalog *Interfaces for HEIDENHAIN Encoders* or at www.heidenhain.de
- 4) 10 Hz to 55 Hz, constant over distance, 4.9 mm peak to peak

Mounting

The blind hollow shaft of the rotary encoder is slid onto the motor's drive shaft and fastened with a central screw. The stator is mounted by a centering diameter with three mounting screws. Screws with materially bonding anti-rotation lock are to be used (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	$\geq 600 \text{ N/mm}^2$	$\geq 220 \text{ N/mm}^2$
Shear strength τ_m	-	$\geq 150 \text{ N/mm}^2$
Interface pressure P_G	$\geq 500 \text{ N/mm}^2$	$\geq 200 \text{ N/mm}^2$
Surface roughness R_z	$\leq 10 \mu\text{m}$	$\leq 10 \mu\text{m}$
Coefficient of expansion α_{therm}	$(10 \text{ to } 17) \times 10^{-6} \text{ K}^{-1}$	$\leq 25 \times 10^{-6} \text{ K}^{-1}$



Mounting accessories

Screws

Screws (mounting screws, central screws) are not included in delivery. They can be ordered separately. The screws from HEIDENHAIN feature a coating as per DIN 267-27 which, after hardening, provides a materially bonding anti-rotation lock. For this reason the screws cannot be reused. Unused screws are not storable indefinitely. The minimum shelf life is 2 years (storage at $\leq 30 \text{ }^\circ\text{C}$ and $\leq 65 \%$ relative humidity). The expiration date is on the package.

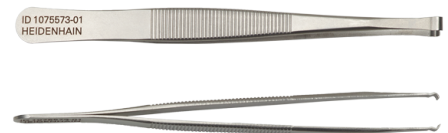
ECI 1319; EQI 1331	Screws ¹⁾		Lot size
Central screw for fastening the shaft	DIN 6912-M5×30-08.8-MKL	ID 202264-76	10 or 100 pieces
Mounting screw for flange	ISO 4762-M4×10-8.8-MKL	ID 202264-85	30 or 300 pieces

1) With coating for materially bonding anti-rotation lock

Please note: The adhesive on the screws with materially bonding coating hardens quickly. Screw insertion and application of tightening torque must therefore take no longer than 5 minutes (see dimension drawing). The required strength is attained after 6 hours at room temperature. The curing time increases with decreasing temperature. Curing temperatures below $5 \text{ }^\circ\text{C}$ are not permissible.

Mounting aid for engaging and disengaging the PCB connector. The mounting aid prevents damage to the cable because it applies the pulling force solely to the connector. Tension must not be applied to the wires.

ID 1075573-01



For further mounting information and mounting aids see the Mounting Instructions and the catalog *Encoders for Servo Drives*. The installation can be inspected with the PWM 20 and ATS software (see document 1082415)

Integrated temperature evaluation

This rotary encoder features a temperature sensor integrated in the encoder electronics and an evaluation circuit for an external temperature sensor. In both cases, the respective digitized temperature value is transmitted purely serially over the EnDat protocol. It must be noted in both cases that temperature measurement and transmission is not "safe" in the sense of functional safety.

With regard to the internal temperature sensor, the rotary encoder supports a dual-level cascaded signaling of exceeded temperature. It consists of an EnDat warning and an EnDat error message.



In accordance with the EnDat specification, when the warning threshold of the internal temperature sensor is reached, an EnDat warning is transmitted (EnDat operating condition memory area, word 1 – "warnings," bit 2¹ – "temperature exceeded"). This warning threshold for the internal temperature sensor is saved in the EnDat operational-parameter memory area, word 6 – "Threshold sensitivity warning bit for exceeded temperature," and can be individually adjusted. A device-specific default value is saved here when the encoder is shipped. The temperature measured by the internal temperature sensor is higher by a device-specific and application-specific amount than the temperature at the measuring point M1 according to the dimension drawing.

The rotary encoder features a further, but nonadjustable, threshold sensitivity for the EnDat error message "Temperature exceeded" of the internal temperature sensor which, when triggered, transmits an EnDat error message (EnDat memory area "Operating condition," word 0 – "Error messages," bit 2² – "Position," and in the additional datum 2 "Operating condition error sources", bit 2⁶ – "Temperature exceeded"). This threshold sensitivity depends on the encoder and is shown in the specifications.





HEIDENHAIN recommends adjusting the threshold sensitivity so that it lies below the threshold sensitivity for the EnDat error message "Temperature exceeded" by a sufficient value. Compliance with the permissible operating temperature with respect to the measuring point M1 is definitive for the intended use of the encoder.

Electrical connection

Cable

Cables inside the motor housing with wires for temperature sensor		
Complete with PCB connector (12-pin and 4-pin) and M23 right-angle socket (male), 9-pin		ID 746254-01 EPG Ø 4.5 mm; [6×2×0.09 mm ²]
Complete with PCB connector (12-pin and 4-pin) and M12 flange socket (male), 8-pin		ID 746820-01 ¹⁾ TPE 0.14 mm ² single leads with braided sleeving

1) **Note for safety-related applications:** Provide bit error rate as per specification 533095!

PUR connecting cable Ø 6 mm; [(4×0.14 mm ²) + (4×0.34 mm ²); A _P = 0.34 mm ²	M12 connector, 8-pin	M23 connector, 9-pin
Complete with connector (female) and M12 coupling (male), 8 pins each		ID 368330-xx ID 745796-xx
Complete with M12 connector (female), 8-pin and D-sub connector (female), 15-pin		ID 533627-xx -
Complete with M12 connector (female), 8-pin and D-sub connector (male), 15-pin		ID 524599-xx -
With one M12 connector (female), 8-pin		ID 634265-xx ¹⁾ -


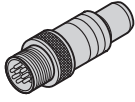
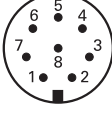

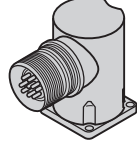
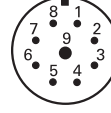
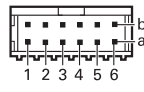








A_P: Cross section of power supply lines

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

8-pin coupling or flange socket M12   		9-pin M23 right-angle socket   								
12-pin PCB connector  		4-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	/	/
 12	1b	6a	4b	3a	6b	1a	2b	5a	/	/
 4	/	/	/	/	/	/	/	/	1a	1b
	U_P	Sensor U_P	0 V	Sensor 0 V	DATA	DATA	CLOCK	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; **U_P** = 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

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

1000353 · 02 · A · 02 · 4/2014 · PDF

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: *ECl 1319, EQl 1331*: 1000453-xx
- Technical Information: *Safety-Related Position Measuring Systems*: 596632
- For implementation in a control or inverter: *Specification*: 533095 and *supplementary catalog of measures (SIL 3, PL e)*: 1000344