



HEIDENHAIN



**Functional
Safety**

Product Information

ECI 1119/ECI 1122 EQI 1131/EQI 1134

Absolute Rotary Encoders
without Integral Bearing

For safety-related applications
with SIL 2 or SIL 3

EnDat 3

70G flange (82A)

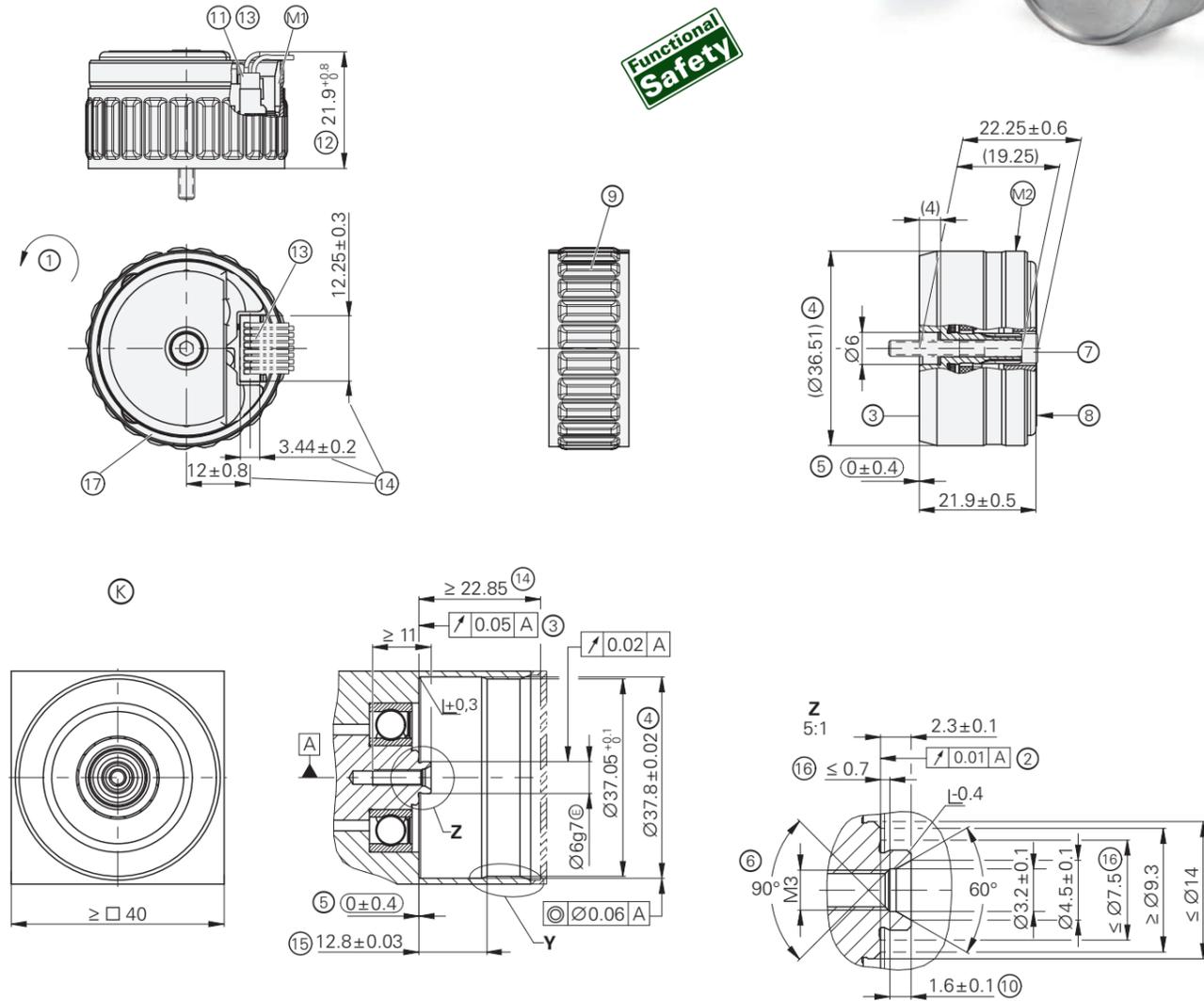
For HMC 2 connection
technology

03/2024

ECI 1119, ECI 1122, EQI 1131, EQI 1134

Rotary encoders for absolute position values with safe singleturn information

- Robust inductive scanning principle
- 70G flange for press-fitting with a tolerance sleeve
- 82A blind hollow shaft (Ø 6 mm) for axial clamping without a positive-locking element
- Required mating dimensions with M3x25 central screw



- ⊠ = Bearing of mating shaft
- ⊙ = Required mating dimensions
- M1 = Measuring point for operating temperature
- M2 = Measuring point for vibration
- 1 = Direction of shaft rotation for ascending position values
- 2 = Shaft surface; ensure full-surface contact!
- 3 = Flange surface; ensure full-surface contact!
- 4 = Centering diameter
- 5 = Mounting clearance:
Maximum permissible deviation between shaft surface and flange surface;
compensation of mounting tolerances and thermal expansion;
dynamic motion permitted over entire range.
- 6 = Chamfer at start of thread is mandatory for material-bonding anti-rotation lock
- 7 = Screw: ISO 4762 – M3x25 – 8.8 with material-bonding anti-rotation lock: ID 202264-86;
tightening torque: 1.0 Nm ±0.1 Nm
- 8 = Attention! Not a clamping surface
- 9 = Flange fastening with tolerance sleeve (for press-fitting parameters, see the mounting instructions)
- 10 = Possible centering hole
- 11 = 15-pin PCB connector
- 12 = Dimension for standard HEIDENHAIN cable
- 13 = Ensure space for cable
- 14 = Distance to cover; note the opening for PCB connector, header connector, and wires
- 15 = Min. wall thickness: 1.09 mm; no interruption permitted!
- 16 = Undercut
- 17 = Surface for application of force for press-fitting the encoder (ensure full-surface contact)

Workpiece edges as per ISO 13715

mm
Tolerancing ISO 8015
ISO 2768:1989-mH
≤ 6 mm: ±0.2 mm

Operating status data acquisition

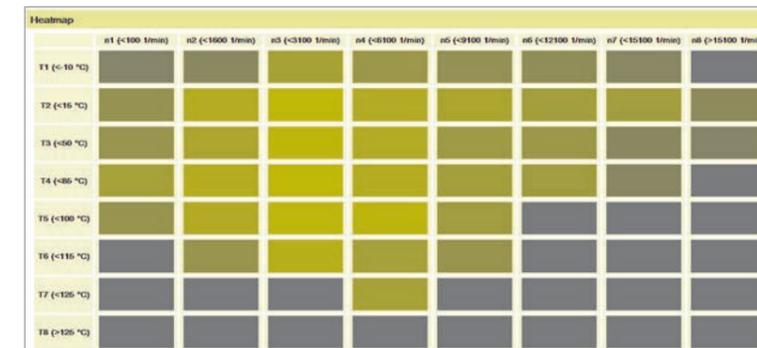


HEIDENHAIN encoders support the acquisition of operating status data. This data is collected during operation of the encoder within the application and then stored in the encoder (data logger function).

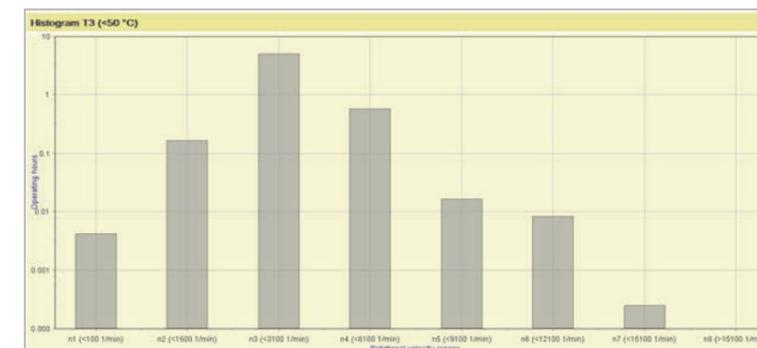
The resulting application-specific data can be used for ongoing analysis of the application or as an input value for higher-level condition monitoring. The data can also be output to help during servicing or quality management. In such cases, the specific mounting situation of the encoder must be taken into account because it may affect the collected values (especially temperatures).

The data can be output directly via the EnDat 3 interface or via an inspection or testing device from HEIDENHAIN (EnDat 3 and EnDat 22). The software belonging to the inspection or testing device (such as the ATS software for the PWM 21) enables visualization of the collected data in the form of tables and histograms. Access to the data depends on the specific encoder.

Acquisition of operating status data (data logger function)	
Operating statuses	<ul style="list-style-type: none"> • Operating time • Active time • Distance traveled • Number of reservations • Number of strokes
Extreme values	<ul style="list-style-type: none"> • Max. external temperature • Max. internal temperature • Min. internal temperature • Max. rotational speed / velocity • Max. acceleration • Min. mounting clearance • Max. mounting clearance
Alarm-triggered data	<ul style="list-style-type: none"> • Timestamp • External temperature • Internal temperature • Valuation numbers • Mounting clearance • Position • Speed
Heat map and histogram	<ul style="list-style-type: none"> • Heat map: operating times in relation to 8 temperature ranges and 8 speed ranges • Histogram: one operating time per temperature range in relation to 8 speed ranges
Status	<ul style="list-style-type: none"> • Number of write-accesses to the OEM memory • Number of restarts



Typical heat map



Typical histogram

Specifications

Specifications	ECI 1119 SIL 2 singletum	ECI 1122 SIL 2 singletum	ECI 1122 SIL 3 singletum	EQI 1131 SIL 2 multitum	EQI 1134 SIL 2 multitum	EQI 1134 SIL 3 multitum	
Functional safety for applications with up to	As a single-encoder system for monitoring functions and control-loop functions: <ul style="list-style-type: none"> SIL 2 as per EN 61508:2010 and IEC 61800-5-3:2021 Category 3, PL d, in accordance with EN ISO 13849-1:2015 Safe in the singleturn range			As a single-encoder system for monitoring functions and control-loop functions: <ul style="list-style-type: none"> SIL 2 as per EN 61508:2010 and IEC 61800-5-3:2021 Category 3, PL d, in accordance with EN ISO 13849-1:2015 Safe in the singleturn range			<ul style="list-style-type: none"> SIL 3 as per EN 61508:2010 and IEC 61800-5-3:2021 Category 3, PL e as per EN ISO 13849-1:2015 Safe in the singleturn range
PFH ¹⁾	≤ 15 · 10 ⁻⁹ (probability of dangerous failure per hour)		≤ 10 · 10 ⁻⁹ (probability of dangerous failure per hour)	≤ 15 · 10 ⁻⁹ (probability of dangerous failure per hour)		≤ 10 · 10 ⁻⁹ (probability of dangerous failure per hour)	
	With additional measures as per Document 3000006, suitable for safety-related applications with up to SIL 3 or Category 4, PL e 2 · 10 ⁻⁹ (probability of dangerous failure per hour)			With additional measures as per Document 3000006, suitable for safety-related applications with up to SIL 3 or Category 4, PL e 2 · 10 ⁻⁹ (probability of dangerous failure per hour)			
Safe position ²⁾	<i>Encoder</i> : ±1.16° (safety-related measuring step SM = 0.35°) <i>Mechanical coupling of 82A shaft</i> : ±0°; (fault exclusion for the loosening of the shaft coupling and stator coupling; designed for accelerations at the stator of ≤ 400 m/s ² ; at the rotor: ≤ 600 m/s ²)			<i>Encoder</i> : ±1.16° (safety-related measuring step SM = 0.35°) <i>Mechanical coupling of 82A shaft</i> : ±0°; (fault exclusion for the loosening of the shaft coupling and stator coupling; designed for accelerations at the stator of ≤ 400 m/s ² ; at the rotor: ≤ 600 m/s ²)			
Interface	EnDat 3			EnDat 3			
Ordering designation	E30-R2			E30-R2			
Position values per revolution	524288 (19 bits)	4 194 304 (22 bits)		524288 (19 bits)	4 194 304 (22 bits)		
Revolutions	–			4096 (12 bits)			
XEL.time HPFout data rate	≤ 11 µs at 12.5 Mbit/s ≤ 8.2 µs at 25 Mbit/s			≤ 11 µs at 12.5 Mbit/s ≤ 8.2 µs at 25 Mbit/s			
Analog delay time t _{AD}	22.9 µs			22.9 µs			
System accuracy	±120"	±65"		±120"	±65"		
Electrical connection	15-pin PCB connector (with connection for external temperature sensor) ³⁾			15-pin PCB connector (with connection for external temperature sensor) ³⁾			
External temperature sensor	PT 1000			PT 1000			
Cable length	At 12.5 Mbit/s: ≤ 100 m; at 25 Mbit/s: ≤ 40 m			At 12.5 Mbit/s: ≤ 100 m; at 25 Mbit/s: ≤ 40 m			
Supply voltage	DC 4 V to 14 V			DC 4 V to 14 V			
Current consumption (typical)	At 12 V: 28 mA			At 12 V: 53 mA			
Power consumption ⁴⁾ (max.)	At 4 V: ≤ 350 mW; at 14 V: ≤ 340 mW			At 4 V: ≤ 650 mW; at 14 V: ≤ 660 mW			

¹⁾ For use at ≤ 2000 m above sea level

²⁾ Further tolerances may arise in the downstream electronics after position value comparison (contact mfr. of the downstream 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

Specifications

Specifications	ECI 1119 SIL 2 singletum	ECI 1122 SIL 2 singletum	ECI 1122 SIL 3 singletum	EQI 1131 SIL 2 multitum	EQI 1134 SIL 2 multitum	EQI 1134 SIL 3 multitum
Shaft	82A blind hollow shaft (Ø 6 mm) for axial clamping, without positive-locking element			82A blind hollow shaft (Ø 6 mm) for axial clamping, without positive-locking element		
Operating status data	–	Available		–	Available	
Speed	≤ 15000 rpm			≤ 8000 rpm	≤ 12000 rpm	
Moment of inertia of rotor	0.2 · 10 ⁻⁶ kgm ²			0.2 · 10 ⁻⁶ kgm ²		
Angular acceleration of rotor	≤ 1 · 10 ⁵ rad/s ²			≤ 1 · 10 ⁵ rad/s ²		
Axial motion of measured shaft	≤ ±0.4 mm			≤ ±0.4 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)			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 110 °C	–40 °C to 115 °C		–40 °C to 110 °C	–40 °C to 115 °C	
Trigger threshold of error message for excessive temperature	128 °C (measuring accuracy of the internal temperature sensor: ±1 K)			128 °C (measuring accuracy of the internal temperature sensor: ±1 K)		
Relative humidity	≤ 93 % (40 °C/21 d as per EN 60068-2-78), without condensation			≤ 93 % (40 °C/21 d as per EN 60068-2-78), without condensation		
Protection EN 60529	IP00			IP00		
Mass	≈ 0.04 kg			≈ 0.04 kg		
ID number	Upon request	1391210-04 1391210-54 ⁶⁾	Upon request	Upon request	1391216-04 1391216-54 ⁶⁾	Upon request

⁵⁾ At 10 Hz to 55 Hz, constant over 6.5 mm peak to peak (stator), 10 mm peak to peak (rotor)

⁶⁾ Rotary encoders in collective package

Mounting

After inserting the tolerance sleeve (see *Mounting accessories*) in the customer's machine, the encoder flange is press-fit until it comes to a stop in the axial direction. Then the blind hollow shaft of the rotary encoder is fastened to the customer-side motor shaft with a central screw.

Online diagnostics

With EnDat 3 encoders, valuation numbers can be read cyclically from the encoder in order to evaluate its functionality. These valuation numbers indicate the encoder's current status and can be used to determine its "function reserves." Further information is available from HEIDENHAIN upon request.

Mounting accessories

Fastening elements

The central screw and the tolerance sleeve are not included in delivery and can be ordered separately.

ECI 1119/ECI 1122 EQI 1131/EQI 1134	Fastening elements		Quantity
Central screw ¹⁾ for fastening the shaft	ISO 4762- M3x25-8.8-MKL	ID 202264-86	10 or 100
Tolerance sleeve for clamping the flange	D 37.8 mm x L 15 mm	ID 1264352-10 ID 1264352-11	10 or 100

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 *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 solely to the connector and not to the wires.

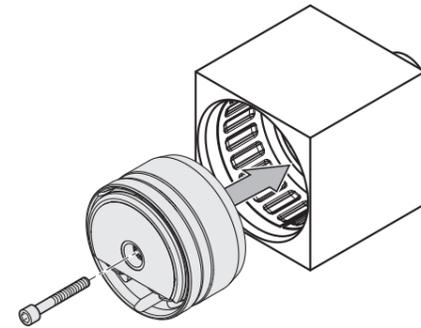
ID 1075573-01

For more mounting information and mounting aids, see the Mounting Instructions and the *Encoders for Servo Drives* brochure. The installation can be inspected with the PWM 21 and the ATS software (see Document 1082415).

EnDat 3 adapter

Adapter for connecting an encoder with EnDat 3 (E30-R2) to the PWM 21.

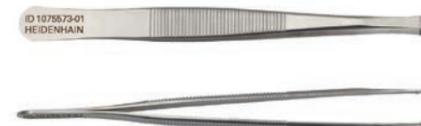
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More information:

For the customer-side mounting design, aluminum and steel are permissible materials for the customer-side shaft and stator.

In addition, comply with the material specifications and other material characteristics in the *Encoders for Servo Drives* brochure (ID 208922-xx).



Integrated temperature evaluation

This rotary encoder features an internal 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 over 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 second, 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. Fulfillment of the encoder's intended use requires adherence to the operating temperature at measuring point M1.

Connectible external temperature sensors

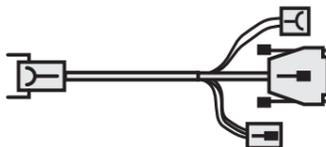
The following external temperature sensors can be evaluated in the encoder:

- PT1000 (activated by default)
- KTY84-130
- KTY83-110

See *Sensor settings* in the EnDat 3 interface specification (Document 3000001).

Electrical connection

Cables

ETFE output cables inside the motor \varnothing 1.8 mm $2 \times 0.15 \text{ mm}^2$, without shield and with ETFE wires \varnothing 2.2 mm $2 \times 0.15 \text{ mm}^2$ for temperature sensor; $A_p = 0.15 \text{ mm}^2$		
15-pin PCB connector (female) and stripped cable end 2 x ETFE twisted single wires (communication); 2 x ETFE single wires (length: 0.10 m) with heat-shrink tubing (temperature sensor)		1302347-xx
15-pin PCB connector (female) and 8-pin M12 angle flange socket (male) 2 x ETFE twisted single wires (communication); 2 x ETFE single wires (length: 0.10 m) with heat-shrink tubing and 2-pin connector (male, for a temperature sensor)		1279930-xx
PUR adapter cable \varnothing 9.3 mm with external shield $4 \times 0.5 \text{ mm}^2$ (power wires) $2 \times 0.34 \text{ mm}^2$ (brake wires, shielded) $2 \times 0.14 \text{ mm}^2$ (communication wires, shielded); $A_p = 0.14 \text{ mm}^2$		
8-pin M12 SpeedTEC straight connector (female), and 3-pin header connector (power), and 4-pin header (brake wires), and 15-pin D-sub connector (male, for communication)		1279881-xx

The connecting element must be suitable for the maximum clock frequency used.

Note for safety-related applications:

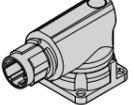
- Conformity with the EMC Directive must be ensured in the complete system!

SpeedTEC is a registered trademark of TE Connectivity Industrial GmbH.

More information:

For connecting cables and adapter cables, see the *Cables and Connectors* brochure (ID 1206103-xx).

Pin layout of ECI, EQI

8-pin M12 SpeedTEC angle flange socket		15-pin PCB connector	
			
Encoder			
Power supply / Serial data transfer		Other signals	
	A	B	/
	9	10	5
	-	-	2
	P_SD+¹⁾	P_SD-¹⁾	T+²⁾
	Violet	Yellow	Brown

Motor						
Brake		Power				
	C	D	1	2	3	4
	Brake +	Brake -	U	V	W	PE

¹⁾ Power supply and data: P_SD+ includes U_p ; P_SD- includes 0 V

²⁾ Connections for an external temperature sensor

Cable shield connected to housing; **U_p** = Power supply voltage

Vacant pins or 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!

SpeedTEC is a registered trademark of TE Connectivity Industrial GmbH.

HEIDENHAIN

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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 placed.



More information:

Comply with the requirements described in the following documents to ensure correct and intended operation:

- Operating Instructions

1416681-xx