



# HEIDENHAIN



Product Information

## **ECI 4090S**

Absolute Rotary Encoder  
with 90 mm Hollow Shaft and  
DRIVE-CLiQ Interface for  
Safety-Related Applications

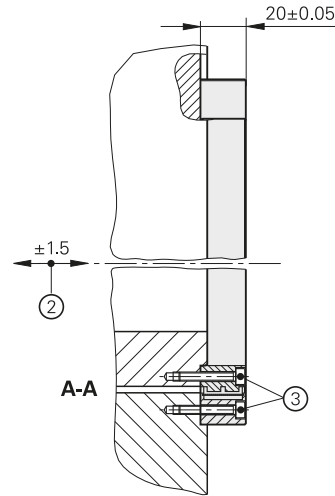
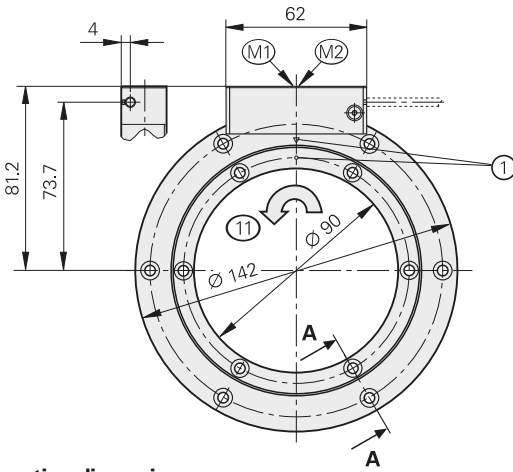


March 2017

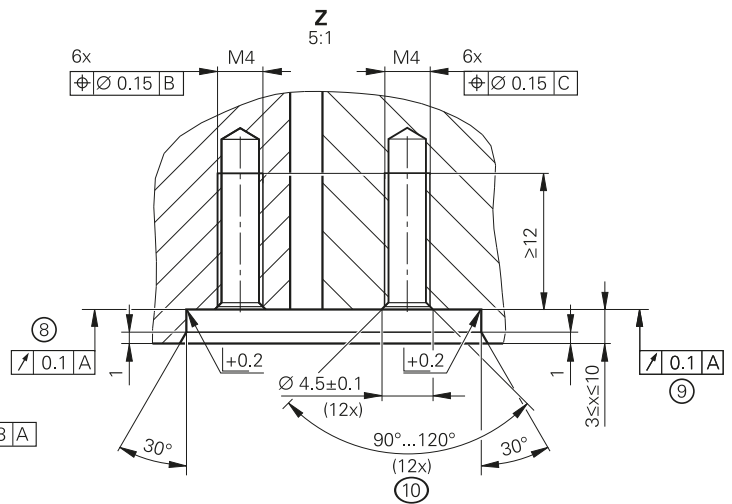
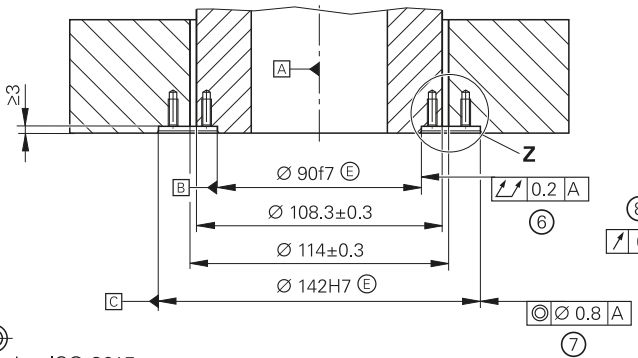
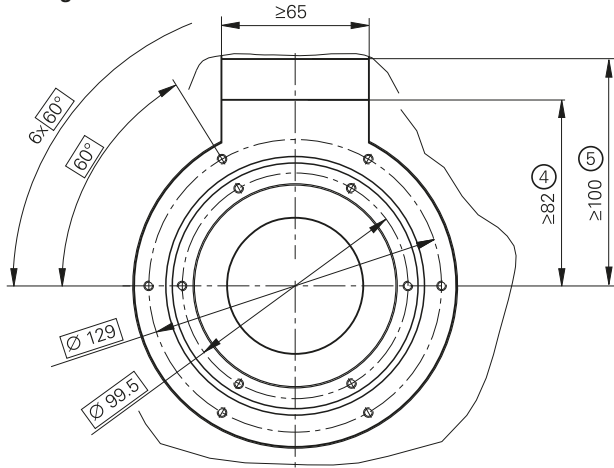
# ECI 4090S

Rotary encoder for absolute position values with safe singleturn information

- Rugged inductive scanning principle
- Hollow through shaft  $\varnothing 90$  mm
- Consists of scanning unit and scale drum



## Required mating dimensions



mm  
 Tolerancing ISO 8015  
 ISO 2768 - m H  
 < 6 mm:  $\pm 0.2$  mm

- ☐ = Bearing of mating shaft
- M1 = Measuring point for operating temperature on housing
- M2 = Measuring point for vibration on housing
- 1 = Datum position  $\pm 5^\circ$
- 2 = Maximum permissible axial deviation between shaft and flange surfaces.  
 Compensation of mounting tolerances and thermal expansion. Dynamic motion permitted over entire range.
- 3 = Use screws with material bonding anti-rotation lock, ISO 4762 – M4 x 25 – 8.8 – MKL as per DIN 267-27 (not included in delivery, ID 202264-88).  
 Tightening torque 2.2 Nm  $\pm 0.13$  Nm
- 4 = Space required when encoder cover is closed
- 5 = Space required for opening the encoder cover
- 6 = Total runout of mating shaft
- 7 = Coaxiality of stator mating surface
- 8 = Bearing surface of rotor
- 9 = Bearing surface of stator
- 10 = Chamfer is obligatory at start of thread for material bonding anti-rotation lock
- 11 = Direction of shaft rotation for output signals according to interface description

Specifications	ECI 4090S – Singleturn
Consisting of	AE ECI4090S scanning unit: ID 1130171-02
	TTR EXI4000 scale drum: ID 1130175-02
<b>Functional safety</b> For applications up to	As single-encoder system for monitoring and closed-loop functions <ul style="list-style-type: none"> <li>• SIL 2 as per EN 61508 (further basis for testing: EN 61800-5-2)</li> <li>• Category 3, PL d according to EN ISO 13849-1:2015</li> </ul> Safe in the singleturn range
PFH <sup>1)</sup>	SIL 2: $\leq 27 \cdot 10^{-9}$ (Probability of dangerous Failure per Hour)
Safe position <sup>2)</sup>	Encoder: $\pm 0.44^\circ$ (safety-related measuring step: SM = 0.176°) Fault exclusion for the loosening of AE scanning unit and TTR scale drum, designed for acceleration of AE: $\leq 400 \text{ m/s}^2$ ; of TTR: $\leq 600 \text{ m/s}^2$
<b>Interface</b>	DRIVE-CLiQ
Ordering designation	DQ01
Firmware	01.32.27.11
Siemens software (ver.: 14.7.2016)	SINAMICS, SIMOTION: $\geq \text{V4.6 HF3}$ ; SINUMERIK with Safety: $\geq \text{V4.7 SP1 HF1}$
Position values/revolution	1 048 576 (20 bits)
Processing TIME_MAX_ACTVAL	$\leq 11 \mu\text{s}$
<b>System accuracy</b>	$\pm 25''$
<b>Electrical connection</b>	15-pin PCB connector (with connection for external temperature sensor <sup>3)</sup> )
Cable length <sup>4)</sup>	$\leq 40 \text{ m}$ (see description in the brochure <i>Interfaces of HEIDENHAIN encoders</i> )
Voltage supply	DC 24 V (10 V to 28.8 V); up to 36 V possible without compromising functional safety
Power consumption <sup>5)</sup> (maximum)	At 10 V: $\leq 1100 \text{ mW}$ ; at 28.8 V: $\leq 1250 \text{ mW}$
Current consumption (typical)	At 24 V: 40 mA (without load)
<b>Shaft</b>	Hollow through shaft $\varnothing 90 \text{ mm}$
Speed	$\leq 6000 \text{ rpm}$
Moment of inertia of rotor	$4.26 \cdot 10^{-4} \text{ kgm}^2$ (without screws)
Angular acceleration of rotor	$\leq 2 \cdot 10^4 \text{ rad/s}^2$
Axial motion of measured shaft	$\leq \pm 1.5 \text{ mm}$
<b>Vibration</b> 55 to 2000 Hz <sup>6)</sup> <b>Shock</b> 6 ms	AE scanning unit: $\leq 400 \text{ m/s}^2$ ; TTR scale drum: $\leq 600 \text{ m/s}^2$ (EN 60068-2-6) $\leq 2000 \text{ m/s}^2$ (EN 60068-2-27)
<b>Operating temperature</b>	$-40 \text{ }^\circ\text{C}$ to $100 \text{ }^\circ\text{C}$ (at the measuring point and the entire scale drum)
<b>Trigger threshold</b> of error message for excessive temperature	$120 \text{ }^\circ\text{C}$ (measuring accuracy of internal temperature sensor: $\pm 1 \text{ K}$ )
<b>Relative humidity</b>	$\leq 93 \%$ ( $40 \text{ }^\circ\text{C}/21 \text{ d}$ as per EN 60068-2-78); without condensation
<b>Protection</b> EN 60529	Complete encoder in mounted condition: IP20 <sup>7)</sup> ; Scanning unit: IP40 (see <i>Insulation</i> under <i>Electrical safety</i> in the brochure <i>Interfaces of HEIDENHAIN Encoders</i> )
<b>Mass</b>	AE scanning unit: $\approx 0.27 \text{ kg}$ ; TTR scale drum: $\approx 0.17 \text{ kg}$

<sup>1)</sup> For altitude of  $\leq 1000 \text{ m}$  above sea level

<sup>2)</sup> Further tolerances may occur in subsequent electronics after position value comparison (contact manufacturer of subsequent electronics)

<sup>3)</sup> See *Temperature measurement in motors* in the brochure *Encoders for Servo Drives*

<sup>4)</sup> With encoder cable length (inside the motor)  $\leq 1 \text{ m}$

<sup>5)</sup> See *General electrical information* in the brochure *Interfaces of HEIDENHAIN Encoders*

<sup>6)</sup> AE: Hz to 55 Hz constant over 6.5 mm distance peak to peak; TTR: 10 Hz to 55 Hz constant over 10 mm distance peak to peak

<sup>7)</sup> The encoder must be protected in use against abrasive and harmful media. Use an appropriate enclosure if required.

# Mounting

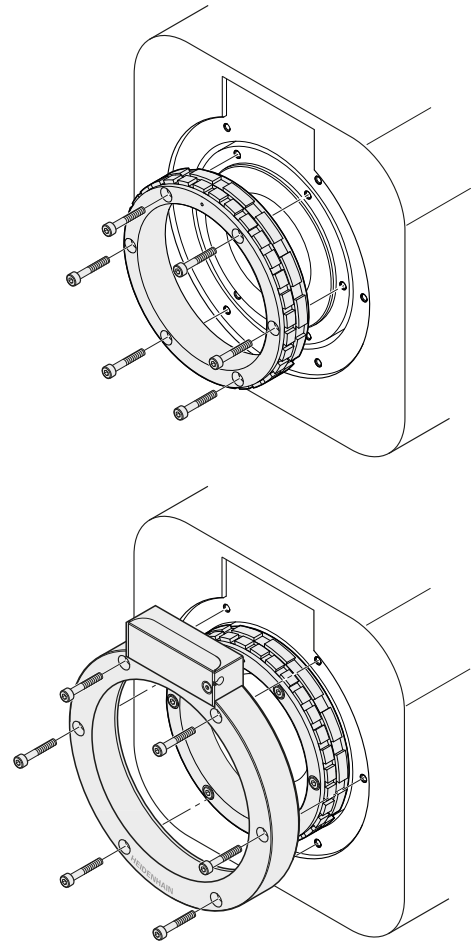
The scale drum of the rotary encoder is slid onto the measured shaft's centering collar and fastened. The stator is mounted via an external centering diameter. In each case, use screws with materially bonding anti-rotation lock (see *Mounting accessories*).

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 $\tau_m$	$\geq 390 \text{ N/mm}^2$	$\geq 130 \text{ N/mm}^2$
Interface pressure $P_G$	$\geq 660 \text{ N/mm}^2$	$\geq 250 \text{ N/mm}^2$
Surface roughness $R_z$	$\leq 16 \mu\text{m}$	
Coefficient of thermal expansion $\alpha_{\text{therm}}$ (at 20 °C)	$(10 \text{ to } 17) \cdot 10^{-6} \text{ K}^{-1}$	$\leq 25 \cdot 10^{-6} \text{ K}^{-1}$

## Protection against contact (EN 60529)

After encoder installation, all rotating parts must be protected against accidental contact during operation.



## Mounting accessories

### Screws

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

ECI 4090S	Screws		Lot size
Mounting screws for stator and rotor	ISO 4762-M4x25-8.8-MKL	ID 202264-88	60 or 300 pieces

<sup>1)</sup> With coating for materially bonding anti-rotation lock

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

### Mounting aid

The mounting aid serves to plug and unplug the PCB connector. It prevents damage to the wires and crimp contacts because the strain is applied only to the connector. The wires must not be pulled.

ID 1075573-01

For further mounting information and mounting aids, refer to the *Encoders for Servo Drives* catalog.



# Integrated temperature evaluation

This rotary encoder features an internal temperature sensor integrated in the encoder electronics as well as an evaluation circuit for an external temperature sensor. The digitized temperature value of the external temperature sensor can be transferred purely serially over the DRIVE-CLiQ interface. Note that temperature measurement and transmission are not secure in the sense of functional safety.

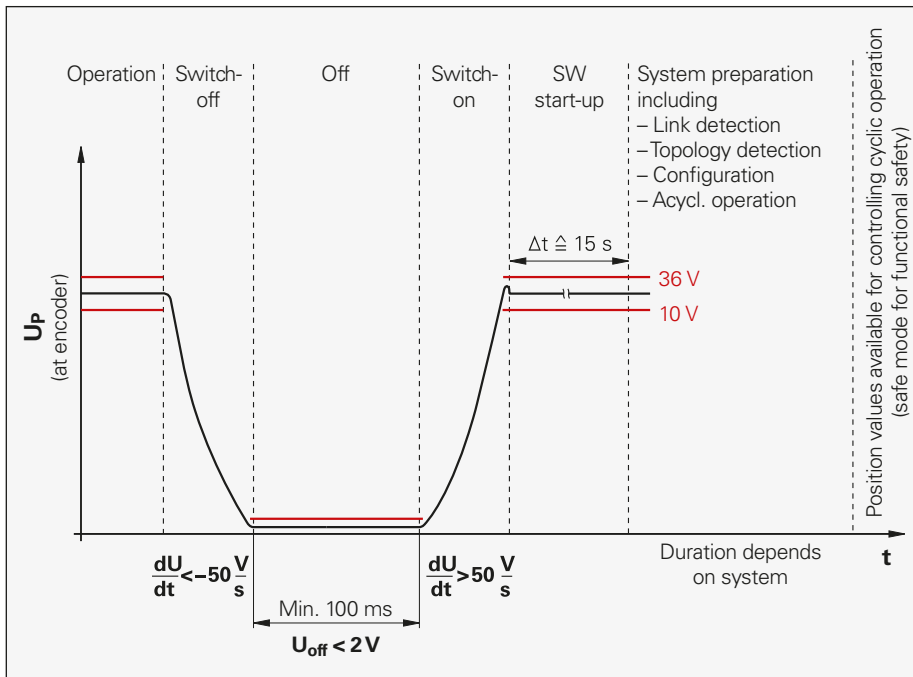
The temperature ascertained by the internal temperature sensor is higher by a device-specific and application-specific amount than the temperature at the measuring point M1 in accordance with the dimension drawing. When the trigger threshold is exceeded for the internal temperature, the encoder issues the error message "Alarm 135." This threshold depends on the encoder model and is shown in the specifications. Keeping a sufficient distance from the error-message threshold is recommended during operation.

The encoder's intended use requires compliance with the operating temperature at the measuring point M1.

DRIVE-CLiQ is a registered trademark of SIEMENS AG.

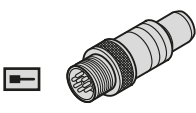
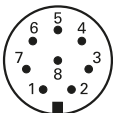
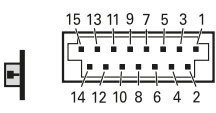

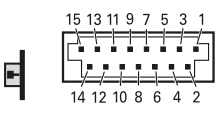


# Electrical requirements

## Switch-on and switch-off conditions



# Electrical connection – Pin layout

## Pin layout of ECI

Pin layout of ECI										
<b>8-pin coupling, M12</b> 			<b>9-pin right-angle socket, M23</b> 			<b>15-pin PCB connector</b> 				
	Power supply				Serial data transfer				Other signals <sup>1)</sup>	
 M12	<b>8</b>	<b>2</b>	<b>5</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>7</b>	<b>6</b>	/	/
 M23	<b>3</b>	<b>7</b>	<b>4</b>	<b>8</b>	<b>5</b>	<b>6</b>	<b>1</b>	<b>2</b>	/	/
	<b>13</b>	<b>11</b>	<b>14</b>	<b>12</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>5</b>	<b>6</b>
	–	–	<b>0V</b>	<b>U<sub>p</sub></b>	<b>RXP</b>	<b>RXN</b>	<b>TXP</b>	<b>TXN</b>	<b>T<sup>+</sup></b> <sup>2)</sup>	<b>T<sup>-</sup></b> <sup>2)</sup>
	Brown/ Green	Blue	White/ Green	White	Gray	Pink	Violet	Yellow	Brown	Green

<sup>1)</sup> Only for cables inside the motor housing

<sup>2)</sup> Connections for external temperature sensor (depending on the encoder cable inside the motor); evaluation optimized for KTY 84-130 (see *Temperature measurement in motors in the Encoders for Servo Drives brochure*)


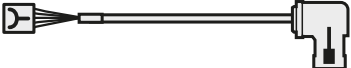

**Cable shield** connected with housing; **U<sub>p</sub>** = Power supply voltage

**Note for safety-related applications:** Use only DRIVE-CLiQ cable complete with connectors from HEIDENHAIN or SIEMENS. Exchange connectors or modify cables only after consultation with HEIDENHAIN Traunreut.

Vacant pins or wires must not be used.






# Electrical connection

## Cables

<b>Encoder cable inside the motor EPG</b> $\varnothing$ 3.7 mm; $[(2 \cdot 2 \cdot 0.06) + (4 \cdot 0.06)] \text{ mm}^2$ ; $A_P = 0.06 \text{ mm}^2$ ; wires for TPE $[2 \cdot 0.16] \text{ mm}^2$ temperature sensor		
<b>Complete</b> with PCB connector (15-pin) and M23 SpeedTEC right-angle socket (male) 9-pin; wires for temperature sensor		ID 1125403-N3 <sup>1)</sup> ; length 0.3 m
<b>Complete</b> with PCB connector (15-pin) and M23 SpeedTEC right-angle socket (male) 9-pin		ID 1125408-N3 <sup>1)</sup> ; length 0.3 m
<b>Complete</b> with PCB connector (15-pin) and M12 coupling (male)		ID 1160559-01 <sup>2)</sup> ; length 1 m

<sup>1)</sup> Operating temperature range (conditional): -20 °C to 120 °C

<sup>2)</sup> Operating temperature range (conditional): -40 °C to 85 °C

<b>PUR connecting cable</b> $\varnothing$ 6.8 m; $[2(2 \cdot 0.17 \text{ mm}^2) + (2 \cdot 0.24 \text{ mm}^2)]$ ; $A_P = 0.24 \text{ mm}^2$		
<b>Complete</b> with M12 connector (female) and M12 coupling (male), 8 pins each		ID 822504-xx
<b>Complete</b> with 8-pin M12 connector (female) and Siemens RJ45 connector (IP67)		ID 1094652-xx
<b>Complete</b> with 8-pin M12 connector (female) and Siemens RJ45 connector (IP20)		ID 1093042-xx
<b>Complete</b> with M23 SpeedTEC connector (female) and Siemens RJ45 connector (IP20)		ID 1121546-xx
<b>Complete with</b> M23-SpeedTEC connector (female) and M12 coupling (male), 8-pin each		ID 1121536-xx

$A_P$ : Cross section of power supply lines

Encoder cables may need strain relief. For cable lengths > 0.5 m always provide strain relief.

SpeedTEC is a registered trademark of Intercontec Pfeiffer Industriesteckverbindungen GmbH.  
DRIVE-CLiQ is a registered trademark of SIEMENS AG.

## HEIDENHAIN

**DR. JOHANNES HEIDENHAIN GmbH**

Dr.-Johannes-Heidenhain-Straße 5

**83301 Traunreut, Germany**

☎ +49 8669 31-0

FAX +49 8669 32-5061

E-mail: info@heidenhain.de

[www.heidenhain.de](http://www.heidenhain.de)

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
- Mounting instructions for *AE ECi4090S*: 1184567 and *TTR EXi4000*: 1147618-xx
- *Interfaces of HEIDENHAIN Encoders* brochure: 1078628