Product Information

ECI 4090S
Absolute Rotary Encoder with 180 mm Hollow Shaft and DRIVE-CLiQ Interface for Safety-Related Applications
ECI 4090S

Rotary encoders for absolute position values with safe singletum information

- Rugged inductive scanning principle
- Hollow through shaft Ø 180 mm
- Consists of scanning unit and scale drum

**Functional Safety**

**Required mating dimensions**

- Bearing of mating shaft
- Measuring point for operating temperature
- Measuring point for vibration on scanning unit
- Mark for 0° position ±5°
- Slot for machine key DIN 6885–A–10x8x20
- Machine key as per DIN 6885–A–10x8x20
- Maximum permissible axial deviation between shaft and flange surfaces. Compensation of mounting tolerances and thermal expansion.
- Mounting screws: ISO 4762–M4x25–8.8. Tightening torque 2.2 Nm ±0.13 Nm. A suitable anti-rotation lock is to be used for the screw connection (e.g. screw with material bonding anti-rotation lock, ISO 4762–M4x25–8.8 MKL as per DIN 267-27 ID 202264-88).
- Space necessary when encoder cover is closed
- Space required when encoder cover is open
- Coaxiality of stator mating surface
- Chamfer at start of thread is obligatory for materially bonding anti-rotation lock
- Bearing surface of stator
- Bearing surface of rotor
- Direction of shaft rotation for output signals according to interface description

Tolerancing ISO 8015
ISO 2 768 - m H
< 6 mm: ±0.2 mm

View of customer's side
## Specifications

**ECI 4090S – Singleturn**

| Consisting of | AE ECI4090S scanning unit: ID 1087527-02  
TTR EXI4000 scale drum: ID 1113606-02 |
|---------------|----------------------------------------------------------------------------------|
| **Functional safety** | For applications up to  
As single-encoder system for monitoring and closed-loop functions  
- SIL 2 according to EN 61 508 (further basis for testing: EN 61 800-5-2)  
- Category 3, PL d according to EN ISO 13849-1:2015  
Safe in the singleturn range  
PFH\(^{1}\)  
SIL 2: \(27 \cdot 10^{-9}\) (Probability of dangerous Failure per Hour)  
Safe position\(^2\)  
Encoder: ± 0.44\(^o\) (safety-related measuring step: SM = 0.176\(^o\))  
Mechanical coupling: ±0.5\(^o\) (Fault exclusion for the loosening of AE scanning unit and TTR scale drum, designed for acceleration of AE: \(400 \text{ m/s}^2\); of TTR: \(600 \text{ m/s}^2\)) |
| **Interface/ordering designation** | DRIVE-CliQ/DQ01 |
| **Firmware** | 01.32.27.11 |
| Siemens software (version: 14.7.2016) | SINAMICS, SIMOTION: ≥ V4.6 HF3; SINUMERIK with Safety: ≥ V4.7 SP1 HF1 |
| Position values/revolution | 1048576 (20 bits) |
| Processing time TIME\(_{\text{MAX\_ACTVAL}}\) | ≤ 11 µs |
| **System accuracy** | ±40\(^\circ\) |
| **Electrical connection** | 15-pin PCB connector (with connection for external temperature sensor\(^3\)) |
| Cable length\(^4\) | ≤ 40 m (see description in the brochure Interfaces of HEIDENHAIN encoders) |
| Voltage supply | DC 24 V (10 V to 28.8 V); up to 36 V possible without compromising functional safety |
| Power consumption\(^5\) (maximum) | At 10 V: ≤ 1100 mW; at 28.8 V: ≤ 1250 mW |
| Current consumption (typical) | At 24 V: 40 mA (without load) |
| **Shaft** | Hollow through shaft Ø 180 mm (with keyway) |
| Speed | ≤ 6000 rpm |
| Moment of inertia of rotor | \(3.1 \cdot 10^{-3} \text{ kgm}^2\) (without screws, without machine key) |
| Angular acceleration of rotor | ≤ 2 \cdot 10^4 \text{ rad/s}^2 |
| Axial motion of measured shaft | ≤ ±1.5 mm |
| **Vibration** | 55 to 2000 Hz\(^6\)  
Shock | 6 ms |
| **Operating temperature** | −40 °C to 100 °C (at the measuring point and the entire scale drum) |
| **Trigger threshold** of error message for excessive temperature | 120 °C (measuring accuracy of internal temperature sensor: ±1 K) |
| **Relative humidity** | ≤ 93 % (40 °C/21 d as per EN 60068-2-78); without condensation |
| **Protection** | EN 60529  
Complete encoder in mounted condition: IP20\(^7\); Scanning unit: IP40 (see Insulation under Electrical safety in the brochure Interfaces of HEIDENHAIN Encoders) |
| **Mass** | AE scanning unit: ≈ 0.39 kg; TTR scale drum: ≈ 0.33 kg |

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\(^1\) For altitude of ≤ 1000 m above sea level  
\(^2\) Further tolerances may occur in subsequent electronics after position value comparison (contact manufacturer of subsequent electronics)  
\(^3\) See Temperature measurement in motors in the brochure Encoders for Servo Drives  
\(^4\) With encoder cable length (inside the motor) ≤ 1 m  
\(^5\) See General electrical information in the brochure Interfaces of HEIDENHAIN Encoders  
\(^6\) 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  
\(^7\) The encoder must be protected in use against abrasive and harmful media. Use an appropriate enclosure if required.

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Product Information ECI 4090 S 7/2017
Mounting

The scale drum of the rotary encoder is slid onto the centering collar of the measured shaft with machine key 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:

<table>
<thead>
<tr>
<th>Mating shaft/mating stator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Steel</td>
</tr>
<tr>
<td>Tensile strength $R_m$</td>
</tr>
<tr>
<td>Shear strength $\tau_m$</td>
</tr>
<tr>
<td>Interface pressure $P_G$</td>
</tr>
<tr>
<td>Surface roughness $R_z$</td>
</tr>
<tr>
<td>Coefficient of thermal expansion $\alpha_{\text{therm}}$ (at 20 °C)</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>ID 4090S</th>
<th>Screws</th>
<th>Lot size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting screws For stator and rotor</td>
<td>ISO 4762 M4x25-8.8-MKL</td>
<td>ID 202264-88 60 or 300 pieces</td>
</tr>
</tbody>
</table>

1) 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.

Machine key
The machine keys are not included in delivery.

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 form over the DRIVE-QLiQ 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 issue 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.

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## Electrical requirements

### Switch-on and switch-off conditions

**Operation:** Switch-off

**Switch-on:**
- System preparation including:
  - Link detection
  - Topology detection
  - Configuration
  - Acyclic operation

**SW start-up:** Position values available for controlling cyclic operation (safe mode for functional safety)

- Min. 100 ms
- Duration depends on system
- $U_{off} < 2 \text{ V}$

**$U_P$ (at encoder):**
- $\frac{dU}{dt} > 50 \text{ V/s}$
- $\Delta t \leq 15 \text{ s}$
- $36 \text{ V}$
- $10 \text{ V}$

$U_{off} = 2 \text{ V}$
## Electrical connection – pin layout

### Pin layout of ECI

<table>
<thead>
<tr>
<th>8-pin coupling M12</th>
<th>9-pin right-angle socket M23</th>
<th>15-pin PCB connector</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="8-pin coupling" /></td>
<td><img src="image" alt="9-pin right-angle socket" /></td>
<td><img src="image" alt="15-pin PCB connector" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Serial data transfer</th>
<th>Other signals ¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M12 8 2 5 1 3 4 7 6</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>M23 3 7 4 8 5 6 1 2</td>
<td>/</td>
<td>/</td>
</tr>
<tr>
<td>13 11 14 12 7 8 9 10 5 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>– – 0 V U_P RXP RXN TXP TXN T+ ²) T– ²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown/Green Blue White/Green White Gray Pink Violet Yellow Brown Green</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹) Only for cables inside the motor housing

²) 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 to housing; **U_P** = 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

**EPG encoder cable inside the motor** \( \varnothing \) 3.7 mm; \([(2 \times 2 \times 0.06) + (4 \times 0.06)] \text{ mm}^2; \ AP = 0.06 \text{ mm}^2; \) wires for TPE temperature sensor \([(2 \times 0.16)] \text{ mm}^2

| Complete with PCB connector (15-pin) and M23 SpeedTEC right-angle socket (male) 9-pin; wires for temperature sensor | ID 1125403-N3; length 0.3 m |
| Complete with PCB connector (15-pin) and M23 SpeedTEC right-angle socket (male) 9-pin | ID 1125408-N3; length 0.3 m |
| Complete with PCB connector (15-pin) and M12 coupling (male) | ID 1160559-01; length 1 m |

CE compliance of the complete system must be documented.

1) Operating temperature range (conditional): –20 °C to 120 °C
2) Operating temperature range (conditional): –40 °C to 85 °C

**PUR connecting cable** \( \varnothing \) 6.8 m; \([(2 \times 0.17 \text{ mm}^2) + (2 \times 0.24 \text{ mm}^2)] \text{ mm}^2; \ AP = 0.24 \text{ mm}^2

| Complete with M12 connector (female) and M12 coupling (male), 8 pins each | ID 822504-xx |
| Complete with 8-pin M12 connector (female) and Siemens RJ45 connector (IP67) | ID 1094652-xx |
| Complete with 8-pin M12 connector (female) and Siemens RJ45 connector (IP20) | ID 1093042-xx |
| Complete with M23 SpeedTEC connector (female) and Siemens RJ45 connector (IP20) | ID 1121546-xx |
| Complete with M23 SpeedTEC connector (female) and M12 coupling (male), 8-pin | ID 1121536-xx |

**AP**: Cross section of power supply lines

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

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SpeedTEC is a registered trademark of Intercontec Pfeiffer Industriesteckverbindungen GmbH.

DRIVE-CLIQ is a registered trademark of SIEMENS AG.

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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.

**For more information:**

Comply with the requirements described in the following documents to ensure the correct operation of the encoder:

- **Encoders for Servo Drives** brochure: 208922-xx
- **Mounting instructions** for AE ECI4090S: 1214406-xx and for TTR EXI4000: 1214404-xx
- **Interfaces of HEIDENHAIN Encoders** brochure: 1078628