ECI 4090 S
Absolute Rotary Encoder with 90 mm Hollow Shaft and DRIVE-CLiQ Interface for Safety-Related Applications
ECI 4090 S

Rotary encoder for absolute position values with safe singleturn information
- Rugged inductive scanning principle
- Hollow through shaft Ø 90 mm
- Consists of scanning unit and scale drum

Required mating dimensions

1 = Bearing of mating shaft
M1 = Measuring point for operating temperature on housing
M2 = Measuring point for vibration on housing
1 = Datum position ±5°
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 ±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 materially bonding anti-rotation lock
11 = Direction of shaft rotation for output signals according to interface description

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

Diagram and dimensions as per drawing detail.
### Specifications

<table>
<thead>
<tr>
<th>Consisting of</th>
<th>AE ECI4090S scanning unit: ID 1130171-02</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TTR EXI4000 scale drum: ID 1130175-02</td>
</tr>
</tbody>
</table>

#### Functional safety

For applications up to

- As 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 according to EN ISO 13849-1:2015
  - Safe in the singleturn range

- SIL 2: $27 \cdot 10^{-9}$ (Probability of dangerous Failure per Hour)

- Safe position
  - Encoder: $\pm 0.44^\circ$ (safety-related measuring step: $SM = 0.176^\circ$)

- 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

- DRIVE-CLiQ

#### Ordering designation

DQ01

#### Firmware

01.32.27.11

#### Siemens software (ver.: 14.7.2016)

- SINAMICS, SIMOTION: $\geq 4.6$ HF3; SINUMERIK with Safety: $\geq 4.7$ SP1 HF1

#### Position values/revolution

$1048576$ (20 bits)

#### Processing

$TIME_{\text{MAX\_ACTVAL}} \leq 11 \text{ }\mu\text{s}$

#### System accuracy

$\pm 25^\circ$

#### Electrical connection

- 15-pin PCB connector (with connection for external temperature sensor)
- $\leq 40 $ m (see description in the brochure Interfaces of HEIDENHAIN Encoders)

#### Cable length

- $\leq 40 $ m (see description in the brochure Interfaces of HEIDENHAIN Encoders)
- Voltage supply DC $24 \text{ V}$ ($10 \text{ V}$ to $28.8 \text{ V}$); up to $36 \text{ V}$ possible without compromising functional safety

#### Power consumption

- At $10 \text{ V}$: $\leq 1100 \text{ mW}$; at $28.8 \text{ V}$: $\leq 1250 \text{ mW}$

#### Current consumption (typical)

- $\leq 40 \text{ mA}$ (without load)

#### Shaft

- 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

- $\leq 1.5 \text{ mm}$

#### Vibration

- 55 to $2000 \text{ Hz}$
- $\leq 400 \text{ m/s}^2$ (EN 60068-2-6)
- $\leq 600 \text{ m/s}^2$ (EN 60068-2-27)

#### Shock

- 6 ms

#### Operating temperature

- $-40 \text{ °C}$ to $100 \text{ °C}$ (at the measuring point and the entire scale drum)

#### Trigger threshold

- of error message for excessive temperature
  - $120 \text{ °C}$ (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 60529
  - Complete encoder in mounted condition: IP20
  - Scanning unit: IP40 (see Insulation under Electrical safety in the brochure Interfaces of HEIDENHAIN Encoders)

#### Mass

- AE scanning unit: $\approx 0.27 \text{ kg}$; TTR scale drum: $\approx 0.17 \text{ kg}$

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1) For altitude of $\leq 1000 \text{ m}$ 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) $\leq 1 \text{ m}$
5) See General electrical information in the brochure Interfaces of HEIDENHAIN Encoders
6) AE: $10 \text{ Hz}$ to $55 \text{ Hz}$ constant over $6.5 \text{ mm}$ distance peak to peak; TTR: $10 \text{ Hz}$ to $55 \text{ Hz}$ constant over $10 \text{ mm}$ distance peak to peak
7) The encoder must be protected in use against abrasive and harmful media. Use an appropriate enclosure if required.

DRIVE-CLiQ is a registered trademark of SIEMENS AG.
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:

<table>
<thead>
<tr>
<th>Mating shaft/mating stator</th>
<th>Material</th>
<th>Steel</th>
<th>Aluminum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength $R_m$</td>
<td>$\geq 600 \text{ N/mm}^2$</td>
<td>$\geq 220 \text{ N/mm}^2$</td>
<td></td>
</tr>
<tr>
<td>Shear strength $\tau_m$</td>
<td>$\geq 390 \text{ N/mm}^2$</td>
<td>$\geq 130 \text{ N/mm}^2$</td>
<td></td>
</tr>
<tr>
<td>Interface pressure $P_G$</td>
<td>$\geq 660 \text{ N/mm}^2$</td>
<td>$\geq 250 \text{ N/mm}^2$</td>
<td></td>
</tr>
<tr>
<td>Surface roughness $R_Z$</td>
<td>$\leq 16 \mu\text{m}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of thermal expansion $\alpha_{\text{therm}}$ (at 20 °C)</td>
<td>$(10 \text{ to } 17) \cdot 10^{-6} \text{ K}^{-1}$</td>
<td>$\leq 25 \cdot 10^{-6} \text{ K}^{-1}$</td>
<td></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>ECI 4090 S</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.

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.

DRIVE-QLiQ is a registered trademark of SIEMENS AG.
Electrical requirements

Switch-on and switch-off conditions

- Operation Switch-off
- Off
- Switch-on SW start-up
- System preparation including:
  - Link detection
  - Topology detection
  - Configuration
  - Acycl. operation

Position values available for controlling cyclic operation (safe mode for functional safety):
- 36 V
- 10 V

- U_{\text{off}} < 2 V
- \Delta t \leq 15 \text{s}
- Duration depends on system
- Min. 100 ms
- \frac{dU}{dt} \leq -50 \text{ V/s}
- \frac{dU}{dt} \leq 50 \text{ V/s}
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>Power supply</td>
<td>Serial data transfer</td>
<td>Other signals 1)</td>
</tr>
<tr>
<td>M12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
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<td>5</td>
<td>6</td>
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<td>T– 2)</td>
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<td>Brown/ Green</td>
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<td>Blue</td>
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<td>White/ Green</td>
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<td>Green</td>
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</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 with housing; UP = 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

<table>
<thead>
<tr>
<th>Encoder cable inside the motor EPG</th>
<th>Complete with PCB connector (15-pin) and M23 SpeedTEC right-angle socket (male) 9-pin; wires for temperature sensor</th>
<th>ID 1125403-N3</th>
<th>length 0.3 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete with PCB connector (15-pin) and M23 SpeedTEC right-angle socket (male) 9-pin</td>
<td>ID 1125408-N3</td>
<td>length 0.3 m</td>
<td></td>
</tr>
<tr>
<td>Complete with PCB connector (15-pin) and M12 coupling (male)</td>
<td>ID 1160559-01</td>
<td>length 1 m</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PUR connecting cable</th>
<th>Complete with M12 connector (female) and M12 coupling (male), 8 pins each</th>
<th>ID 822504-xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete with 8-pin M12 connector (female) and Siemens RJ45 connector (IP67)</td>
<td>ID 1094652-xx</td>
<td></td>
</tr>
<tr>
<td>Complete with 8-pin M12 connector (female) and Siemens RJ45 connector (IP20)</td>
<td>ID 1093042-xx</td>
<td></td>
</tr>
<tr>
<td>Complete with M23 SpeedTEC connector (female) and Siemens RJ45 connector (IP20)</td>
<td>ID 1121546-xx</td>
<td></td>
</tr>
<tr>
<td>Complete with M23-SpeedTEC connector (female) and M12 coupling (male), 8-pin each</td>
<td>ID 1121536-xx</td>
<td></td>
</tr>
</tbody>
</table>

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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HEIDENHAIN

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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.

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

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