Absolute Rotary Encoders with Tapered Shaft and Expanding Ring Coupling for Safety-Related Applications
Rotary encoders for absolute position values with safe singletum information

- 65 mm installation diameter
- 07B expanding ring coupling
- 65B tapered shaft
- IP64 rating

**Required mating dimensions**

- M1 = Measuring point for operating temperature
- M2 = Measuring point for vibration, see D 741714
- 1 = Clamping screw for coupling ring, width A/F 2, tightening torque: 1.25 Nm – 0.2 Nm
- 2 = Screw plug, widths A/F 3 and 4, tightening torque: 5 Nm + 0.5 Nm
- 3 = Screw: DIN 6912 – M5x50-08.8 – MKL, width A/F 4, tightening torque: 5 Nm + 0.5 Nm
- 4 = M10 back-off thread
- 5 = M6 back-off thread
- 6 = Compensation of mounting tolerances and thermal expansion; no dynamic motion permitted
- 7 = Chamfer at start of thread is obligatory for material bonding anti-rotation lock
- 8 = Direction of shaft rotation for ascending position values
## Specifications

### ECN 425 – Singleturn

**Functional safety** for applications up to

- SIL 1 as per EN 61508 (further basis for testing: EN 61800-5-2)
- Category 2, PL c as per EN ISO 13849-1:2015

As single-encoder system for monitoring functions

- SIL 2 as per EN 61508 (further basis for testing: EN 61800-5-2)
- Category 3, PL d as per EN ISO 13849-1:2015

Safe in the singleturn range

**PFH** \( \leq 10 \cdot 10^{-9} \) (probability of dangerous failure per hour)

**Safe position**

- **Encoder:** \( \pm 1.76^\circ \) (safety-related measuring step: SM = 0.7°)
- **Mechanical coupling:** \( \pm 2^\circ \) (fault exclusion for the loosening of shaft and stator coupling, designed for accelerations \( \leq 300 \, \text{m/s}^2 \))

**Interface**

- **EnDat 2.2**

**Ordering designation**

- **EnDat22**

**Position values per revolution**

- 33 554 432 (25 bits)

**Revolutions**

- 4096 (12 bits)

**Calculation time** \( t_{\text{calc}} \)

- \( \leq 7 \, \mu\text{s} \)
- \( \leq 8 \, \text{MHz} \)

**System accuracy**

- \( \pm 20^\circ \)

**Electrical connection**

- Cable (1 m) with 8-pin M12 coupling (male)

**Cable length**

- \( \leq 100 \, \text{m} \) (see the EnDat description in the *Interfaces of HEIDENHAIN Encoders* brochure)

**Supply voltage**

- DC 3.6 V to 14 V

**Power consumption** \( \text{max.} \)

- At 3.6 V: \( \leq 600 \, \text{mW} \)
- At 14 V: \( \leq 700 \, \text{mW} \)

**Current consumption (typical)**

- At 5 V: \( 85 \, \text{mA} \) (without load)
- At 5 V: \( 105 \, \text{mA} \) (without load)

**Shaft**

- 65B tapered shaft \( \varnothing 9.25 \, \text{mm}; \) taper 1:10

**Shaft speed**

- \( \leq 15 \, \text{000 rpm} \)
- \( \leq 12 \, \text{000 rpm} \)

**Starting torque at 20 °C (typical)**

- 0.01 Nm

**Moment of inertia of rotor**

- \( 2.6 \cdot 10^{-6} \, \text{kgm}^2 \)

**Angular acceleration of rotor**

- \( \leq 1 \cdot 10^5 \, \text{rad/s}^2 \)

**Natural frequency of stator coupling**

- \( \geq 1800 \, \text{Hz} \)

**Axial motion of measured shaft**

- \( \leq \pm 0.5 \, \text{mm} \)

**Vibration**

- 55 Hz to 2000 Hz
- \( \leq 300 \, \text{m/s}^2 \) (EN 60068-2-6);
- 10 Hz to 55 Hz constant over 4.9 mm peak to peak
- \( \leq 2000 \, \text{m/s}^2 \) (EN 60068-2-27)

**Shock**

- 6 ms
- \( \leq 10 \, \text{Hz to 55 Hz constant over 4.9 mm peak to peak} \)
- \( \leq 200 \, \text{Hz} \)

**Min. operating temperature**

- Stationary cable: \( -40 \, ^\circ \text{C} \); moving cable: \( -10 \, ^\circ \text{C} \)

**Max. operating temperature**

- 100 °C

**Trigger threshold of error message for temperature exceedance**

- 125 °C (measuring accuracy of the internal temperature sensor: \( \pm 4 \, ^\circ \text{K} \))

**Relative humidity**

- \( \leq 93 \% \) (40 °C/21 d as per EN 60068-2-78); without condensation

**Protection class**

- EN 60529 IP64 (read about insulation under *General mechanical information* in the *Interfaces of HEIDENHAIN Encoders* brochure; contamination from the ingress of liquids must be prevented)

**Mass**

- \( \approx 0.25 \, \text{kg} \)

**ID number**

- ID 678920-02
- ID 678922-02

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1) Further tolerances may arise in subsequent electronics after pos. value comparison (contact manufacturer of subsequent electronics)

2) See *General electrical information* in the *Interfaces of HEIDENHAIN Encoders* brochure
Mounting

The tapered shaft of the rotary encoder is slid onto the measured shaft and fastened with a central screw. It is particularly important to ensure that the positive-locking element of the stator coupling securely engages the corresponding slot in the measured shaft. Use a screw with material bonding anti-rotation lock (see Mounting accessories). The stator coupling is clamped by an axially tightened screw in a location hole.

Requirements on the motor side for safe mechanical coupling:

<table>
<thead>
<tr>
<th>Material</th>
<th>Mating shaft</th>
<th>Mating stator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td></td>
<td>Aluminum</td>
</tr>
<tr>
<td>Tensile strength $R_m$</td>
<td>$\geq 600 , \text{N/mm}^2$</td>
<td>$\geq 220 , \text{N/mm}^2$</td>
</tr>
<tr>
<td>Interface pressure $P_G$</td>
<td>$\geq 500 , \text{N/mm}^2$</td>
<td>$\geq 200 , \text{N/mm}^2$</td>
</tr>
<tr>
<td>Surface roughness $R_z$</td>
<td>$\leq 16 , \mu\text{m}$</td>
<td></td>
</tr>
<tr>
<td>Coefficient of thermal expansion $\alpha_{\text{therm}}$</td>
<td>$10 \cdot 10^{-6} , \text{K}^{-1}$ to $17 \cdot 10^{-6} , \text{K}^{-1}$</td>
<td>$\leq 25 \cdot 10^{-6} , \text{K}^{-1}$</td>
</tr>
</tbody>
</table>

For the design of the mechanical fault exclusion for the shaft connection, the following maximum torque $M_{\text{max}}$ must be considered:

$M_{\text{max}} = 1.0 \, \text{Nm}$

The customer’s mechanical design must ensure that the maximum torque $M_{\text{max}}$ occurring in the application can be transmitted.

Mounting accessories

Screws

Screws (central screw, mounting screws) are not included in delivery and can be ordered separately.

<table>
<thead>
<tr>
<th>ECN 425, EQN 437</th>
<th>Screws $^1$</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central screw for shaft fastening</td>
<td>DIN 6912 – M5×50-08.8 – MKL</td>
<td>ID 202264-54 10 or 100</td>
</tr>
</tbody>
</table>

1) With coating for material bonding anti-rotation lock

For further mounting information and mounting aids, please refer to the relevant mounting instructions and the Encoders for Servo Drives brochure. The mounting can be tested with the PWM 21 and the ATS software.
Electrical connection

Cables with M12 connecting elements

<table>
<thead>
<tr>
<th>PUR connecting cables and adapter cables</th>
<th>ID 1036372-xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecting cable with 8-pin M12 connector (female) and 8-pin M12 coupling (male)</td>
<td></td>
</tr>
<tr>
<td>Adapter cable with 8-pin M12 connector (female) and 15-pin D-sub connector (female)</td>
<td>ID 1036521-xx</td>
</tr>
<tr>
<td>Adapter cable with 8-pin M12 connector (female) and 15-pin D-sub connector (male)</td>
<td>ID 1036526-xx</td>
</tr>
<tr>
<td>Connecting cable with 8-pin M12 connector (female) and unstripped cable end</td>
<td>ID 1129681-xx</td>
</tr>
</tbody>
</table>

\[ A_P = 2 \times 0.16 \text{ mm}^2 \]

Conformity with the EMC Directive must be ensured for the complete system!

Note for safety-related applications: Document the bit error rate in accordance with Specification 533095!

Pin layout

8-pin M12 coupling

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Absolute position values</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>( U_P )</td>
<td>Sensor</td>
</tr>
<tr>
<td>Brown/Green</td>
<td>Blue</td>
</tr>
</tbody>
</table>

Cable shield connected to housing; \( U_P = \) Power supply

Sensor: The sense line is connected in the encoder with the corresponding power supply. Vacant pins and 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.

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

- Brochure: Encoders for Servo Drives 208922-xx
- Brochure: Interfaces of HEIDENHAIN Encoders 1078628-xx
- Brochure: Cables and Connectors 1206103-xx
- Mounting instructions: ECN 425, EON 437 727583-xx
- For implementation in a safe control or inverter: Specification 533095-xx