Product Information

ECN 1123
EQN 1135

Absolute Rotary Encoders with 1KA Positive-Locking Hollow Shaft for Safety-Related Applications
ECN 1123, EQN 1135

Rotary encoders for absolute position values with safe singletum information
- Mounted stator coupling, 75A
- Ø 6 mm blind hollow shaft for axial clamping (1KA)

Required mating dimensions

- Bearing of mating shaft
- M1 = Measuring point for operating temperature
- M2 = Measuring point for vibration
- 1 = Contact surface of slot
- 2 = Chamfer is obligatory at start of thread for materially bonding anti-rotation lock
- 3 = Shaft surface, ensure full-surface contact!
- 4 = Slot required only for ECN/EQN and ECI/EQI with WELLA1 = 1KA
- 5 = Flange surface ECI/EQI FS; ensure full-surface contact!
- 6 = Coupling surface of ECN/EQN
- 7 = Maximum permissible deviation between shaft and flange surfaces. Compensation for mounting tolerances and thermal expansion, of which ±0.15 mm of dynamic axial motion is permitted
- 8 = Maximum permissible deviation between shaft and flange surfaces. Compensation for mounting tolerances and thermal expansion
- 9 = Flange surface of ECI/EBI; ensure full-surface contact!
- 10 = Undercut
- 11 = Possible centering hole
- 12 = 15-pin PCB connector
- 13 = Cable outlet for cables with crimp sleeve; diameter: 4.3 ±0.1 mm; length: 7 mm
- 14 = Positive-locking element; ensure correct engagement in slot 4, e.g. by measuring the device overhang
- 15 = Direction of shaft rotation for ascending position values

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

<table>
<thead>
<tr>
<th>ID number</th>
<th>ECN 1123 – Singletum</th>
<th>EQN 1135 – Multitum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>743586-01</td>
<td>743587-01</td>
</tr>
</tbody>
</table>

### Functional safety for applications up to

- As single-encoder system for monitoring functions:
  - 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 closed-loop 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 singleturn operation

<table>
<thead>
<tr>
<th>PFH</th>
<th>≤ 15 · 10⁻⁹ (probability of dangerous failure per hour)</th>
</tr>
</thead>
</table>

Safe position

- Encoder: ±1.75° (safety-related measuring step: SM = 0.7°)
- Mechanical coupling: ±2° (fault exclusion for loosening of shaft coupling and stator coupling; designed for accelerations of ≤ 300 m/s²)

### Interface

- EnDat 2.2

### Ordering designation

- EnDat22

### Position values per rev.

- 8 388 608 (23 bits)
- 4096 (12 bits)

### Revolutions

<table>
<thead>
<tr>
<th>Calculation time t&lt;sub&gt;calc&lt;/sub&gt;</th>
<th>≤ 7 µs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock frequency</td>
<td>≤ 8 MHz</td>
</tr>
</tbody>
</table>

### System accuracy

- ±60°

### Electrical connection

- 15-pin PCB connector (with connection for external temperature sensor)

### Cable length

- ≤ 100 m (see EnDat description in the Interfaces of HEIDENHAIN Encoders brochure)

### Supply voltage

- DC 3.6 V to 14 V

### Power consumption (max.)

- At 3.6 V: ≤ 600 mW
- At 14 V: ≤ 700 mW

### Current consumption (typical)

- At 5 V: 85 mA (without load)
- At 5 V: 105 mA (without load)

### Shaft

- Blind hollow shaft, Ø 6 mm, with positive-locking element (1KA)

### Speed

- ≤ 12 000 rpm

### Starting torque a at 20 °C

- ≤ 0.001 Nm
- ≤ 0.002 Nm

### Moment of inertia

- Rotor: 0.4 · 10⁻⁶ kgm²
- Stator: 1.0 · 10⁻⁵ kgm²

### Angular acceleration

- Rotor: ≤ 1 · 10⁵ rad/s²
- Stator: ≤ 1 · 10⁴ rad/s²

### Axial motion of measured shaft

- ≤ ±0.5 mm

### Natural frequency of stator coupling

- ≥ 1000 Hz

### Vibration

- 55 Hz to 2 000 Hz
- ≤ 200 m/s² (EN 60068-2-6); 10 Hz to 55 Hz constant over 3.2 mm peak to peak
- ≤ 2000 m/s² (EN 60068-2-27)

### Shock

- 6 ms
- ≤ 40 °C to 110 °C

### Operating temperature

- -40 °C to 110 °C

### Trigger threshold of error message for excessive temperature

- 125 °C (measuring accuracy of internal temperature sensor: ±5 K)

### Relative humidity

- ≤ 93 % (40 °C/21 d as per EN 60068-2-78); condensation excluded

### Protection

- EN 60529
- IP40 (see Insulation under General mechanical information in the Encoders for Servo Drives brochure; contamination from the ingress of liquid must be prevented)

### Mass

- ≈ 0.1 kg

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1) Further tolerances may apply in the subsequent electronics after position value comparison (contact mfr. of subsequent electronics)
2) See General electrical information in the Interfaces of HEIDENHAIN Encoders brochure
3) See Temperature measurement in motors in the Encoders for Servo Drives brochure
4) Comply with the maximum torque when designing the mechanical fault exclusion (page 4)
Mounting

The blind hollow 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 encoder shaft securely engages the corresponding slot in the measured shaft. The stator is connected without a centering collar to a flat surface with two clamping screws. Use screws with materially bonding anti-rotation lock (see Mounting accessories).

The following material properties and conditions must be complied with when planning and executing customer-side installation:

<table>
<thead>
<tr>
<th>Material</th>
<th>Mating stator</th>
<th>Mating shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>aluminum</td>
<td>Steel</td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td>$\geq 220 \text{ N/mm}^2$</td>
<td>$\geq 600 \text{ N/mm}^2$</td>
</tr>
<tr>
<td>Yield strength  $R_{\sigma 2}$ or yield point $R_{\sigma}$</td>
<td>$-$</td>
<td>$\geq 400 \text{ N/mm}^2$</td>
</tr>
<tr>
<td>Shear strength $\tau$</td>
<td>$130 \text{ N/mm}^2$</td>
<td>$\geq 390 \text{ N/mm}^2$</td>
</tr>
<tr>
<td>Interface pressure $P_G$</td>
<td>$\geq 250 \text{ N/mm}^2$</td>
<td>$\geq 660 \text{ N/mm}^2$</td>
</tr>
<tr>
<td>Modulus of Elasticity $E$ (at 20 °C)</td>
<td>70 kN/mm$^2$ to 75 kN/mm$^2$</td>
<td>200 kN/mm$^2$ to 215 kN/mm$^2$</td>
</tr>
<tr>
<td>Coefficient of thermal expansion $\alpha_{\text{therm}}$ (at 20 °C)</td>
<td>$\leq 25 \cdot 10^{-6} \text{ K}^{-1}$</td>
<td>$10 \cdot 10^{-6} \text{ K}^{-1}$ to $17 \cdot 10^{-6} \text{ K}^{-1}$</td>
</tr>
<tr>
<td>Surface roughness $R_Z$</td>
<td>$\leq 16 \mu m$</td>
<td></td>
</tr>
<tr>
<td>Friction values</td>
<td>Mounting surfaces must be clean and free of grease. Use screws and washers in the condition as delivered.</td>
<td></td>
</tr>
<tr>
<td>Tightening process</td>
<td>Use a signaling torque tool as per DIN EN ISO 6789; accuracy ±6 %</td>
<td></td>
</tr>
<tr>
<td>Mounting temperature</td>
<td>15 °C to 35 °C</td>
<td></td>
</tr>
</tbody>
</table>

When designing the mechanical fault exclusion for the shaft connection, use the following maximum torque $M_{\text{max}}$:

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

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

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

<table>
<thead>
<tr>
<th>Screws</th>
<th>Lot size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central screw for ECN 1123</td>
<td>ISO 4762-M3×22-8.8-MKL</td>
</tr>
<tr>
<td>Central screw for EQN 1135</td>
<td>ISO 4762-M3×35-8.8-MKL</td>
</tr>
<tr>
<td>Mounting screw for flange</td>
<td>ISO 4762-M3×10-8.8-MKL</td>
</tr>
</tbody>
</table>

1) With coating for materially bonding anti-rotation lock

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

Mounting aid
To avoid damage to the cable, use the mounting aid to connect and disconnect the cable assembly. The pulling force must be applied only to the connector of the cable assembly, and not to the wires.

ID 1075573-01

Mounting aid
This tool is for turning the encoder shaft from the rear, thereby making it easy to find the positive-locking connection between the encoder shaft and the measured shaft.

ID 821017-03
### Output cables inside the motor housing

<table>
<thead>
<tr>
<th>Description</th>
<th>Diagram</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete with 15-pin PCB connector and 8-pin M12 flange socket (male); TPE single wires in braided sleeve and wires for temperature sensor</td>
<td><img src="image1.png" alt="Diagram" /></td>
<td>1117412-xx</td>
</tr>
<tr>
<td>One 15-pin PCB connector and free cable end (unstripped); Ø 3.7 mm EPG (with shield crimp sleeve: Ø 4.3 mm) and wires for temperature sensor</td>
<td><img src="image2.png" alt="Diagram" /></td>
<td>1108078-xx</td>
</tr>
</tbody>
</table>

1) Single wires with braided sleeve  
2) Shield connection required on the motor side  

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

### PUR adapter cables and connecting cables

<table>
<thead>
<tr>
<th>Description</th>
<th>Diagram</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 6 mm; 2 × (2 × 0.09 mm²) + 2 × (2 × 0.16 mm²); $A_P = 0.16$ mm²</td>
<td><img src="image3.png" alt="Diagram" /></td>
<td>1036526-xx</td>
</tr>
<tr>
<td><strong>Adapter cable</strong> with 8-pin M12 connector (female) and 15-pin D-sub connector (male) for IK 215, PWM 21, EIB 741, etc.</td>
<td><img src="image4.png" alt="Diagram" /></td>
<td>1133855-xx</td>
</tr>
<tr>
<td><strong>Connecting cable</strong> with 8-pin M12 connector (female) and 8-pin M12 coupling (male)</td>
<td><img src="image5.png" alt="Diagram" /></td>
<td>1036372-xx</td>
</tr>
<tr>
<td><strong>Connecting cable</strong> with 8-pin angled M12 connector (female) and 8-pin M12 coupling (male)</td>
<td><img src="image6.png" alt="Diagram" /></td>
<td>1036386-xx</td>
</tr>
<tr>
<td><strong>Connecting cable</strong> with 8-pin M12 connector (female) and free cable end (unstripped)</td>
<td><img src="image7.png" alt="Diagram" /></td>
<td>1129681-xx</td>
</tr>
<tr>
<td><strong>Connecting cable</strong> with 8-pin angled M12 connector (female) and free cable end (unstripped)</td>
<td><img src="image8.png" alt="Diagram" /></td>
<td>1133799-xx</td>
</tr>
</tbody>
</table>

$A_P$: Cross section of power supply lines  
1) Use connecting elements for 8 MHz signal transmission  

**Note for safety-related applications:**  
- Document the bit error rate in accordance with Specification 533095!  
- CE compliance of the complete system must be documented!
## Electrical connection – pin layout

### Pin layout

#### 8-pin M12 coupling or flange socket

#### 15-pin PCB connector

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Serial data transfer</th>
<th>Other signals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M12</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

1) Only for encoder cables within the motor housing
2) Connections for external temperature sensor; evaluation optimized for KTY 84-130 (see Temperature measurement in motors in the Encoders for Servo Drives brochure)

Cable shield connected to housing; **Up** = Power supply

Sensor: The sense line is connected in the encoder with the corresponding power line. 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:** 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 ECN 1123, EQN 1135:** 816487-xx
- **Safety-Related Position Measuring Systems Technical Information document:** 596632
- For implementation in a safe control or inverter, refer to Specification 533095

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