Product Information

ECN 424 S  
EQN 436 S

Absolute Rotary Encoders with DRIVE-CLiQ Interface for Safety-Related Applications

December 2016
ECN 424S, EQN 436S

Rotary encoders for absolute position values with safe singletum information

- Blind hollow shaft with steel clamping ring:
  - Ø 12 mm (68S)
  - Ø 10 mm (68T)

[Images of rotary encoders]

Required mating dimensions

<table>
<thead>
<tr>
<th>D1</th>
<th>D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 10H6</td>
<td>Ø 10g7</td>
</tr>
<tr>
<td>Ø 12H6</td>
<td>Ø 12g7</td>
</tr>
</tbody>
</table>

**mm**

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

- = Bearing of mating shaft
- M1 = Measuring point for operating temperature
- M2 = Measuring point for vibration
- ① = Connector coding
- ② = Clamping screw with hexalobular socket X8, tightening torque 1 Nm ±0.06 Nm
- ③ = Compensation of mounting tolerances and thermal expansion, no dynamic motion permitted
- ④ = Protection against contact as per EN 60529
- ⑤ = Chamfer at start of thread is obligatory for materially bonding anti-rotation lock
- ⑥ = Direction of shaft rotation for output signals as per the interface description
## Specifications

<table>
<thead>
<tr>
<th>ECN 424 S</th>
<th>EQN 436 S</th>
</tr>
</thead>
</table>
| **Functional safety** | As single-encoder system for monitoring and closed-loop functions:  
- SIL 2 according to EN 61508 (further basis for testing: EN 61800-5-2)  
- Category 3, PL d as per EN ISO 13849-1:2008  
Safe in the singleturn range |
| PFH¹): | ≤ 27 · 10⁻⁹ (Probability of dangerous Failure per Hour) |
| Safe position²): | Encoder: ±1.76° (safety-related measuring step: SM = 0.7°)  
Mechanical coupling: ±2° (exclusion for loosening of shaft and stator coupling, designed for accelerations of ≤ 150 m/s²) |
| Interface/ordering designation | DRIVE-CLiQ protocol/DQ01 |
| Siemens software (date: 12. 2. 2014) | Sinamics Simotion: ≥ V4.4 HF4; Sinumerik with safety: ≥ V4.4 SP2 |
| Position values/revolution | 16777216 (24 bits) |
| Revolutions | – 4096 (12 bits) |
| Processing time TIME_MAX_ACTVAL | ≤ 8 µs |
| **System accuracy** at 20 °C | ±20” |
| Voltage supply | DC 24 V (10 V to 28.8 V) (Up to DC 36.0 V possible without impairment of functional safety) |
| Power consumption (max.) | At 10 V: ≤ 900 mW  
At 28.8 V: ≤ 1000 mW |
| Current consumption (typical) | At 24 V: 38 mA (without load)  
At 24 V: 43 mA (without load) |
| **Electrical connection** | M12 radial flange socket (8-pin) or 1 m cable (EPG) with M12 coupling (8-pin)³ |
| Cable length | ≤ 40 m (see Interfaces of HEIDENHAIN Encoders catalog) |
| Shaft* | Blind hollow shaft D = 12 mm or D = 10 mm |
| Permissible speed⁴): | ≤ 6000 rpm |
| Starting torque at 20 °C | ≤ 0.01 Nm |
| Moment of inertia of rotor | ≤ 6 x 10⁻⁶ kgm² |
| Angular acceleration of rotor | ≤ 4 x 10⁴ rad/s² |
| Permissible axial motion of measured shaft | ≤ ±1 mm |
| **Vibration** 55 Hz to 2000 Hz⁵): | ≤ 150 m/s² (EN 60068-2-6)  
≤ 1000 m/s² (EN 60068-2-27) |
| **Shock** 6 ms | ≤ |
| **Operating temperature** ⁶): | –30 °C to 100 °C |
| **Trigger threshold for error message due to temperature** ⁷): | 125 °C in the scanning ASIC (measuring accuracy of internal temperature sensor ±7 K) |
| **Relative humidity** | ≤ 93 % (40 °C/21 d as per EN 60068-2-78); without condensation |
| **Protection** EN 60529 | IP67 on housing; IP64 at shaft inlet (See Isolation under Electrical safety in the Interfaces of HEIDENHAIN Encoders catalog; contamination from the ingress of liquid must be prevented.) |
| **Mass** | ≈ 0.3 kg |
| **Valid for ID** | 1156836-03/-04/-05/-06 1156837-03/-04/-05/-06 |

**Bold:** This preferred version is available on short notice.  
* Please select when ordering  
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 Interfaces of HEIDENHAIN Encoders catalog  
⁴) With ≥ 2 position requests per revolution  
⁵) 10 Hz to 55 Hz constant over distance 4.9 mm peak to peak  
⁶) For information on operating temperature, shaft speed and supply voltage, see General mechanical information in the Rotary Encoders catalog  
⁷) The internal temperature is not designed for functional safety  

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Mounting

The rotary encoder is slid by its hollow shaft onto the measured shaft and fastened by a screw (tightening torque 1 Nm ±0.06 Nm). The stator is connected without a centering collar on a flat surface.

For the hollow-shaft connections 68S and 68T, the repetition of fastening reduces the screw force. In order to retain the required safety factor for friction-locked connections, the maximum number of permissible fastening repetitions is limited to four. A mechanical fault exclusion cannot be guaranteed for more repetitions.

In these cases, new clamping rings must be ordered separately.

Clamping ring for 10 mm  ID 540741-06
Clamping ring for 12 mm  ID 540741-07

The following maximum torque $M_{\text{max}}$ is to be used when designing the mechanical fault exclusion for the shaft connection:

$M_{\text{max}} = 1 \text{ Nm}$

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

For a safe mechanical coupling, the following prerequisites are to be met by the customer.

<table>
<thead>
<tr>
<th>Material</th>
<th>Steel</th>
<th>Aluminum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tensile strength $R_m$</strong></td>
<td>$\geq 600 \text{ N/mm}^2$</td>
<td>$\geq 220 \text{ N/mm}^2$</td>
</tr>
<tr>
<td><strong>Interface pressure $P_G$</strong></td>
<td>$\geq 500 \text{ N/mm}^2$</td>
<td>$\geq 200 \text{ N/mm}^2$</td>
</tr>
<tr>
<td><strong>Surface roughness $R_z$</strong></td>
<td>$\leq 16 \mu m$</td>
<td></td>
</tr>
<tr>
<td><strong>Coefficient of thermal expansion $\alpha_{\text{therm}}$</strong></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>
<tr>
<td><strong>Minimum shear strength</strong></td>
<td>Not applicable</td>
<td>120 N/mm$^2$</td>
</tr>
</tbody>
</table>

For further mounting information and help, see the Rotary Encoders mounting instructions and the catalog.
Integrated temperature evaluation

These rotary encoders feature an internal temperature sensor integrated in the encoder electronics as well as an evaluation circuit for an external temperature sensor. In both cases, the respective digitized temperature value is transmitted purely serially over the DRIVE-CLiQ interface. Note that temperature measurement and transmission are not secure in the sense of functional safety.

The temperature measured 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 encoders issue the error message “Alarm 405.” 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.
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
- Acyclic operation

Duration depends on system

Position values available for controlling cyclic operation
Safe mode for functional safety

U_{\text{p}} (at encoder)

\frac{dU}{dt} < -50 V/s
\frac{dU}{dt} > 50 V/s
Min. 100 ms
U_{\text{off}} < 2 V

\Delta t \geq 15 \text{ s}

36 V
10 V
PWM 20
Together with the ATS adjusting and testing software, the PWM 20 phase angle measuring unit serves for diagnosis and adjustment of HEIDENHAIN encoders.

For more information, see the Product Information document PWM 20/ATS Software.

PWM 20

| Encoder input | • EnDat 2.1 or EnDat 2.2 (absolute value with or without incremental signals)  
|               | • DRIVE-CLiQ  
|               | • Fanuc Serial Interface  
|               | • Mitsubishi high speed interface  
|               | • Yaskawa Serial Interface  
|               | • Panasonic serial interface  
|               | • SSI  
|               | • 1 VPP/TTL/11 µAPP  
|               | • HTL (via signal adapter)  
| Interface       | USB 2.0  
| Voltage supply   | AC 100 V to 240 V or DC 24 V  
| Dimensions       | 258 mm x 154 mm x 55 mm  

ATS

| Languages       | Choice between English and German  
| Functions        | • Position display  
|                  | • Connection dialog  
|                  | • Diagnostics  
|                  | • Mounting wizard for EB/ECI/EQI, LIP 200, LIC 4000 and others  
|                  | • Additional functions (if supported by the encoder)  
|                  | • Memory contents  
| System requirements and recommendations | PC (dual-core processor > 2 GHz)  
|                  | RAM > 2 GB  
|                  | Operating systems: Windows Vista (32-bit), 7, 8, and 10 (32-bit/64-bit)  
|                  | 500 MB free space on hard disk  

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Electrical connection

Pin layout

<table>
<thead>
<tr>
<th>Voltage supply</th>
<th>Position values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transmit data</td>
</tr>
<tr>
<td>5</td>
<td>Receive data</td>
</tr>
<tr>
<td>7</td>
<td>TXP</td>
</tr>
<tr>
<td>6</td>
<td>TXN</td>
</tr>
<tr>
<td>3</td>
<td>RXP</td>
</tr>
<tr>
<td>4</td>
<td>RXN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage supply</th>
<th>Position values</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP</td>
<td>0 V</td>
</tr>
</tbody>
</table>

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

Cables with M12 connecting element

<table>
<thead>
<tr>
<th>Cable description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUR connecting and adapter cable ( \varnothing ) 6.8 mm; ( [2\times0.17 \text{ mm}^2] + [2\times0.24 \text{ mm}^2] ); ( A_p = 0.24 \text{ mm}^2 )</td>
<td></td>
</tr>
<tr>
<td>Complete With M12 connector (female) and M12 coupling (male), 8-pin</td>
<td>822504-xx</td>
</tr>
<tr>
<td>Complete With M12 connector (female), 8-pin, and Siemens RJ45 connector (IP67)</td>
<td>1094652-xx</td>
</tr>
<tr>
<td>Complete With M12 connector (female), 8-pin, and Siemens RJ45 connector (IP20)</td>
<td>1093042-xx</td>
</tr>
</tbody>
</table>

\( A_p \): Cross section of power supply lines

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:
- Catalog: Rotary Encoders 349529-xx
- Catalog: Interfaces of HEIDENHAIN Encoders 1078628-xx
- Mounting Instructions ECN 424S/EOQ 436S 1163012-xx

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