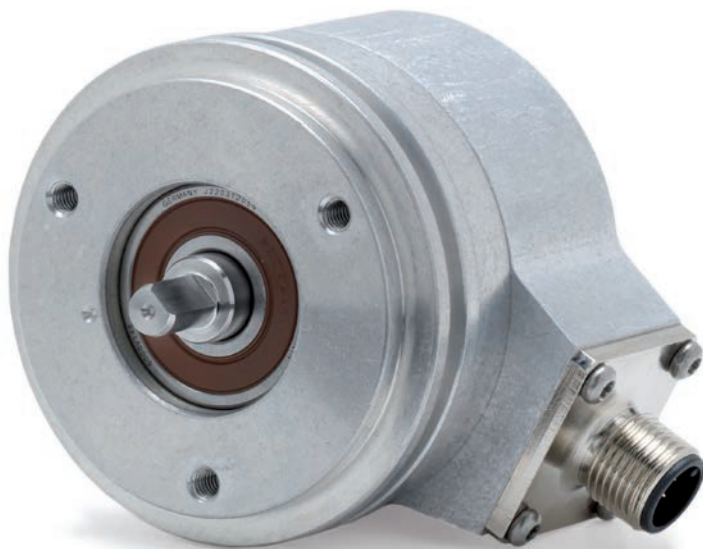




HEIDENHAIN



**Functional
Safety**

Product Information

ROC 424S ROQ 436S

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

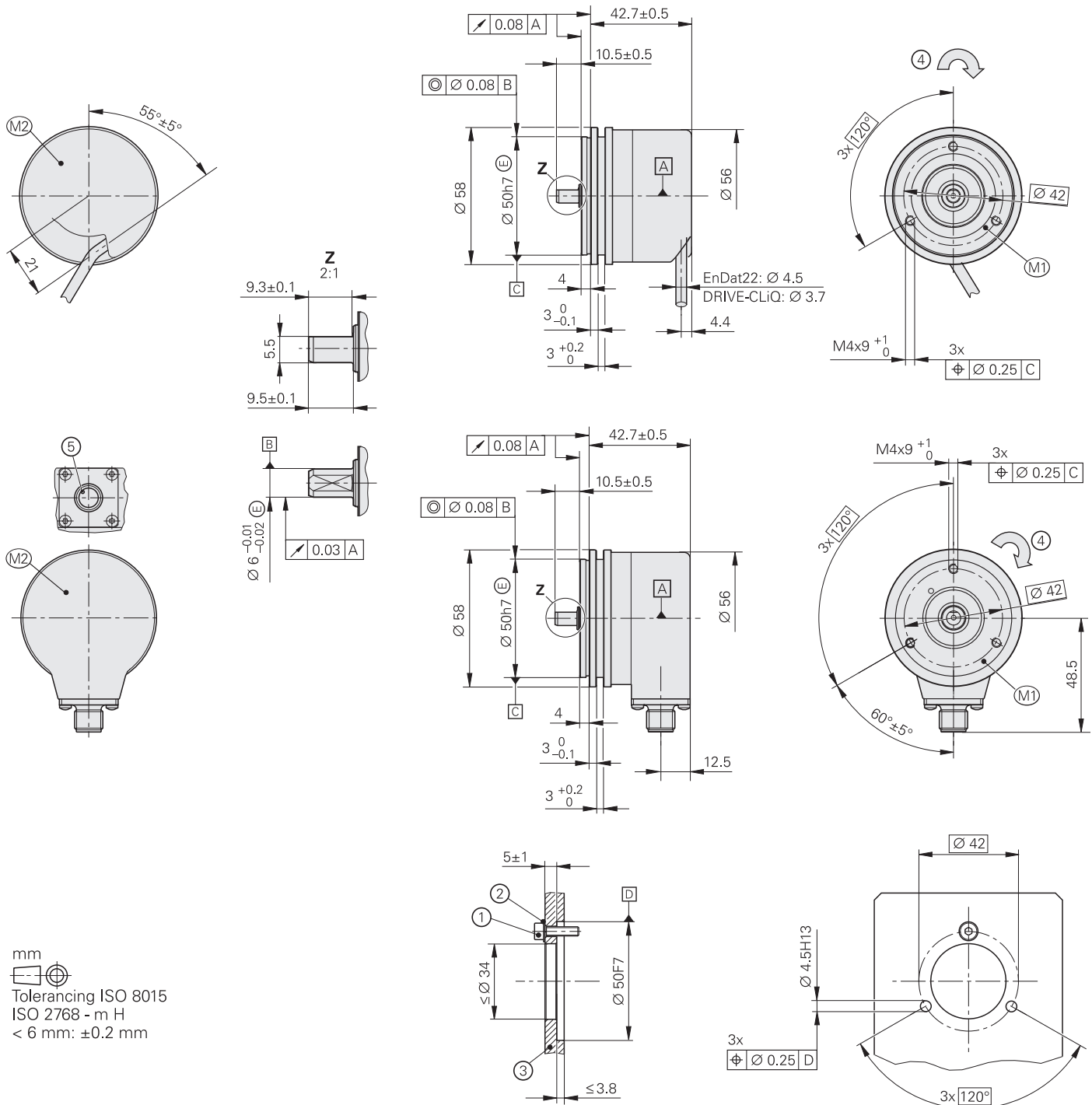
Firmware 53

05/2019

ROC 424S/ROQ 436S series

with synchro flange

- Rotary encoders for absolute position values with safe singletum information
- Rotary encoders for separate shaft coupling
- 01 C synchro flange
- 92 A solid shaft with flat



- ☒ = Encoder bearing
- M1 = Measuring point for operating temperature
- M2 = Measuring point for vibration; see also D 741714
- 1 = Screw: M4 – 8.8 with material bonding anti-rotation lock; tightening torque: $2.65 \text{ Nm} \pm 0.1 \text{ Nm}$; minimum engagement depth: 6 mm
- 2 = With permissible interface pressure $P_G \leq 280 \text{ N/mm}^2$, use a washer
- 3 = For material characteristics, see table on the *Mounting* page
- 4 = Direction of shaft rotation for ascending position values
- 5 = Connector coding

| Specifications | ROC 424S – singletum | ROQ 436S – multitum |
|---|--|--|
| Functional safety for applications with up to | <i>As single-encoder system for monitoring and closed-loop functions:</i> <ul style="list-style-type: none"> • 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 singletum range | |
| PFH ¹⁾ | ≤ 27 · 10 ⁻⁹ (probability of dangerous failure per hour) | |
| Safe position ²⁾ | <i>Encoder: ±1.76° (safety-related measuring step: SM = 0.7°)</i> <i>Mechanical coupling: ±0° (fault exclusion for stator coupling and shaft breakage; designed for accelerations ≤ 300 m/s²)</i> | |
| Interface | DRIVE-CLiQ | |
| Ordering designation | DQ01 | |
| Firmware | 01.32.26.53 | |
| SINAMICS/SIMOTION ³⁾ | ≥ V4.4 HF4 | |
| SINUMERIK with safety ³⁾ | ≥ V4.4 SP2 | |
| Position values per rev. | 16 777 216 (24 bits) | |
| Revolutions | – | 4096 (12 bits) |
| Calculation time TIME_MAX_ACTVAL ⁴⁾ | ≤ 8 μs | |
| System accuracy | ±20" | |
| Electrical connection | 8-pin radial M12 flange socket (male)* ⁵⁾ or 1 m EPG cable with M12 | |
| Supply voltage | DC 24 V (10 V to 28.8 V); up to DC 36.0 V possible without limitation of functional safety | |
| Power consumption (max.) | <i>At 10 V: ≤ 900 mW</i> <i>At 28.8 V: ≤ 1000 mW</i> | <i>At 10 V: ≤ 1000 mW</i> <i>At 28.8 V: ≤ 1140 mW</i> |
| Current consumption (typical) | <i>At 24 V: 38 mA (without load)</i> | <i>At 24 V: 43 mA (without load)</i> |
| Cable length | <i>Electrical connection with flange socket: ≤ 100 m</i> <i>Electrical connection with cable: ≤ 40 m</i> | |

* This preferred version is available on short notice

1) For installation at ≤ 1000 m above seal level

2) Further tolerances may apply in the subsequent electronics after position value comparison (contact manufacturer of the subsequent electronics)

3) Information from Siemens as per the document "Certified encoders with DRIVE-CLiQ Dependencies on SIMOTION / SINUMERIK and SINAMICS Hardware and Software versions" (version: 12/2018)

4) The calculation time TIME_MAX_ACTVAL specifies the earliest time (relative to the request time) after which the transfer of data from the encoder to the control can begin (data such as position or diagnostics data)

5) Cable output with cable length > 0.5 m requires strain relief for the cable;
flange socket version may be used only with plastic-coated M12 mating connectors

DRIVE-CLiQ is a registered trademark of Siemens AG.

| Specifications | ROC 424 S – singletum | ROQ 436 S – multitem |
|--|---|--------------------------|
| Shaft | Solid shaft D = 6 mm with flat (92A) | |
| Speed ¹⁾ | ≤ 15000 rpm | ≤ 12000 rpm |
| Starting torque at 20 °C (typical) | 0.01 Nm | |
| Moment of inertia of rotor | ≤ 2.9 · 10 ⁻⁶ kgm ² | |
| Angular acceleration of rotor | ≤ 1 · 10 ⁵ rad/s ² | |
| Shaft load | <i>Axial</i> : ≤ 40 N; <i>radial</i> : ≤ 60 N at shaft end | |
| Vibration 55 Hz up to 2000 Hz ²⁾ Shock 6 ms | ≤ 300 m/s ² (EN 60068-2-6) ≤ 2000 m/s ² (EN 60068-2-27) | |
| Operating temperature ³⁾ | -40 °C to 100 °C | |
| Response threshold for exceeded temperature error message ⁴⁾ | 117 °C in the scanning ASIC (measuring accuracy of the internal temperature sensor: ±2 K at 117 °C) | |
| 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 <i>Electrical safety</i> in the <i>Interfaces of HEIDENHAIN Encoders</i> brochure; contamination from the ingress of fluids must be avoided) | |
| Mass | ≈ 0.3 kg | |
| ID number | 1179140-02* 1179140-03 | 1176752-03 1176752-02 |

* This preferred version is available on short notice

¹⁾ At ≥ 2 position requests per revolution

²⁾ 10 Hz to 55 Hz constant over 4.9 mm peak to peak

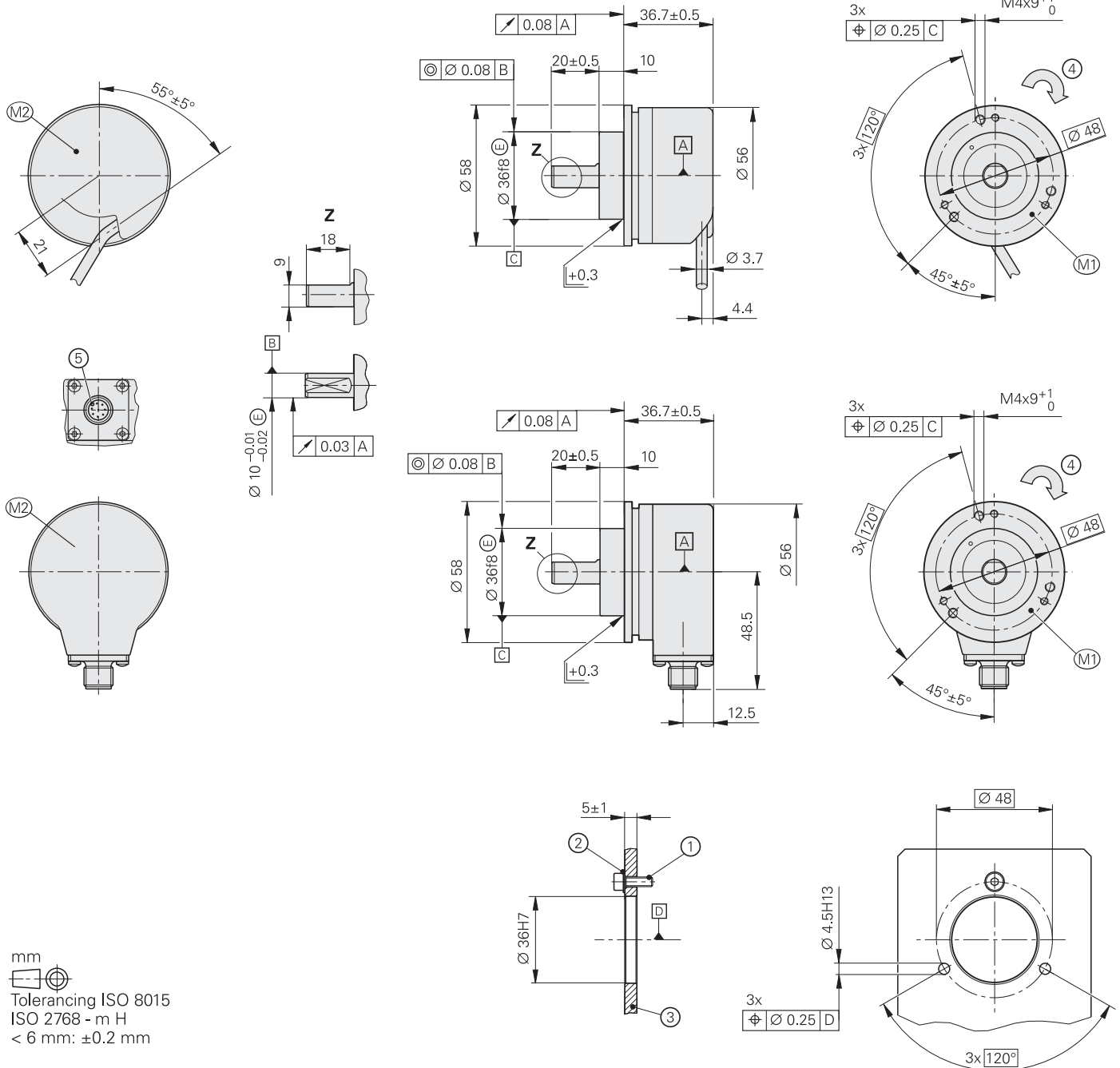
³⁾ For information on operating temperature, shaft speed, and supply voltage, see *General mechanical information* in the *Rotary Encoders* brochure

⁴⁾ The internal temperature evaluation is not designed for functional safety

ROC 424S/ROQ 436S series

with clamping flange

- Rotary encoders for absolute position values with safe singletum information
- Rotary encoders for separate shaft coupling
- 39 A clamping flange
- Ø3 D solid shaft with flat



mm

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

- ▣ = Encoder bearing
- M1 = Measuring point for operating temperature
- M2 = Measuring point for vibration; see also D 741714
- 1 = Screw: M4 – 8.8 with material bonding anti-rotation lock; tightening torque: 2.65 Nm ±0.1 Nm; minimum engagement depth: 6 mm
- 2 = With permissible interface pressure $P_G \leq 280 \text{ N/mm}^2$, use a washer.
- 3 = For material characteristics, see table on the *Mounting* page
- 4 = Direction of shaft rotation for ascending position values
- 5 = Connector coding

| Specifications | ROC 424S – singletum | ROQ 436S – multitum |
|---|--|--|
| Functional safety for applications with up to | <i>As single-encoder system for monitoring and closed-loop functions:</i> <ul style="list-style-type: none"> • 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 singletum range | |
| PFH ¹⁾ | ≤ 27 · 10 ⁻⁹ (probability of dangerous failure per hour) | |
| Safe position ²⁾ | <i>Encoder: ±1.76° (safety-related measuring step: SM = 0.7°)</i> <i>Mechanical coupling: ±0° (fault exclusion for stator coupling and shaft breakage, designed for accelerations ≤ 300 m/s²)</i> | |
| Interface | DRIVE-CLiQ | |
| Ordering designation | DQ01 | |
| Firmware | 01.32.26.53 | |
| SINAMICS/SIMOTION | ≥ V4.4 HF4 | |
| SINUMERIK with safety | ≥ V4.4 SP2 | |
| Position values per rev. | 16 777 216 (24 bits) | |
| Revolutions | – | 4096 (12 bits) |
| Calculation time TIME_MAX_ACTVAL ⁴⁾ | ≤ 8 μs | |
| System accuracy | ±20" | |
| Electrical connection | 8-pin radial M12 flange socket (male)* ⁵⁾ or 1 m EPG cable with M12 | |
| Supply voltage | DC 24 V (10 V to 28.8 V); up to DC 36.0 V possible without limitation of functional safety | |
| Power consumption (max.) | At 10 V: ≤ 900 mW At 28.8 V: ≤ 1000 mW | At 10 V: ≤ 1000 mW At 28.8 V: ≤ 1140 mW |
| Current consumption (typical) | At 24 V: 38 mA (without load) | At 24 V: 43 mA (without load) |
| Cable length | <i>Electrical connection with flange socket: ≤ 100 m</i> <i>Electrical connection with cable: ≤ 40 m</i> | |

* These preferred versions are available on short notice

1) For installation at ≤ 1000 m above sea level

2) Further tolerances may apply in the subsequent electronics after position value comparison (contact manufacturer of the subsequent electronics)

3) Information from Siemens as per the document "Certified encoders with DRIVE-CLiQ Dependencies on SIMOTION / SINUMERIK and SINAMICS Hardware and Software versions" (version: 12/2018)

4) The calculation time TIME_MAX_ACTVAL specifies the earliest time (relative to the request time) after which the transfer of data from the encoder to the control can begin (data such as position or diagnostics data)

5) A cable output with cable length > 0.5 m requires strain relief for the cable;
flange socket versions may be used only with plastic-coated M12 mating connectors

DRIVE-CLiQ is a registered trademark of Siemens AG.

| Specifications | ROC 424S – singletum | ROQ 436S – multitum |
|--|--|---------------------------|
| Shaft | Solid shaft D = 10 mm with flat (03D) | |
| Speed ¹⁾ | ≤ 15000 rpm | ≤ 12000 rpm |
| Starting torque at 20 °C (typical) | 0.01 Nm | |
| Moment of inertia of rotor | ≤ 2.9 · 10 ⁻⁶ kgm ² | |
| Angular acceleration of rotor | ≤ 1 · 10 ⁵ rad/s ² | |
| Shaft load | <i>Axial</i> : ≤ 40 N; <i>radial</i> : ≤ 60 N at shaft end | |
| Vibration 55 Hz to 2000 Hz ²⁾ Shock 6 ms | ≤ 300 m/s ² (EN 60068-2-6) ≤ 2000 m/s ² (EN 60068-2-27) | |
| Operating temperature ³⁾ | -40 °C to 100 °C | |
| Response threshold for exceeded temperature error message ⁴⁾ | 117 °C in the scanning ASIC (measuring accuracy of the internal temperature sensor: ±2 K at 117 °C) | |
| Relative humidity | ≤ 93 % (40 °C/21 d as per EN 60068-2-78); without condensation | |
| Protection EN 60529 | IP67 for housing; IP64 at shaft inlet (see "isolation" under <i>Electrical safety</i> in the <i>Interfaces of HEIDENHAIN Encoders</i> brochure; contamination from the ingress of fluids must be avoided) | |
| Mass | ≈ 0.3 kg | |
| ID number | 1179141-01* 1179141-03 | 1176753-01* 1176753-04 |

* These preferred versions is available on short notice

¹⁾ At ≥ 2 position requests per revolution

²⁾ 10 Hz to 55 Hz constant over 4.9 mm peak to peak

³⁾ For information on operating temperature, shaft speed, and supply voltage, see *General mechanical information* in the *Rotary Encoders* brochure

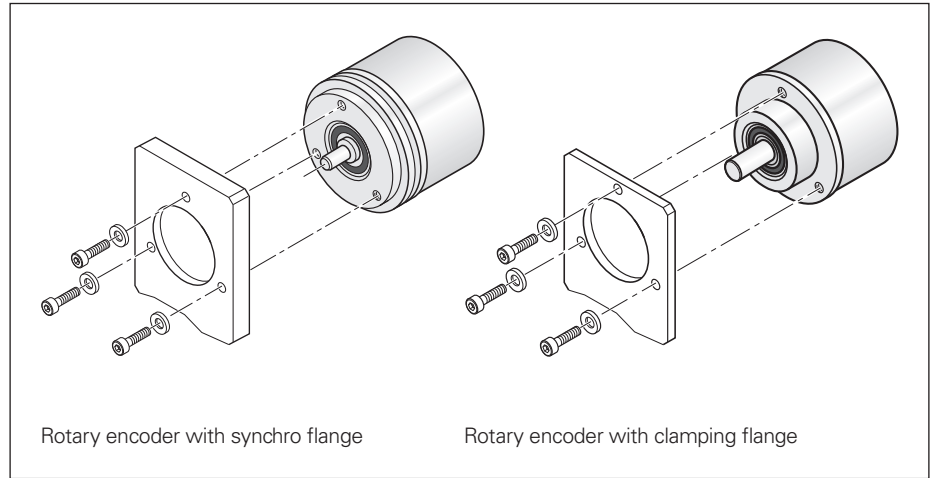
⁴⁾ The internal temperature evaluation is not designed for functional safety

Mounting

Mounting

The rotary encoders are centered by means of the centering collar of the synchro or clamping flange and are secured with screws at their front. Mechanical fault exclusion can be ensured only when mounting with three M4 screws of strength class 8.8 and at a minimum engagement depth of 6 mm in the rotary encoder flange. Screws are not included in delivery. The machine designer is responsible for specifying a material bonding anti-rotation lock for the screws depending on the application.

Fault exclusion was calculated based on a material bonding anti-rotation lock with a thread friction coefficient of between 0.1 and 0.16. The holes for the screws must be designed in accordance with EN 20273 (medium). The washers must be used for materials with permissible interface pressures of $\leq 280 \text{ N/mm}^2$.



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

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

The customer's mechanical design must ensure that the maximum torque M_{\max} occurring in the application can be transmitted. For a safe mechanical connection, the customer-side requirements in the *Rotary Encoders* brochure must be complied with.

In deviation from the standard specifications in the brochure, the following material specifications are permitted:

| | Aluminum | Steel |
|--|--|---|
| Coefficient of thermal expansion α_{therm} (at 20 °C) | $\leq 25 \cdot 10^{-6} \text{ K}^{-1}$ | $10 \cdot 10^{-6} \text{ K}^{-1}$ to $14 \cdot 10^{-6} \text{ K}^{-1}$ |
| Thickness of the mounting flange | 5 mm \pm 1 mm | 4 mm to 20 mm |

The firmware version can be read out over the DRIVE-CLiQ parameter "Act_FW_Version" (index 0). The last two places of the displayed value are decisive.

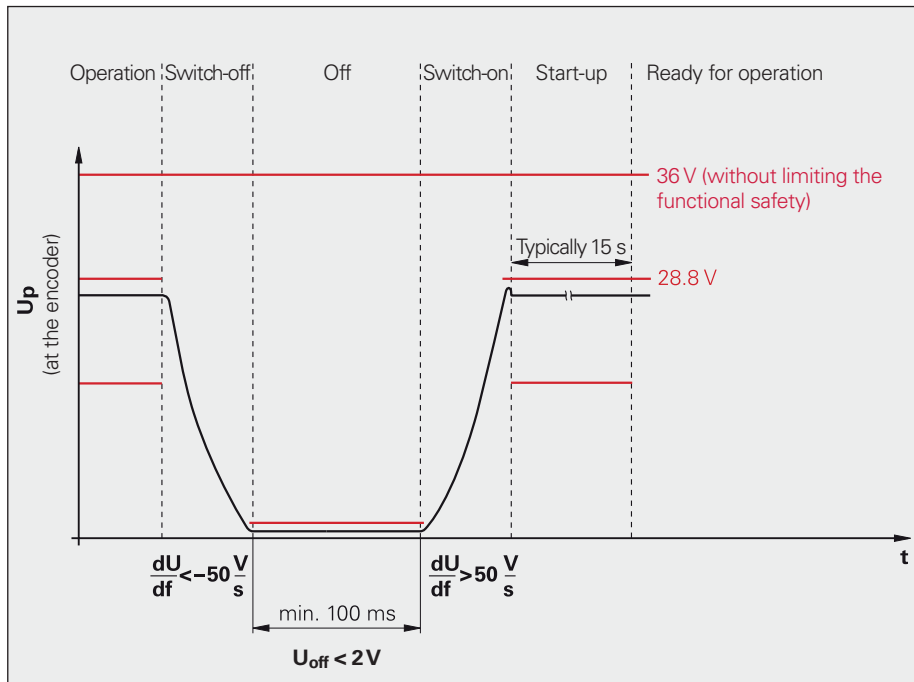
With EnDat 2.2 encoders, valuation numbers can be read cyclically from the encoder to evaluate its functioning. The valuation numbers provide the current state of the encoder and ascertain the encoder's "function reserves." These function reserves are also transmitted via the DRIVE-CLiQ interface and can be displayed in the higher-level control. Further information is available from HEIDENHAIN upon request.

Further information:

For mounting information and mounting aids, see the mounting instructions in the *Rotary Encoders* brochure.

Electrical requirements

Switch-on and switch-off conditions



Integrated temperature evaluation

These rotary encoders feature an internal temperature sensor integrated into the encoder electronics. The digitalized temperature value is transmitted purely serially via the DRIVE-CLiQ interface. Please bear in mind that neither the temperature measurement nor the transmission of the temperature value are "safe" in terms 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 measuring point M1 in accordance with the dimension drawing.

Upon reaching a trigger threshold for the internal temperature sensor, these rotary encoders issue an "Alarm 405" error message. The specific switching threshold depends on the encoder model and is provided in the specifications. During operation, HEIDENHAIN recommends keeping the temperature adequately below the trigger threshold for the error message.

Compliance with the operating temperature at measuring point M1 is required for adherence to the encoder's proper and intended use.

Testing equipment and diagnostics

PWM 21

The PWM 21 phase angle measuring unit, in conjunction with the ATS adjusting and testing software, serves as an adjusting and testing package for the diagnosis and adjustment of HEIDENHAIN encoders.

| | PWM 21 |
|----------------------|--|
| Encoder input | <ul style="list-style-type: none"> • 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 V_{PP}/TTL/11 μA_{PP} • HTL (via signal adapter) |
| Interface | USB 2.0 |
| Power 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 | <ul style="list-style-type: none"> • Position display • Connection dialog • Diagnostics • Mounting wizard for EBI/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 of free space on hard disk |



Further information:

Product Information document:
PWM 21/ATS Software.


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PWM 21

Electrical connection

Pin layout

| 8-pin M12 flange socket | | | | | | |
|---|----------------------|----------------|------------|----------------------|------------|--------------|
| | | Voltage supply | | Serial data transfer | | |
| | | | | Transmit data | | Receive data |
|  | 1 | 5 | 7 | 6 | 3 | 4 |
| | U_P | 0V | TXP | TXN | RXP | RXN |

Cable shield connected to housing; **U_P** = Power supply voltage

| PUR connecting and adapter cables \varnothing 6.8 mm; $2 \times (2 \times 0.17 \text{ mm}^2) + (2 \times 0.24 \text{ mm}^2)$; $A_P = 0.24 \text{ mm}^2$ | | |
|--|--|------------|
| M12 connector (female) and 8-pin M12 coupling (male) |  | 822504-xx |
| 8-pin M12 connector (female) and RJ45 Siemens connector (IP67) |  | 1094652-xx |
| 8-pin M12 connector (female) and RJ45 Siemens connector (IP20) |  | 1093042-xx |

Ap: Cross section of power supply lines

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HEIDENHAIN

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This Product Information document 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.



More information:

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

- Brochure: *Rotary Encoders* 349529-xx
- Brochure: *Interfaces of HEIDENHAIN Encoders* 1078628-xx
- Mounting instructions: *ROC 424S/ROQ 436S* 1038274-xx
- Brochure: *Cables and Connectors* 1206103-xx