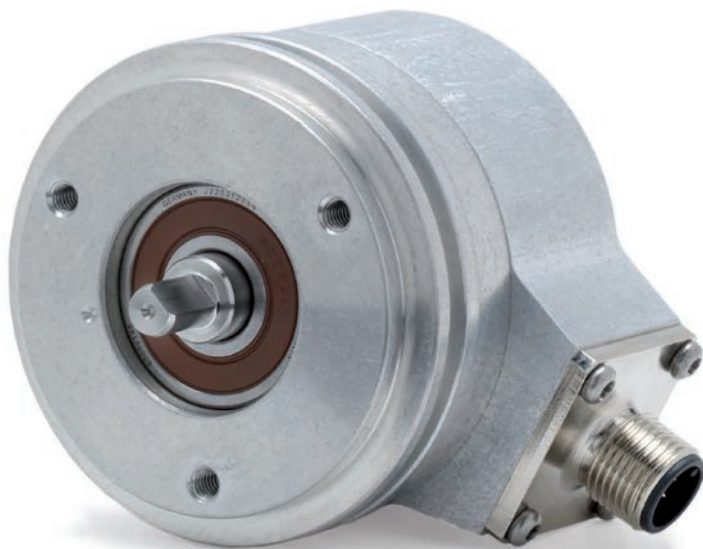




# HEIDENHAIN



**Functional  
Safety**

Product Information

## **ROC 424 S ROQ 436 S**

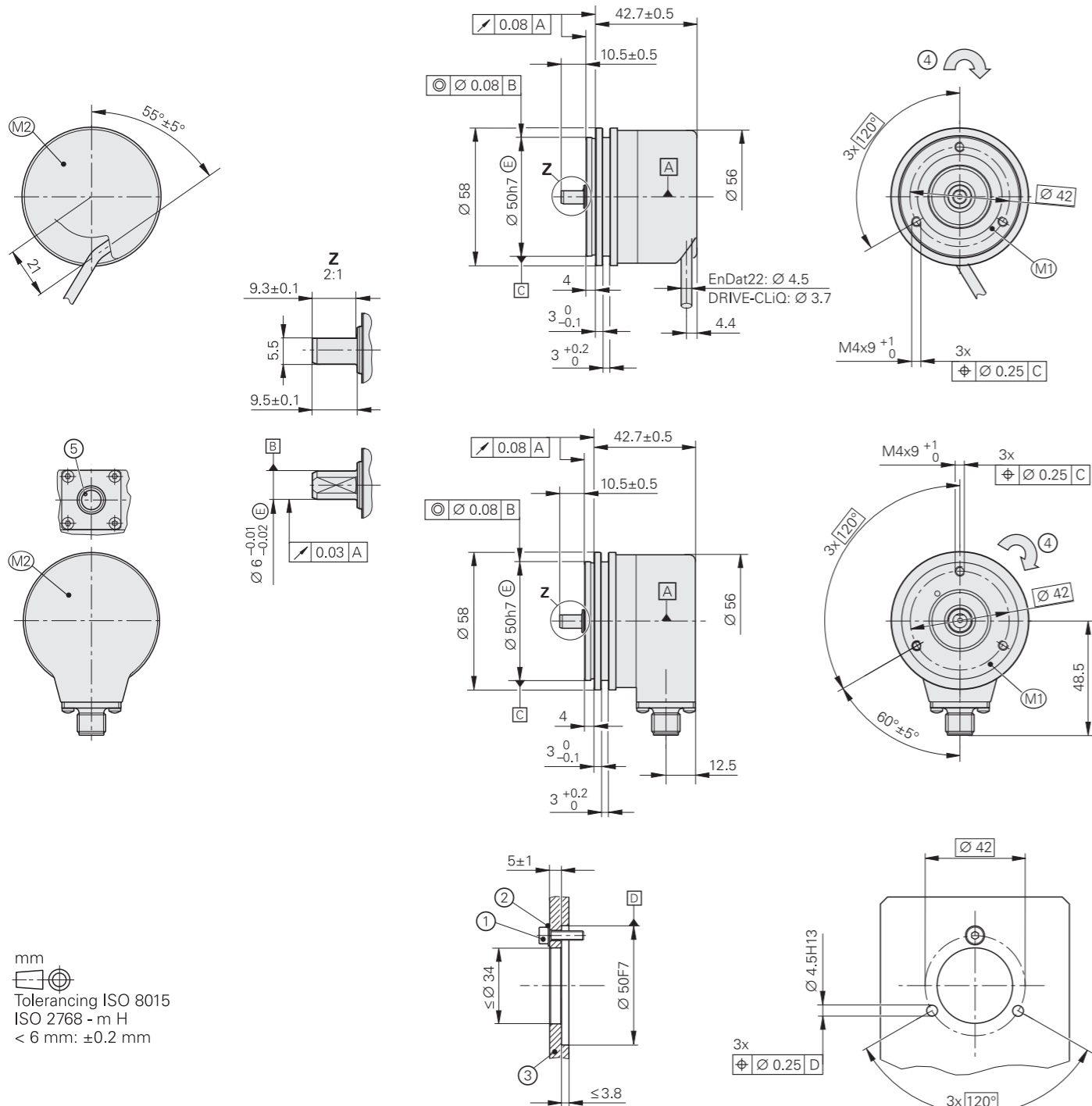
Absolute Rotary Encoders  
with DRIVE-CLiQ Interface  
for Safety-Related  
Applications

Firmware 53

# ROC 424S/ROQ 436S series

with synchro flange

- Rotary encoders for absolute position measurement with safe singleturn information
- Rotary encoders for separate shaft coupling
- 01C synchro flange
- 92A 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 = If permissible interface pressure  $P_G \leq 280 \text{ N/mm}^2$ , use a washer
- 3 = For information on material properties, see *General mechanical information* in the *Rotary Encoders* brochure
- 4 = Direction of shaft rotation for ascending position values
- 5 = Connector coding

Specifications	ROC 424S singleturn	ROQ 436S multiturn
<b>Functional safety</b> for applications with up to	As a single-encoder system for monitoring and control-loop functions: <ul style="list-style-type: none"> <li>• SIL 2 as per EN 61508 (further basis for testing: EN 61800-5-2)</li> <li>• Category 3, PL d as per EN ISO 13849-1:2015</li> </ul> Safe in the singleturn range	
PFH <sup>1)</sup>	$\leq 27 \cdot 10^{-9}$ (probability of dangerous failure per hour)	
Safe position <sup>2)</sup>	Encoder: $\pm 1.76^\circ$ (safety-related measuring step: SM = $0.7^\circ$ ) Mechanical coupling: $\pm 0^\circ$ (fault exclusion for stator coupling and shaft breakage, designed for accelerations $\leq 300 \text{ m/s}^2$ )	
Interface	DRIVE-CLiQ	
Ordering designation	DQ01	
Firmware	01.32.26.53	
SINAMICS/SIMOTION <sup>3)</sup>	$\geq V4.4 \text{ HF4}$	
SINUMERIK with safety <sup>3)</sup>	$\geq V4.4 \text{ SP2}$	
Position values per revolution	16777216 (24 bits)	
Revolutions	–	4096 (12 bits)
Calculation time TIME_MAX_ACTVAL <sup>4)</sup>	$\leq 8 \mu\text{s}$	
<b>System accuracy</b>	$\pm 20''$	
<b>Electrical connection</b>	<b>8-Pin M12 radial flange socket*<sup>5)</sup> (male)</b> or 1 m EPG cable with M12 coupling	
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: $\leq 950 \text{ mW}$ At 28.8 V: $\leq 1000 \text{ mW}$	At 10 V: $\leq 1050 \text{ mW}$ At 28.8 V: $\leq 1150 \text{ mW}$
Current consumption (typical)	At 24 V: 38 mA (without load)	At 24 V: 43 mA (without load)
Cable length <sup>6)</sup>	$\leq 40 \text{ m}$	

- \* This preferred version is available on short notice
- 1) For use at  $\leq 1000 \text{ m}$  above sea level ( $\leq 6000 \text{ m}$  above sea level upon request)
- 2) Further tolerances may arise in the downstream electronics after position value comparison (contact mfr. of the downstream 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: 06/2021)
- 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 diagnostic data)
- 5) Cable outlet with cable length  $> 0.5 \text{ m}$  requires strain relief for the cable; flange socket versions may be used only with plastic-coated M12 mating connectors
- 6) See also the *Cables and Connectors* brochure, as well as the *Interfaces of HEIDENHAIN Encoders*

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Specifications	ROC 424S singleturn	ROQ 436S multiturn
<b>Shaft</b>	Solid shaft D = 6 mm with flat (92A)	
Speed <sup>1)</sup>	≤ 15000 rpm	≤ 12000 rpm
Starting torque at 20 °C (typical)	≤ 0.01 Nm	
Moment of inertia of rotor	≤ 2.9 · 10 <sup>-6</sup> kgm <sup>2</sup>	
Angular acceleration of rotor	≤ 1 · 10 <sup>5</sup> rad/s <sup>2</sup>	
Shaft load	Axial: ≤ 40 N; radial: ≤ 60 N at shaft end	
<b>Vibration</b> 55 Hz to 2000 Hz <sup>2)</sup> <b>Shock</b> 6 ms	≤ 300 m/s <sup>2</sup> (EN 60068-2-6) ≤ 2000 m/s <sup>2</sup> (EN 60068-2-27)	
<b>Operating temperature</b> <sup>3)</sup>	-40 °C to 100 °C	
<b>Trigger threshold</b> for exceeded temperature error message <sup>4)</sup>	117 °C in the scanning ASIC (measuring accuracy of internal temperature sensor. ±2 K at 117 °C)	
<b>Relative humidity</b>	≤ 93 % (40 °C/21 d as per EN 60068-2-78), condensation excluded	
<b>Protection rating</b> EN 60529	IP67 on housing; IP64 at shaft inlet (read about "insulation" under <i>Electrical safety</i> in the <i>Interfaces of HEIDENHAIN Encoders</i> brochure; contamination from the ingress of fluids must be avoided)	
<b>Mass</b>	≈ 0.3 kg	
<b>ID number</b>	1179140-05* 1179140-04	1176752-05 1176752-04*

\* 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

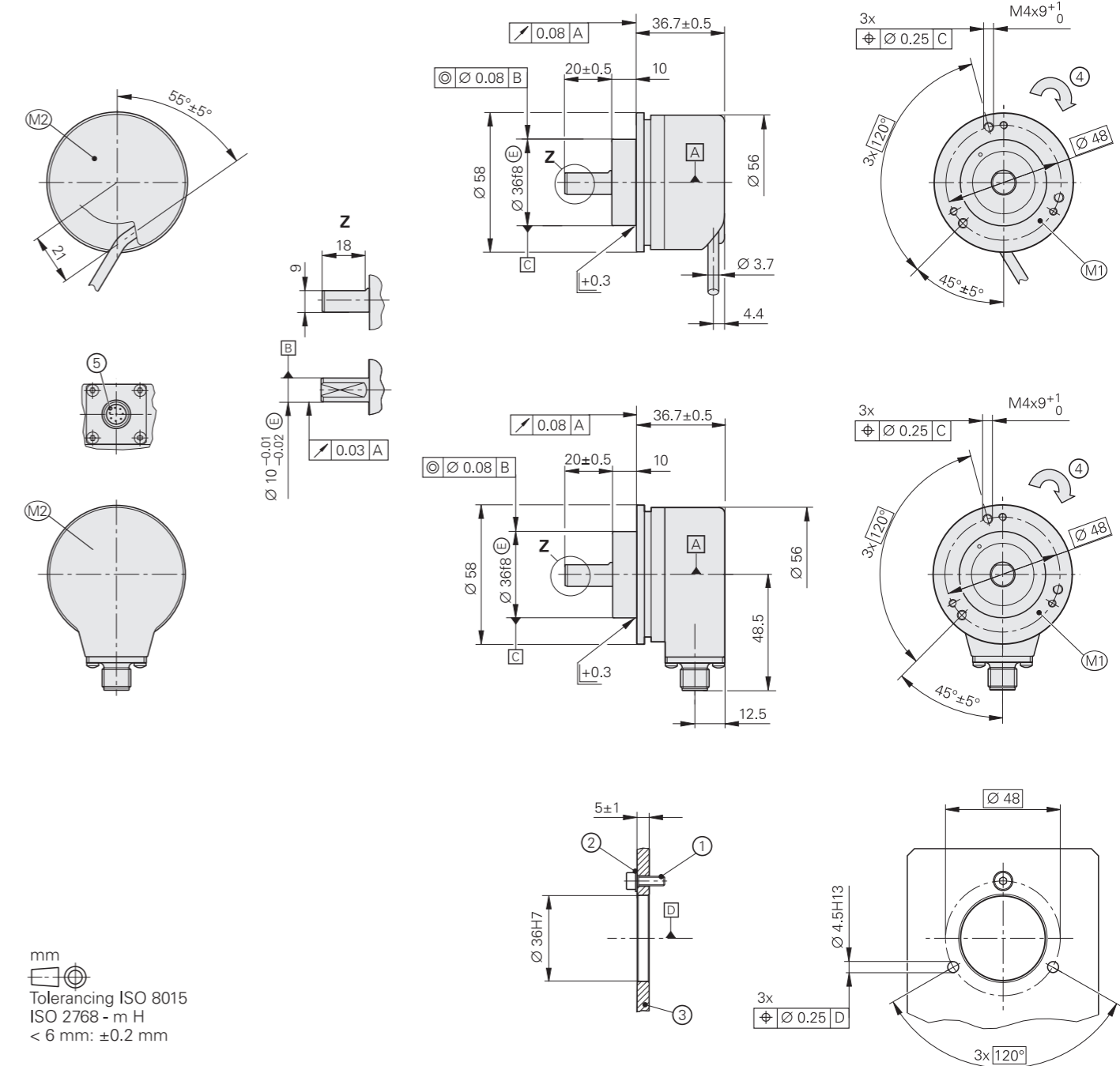
4) The internal temperature evaluation is not designed for functional safety

## ROC 424S/ROQ 436S series with clamping flange

- Rotary encoders for absolute position measurement with safe singleturn information
- Rotary encoders for separate shaft coupling
- 39A clamping flange
- Ø3D solid shaft with flat



Functional Safety



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 = If permissible interface pressure  $P_G \leq 280 \text{ N/mm}^2$ , use a washer
- 3 = For information on material properties, see *General mechanical information* in the *Rotary Encoders* brochure
- 4 = Direction of shaft rotation for ascending position values
- 5 = Connector coding

Specifications	ROC 424S singletum	ROQ 436S multitem
<b>Functional safety</b> for applications with up to	As a single-encoder system for monitoring and control-loop functions: <ul style="list-style-type: none"> <li>SIL 2 as per EN 61508 (further basis for testing: EN 61800-5-2)</li> <li>Category 3, PL d as per EN ISO 13849-1:2015</li> </ul> Safe in the singletum range	
PFH <sup>1)</sup>	$\leq 27 \cdot 10^{-9}$ (probability of dangerous failure per hour)	
Safe position <sup>2)</sup>	Encoder: $\pm 1.76^\circ$ (safety-related measuring step: SM = 0.7°) Mechanical coupling: $\pm 0^\circ$ (fault exclusion for stator coupling and shaft breakage, designed for accelerations $\leq 300 \text{ m/s}^2$ )	
Interface	DRIVE-CLiQ	
Ordering designation	DQ01	
Firmware	01.32.26.53	
SINAMICS/SIMOTION	$\geq$ V4.4 HF4	
SINUMERIK with safety	$\geq$ V4.4 SP2	
Position values per revolution	16777216 (24 bits)	
Revolutions	–	4096 (12 bits)
Calculation time TIME_MAX_ACTVAL <sup>4)</sup>	$\leq 8 \mu\text{s}$	
<b>System accuracy</b>	$\pm 20''$	
<b>Electrical connection</b>	<b>8-pin M12 radial flange socket*<sup>5)</sup> (male)</b> or 1 m EPG cable with M12 coupling	
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: $\leq 950 \text{ mW}$ At 28.8 V: $\leq 1000 \text{ mW}$	At 10 V: $\leq 1050 \text{ mW}$ At 28.8 V: $\leq 1150 \text{ mW}$
Current consumption (typical)	At 24 V: 38 mA (without load)	At 24 V: 43 mA (without load)
Cable length <sup>6)</sup>	$\leq 40 \text{ m}$	

\* This preferred version is available on short notice

<sup>1)</sup> For use at  $\leq 1000 \text{ m}$  above sea level ( $\leq 6000 \text{ m}$  above sea level upon request)

<sup>2)</sup> Further tolerances may arise in the downstream electronics after position value comparison (contact mfr. of the downstream electronics)

<sup>3)</sup> Information from Siemens as per the document "Certified encoders with DRIVE-CLiQ Dependencies on SIMOTION / SINUMERIK and SINAMICS Hardware and Software versions" (version: 06/2021)

<sup>4)</sup> 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 diagnostic data)

<sup>5)</sup> Cable outlet with cable length  $> 0.5 \text{ m}$  requires strain relief for the cable; flange socket versions may be used only with plastic-coated M12 mating connectors

<sup>6)</sup> See also the *Cables and Connectors* brochure, as well as the *Interfaces of HEIDENHAIN Encoders*

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Specifications	ROC 424S singletum	ROQ 436S multitem
<b>Shaft</b>	Solid shaft D = 10 mm with flat (O3D)	
Speed <sup>1)</sup>	$\leq 15000 \text{ rpm}$	$\leq 12000 \text{ rpm}$
Starting torque at 20 °C (typical)	$\leq 0.01 \text{ Nm}$	
Moment of inertia of rotor	$\leq 2.9 \cdot 10^{-6} \text{ kgm}^2$	
Angular acceleration of rotor	$\leq 1 \cdot 10^5 \text{ rad/s}^2$	
Shaft load	Axial: $\leq 40 \text{ N}$ ; radial: $\leq 60 \text{ N}$ at shaft end	
<b>Vibration</b> 55 Hz to 2000 Hz <sup>2)</sup> <b>Shock</b> 6 ms	$\leq 300 \text{ m/s}^2$ (EN 60068-2-6) $\leq 2000 \text{ m/s}^2$ (EN 60068-2-27)	
<b>Operating temperature</b> <sup>3)</sup>	–40 °C to 100 °C	
<b>Trigger threshold</b> for exceeded temperature error message <sup>4)</sup>	117 °C in the scanning ASIC (measuring accuracy of internal temperature sensor. $\pm 2 \text{ K}$ at 117 °C)	
<b>Relative humidity</b>	$\leq 93\%$ (40 °C/21 d as per EN 60068-2-78); condensation excluded	
<b>Protection rating</b> EN 60529	IP67 for housing; IP64 at shaft inlet (read about "insulation" under <i>Electrical safety</i> in the <i>Interfaces of HEIDENHAIN Encoders</i> brochure; contamination from the ingress of fluids must be avoided)	
<b>Mass</b>	$\approx 0.3 \text{ kg}$	
<b>ID number</b>	1179141-04* 1179141-05	1176753-06* 1176753-05

\* This preferred version is available on short notice

<sup>1)</sup> At  $\geq 2$  position requests per revolution

<sup>2)</sup> 10 Hz to 55 Hz constant over 4.9 mm peak to peak

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

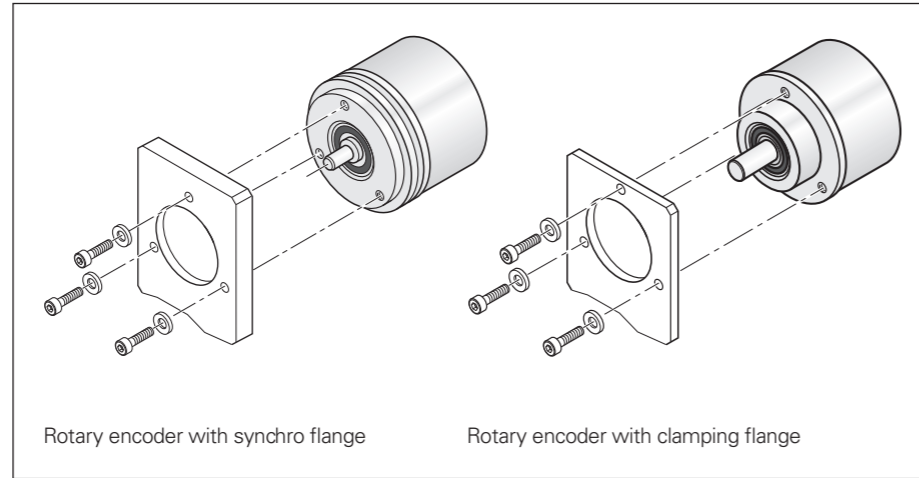
<sup>4)</sup> The internal temperature evaluation is not designed for functional safety

# 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  $\leq 280 \text{ N/mm}^2$ .



Rotary encoder with synchro flange

Rotary encoder with clamping flange

### More information:

For the customer-side mounting design, the material specifications for steel apply to the customer-side shaft. For the customer-side stator, the material specifications for aluminum apply.

Note the other material properties in the *Rotary Encoders* brochure (ID349529-xx).

The firmware version can be read out over the DRIVE-CLiQ parameter "Act\_FW\_Version" (index 0). The final two digits 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.

# Integrated temperature evaluation

These rotary encoders feature an internal temperature sensor integrated into the encoder electronics. The digitized 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 is safe in terms of functional safety.


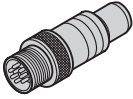
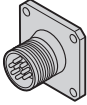



The temperature measured by the internal temperature sensor is higher by a device-specific and application-specific amount than the temperature at measuring point M1, as shown in the dimension drawing.

Upon reaching a trigger threshold for the internal temperature sensor, these rotary encoders issue an "Alarm 405" error message. This threshold may vary depending on the encoder and is stated in the specifications. During operation, it is recommended that the temperature be kept adequately below the error-message threshold.

The encoder's intended use requires compliance with the operating temperature at measuring point M1.

# Electrical connection

## Pin layout

8-pin M12 flange socket or 8-pin M12 coupling								
								
	Power supply		Serial data transmission					
			Transmit data		Receive data			
	<b>1</b>	<b>5</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>8</b>
	<b>U<sub>P</sub></b>	<b>0V</b>	<b>TXP</b>	<b>TXN</b>	<b>RXP</b>	<b>RXN</b>	/	/
	White	White/Green	Violet	Yellow	Gray	Pink	Blue	Brown/Green

**Cable shield** connected to housing; **U<sub>P</sub>** = Power supply voltage  
Unused pins must not be assigned!



### More information:

For connecting and adapter cables, see the *Cables and Connectors* brochure (ID 1206103-xx).

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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 placed.



### More information:

Comply with the requirements described in the following documents to ensure correct and intended operation:

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