HEIDENHAIN

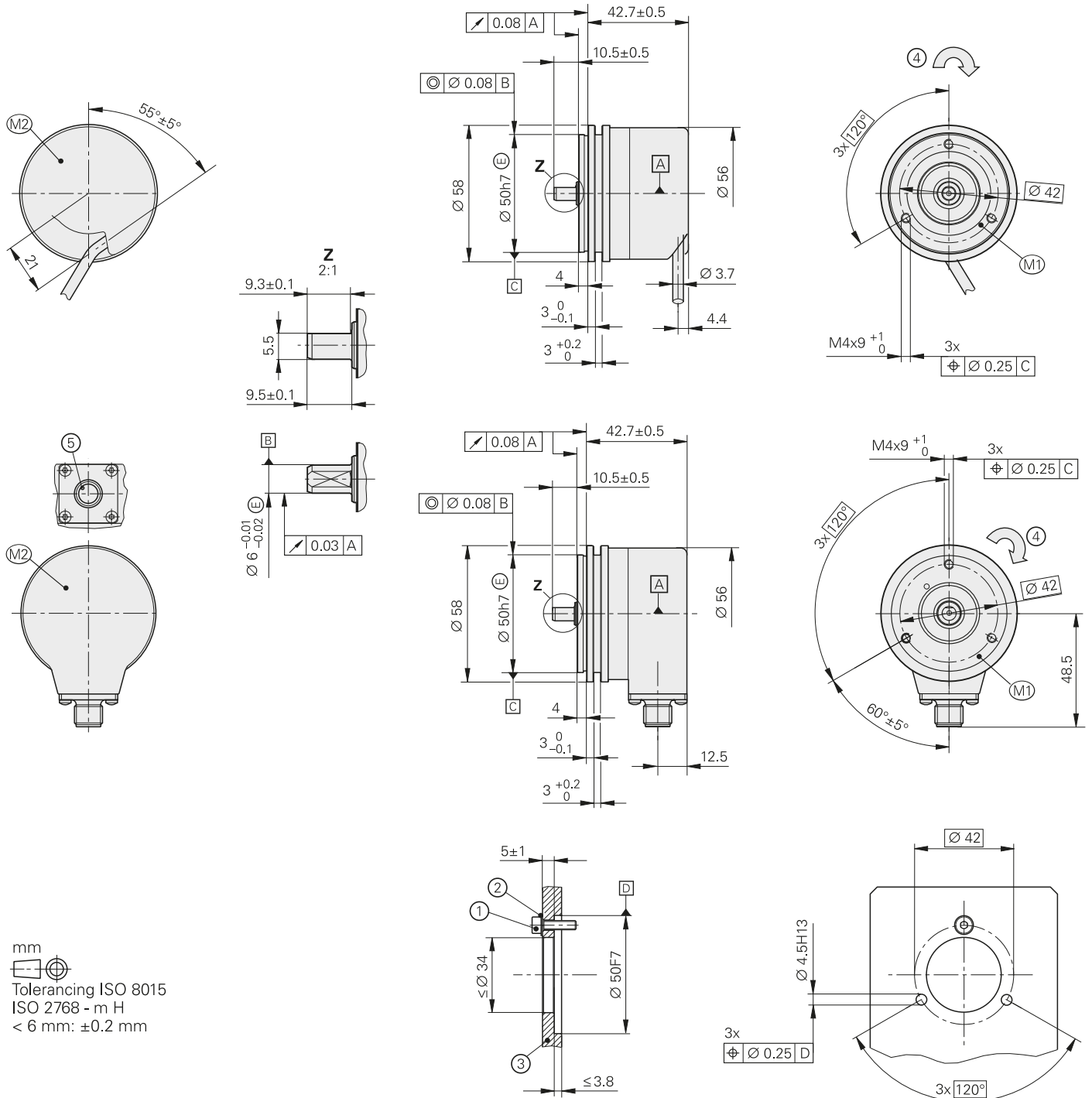Functional Safety

Product Information

ROC 424 S
ROQ 436 S

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

ROC 424 S, ROQ 436 S

Rotary encoders for absolute position values with safe singleturn information
- **Synchro flange (01C)**
  Mechanical fault exclusion only when fastened by 3 x M4 screws
- **Stub shaft with flat (92A)**

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 materially bonding anti-rotation lock, tightening torque 2.65 Nm ±0.1 Nm, minimum screw depth 6 mm
② = For permissible interface pressure P_G ≤ 280 N/mm² use a washer
③ = For material properties, see the table on the "Mounting" page
④ = Direction of shaft rotation for output signals as per the interface description
⑤ = Connector coding

Specifications	ROC 424 S	ROQ 436 S
Functional safety* For applications up to	*As single-encoder system for monitoring and closed-loop functions:* • SIL 2 according to EN 61 508 (further basis for testing: EN 61 800-5-2) • Category 3, PL d as per EN ISO 13849-1:2008 Safe in the singleturn range	
PFH[1]	$\leq 27 \times 10^{-9}$ (Probability of dangerous Failure per Hour)	
Safe position[2]	*Encoder:* ± 1.76° (safety-related measuring step: SM = 0.7°) *Mechanical coupling of stator:* ±0° (fault exclusion for stator fastening and shaft breakage, designed for acceleration $\leq 300 \text{ m/s}^2$)	
Interface/ordering designation	DRIVE-CLiQ protocol/DQ01	
Siemens software (version: 12.2.2014)	*Sinamics Simotion:* ≥ V4.4 HF4; *Sinumerik with safety:* ≥ V4.4 SP2	
Position values/revolution	16 777 216 (24 bits)	
Revolutions	–	4096 (12 bits)
Processing time TIME_MAX_ACTVAL	≤ 8 µs	
System accuracy at 20 °C	±20″	
Voltage supply	DC 10 V to 28.8 V; up to DC 36 V is possible without compromising 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)
Electrical connection	**M12 flange socket (8-pin), radial** or 1 m cable, EPG with M12	
Cable length	≤ 40 m (see catalog *Interfaces of HEIDENHAIN Encoders*)	
Shaft	Stub shaft with flat D = 6 mm	
Permissible speed[3]	≤ 15 000 rpm	≤ 12 000 rpm
Starting torque at 20 °C	≤ 0.01 Nm	
Moment of inertia of rotor	$\leq 2.9 \times 10^{-6} \text{ kgm}^2$	
Angular acceleration of rotor	$\leq 1 \times 10^5 \text{ rad/s}^2$	
Max. shaft load[4]	Axial 40 N / radial 60 N at shaft end	
Vibration 55 Hz to 2000 Hz[5] **Shock** 6 ms	$\leq 300 \text{ m/s}^2$ (EN 60068-2-6) $\leq 2000 \text{ m/s}^2$ (EN 60068-2-27)	
Operating temperature[4]	–30 °C to 100 °C	
Trigger threshold for error message if temperature is exceeded[6]	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 60 529	IP 67 at housing, IP 64 at shaft inlet (IP 66 upon request) (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	**1036789-01** 1036789-03	**1036786-01** 1036786-02

These preferred versions are 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] With ≥ 2 position requests per revolution
[4] For information on operating temperature, shaft speed and max. shaft load, see *General mechanical information* in the *Rotary Encoders* catalog
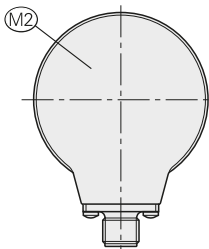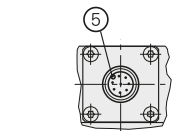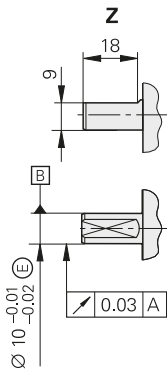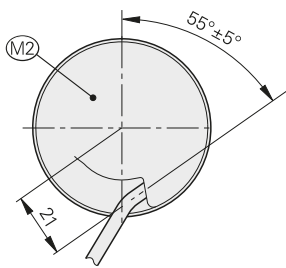[5] 10 Hz to 55 Hz constant over distance 4.9 mm peak to peak
[6] The internal temperature is not designed for functional safety
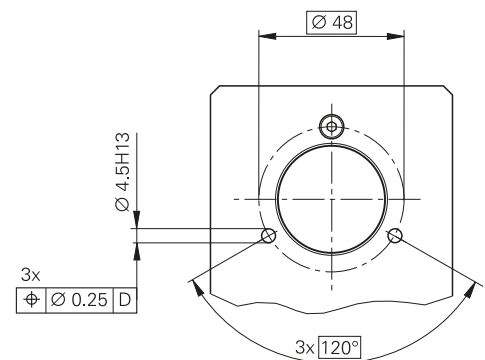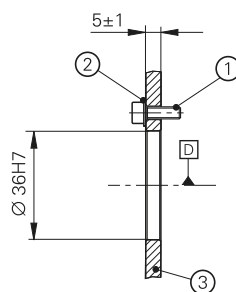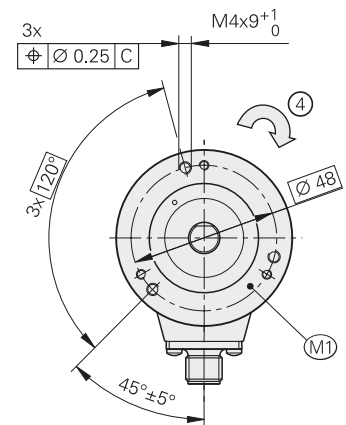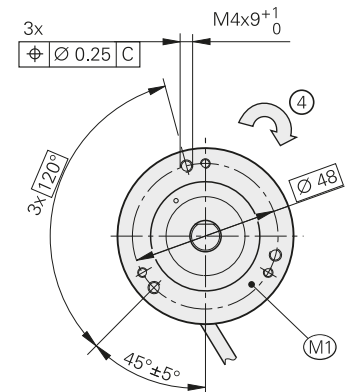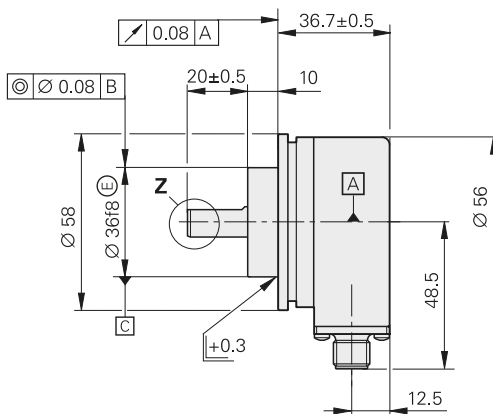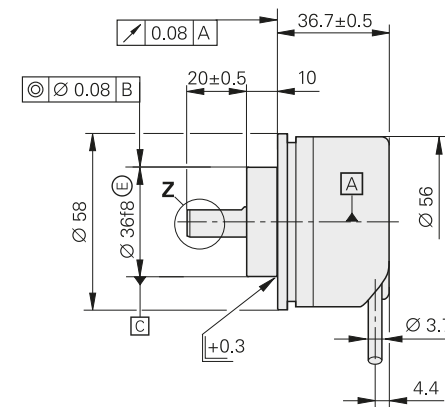DRIVE-CLiQ is a registered trademark of SIEMENS AG.

ROC 424 S, ROQ 436 S

Rotary encoders for absolute position values with safe singleturn information
- **Clamping flange with additional slot for fastening with fixing clamps (39A)**
  Mechanical fault exclusion only when fastened with 3 x M4 screws
- **Stub shaft with flat (03D)**

Functional
Safety

mm

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

$\boxed{A}$ = Encoder bearing
M1 = Measuring point for operating temperature
M2 = Measuring point for vibration, see also D 741714
① = Screw, M4 – 8.8 with materially bonding anti-rotation lock, tightening torque 2.65 Nm ±0.1 Nm, minimum screw depth 6 mm
② = For permissible interface pressure $P_G \leq 280$ N/mm^2 use a washer
③ = For material properties, see the table on the "Mounting" page
④ = Direction of shaft rotation for output signals as per the interface description
⑤ = Connector coding

Specifications	ROC 424 S	ROQ 436 S
Functional safety* For applications up to	*As single-encoder system for monitoring and closed-loop functions:* • SIL 2 according to EN 61 508 (further basis for testing: EN 61 800-5-2) • Category 3, PL d as per EN ISO 13849-1:2008 Safe in the singleturn range	
PFH[1]	$\leq$ 27 x 10^{-9} (Probability of dangerous Failure per Hour)	
Safe position[2]	*Encoder:* ± 1.76° (safety-related measuring step: SM = 0.7°) *Mechanical coupling of stator:* ±0° (fault exclusion for stator fastening and shaft breakage, designed for acceleration $\leq$ 300 m/s^2)	
Interface/ordering designation	DRIVE-CLiQ protocol/DQ01	
Siemens software (version: 12.2.2014)	*Sinamics Simotion:* $\geq$ V4.4 HF4; *Sinumerik with safety:* $\geq$ V4.4 SP2	
Position values/revolution	16 777 216 (24 bits)	
Revolutions	–	4096 (12 bits)
Processing time TIME_MAX_ACTVAL	$\leq$ 8 µs	
System accuracy at 20 °C	±20″	
Voltage supply	DC 10 V to 28.8 V; up to DC 36 V is possible without compromising functional safety	
Power consumption (max.)	*At 10 V:* $\leq$ 900 mW *At 28.8 V:* $\leq$ 1000 mW	*At 10 V:* $\leq$ 1000 mW *At 28.8 V:* $\leq$ 1140 mW
Current consumption (typical)	*At 24 V:* 38 mA (without load)	*At 24 V:* 43 mA (without load)
Electrical connection	**M12 flange socket (8-pin), radial** or 1 m cable, EPG with M12	
Cable length	$\leq$ 40 m (see *Interfaces of HEIDENHAIN Encoder* catalog)	
Shaft	Stub shaft with flat D = 10 mm	
Permissible speed[3]	$\leq$ 15 000 rpm	$\leq$ 12 000 rpm
Starting torque at 20 °C	$\leq$ 0.01 Nm	
Moment of inertia of rotor	$\leq$ 2.9 x 10^{-6} kgm^2	
Angular acceleration of rotor	$\leq$ 1 x 10^5 rad/s^2	
Max. shaft load[4]	Axial 40 N / radial 60 N at shaft end	
Vibration 55 Hz to 2000 Hz[5] **Shock** 6 ms	$\leq$ 300 m/s^2 (EN 60 068-2-6) $\leq$ 2000 m/s^2 (EN 60 068-2-27)	
Operating temperature[4]	–30 °C to 100 °C	
Trigger threshold for error message if temperature is exceeded[6]	125 °C in the scanning ASIC (measuring accuracy of internal temperature sensor ±7 K)	
Relative humidity	$\leq$ 93 % (40 °C / 21 d as per EN 60 068-2-78); without condensation	
Protection EN 60 529	IP 67 at housing, IP 64 at shaft inlet (IP 66 upon request) (See *Isolation* under *Electrical safety* in the *Interfaces of HEIDENHAIN Encoders* catalog; contamination from the ingress of liquid must be prevented.)	
Mass	$\approx$ 0.3 kg	
Valid for ID	**1036790-01** 1036790-03	**1036792-01** 1036792-02 / 1036792-04

These preferred versions are available on short notice
* Please select when ordering
[1] For altitude of $\leq$ 1000 m above sea level
[2] Further tolerances may occur in subsequent electronics after position value comparison (contact manufacturer of subsequent electronics)
[3] With $\geq$ 2 position requests per revolution

[4] For information on operating temperature, shaft speed and max. shaft load, see *General mechanical information* in the *Rotary Encoders* catalog
[5] 10 Hz to 55 Hz constant over distance 4.9 mm peak to peak
[6] The internal temperature is not designed for functional safety DRIVE-CLiQ is a registered trademark of Siemens AG.
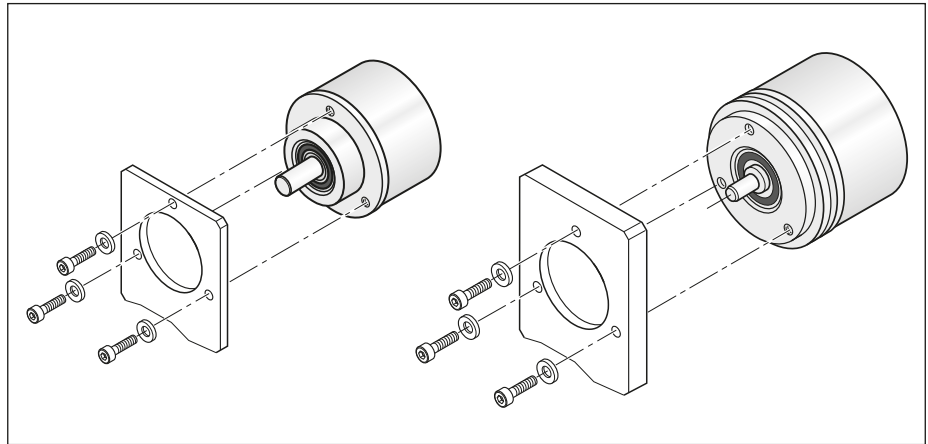
Mounting

A mechanical fault exclusion can be achieved only with 3 x M4 screws of strength class 8.8 and with a minimum screw depth of 6 mm in the encoder flange!

The fault exclusion was calculated based on a materially bonding anti-rotation lock with a thread friction coefficient between 0.1 and 0.16.

The machine manufacturer/designer is responsible for specifying a materially bonding anti-rotation lock for the screws in the specific application.

Screws are not included in delivery.

The rotary encoders are centered either by a centering collar to the synchro flange or by clamping flange.

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

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

The customer's mechanical design must ensure that the torque M_{actl} actually occurring in the application can be transmitted. This M_{actl} can be smaller than the M_{max} to be considered for designing the fault exclusion.

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

	Mounting surface on the customer's side	
Material	Steel	Aluminum
Tensile strength R_m	$\geq 600\ N/mm^2$	$\geq 220\ N/mm^2$
Interface pressure P_G[1]	$\geq 280\ N/mm^2$	
Surface roughness R_Z	$\leq 16\ \mu m$	
Coefficient of thermal expansion α_{therm}	10 to 14 x $10^{-6}\ K^{-1}$	$\leq 25\ x\ 10^{-6}\ K^{-1}$
Thickness of the mounting flange	4 mm to 20 mm	5 mm ±1

[1] For permissible interface pressure PG $\leq 280\ N/mm^2$ use a washer!

PWM 20

The PWM 20 phase angle measuring unit serves together with the provided ATS adjusting and testing software for diagnosis and adjustment of HEIDENHAIN encoders.

For more information, refer to the Product Information document *PWM 20/ATS Software.*

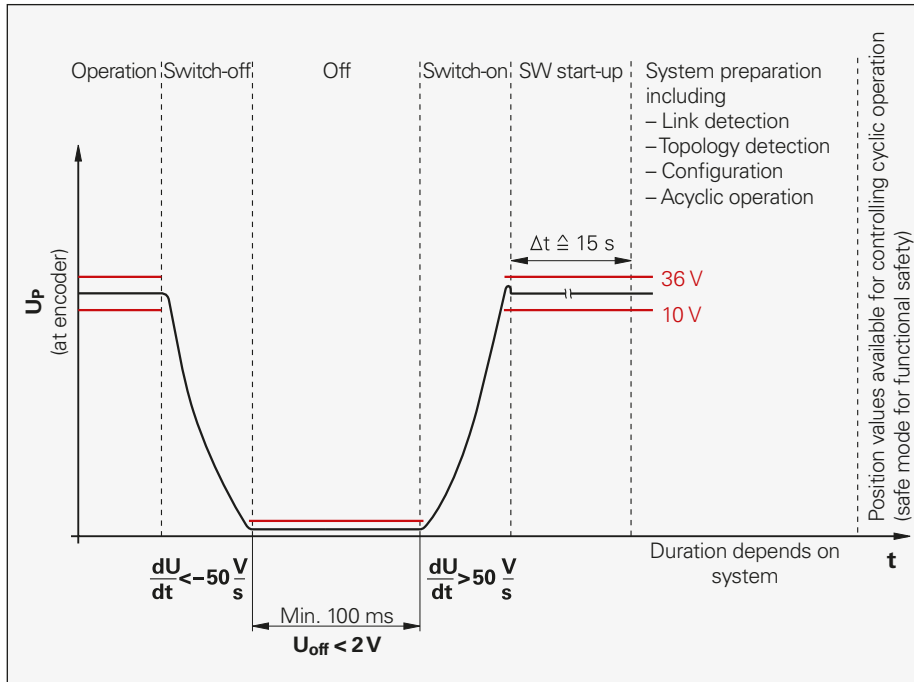For further mounting information and help, see the *Rotary Encoders* mounting instructions and the catalog.

	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 V_{PP}/TTL/11 μA_{PP} • 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 EBI/ECI/EQI, LIP200, 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 requirements

Switch-on and switch-off conditions

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.
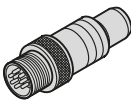
When the trigger threshold is exceeded for the internal temperature, the encoders issue the error message "Alarm 405." This

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 connection

Pin layout

8-pin flange socket, M12							
	Voltage supply		Position values				
			Transmit data		Receive data		
	1	**5**	**7**	**6**	**3**	**4**	
	U_P	0 V	TXP	TXN	RXP	RXN	

Shield on housing; U_P = Power supply

PUR connecting and adapter cable $\varnothing$ 6.8 mm; $[2(2 \times 0.17 \text{ mm}^2) + (2 \times 0.24 \text{ mm}^2)]$; $A_P = 0.24 \text{ mm}^2$		
Complete with M12 connector (female) and M12 coupling (male), 8 pins each		822504-xx
Complete with 8-pin M12 connector (female) and Siemens RJ45 connector (IP67)		1094652-xx
Complete with 8-pin M12 connector (female) and Siemens RJ45 connector (IP20)		1093042-xx

A_P: Cross section of power supply lines

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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: *ROC 424 S / ROQ 436 S* — 1038274-xx