



HEIDENHAIN



**Functional
Safety**

Product Information

ECN 424 S
EQN 436 S

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

December 2016

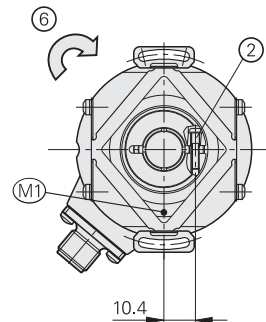
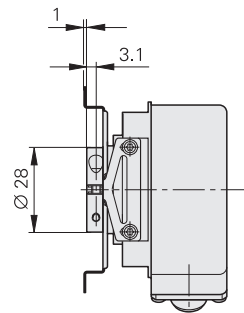
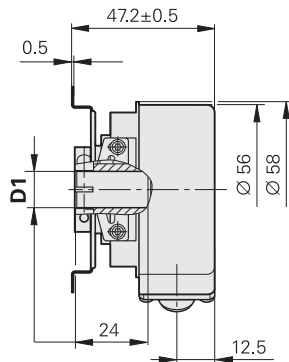
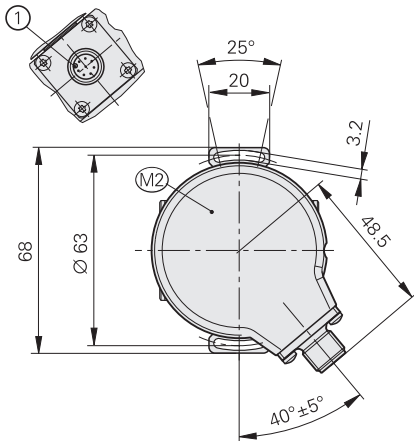
ECN 424S, EQN 436S

Rotary encoders for absolute position values with safe singleturn information

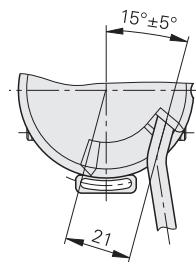
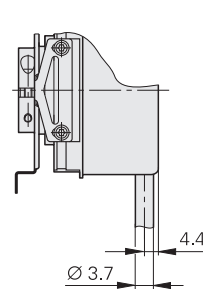
• Blind hollow shaft with steel clamping ring:

Ø 12 mm (68S)

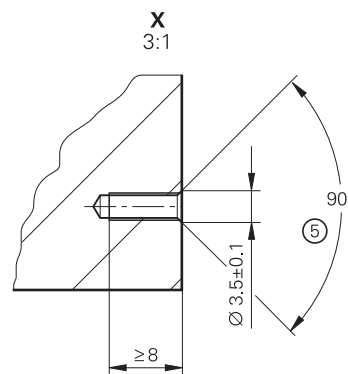
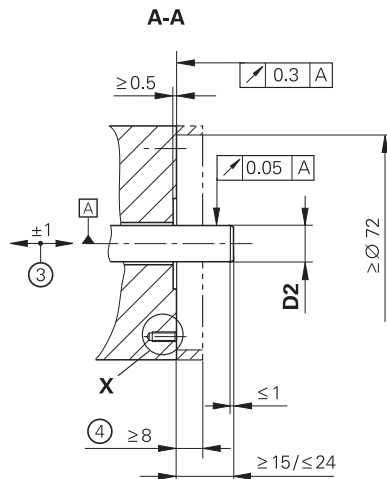
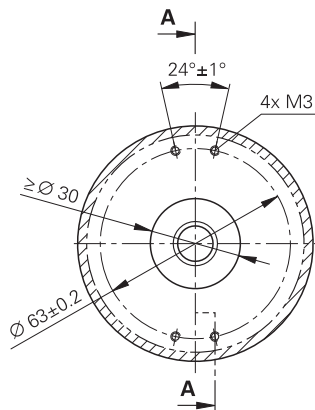
Ø 10 mm (68T)



D1	D2
Ø 10H6 \oplus	Ø 10g7 \ominus
Ø 12H6 \oplus	Ø 12g7 \ominus



Required mating dimensions



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	ECN 424S	EQN 436S
Functional safety For applications up to	As single-encoder system for monitoring and closed-loop functions: <ul style="list-style-type: none"> • 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⁾	$\leq 27 \cdot 10^{-9}$ (Probability of dangerous Failure per Hour)	
Safe position ²⁾	Encoder: $\pm 1.76^\circ$ (safety-related measuring step: SM = 0.7°) Mechanical coupling: $\pm 2^\circ$ (exclusion for loosening of shaft and stator coupling, designed for accelerations of $\leq 150 \text{ m/s}^2$)	
Interface/ordering designation	DRIVE-CLiQ protocol/DQ01	
Siemens software (date: 12. 2. 2014)	Sinamics Simotion: $\geq \text{V4.4 HF4}$; Sinumerik with safety: $\geq \text{V4.4 SP2}$	
Position values/revolution	16777216 (24 bits)	
Revolutions	–	4096 (12 bits)
Processing time TIME_MAX_ACTVAL	$\leq 8 \mu\text{s}$	
System accuracy at 20 °C	$\pm 20''$	
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: $\leq 900 \text{ mW}$ At 28.8 V: $\leq 1000 \text{ mW}$	At 10 V: $\leq 1000 \text{ mW}$ At 28.8 V: $\leq 1140 \text{ mW}$
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	$\leq 40 \text{ m}$ (see <i>Interfaces of HEIDENHAIN Encoder</i> catalog)	
Shaft*	Blind hollow shaft D = 12 mm or D = 10 mm	
Permissible speed ⁴⁾	$\leq 6000 \text{ rpm}$	
Starting torque at 20 °C	$\leq 0.01 \text{ Nm}$	
Moment of inertia of rotor	$\leq 6 \times 10^{-6} \text{ kgm}^2$	
Angular acceleration of rotor	$\leq 4 \times 10^4 \text{ rad/s}^2$	
Permissible axial motion of measured shaft	$\leq \pm 1 \text{ mm}$	
Vibration 55 Hz to 2000 Hz ⁵⁾ Shock 6 ms	$\leq 150 \text{ m/s}^2$ (EN 60068-2-6) $\leq 1000 \text{ m/s}^2$ (EN 60068-2-27)	
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 $\pm 7 \text{ K}$)	
Relative humidity	$\leq 93 \%$ (40 °C/21 d as per EN 60068-2-78); without condensation	
Protection EN 60529	IP67 on housing; IP64 at shaft inlet (See <i>Isolation</i> under <i>Electrical safety</i> in the <i>Interfaces of HEIDENHAIN Encoders</i> catalog; contamination from the ingress of liquid must be prevented.)	
Mass	$\approx 0.3 \text{ kg}$	
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 $\leq 1000 \text{ m}$ 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

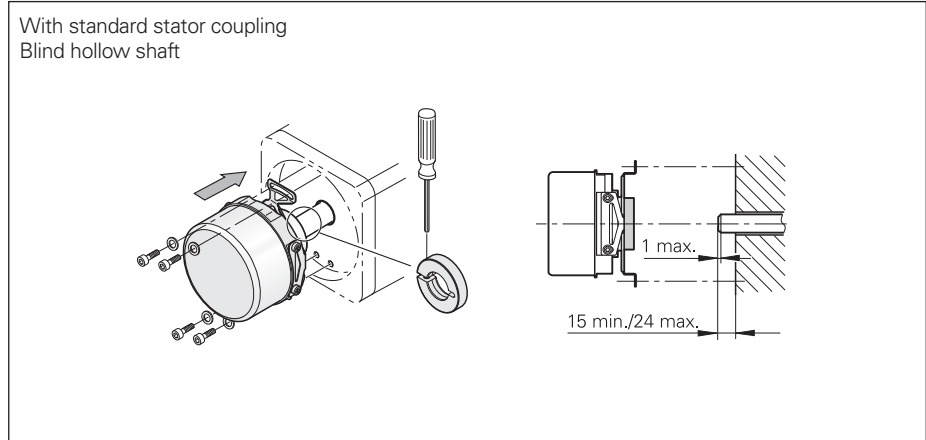
Mounting

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_{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 coupling, the following prerequisites are to be met by the customer.

	Mating shaft	Mating stator
Material	Steel	Aluminum
Tensile strength R_m	$\geq 600 \text{ N/mm}^2$	$\geq 220 \text{ N/mm}^2$
Interface pressure P_G	$\geq 500 \text{ N/mm}^2$	$\geq 200 \text{ N/mm}^2$
Surface roughness R_z	$\leq 16 \mu\text{m}$	
Coefficient of thermal expansion α_{therm}	$10 \cdot 10^{-6} \text{K}^{-1}$ to $17 \cdot 10^{-6} \text{K}^{-1}$	$\leq 25 \cdot 10^{-6} \text{K}^{-1}$
Minimum shear strength	Not applicable	120 N/mm^2

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.

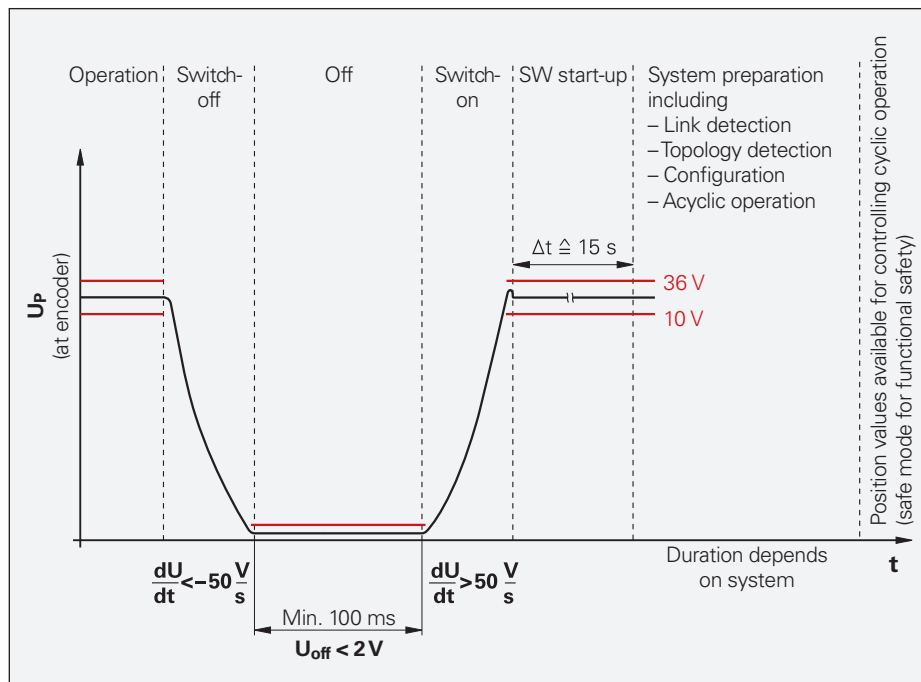
The temperature measured by the internal temperature sensor is higher by a device-specific and application-specific amount than the temperature at the measuring point M1 in accordance with the dimension drawing.

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



Diagnostic and testing equipment

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*.


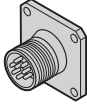
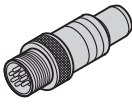


PWM 20	
Encoder input	<ul style="list-style-type: none"> • EnDat 2.1 or EnDat 2.2 (absolute value with or without incremental signals) • DRIVE-CLiQ • Fanuc Serial Interface • Mitsubishi high speed interface • Yaskawa Serial Interface • Panasonic serial interface • SSI • 1 V_{PP}/TTL/11 μA_{PP} • HTL (via signal adapter)
Interface	USB 2.0
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	<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 free space on hard disk

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Electrical connection

Pin layout

8-pin flange socket or coupling M12						
						
	Voltage supply		Position values			
			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

Cables with M12 connecting element

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

A_P: Cross section of power supply lines

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HEIDENHAIN

DR. JOHANNES HEIDENHAIN GmbH

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

FAX +49 8669 32-5061

E-mail: info@heidenhain.de

www.heidenhain.de

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 424 S/EQN 436 S* 1163012-xx