HEIDENHAIN

Product Information
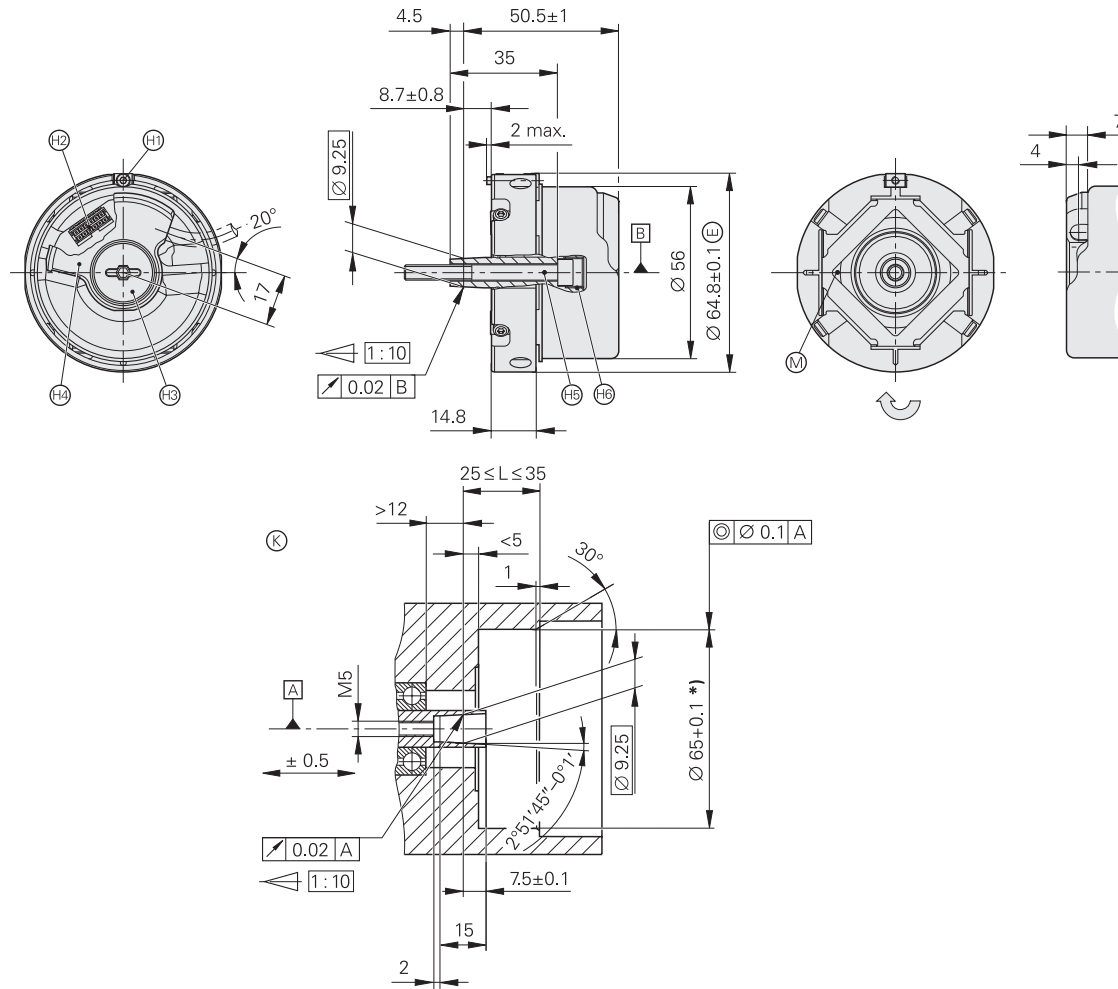
ECN 1325
EQN 1337

Rotary Encoders
with EnDat 2.2
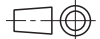for Safety-Related Applications

Functional Safety

ECN 1325/EQN 1337 Series

Rotary encoders for safety-related applications
- **With integral bearing**
- **Built-on stator coupling**
- **Installation diameter 65 mm**
- **Taper shaft**

Dimensions in mm

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

Ⓐ = Bearing of mating shaft
Ⓑ = Bearing of encoder
Ⓚ = Required mating dimensions
Ⓜ = Measuring point for operating temperature
Ⓗ₁ = Clamping screw for coupling ring – width A/F 2; Tightening torque 1.25 Nm–0.2 Nm
Ⓗ₂ = ECN/EQN: Plug connector 12-pin (and 4 pins for temperature sensor, on ECN 1325/EQN 1337)
Ⓗ₃ = Screw plug widths A/F 3 and 4; tightening torque 5+0.5 Nm
Ⓗ₄ = Die-cast cover
Ⓗ₅ = Self-tightening screw M5 x 50 DIN 6912 width A/F 4; tightening torque 5+0.5 Nm
Ⓗ₆ = Back-off thread M10
↻ Direction of shaft rotation for output signals as per the interface description

	Absolute	
	ECN 1325 **Singleturn**	**EQN 1337** **Multiturn**
Safety-related data	Applicable as single-encoder system in the control loop for applications of the control category • SIL 2 (Safety Integrated Level) as in DIN EN IEC 61508 • PL2 (Performance Level) as in DIN EN ISO 13849 • Category 3 according to EN 954-1 Safe in the singleturn range	
PFH	$\leq 1 \times 10^{-8}$ Probability of failure per hour	
Angular error of the safe position	$\leq \pm 0.7°$ (9 bits)	
Absolute position values	EnDat 2.2	
Ordering designation	EnDat 22	
Position values/rev	33554432 (25 bits)	
Revolutions	–	4096 (12 bits)
Elec. permissible speed	≤ 12000 rpm (for continuous position value)	
Calculation time t_{cal}	≤ 5 µs	
System accuracy	$\pm 20''$	
Power supply	3.6 to 14 V–	
Current consumption[1]	≤ 150 mA (without load)	≤ 180 mA (without load)
Electrical connection via PCB connector	*Rotary encoder:* 12-pin *Temperature sensor*[2]*:* 4-pin	
Cable length	≤ 100 m	
Shaft	Taper shaft Ø 9.25 mm; taper 1:10	
Mech. permissible speed n	$\leq 15\,000$ rpm	≤ 12000 rpm
Starting torque at 20 °C	≤ 0.01 Nm	
Moment of inertia of rotor	$2.6 \cdot 10^{-6}$ kgm^2	
Angular acceleration of rotor	$\leq 1 \times 10^5$ rad/s^2	
Natural frequency of stator coupling	≥ 1800 Hz	
Permissible axial motion of measured shaft	± 0.5 mm	
Vibration 10 to 2000 Hz[3] **Shock** 6 ms	$\leq\ \ 300$ m/s^2 [4] (IEC 60068-2-6) ≤ 1000 m/s^2 / ≤ 2000 m/s^2 (IEC 60068-2-27)	$\leq\ \ 300$ m/s^2 (IEC 60068-2-6) ≤ 1000 m/s^2/≤ 2000 m/s^2 (IEC 60068-2-27)
Max. operating temperature	115 °C	
Min. operating temperature	–40 °C	
Relative humidity	≤ 75 %; temporary ≤ 95 % (condensation not permissible)	
Protection IEC 60529	IP 40 when mounted	
Weight	Approx. 0.25 kg	

[1] Plus 50 mA through input circuitry according to interface specification.
[2] Evaluation optimized for KTY 84
Only use sensors with double or reinforced insulation. Ensure that the lines are routed inside the motor housing.
[3] 10 to 55 Hz constant over distance 4.9 mm peak to peak
[4] As per standard at room temperature, the following applies for operating temperature   Up to 100 °C: ≤ 300 m/s^2
Up to 115 °C: ≤ 150 m/s^2

General Electrical Information

Power supply

The encoders require a **stabilized dc voltage U_P** as power supply. The respective specifications state the required power supply and the current consumption. The values apply as measured at the encoder, i.e., without cable influences.

Connect HEIDENHAIN position encoders only to subsequent electronics whose power supply is generated through double or strengthened insulation against line voltage circuits. Also see **IEC 364-4-41:** 1992, modified Chapter 411 regarding "protection against both direct and indirect touch" (PELV or SELV). If position encoders or electronics are used in safety-related applications, they must be operated with protective extra-low voltage (PELV) and provided with overcurrent protection or, if required, with overvoltage protection.

Isolation
The encoder housings are isolated against internal circuits.
Rated surge voltage: 500 V (preferred value as per VDE 0110 Part 1, overvoltage category II, contamination level 2)

Cables

HEIDENHAIN cables are mandatory for use in safety-related applications.

Lengths
The cable lengths listed in the *Specifications* apply only for HEIDENHAIN cables and the recommended input circuitry of the subsequent electronics.

Durability
All encoders have polyurethane (PUR) cables. PUR cables are resistant to oil, hydrolysis and microbes in accordance with **VDE 0472.** They are free of PVC and silicone and comply with UL safety directives. The **UL certification** AWM STY LE 20963 80 °C 30 V E63216 is documented on the cable.

Temperature range
HEIDENHAIN cables can be used
for rigid configuration   –40 to 85 °C
for frequent flexing   –10 to 85 °C

Cables with limited resistance to hydrolysis and microbes are rated for up to 100 °C. If required, please ask for assistance from HEIDENHAIN Traunreut.

Bending radius
The permissible bending radii R depend on the cable diameter and the configuration:
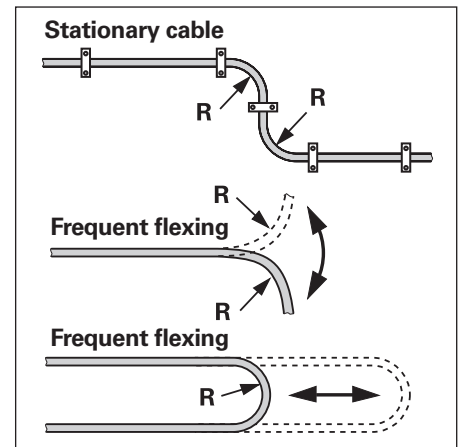
HEIDENHAIN cables	Rigid con-figuration	Frequent flexing
Ø 4.5 mm	R ≥ 10 mm	R ≥ 50 mm
Ø 6 mm	R ≥ 20 mm	R ≥ 75 mm

Noise-free signal transmission

Electromagnetic compatibility/ CE compliance

When properly installed, and when HEIDENHAIN connecting cables and cable assemblies are used, HEIDENHAIN encoders fulfill the requirements for electromagnetic compatibility according to 89/336/EEC with respect to the generic standards for:

- **Noise immunity IEC 61000-6-2:**
  Specifically:
  – ESD   IEC 61000-4-2
  – Electromagnetic fields   IEC 61000-4-3
  – Burst   IEC 61000-4-4
  – Surge   IEC 61000-4-5
  – Conducted disturbances   IEC 61000-4-6
  – Power frequency
    magnetic fields   IEC 61000-4-8
  – Pulse magnetic fields   IEC 61000-4-9
- **Interference IEC 61000-6-4:**
  Specifically:
  – For industrial, scientific and medical
    (ISM) equipment   IEC 55011
  – For information technology
    equipment   IEC 55022

Transmission of measuring signals— electrical noise immunity

Noise voltages arise mainly through capacitive or inductive transfer. Electrical noise can be introduced into the system over signal lines and input or output terminals.

Possible sources of noise are:
- Strong magnetic fields from transformers, brakes and electric motors
- Relays, contactors and solenoid valves
- High-frequency equipment, pulse devices, and stray magnetic fields from switch-mode power supplies
- AC power lines and supply lines to the above devices

Protection against electrical noise

The following measures must be taken to ensure disturbance-free operation:
- Use only original HEIDENHAIN cables.
- Use connectors or terminal boxes with metal housings. Do not conduct any extraneous signals.
- Connect the housings of the encoder, connector, terminal box and evaluation electronics through the shield of the cable. Connect the shielding in the area of the cable outlets to be as induction-free as possible (short, full-surface contact).
- Connect the entire shielding system with the protective ground.
- Prevent contact of loose connector housings with other metal surfaces.
- The cable shielding has the function of an equipotential bonding conductor. If compensating currents are to be expected within the entire system, a separate equipotential bonding conductor must be provided. See also **EN 50178**/4.98 Chapter 5.2.9.5 regarding "protective connection lines with small cross section."

- Do not lay signal cables in the direct vicinity of interference sources (inductive consumers such as contacts, motors, frequency inverters, solenoids, etc.).
- Sufficient decoupling from interference-signal-conducting cables can usually be achieved by an air clearance of 100 mm or, when cables are in metal ducts, by a grounded partition.
- A minimum spacing of 200 mm to inductors in switch-mode power supplies is required. See also **EN 50178**/4.98 Chapter 5.3.1.1 regarding cables and lines, **EN 50174-2**/09.01, Chapter 6.7 regarding grounding and potential compensation.
- When using **multiturn encoders in electromagnetic fields** greater than 30 mT, HEIDENHAIN recommends consulting with the main facility in Traunreut.

Both the cable shielding and the metal housings of encoders and subsequent electronics have a shielding function. The housings must have the **same potential** and be connected to the main signal ground over the machine chassis or by means of a separate potential compensating line. Potential compensating lines should have a minimum cross section of 6 mm^2 (Cu).
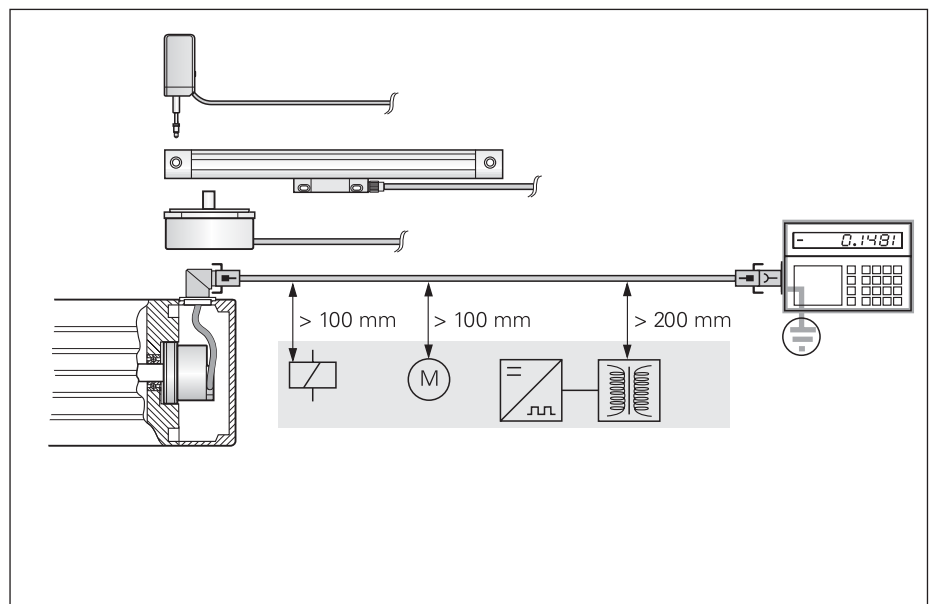
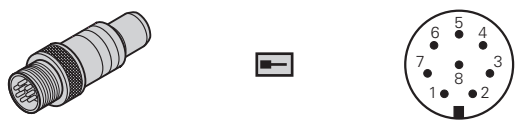Minimum distance from sources of interference

Electrical Connection

Cable with M12 connecting element, 8-pin

EnDat 22 without incremental signals

Encoder cable inside the motor housing
Cable diameter 4.5 mm
16xAWG30/7

Complete with 12-pin and 4-pin PCB connector and M12, 8–pin		530 094-01

PUR connecting cable — **8-pin:** $[(4 \times 0.14\ \text{mm}^2) + (4 \times 0.34\ \text{mm}^2)]$ **Ø 6 mm**

Complete with connector (female) and coupling (male)		368 330-xx
Complete with connector (female) and D-sub connector (female) for IK 220		533 627-xx
Complete with connector (female) and D-sub connector (male) for IK 115/IK 215		524 599-xx
With one connector (female)		559 346-xx[1]

[1] Connecting element must be suitable for 8 MHz signal transmission.

Pin layout

8-pin M12 coupling

	Power supply				Absolute position values			
	2	**8**	**1**	**5**	**3**	**4**	**7**	**6**
	U_P[1]	U_P	$0\,V$[1]	$0\,V$	**DATA**	$\overline{\textbf{DATA}}$	**CLOCK**	$\overline{\textbf{CLOCK}}$
	Blue	Brown/Green	White	White/Green	Gray	Pink	Violet	Yellow

Shield on housing; U_P = power supply voltage
Vacant pins or wires must not be used!
[1] For parallel supply lines
HEIDENHAIN cables, complete with connectors, are required for use in safety-related applications!

Related documents
- Mounting instructions: *ECN 1325, EQN 1337* 572 706-xx
- Technical Information: *Safety-Related Position Encoders* 596 632-xx
- Interface Description: *EnDat* 297 403-xx
- System Specification: *Specification of the E/E/PES safety requirements for the EnDat master and measures for safe controls*
  533 095-xx