

Linear Encoders

Angle Encoders

**Rotary Encoders**

3-D Touch Probes

Digital Readouts

Numerical Controls

## Absolute Rotary Encoders for PROFIBUS-DP

In factory automation, many applications require as many devices as possible to be networked within one system. Connecting sensors through field bus systems directly to the control terminal can minimize cabling and reduce the number of lines between encoder and subsequent electronics. HEIDENHAIN offers two possibilities for connecting to the

PROFIBUS-DP: One possibility is connecting any rotary, linear or angle encoder with **EnDat interface** via a separate **gateway**. This makes applications with temperatures up to 115 °C (239 °F) possible. The other possibility is rotary encoders with **integrated PROFIBUS-DP interface**, which are described in this product overview.

The **ROC 413 singleturn encoder** provides 13-bit resolution, which equals 8192 encoded measuring positions per revolution, while the **ROQ 425 multiturn rotary encoders** can also distinguish between 4096 revolutions.

The encoders are connected directly to the field bus through their integral PROFIBUS-DP interface. They comply with **Class 2** requirements of the **PROFIBUS specification** including optional functions, but can also be configured as Class 1 devices. Resolution and reversal of rotational direction are **programmable**

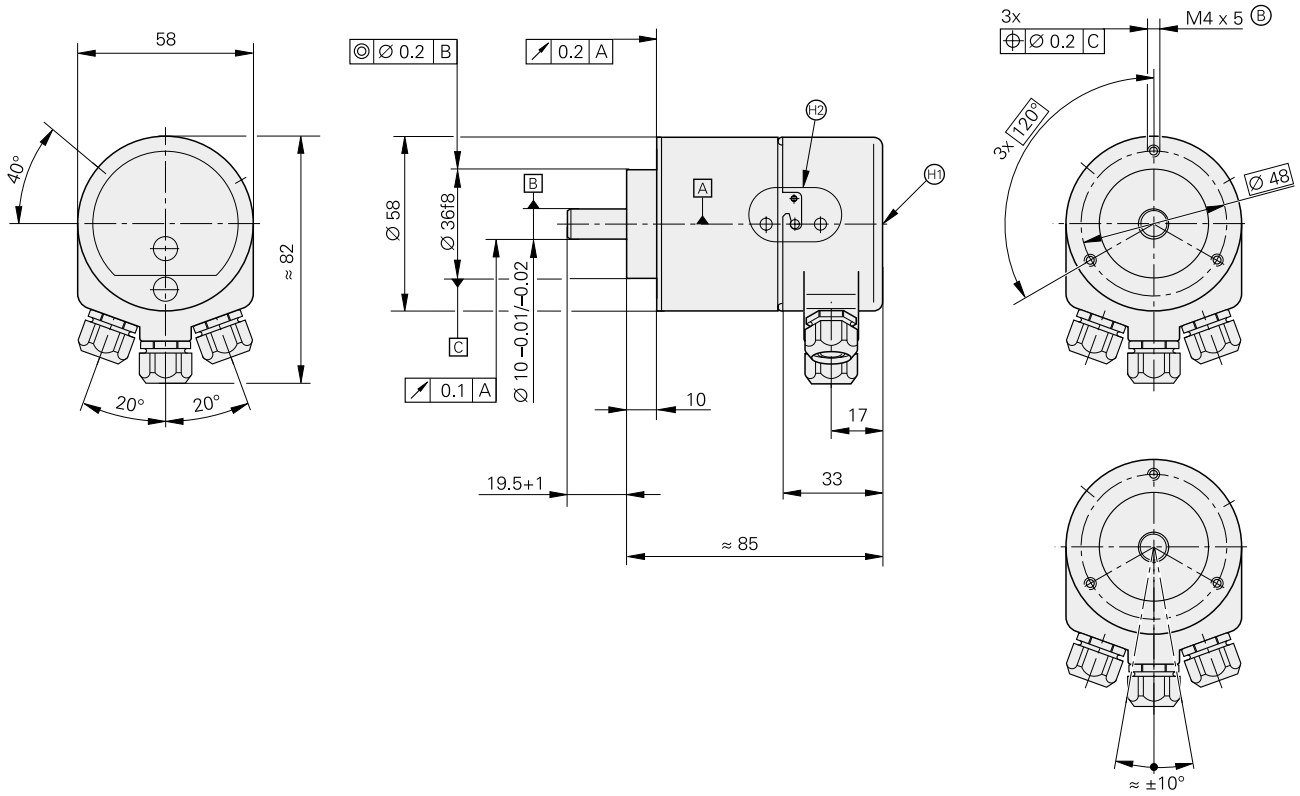
through the Profibus-DP, and the **operating time** can be interrogated. Absolute rotary encoders with integrated PROFIBUS-DP interface are available in the mechanical designs for shaft coupling with synchro flange and with clamping flange.

Their **compact dimensions** of only 85-mm overall length and 58-mm diameter save space. The bayonet socket for opening the encoder is very handy and saves time, especially after the encoder has already been installed. The encoder cables are conducted through heavy-gauge compression fittings to screw terminals.

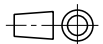


# ROC 413, ROQ 425 with Clamping Flange

- Rotary encoder for separate shaft coupling
- PROFIBUS-DP



Dimensions  
in mm



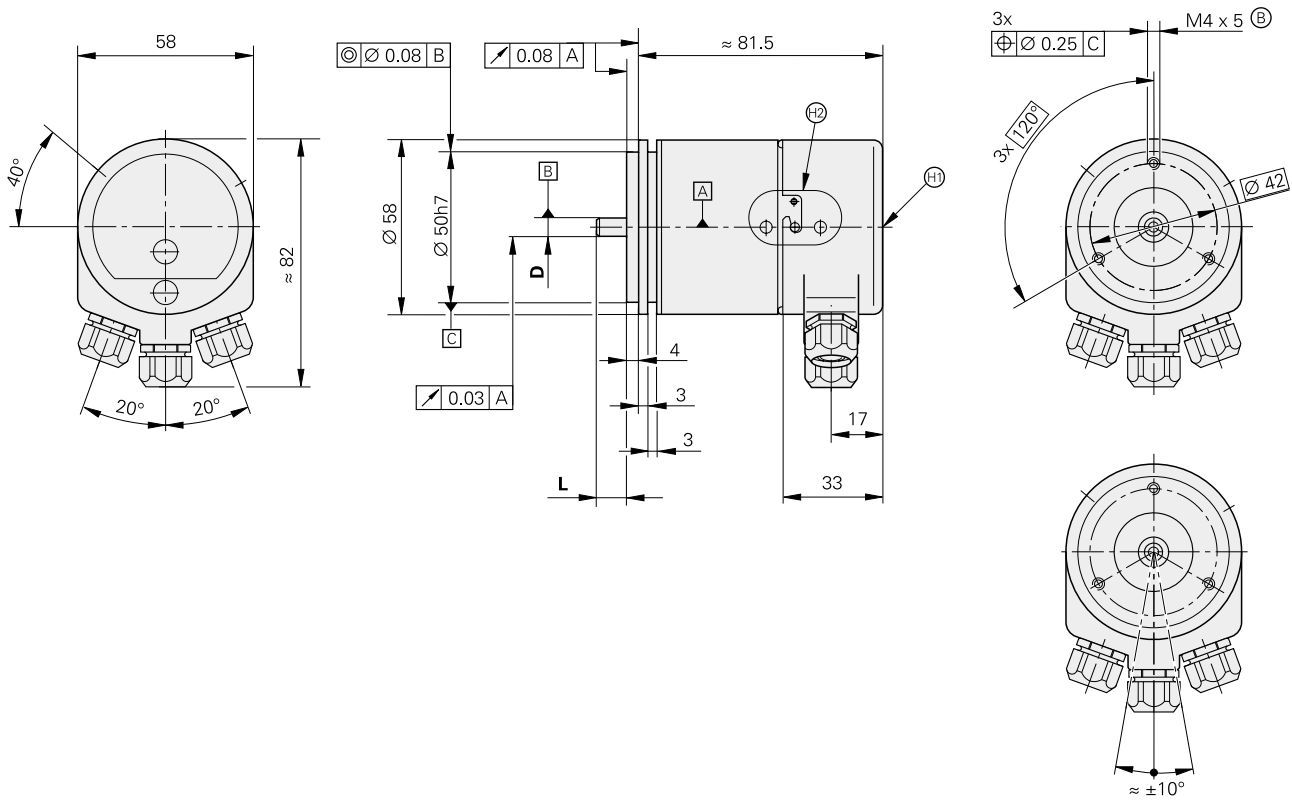
DIN ISO 8015  
ISO 2768 - m H

- ▣ = Bearing
- ⊕ = Threaded mounting hole
- Ⓜ = Measurement point for operating temperature
- Ⓩ = Drawn rotated by  $40^\circ$

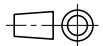
	Absolute	Multiturn
	Singleturn ROC 413	ROQ 425
<b>Absolute position values</b>	PROFIBUS-DP (EN 50 170)	PROFIBUS-DP (EN 50 170)
Positions per rev	8192 (13 bits) programmable	8192 (13 bits) programmable
Resolvable revolutions	–	4096 (programmable)
Code	Pure binary	Pure binary
Electrically permissible speed/ System accuracy	5 000 min <sup>-1</sup> /± 1 bit LSB 12 000 min <sup>-1</sup> /± 100 bit LSB	5 000 min <sup>-1</sup> /± 1 bit LSB 10 000 min <sup>-1</sup> /± 100 bit LSB
<b>Power supply</b>	10 to 30 V	10 to 30 V
<b>Current consumption</b> (without load)	Max. 125 mA at 24 V	Max. 125 mA at 24 V
<b>Electrical connection</b>	Screw terminals Cable exit radial via heavy gauge compression fittings	Screw terminals Cable exit radial via heavy gauge compression fittings
<b>Mech. perm. speed <i>n</i></b>	Max. 12 000 rpm	Max. 10 000 rpm
<b>Starting torque</b>	≤ 0.01 Nm at 20 °C (68 °F)	≤ 0.01 Nm at 20 °C (68 °F)
<b>Moment of inertia of rotor</b>	3.6 · 10 <sup>-6</sup> kgm <sup>2</sup>	3.8 · 10 <sup>-6</sup> kgm <sup>2</sup>
<b>Shaft load</b> at shaft end	<i>n</i> ≤ 6 000 rpm: axial 40 N/radial 60 N <i>n</i> > 6 000 rpm: axial 10 N/radial 20 N	<i>n</i> ≤ 6 000 rpm: axial 40 N/radial 60 N <i>n</i> > 6 000 rpm: axial 10 N/radial 20 N
<b>Vibration</b> (55 to 2000 Hz) <b>Shock</b> (6 ms)	≤ 100 m/s <sup>2</sup> (IEC 60 068-2-6) ≤ 1000 m/s <sup>2</sup> (IEC 60 068-2-27)	≤ 100 m/s <sup>2</sup> (IEC 60 068-2-6) ≤ 1000 m/s <sup>2</sup> (IEC 60 068-2-27)
<b>Max. operating temp.</b>	60 °C (140 °F)	60 °C (140 °F)
<b>Min. operating temp.</b>	-20 °C (-4 °F)	-20 °C (-4 °F)
<b>Protection</b> (IEC 60 529)	IP 64	IP 64
<b>Weight</b>	Approx. 0.35 kg (12 oz)	Approx. 0.35 kg (12 oz)

# ROC 413, ROQ 425 with Synchro Flange

- Rotary encoder for separate shaft coupling
- PROFIBUS-DP



Dimensions  
in mm



DIN ISO 8015  
ISO 2768 - m H

- ▣ = Bearing
- ⊕ = Threaded mounting hole
- Ⓜ = Measurement point for operating temperature
- Ⓡ = Drawn rotated by 40°

D	L
∅ 6 -0.01/-0.02	10+1
∅ 10 -0.01/-0.02	19.5+1

	<b>Absolute</b>	
	<b>Singleturn</b>	<b>Multiturn</b>
	<b>ROC 413</b>	<b>ROQ 425</b>
<b>Absolute position values</b>	PROFIBUS-DP (EN 50170)	PROFIBUS-DP (EN 50170)
Positions per rev	8192 (13 bits) programmable	8192 (13 bits) programmable
Resolvable revolutions	–	4096 (programmable)
Code	Pure binary	Pure binary
Electrically permissible speed/ System accuracy	5000 min <sup>-1</sup> /± 1 bit LSB 12000 min <sup>-1</sup> /± 100 bit LSB	5000 min <sup>-1</sup> /± 1 bit LSB 10000 min <sup>-1</sup> /± 100 bit LSB
<b>Power supply</b>	10 to 30 V	10 to 30 V
<b>Current consumption</b> (without load)	Max. 125 mA at 24 V	Max. 125 mA at 24 V
<b>Electrical connection</b>	Screw terminals Cable exit radial via heavy gauge compression fittings	Screw terminals Cable exit radial via heavy gauge compression fittings
<b>Mech. perm. speed <i>n</i></b>	Max. 12000 rpm	Max. 10000 rpm
<b>Starting torque</b>	≤ 0.01 Nm at 20 °C (68 °F)	≤ 0.01 Nm at 20 °C (68 °F)
<b>Moment of inertia of rotor</b>	3.6 · 10 <sup>-6</sup> kgm <sup>2</sup>	3.8 · 10 <sup>-6</sup> kgm <sup>2</sup>
<b>Shaft load</b> at shaft end	<i>n</i> ≤ 6000 rpm: axial 40 N/radial 60 N <i>n</i> > 6000 rpm: axial 10 N/radial 20 N	<i>n</i> ≤ 6000 rpm: axial 40 N/radial 60 N <i>n</i> > 6000 rpm: axial 10 N/radial 20 N
<b>Vibration</b> (55 to 2000 Hz) <b>Shock</b> (6 ms)	≤ 100 m/s <sup>2</sup> (IEC 60068-2-6) ≤ 1000 m/s <sup>2</sup> (IEC 60068-2-27)	≤ 100 m/s <sup>2</sup> (IEC 60068-2-6) ≤ 1000 m/s <sup>2</sup> (IEC 60068-2-27)
<b>Max. operating temp.</b>	60 °C (140 °F)	60 °C (140 °F)
<b>Min. operating temp.</b>	-20 °C (-4 °F)	-20 °C (-4 °F)
<b>Protection</b> (IEC 60529)	IP 64	IP 64
<b>Weight</b>	Approx. 0.35 kg (12 oz)	Approx. 0.35 kg (12 oz)

# Interfaces

## PROFIBUS-DP

### PROFIBUS-DP

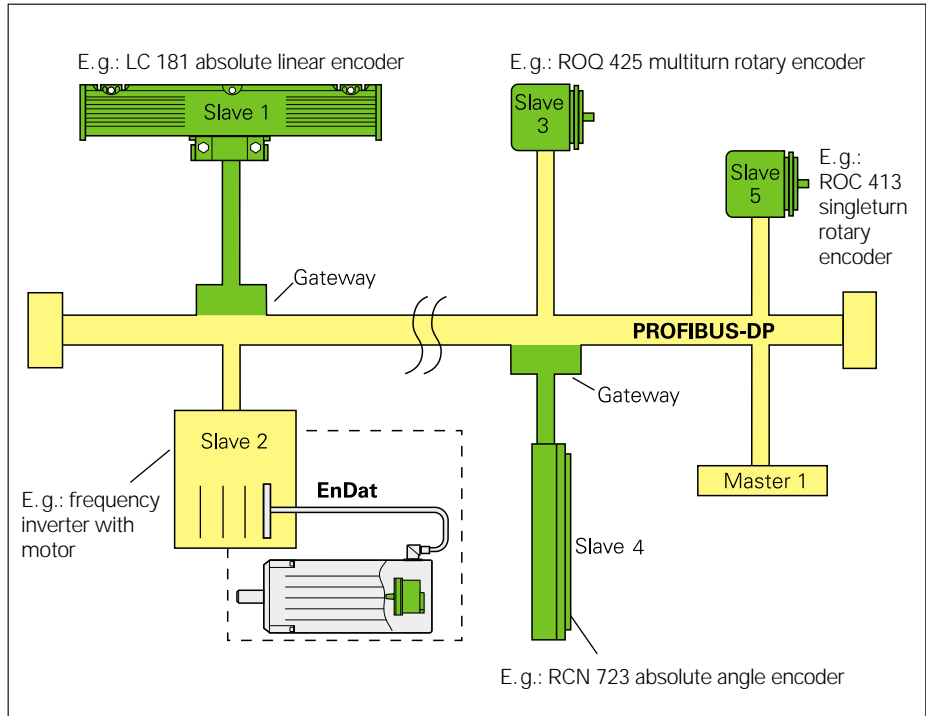
PROFIBUS is a nonproprietary, open field bus in accordance with the international EN 50170 standard. Connecting sensors through field bus systems minimizes the cost of cabling and the number of lines between encoder and subsequent electronics.

### Topology and bus assignment

The PROFIBUS-DP has a linear structure, which permits transfer rates up to 12 Mb/s. Both mono-master and multi-master systems are possible. Each master can serve only its own slaves (polling). The slaves are polled cyclically by the master. Slaves are sensors, such as absolute rotary encoders, linear encoders, or also control devices such as motor frequency inverters.

### Physical characteristics

The electrical features of the PROFIBUS-DP comply with the RS-485 standard. The bus connection is a shielded, twisted two-wire cable with active bus terminations at each end.



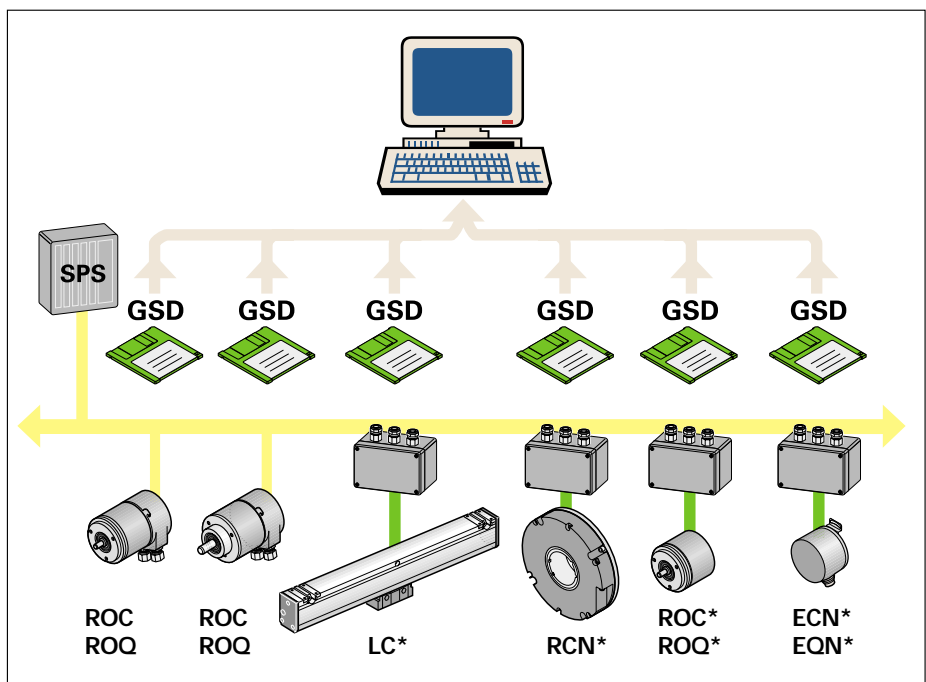
Bus structure of PROFIBUS-DP

### Self-commissioning

The characteristics of the HEIDENHAIN encoders required for system configuration are available as "electronic data sheets"—also called device identification records (GSD)—for each encoder. These device identification records hold the complete and exact characteristics of a device in a precisely defined format, which permits the simple and application-friendly integration of the devices into the bus system.

### Configuration

The PROFIBUS-DP encoders can be configured and parameterized according to the requirements of the user. The GSD file in the configuration tool is used to make the settings, which are stored in the master. The master configures the PROFIBUS encoders each time the system is started. This simplifies the process for exchanging encoders: the configuration data do not need to be edited or reentered.



\* With EnDat interface



**PROFIBUS-DP profile**

The PNO (PROFIBUS user organization) has defined a standard, nonproprietary profile for the connection of absolute encoders to the PROFIBUS-DP, thus ensuring high flexibility and simple configuration on all systems that use this standardized profile.

You can request the profile for absolute encoders from the PNO in Karlsruhe, Germany, under the order number 3.062. There are two classes defined in the profile, whereby class 1 provides minimum support, and class 2 allows additional, in part optional functions.

**Supported functions**

Particularly important in decentralized field bus systems are the **diagnostic functions** (e.g. warnings and alarms), and the **electronic ID label** with information on the type of encoder, resolution, and measuring range. But also programming functions such as counting direction reversal, **preset/datum shift** and **changing the resolution (scaling)** are possible. The **operating time** of the encoder can also be recorded.

**Operating conditions**

In addition to the transmission of diagnostic information through the PROFIBUS-DP, the operating conditions

- power supply and
- bus status

are indicated with LEDs on the back of the rotary encoder.

Characteristic	Class	ECN 113 <sup>1)</sup> ECN 413 <sup>1)</sup> ROC 413	EQN 425 <sup>1)</sup> ROQ 425	ROC 415 <sup>1)</sup> ROC 417 <sup>1)</sup> RCN 220 <sup>1)</sup> RCN 723 <sup>1)</sup>	LC 481 <sup>1)</sup> LC 181 <sup>1)</sup>
<b>Position value in pure binary code</b>	1, 2	✓	✓	✓	✓
<b>Data word length</b>	1, 2	16	32	32	32
<b>Scaling function</b>					
Measuring steps/rev	2	✓	✓	✓ <sup>2)</sup>	–
Total resolution	2	✓	✓	–	–
<b>Reversal of counting direction</b>	1, 2	✓	✓	✓	–
<b>Preset/Datum shift</b>	2	✓	✓	✓	–
<b>Diagnostic functions</b>					
Warnings and alarms	2	✓	✓	✓	✓
<b>Recording of operating time</b>	2	✓	✓	✓	✓
<b>Profile version</b>	2	✓	✓	✓	✓
<b>Serial number</b>	2	✓	✓	✓	✓

<sup>1)</sup> With EnDat interface: connectable to PROFIBUS-DP via gateway

<sup>2)</sup> Scaling factor in binary steps



## Connection

The absolute rotary encoders with **integrated PROFIBUS-DP interface** have screw-type terminals for the PROFIBUS-DP and the power supply. The cable enters the encoder through three PG7 heavy-gauge compression screw fittings on the encoder bus housing. The bus housing also contains the coding switches for addressing (0 to 99) and the terminal resistor switch. The terminal resistor must be activated if the encoder is the last participant on the PROFIBUS-DP bus line. All connections and controls are easily reachable in the encoder bus housing.

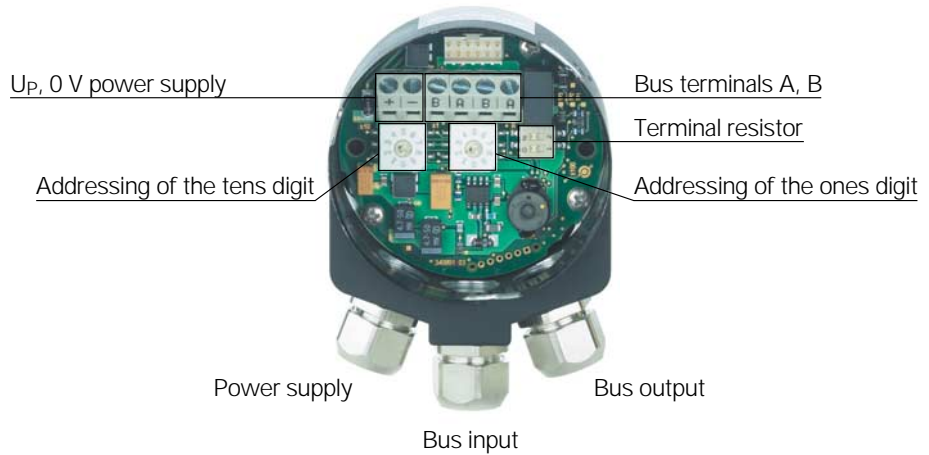
## Connection via gateway

All absolute encoders from HEIDENHAIN with **EnDat interface** are suitable for PROFIBUS-DP. The encoder is electrically connected through a **gateway**. The complete interface electronics are integrated in the gateway, which offers a number of benefits:

- Simple connection of the field bus cable, since the terminals are easily accessible.
- Encoder dimensions remain small.
- No temperature restrictions for the encoder. All temperature-sensitive components are in the gateway.
- No bus interruption when an encoder is exchanged.

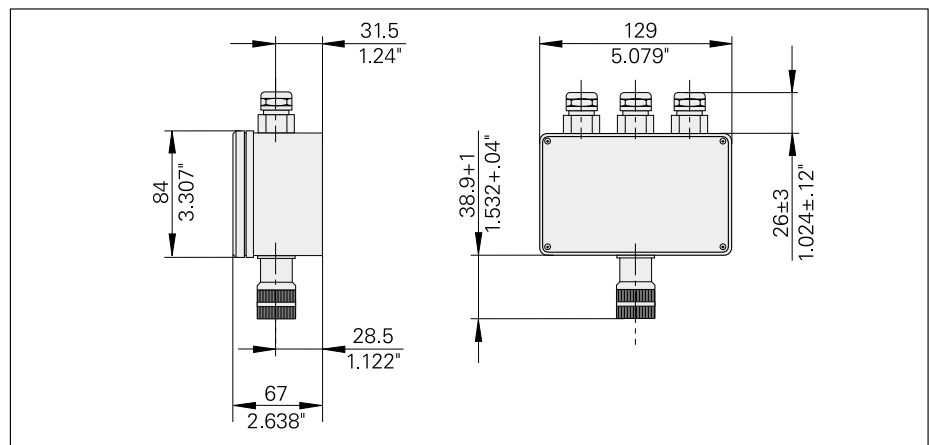
Besides the EnDat encoder connector, the gateway provides connections for the PROFIBUS and the power supply. The gateway contains coding switches for addressing and selecting the terminating resistor.

Since the gateway is connected as a bus participant, the cable to the encoder does not function as a stub line, although it can be up to 150 meters (492 ft) long.



## Gateway

<b>Power supply</b>	10 to 30 V Max. 400 mA
<b>Protection</b>	IP 67
<b>Operating temperature</b>	-40 °C to 80 °C (-40 °F to 176 °F)
<b>Electrical connection</b>	EnDat PROFIBUS-DP Flange socket, 17-pin terminations PG9 cable exit
<b>Part number</b>	Id. Nr. 325 771-01



# HEIDENHAIN

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*Standards (ISO, EN, etc.) apply only where explicitly stated in the catalog.*

## Further Information

- Rotary Encoders brochure
- Angle Encoders brochure
- Sealed Linear Encoders brochure
- Encoders with PROFIBUS-DP Interface User's Manual