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# Incremental encoder GEL 293

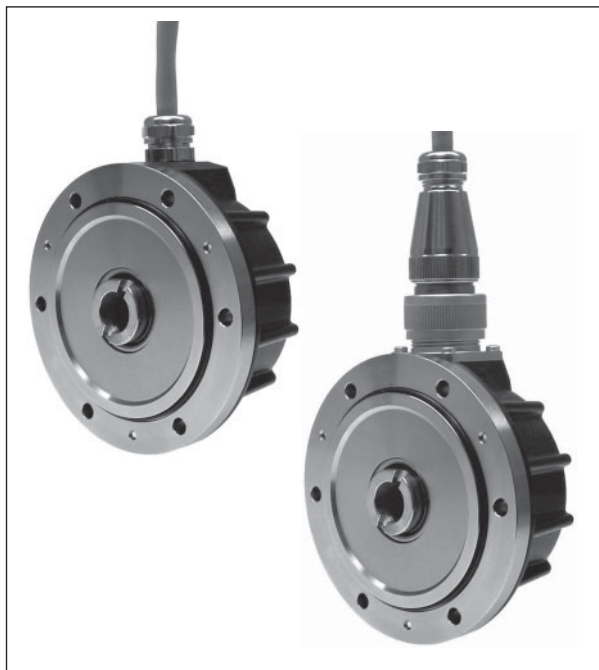
- with hollow-shaft and integrated coupling
- magnetic measuring system

SENSORLINE

LENORD+BAUER

Technical information

version 01.05



## General information

Incremental encoders convert rotations into electric signals. The Lenord + Bauer encoders combine the advantages of a magnetic measuring system and a robust mechanic design. They have proven successful all over the world in many different applications and even under roughest industrial conditions. Their high reliability and a long service life go without saying.

## Fields of application

- Up to 10,000 pulses per revolution (40,000 with external four-edge evaluation)
- Additionally current output  
0 ... 20 mA, 4 ... 20 mA, -20 ... + 20 mA (option)
- Reference signal
- High electromagnetic compatibility (EMC)

Further outstanding features of the GEL 293 are

- A hollow shaft for 16-mm shafts
- A coupling is integrated which is highly elastic and offers torsional rigidity
- Extremely high angular acceleration
- IP 66

## Measuring principle

The encoders work with differential sensors depending on magnetic fields and a precision toothed wheel as measure. The sensors scan the tooth structure of the toothed wheel and emit a sine or cosine voltage. The integrated evaluation electronics in ASIC and SMD technology converts the analogue sensor signals into incremental output signals.

## Advantages of the magnetic system

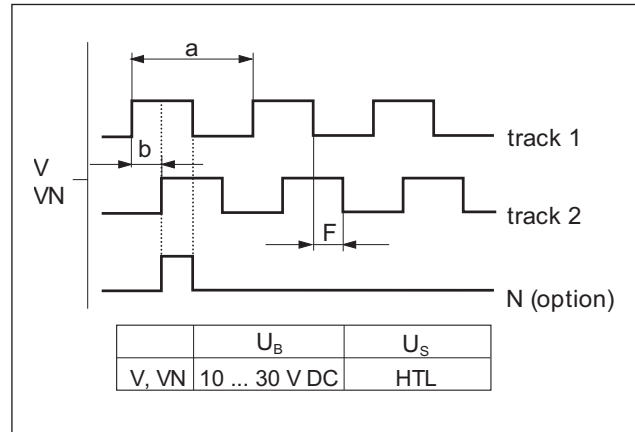
- No adverse effect due to condensed water
- Absolute operational reliability even in case of high humidity (dewing) and frequent change of ambient temperature
- Extremely insensitive to dirt, oil and water
- Extremely shock- and vibration-resistant because the measure is not made of glass nor plastic
- Outstanding operational safety over a very long period of time as it does not suffer from ageing effects as optical systems do

# Output signals

## Signal pattern V, VN

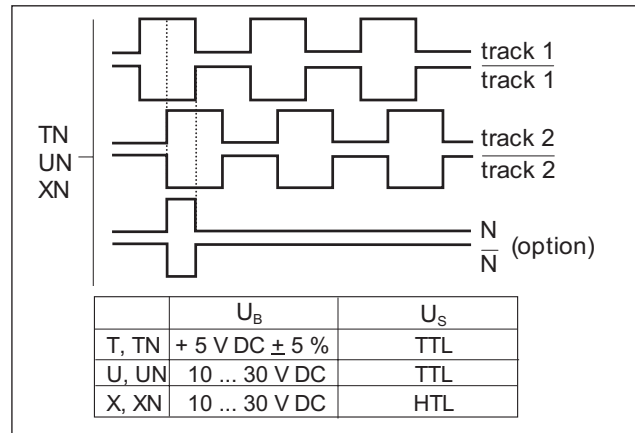
Signal pattern "V" stands for two tracks with square-wave signals, offset by 90° (push-pull output). With each revolution, a reference signal with defined length is put out on the third track N (optionally).

At an output frequency of 200 kHz the edge distance (F) is  $\geq 0.6 \mu\text{s}$ .



## Signal pattern T, TN, U, UN, X, XN

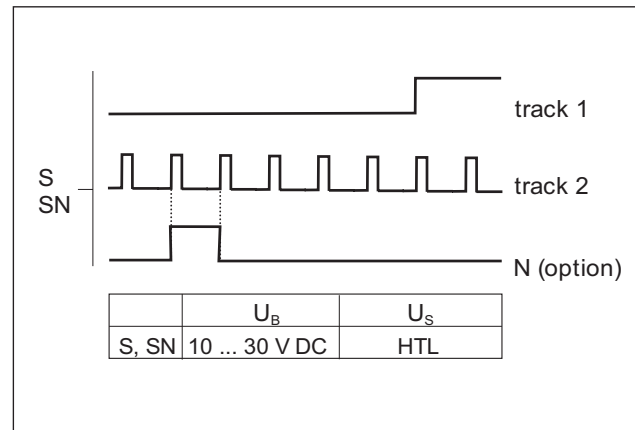
Both tracks and the reference signal (option) are additionally output as inverse signals.



## Signal pattern S, SN

Pulses which are independent of the rotational direction and the duration of which is constant are derived from the square-wave signals as per signal pattern V and put out on track 2. Furthermore, a signal depending on the rotational direction is obtained from the signal pattern which is put on track 1.

Once per each revolution a reference signal is output on the third track N (optional). The outputs have a final push-pull power stage. All outputs are sustained short-circuit-proof. The pulses follow a possible change of rotation with a slight delay, in order that a subsequent counter setting can be adjusted to the counting direction prior to the pulse. The sense-dependent signal may be reversed via a which is accessible from outside (switch 1).



## Key

- $U_B$  = operating voltage
- $U_S$  = signal voltage
- a = 360° electrical
- b = 90° phase shift
- F = edge distance (for an output frequency of 200 kHz the edge distance is  $F > 0.6 \mu$ )

Signal pattern = shown for clockwise rotation (view on top of the encoder shaft)

Reference signals with other lengths upon request.

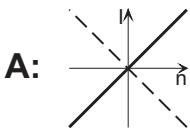
## Output level

The signal patterns V, VN, X and XN have HTL level, the signal patterns T, TN, U and UN have TTL level (for the output voltage see electrical data).

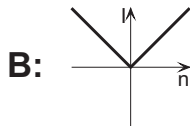
All outputs have a push-pull power amplifier and are short-circuit-proof. The peak output current for recharging the cable capacity is 100 mA.

# Current outputs

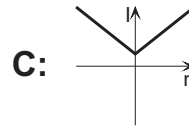
## Various current outputs



Measuring current which is independent on the sense of rotation and which has a nominal range of -20 ... +20 mA.



Measuring current which is independent of the sense of rotation and which has a nominal range of 0 ... +20 mA.

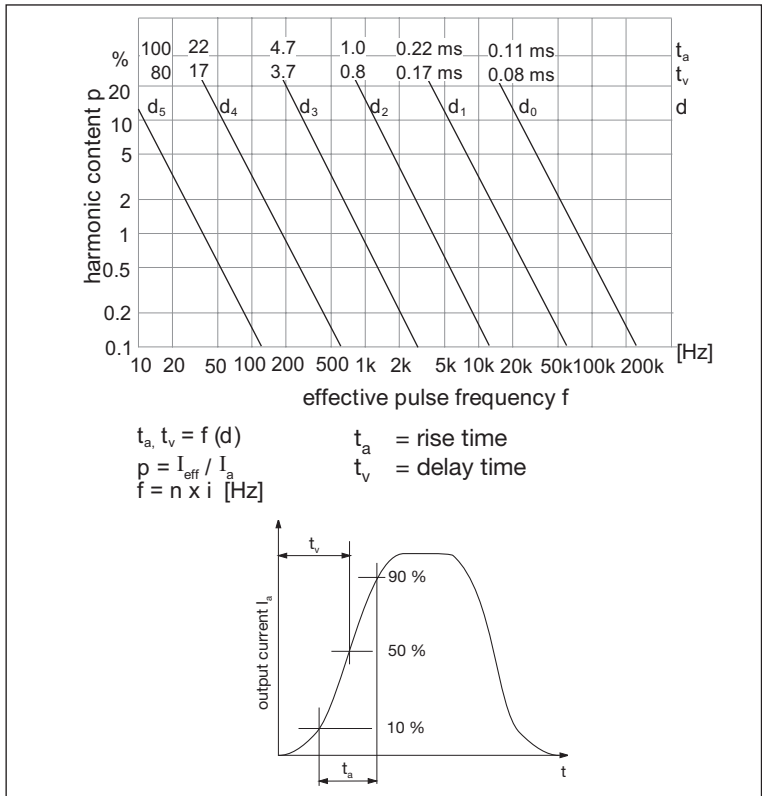


Measuring current which is independent of the sense of rotation and which has a nominal range of +4 ... +20 mA.

## Current output

For displaying and controlling a standardized measuring current of 0 ... 20 mA, 4 ... 20 mA or -20 ... +20 mA which depends on the speed and sometimes on the sense of rotation can be obtained from the pulse frequency. For this purpose the pulse frequency is integrated and converted into an applied current. This results in a strictly linear interrelation between the measuring current and the pulse frequency. Because of the high resolution (up to 40,000 pulses per revolution, each pulse being dependent on the sense of rotation) a standard measuring current with a low harmonic content is obtained at a very low speed range (e.g. 0 ... 0.5 min<sup>-1</sup>) already.

The harmonic content of the output DC depends on the pulse frequency as well as on the chosen attenuation, latter influencing the rise, fall and delay time in case of the speed changing erratically. Attenuation may be specified when ordering corresponding to the above diagram, d<sub>3</sub> is the default setting.



## Data of the current outputs

max. apparent ohmic resistance	$R_a$	550	$\Omega$
measuring device class	K	1	
rated current tolerance		< 1	%
linearity error		< 1	%
repeatability	r	100	%
temperature drift	$\Delta I_{aT}$	< $\pm 3$	$\mu A/1^\circ K$
min. RPM	$n_{\text{min}}$	electrical (attenuation d <sub>5</sub> )	$1.5 \times 10^3/i$ RPM
max. RPM	$n_{\text{max}}$	electrical	$6 \times 10^6/i$ RPM

i = rated pulse number

# Technical data according to DIN 32878

Description		GEL 293
measuring step from ... to <sup>1)</sup>		9 ... 0.087°
pulse number per revolution <sup>1)</sup>		40 ... 40,000 number of pulses
accuracy	error limit <sup>2)</sup>	0.07°
	incremental deviation <sup>2)</sup>	0.01°
	repeatability <sup>2)</sup>	0.005°
electrical data	power consumption $R_L = \infty, U_B = 10...30 \text{ V DC}$ $R_L = \infty, U_B = 5 \text{ V DC}$	$\leq 1.3 \text{ W}$ (with current output: $\leq 1.65$ ) $\leq 1.0 \text{ W}$ (with current output: $\leq 1.40$ )
	output frequency	0 ... 200 kHz
	output level for signal pattern T/TN (logic level TTL)	high signal: $\geq U_B - 1.00 \text{ V}$ at $I = 10 \text{ mA}$ ; $\geq U_B - 1.20 \text{ V}$ at $I = 30 \text{ mA}$ low signal: $\leq 0.75 \text{ V}$ at $I = 10 \text{ mA}$ ; $\leq 1.00 \text{ V}$ at $I = 30 \text{ mA}$
	output level for signal pattern U/UN (logic level TTL)	high signal: $\geq 4.00 \text{ V}$ at $I = 10 \text{ mA}$ ; $\geq 3.85 \text{ V}$ at $I = 30 \text{ mA}$ low signal: $\leq 0.75 \text{ V}$ at $I = 10 \text{ mA}$ ; $\leq 1.00 \text{ V}$ at $I = 30 \text{ mA}$
mechanical data	output level for signal pattern S/SN, V/VN and X/XN (logic level HTL)	high signal: $\geq U_B - 1.80 \text{ V}$ at $I = 10 \text{ mA}$ ; $\geq U_B - 2.20 \text{ V}$ at $I = 30 \text{ mA}$ low signal: $\leq 1.15 \text{ V}$ at $I = 10 \text{ mA}$ ; $\leq 1.55 \text{ V}$ at $I = 30 \text{ mA}$
	weight	approx. 0.7 kg
	max. operating r. p. m.	8,000
	moment of inertia of rotor	$8 \cdot 10^{-5} \text{ kgm}^2$
	max. acceleration	$5 \cdot 10^{-5} \text{ rad / s}^2$
	operating torque	0.01 Nm
	starting torque	0,015 Nm
	permissible shaft load	$\pm 1 \text{ mm axial } ^{3)}$ , $\pm 0.5 \text{ mm radial}$
bearing life	$>15,000 \cdot 10^6 \text{ revolution}$	
environmental conditions	operating temperature	0 ... +70 °C (standard); -20 ... +85 °C (option)
	ambient temperature	-20 ... +85 °C
	storage temperature	-40 ... +105 °C
	protection class according to DIN EN 60529	IP 66
	dust and spray protection with O-ring at the flange side (except for the shaft duct)	same tightness as driving unit, max. IP 66
	vibration protection (option) according to DIN EN 60068-2-6	frequency 10 ... 2,000 Hz; peak acceleration 100 m/s <sup>2</sup> ; frequency cycles 10
	shock protection (option) according to DIN EN 60068-2-27	peak acceleration 1,000 m/s <sup>2</sup> ; duration 11 ms
	insulation strength according to VDE 0660 part 500 version 08/00 or DIN EN 60439-1	$R_i > 1\text{M}\Omega$ , at a testing voltage of 500 V AC
electromagnetic compatibility electromagnetic emissions EN 61000-6-3 electromagnetic immunity EN 61000-6-2	The encoders are in strict conformity with Directive EMC 89/336/EEC of the European Union and are therefore certified by the CE mark.	

<sup>1)</sup> max. value with external evaluation of the signal pattern. See page 7 for possible pulse numbers (resolutions).

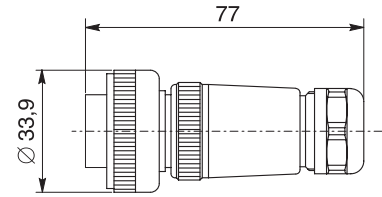
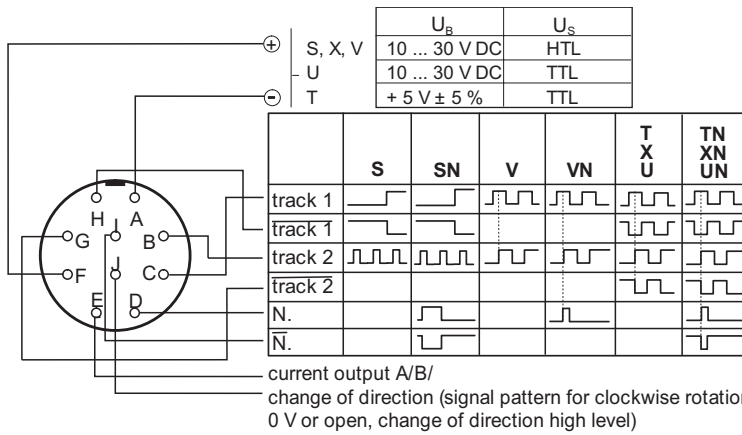
<sup>2)</sup> value for highest resolutions. Values for low resolutions on request.

<sup>3)</sup> recommended value for minimum pre-tension of the hollow-shaft 1.5 mm

# Pin layout: connector, cable

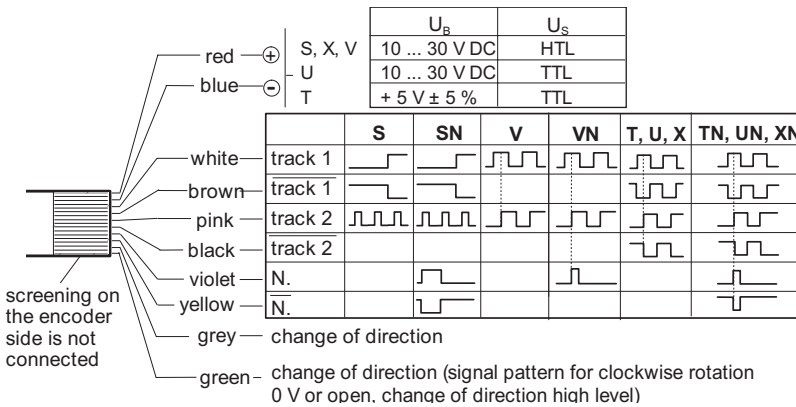
## Pin layout and dimensioned drawing 10-pole connector GG106

(The counter connector is included in the scope of supply.)



U<sub>B</sub> = operating voltage  
U<sub>S</sub> = signal voltage  
current output A = -20 mA ... +20 mA  
current output B = 0 mA ... +20 mA  
current output C = +4 mA ... +20 mA  
Signal pattern shown for clockwise rotation (view on top of the encoder shaft). Reference signal with other length upon the request.

## Pin layout 10-core cable



## Maximum Cable Lengths

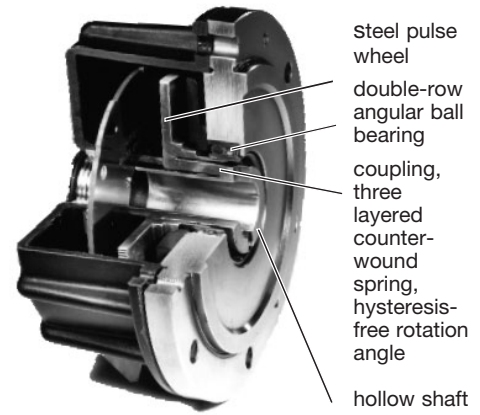
between encoder and secondary electronics.  
The cable screening is to be earthed one-sided at the receiver. The stated data are standard values referring to cable type LiYCY 6 (10) x 0,25 mm<sup>2</sup>.

signal pattern TN, UN, level TTL						
f [kHz]	5	10	20	50	100	200
L <sub>max</sub> [m]	200	200	200	200	145	72

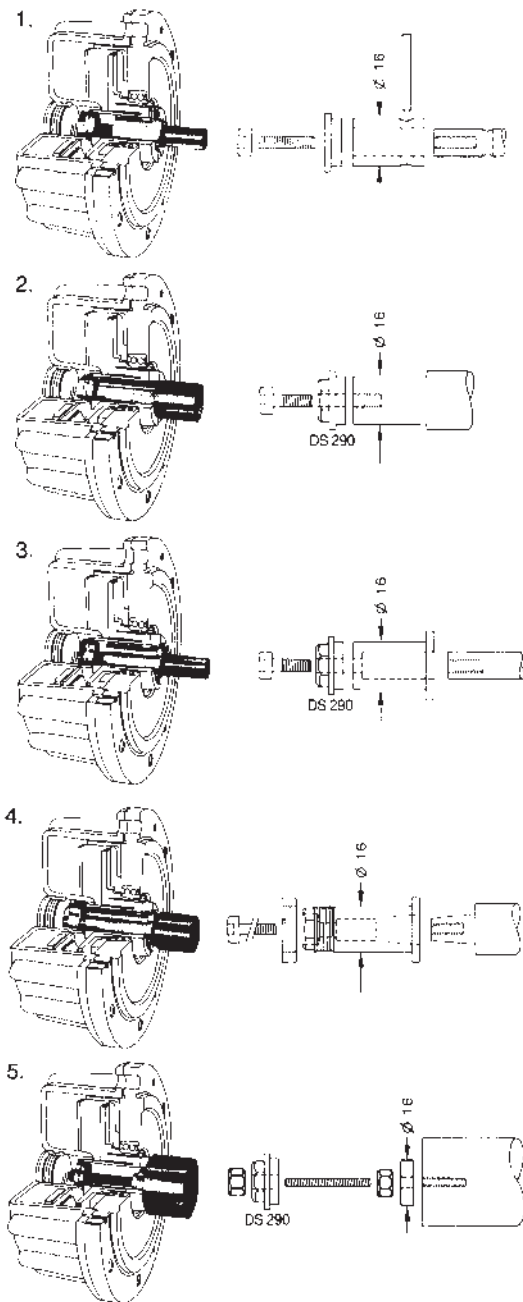
signal pattern SN, VN, level HTL (U <sub>B</sub> = 20 V)						
f [kHz]	5	10	20	50	100	200
L <sub>max</sub> [m]	200	200	200	80	40	20

signal pattern X, XN, level HTL (U <sub>B</sub> = 20 V)						
f [kHz]	5	10	20	50	100	200
L <sub>max</sub> [m]	200	200	100	40	20	10

# Hollow-Shaft Encoder GEL 293



## Example for shaft mounting



When mounting as shown in examples 2 -5, the position of the zero signal may be adjusted from the rear of the mounted encoder.  
When attaching the shaft preload coupling according to dimensioned drawing on page 8.

## Protection of the electronics (optional)

### Protection against humidity

The encoders' electronic unit is coated with a highly effective protection against humidity, salt-water atmosphere and corrosive vapours to ensure their proper functioning during years even under roughest conditions.

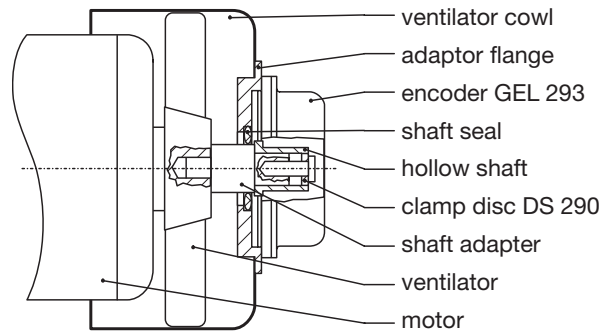
### Condensed-water outlet

Water may accumulate in the encoder if it is exposed to multiple dewing. The water can drain off through the condensed-water outlet. When mounting the encoder the outlet must show downward. The protection class drops to IP 64.

### Protection against vibration

The additional fixing of mechanical parts with special plastic prevents the electronics and the connections inside the encoder from vibrating. Thus the proper and continuous operation of the encoder - even if exposed to extreme vibration and shock - is guaranteed.

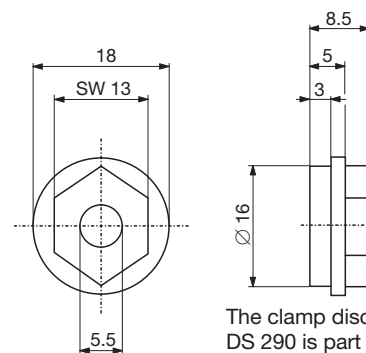
## Mounting example incl. counter flange



An adaptor flange is to be used, if the encoder has to be mounted dust and waterprotected from the flange side.

## Thrust disc DS 290

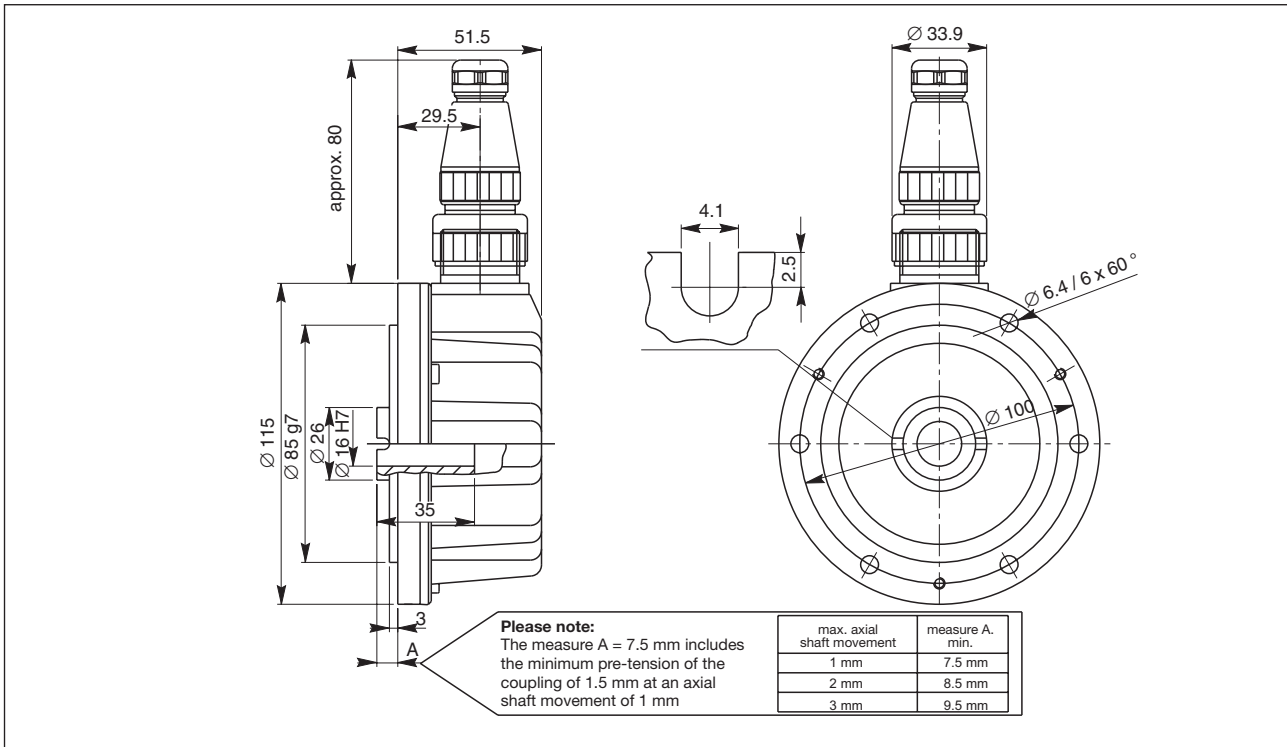
also see "Examples for shaft mounting"







## Dimensioned drawing GEL 293 with counter connector GG106



### Type code GEL

<b>current output</b>	
-	without
<b>A</b>	- 20 mA ... + 20 mA
<b>B</b>	0 mA ... + 20 mA
<b>C</b>	+ 4 mA ... + 20 mA
<b>signal pattern (see page 2)</b>	
<b>S</b>	signal pattern S
<b>V</b>	signal pattern V
<b>X</b>	signal pattern X
<b>U</b>	signal pattern U
<b>T</b>	signal pattern T
<b>reference signal</b>	
-	without
<b>N</b>	incl. reference signal
<b>pulse number per revolution (see page 7)</b>	
<b>connector / cable output</b>	
<b>L</b>	10-pole connector
<b>I</b>	10-core cable, radial
<b>protection of the electronics</b>	
<b>0</b>	without any additional protection (standard)
<b>1</b>	moisture-proof
<b>2</b>	vibration-proof
<b>3</b>	moisture- and vibration-proof
<b>4</b>	moisture-proof of incl. condensed-water outlet*
<b>5</b>	moisture-proof of incl. condensed-water outlet* and vibration-proof
<b>temperature range</b>	
<b>1</b>	0°C ... +70°C
<b>3</b>	-20°C ... +85°C (option)
* When mounting the encoder the outlet must show downward.	
<b>293</b>	- - - - - 0 - -

### Order details

Standard cable length: 1 metre. Please state in your order, if you wish other cable length. The counter connector GG 106 is included in the scope of supply, if the connector option is selected.

### Order example

For current outputs please state the nominal speed for  $I_{max}$ .  
**293 A V N 01000 L001; 3000 U min<sup>-1</sup> = 20 mA**