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Incremental encoder GEL 293

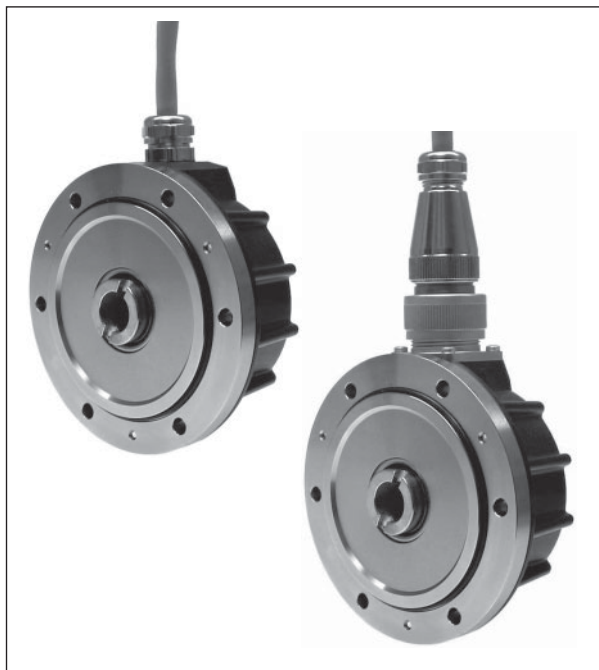
- with hollow-shaft and integrated coupling
- magnetic measuring system

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

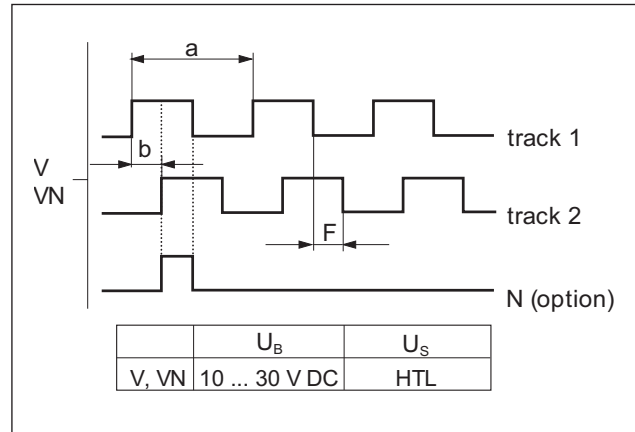
- No adverse effect due to condensed water
- Absolute operational reliability even in case of high humidity (dewing) and frequent change of ambient temperature
- Extremely insensitive to dirt, oil and water
- Extremely shock- and vibration-resistant because the measure is not made of glass nor plastic
- 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

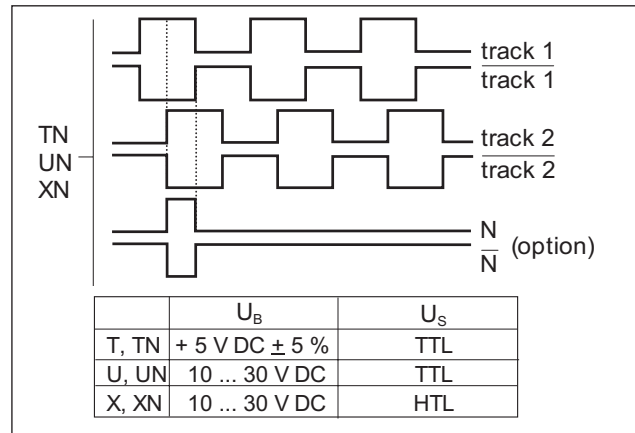
Signal pattern "V" stands for two tracks with square-wave signals, offset by 90° (push-pull output). With each revolution, a reference signal with defined length is put out on the third track N (optionally).

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

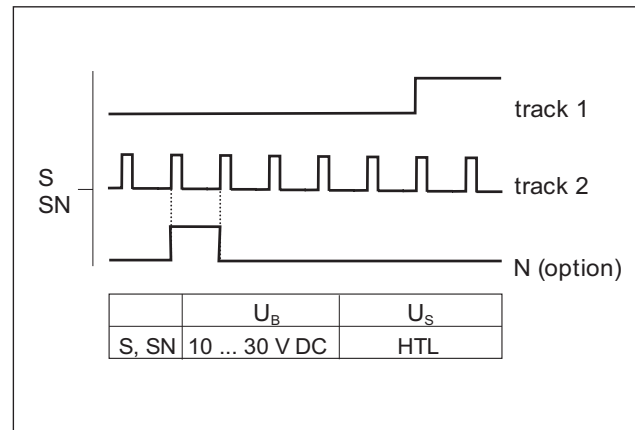
Both tracks and the reference signal (option) are additionally output as inverse signals.



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.

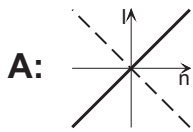
Output level

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).

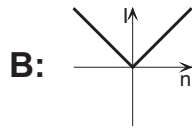
All outputs have a push-pull power amplifier and are short-circuit-proof. The peak output current for recharging the cable capacity is 100 mA.

Current outputs

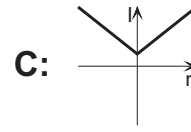
Various current outputs



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.

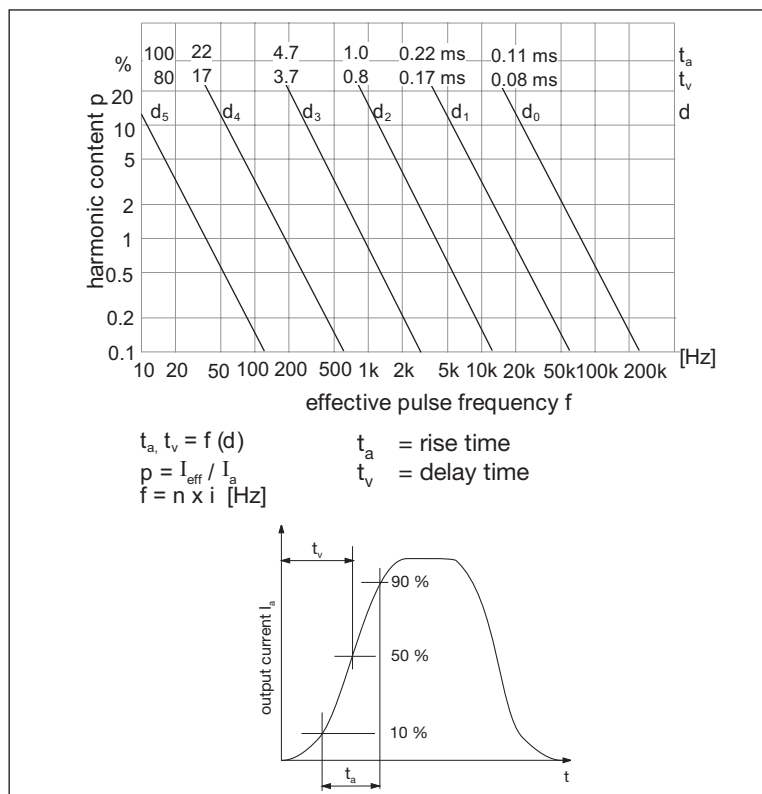


Measuring current which is independent of the sense of rotation and which has a nominal range of +4 ... +20 mA.

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⁻¹) 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, d₃ is the default setting.



Data of the current outputs

max. apparent ohmic resistance	R_a	550	Ω	
measuring device class	K	1		
rated current tolerance		< 1	%	
linearity error		< 1	%	
repeatability	r	100	%	
temperature drift	ΔI_{aT}	< ± 3	$\mu A/1^\circ K$	
min. RPM	n_{min}	electrical (attenuation d ₀)	$1.5 \times 10^3/i$	RPM
max. RPM	n_{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 ¹⁾		9 ... 0.087°
pulse number per revolution ¹⁾		40 ... 40,000 number of pulses
accuracy	error limit ²⁾	0.07°
	incremental deviation ²⁾	0.01°
	repeatability ²⁾	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: ≤ 1.65) $\leq 1.0 \text{ W}$ (with current output: ≤ 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 $I = 30 \text{ mA}$
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 $I = 30 \text{ mA}$	
mechanical data	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 ² ; frequency cycles 10
	shock protection (option) according to DIN EN 60068-2-27	peak acceleration 1,000 m/s ² ; 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.

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

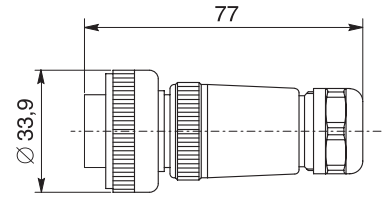
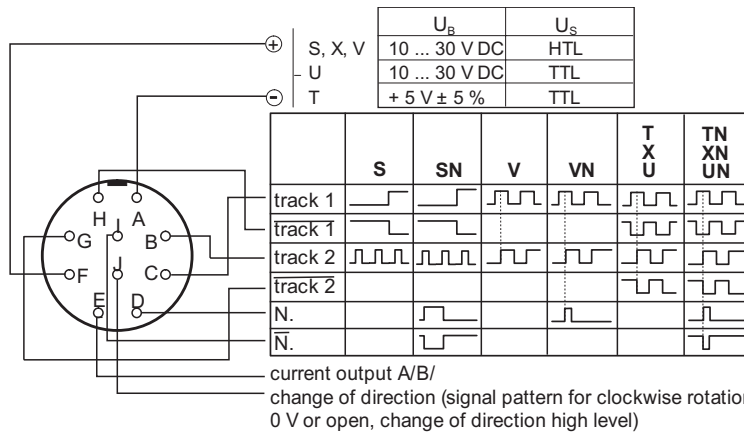
²⁾ value for highest resolutions. Values for low resolutions on request.

³⁾ recommended value for minimum pre-tension of the hollow-shaft 1.5 mm

Pin layout: connector, cable

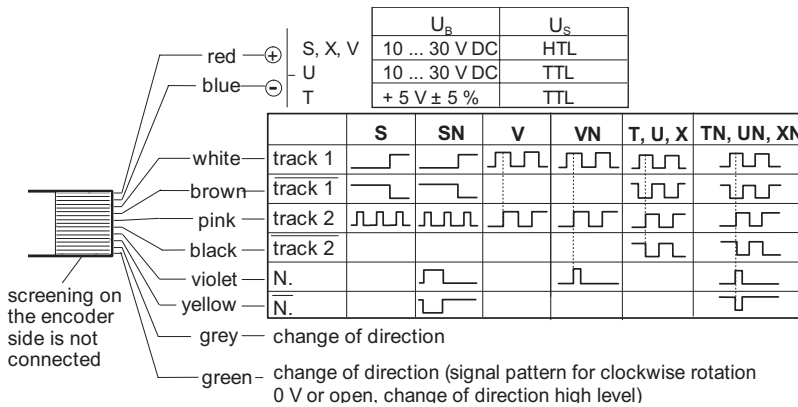
Pin layout and dimensioned drawing 10-pole connector GG106

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



U_B = operating voltage
U_S = 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

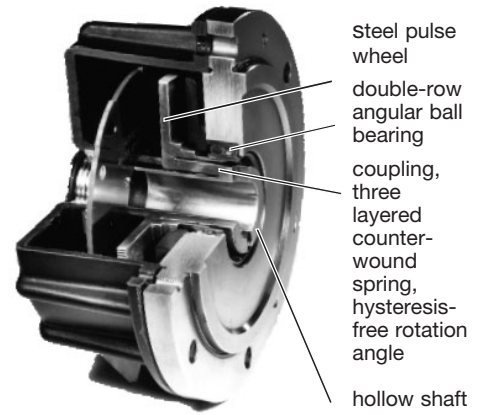
between encoder and secondary electronics.
The cable screening is to be earthed one-sided at the receiver. The stated data are standard values referring to cable type LiYCY 6 (10) x 0,25 mm².

signal pattern TN, UN, level TTL						
f [kHz]	5	10	20	50	100	200
L _{max} [m]	200	200	200	200	145	72

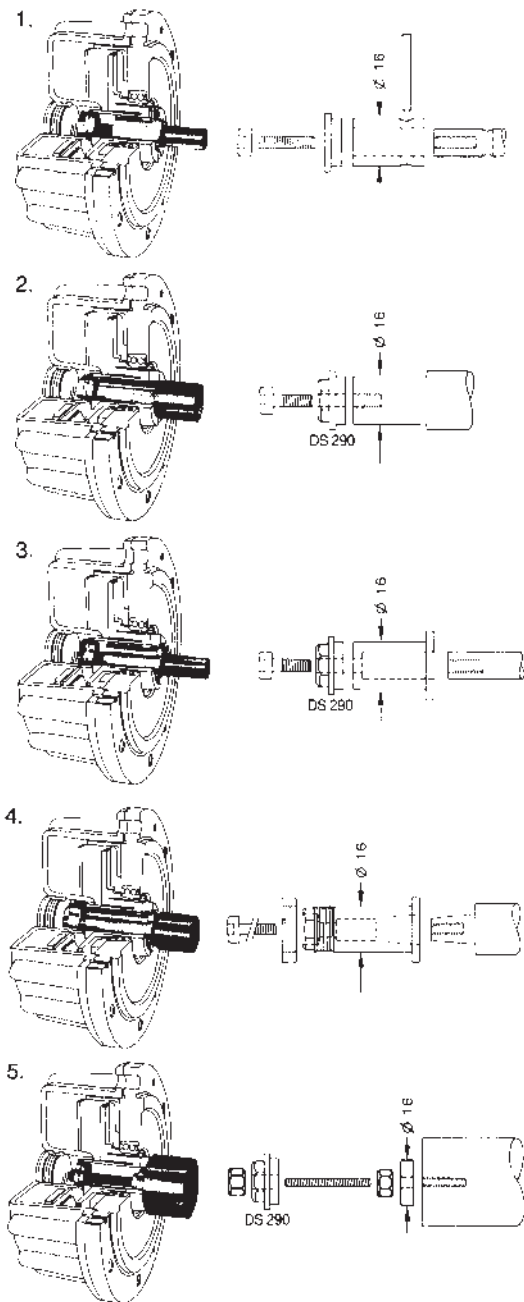
signal pattern SN, VN, level HTL (U _B = 20 V)						
f [kHz]	5	10	20	50	100	200
L _{max} [m]	200	200	200	80	40	20

signal pattern X, XN, level HTL (U _B = 20 V)						
f [kHz]	5	10	20	50	100	200
L _{max} [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.

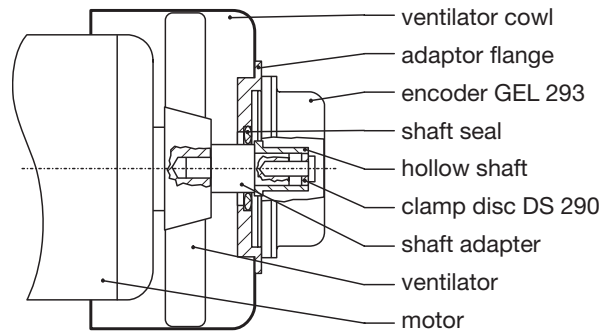
Condensed-water outlet

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.

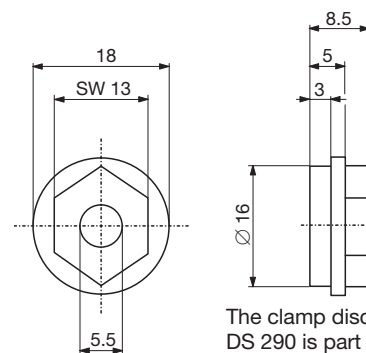
Mounting example incl. counter flange



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

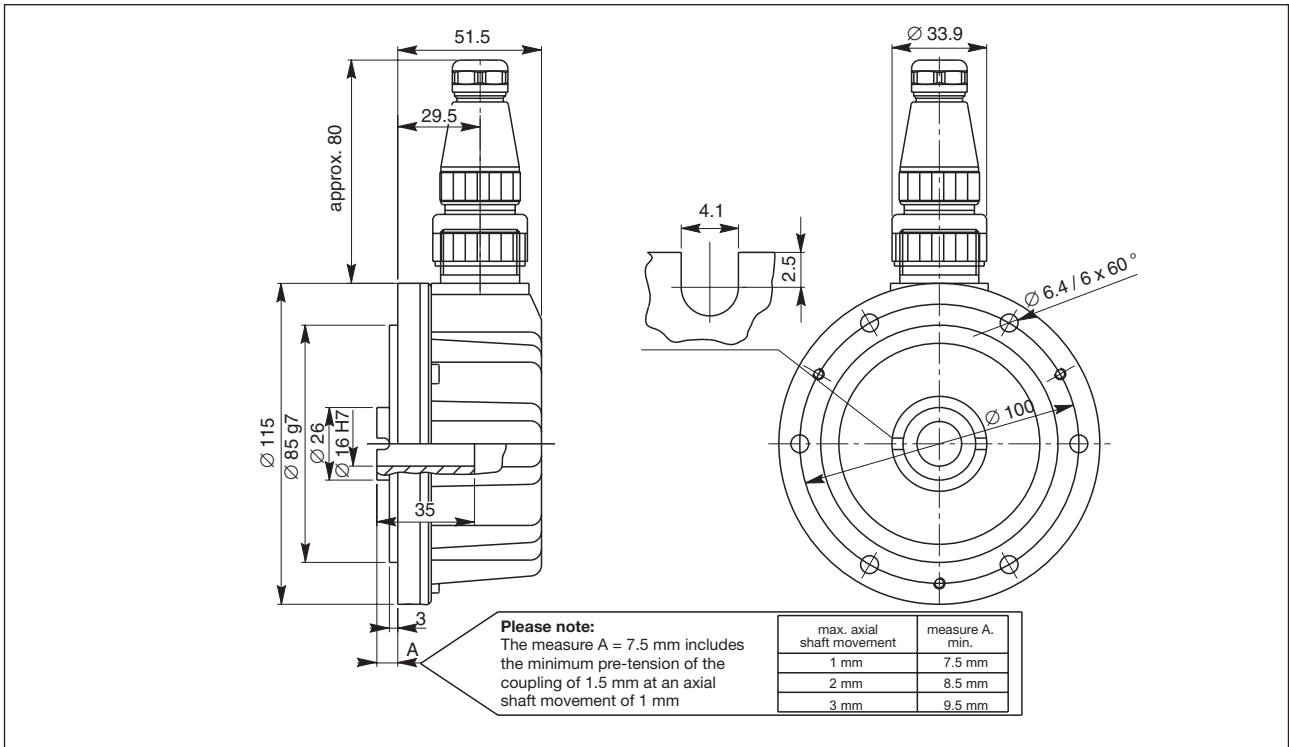
also see "Examples for shaft mounting"



Possible pulse numbers GEL 293

40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111
112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129
130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147
148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183
184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201
202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219
220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237
238	239	240	241	242	243	244	245	246	247	248	249	250	252	254	256	258	260
262	264	266	268	270	272	274	276	278	280	282	284	286	288	290	292	294	296
298	300	302	304	306	308	310	312	314	316	318	320	322	324	326	328	330	332
334	336	338	340	342	344	346	348	350	352	354	356	358	360	362	364	366	368
370	372	374	376	378	380	382	384	386	388	390	392	394	396	398	400	402	404
406	408	410	412	414	416	418	420	422	424	426	428	430	432	434	436	438	440
442	444	446	448	450	452	454	456	458	460	462	464	466	468	470	472	474	476
478	480	482	484	486	488	490	492	494	496	498	500	504	508	510	512	516	520
522	524	528	532	534	536	540	544	546	548	552	556	558	560	564	568	570	572
576	580	582	584	588	592	594	596	600	604	606	608	610	612	616	618	620	624
628	630	632	636	640	642	644	648	650	652	654	656	660	664	666	668	670	672
676	678	680	684	688	690	692	696	700	702	704	708	710	712	714	716	720	724
726	728	730	732	736	738	740	744	748	750	752	756	760	762	764	768	770	772
774	776	780	784	786	788	790	792	796	798	800	804	808	810	812	816	820	822
824	828	830	832	834	836	840	844	846	848	850	852	856	858	860	864	868	870
872	876	880	882	884	888	890	892	894	896	900	904	906	908	910	912	916	918
920	924	928	930	932	936	940	942	944	948	950	952	954	956	960	964	966	968
970	972	976	978	980	984	988	990	992	996	1000	1002	1008	1010	1014	1016	1020	1024
1026	1030	1032	1038	1040	1044	1048	1050	1056	1060	1062	1064	1068	1070	1072	1074	1080	1086
1088	1090	1092	1096	1098	1100	1104	1110	1112	1116	1120	1122	1128	1130	1134	1136	1140	1144
1146	1150	1152	1158	1160	1164	1168	1170	1176	1180	1182	1184	1188	1190	1192	1194	1200	1206
1208	1210	1212	1216	1218	1220	1224	1230	1232	1236	1240	1242	1248	1250	1254	1256	1260	1264
1266	1270	1272	1278	1280	1284	1288	1290	1296	1300	1302	1304	1308	1310	1312	1314	1320	1326
1328	1330	1332	1336	1338	1340	1344	1350	1352	1356	1360	1362	1368	1370	1374	1376	1380	1384
1386	1390	1392	1398	1400	1404	1408	1410	1416	1420	1422	1424	1428	1430	1432	1434	1440	1446
1448	1450	1452	1456	1458	1460	1464	1470	1472	1476	1480	1482	1488	1490	1494	1496	1500	1504
1510	1512	1520	1524	1528	1530	1536	1540	1544	1548	1550	1552	1560	1568	1570	1572	1576	1580
1584	1590	1592	1596	1600	1608	1610	1616	1620	1624	1630	1632	1640	1644	1648	1650	1656	1660
1664	1668	1670	1672	1680	1688	1690	1692	1696	1700	1704	1710	1712	1716	1720	1728	1730	1736
1740	1744	1750	1752	1760	1764	1768	1770	1776	1780	1784	1788	1790	1792	1800	1808	1810	1812
1816	1820	1824	1830	1832	1836	1840	1848	1850	1856	1860	1864	1870	1872	1880	1884	1888	1890
1896	1900	1904	1908	1910	1912	1920	1928	1930	1932	1936	1940	1944	1950	1952	1956	1960	1968
1970	1976	1980	1984	1990	1992	2000	2004	2010	2016	2020	2028	2030	2032	2040	2048	2050	2052
2060	2064	2070	2076	2080	2088	2090	2096	2100	2110	2112	2120	2124	2128	2130	2136	2140	2144
2148	2150	2160	2170	2172	2176	2180	2184	2190	2192	2196	2200	2208	2210	2220	2224	2230	2232
2240	2244	2250	2256	2260	2268	2270	2272	2280	2288	2290	2292	2300	2304	2310	2316	2320	2328
2330	2336	2340	2350	2352	2360	2364	2368	2370	2376	2380	2384	2388	2390	2400	2410	2412	2416
2420	2424	2430	2432	2436	2440	2448	2450	2460	2464	2470	2472	2480	2484	2490	2496	2500	2508
2512	2520	2528	2532	2540	2544	2556	2560	2568	2576	2580	2592	2600	2604	2608	2616	2620	2624
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2752	2760	2768	2772	2780	2784	2796	2800	2808	2816	2820	2832	2840	2844	2848	2856	2860	2864
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2992	3000	3008	3020	3024	3040	3048	3056	3060	3072	3080	3088	3096	3100	3104	3120	3136	3140
3144	3152	3160	3168	3180	3184	3192	3200	3216	3220	3232	3240	3248	3260	3264	3280	3288	3296
3300	3312	3320	3328	3336	3340	3344	3360	3376	3380	3384	3392	3400	3408	3420	3424	3432	3440
3456	3460	3472	3480	3488	3500	3504	3520	3528	3536	3540	3552	3560	3568	3576	3580	3584	3600
3616	3620	3624	3632	3640	3648	3660	3664	3672	3680	3696	3700	3712	3720	3728	3740	3744	3760
3768	3776	3780	3792	3800	3808	3816	3820	3824	3840	3856	3860	3864	3872	3880	3888	3900	3904
3912	3920	3936	3940	3952	3960	3968	3980	3984	4000	4008	4020	4032	4040	4056	4060	4064	4080
4096	4100	4104	4120	4128	4140	4152	4160	4176	4180	4192	4200	4220	4224	4240	4248	4256	4260
4272	4280	4288	4296	4300	4320	4340	4344	4352	4360	4368	4380	4384	4392	4400	4416	4420	4440
4448	4460	4464	4480	4488	4500	4512	4520	4536	4540	4544	4560	4576	4580	4584	4600	4608	4620
4632	4640	4656	4660	4672	4680	4700	4704	4720	4728	4736	4740	4752	4760	4768	4776	4780	4800
4820	4824	4832	4840	4848	4860	4864	4872	4880	4896	4900	4920	4928	4940	4944	4960	4968	4980
4992	5000	5016	5024	5040	5056	5064	5080	5088	5112	5120	5136	5152	5160	5184	5200	5208	5216
5232	5240	5248	5256	5280	5304	5312	5320	5328	5344	5352	5360	5376	5400	5408	5424	5440	5448
5472	5480	5496	5504	5520	5536	5544	5560	5568	5592	5600	5616	5632	5640	5664	5680	5688	5696
5712	5720	5728	5736	5760	5784	5792	5800	5808	5824	5832	5840	5856	5880	5888	5904	5920	5928
5952	5960	5976	5984	6000	6016	6040	6048	6080	6112	6120	6144	6160	6176	6200	6208	6240	6272
6280	6304	6320	6336	6360	6368	6400	6432	6440	6464	6480	6496	6520	6528	6560	6592	6600	6624
6640	6656	6680	6688	6720	6752	6760	6784	6800	6816	6840	6848	6880	6912	6920	6944	6960	6976
7000	7008	7040	7072	7080	7104	7120	7136	7160	7168	7200	7232	7240	7264	7280	7296	7320	7328
7360	7392	7400	7424	7440	7456	7480	7488	7520	7552	7560	7584	7600	7616	7640	7648	7680	7712
7720	7744	7760	7776	7800	7808	7840	7872	7880	7904	7920	7936	7960	7968	8000	8040	8080	8120
8160	8200	8240	8280	8320	8360	8400	8440	8480	8520	8560	8600	8640	8680	8720	8760	8800	8840
8880	8920	896															

Dimensioned drawing GEL 293 with counter connector GG106



Type code GEL

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