



General description

Incremental encoders measure rotations and supply digital output signals. Our encoders are equipped with contactless, magnetic scanning systems. The change of the magnetic field by the gearwheel which serves as measure causes a sine-shaped voltage. With this generation of GEL 293 devices the sine-shaped sensor signals are evaluated by an electronics operating according to ASIC and SMD technology.

The robust magnetic incremental encoders offer many an advantage compared with optically working encoders:

- they are insensitive to dirt, shock and vibration
- they can be used within a large range of temperatures, i.e. -20°C ... 85°C
- they are dew-point-proof

All encoder types can be delivered within a fortnight. And beyond that - thanks to our extremely flexible modular system - we are even in a position to offer our customers an express service (extra charge), i.e. we can produce a standard article either in 24 or in 72 hours.

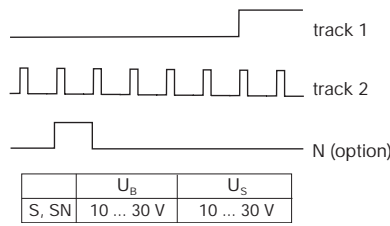
Further outstanding features of the GEL 293 are

- a hollow shaft for 16-mm shafts can be supplied
- a coupling is integrated which is highly elastic and offers torsional rigidity
- more than 1,500 standard and special pulse numbers from 10 up to 10,000 pulses per revolution (40,000 pulses/360° upon external quad-slop evaluation)
- extremely high angular acceleration
- IP 66
- for use in extremely rough ambient conditions additional protective features are available (e.g. protection against moisture and vibration, etc.)
- we can supply them with a current outlet (0 ... 20 mA, 4 ... 20 mA) too (tachometre)

Output Signals

Signal Patterns S, SN

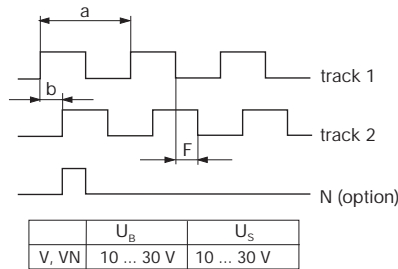
Pulses which are independent of the rotational direction and the duration of which is constant are derived from the square-wave signals as per signal pattern V and put out on track 2. Furthermore, a signal depending on the rotational direction is obtained from the signal pattern which is put on track 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 control input (has also an affect on the optional current outputs).

Signal Patterns V, VN

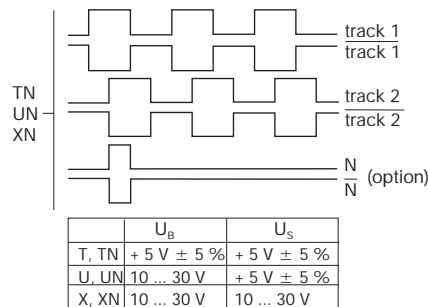
Signal pattern "V" stands for two tracks with square-wave signals, offset by 90° (push-pull output). With each revolution, a reference signal with defined length is put out on the third track N (optionally). Reference signals with different pulse lengths are available on request. The outputs have a final push-pull power stage.



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

Signal Patterns T, TN, U, UN, X, XN

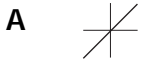
Both impulse outputs and the zero signal (option) are additionally put out as inverse signals. The 5 V outputs of the signal patterns TN and UN are TTL-, RS 422- and RS 485 compatible. The max. output current is 100 mA.



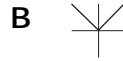
U_B = supply voltage
 U_S = signal voltage
 a = 360° electrical
 b = 90° phase shift
 F = edge distance
 signal pattern shown for clockwise rotation

Current Outputs

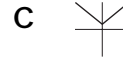
Various Current Outputs



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.

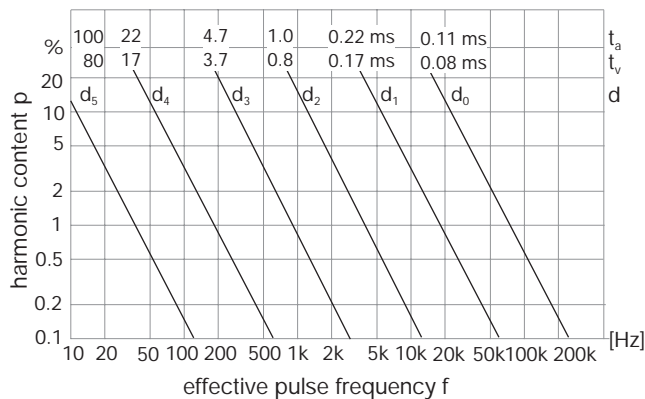


Measuring current which is independent of the sense of rotation and which has a nominal range of +4 ... +20 mA.

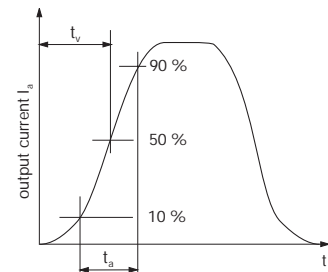
Current Output

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) a standard measuring current with a low harmonic content is obtained at a very low speed range (e.g. 0 ... 0.5 revs/min) 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_3 is the default setting.



t_a = rise time
 t_v = delay time
 d = attenuation
 $t_a, t_v = f(d)$
 $p = I_{\text{eff}} / I_a$
 $f = n \cdot i$ [Hz]



Data of the Current Outputs

apparent ohmic resistance R_a			max. 550	Ω
measuring device class	K		1	
rated current tolerance			< 1	%
linearity error			< 1	%
repeatability	r		100	%
temperature drift	ΔI_{aT}		< ± 3	$\mu\text{A}/1^\circ\text{K}$
min. RPM	n_{min}	electrical (attenuation d_5)	$1.5 \times 10^3/i$	RPM
max. RPM	n_{max}	electrical	$6 \times 10^6/i$	RPM

i = rated pulse number

Technical Data

Technical data according to DIN 32878

		GEL 293
measuring step from ... to ¹⁾	degree	9 ... 0.0087
pulse number per revolution from ... to ¹⁾		40 ... 40,000
error limit ²⁾	degree	0.07
incremental deviation ²⁾	degree	0.01
repeatability ²⁾	degree	0.005
position error upon reversal ²⁾	degree	0.005
operating threshold ²⁾	degree	0.012
power consumption R _L = ∞ U _B = 10 ... 30 V R _L = ∞ U _B = 5 V	W W	≤ 1.3 (with current output: A, B, C ≤ 1.65) ≤ 1.0 (with current output: ≤ 1.4)
max. output frequency	Hz	200 · 10 ³
max. operating r.p. m.	RPM	8,000
moment of inertia of rotor	kgm ²	8 · 10 ⁻⁵
max. acceleration	rad/s ²	5 · 10 ⁵
operating torque	Nm	0.01
starting torque	Nm	0.015
permissible shaft movement axial radial	mm mm	± 1 ⁵⁾ ± 0.5
operating temperature	° C	0 ... +70 (standard), -20 ... +85 (option) acc. to DIN 32876
ambient temperature	° C	-20 ... +85 (option) according to DIN 32876
storage temperature	° C	-40 ... +105 according to DIN 32876
protection class according to DIN 40050		IP 66
vibration protection acc. to IEC 68 part 2-6 (option)		
frequency range	Hz	10 ... 2,000
peak acceleration	m/s ²	100
frequency cycles		10
shock protection acc. to IEC 68 part 2-27 (option)		
peak acceleration	m/s ²	1,000 , length 11 ms
insulation strength according to DIN 57660 part 500 (8.2.2) or VDE 0113 (13.1)		Ri > 1 MΩ, at a testing voltage of 500 V
electromagnetic compatibility electromagnetic emissions EN 50081-1 electromagnetic immunity EN 50082-2		The encoders are in strict conformity with Directive EMC 89/336/EEC of the European Union and are therefore certified by the CE mark.
bearing life	U	>15,000 · 10 ⁶
weight	kg	approx. 0.7

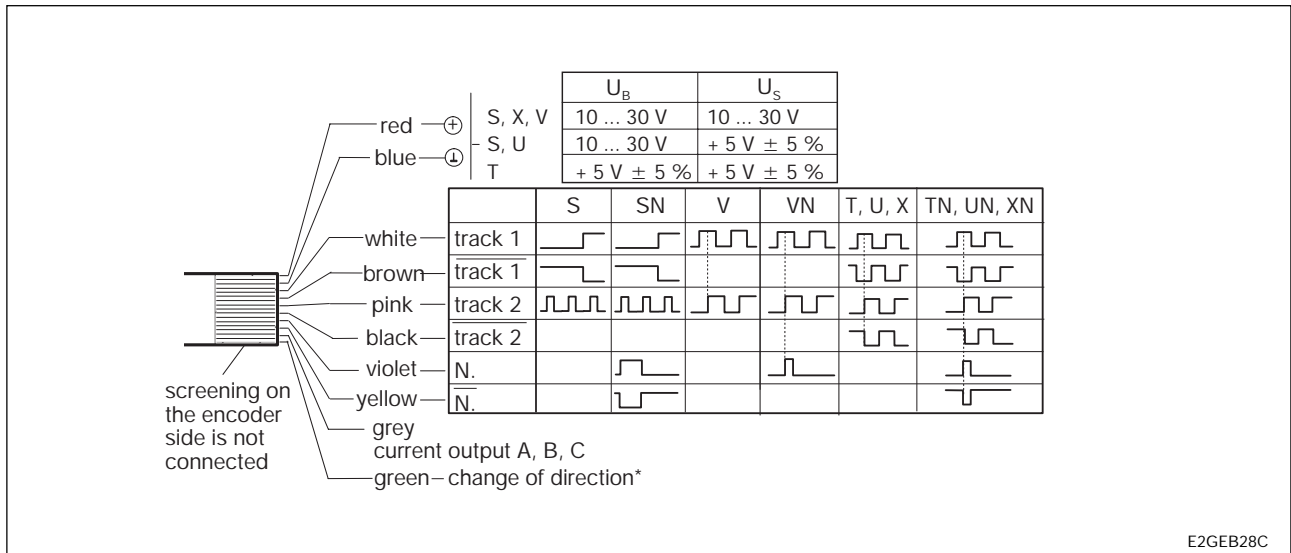
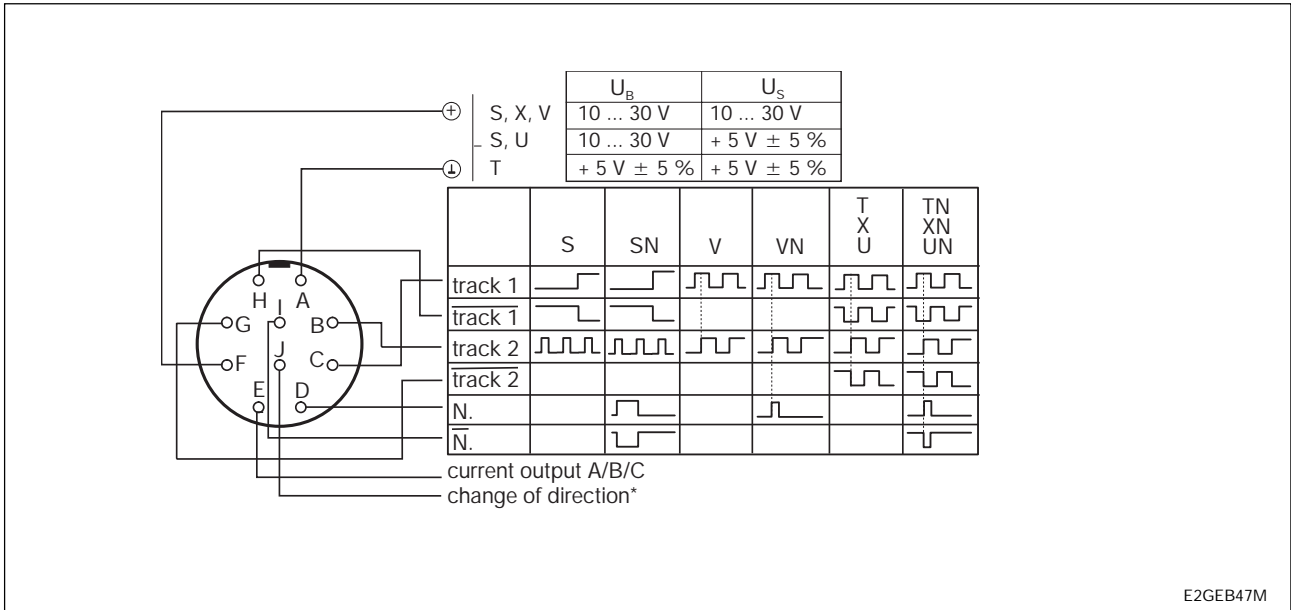
¹⁾ max. value with external edge evaluation of the signal pattern. See order specifications for possible pulse numbers.

²⁾ value for highest pulse number. Values for low pulse numbers on request.

³⁾ point of impact 15 mm off the flange system

⁵⁾ recommended value for minimum pre-tension of the hollow-shaft 1.5 mm (limit values ± 3 mm, see dimensioned drawing further below)

Pin Layouts: plug, cable



U_B = supply 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
 all signal patterns are shown for clockwise rotation

* If open or connected to 0 V output current and S signal are positive in case of **clockwise** rotation.

When connected to + U_A this is valid for **anti-clockwise** rotation.

Maximum Cable Lengths

between encoder and secondary electronics.

The cable screening is to be earthed one-sided at the receiver.

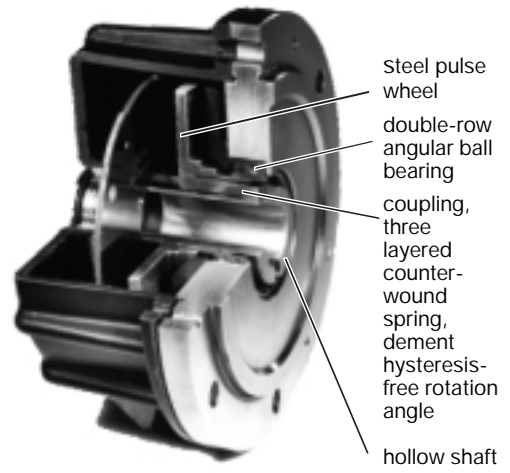
The stated data are standard values referring to cable type LiYCY 6 (10) x 0,25 mm².

$U_B = 5 \text{ V (TN, UN), sense connected}$						
f [kHz]	5	10	20	50	100	200
L_{max} [m]	>200	>200	>200	>200	145	72

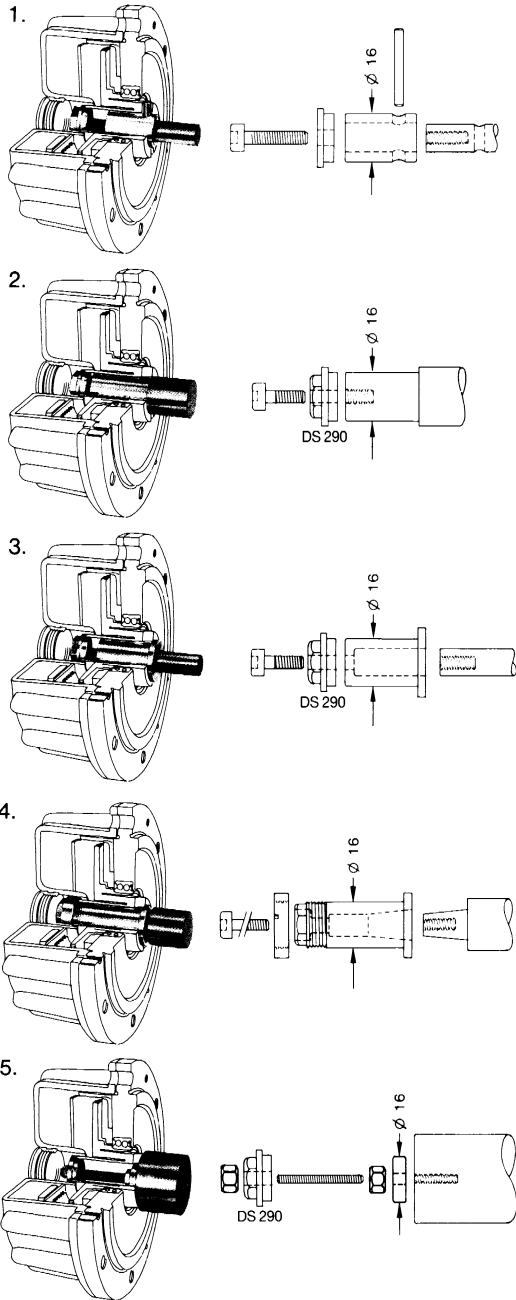
$U_B = 20 \text{ V (S, V (SN, VN))}$						
f [kHz]	5	10	20	50	100	200
L_{max} [m]	>200	>200	>200	80	40	20

$U_B = 20 \text{ V (XN)}$						
f [kHz]	5	10	20	50	100	200
L_{max} [m]	>200	200	100	40	20	10

Hollow-Shaft Encoder GEL 293

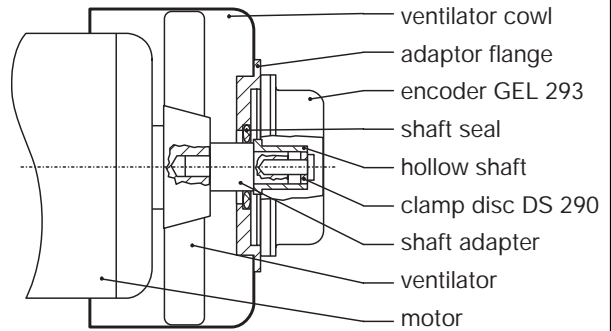


Example for shaft mounting



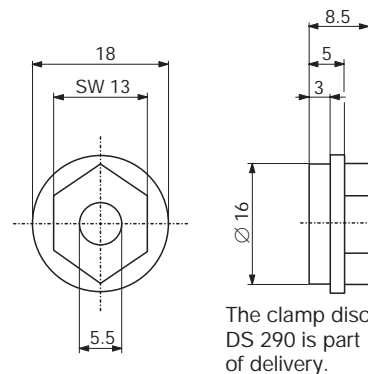
When mounting as shown in examples 2 -5, the position of the zero signal may be adjusted from the rear of the mounted encoder.
 When attaching the shaft preload coupling according to dimensioned drawing on page 8.

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.

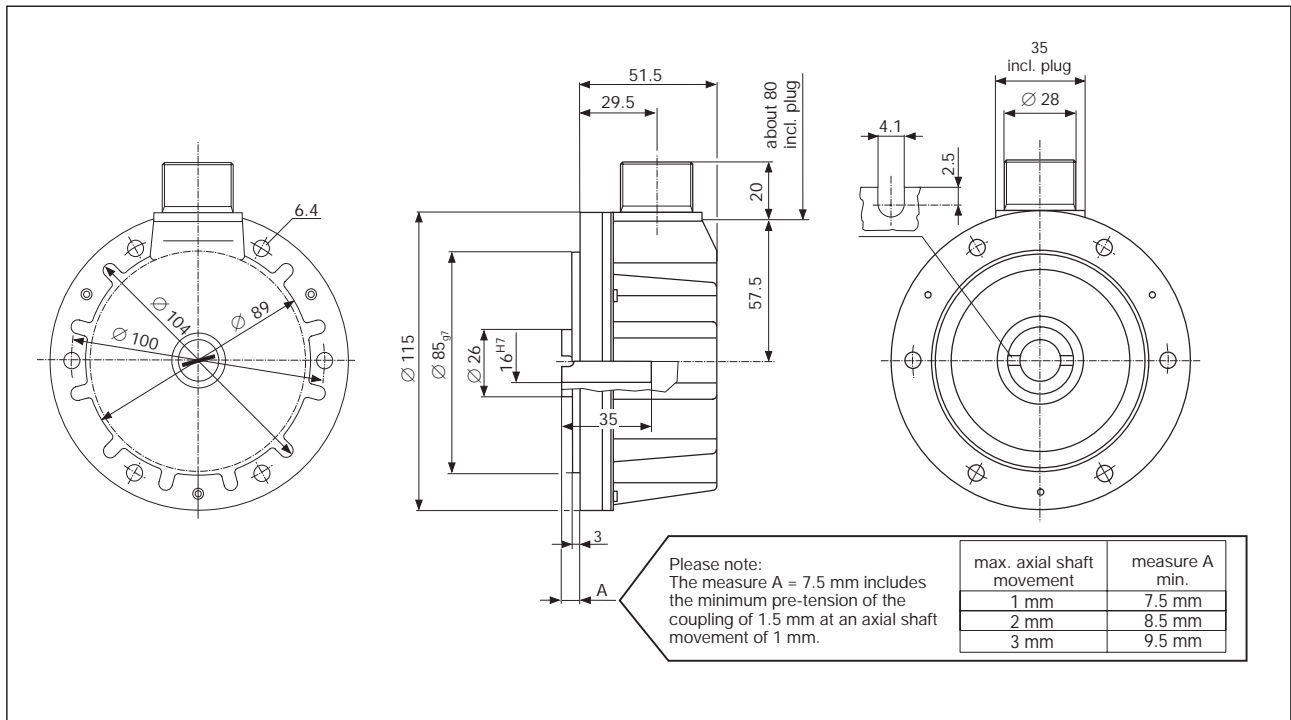
Thrust disc DS 290 also see "Examples for shaft mounting"



Pulse numbers available for 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
2628	2640	2652	2656	2660	2664	2672	2676	2680	2688	2700	2704	2712	2720	2724	2736	2740	2748
2752	2760	2768	2772	2780	2784	2796	2800	2808	2816	2820	2832	2840	2844	2848	2856	2860	2864
2868	2880	2892	2896	2900	2904	2912	2916	2920	2928	2940	2944	2952	2960	2964	2976	2980	2988
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																

Dimensioned drawing



Order Specifications

** encoders incl. condensed- water outlet have to be mounted in such a way that the outlet points down

293	X	X	X	XXXXX	X	0	X	X	description
									temperature range
								1	0°C ... +70°C
								3	-20°C ... +85°C (option)
									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
									plug / cable output
								L	10-pole plug
								I	10-core cable, radial
									pulse number per revolution (see previous page)
									zero signal
								-	without
								N	incl. (option)
									signal pattern
								S	U _B = 10 ... 30 V DC
								V	U _B = 10 ... 30 V DC
								X	U _B = 10 ... 30 V DC
								U	U _B = V DC ± 5 %
								T	U _B = V DC ± 5 %
									current output
								-	without
								A	- 20 mA ... + 20 mA
								B	0 mA ... + 20 mA
								C	+ 4 mA ... + 20 mA

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