Servodyn-T

Servo motors SE

Version 104

Servodyn-T

Servo motors SE

1070 054 293-104 (93.10) GB

Reg. Nr. 16149-03

Discretionary charge 10.– DM

Contents

Brushless Servo Drives for the entire field of mechanical engineering

1 Structure of the Servodyn SE series of motors

1.1 Motors with rare-earth magnets

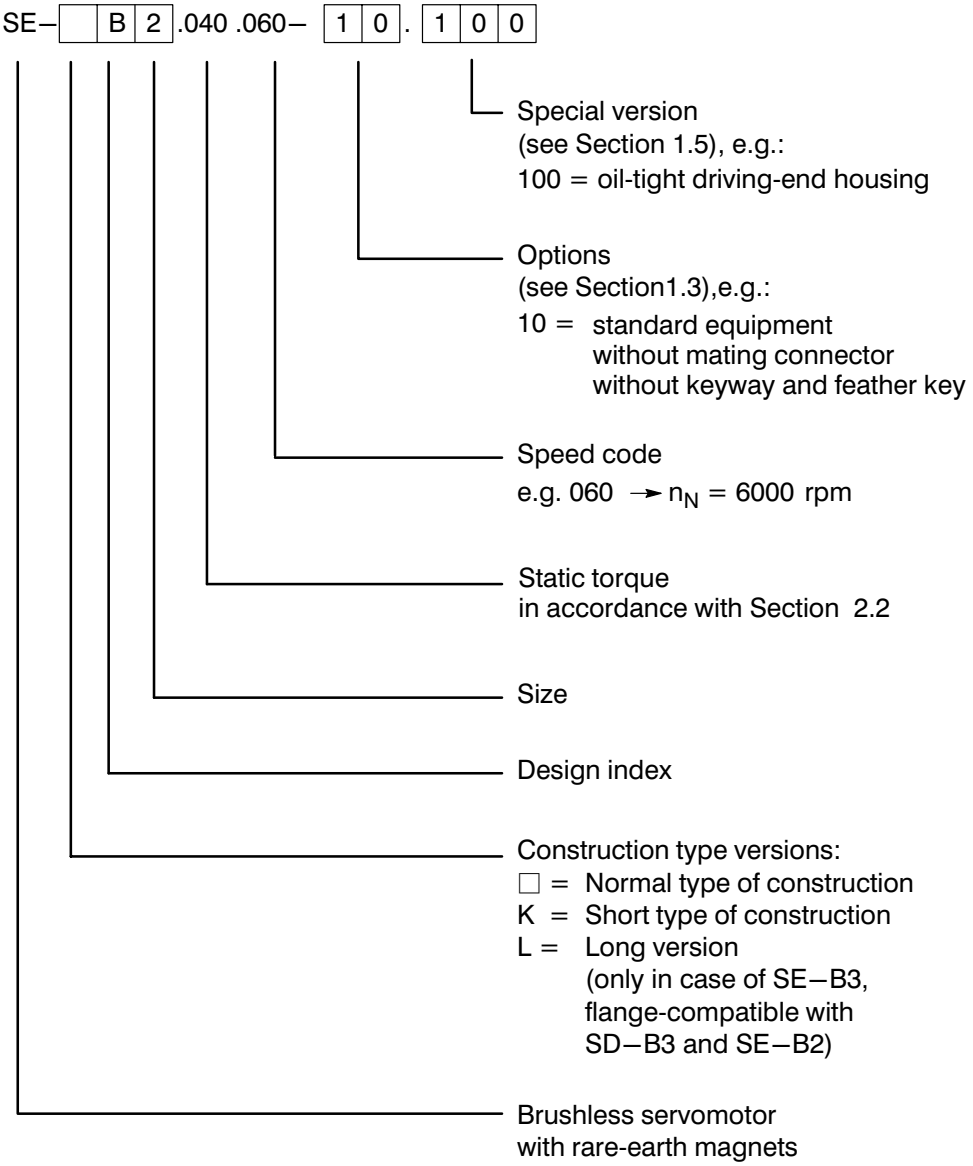
Bosch servo motors, type SE, are a part of the Bosch Servodyn drive concept for the entire field of mechanical engineering. They are operated together with inverters of Series –T(A) or –TC and are designed for applications in position and speed servo loops.

Servo motors, Type SE, are permanent-field motors for inverter operation with electronic commutation. The rotor's permanent magnets are made of rare earth materials and allow the SE motors, with their low moment of inertia, to comply with even very stringent dynamic requirements.
A brushless tachogenerator and a commutation sensor are integrated for speed acquisition and rotor position detection, respectively.

The most important features are as follows:

Very high dynamic response	thanks to low motor moment of inertia
Maintenance-free operation	thanks to the use of brushless motors and tachogenerators
Long service life	bearings > 20 000 h winding > 70 000 h
High demagnetization strength	up to 6 times the standstill current
Broad overload range	thanks to favorable heat dissipation. The entire power loss occurs in the stator winding which has a low thermal resistance with respect to the motor surface.
Very smooth operation	thanks to special magnet arrangement and precise current conduction in all three phases.
High-protection enclosure	thanks to completely enclosed design.
Compact design	in the overall power range.

1.2 Type code



1.3 Options

Code table of the options

Code	Standard equipment without mating connector without keyway or feather key	Shaft with keyway and feather key	Holding brake*
00		●	
04		●	●
10	●		
14	●		●

* Installed by the manufacturer

The equipment combinations of the code table comprise the following options:

Code

10 standard equipment, without mating connector, without keyway or feather key

Mating connectors of various versions must be ordered separately (see information in Section 1.4).

The standard equipment includes:

- ○ Brushless tachogenerator
- ○ Temperature monitoring, evaluation in the inverter
- ○ Housing is safety standard IP 67 for SE−B2...B4, C4, KB4 with angled flange socket, except driving-end shaft gland, safety standard IP 65 for SE−D1 and for SE−B5, without driving-end shaft gland
- ○ Type of construction IM B 5
- ○ Shaft without keyway or feather key
- ○ Balance quality category 'N'
- ○ Centering facility for measuring system fixture on the non-driving-end bearing housing
- ○ Tachogenerator socket, socket for power and brake connection (size SE−B5 with terminal box and tachogenerator socket)

00 Shaft with keyway and feather key

Driving-end shaft end with feather key and keyway in accordance with DIN 6885 for keyed torque transmission (dimensions, see Section 4.1). Other equipment as with standard equipment.

Shaft connections with feather key, spline and multiple-spline connections are suitable for normal requirements.
The connection between shaft and hub when under load is subjected to multi-axis stress, resulting from torsional forces, radial forces, axial forces and flexural torque. In the case of heavy reversing duty, the seat of the feather key may deflect and cause a change in running behavior.

We thus recommend using the standard equipment with shaft without keyway and with feather key for stringent requirements.

Code

04 **Incorporated holding brake**

For locking the feed axis, free of backlash, at standstill, or when the system is in a de-energized state. The permanent-magnet single-disk brake developed specifically for this series of motors operates on the closed-circuit current principle.
The magnetic field of the permanent magnet used produces a tensile force on the brake anchor plate. This closes the brake and locks the axis in de-energized condition. When 24 V DC is applied, the permanent magnet field is cancelled by the electrically generated magnetic field and the brake lifts, or is kept open.
In open condition, no residual torque is present. Locking, free of backlash, is guaranteed with the brake closed.
Technical data, see Section 2.2.

CAUTION

The holding brake is not an operating brake and may be operated only with the axis stationary. It will be necessary to return the system to the factory for inspection of the holding brake after approx. 1000 EMERGENCY-STOP braking operations with load moment of inertia $\leq$ motor moment of inertia.

Option without coding

All motors, with the exception of type SE−D1, are available with the ERN 221 incremental encoder.
When placing orders, indicate the desired bar number in accordance with Section 1.7 .

1.4 Mating connectors

- Sizes SE−D1, SE−B2...B4, C4 require :
  - a motor connector
  - a tachogenerator connector
- Size SE−B5 requires :
  - a tachgenerator connector

See dimension sheets, Section 4.1, for required space.

	Motor type	Order No., Plastic connector with aluminum fastening ring	
		right-angled	straight
Motor plug	SE−D1...	–	1070 916 352
	SE−B2... SE−B3... SE−LB3... SE−B4....030 SE−KB4...	1070 914 039	1070 914 637
	SE−C4....030 SE−B4....050	1070 914 038	1070 915 965
Tachogenerator plug	SE−D1...	–	1070 916 192
	SE−B... SE−C...	1070 914 036	1070 914 636

☞ **Note** **Avoid damage to the motor connectors during transportation! When returning equipment, srecw the attached plastic protective caps onto the motor sockets.**

Encoder mating connectors

Encoder type	Order no., Mating connector, metal construction	
	right-angled	straight
ERN 221.21..3	–	1070 916 192

CAUTION

The encoder mating connector, order no. 1070 916 192, must be used only in conjunction with the Bosch encoder cable, order no. 1070 903 499

1.5 Special version

Code

010 **Increased flange accuracy 'R'**

Concentricity of the shaft end increased in accordance with DIN 42955.

011 **Vibration severity grade 'R' flange accuracy 'R'**

Vibration severity grade 'R' in accordance with DIN ISO 2373 in conjunction with increased concentricity of the shaft end in accordance with DIN 42955.

100 Oil-tight driving-end end plate, size LB3

SE—LB3 motors with the oil-tight driving-end end plate have the same flange as size LB3 standard motors.

They are additionally equipped with:

- a shaft sealing ring
- sealing discs on the end plate

The end plate is sealed to the outside with a flt seal.
The flat seal is not included in delivery.

CAUTION

At least half of the rotary shaft seal must run in oil.

Motors with oil-tight driving-end end plates can also be mounted vertically with the flange pointing upward (type IM V3).
Vertical attachment with the flange pointing down (type IM V1) is permitted only if lubrication and heat dissipation of the sealing point is guaranteed by an appropriate level of oil or splash lubrication.

101 Oil-tight driving-end end plate, sizes B2, B3, B4, C4, B5, KB4

The motors are equipped with:

- a special flange; see dimension sheet in Section 4.6
- a shaft sealing ring
- sealing discs on the end plate

The end plate is sealed to the outside with a flt seal.
The flat seal is not included in delivery.

CAUTION

The centering collar has a large depression; see dimension sheet, Section 4.6 .

At least half of the rotary shaft seal must run in oil.

Motors with oil-tight driving-end end plates can also be mounted vertically with the flange pointing upward (type IM V3).
Vertical attachment with the flange pointing down (type IM V1) is permitted only if lubrication and heat dissipation of the sealing point is guaranteed by an appropriate level of oil or splash lubrication.

SE—D1 motors are delivered standard with a driving-end shaft sealing ring with permanent lubrication.
All versions are authorized for operation.

1.6 Special accessories (not including installation)

Preparation kit for incremental encoder ROD 426.014 or CE 65-M
(without plug connection)

The preparation kit includes:
Adapter flange, coupling part (not on SE−D1), drive coupling, miscellaneous installation hardware.
For attachment, see dimension sheet, Section 4.3 .

	Order No.
Size SE−D1	1070 916 351
Size SE−B2	1070 915 511
Size SE−B3/LB3	1070 915 127
Size SE−B4/C4	1070 914 643
Size SE−B5	1070 914 643
Size SE−KB4	1070 914 643

Second shaft end

Not possible: – for incremental encoder attachment
– for SE−D1... motors

Non-driving-end shaft end with hexagon (a/f 13) for wrench or handwheel.
Maximum torque for all motors 8 Nm.

	Order No.
Size SE−B2	1070 914 638
Size SE−B3/LB3	1070 915 721
Size SE−B4/C4	1070 914 642
Size SE−B5	1070 914 642
Size SE−KB4	1070 914 642

1.7 Incremental encoder for self-attachment

ROD 426.014

Encoder without connector system, including 1 m connection cable with preparation kit in accordance with Section 1.5 (see dimension sheet, Section 4.3):

Increments per revolution	Order no.
100	1070 913 978
360	1070 911 687
500	1070 909 714
1000	1070 909 686
1250	1070 909 605
1500	1070 910 710
2000	1070 911 356
2500	1070 909 713
3600 (max. 5000 rpm)	1070 914 498
5000 (max. 3600 rpm)	1070 911 357

ERN 221.21..3

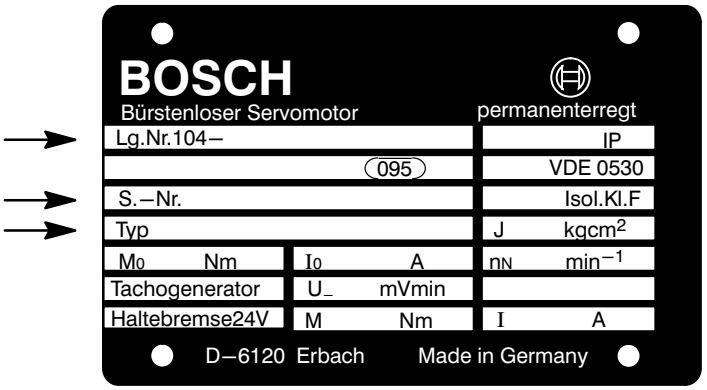
Encoder including preparation kit and kick-plate, with connector system without mating connector (see dimension sheet, Section 4.4):

Increments per revolution	Order no.		SE−(K)B 4 SE−C4 SE−B5
	SE−B2	SE−(L)B3	
500	1070 916 555	1070 916 559	1070 916 563
1000	1070 916 556	1070 916 560	1070 916 564
1250	1070 916 557	1070 916 561	1070 916 565
1500	1070 916 595	1070 916 596	1070 916 597
2500	1070 916 558	1070 916 562	1070 916 566
5000 (max. 3600 rpm)	–	–	1070 916 623

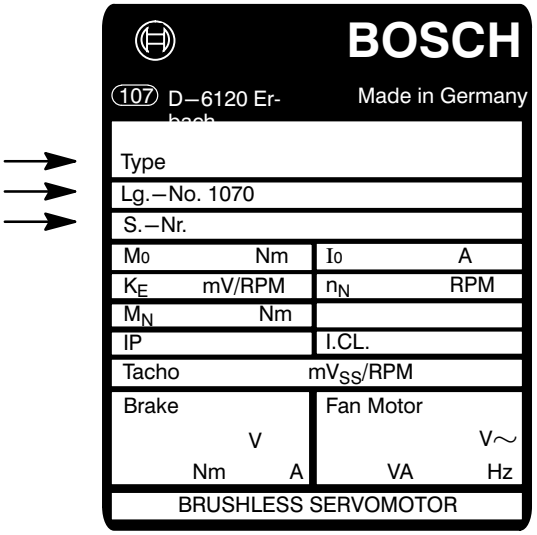
☞ **Note** **Other versions available on request.**

1.8 Rating plate

SE–B... and SE–C



SE–D1



For servicing or if you have any queries, please state the bearing number (Lg.-Nr.), the S-No. (S-Nr.), and the motor type.

☞ **Note** **For servicing, please use our fault report card in order to speed up diagnosis and processing.**

2 Technical data

2.1 Motor data

Permitted ambient temperature	θ_{amb} = 0° to 40°C
Housing in accordance with DIN 40050/40053, EN 60 445	IP 67 for SE−B2...B4, C4, KB4 with angled flange socket for authorized mating connector screw-attached at 4 Nm, without driving-end shaft gland IP 65 for SE−D1 with authorized mating connector for SE−B5 without driving end shaft gland for SE−B2...B4, C4, KB4 without angled flange socket
Type of construction	Basic type of construction IM B5 in accordance with DIN IEC 34-7, can also be used as IM V1 and im V3. SE−D1: Design, as desired SE−B, SE−C: On IM V3, no fluid may remain in the flange-type end shield. IM V1 is permitted only conditionally in the case of oil-tight driving-end housing (see Section 1.5).
Flange	Flange in accordance with IEC 72-2 / DIN 42 948; 42 677 (SE−D1)
Ball bearings	Locating bearings at the driving-end (flange end). Minimum service life 20.000 h
Shaft end	Cylindrical shaft end in accordance with DIN 748 without feather key and keyway. Version with keyway and feather key, see options in Section 1.3. Shaft end with thread for mounting and removing drive elements.
Vibration severity grade	Vibration severity grades 'N', 'R' in accordance with DIN-ISO 2373. SE−D1: Basic version with vibration severity grade 'R' SE−B, SE−C: Basic version with vibration severity grade 'N' (in the case of shaft with keyway and feather key, the motors are balanced with feather key).
Shock resistance	6 g in accordance with DIN IEC 68-2-27, with no effect on function
Noice behavior	max. 58 dB(A) at a distance of 1.0 m
Insulation class	'F' in accordance with VDE 0530
Cooling	By radiation and natural convection. High surface temperatures may occur on the motors. If necessary, a touch guard must be provided.
Thermal motor protection	Thermistor integrated in the winding, with evalutation in the SM. SE−D1: Shutdown temperature + 155˚C SE−B, SE−C: Temperature range −10˚C to + 145˚C.
Tachogenerator and commutation sensor	Brushless version, integrated in the non-driving-end of the motor. The commutation sensor controls commutation of the phase currents in the connected inverter.
Holding brake	Permanent magnet brake, free of backlash. See Section 1.3 .

2.2 Performance data

	Symbol	Unit	SE–D1	SE – B2						
			010. 030	020. 030	030. 030	040. 030	010. 060	020. 060	030. 060	040. 060
Static torque n_0=200 rpm; $\Delta\vartheta_W$(30s)=105K	M_0	Nm	1.0	2.9	4.0	5.0	1.0	2.0	3.0	4.0
Maximum torque (dependent upon inverter)	M_{max}	Nm	3.6 with SM 1,5/3	6.9 with SM 5/10	9.7 with SM 5/10	13.2 with SM 10/20	2.6 with SM 5/10	4.0 with SM 5/10	7.8 with SM 10/20	8.0 with SM 10/20
Nominal speed	n_N	rpm	3000	3000	3000	3000	6000	6000	6000	6000
Ramp-up time to n_N	t_H	ms	12	24	23	21	77	76	55	64
Current at standstill at M_0 n_0=2000 rpm; $\Delta\vartheta_W$(30s)=105K	I_0	A	1.0	2.7	3.5	4.5	2.5	5.0	7.5	10.0
Peak current at ϑ_{amb} = 20˚C	I_{max}	A	4.5	16	21	26	14	30	45	60
Torque constant ϑ_{amb} = 40˚C; $\Delta\vartheta_W$ = 105 K	K_T	Nm/A	1.00	1.10	1.14	1.14	0.41	0.43	0.42	0.40
Voltage constant ϑ_{amb} = 40˚C; $\Delta\vartheta_W$ = 105 K	K_E	$\frac{V}{1000\ rpm}$	115	114	116	112	41	46	45	45
Windindg resistance ϑ_W = 20˚C	R_{2ph}	Ohm	67.4	14.7	9.5	6.4	13.4	4.43	2.25	1.40
Winding inductance	L_{2ph}	mH	91.4	76	82.0	54	47.6	20.8	14.0	9.4
Electr.time constant ϑ_W = 20˚C	T_{el}	ms	1.36	5.0	7.3	8.1	3.5	4.6	6.1	6.6
Mech. time constant ϑ_W = 20˚C	T_{mech}	ms	5.1	4.8	5.1	4.3	22.7	10.2	7.5	6.0
Therm.time constant ϑ_W = 20˚C	T_{therm}	min		17	18	21	6	15	19	25
Moment of inertia, incl. tachogen.	J	kgm^2x10^{-3}	0.074	0.44	0.60	0.75	0.28	0.44	0.60	0.75
Dimensions Flange	a/f	mm	72 ☐	100 ☐						
Shaft	d x l	mm	Ø11 x 23	Ø 14 x 30						
max. Lenght, not incl. holding brake	L	mm	211.5	230	254	277	207	230	254	277
Mass, not incl. holding brake	m	kg	2.9	6.5	7.6	8.8	5.3	6.5	7.6	8.8
Tachogenerator										
EMF at ϑ_{amb} = 20˚C			3 x 20 V_{ss} ±5% at 1000 rpm			$U_{\_}$ = 2.7 V/1000 rpm ± 5%			$U_{\_}$ = 1.8 V/ 1000 rpm ± 5%	
Voltage ripple			2 %			≦ 1.5 %			≦ 1.5 %	
Holding brake										
Holding torque (transmittable)	M_{BR}	Nm	1.5	3.5						
Supply voltage	U_{BR}	V	24 ±10%	24 ± 10%						
Nominal current	I_{BR}	A	0.38	0.7						
Moment of inertia	J_{BR}	kgm^2x10^{-3}	0.012	0.11						
Mass	m_{BR}	kg	0.21	0.6						

ϑ_W = Winding temperature ϑ_{amb} = Ambient temperature

	Symbol	Unit	SE – (L)B3							
			033. 030	055. 030	075. 030	095. 030	033. 060	055. 060	075. 060	095. 060
Static torque n_0=2000 rpm; $\Delta\theta_W$(30s)=105K	M_0	Nm	4.2	6.8	9.3	11.6	3.8	6.5	8.2	9.5
Maximum torque (dependent upon inverter)	M_{max}	Nm	9.1 with SM 5/10	16.2 with SM 10/20	18.6 with SM 10/20	18.4 with SM 10/20	9.2 with SM 10/20	16.2 with SM 17/35	22.0 with SM 25/50	26.0 with SM 25/50
Nominal speed	n_N	rpm	3000	3000	3000	3000	6000	6000	6000	6000
Ramp-up time to n_N	t_H	ms	32	27	30	39	61	53	59	60
Current at standstill at M_0 n_0=200 rpm; $\Delta\theta_W$(30s)=105K	I_0	A	4.0	6.7	9.5	10.5	7.7	12.6	14	15
Peak current at θ_{amb} = 20˚C	I_{max}	A	24	40	57	63	46	76	84	92
Torque constant θ_{amb} = 40˚C; $\Delta\theta_W$ = 105 K	K_T	Nm/A	1.02	1.02	0.98	1.10	0.49	0.52	0.58	0.64
Voltage constant θ_{amb} = 40˚C; $\Delta\theta_W$ = 105 K	K_E	$\frac{V}{1000\ rpm}$	112	113	113	118	60	61	63	64
Winding resistance θ_W = 20˚C	R_{2ph}	Ohm	7.9	3.53	2.1	1.68	2.36	1.03	0.90	0.66
Winding inductance	L_{2ph}	mH	60	30	21	18	18	11	8.7	8.4
Electr.time constant θ_W = 20˚C	T_{el}	ms	7.6	8.4	10.2	10.8	7.7	10.2	9.3	12.7
Mech.time constant θ_W = 20˚C	T_{mech}	ms	5.8	3.8	3.3	2.8	6.7	4.1	4.3	3.4
Therm.time constant θ_W = 20˚C	T_{therm}	min	19	29	32	35	20	28	25	25
Moment. of inertia incl. tachogen.	J	$kgm^2 x10^{-3}$	0.81	1.21	1.66	2.07	0.81	1.21	1.66	2.07
Dimensions (B3/LB3) Flange		mm	116/105 ☐							
Shaft	d x l	mm	Ø 19 x 40							
max. Lenght, not incl. holding brake	L	mm	225/ 256	256/2 87	288/ 319	320/ 351	225/ 256	256/2 87	288/ 319	320/ 351
Mass, not incl. holding brake (B3 / LB3)	m	kg	8.1/ 8.5	10.2/ 10.6	12.4/ 12.8	14.5/ 14.9	8.1/ 8.5	10.2/ 10.6	12.4/ 12.8	14.5/ 14.9

Tachogenerator

EMF at θ_{amb} = 20˚C	$U_{\_}$ = 2.7 V/1000 rpm ±5%	$U_{\_}$ = 1.8 V/ 1000 rpm ±5%
Minimum termination resistance	≦ 1.5 %	≦ 1.5 %

Holding brake

Holding torque (transmittable)	M_{BR}	Nm	8.0
Supply voltage	U_{BR}	V	24 ± 10%
Nominanl current	I_{BR}	A	0.8
Moment of inertia	J_{BR}	kgm^2	$0.12 x 10^{-3}$
Mass	m_{BR}	kg	0.7

θ_W = Winding temperature θ_{amb} = Ambient temperature

	Symbol	Unit	SE – B(C)4							
			B4.090. 030	B4.130. 030	C4.170. 030	C4.210. 030	B4.090. 050	B4.130. 050	B4.170. 050	B4.210. 050
Static torque n_0=200 rpm; $\Delta\theta_W$(30s)=105K	M_0	Nm	9.0	13	17	21	8.0	11	14	18
Maximum torque (dependent upon inverter)	M_{max}	Nm	17.3 with SM 10/20	27.6 with SM 17/35	43.0 with SM 25/50	57.4 with SM 35/70	23.0 with SM 25/50	34.0 with SM 35/70	37.5 with SM 35/70	52.0 with SM 50/100
Nominal speed	n_N	rpm	3000	3000	3000	3000	5000	5000	5000	5000
Ramp-up time to n_N	t_H	ms	45	39	35	32	60	61	66	60
Current at standstill at M_0 n_0=2000 rpm; $\Delta\theta_W$(30s)=105K	I_0	A	10	15	19	23	14	18	24	28
Peak current at θ_{amb} = 20˚C	I_{max}	A	62	84	111	158	85	108	145	174
Torque constant θ_{amb} = 40˚C; $\Delta\theta_W$ = 105 K	K_T	Nm/A	0.87	0.80	0.91	0.92	0.57	0.61	0.58	0.64
Voltage constant θ_{amb} = 40˚C; $\Delta\theta_W$ = 105 K	K_E	$\frac{V}{1000\ rpm}$	97	99	104	102	68	71	67	68
Winding resistance θ_W = 20˚C	R_{2ph}	Ohm	1.92	0.96	0.68	0.51	0.94	0.61	0.37	0.27
Winding inductance	L_{2ph}	mH	16.1	9.7	9.3	6.2	9.0	6.3	4.5	3.3
Electr.time constant θ_W = 20˚C	T_{el}	ms	8.2	9.7	13.6	11.9	9.5	10.4	12.3	12.0
Mech.time constant θ_W = 20˚C	T_{mech}	ms	5.1	3.8	3.5	3.1	5,.2	4.4	4.1	3.3
Therm.time constant θ_W = 20˚C	T_{therm}	min	28	37	31	35	27	28	30	32
Moment of inertia, incl. tachogen.	J	$kgm^2 x10^{-3}$	2.18	3.08	4.08	4.98	2.18	3.08	4.08	4.98
Dimensions Flange	a/f	mm	142 ☐							
Shaft	d x l	mm	Ø 24 x 50							
max. Lenght, not incl. holding brake	L	mm	252	283	315	347	252	283	315	347
Mass, not incl. holding brake	m	kg	13.0	16.0	19.0	22.0	13.0	16.0	19.0	22.0

Tachogenerator

EMF at θ_{amb} = 20˚C	$U_{\_}$ = 2.7 V/1000 rpm ±5%	$U_{\_}$ = 1.8 V/ 1000 rpm ±5%
Voltage ripple	≦ 1.5 %	≦ 1.5 %

Holding brake

Holding torque (transmittable)	M_{BR}	Nm	18
Supply voltage	U_{BR}	V	24 ± 10%
Nominal current	I_{BR}	A	1.0
Moment of inertia	J_{BR}	kgm^2	0.90×10^{-3}
Mass	m_{BR}	kg	1.7

θ_W = Winding temperature θ_{amb} = Ambient temperature

	Symbol	Unit	SE – B5							
			320. 020	440. 020	570. 020	700. 020	320. 030	440. 030	570. 030	700. 030
Static torque n_0=2000 rpm; $\Delta\theta_W$(30s)=105K	M_0	Nm	39	52	62	74	38	51	63	71
Maximum torque (dependent upon inverter)	M_{max}	Nm	90 with SM 35/70	123 with SM 50/100	135 with SM 50/100	149 with SM 50/100	92 with SM 50/100	95 with SM 50/100	138 with SM 75/150	147 with SM 75/150
Nominal speed	n_N	rpm	2000	2000	2000	2000	3000	3000	3000	3000
Ramp-up time to n_N	t_H	ms	37	36	41	45	54	69	59	67
Current at standstill at M_0 n_0=200 rpm; $\Delta\theta_W$(30s)=105K	I_0	A	24	35	40	43	34	47	62	70
Peak current at θ_{amb} = 20˚C	I_{max}	A	146	207	240	261	256	279	369	446
Torque constant θ_{amb} = 40˚C; $\Delta\theta_W$ = 105 K	K_T	Nm/A	1.60	1.51	1.55	1.71	1.11	1.09	0.96	1.02
Voltage constant θ_{amb} = 40˚C; $\Delta\theta_W$ = 105 K	K_E	$\frac{V}{1000\ rpm}$	176	167	170	185	118	120	115	117
Winding resistance θ_W = 20˚C	R_{2ph}	Ohm	0.47	0.26	0.21	0.19	0.22	0.14	0.094	0.074
Winding inductance	L_{2ph}	mH	8.7	5.0	4.9	4.2	4.6	3.3	2.2	1.4
Electr.time constant θ_W = 20˚C	T_{el}	ms	18.0	18.6	21.9	21.3	20.4	22.1	23.1	19.0
Mech.time constant θ_W = 20˚C	T_{mech}	ms	2.4	2.0	2.0	1.8	2.4	2.1	2.1	1.9
Therm.time constant θ_W = 20˚C	T_{therm}	min	40	52	59	61	40	47	52	53
Moment of inertia incl. tachogen.	J	$kgm^2 x10^{-3}$	13.6	18.6	23.6	28.8	13.6	18.6	23.6	28.8
Dimensions Flange	a/f	mm	190 ☐							
Shaft	d x l	mm	Ø 32 x 58							
max. Lenght, not incl. holding brake	L	mm	345	395	445	495	345	395	445	495
Mass, not incl. holding brake	m	kg	31	39	45	51	31	39	45	51

Tachogenerator

EMF at θ_{amb} = 20˚C	$U_{\_}$ = 2.7 V/ 1000 rpm ±5%
Voltage ripple	≦ 1.5 %

Holding brake

Holding torque (transmittable)	M_{BR}	Nm	56
Supply voltage	U_{BR}	V	24 ± 10%
Nominal current	I_{BR}	A	1.5
Moment of inertia	J_{BR}	kgm^2	$4.5 x 10^{-3}$
Mass	m_{BR}	kg	5.2

θ_W = Winding temperature θ_{amb} = Ambient temperature

	Symbol	Unit	SE – KB4			
			KB4.020.030	KB4.040.030	KB4.065.030	KB4.090.030
Static torque n_0=200 rpm; $\Delta\theta_W$(30s)=105K	M_0	Nm	2.0	4.9	7.6	9.0
Maximum torque (dependent upon inverter)	M_{max}	Nm	4.7 with SM 5/10	8.8 with SM 5/10	18.8 with SM 10/20	27.5 with SM 17/35
Nominal speed	n_N	rpm	3000	3000	3000	3000
Ramp-up time to n_N	t_H	ms	54	50	33	43
Current at standstill at M_0 n_0=2000 rpm; $\Delta\theta_W$(30s)=105K	I_0	A	2.5	5.4	7.5	10
Peak current at θ_{amb} = 20˚C	I_{max}	A	15	32	45	62
Torque constant θ_{amb}= 40˚C; $\Delta\theta_W$ = 105 K	K_T	Nm/A	0.80	0.91	1.01	0.90
Voltage constant θ_{amb} = 40˚C; $\Delta\theta_W$ = 105 K	K_E	$\frac{V}{1000\ rpm}$	85	106	114	98
Winding resistance θ_W = 20˚C	R_{2ph}	Ohm	17.30	5.89	3.39	1.90
Winding inductance	L_{2ph}	mH	81.0	42.5	30	17.1
Electr.time constant θ_W = 20˚C	T_{el}	ms	4.6	7.0	8.5	9.0
Mech.time constant θ_W = 20˚C	T_{mech}	ms	19.0	7.8	5.3	4.8
Therm.time constant θ_W = 20˚C	T_{therm}	min	11	22	26	28
Moment of inertia, incl. tachogen.	J	$kgm^2 x10^{-3}$	0.74	1.22	1.71	2.18
Dimensions Flange		mm	185 Ø			
Shaft	d x l	mm	Ø 19 x 28			
max. Lenght, not incl. holding brake	L	mm	204	220	236	252
Mass, not incl. holding brake	m	kg	7	9	11	13

Tachogenerator

EMF at θ_{amb} = 20˚C	$U_{\_}$ = 2.7 V/ 1000 rpm ±5%
Voltage ripple	≦ 1.5 %

Holding brake

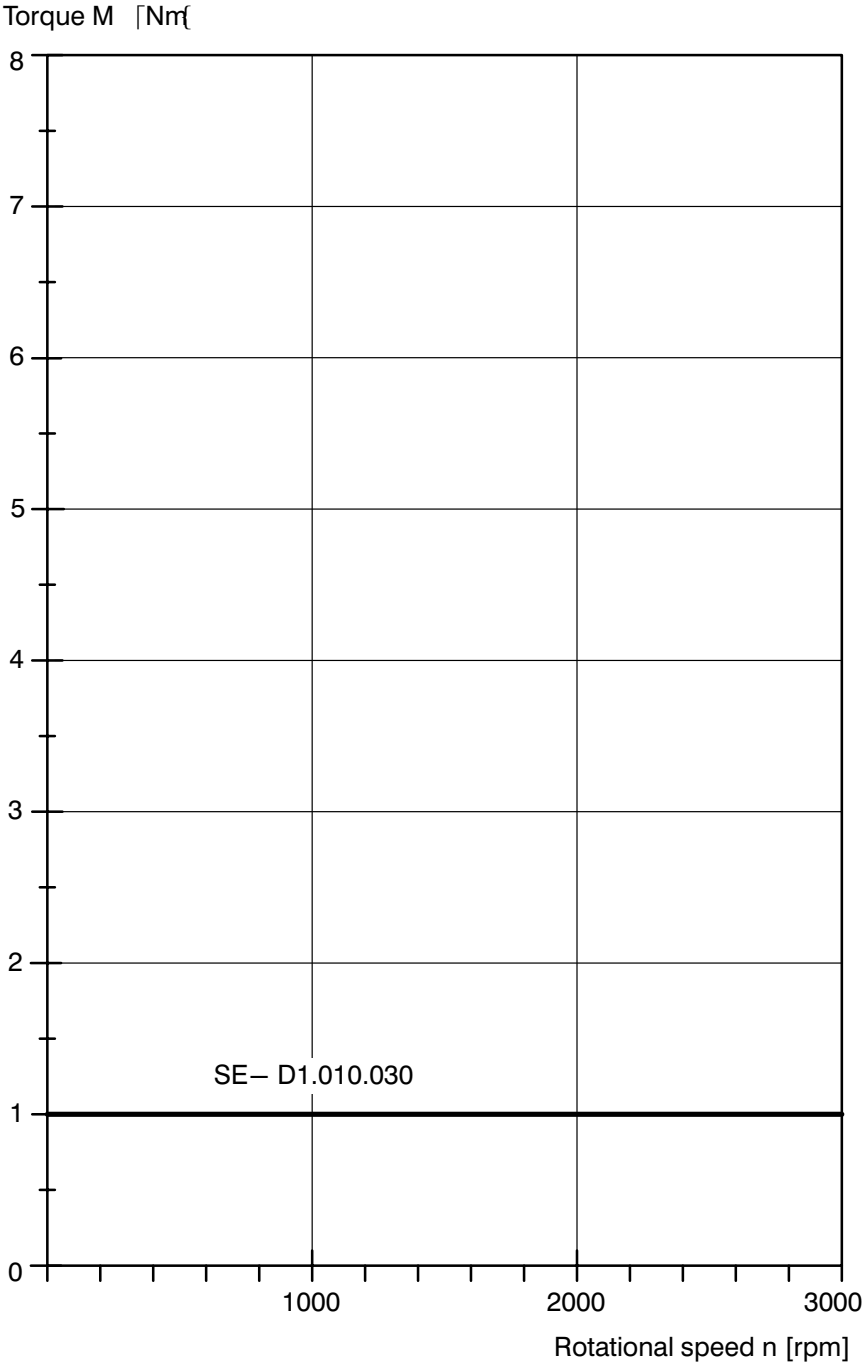
Holding torque (transmittable)	M_{BR}	Nm	18
Supply voltage	U_{BR}	V	24 ± 10%
Nominal current	I_{BR}	A	1.0
Moment of inertia	J_{BR}	kgm^2	0.90×10^{-3}
Mass	m_{BR}	kg	1.7

θ_W = Winding temperature θ_{amb} = Ambient temperature

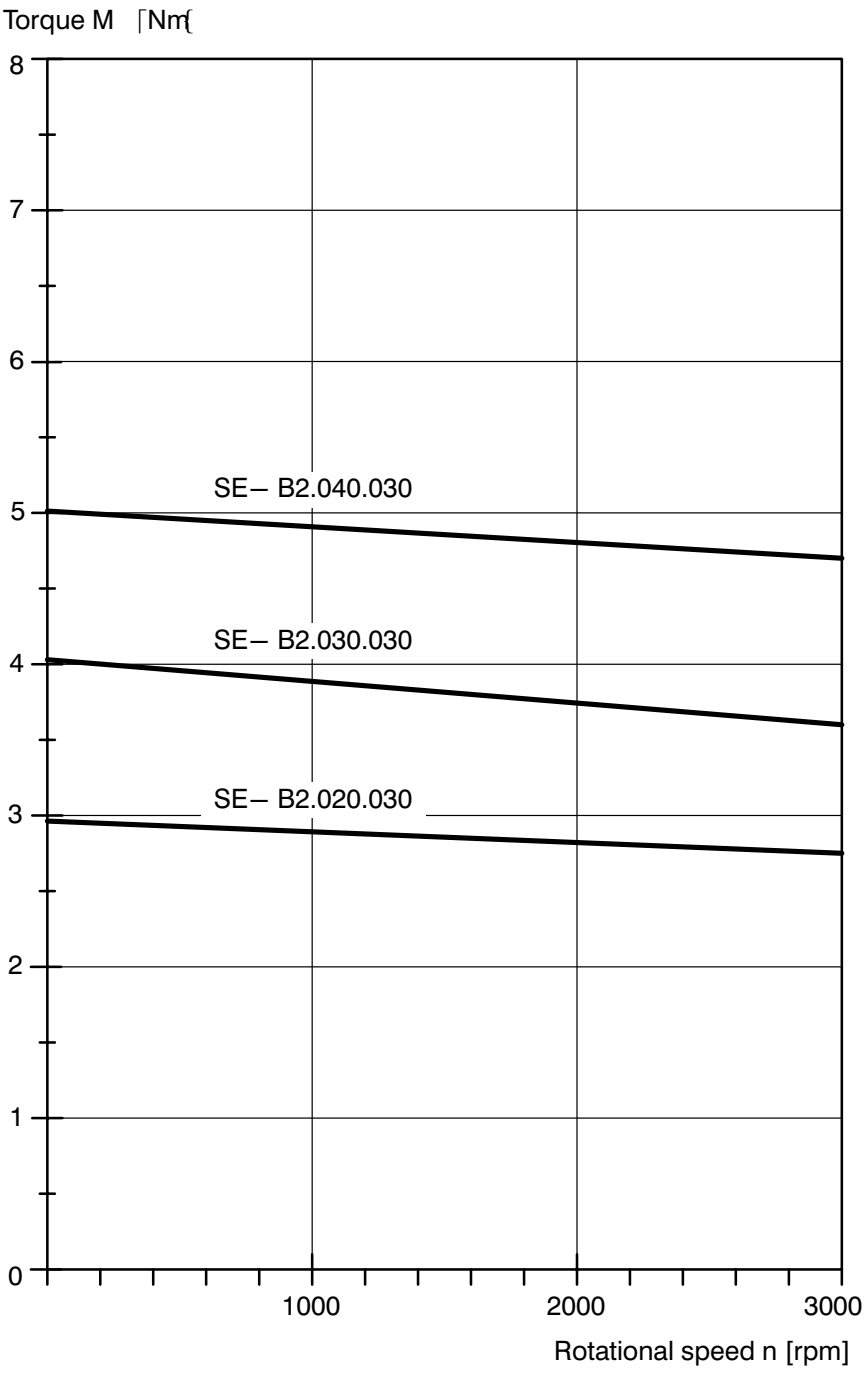
2.3 Speed-torque characteristic curves (S1 characteristic curves)

The S1 characteristic curves shown indicate the permissible permanent torque of an SE motor at a specific, continuously operated rotation speed (continuous duty with maximum permissible heating).

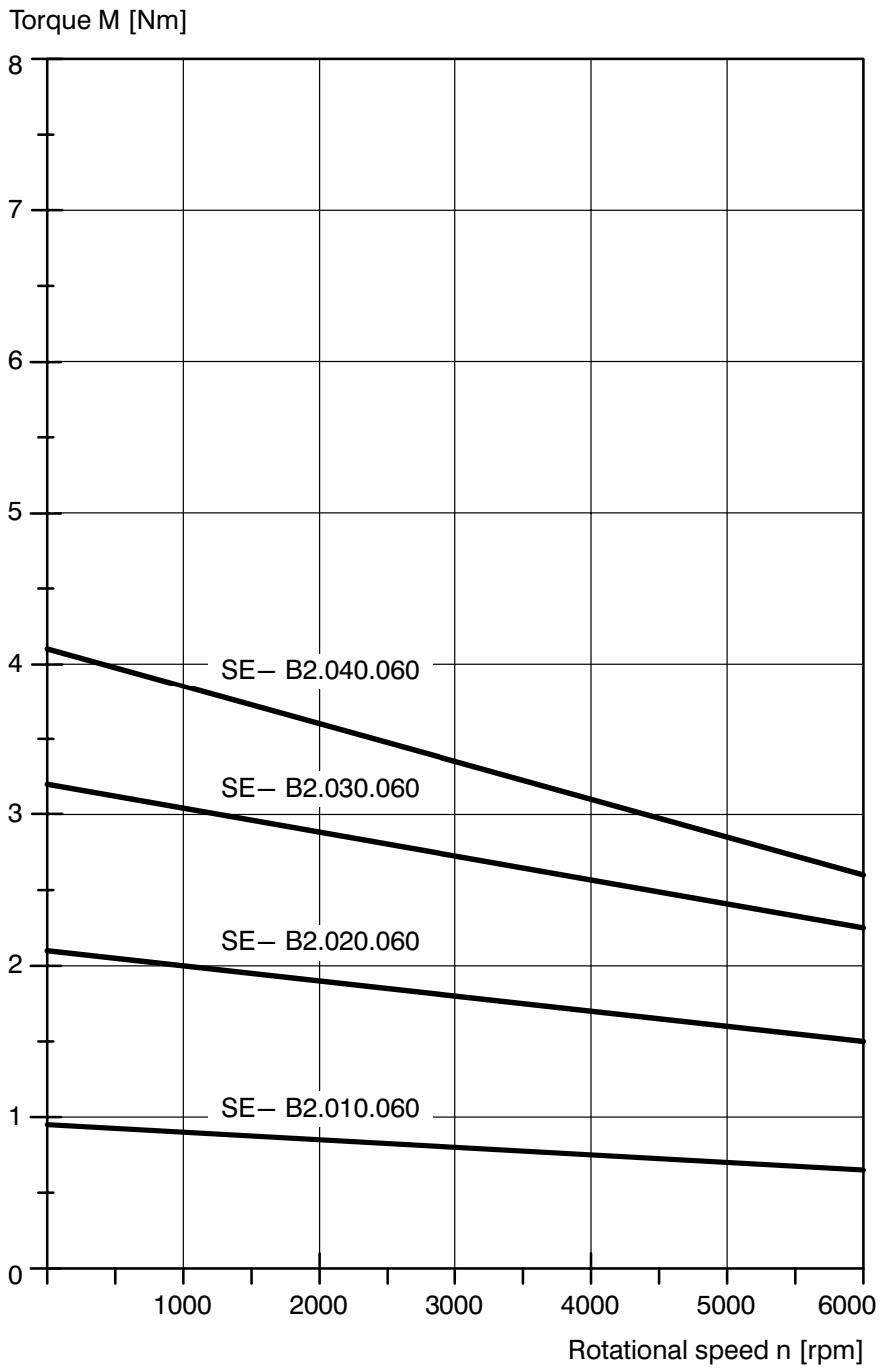
**SE–D1 motor,
3 000 rpm,
at $\Delta\theta_w$ (30s) = 105 K
(S1 characteristic curves)**



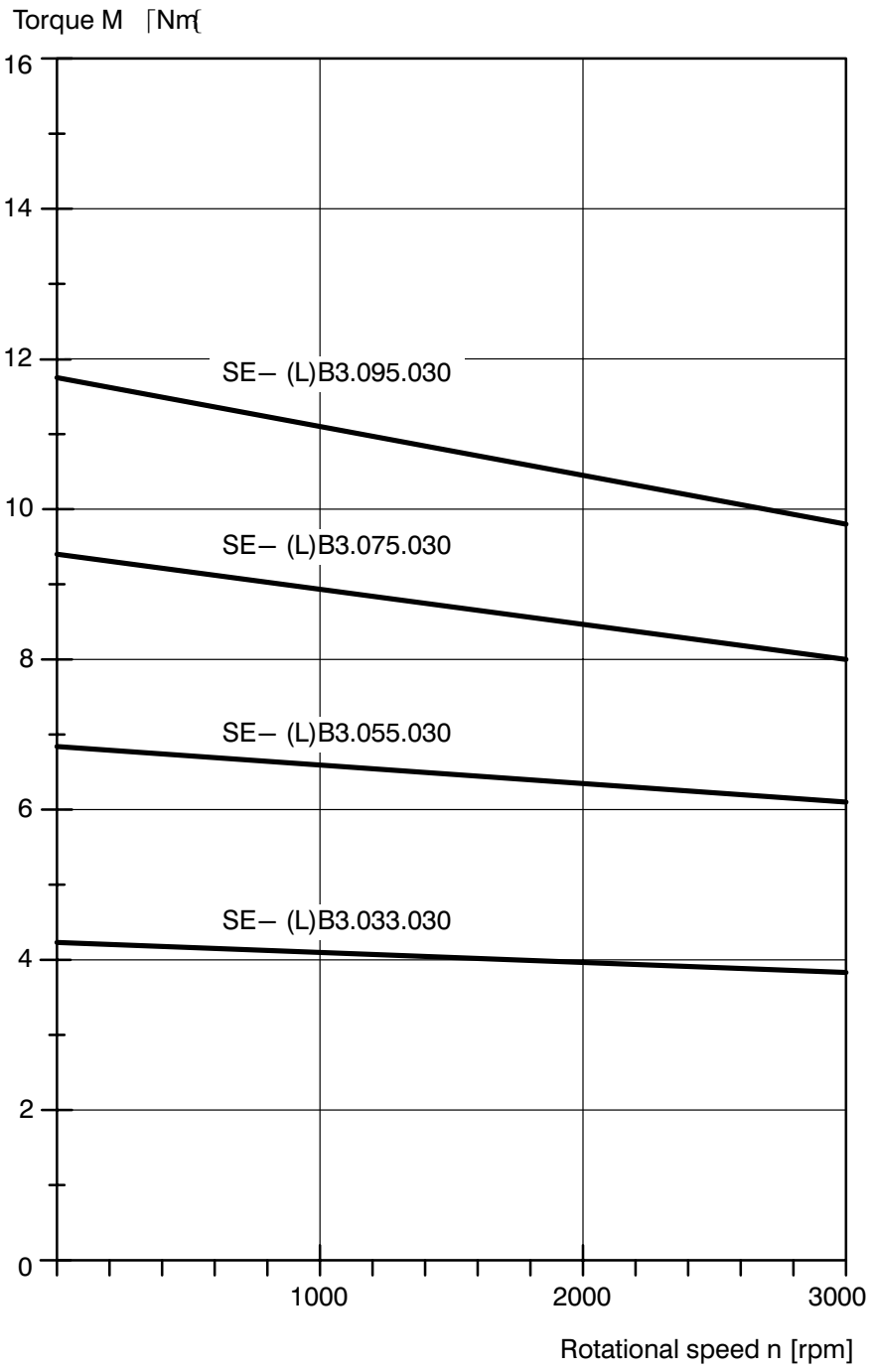
**SE–B2 motors,
3 000 rpm,
at $\Delta\theta_w$ (30s) = 105 K
(S1 characteristic curves)**



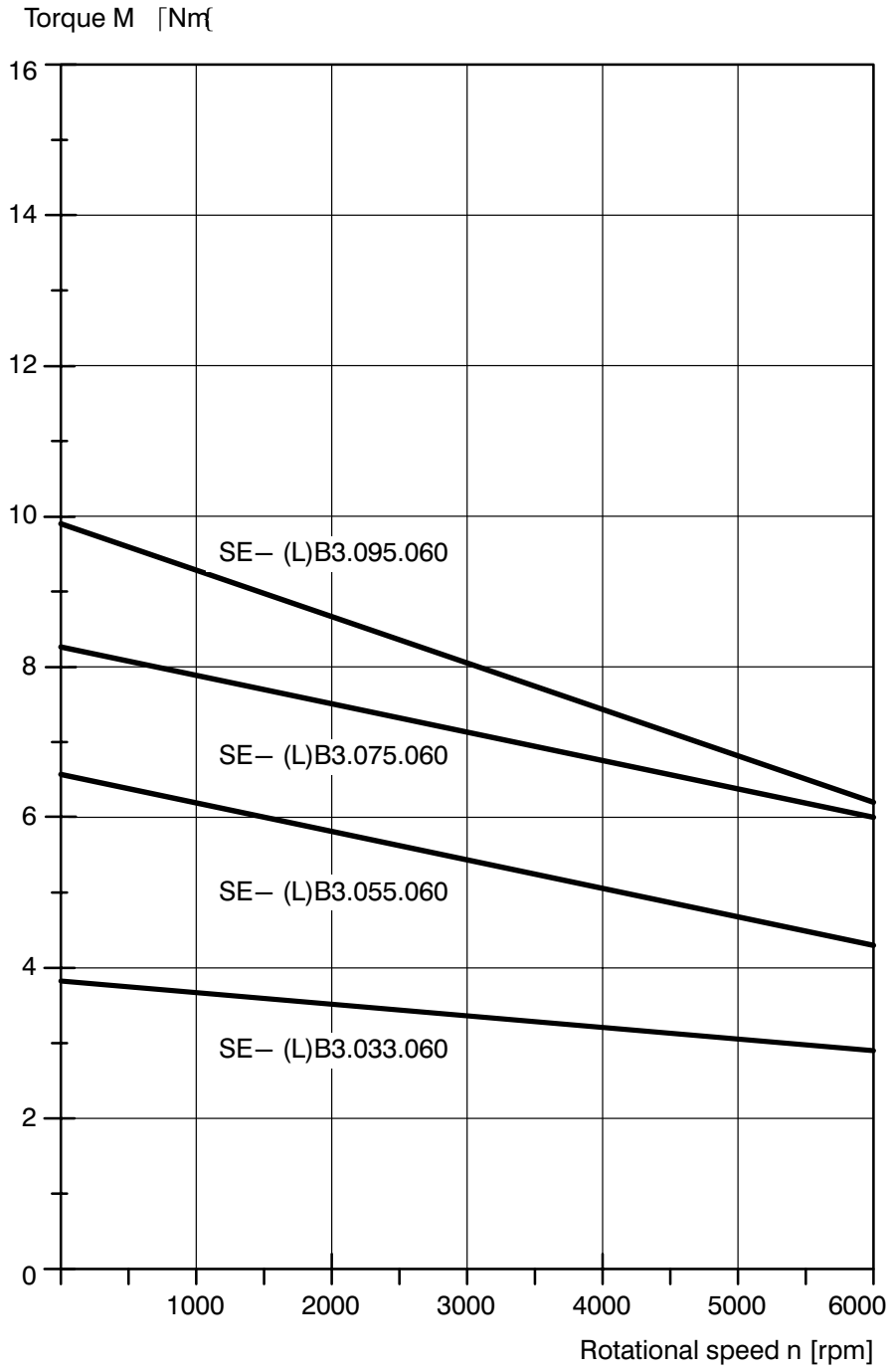
SE–B2 motors,
6 000 rpm,
at $\Delta\theta_w$ (30s) = 105 K
(S1 characteristic curves)



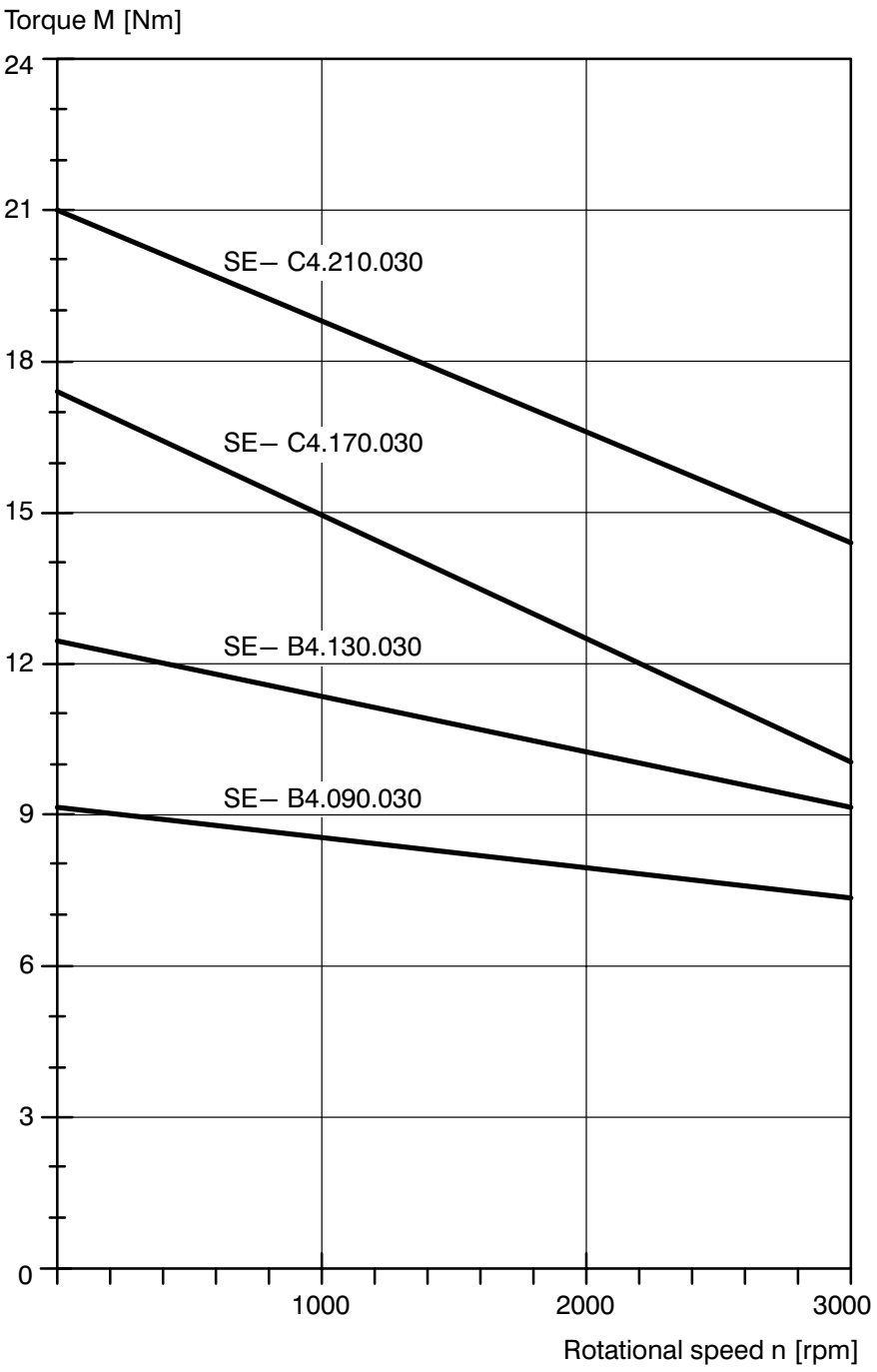
**SE–B3 / SE–LB3 motors,
3 000 rpm,
at $\Delta\theta_w$ (30 s) = 105 K
(S1 characteristic curves)**



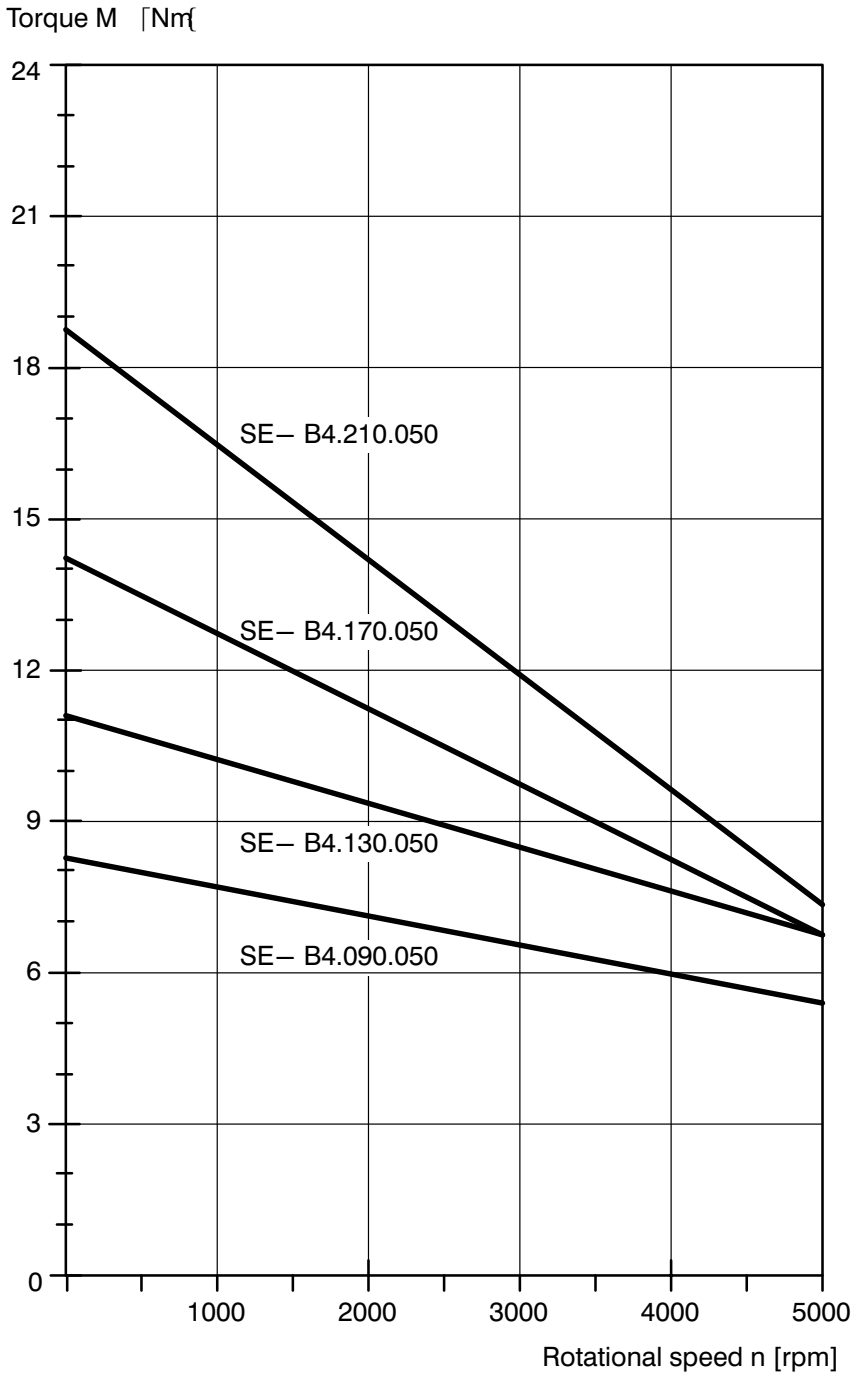
**SE–B3 / SE–LB3 motors,
6 000 rpm,
at $\Delta\theta_w$ (30s) = 105 K
(S1 characteristic curves)**



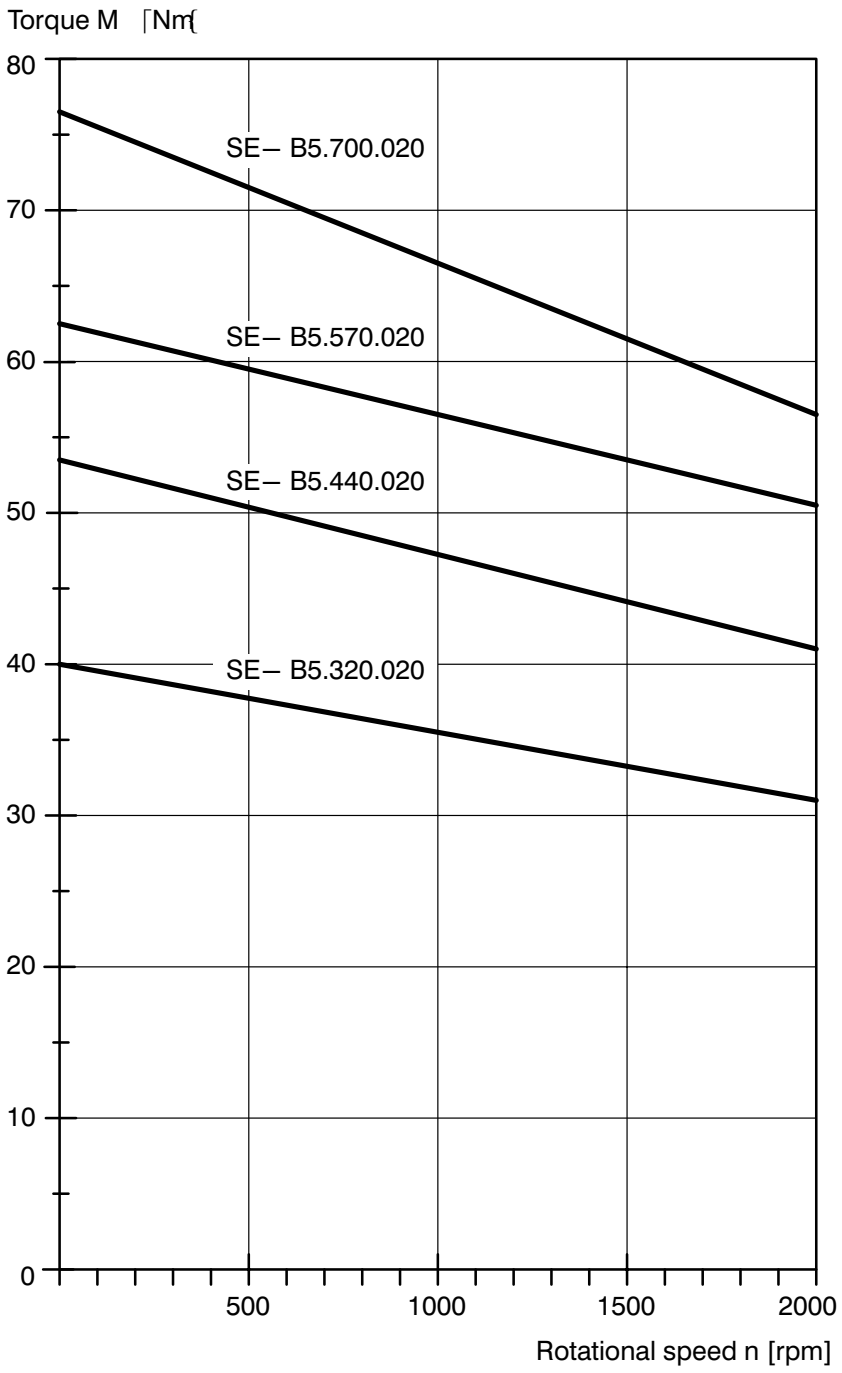
SE–B4 motors and SE–C4 motors, 3 000 rpm, at $\Delta\theta_w$ (30 s) = 105 K (S1 characteristic curves)



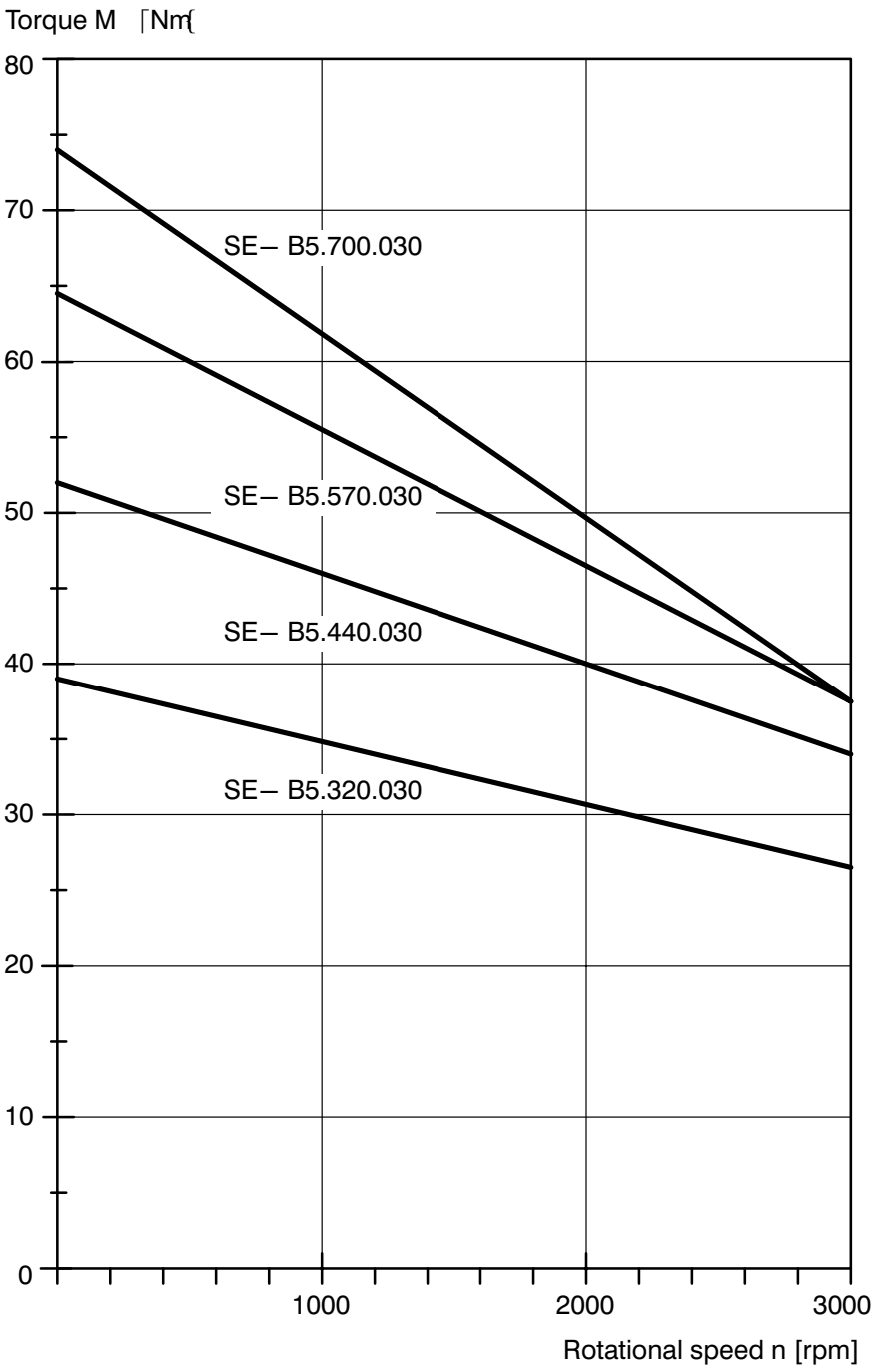
SE–B4 motors,
5 000 rpm,
at $\Delta\theta_w$ (30s) = 105 K
(S1 characteristic curves)



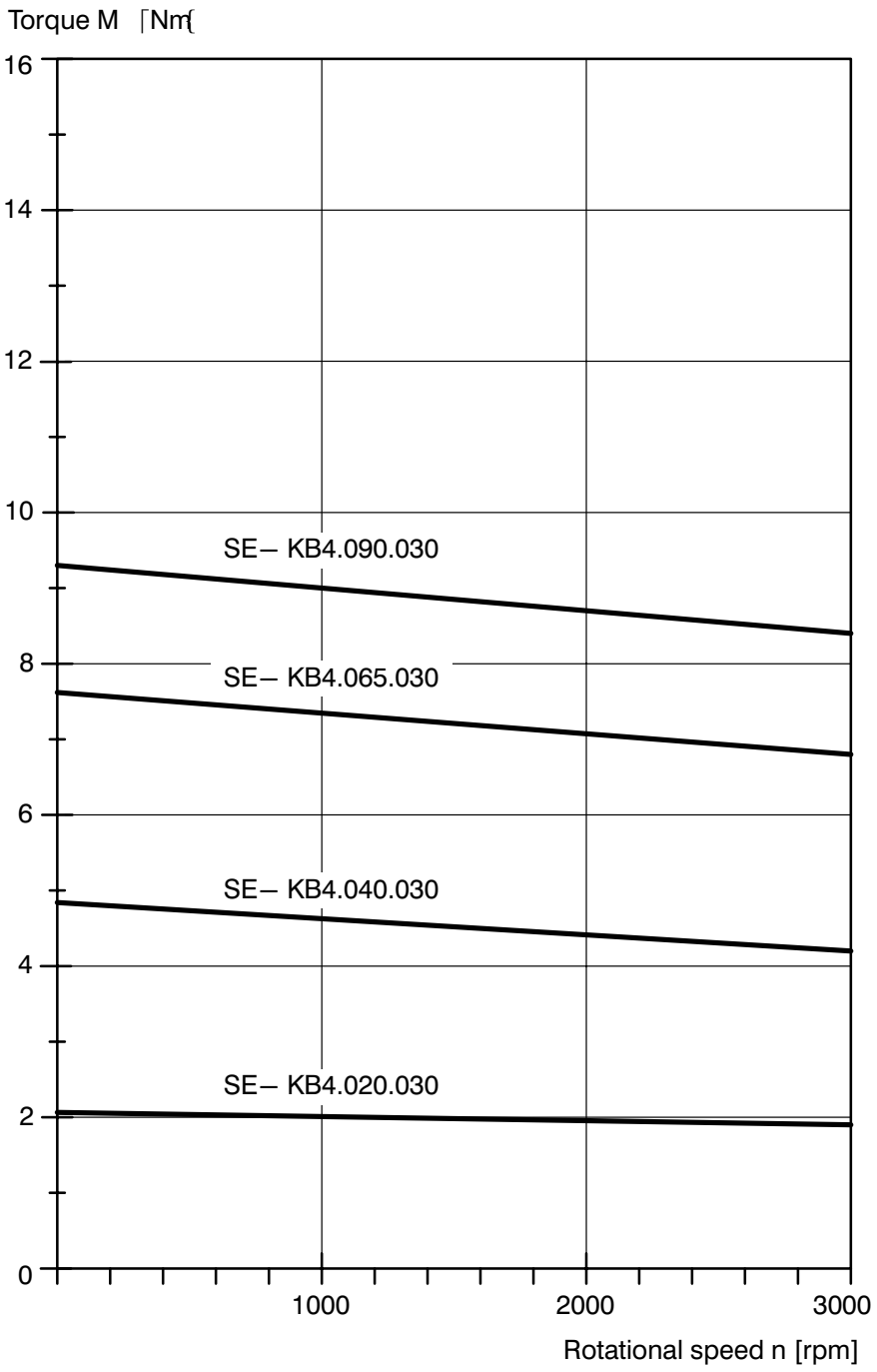
**SE–B5 motors,
2 000 rpm,
at $\Delta\theta_w$ (30 s) = 105 K
(S1 characteristic curves)**



SE–B5 motors,
3 000 rpm,
at $\Delta\theta_w$ (30 s) = 105 K
(S1 characteristic curves)



SE–KB4 motors,
at $\Delta\theta_w$ (30 s) = 105 K
(S1 characteristic curves)



2.4 Recommended motor-module combinations

Other motor-module combinations are available on request only after consultation with us.

● = Module peak current
○ = Module peak current, reduced

Rare-earth motors		Servodyn – T(A) Servo modules SM..–T(A)						Servodyn – TC(1) Servo modules SM..–TC(1)				
Type	I_0 [A]*	5/10	10/20	17/35	25/50	35/70	50/100	1,5/3	5/10	10/20	15/30	25/50
SE–D1.010.030	1.0							●				
SE–B2.020.030	2.7	○							○			
SE–B2.030.030	3.5	●							●			
SE–B2.040.030	4.5	●	○						●	○		
SE–B2.010.060	2.5	○							○			
SE–B2.020.060	5.0	●	○						●	○		
SE–B2.030.060	7.5		●	○						●	○	
SE–B2.040.060	10		●	○						●	●	
SE–(L)B3.033.030	4.0	●							●			
SE–(L)B3.055.030	6.7		●							●		
SE–(L)B3.075.030	9.5		●	○						●	●	
SE–(L)B3.095.030	10.5		●	○						●	●	
SE–(L)B3.033.060	7.7		●	○						●	○	
SE–(L)B3.055.060	12.6			●							●	
SE–(L)B3.075.060	14			●	○						●	○
SE–(L)B3.095.060	15			●	●						●	●

Continued on next page

* I_0 = Standstill current. See Section 2.2 for further data.

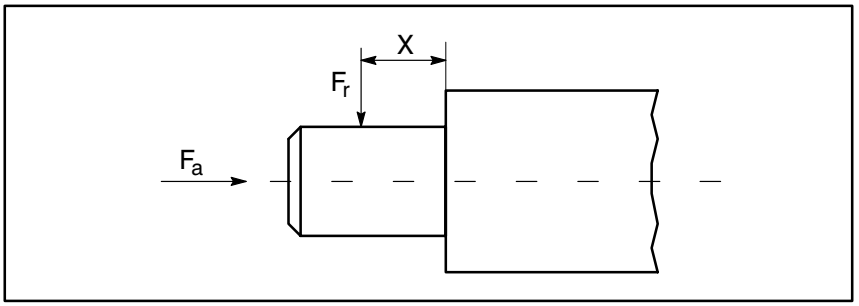
● = Module peak current
○ = Module peak current, reduced

Rare-earth motors (continued)		Servodyn – T(A) Servo modules SM..–T(A)							Servodyn – TC(1) Servo modules SM..–TC(1)				
Type	I_0 [A]*	5/10	10/20	17/35	25/50	35/70	50/100	75/150	1,5/3	5/10	10/20	15/30	25/50
SE–B4.090.030	10		●	○							●	●	
SE–B4.130.030	15			●	●							●	●
SE–C4.170.030	19				●	○							●
SE–C4.210.030	23				●	●							●
SE–B4.090.050	14			●	○							●	○
SE–B4.130.050	18				●	○							●
SE–B4.170.050	24				●	●							●
SE–B4.210.050	28					●	○						
SE–B5.320.020	24				●	●							●
SE–B5.440.020	35					●	●						
SE–B5.570.020	40						●	○					
SE–B5.700.020	43						●	○					
SE–B5.320.030	34					●	●						
SE–B5.440.030	47						●	○					
SE–B5.570.030	62							●					
SE–B5.700.030	70							●					

Motors with short type of construction		Servodyn – T(A) Servo modules SM..–T(A)							Servodyn – TC(1) Servo modules SM..–TC(1)				
Type	I_0 [A]*	5/10	10/20	17/35	25/50	35/70	50/100	75/100	1,5/3	5/10	10/20	15/30	25/50
SE–KB4.020.030	2.5	○								○			
SE–KB4.040.030	5.4	●	○							●	○		
SE–KB4.065.030	7.5		●								●		
SE–KB4.090.030	10		●	●							●	●	

* I_0 = Standstill current. See Section 2.2 for further data.

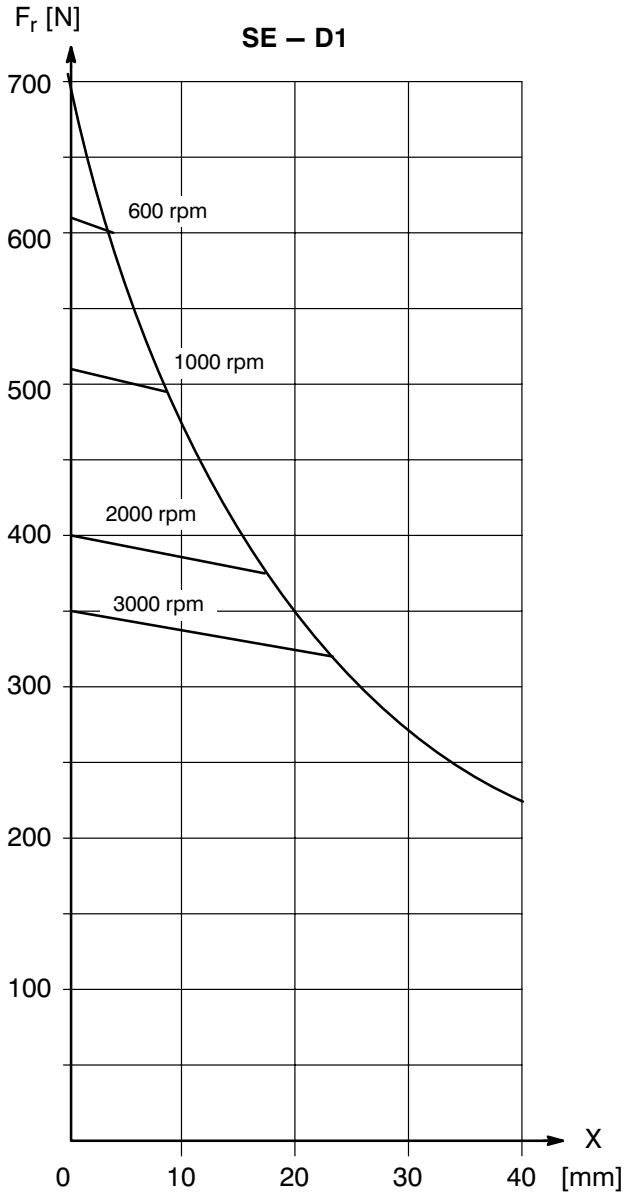
2.5 Mechanical load of the motor shaft

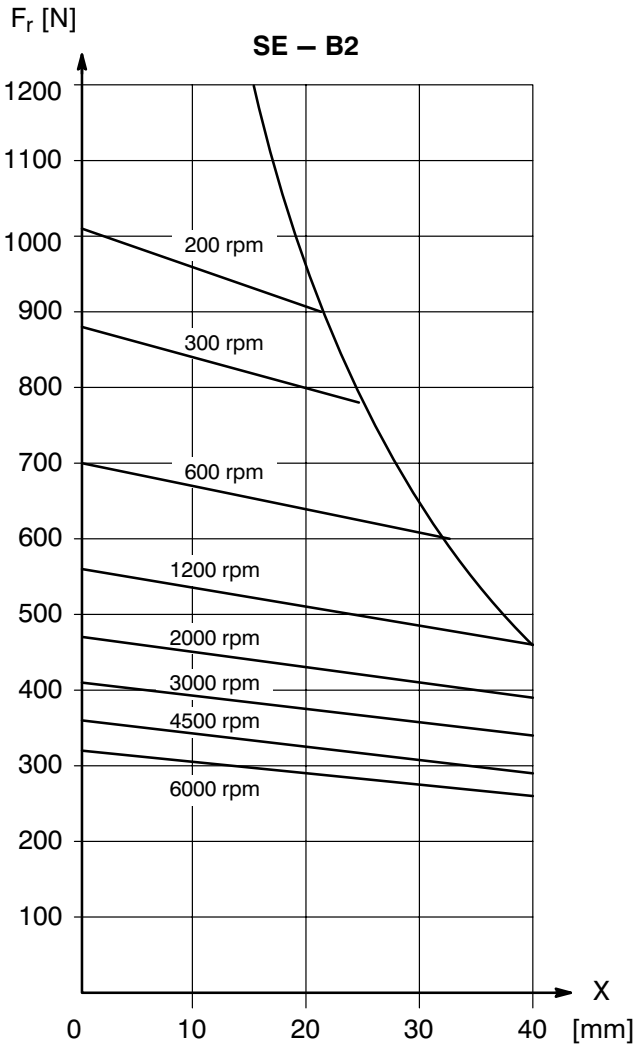


Axial load

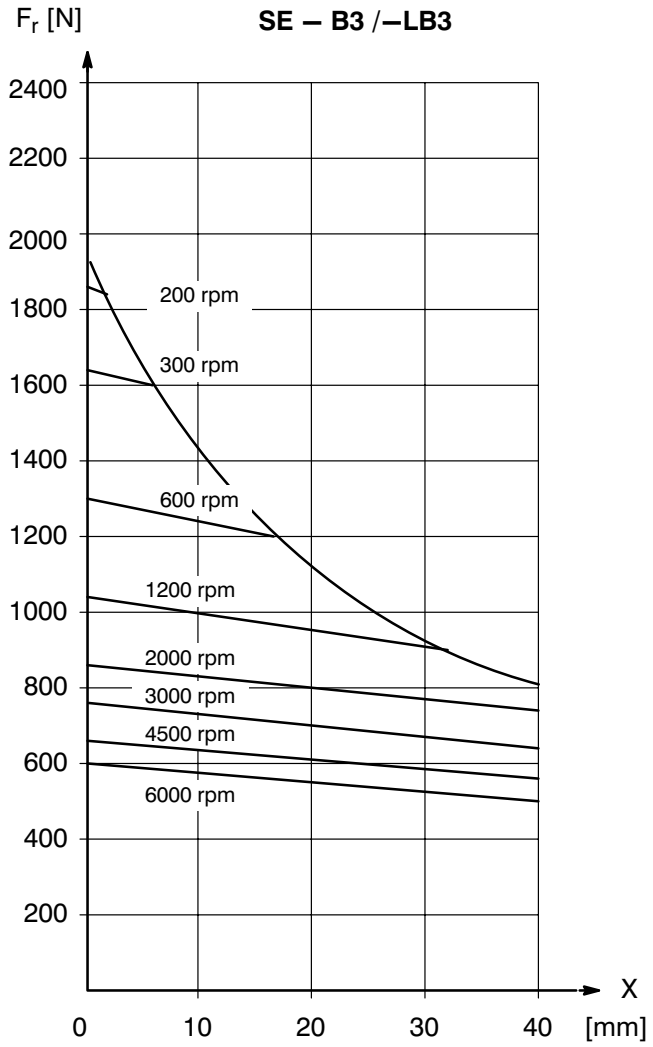
Motor Size	Permissible axial force F_a [N]
SE−D1...	10 % of the permissible force F_r
SE−B2...	70
SE−B3 /LB3...	133
SE−B4...	154
SE−B5...	145
SE−KB4...	380

Radial load

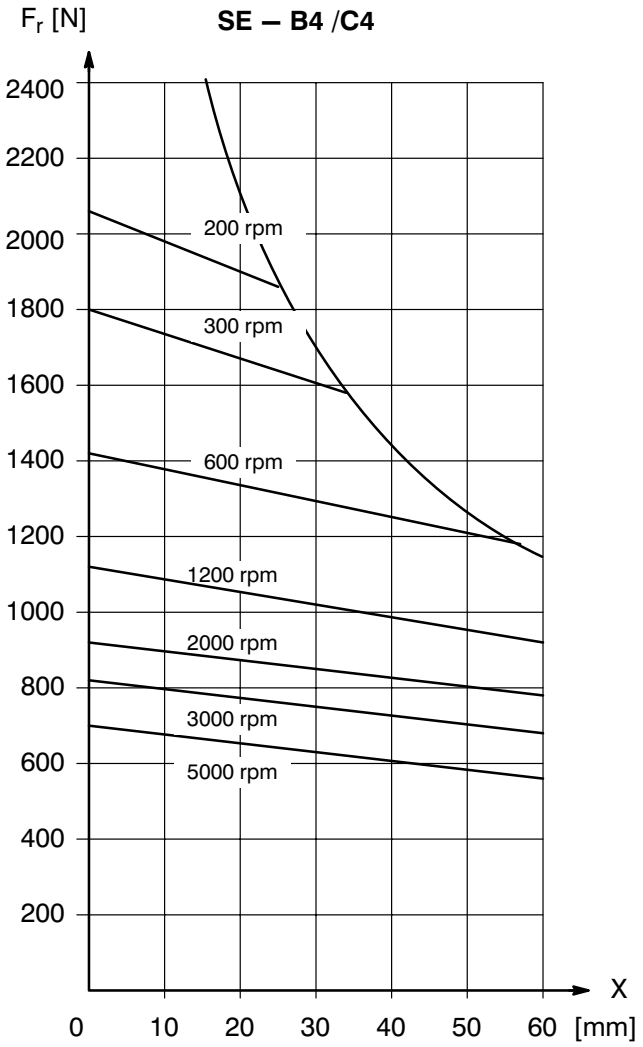


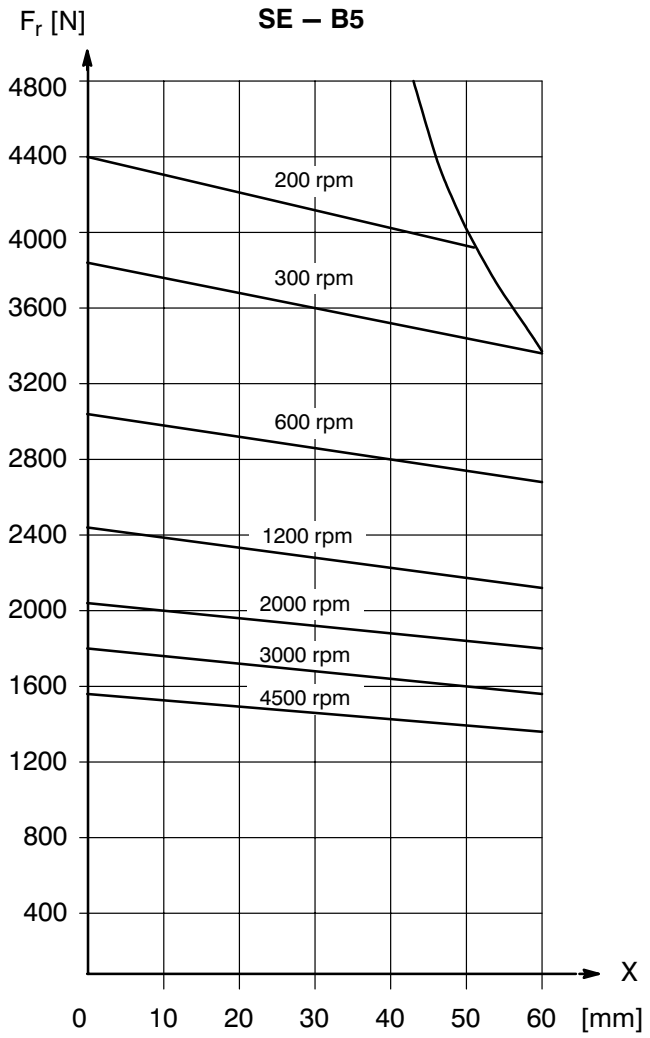


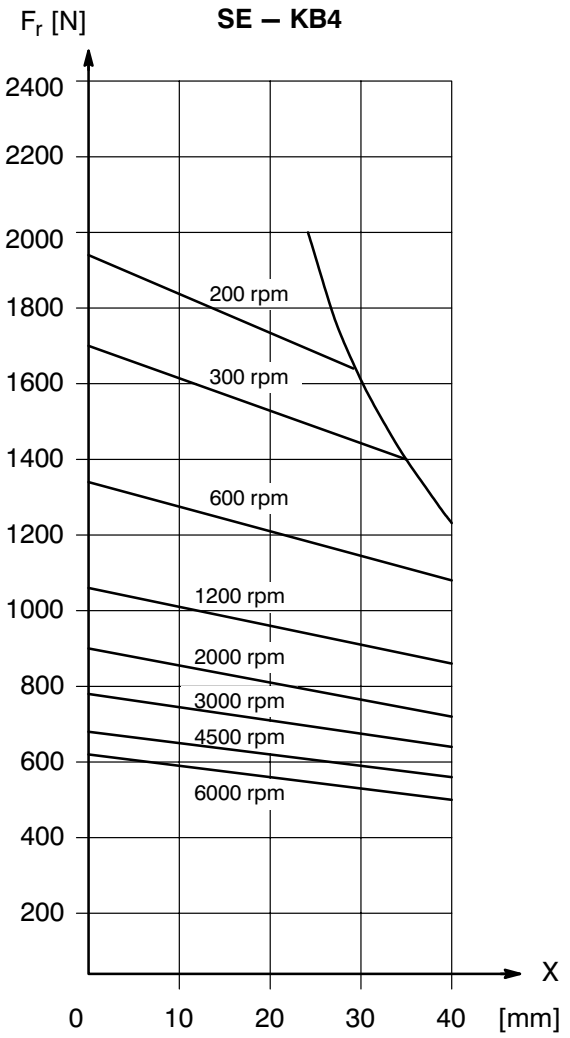
SE – B3 /–LB3



SE – B4 /C4







2.6 Encoder attachment

IMPORTANT

Operating temperatures may reach 90...100˚C on the encoder attachment surface of the motors. Encoders intended for attachment must be suitable for operation at these temperatures.

2.6.1 Data incremental encoder type ROD 426.014

Number of encoder pulses	either 100/360/500/1000/1250/1500/ 2000/2500/3600*/5000*
Max. speed (mechan.)	12 000 rpm
Operating temp. range	−30°C to +100°C
Storage temp. range	−40°C to +110°C
Light source	miniature lamp 5 V/ 0.6 W
Power supply	electronic circuitry and ligth source +5V ±5% typ.170 mA, max.220 mA (without load)
Output signals	TTL-compatible
Signal sequence	square-wave pulse trains U_{a1}, U_{a2} inverted signals $\overline{U_{a1}}$, $\overline{U_{a2}}$ (U_{a2} lagging behind U_{a1} with clockw. rotation) reference signal U_{a0} inverted pulse $\overline{U_{a0}}$ (once per revolution)
Switching times	≦ 0.2 µs time delay of U_{a0} with respect to signals U_{a1} und U_{a2} ≦ 50 ns
Sampling frequency	0 to 300 kHz
Max. output load	$-I_{High}$ ≦ 20 mA I_{Low} ≦ 20 mA C_{Load} ≦ 1000 pF
Permissible stress on the shaft	axial 10 N radial 20 N
Housing	IP 64 in accordance with DIN 40050 or IEC 529
Moment of inertia of rotor	0.0145 x 10^{-4} kgm^2
Permissile cable length	max. 50 m with differential line receiver at the input of the subsequent circuitry, whereby the value of the supply voltage at the ROD must be observed.

* Max. speed limited: 3600 lines — max. 5000 rpm
5000 lines — max. 3600 rpm

2.6.2 Connection ROD 426.014

Cable ends on the encoder Color	Signal	Bosch encoder cable cross-sectional area [mm²]	Color
brown	U_{a1}	0.14	white/yellow
green	$\overline{U_{a1}}$	0.14	green
grey	U_{a2}	0.14	grey
pink	$\overline{U_{a2}}$	0.14	pink
blue	+5V Sensor	0.5	brown
red	U_{a0}	0.14	white
black	$\overline{U_{a0}}$	0.14	white/grey
violet	–	0.14	violet
brown	+5V Supply	0.5	red
white	0V Sensor	0.5	black
white	0V Supply	0.5	blue
Screen		Screen, connect at both ends	

Plug connections are permitted for disconnecting encoder connection leads, e.g. on the switch cabinet panel.
However, use plug connectors with particularly conductive contact material and completely screened metal housings.

The screen must not be interrupted at the plug connectors, and must be connected to the switch cabinet housing.

CAUTION

Screens must be earthed at both ends.

Unconnected screen connections on encoder lines may lead to uncontrolled drive behavior.

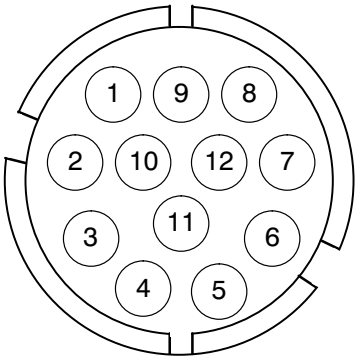
Ensure perfect screen connections in order to avert dangers and risks!

2.6.3 Data incremental encoder type ERN 221.21..3

Number of encoder pulses	either 500/1000/1250/1500/2500//5000* and other specifications on request
Max. speed (mechan.)	12 000 rpm
Operating temp. range	−20°C to +125°C
Storage temp. range	−20°C to +125°C
Light source	miniature lamp
Power supply	+5V ±10 % typ.130 mA, max.160 mA (without load)
Output signals	TTL-compatible
Signal sequence	square-wave pulse trains U_{a1}, U_{a2} inverted signals $\overline{U_{a1}}$, $\overline{U_{a2}}$ (U_{a1} lagging behind U_{a2} with clockw. rotation) reference signal U_{a0} inverted pulse $\overline{U_{a0}}$ (once per revolution)
Switching times	≦ 100 ns time delay of U_{a0} with respect to signals U_{a1} und U_{a2} max. 50 ns
Sampling frequency	0 to 300 kHz
Max. output load	$-I_{High}$ ≦ 20 mA I_{Low} ≦ 20 mA C_{Load} ≦ 1000 pF
Prot. standarnd in housing	IP 64 in accordance with DIN 40050 or IEC 529
Moment of inertia of rotor	0.025 x 10^{-4} kgm^2
Permissile cable length	max.100 m with differential line receiver at the input of the subsequent circuitry.

* Max. speed limited: 5000 lines — max. 3600 rpm

2.6.3 Connection ERN 221



View of the solder end
of the mating connector

Connector socket on the encoder Pin	Signal	Bosch encoder cable cross-sectional area [mm²]	Color
1	$\overline{U_{a2}}$	0.14	pink
2	+5V Sensor	0.5	red
3	U_{a0}	0.14	white
4	$\overline{U_{a0}}$	0.14	white/grey
5	U_{a1}	0.14	white/yellow
6	$\overline{U_{a1}}$	0.14	green
7	–	0.14	violet
8	U_{a2}	0.14	grey
9	Screen	Screen braided	
10	0V	0.5	blue
11		0.5	black
12	+5V Supply	0.5	brown

IMPORTANT

The encoder mating connector, order no. 1070 916 192,
must be used only in conjunction with the Bosch encoder cable 1070 903 499.

Screen connection in the mating connector,

encoder end

Push the braided screen through the screen end cover, and use the screws to connect it to the connector housing as shown in the accompanying installation instructions.

CAUTION

Screens must be earthed at both ends.
Unconnected screen connections on encoder lines may lead to uncontrolled drive behavior.

Ensure perfect screen connections in order to avert dangers and risks!

Plug connections are permitted for disconnecting encoder connection leads, e.g. on the switch cabinet panel.
However, use plug connectors with particularly conductive contact material and completely screened metal housings.

The screen must not be interrupted at the plug connectors, and must be connected to the switch cabinet housing.

3 Interface conditions

3.1 Notes on installation

- Adequate **heat dissipation** by radiation and natural convection must be guaranteed.

IMPORTANT

High surface temperatures may occur on the motors.
A touch guard must be fitted if required.

- In order to insure and maintain the system's **protection standard**, cable cross-sections must comply with specified minimums and the mating connectors must be tightened to 4 Nm.

- SE−B..., SE−C...:
On servomotors for vertical mounting **(type of construction IM V3)** no fluids may remain in the flange-type end shield.

- Drive elements such as belt pulleys, clutch/coupling disks and gear-wheels etc. may be fitted and removed only with a suitable **fitting and extraction device.** Use the thread in the end of the shaft.

IMPORTANT

The shaft end must never be hammered or subjected to impacts in any way as this can damage the ball bearing.

- Motors with **keyway and feather key** are balanced with feather key.

- Servomotors with **encoder preparation kit** must not be operated without encoder and with attached coupling.

- SE−B..., SE−C...:
Servomotors with **oil-tight driving-end housing** (Special version code 100, 101) must run at least half in oil. They must not be operated dry. If this cannot be guaranteed, the rotary shaft seal must be removed. It may not be reused.

- All servomotors may not be **dismantled.**
Any assembly or installation work beyond attaching the encoders and adjusting the outgoing cable direction must be performed at the factory.

3.2 Adjusting the direction of the outgoing cables

All servo motor connector systems have angled flange sockets which allows you to adjust the direction of outgoing cables.
Only the power connection of the SE—B5 motors, which is made in a terminal box, cannot be adjusted.

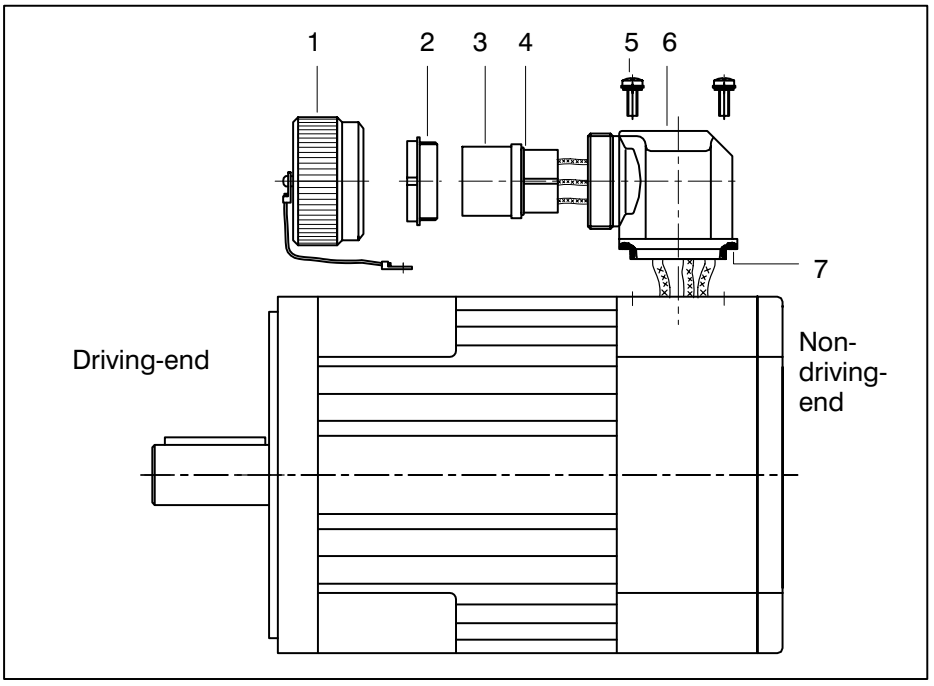
- You can adjust the outgoing cable direction as required by twisting the flange socket and/or the insulator in the flange socket and by using straight or angled mating connectors.
- Units are delivered with the outgoing cable direction to the driving-end of the motor.
- Angled flange sockets allow low motor installation heights.

CAUTION

Improperly adjusting the outgoing cable direction can render protection standard IP 67 ineffective.

All motors undergo a sealing test to insure a 100% seal before leaving the factory. Compliance with protection standard IP 67 is only ensured if the mating connectors of the connector system are properly wired and securely tightened (4 Nm).

Procedure



Item	Designation	Item	Designation
1	Protective cap	5	Oval head screw with spring washer and plain washer
2	Union nut		
3	Insulator		
4	O-ring insulator	6	Angled flange socket
		7	O-ring flange socket

Twisting the angled flange socket

1. Unscrew the oval head screws (5) and remove.
2. Pull the angled flange socket (6) away from the motor and turn to the desired direction.
3. Resecure the angled flange socket (6) to the motor. The O-ring must be properly seated in the slot of the angled flange socket.
4. Securely tighten the angled flange socket by tightening the oval head screws (5) with the accompanying plain washers and spring washers (0.45...0.55 Nm). Only **new spring washers** in accordance with DIN 128—A4—FSt may be used.
   Secure the protective cap (1) with one of the oval head screws (5).

Twisting the insulator in the angled flange socket

Only required in case an angled mating connector is used:

1. Remove the protective cap (1).
2. Unscrew the union nut (2).

For motor connection work, use a Souriau wrench, no. 5106.021.08.03 or a size 32 socket head.
For tacho connection work, use a Souriau wrench, no. 5106.021.08.02 or a size 22 socket head.

Do not use an open-end wrench — this can break the union nut!

3. Carefully pull the insulator (3) out of the angled flange socket and turn to the desired direction.

The desired outgoing direction of the mating connector is determined by the guide tab in the insulator.

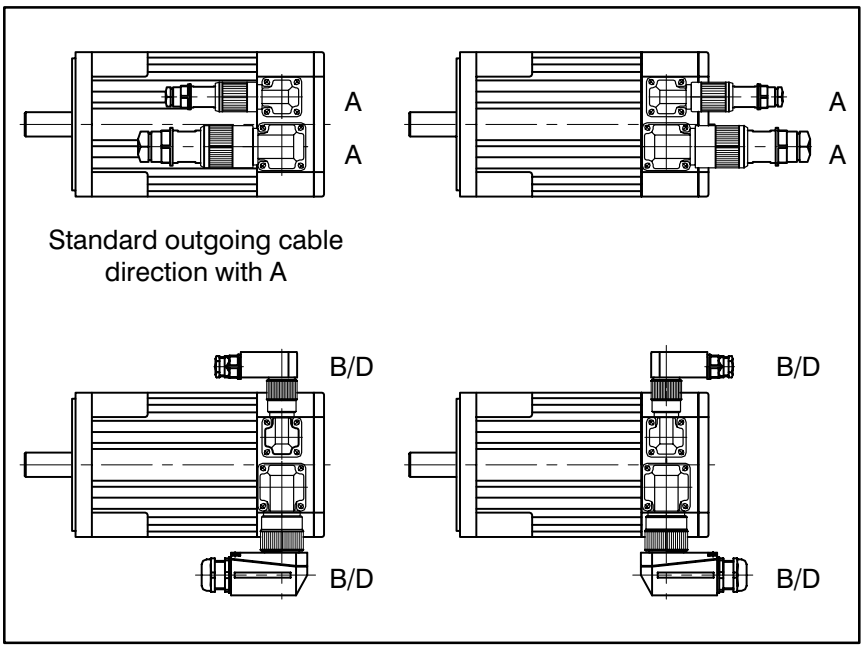
4. Insert the insulator. When doing so, ensure that the O-ring (4) is seated properly (see diagram above).
5. Secure the insulator (3) in the angled flange socket by tightening the union nut (2). Tighten the motor connection to 3.6...4.4 Nm, and the tacho connection to 1.4...1.6 Nm.
6. Hand-tighten the protective cap (1) onto the angled flange socket.

CAUTION

Always turn the angled flange socket and insulator in such a way that the connecting leads in the motor are pulled and twisted as little as possible.

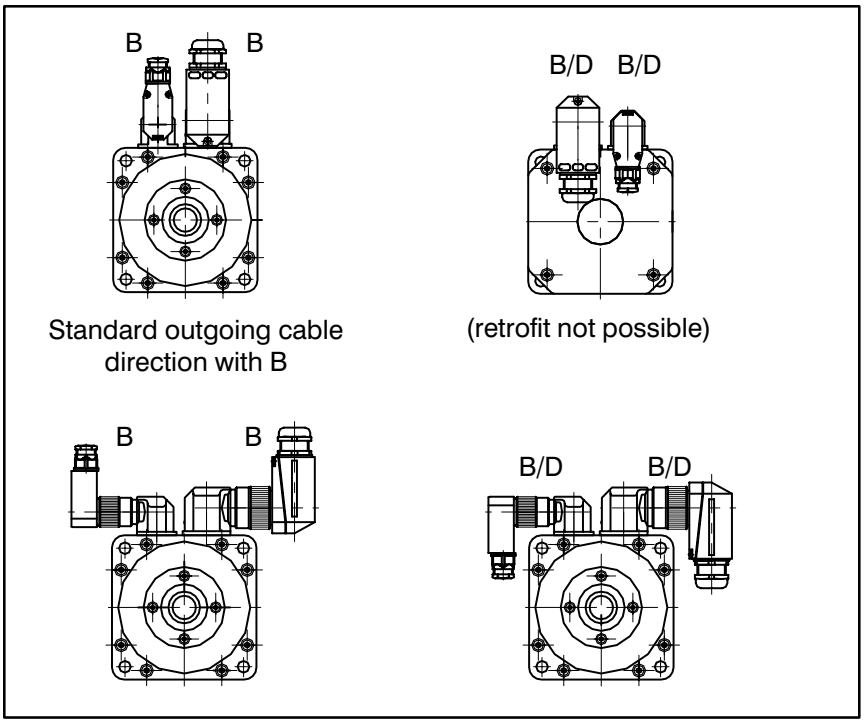
All adjustment possibilities can be made to the power connection as well as to the tacho connection. Various possibilities are offered in the following:

Outgoing cable, driving-end/non-driving-end



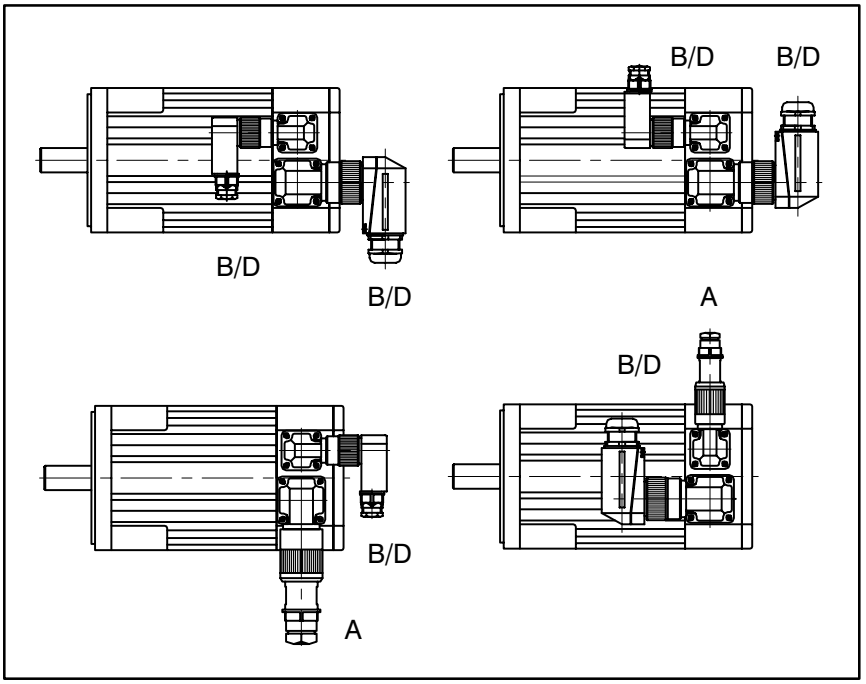
A = straight mating connector
B = right-angled mating connector
D = requires turning the insulator

Outgoing cable, above/below



A = straight mating connector
B = right-angled mating connector
D = requires turning the insulator

Outgoing cable, side



A = straight mating connector
B = right-angled mating connector
D = requires turning the insulator

3.3 Electrical connection

Before placing the servo motors into operation, check the available motor-module combination on the basis of the rating plates
(see Section 2.4).

☞ **Note** **Connecting a module which is not permitted will restrict operation and may cause damage to the motor.**

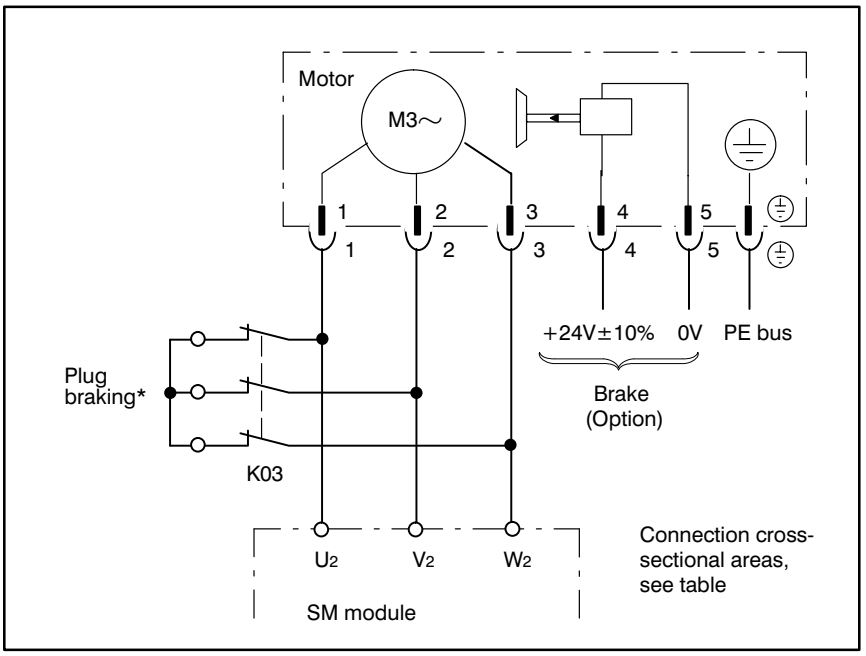
3.3.1 Motor connection

CAUTION

**Always switch off the electrical power supply
before carrying out any connection or installation work.
Harzardous voltage is applied to the power socket due to permanent-field excitation
when the rotor is rotating and the motor is not connected electrically!**

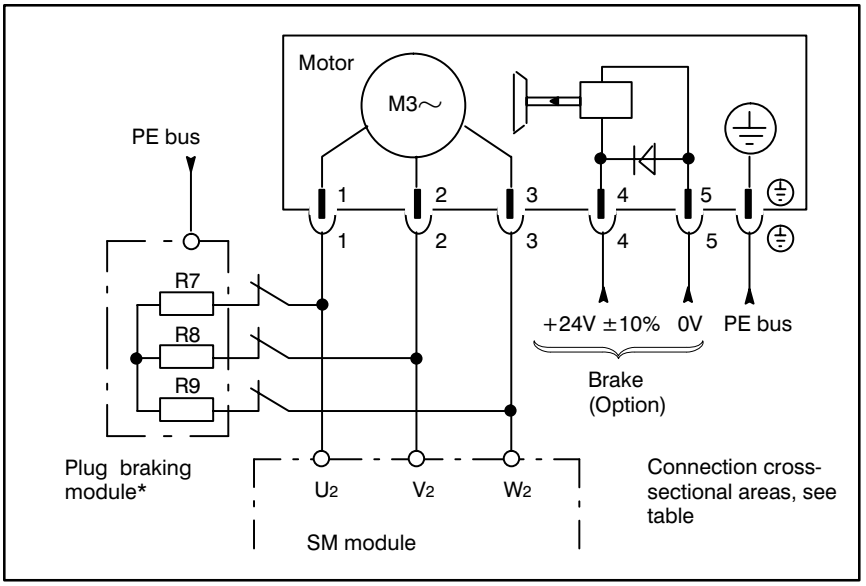
The SE motors must be connected to terminals U2, V2, W2 of the related servomodules. Plug connections are available on the motors
(SE−B5 with terminal box for power and brake connection)

SE−D1



* Plug braking for EMERGENCY-STOP by means of a direct short circuit without the short circuit braking module.

SE−B2, B3, LB3, B4, C4, KB4



PIN 6 (neutral point motor) must not be earthed!

* Plug braking for EMERGENCY-STOP (see Section 3.3.2)

Connection cross-sectional area

(in accordance with EN 60204, Part 1, Table BI and BII for normal applications in the cable duct at an ambient temperature of 45 °C)

Motor	Connection cross-sectional area in the mating connector [mm²]
SE−D1...	1.5
SE−B2...030	1.5
SE−B2...060	1.5
SE−(L)B3...030	2.5
SE−(L)B3...060	2.5
SE−B4...030	2.5
SE−C4...030	6.0
SE−B4...050	6.0

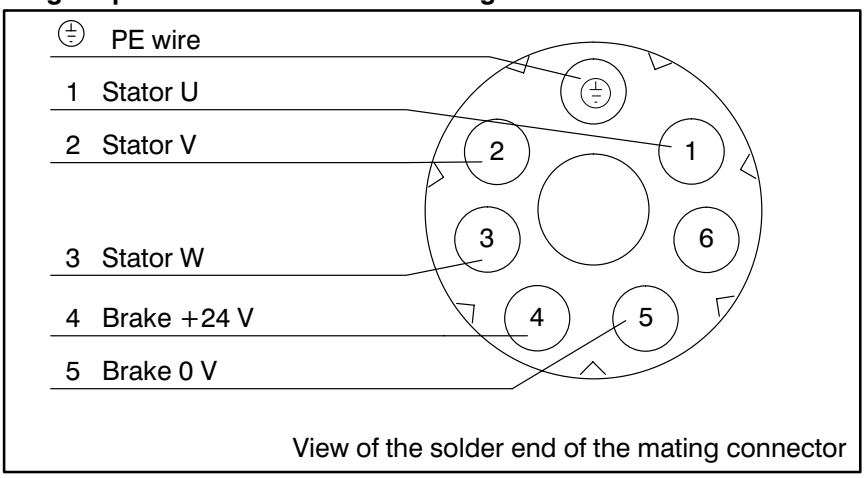
Motor	Connection cross-sectional area in the mating connector [mm²]	
SE−KB4	2.5	
SE−B5.320.020	6.0	terminal box
SE−B5.440.020	10.0	
SE−B5.570.020	10.0	
SE−B5.700.020	16.0	
SE−B5.320.030	10.0	
SE−B5.440.030	16.0	
SE−B5.570.030	25.0	
SE−B5.700.030	25.0	

CAUTION

When the Enable function is activated and SW = 0, incorrect tachogenerator and/or power cable connections, or defective tachogenerator cables, can allow the servo motors to run up to impermissible speeds, thus destroying them.

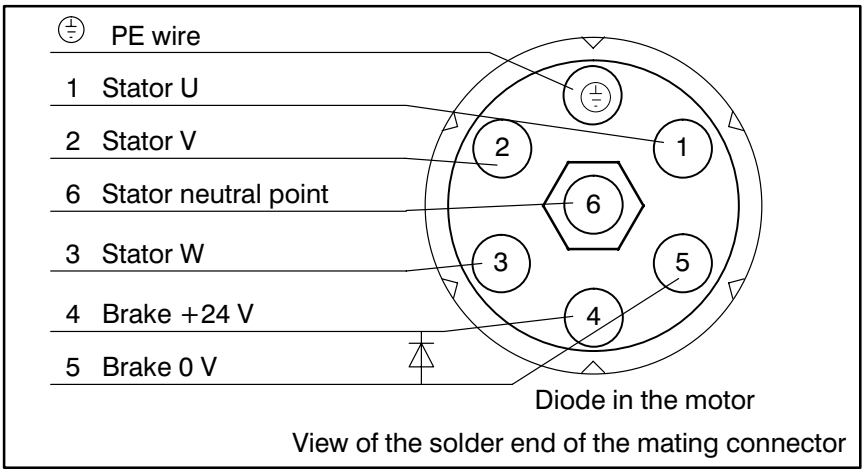
Always inspect tachogenerator and power connections before start-up !

Plug for power connection and holding brake SE−D1



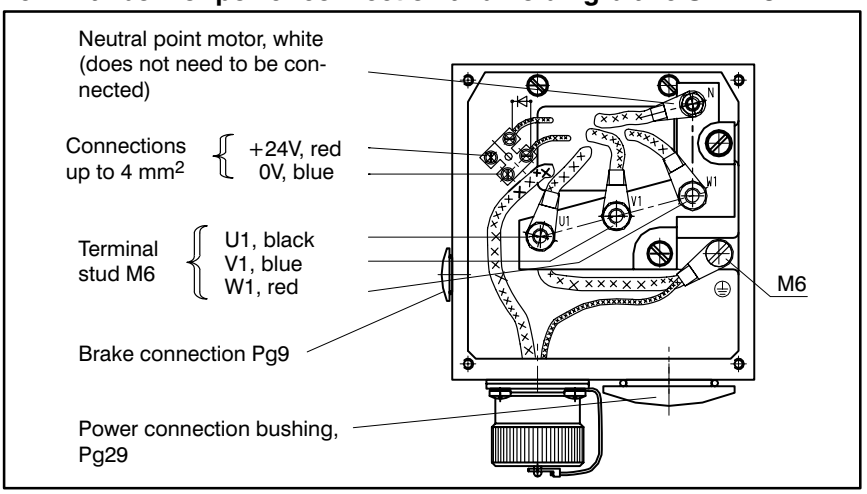
Plug for power connection and holding brake SE−B2, B3, LB3, B4, C4, KB4

! PIN 6 (neutral point motor) must not be connected!



Terminal box for power connection and holding brake SE−B5

! Neutral point motor must not be connected!



3.3.2 Plug braking

The feed motors can be decelerated by shorting the motor windings via braking resistors in order to prevent the feed axes coasting in the event of EMERGENCY-STOP.
The plug braking resistors must be rated so that the motors stop with maximum current in the shortest possible time.
The rating of the resistors is based on:

- the kinetic energy of rotation $W_{rot} = {}^1/_2 \; J\,w^2$ at maximum rotational speed
- the load moment of inertia = motor moment of inertia

The resistors are available as a resistor module:

Motor type	Resistance R_x [Ohm]	Minimum energy in short-time duty [Ws]	Order No.
SE−D1...	Direct short circuit without resistance		
SE−B2...	1.0	785	1070 914 767
SE−(L)B3. ... .030 SE−(L)B3.033.060	5.6	261	1070 913 546
SE−(L)B3.055.060	3.3	293	1070 913 545
SE−(L)B3.075.060 SE−(L)B3.095.060	3.3	785	1070 913 547
SE−B4. ... .030 SE−C4. ... .030	1.0	785	1070 914 767
SE−B4.090.050 SE−B4.130.050	3.3	785	1070 913 547
SE−B4.170.050 SE−B4.210.050 SE−B5. ... .020 SE−B5. ... .030	1.0	4085	1070 913 862
SE−KB4. ... .030	1.0	785	1070 914 767

R_x (+10%)	Each module has 3 resistors. Individual resistor in accordance with the table above
Connection cross-sectional area	max. 4 mm^2
Test voltage	2500 V AC
Ambient temperature	max. 55°C
Mounting	Mounting on hat rail 35 mm in accordance with DIN
Housing	IP 20

Plug braking contactors

The following contactors, for instance, are suitable for use as plug braking contactors :

Type	I_{th}	$\hat{I}$
Siemens 3TH...	16 A	150 A
Klöckner-Möller DIL R	16 A	150 A
Klöckner-Möller DIL 00	20 A	200 A

3.3.3 Holding brake

Control voltage for releasing the brake: 24 V DC ±10%.

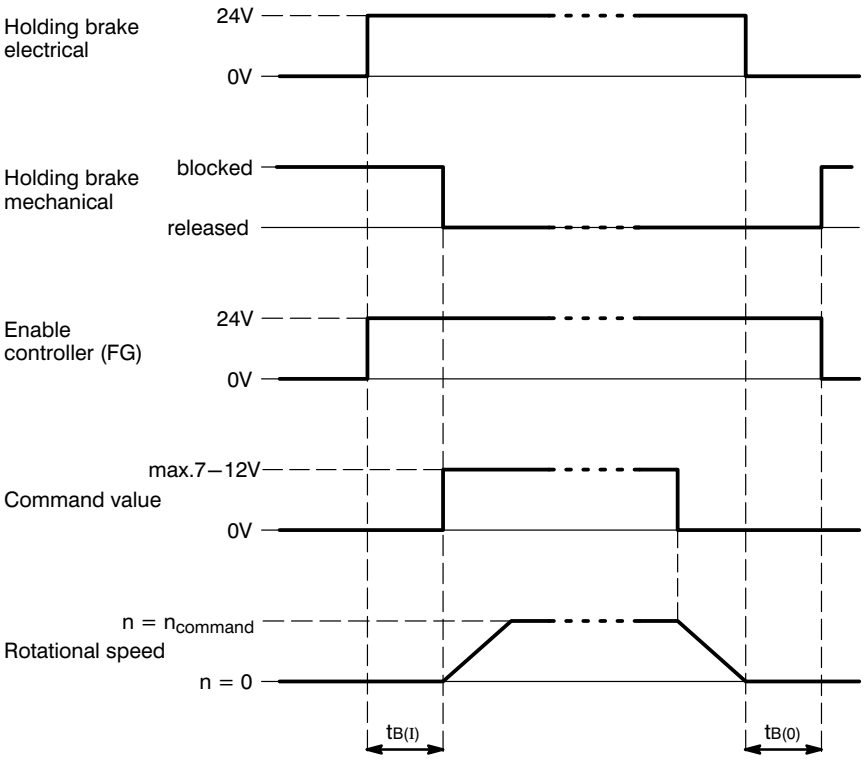
☞ **Note** **If the voltage tolerance is not observed, the holding brake cannot be reliably released.**

CAUTION

The holding brake is not an operating brake and may be operated only with the axis stationary. It will be necessary to return the holding brake to the factory for inspection after approx. 1000 EMERGENCY-STOP braking operations with load moment of inertia ≦ motor moment of inertia.

Control

Control of the holding brake, command value and enabling of the servomodule must be synchronized in accordance with the diagram below:



$t_{B(I)}$ = On time
Period between connection of the supply voltage and completely released brake

$t_{B(0)}$ = Off time
Period between disconnection of the supply voltage and completely blocked brake

In accordance with the above diagram, the holding brake is switched on and off with the servomotor at standstill. Applying a command value SW1 = 0 V produces a rotational speed n = 0 rpm, and the axis is reliably 'locked' until the holding brake is completely released or blocked.

The following on and off times of the holding brakes must be taken into consideration:

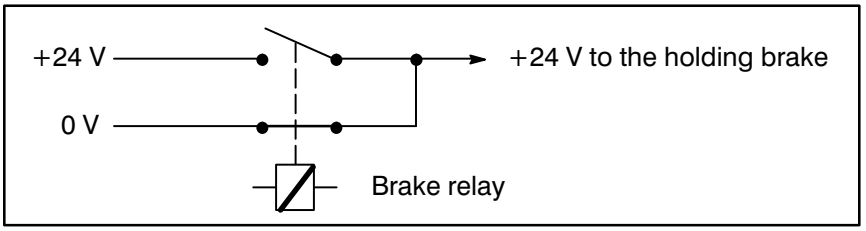
Size	On time $t_{B(I)}$ [ms]	Off time $t_{B(0)}$ [ms]
SE−D1	10	39
SE−B2	25	25
SE−(L)B3	40	55
SE−B4 /−C4	55	50
SE−B5	70	70
SE−KB4	55	50

IMPORTANT

The holding brake is not released if the polarity is reversed.

Interference

Capacitive pickup on the 24 V line to the holding brake may lead to delayed switch-off of the brake. Should such interference occur, we recommend that the holding brake be controlled on the basis of the following circuit schematic:



3.3.4 Tachogenerator and commutation connection SE—D1

A commutation adapter is used for the tachogenerator and commutation connection between the SE—D1 servo motors and the SM 1.5/3—TC1. The adapter is inserted in plug X5 on the underside of the module and, similar to a mating connector, is secured by two screw connections.

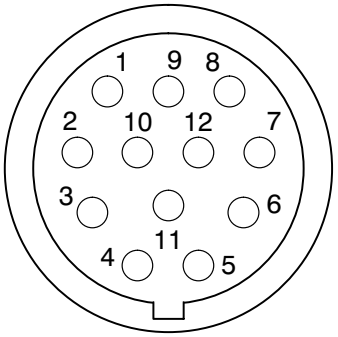
Commutation adapter: order no. 1070 068 080

Tachogenerator and commutation connections on plug X51 are made in accordance with the following table:

Module connection assignment X51 Pin	Signal	Motor connector assignment Pin	Bosch encoder cable Cross-sectional area [mm²]	Bosch encoder cable Color*	Function
1	A	4	0.14	white/grey	Rotor position encoder for commutation control
2	B	2	0.14	violet	
3	C	3	0.14	green	
7	GND	1	0.5	black	Power supply +15 V DC for tachogenerator and encoder
8	V+	12	0.5	red	
4, 9	θ	–	–	–	Bridge in the mating connector
6	θ	10	0.14	grey	Sensor for motor temperature monitoring
10	θ	11	0.14	white	
11	U	8	0.14	white/yellow	3-phase tachogenerator signal, matched with adapter to d.c. signal U = 2.7 V/1000 rpm
12	V	6	0.14	white/green	
13	W	7	0.14	pink	
14	Mp	5	0.5	brown	
Connector housing		–	Screen braided		Screen

* Pins 4 and 9 in the module-end mating connector must be bridged for motor temperature monitoring.

Connector system for tacho-generator and commutation connection (motor-end)

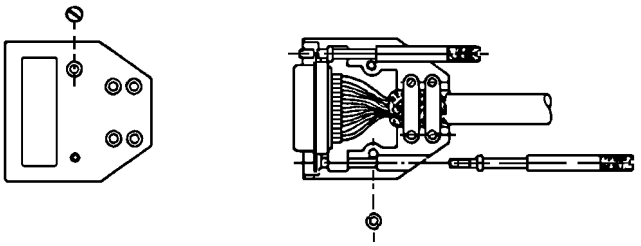


View of the mating connector solder end

Screen connection

In the **motor-end mating connector**, push the braided screen through the screen end cover, using the screws to connect it to the connector housing as shown in the accompanying installation instructions.

In the **module-end mating connector**, after stripping the insulation from the cable, fold back the screen braiding which has been shortened to approx. 1 cm over the cable insulation, clamp it beneath the strain-relief clamp, and connect it to the connector housing.



Tachogenerator cable

The Bosch special cable or comparable cable can be used.
For order no., see Section 5.1 .

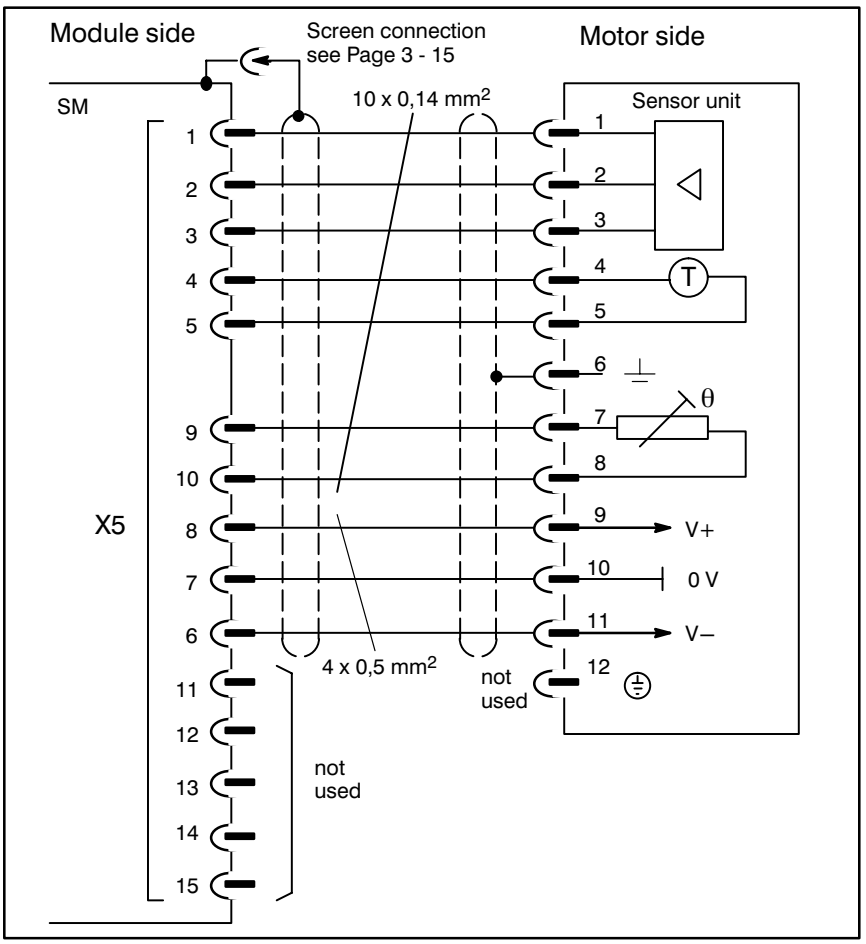
Max. permitted cable length: 100 m

Permitted bending radius:

- with one bend > 93 mm
- with repeated bends >185 mm

This tachogenerator cable is not suitable for trailing cable operation (see Section 3.3.6).

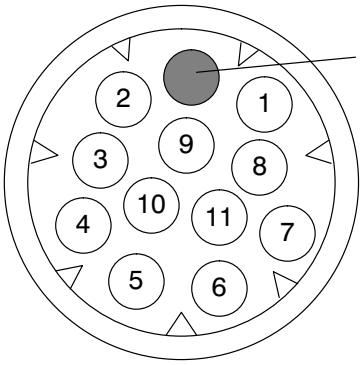
3.3.5 Tachogenerator and commutation connection SE–B2 ... B5, C4



Module connection assignment X5	Signal	Motor connector assignment	Color*	Function sensor unit
1	A	1	grey-white	Rotor position sensor for commutation control
2	B	2	violet	
3	C	3	green	
4	Tacho	4	yellow	Brushless DC tachogenerator U = 2.7 V/1000 rpm to n_N = 3000 rpm U = 1.8 V/1000 rpm to n_N = 6000 rpm
5	N	5	brown-white	
Connector housing (see Page 3 - 15)	Screen	6	–	Screening connected to PE in the motor
9	θ	7	grey	Thermistor for motor temperature monitoring
10	θ	8	white	
8	V+	9	red	Power supply ±15 V DC for tachogenerator and sensor
7	GND	10	black	
6	V–	11	blue	

* Color coding applies only to Bosch special cable

Connector system for tacho-generator and commutation connection (motor-end)



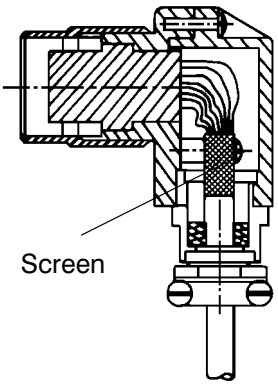
View of the mating connector solder end

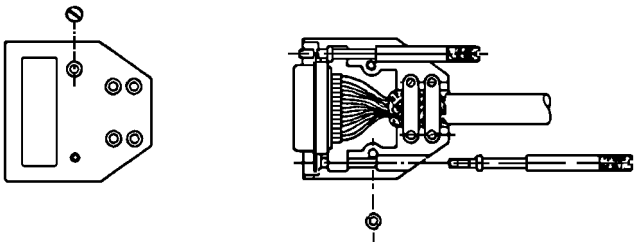
Pin 12 of the mating connector is closed by a **blanking plug.** This prevents confusion of the tachogenerator connector and encoder connector and thus prevents the encoder unit from being distroyed.

Screen connection

In the **motor-end mating connector**, push the braided screen beneath the strain-relief clamp and connect to the connector housing.

In the **module-end mating connector**, after stripping the insulation from the cable, fold back the screen braiding which has been shortened to approx. 1 cm over the cable insulation, clamp it beneath the strain-relief clamp, and connect it to the connector housing.





IMPORTANT

If servomotors which are not electrically connected are caused to rotate at high speeds, the 15 V DC power supply of the tachogenerator board must be connected in order to avoid a defect.

Tachogenerator cable

The Bosch special cable or comparable cable can be used.
For order no., see Section 5.1.

Max. permitted cable length: 100 m

Permitted bending radius:

- with one bend > 93 mm
- with repeated bends >185 mm

This tachogenerator cable is not suitable for trailing cable operation.

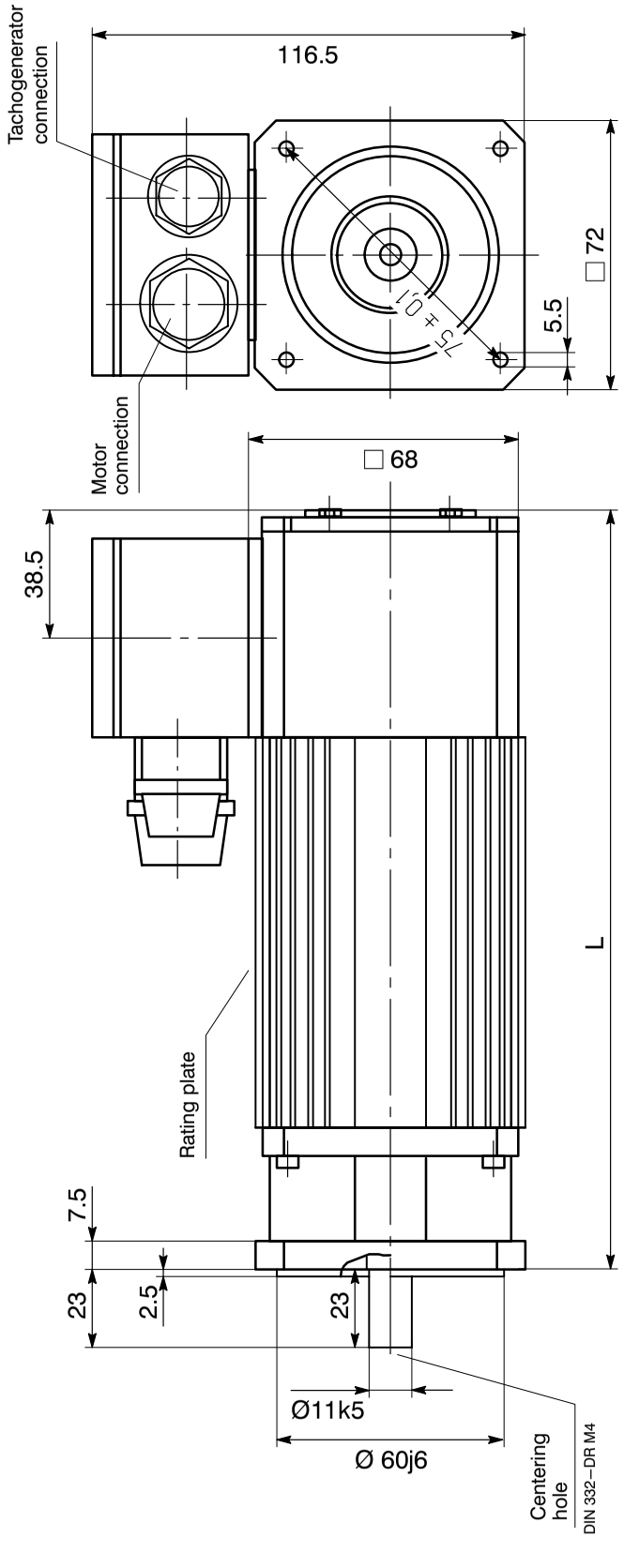
3.3.6 Trailing cable operation

In case of **trailing cable operation,** the mechanical load will depend on the radius and lengths of the chain and the traversing speed and torsional stress on the cable and must be approved by the cable manufacturer.
You can obtain further information from the following companies:

W. L. Gore & Co. GmbH, Pleinfeld, Tel. (09144) 60 10
Kabelmetal electro GmbH, Nürnberg, Tel. (0911) 52 07-0

4 Dimension sheets

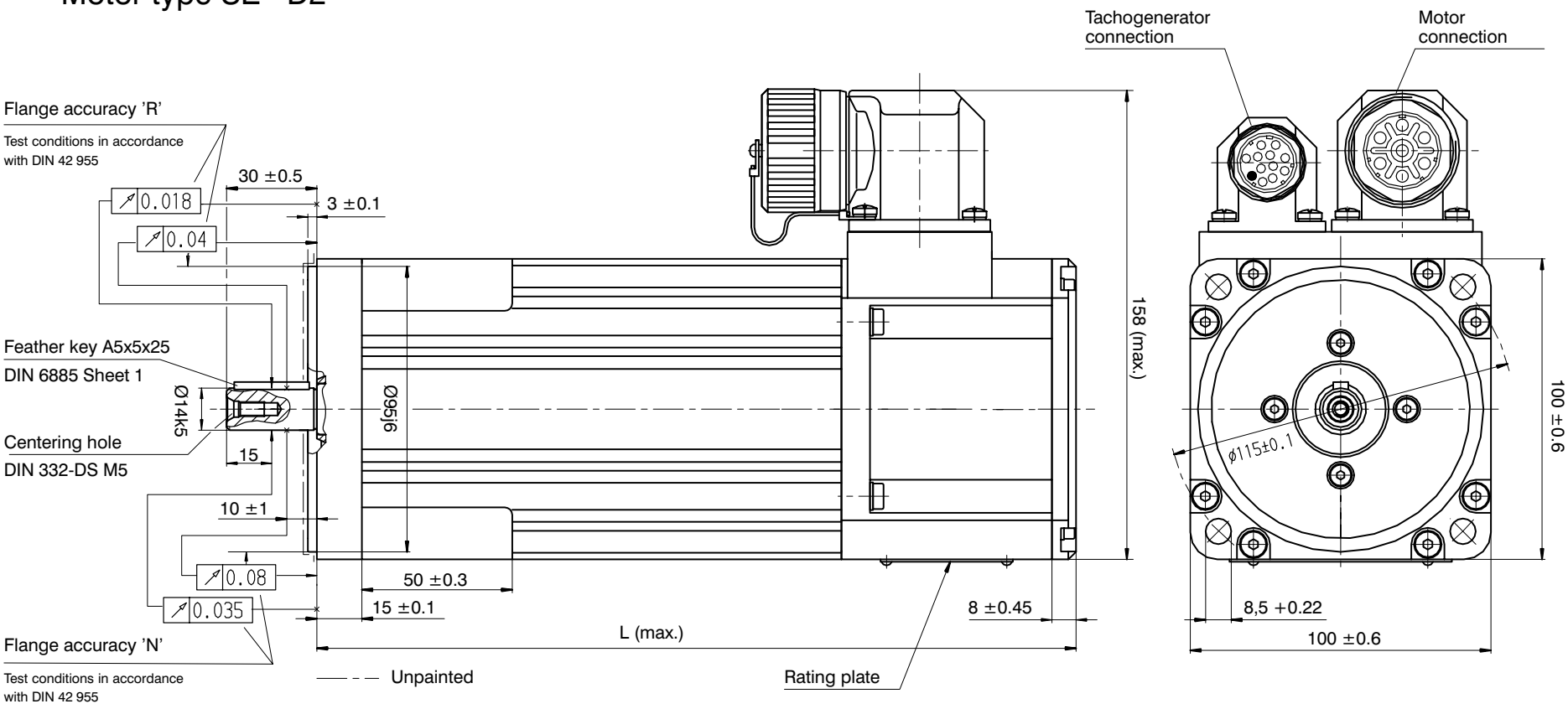
4.1 Dimension sheets servo motors, type SE



Type	Motor length L [mm]		Mass [kg]	
	without holding brake	with holding brake	without holding brake	with holding brake
SE–D1.010	227	227	2.9	3.1

Motor type SE–D1

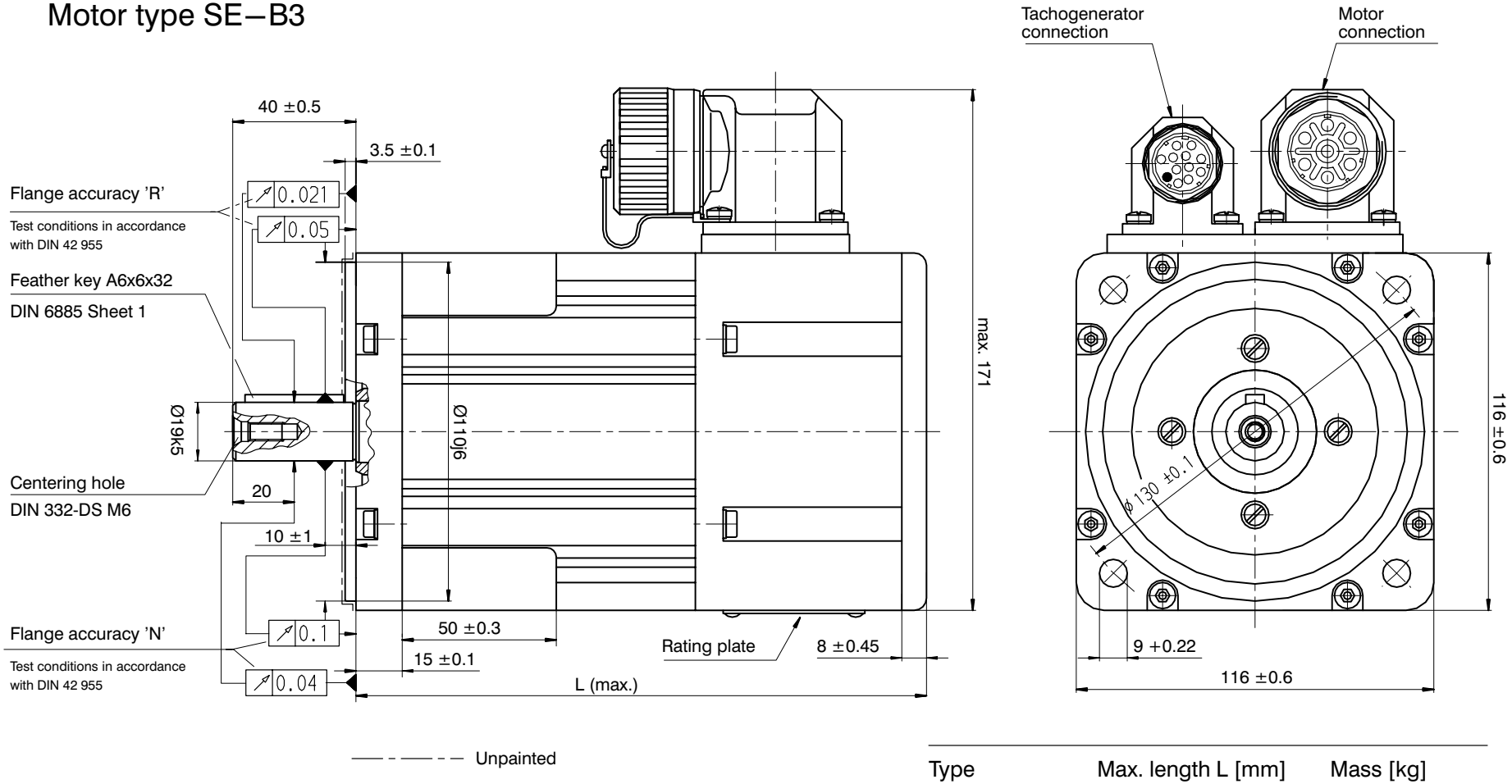
Motor type SE–D2



Type	Max. length L [mm]		Mass [kg]	
	without holding brake	with holding brake	without holding brake	with holding brake
SE–B2.010	207	237	5.3	5.7
SE–B2.020	230	260	6.5	6.9
SE–B2.030	254	283	7.6	8.0
SE–B2.040	277	307	8.8	9.2

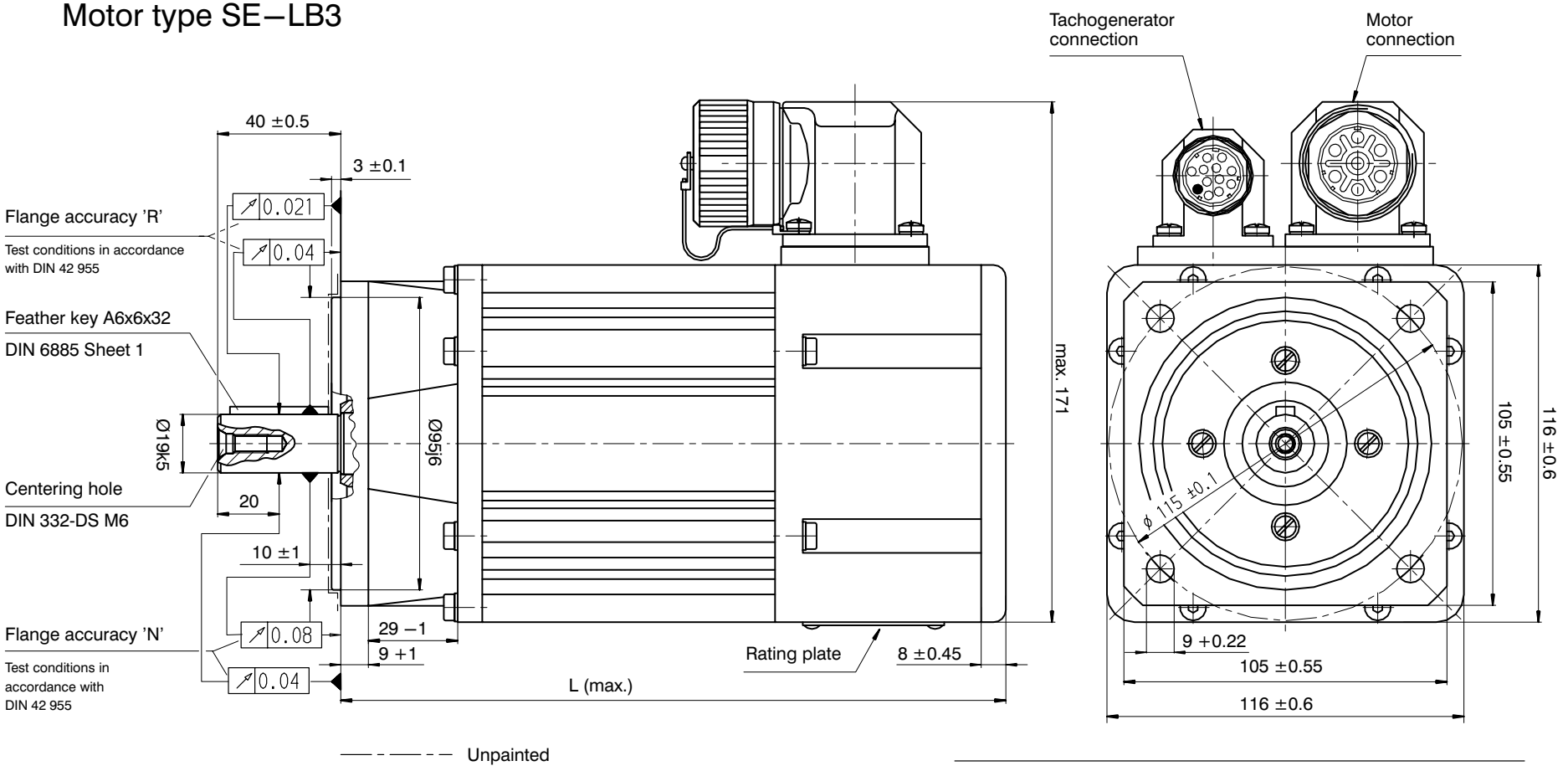
BOSCH

Motor type SE–B3



Type	Max. length L [mm]		Mass [kg]	
	without holding brake	with holding brake	without holding brake	with holding brake
SE–B3.033	225	263	8.1	8.8
SE–B3.055	256	295	10.2	10.9
SE–B3.075	288	327	12.4	13.1
SE–B3.095	320	359	14.5	15.2

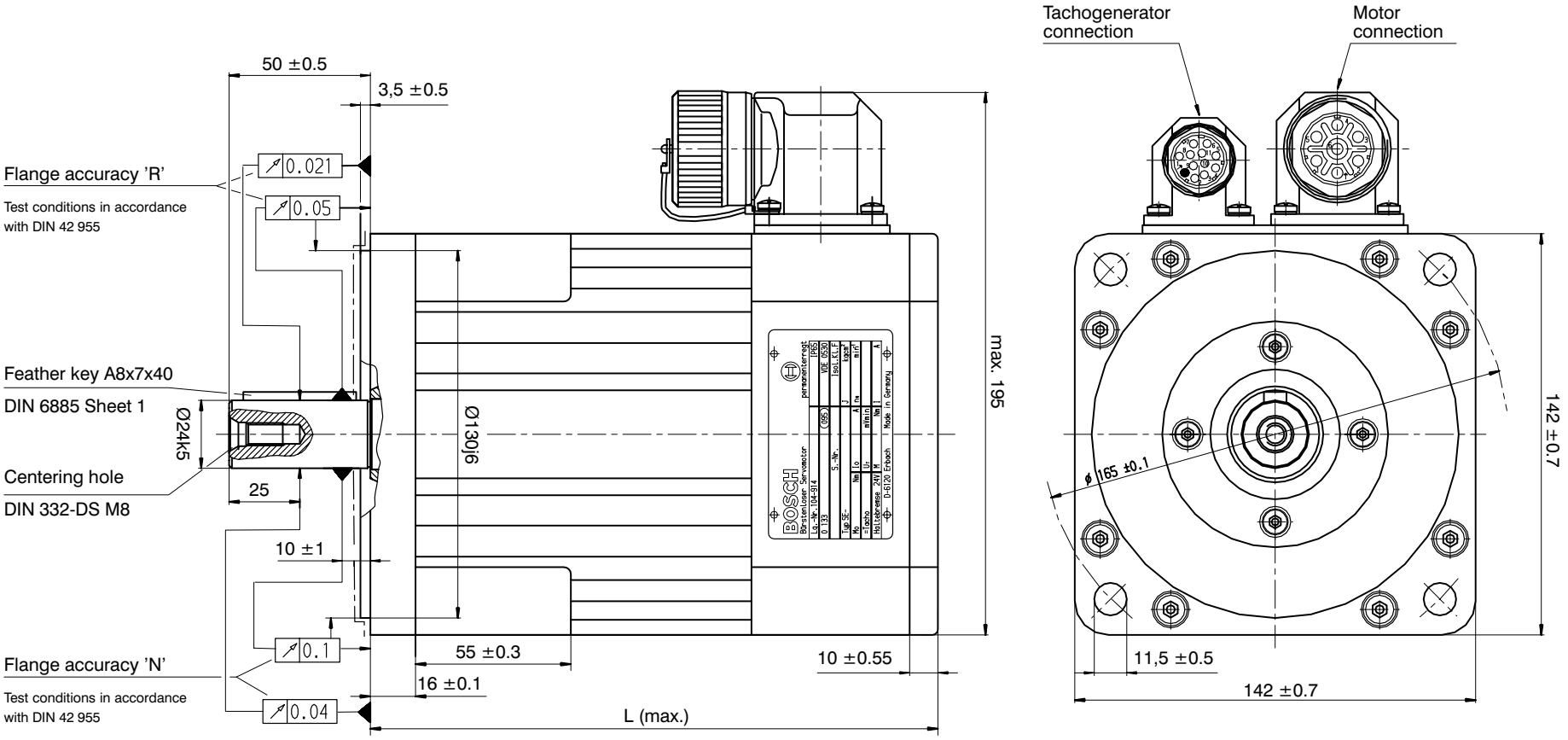
Motor type SE–LB3



Type	Max. length L [mm]		Mass [kg]	
	without holding brake	with holding brake	without holding brake	with holding brake
SE–LB3.033	256	263	8.5	9.2
SE–LB3.055	287	295	10.6	11.3
SE–LB3.075	319	327	12.8	13.5
SE–LB3.095	351	359	14.9	15.6

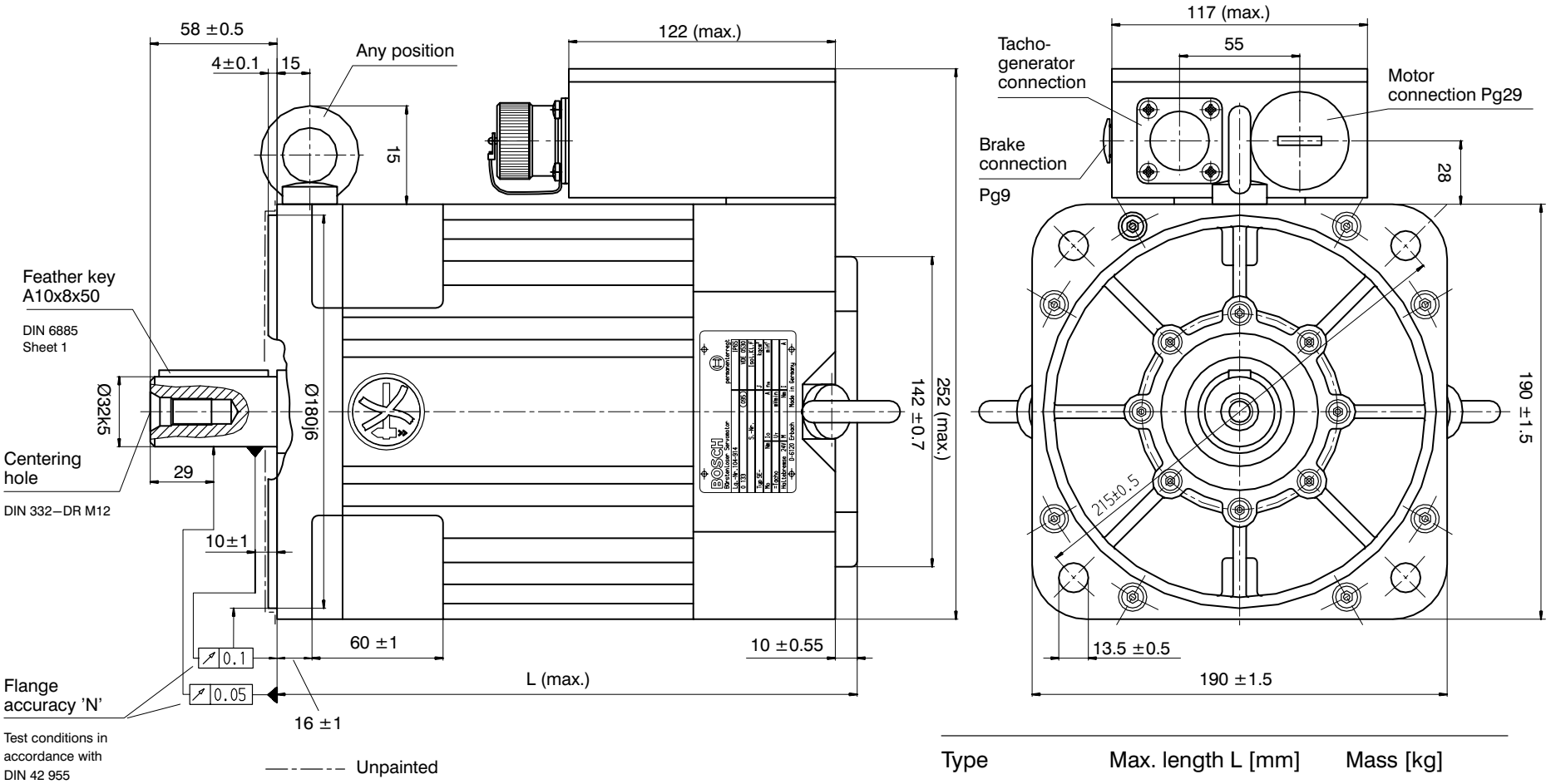
BOSCH

Motor type SE–B4/–C4



Type	Max. length L [mm]		Mass [kg]	
	without holding brake	with holding brake	without holding brake	with holding brake
SE–B4.090	252	299	13	15
SE–B4.130	283	330	16	18
SE–B4/C4.170	315	362	19	21
SE–B4/C4.210	347	394	22	24

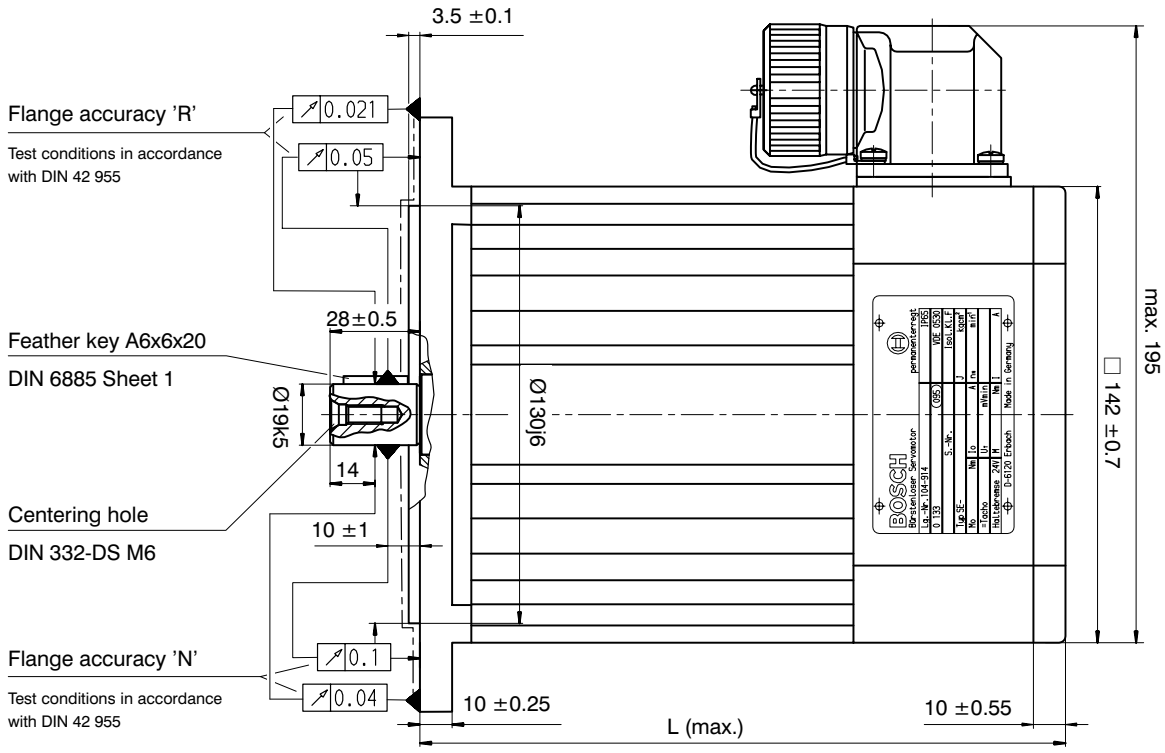
Motor type SE–B5

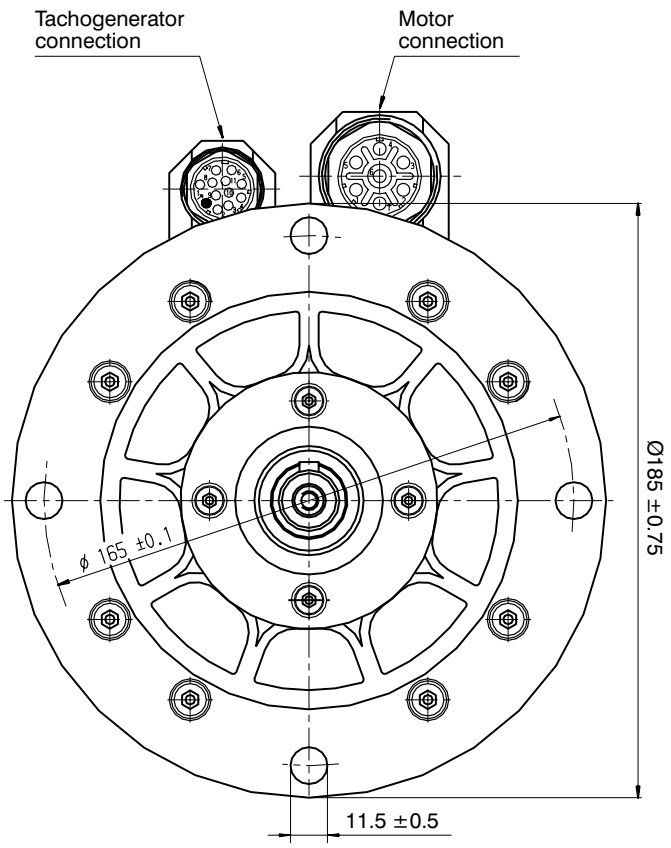


Type	Max. length L [mm]		Mass [kg]	
	without holding brake	with	without holding brake	with
SE–B5.320	345	387	31	37
SE–B5.440	395	437	39	45
SE–B5.570	445	487	45	51
SE–B5.700	495	537	51	57

BOSCH

Motor type SE–KB4





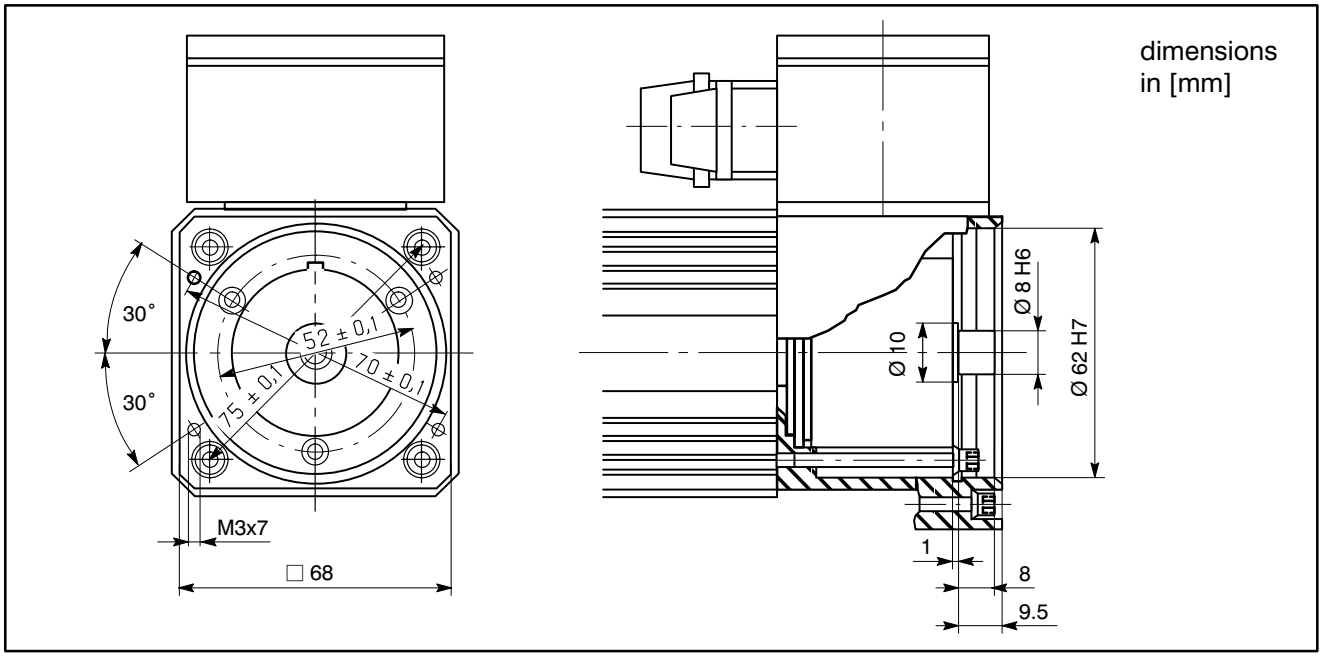
Type	Max. length L [mm]		Mass [kg]	
	without holding brake	with	without holding brake	with
SE–KB4.020	204	251	7	9
SE–KB4.040	220	267	9	11
SE–KB4.060	236	283	11	13
SE–KB4.090	252	299	13	15

4.2 Dimension sheet, non-driving end shaft end for encoder attachment

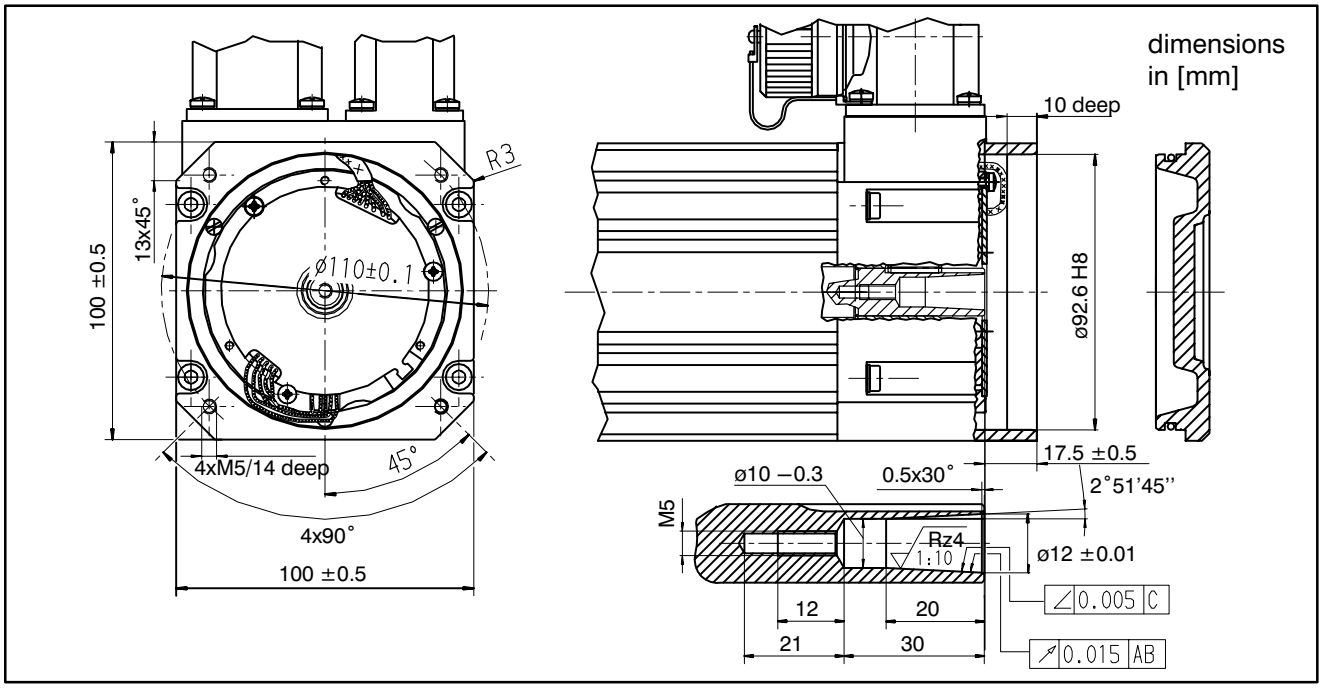
CAUTION

Operating temperatures may reach 90...100˚C on the encoder attachment surface of the motors. Encoders intended for attachment must be suitable for operation at these temperatures.

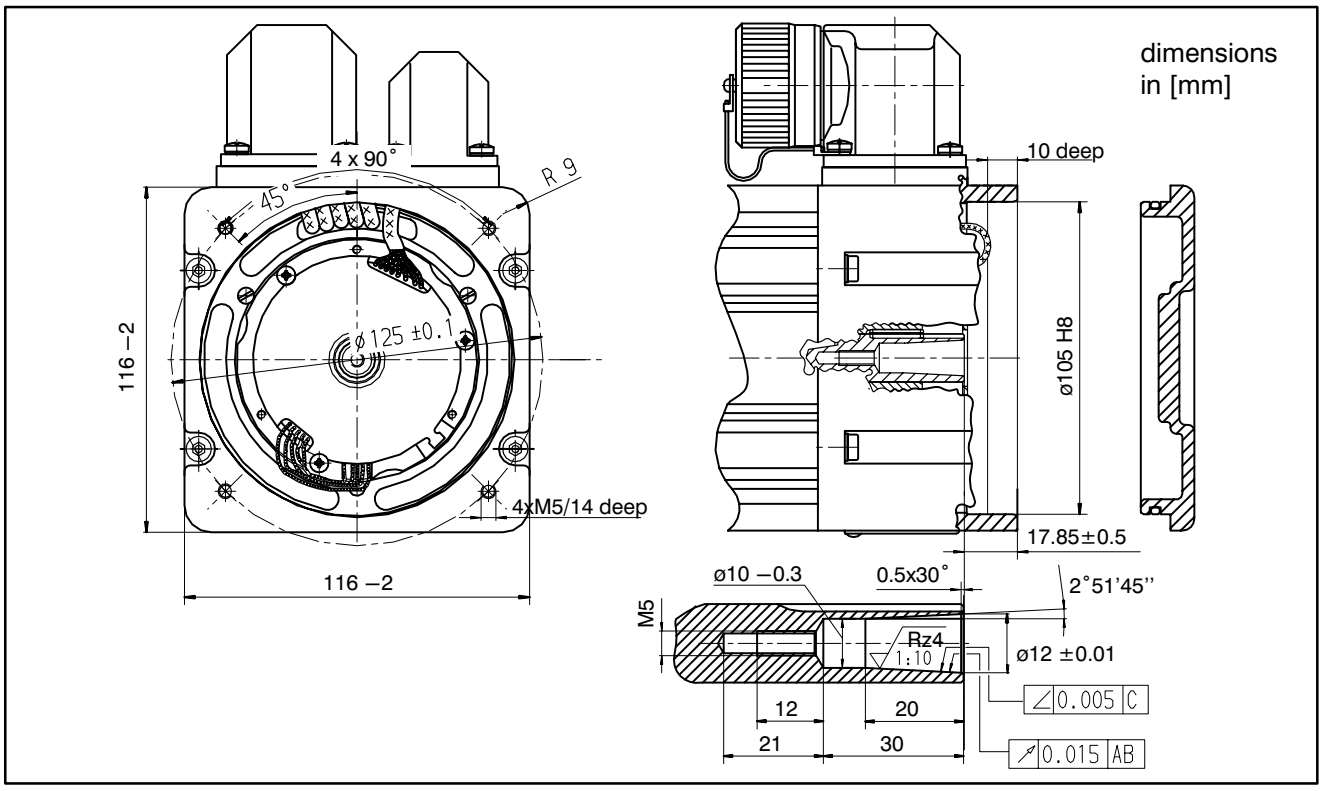
SE–D1



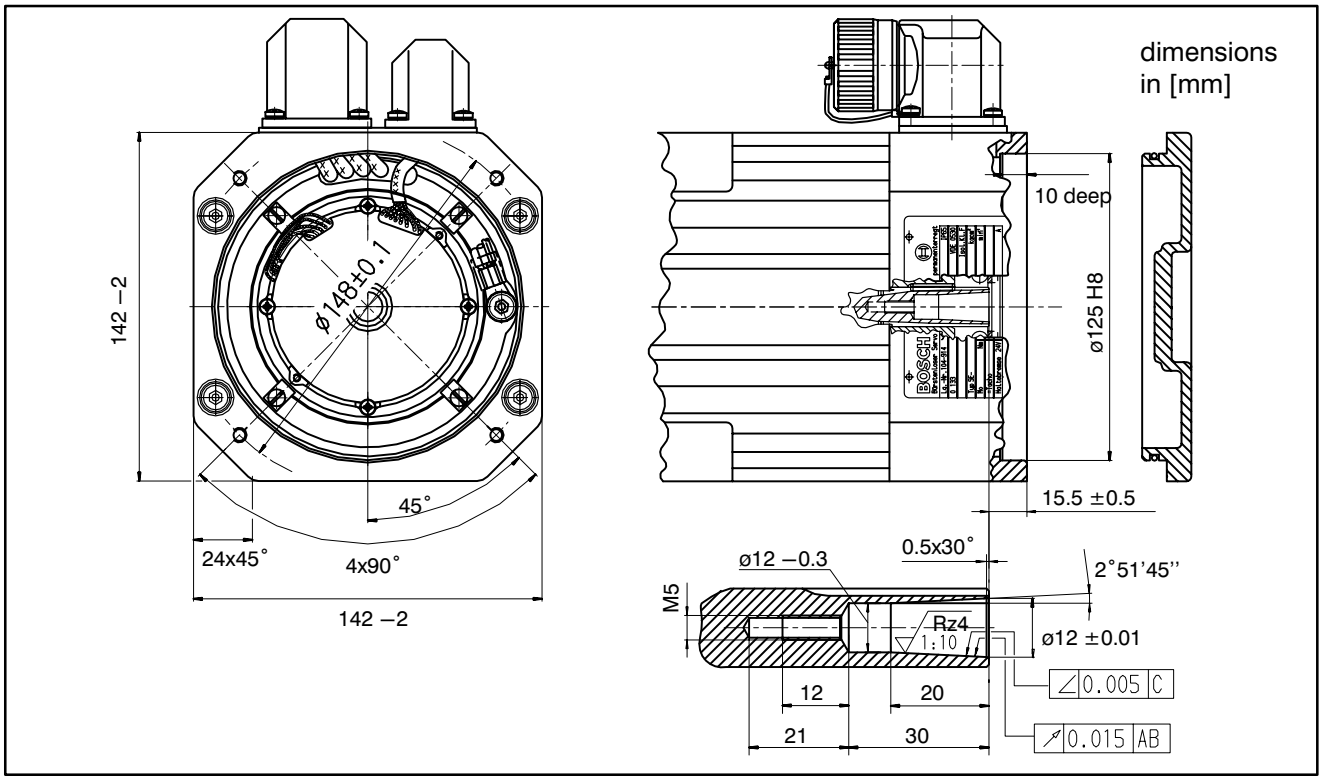
SE–B2



SE–B3, LB3

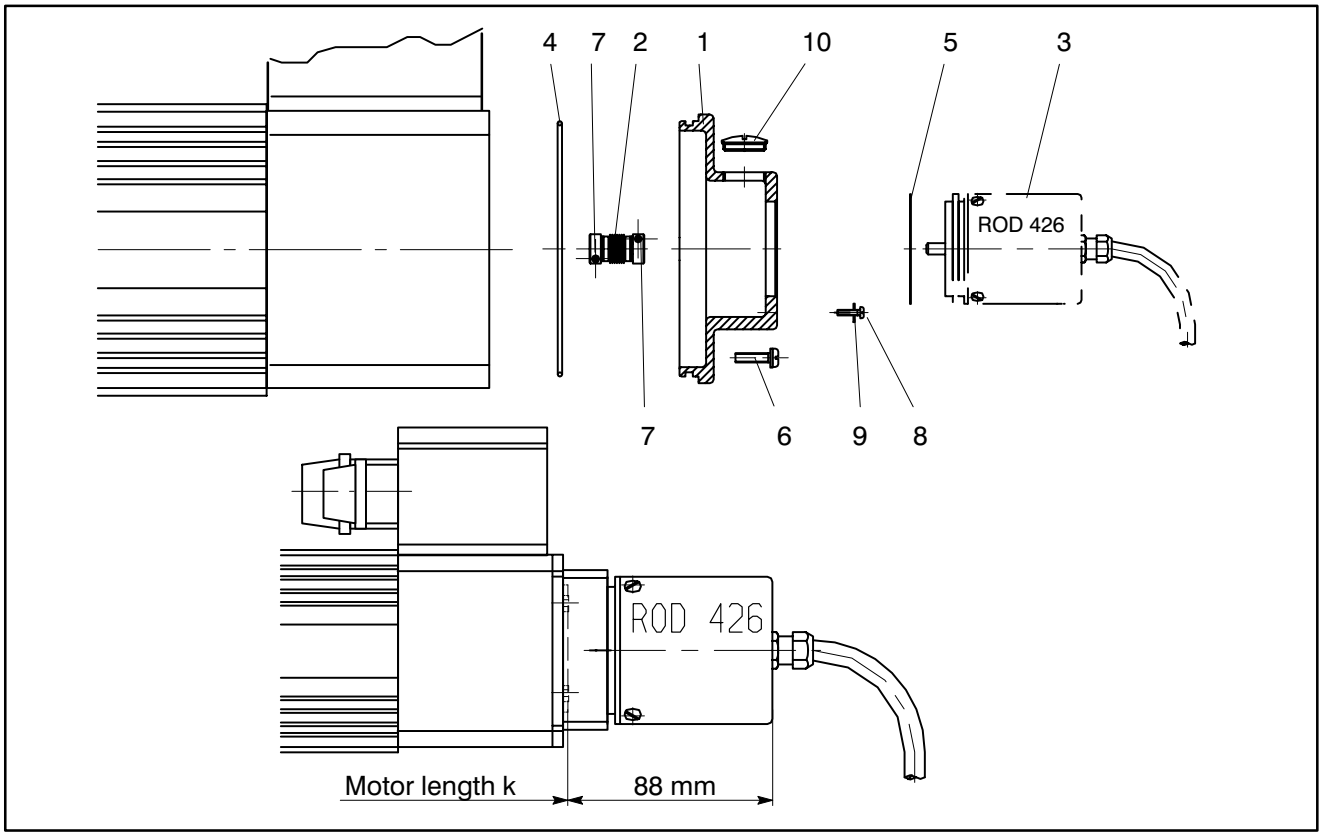


SE–B4, C4, B5, KB4



4.3 Dimension sheet / assembly drawing for ROD attachment

Preparation kit for incremental encoder ROD 426.014 for SE—D1... (cf. Section 1.6)



Item designations

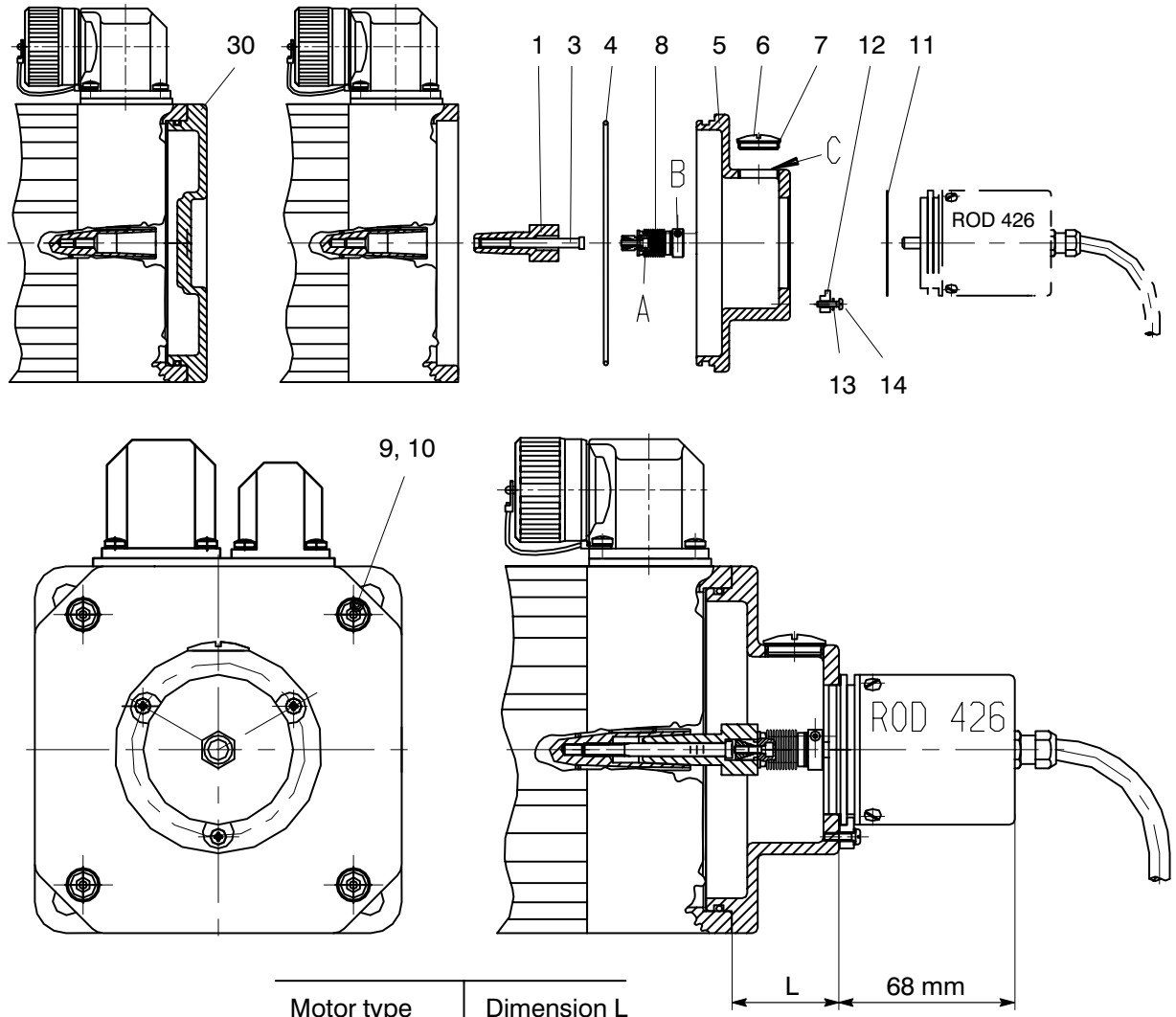
Item No.	Designation	Item No.	Designation
1	Encoder flange	6	Machine screw
2	Coupling	7	Clamping screw
3	Encoder ROD	8	Machine screw M4
4	O-ring	9	Washer
5	Seal ring	10	Blanking plug with O-ring

Installation instructions Preparation kit ROD 426 for SE—D1...

1. Remove the bearing cap with seal from the motor.
2. Place the coupling (2) all the way onto the shaft extension until it stops, and secure with the clamping screw (7).
3. Fit the encoder flange (1) on the fitting surface with the O—ring (4) place onto the end plate, and secure with the machine screw (6).
4. Fit the ROD encoder (3) on the fitting surface with the seal ring (5) and place into the encoder flange while inserting into the coupling (2). Secure with the M4 x 10Z3 machine screws (8) and washers (9).
5. Secure the encoder shaft in the coupling (2) with the clamping screw (7).
6. Close the threaded opening on the encoder flange (1) with the blanking plug (10).

See also enclosed notes on installation.

Preparation kit for incremental encoder ROD 426.014 for SE−B... and SE−C... (cf. Section 1.6)



Motor type	Dimension L
SE−B2	40 mm
SE−B3,−LB3	40 mm
SE−B4,−C4	42 mm

Item designations

Item No.	Designation
1	Coupling half
3	Machine screw
4	O-ring adapter flange
5	Adapter flange
6	Blanking plug
7	O-ring blanking plug
8	Drive coupling

Item No.	Designation
9	Serrated lock washers
10	Machine screw
11	Seal ring
12	Clamping claw
13	Spring washer
14	Oval-head screw
30	Bearing cap

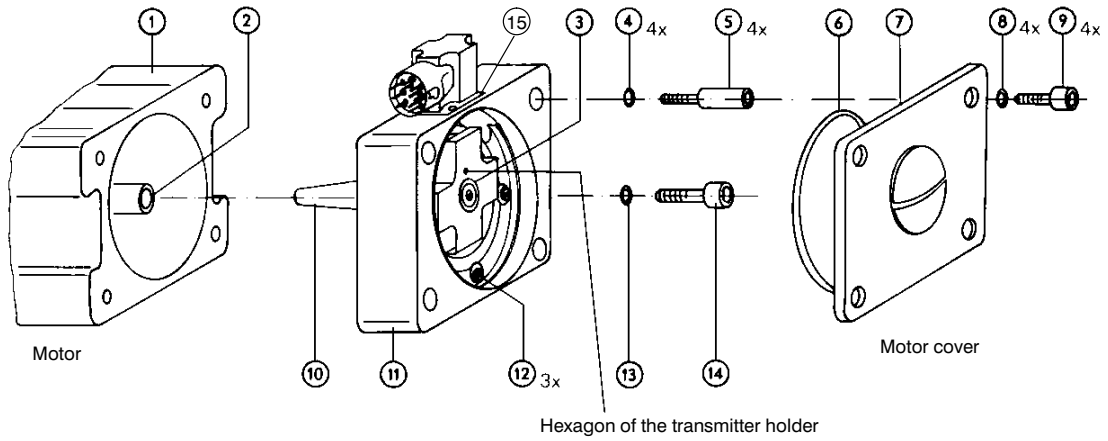
Installation instructions Preparation kit ROD 426 for SE—B... and SE—C...

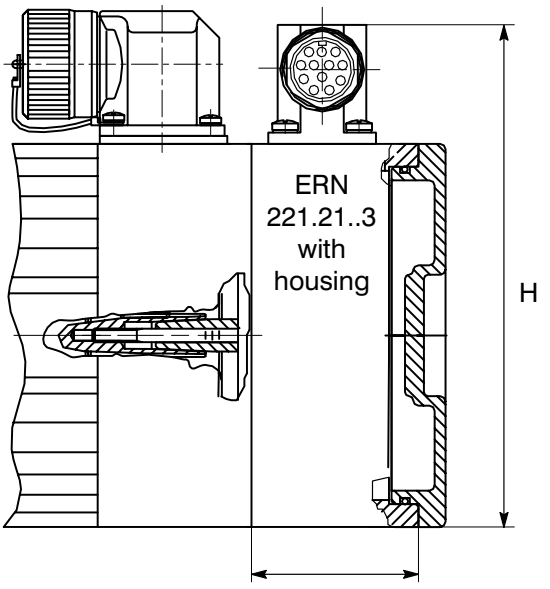
1. Remove the bearing cap (30) with seal from the motor
2. Clean the cone on the motor shaft.
3. Insert the coupling half (1) into the shaft and tighten it with the machine screw (3) (4.3...5.4 Nm).
4. Insert the drive coupling (8) into the coupling half (1) and tighten the screw A in the drive coupling to a torque of 0.9...1.0 Nm.
   Ensure that screw B of the drive coupling is fixed vertically.
5. Fit the O-ring (4) onto the adapter flange (5).
6. Slide the adapter flange (5) onto the motor and secure it with **new** serrated lock washers (9) and the existing machine screws (10) (SE—B2 and B3 to a torque of 3.7...5 Nm, SE—B4 and B5 to a torque of 6.5...8.7 Nm).
7. Fit the seal ring (11) onto the ROD 426.
8. Carefully insert the shaft of the ROD 426 into the drive coupling (8). If necessary, lift the drive coupling slightly through the hole C.
9. Mount the ROD 426 with clamping claws (12), oval-head screws (14) and spring washers (13) to a torque of 0.6...0.8 Nm.
10. Tighten (0.35...0.4 Nm) the drive coupling (8) with screw B on the shaft of the ROD 426.
11. Check that the encoder is correctly positioned by turning the motor shaft.
12. Fit the O-ring (7) onto the blanking plug (6).
    Screw the blanking plug (6) onto the adapter flange (5) and tighten it to a torque of 2.5...3 Nm.

See also enclosed notes on installation.

4.4 Dimension sheet / Assembly drawing for ERN attachment

ERN 221.21..3 incremental encoder in the SE−B... and SE−C... housing (cf. Section 1.6)





15

Motor type	H [mm]
SE−B2...	131
SE−B3, LB3...	147
SE−B4, C4...	173
SE−B5...	173 (to the bottom edge of the motor cover)
SE−KB4...	173

Item designations

Item No.	Designation
1	Motor
2	Motor shaft
3	Zero pulse mark
4	Lock washers
5	Threaded bolts
6	O-ring
7	Motor cover
8	Lock washers
9	Screws
10	Taper shaft
11	Encoder
12	Phillips screws
13	Washer
14	Hexagon socket screw a/f 4
15	Phillips screws

Installation instructions ERN 221.21..3 for SE—B... and SE—C...

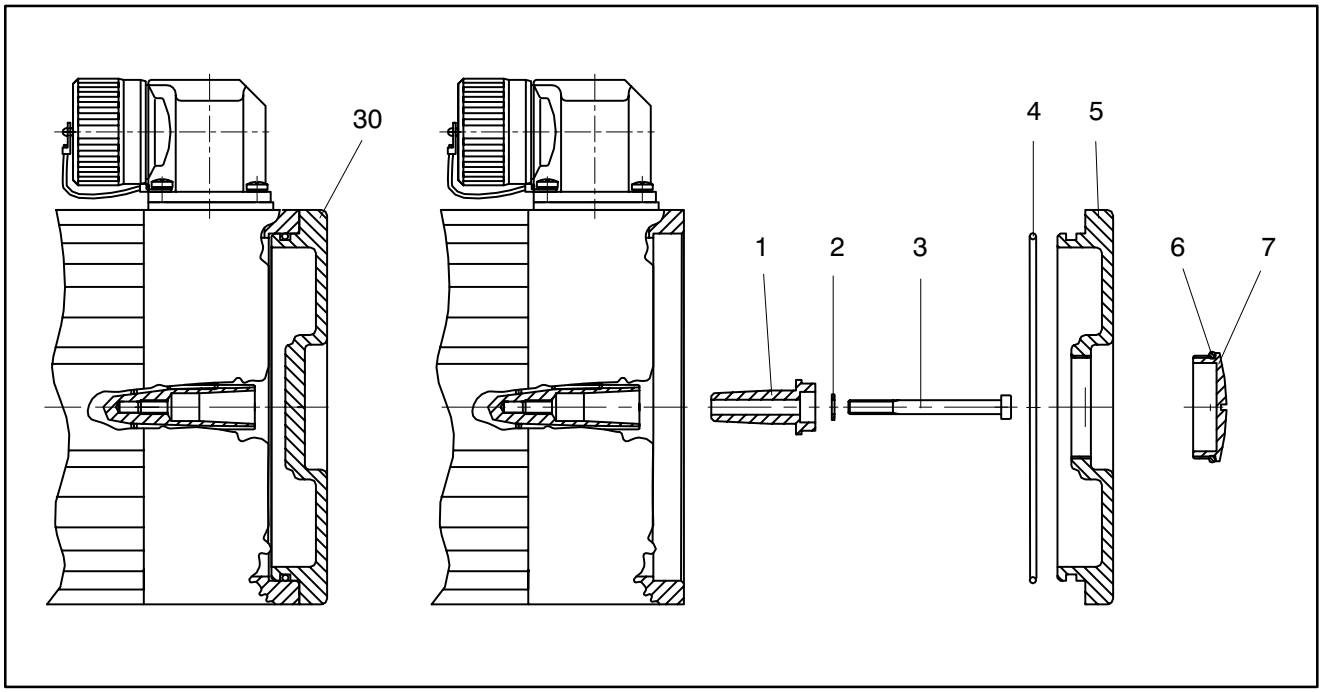
1. Remove motor cover (7) with hexagon socket spanner.
2. Remove encoder (11) from the packaging, remove shipping brace and align the zero pulse mark (3) on the encoder shaft with the slot in the spring steel piece (rough adjustment of the zero pulse).
3. Fit the encoder on the motor shaft, without turning the encoder shaft, and secure with 4 threaded bolts (5) and lock washers (4). Use a screwdriver with a blade size of 1.6 x 10 mm and tighten to 3.7...5 Nm for M6 threads.
4. Fully unscrew all 4 Phillips screws (15) in order to turn the angle connector.
   Carefully turn the connector and then screw in the screw again, tightening with a force of 0.6 Nm.

IMPORTANT

Do not twist the connecting wire excessively!

5. Screw the screw (14) with washer (13) into the taper shaft (10) of the encoder and tighten with a hexagon socket wrench with a force of 3.7...5 Nm.
6. If fine adjustment of the zero pulse is necessary, it is necessary to undo the Phillips screws (12). Now turn the encoder in the housing until the control signals the zero pulse. Hold the encoder in this position and tighten the 3 screws (12) again with a maximum torque of 1 Nm.
7. Renew the O-ring (6) in the motor cover (7) and screw the motor cover onto the encoder (11) with the screws (9) and lock washers (8).
   Tightening torque 3.7...5 Nm for M5, 6.5...8.7 Nm for M6.

4.5 Dimension sheet, 2nd shaft end for handwheel



Item designations

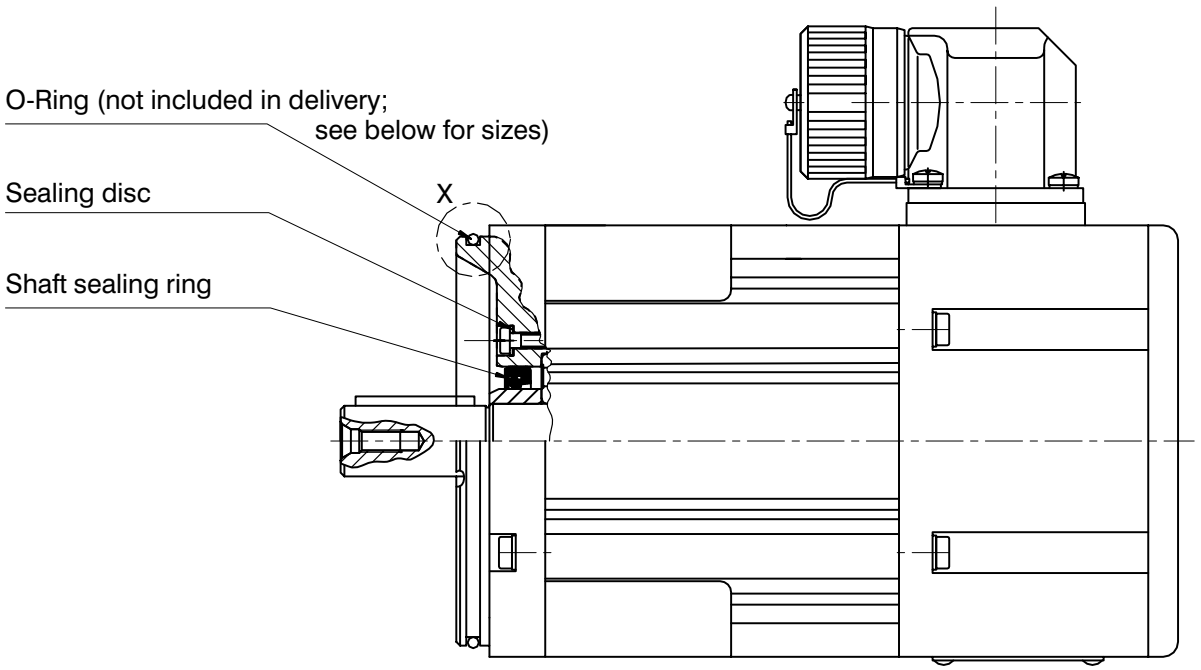
Item No.	Designation	Item No.	Designation
1	Driver with hexagon (a/f 13)	5	Bearing cap
2	Spring washer	6	O-ring blanking plug
3	Machine screw	7	Blanking plug
4	O-ring bearing cap	30	Bearing cap

Installation instructions

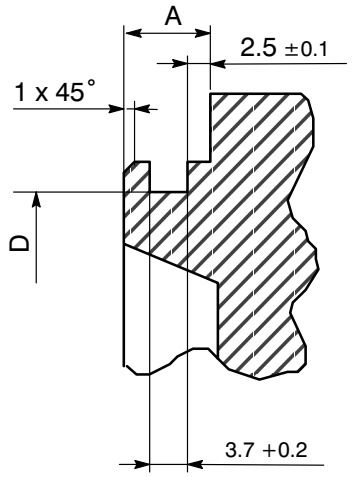
1. Remove the bearing cap (30) with seal from the motor.
2. Clean the cone on the motor shaft.
3. Insert the driver (1) into the shaft and tighten it with the spring washer (2) and machine screw (3) (4.3...5.4 Nm).
4. Check that the driver is correctly positioned by turning the motor shaft.
5. Fit the O-ring (4) onto the bearing cap (5).
6. Fit the bearing cap (5) onto the motor and secure it with spring washers and the existing machine screws (SE−B2 and B3 to a torque of 3.7...5 Nm, SE−B4 and B5 to a torque of 6.5...8.7 Nm).
7. Fit the O-ring (6) onto the blanking plug (7).
   Screw the blanking plug (7) into the bearing cap (5) and tighten to a torque of 3.5...4 Nm.

See also enclosed notes on installation.

4.6 Dimension sheet, oil-tight driving-end end plate (Sizes B2, B3, B4, C4, B5, KB4)



Detail X
(dimensions in mm)



Motor type	A [mm]	D [mm]	Size of the required O-ring
SE−B2...	8.9 −0.1	Ø 90.4 h9	88−3
SE−B3...	8.9 −0.1	Ø105.4 h9	105−3
SE−B4...	8.9 −0.1	Ø125.4 h9	124−3
SE−B5...	10 −0.1	Ø175.4 h9	174−3
SE−KB4...	8.9 −0.1	Ø125.4 h9	124−3

5 Order numbers

5.1 Accessories, Replacement parts

	Designation	Order No.
Accessories	Mating connector for motor, tachogenerator and encoder	Section 1.4
	Bosch encoder cable, delivered by the meter	1070 903 499
	Plug braking resistor modules	Section 3.3.2
	Preparation kit for ROD 426.014 / CE 65 M	Section 1.6
	Second shaft end for handwheel	Section 1.6
	Incremental encoder ROD 426.014	Section 1.7
	Incremental encoder in the ERN 221 housing	Section 1.7
Replacement parts	Coupling for attached ROD 426.014 / CE 65 M on: ○ SE−D1 ○ SE−B...	1070 913 224

5.2 Replacement parts, connector system

Motor designation	SE−B2	SE−(L)B3..030	SE−(L)B3..060	SE−B4..030 SE−KB4	SE−C4 SE−B4..050
Power socket (mating connector, see Section 1.4)					
Angled flange socket, Order No.:	1070 916 656				
Contact pins:					
8291-1439 Order No. 916 652	2 x	2 x	2 x	–	–
8291-1435 Order No. 914 029	4 x	–	–	2 x	–
8291-1433 Order No. 914 031	–	4 x	–	–	–
8291-1431 Order No. 914 030	1 x	1 x	5 x	5 x	–
8291-1679 Order No. 916 423	–	–	–	–	7 x
8291-1697 Adapter sleeve Order No. 916 424	–	–	–	–	2 x

Tachogenerator socket for all sizes (mating connector, see Section 1.4)	
Angled flange socket, Order No.:	1070 916 657
Contact pins:	
10 x 8291-1297 Order No. 914033	10 x
1 x 8291-1295 Order No. 914032	1 x

Dismantling tools for mating connectors and contacts			
Designation	Tachogenerator plug Encoder plug	Motor plug SE−B2, −B3, −LB3 SE−B4..030, −KB4	Motor plug SE−C4 SE−B4..050
Contact Ø 1.6 mm	Order No. 914050		
Contact Ø 2.4 mm		Order No. 914051	
Contact Ø 3.6 mm			Order No. 914115

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