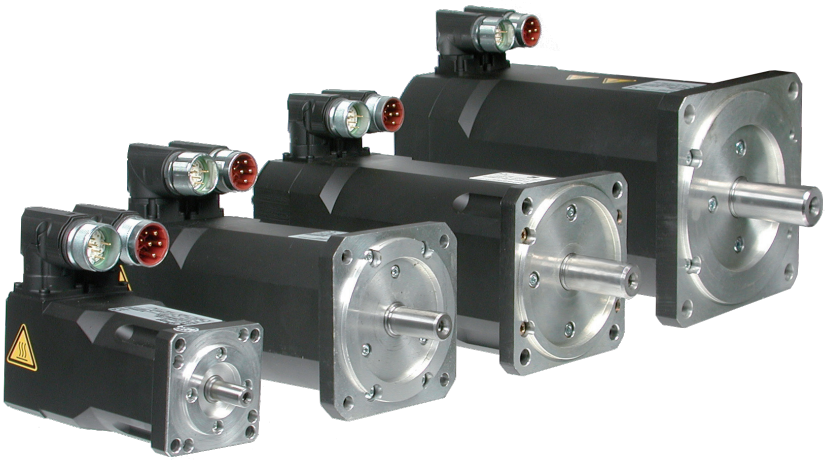
INSTRUCTION MANUAL



Dynamic Line II

GB Servo Motors SM.5 Size A1…E3

Mat.No.	Rev.
00SM0EB-K013	1C

KEB

This instruction manual describes the motors of the series Dynamic Line II. The safety and warning notes listed in this instruction manual as well as in other documentation must be observed at any rate to ensure a safe operation. Non-observance of the safety instructions leads to the loss of any liability claims. The safety and warning instructions specified in this manual do not lay claim on completeness. KEB reserves the right to change/adapt specifications and technical data without prior notice. The pictograms used here have the following meaning:

	Danger Warning Caution	Is used when the life or health of the user is in danger or considerable damage to property can occur.
	Attention observe at all costs	Is used when a measure is necesary for safe and disturbance free operation.
	Information Aid Tip	Is used, if a measure simplifies the handling or operation of the unit.

The use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the machine manufacturer.
The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.
A selection of our units in view of their suitability for the intended use must be done generally by the user.
Tests can only be done by the machine manufacturer in combination with the application. They must be repeated completely, even if only parts of hardware, software or the unit adjustment are modified.
Repairs may be carried out only by the manufacturer or repair places authorized by him. Unauthorised opening and tampering may lead to bodily injury and property damage and may entail the loss of warranty rights. Original spare parts and authorized accessories by the manufacturer serve as security. The use of other parts excludes liability for the consequences arising out of.
The suspension of liability is also valid especially for operation interruption damages, loss of profit, data loss or other damages. This also applies if we have been pre-referred to the possibility of such damages.
If individual regulations should be futile, not effective or impracticable, then the effectivity of all other regulations or agreements is not affected by this.

1. General

1.1 Intended use

The synchronous servo motors KEB COMBIVERT SM serve for the operation on digital servo controllers and are intended for industrial systems. They comply to the harmonized standards of the series VDE 0530/EN 60034. The use in hazardous areas is prohibited, unless it is explicitely permitted (observe additional instructions).

	**Operation within the limit values**	The local conditions on site shall comply with the name plate data. If the servo motors are used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder. The operation of the servo motors outside the indicated limit values of the technical data leads to the loss of any liability claims.

1.2 Safety Instructions

	**Electrical qualified personnel**	Only qualified personnel are allowed to perform any planning, installation or maintenance work (observe VDE 0105, IEC 364). The personnel must be trained for the job and must be familiar with the installation, assembly, start-up and operation of the product. The instructions given in the manual or any other documentation must always be observed. Improper operation can cause damages to personnel and equipment.

	**Dangerous voltage**	During the operation (even at zero speed) the motors posses dangerous live parts. In the case of synchronous motors with rotating rotor a high voltage is applied onto the motor connections. Remove power to the machine before starting any work on the motors. The isolation from supply must be checked and secured.

	**No mains operation**	The motors are not designed for direct connection to the three-phase system but are to be operated via an electronic power inverter. Direct connection to the system may destroy the motor.

	**Hot surfaces**	The motors can reach a surface temperature of more than 100°C. No temperature-sensitive parts may lay close to or be attached onto the motor. If necessary, protective measurements must be taken against touching.

	**Secure feather-key**	Before commissioning motors with a shaft key, secure the key to ensure that it cannot be thrown out if this is not already prevented by driving elements such as a belt pulley, coupling, etc.

	**Operation with integrated brake**	Check the proper functioning of the brake (optional) after installing the motor. The optional holding brake is only designed for a limited number of emergency brakings. The use as a working brake is not permitted. On motors with plug connector and built-in brake, it is the user's responsibility to install the varistor provided to control the brake.

	**Protection of the motor winding**	The temperatur sensor fitted in the winding is to be connected and evaluated by a suitable wiring, for the protection of the motor against thermal overload in case of slow changes. Attention: The thermistor does not represent an all-around protection of the winding. The thermistor does not represent an all-around protection of the winding. Therefore, additional measures such as monitoring i^2t- by the inverter electronic system are required to protect the motor from fastarising thermal overload.

1.3 Transport and packaging

The packaging and transport technologies are dependent on the shipping conditions. The following types of packaging are provided:

- Folding boxes
- Covered and steel-strapped flat pallets (transport by truck)
- Special pallets
- Special packaging in wodden cases

The motors should always be shipped so that no damage can occur in transit.

	**Caution during transport**	Avoid any impacts, sharp sudden movements and strong vibrations during transport. Operate the crane only at creeping speed to lift or place down the motors. This prevents damage to the bearings or the machine.

After final tests all motors leave the factory in perfect condition. Make a visual check for any external damage immediately upon their arrival on site. If any damage caused in transit is found, make a notice of claim in the presence of the forwarder. In addition, report the damage to the manufacturer at the latest within one week. Do not put these motors into operation.

1.4 Storage

If the motors are not installed immediately after their arrival, they should be properly stored. Store the motors only in closed, dry, dust-free, well-ventilated and vibration-free rooms. Damp rooms are unsuitable for storage! Do not remove the anti-corrosive coat from the shaft ends, flange surfaces etc. Check it at certain intervals depending on the ambient conditions and touch up, if required

Take care that noo vibrations occur in storage to prevent the anti-friction from being damaged. It is advisable to turn the rotor several times at certain intervals to prevent corrosion of the bearings.

After a longer storage (> 3 months) operate the motor at slow speed (< 100 min^{-1}) in both directions, so that the lubrication can spread evenly in the bearings.

1.5 Standards, codes and regulations

Servo motors are designed in accordance with IEC recommendations and the applicable VDE and DIN standards (see table opposite). The motors are manufactured in accordance with the international quality standards ISO 9001.

Title	DIN/VDE	EN	IEC
Rotating electrical machines; rating and performance	DIN VDE 0530 Part 1	EN 60 034-1	IEC 600 34-1
Terminal markings and direction of rotation	DIN VDE 0530 Part 8	EN 60 034-8	IEC 600 34-8
Classification of types of construction and mounting arrangements	DIN VDE 0530 Part 7	EN 60 034-7	IEC 600 34-7

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Methods of cooling	DIN VDE 0530 Part 6	EN 60 034-6	IEC 600 34-6
Classification of degree of protection by enclosures	DIN VDE 0530 Part 5	EN 60 034-5	IEC 600 34-5
Mechanical vibration of certain machines - Measurement, evaluation and limits of vibration severity	DIN VDE 0530 Part 14	EN 60 034-14	IEC 600 34-14
Noise limits	DIN VDE 0530 Part 9	EN 60 034-9	IEC 600 34-9
Cylindrical shaft ends for electrical machinery	DIN 748 Part 3		IEC 600 72

2. Product Description

2.1 Part Code

A 2	.	s M	.	5	0	2	-	6	2	B	0

Encoder	0: 2 pole resolver 5: Incremental encoder Stegmann Hiperface Singleturn SRS 50/60 1024 increments per revolution A: Stegmann Hiperface Multiturn SRM 50/60 1024 increments per revolution B: Heidenhain EnDat Singleturn ECN 1113/1313 512 increments per revolution C: Heidenhain EnDat Multiturn EQN 1125/1325 512 increments per revolution D: Heidenhain Sin/Cos encoder ERN 1387 2048 increments per revolution F: Heidenhain Sin/Cos encoder ERN 1185 512 increments per revolution H: Heidenhain EnDat Singleturn ECI 1317 32 increments per revolution I: Heidenhain EnDat Multiturn EQI 1329 32 increments per revolution J:
Connection	B: Plug/plug rotatable angular flange socket
Voltage	2: 190 V (230V class) DC link voltage 270…350 V DC 4: 330 V (400 V class) DC link voltage 510…690 V DC
Speed	0: 1000 rpm 1: 1500 rpm 2: 2000 rpm 3: 3000 rpm 4: 4000 rpm 6: 6000 rpm
Design	0: Feather key 1: Feather key, brake 2: – 3: Brake 4: Feather key, oil-tight flange IP65 (radial shaft sealing ring) 5: Feather key, brake, oil-tight flange IP65 (radial shaft sealing ring) B: Oil-tight flange IP65 (radial shaft sealing ring) C: Brake, oil-tight flange IP65 (radial shaft sealing ring)
cooling	0: Self-cooling with flange B5 (1FT5 compatible) 1: External cooling with flange B5 (1FT5 compatible)
Motor type	5: Three-phase asynchronous motor Dynamic Line II
Unit type	SM: Servo motor
Size/construction length	A1…E3

2.2 Overview of the motor

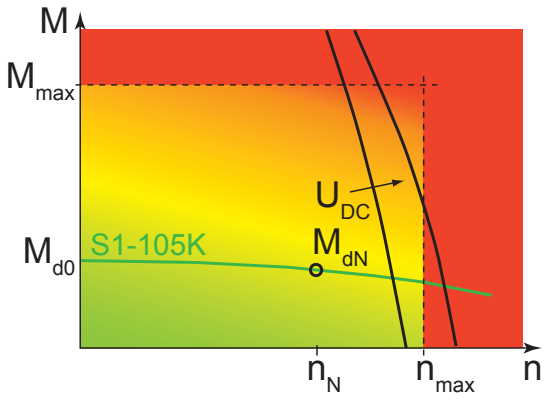
Motor type		Standstill-torque M_{d0} [Nm] at	Rated torque M_{dN} [Nm] dependent on the motor rated speed					
		0 rpm	1.000 rpm	1.500 rpm	2.000 rpm	3.000 rpm	4.000 rpm	6.000 rpm
Self-cooling	A1.SM.50	0,48						0,43
	A2.SM.50	0,66						0,62
	A3.SM.50	0,87						0,80
	A4.SM.50	1,14						1,05
	B1.SM.50	0,92				0.9	0,87	0,76
	B2.SM.50	1.8				1,83	1,75	1,5
	B3.SM.50	2.6				2.6	2,5	2.3
	C1.SM.50	3,9			3,8	3.5	3,1	
	C2.SM.50	5,7			5,5	4,8	4.2	
	C3.SM.50	7,1			6,9	6,4	5,7	
	C4.SM.50	8.5			8,3	7.6	6.8	
	D1.SM.50	8.2		8.0	7.6	6.8		
	D2.SM.50	11.6		11,5	11,0	9.5		
	D3.SM.50	15,3		15,0	14,0	11.9		
	D4.SM.50	18,4		18,0	16,9	13,7		
	E1.SM.50	23,5	21,0		17,2	12,1		
	E2.SM.50	35,0	34,4		28,7	19,7		
	E3.SM.50	48,0	48,7		40,6	27,7		
External cooling	C1.SM.51	5,0			5,2	4,7	4.2	
	C2.SM.51	7.4			7.4	6,4	5,6	
	C3.SM.51	9.2			9,3	8.6	7.7	
	C4.SM.51	11,1			11,2	10.3	9.2	
	D1.SM.51	10,6		10.8	10.3	9,1		
	D2.SM.51	15.1		15,6	14,9	12,8		
	D3.SM.51	19,9		20,2	18,9	16,1		
	D4.SM.51	23,9		24,3	22,8	18,5		
	E1.SM.51	30,6	28,0		25,3	21,3		
	E2.SM.51	45,5	46,1		41.5	35,0		
	E3.SM.51	62,5	65,0		58,7	50,3		

2.3 Standard design of the servo motors

	default	Option
Type	IM B5 (IM V1, IM V3)	
Protective system	IP65	
Shaft gland	IP64	IP65
Motor type	Permanent-field synchronous servo motor	
Magnetic material	Neodymium iron boron	
Rated data	valid for S1- operation (continuous operation)	
Vibration severity level	B	
Flange accuracy	N	R
Insulation class	155 (F); Wire isolation in class 180 (H)	
Winding protection	Thermistor (PTC) 150°C (with strengthened isolation in accordance with EN 50178)	KTY 84; KTY 83; Miniature-bimetal switch
Power connection	Plug (rotatable, speedTEC - compatible)	
Encoder system connection	Plug (rotatable, speedTEC - compatible)	
Encoder system	Resolver	Sin-Cos absolute encoder
Cooling	Self-cooling	External cooling
Brake	–	permanent-field holding brake
Paint	RAL 9005 (matt-black)	
Storage	Radial groove ball bearings with lifetime lubrication	Size Ax…Dx: Fixed bearing on D side
		Size Ex: Fixed bearing on N side
Storage- lifetime	the average storage- lifetime on nominal rating conditions is 20.000 h	
Shaft end	smooth shaft end	Feather key (to DIN 6885) balanced with half-key
Surrounding temperature range	-20°C to +40°C	

2.4 Speed-torque characteristic

Definition	
M_{d0}	Stall torque (n=0)
M_{max}	max. torque
M_{dN}	Rated torque
I_{dN}	Rated current
n_N	Rated speed
n_{max}	max. speed
U_{DC}	DC link voltage



2.5 Project design

2.5.1 Selection of the servo motor
Calculate the following values before you selection the servo motor:

- Determine inertia (J_{App}) of the application without motor
- Calculate required peak torque (ML_{max}) of the application at the drive. The inertia of the motor (JMot) can be accepted here with 1/5 inertia (JApp) of the application.
- Determine the effective torque (M_{eff}) via the time.

Now the motor can be selected on the basis of the calculated values and the technical data of the following pages. The following selection features must be observed:

Calculated data of the application		Motor data
Maximum speed of the application (n_{max})	≤	Rated motor speed (n_N)
required peak torque (M_{Lmax})	≤	Maximum torque (M_{max})
Effective torque (M_{eff})	≤	Rated torque (M_{dN})
Inertia of the application (J_{App}) / 10	≤	Motor torque (J_{mot})

For examination or optimization it can be calculated again with the real motor data.

2.5.2 Selection of the servo controller
The selection of the servo controller occurs via the max. short time current limit and the output rated current. Alternatively KEB provides the „motor configurator" for registered users in Internet and Service&Downloads.

$$\text{Max. short time current} = \frac{\text{MLmax} \cdot \text{Stall current } (I_{d0})}{\text{Stall torque (Md0)}}$$

$$\text{Output rated current} = \frac{\text{Effective torque } (M_{eff}) \cdot \text{Stall current } (I_{d0})}{\text{Stall torque (Md0)}}$$

2.5.3 Output component
The smallest possible effective circular diameter of the output component can be calculated as follows:

$$D_W = \frac{k * 2 * M_b}{F_{Rm}}$$

D_W	effective circular diameter of the output components
K	pretension factor
F_{Rm}	permissible lateral force
M_b	acceleration torque of the drive

2.5.4 pretension factor
Empirical values for the pretension factor k:

Pinion	k ≈	1,5
Toothed belt		1,2…2,0
Flat belt		2,2…3,0

For dynamic processes like braking and accelerating, the permissible lateral force FR is not to be exceeded in order to avoid a mechanical destruction of the motor.

2.6 Construction and definition

The servo motors of the SM.5 series are 6- or 8- pole permanent-field synchronous motors with a sine-wave inducted voltage. A new compact coil technique ensures a high power density of the motors.

2.6.1 Drive end and direction of rotation

Drive end of the motor

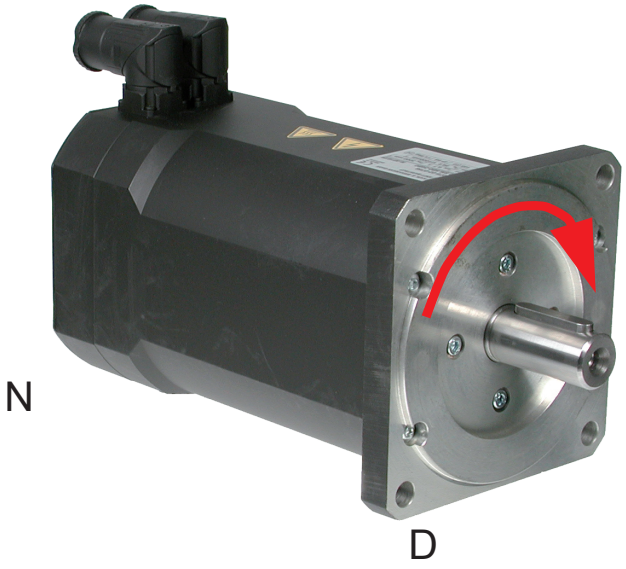
In DIN EN 60034-7, the two ends of a motor are defined as follows:

D (Drive End):
Drive end (AS) of the motor.

N (Non-Drive End):
Non-drive end (BS) of the motor.

Direction of rotation of the motor

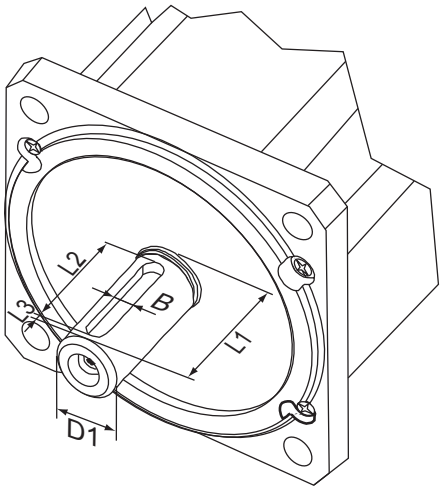
When the motor terminals U1, V1, W1 are connected to the inverter output with U, V, W (with this same phase order) the motor rotates clockwise when viewed facing the D-end.



2.6.2 Shaft end and feather key

Motors of the SM.5 series have cylindrical shaft ends to DIN 748. As an option, the shaft end is also available with a keyway to DIN 6885, Part 1. Use suitable devices for mounting and pulling off driving elements such as gears, pulleys, couplings, etc. Support the device at the DE shaft end.

⚠	**Use suitable tool**	Do not expose the motor to any impacts or blows.



Motor type	Shaft end		Feather key		
	d1	L1	B	L2	L3
Ax.SM.5	Ø 9 k6	20	3	12	4
Bx.SM.5	Ø 14 k6	30	5	22	3
Cx.SM.5	Ø 19 k6	40	6	32	4
Dx.SM.5	Ø 24 k6	50	8	40	5
Ex.SM.5	Ø 32 k6	58	10	50	5

2.6.3 Winding and insulation system

The insulation materials we use ensure insulation class 155 (F) to EN 60034. Therefore, the winding temperature rise may be max. 105 K at a coolant temperature of +40 °C. We also use insulation materials with the temperature profile TI 200 of class 180 (H) to increase the reliability of the motors.

The insulation system of the motors is designed such that they can be connected to an inverter with a maximum DC link voltage $U_{link\ max.}$ = 840 V DC (constant 690 V DC).

	$U_{link\ max.}$ is the maximum value of the DC link voltage which is only transient and approximately equivalent to the inception voltage of the braking shopper or of the regenerative unit.

	No mains operation	The motors are not designed for direct connection to the three-phase system but are to be operated via an electronic power inverter. Direct connection to the system leads to the destruction of the motor.

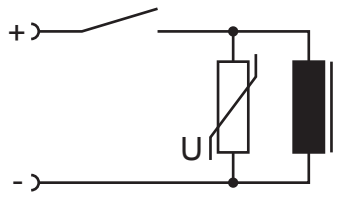
2.6.4 Holding brake (optional)

The optional built-in holding brake is used to fix the motor shaft when the motor is at standstill or de-energized. It is a permanent-field single-disc brake which operates on the closed-cicuit principle, i.e. the brake is effective when the motor is de-energized, thus the motor shaft is held.

	Holding brake is not a working brake	Check the proper functioning of the brake (optional) after installing the motor. The optional holding brake is only designed for a limited number of emergency brakings. The use as a working brake is not permitted.

Holding brakes are operated on DC current. The nominal voltage is 24 V. They can be connected to a central DC voltage supply. Overvoltages, even transient, are not permitted since they deteriorate the permanent magnets irreversibly. The excitation current ripple must be less than 20 % to ensure reliable opening of the brake and prevent disturbing humming noises.

	Motor rotation in spite of an active brake	Since the holding brakes are permanent-magnet brakes, be sure to observe the correct polarity of the DC voltage, otherwise the brake will not open. Modern (field-oriented) frequency inverters are able to produce a high torque even at low motor speeds. If the inverter has a sufficient current reserve, a multiple of the rated motor torque can be produced. In this case the motor shaft may turn even if the holding brakle is applied, because the holding torque of the brake is exceeded.

If the excitation current of the holding brake is switched off on the DC side, a voltage peak occurs which can be higher than 1,000 V. It is caused by the inductance of the holding brake. A varistor should be connected in parallel to the coil to prevent this voltage peak. Attention! On motors with plug connector and built-in brake, it is the user's responsibility to install the varistor provided to control the brake.	

2.6.5 Separately driven fan

The motors SM.51 are forced-air-cooled by an axial fan with a single-phase split motor. The connection data are given on the motor name plate. The necessary terminal plug is included in the delivery of the motor.

Motor type	Rated voltage	Rated current	Protective system
CxSM.51	230 V (+10 % / -10 %) 50/60 Hz	0,12 A	IP 54
DxSM.51	230 V (+ 10 % / -10 %) 50/60 Hz	0,30 A	IP 54
ExSM.51	3 x 400 V (+10 % / -10 %) 50/60 Hz	0,15 A	IP 44

	**Check external fan**	If the motor has an external fan it must be connected proper and the direction of rotation is to be checked (arrow-direction of rotation to fan housing). The fan wheel may not be obstructed in its motion by exterior objects. The exhaust air of neighbouring units may not be sucked in again directly.

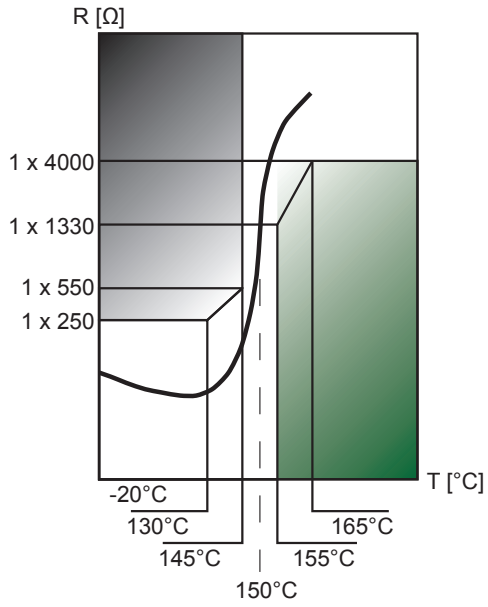
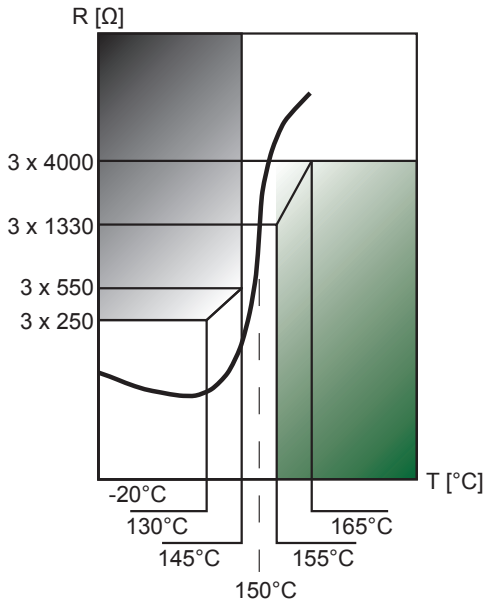
2.6.6 Temperature monitoring

PTC thermistors are installed as standard in the NDE winding head to protect the motors against thermal overload when the temperature change is slow (temperature change in minutes or hours).

	**max. 30 V DC**	The maximum operating voltage of the PTC thermistors must not exceed 30 V DC.

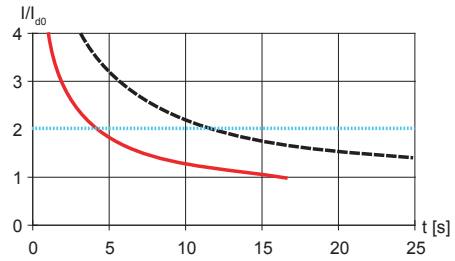
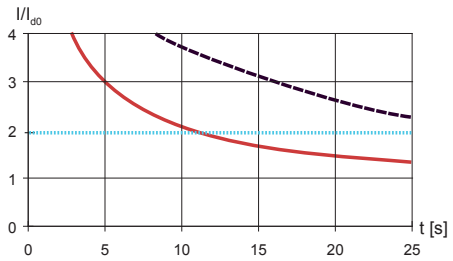
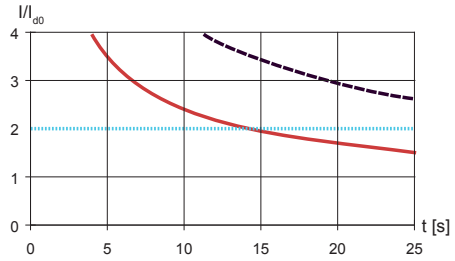
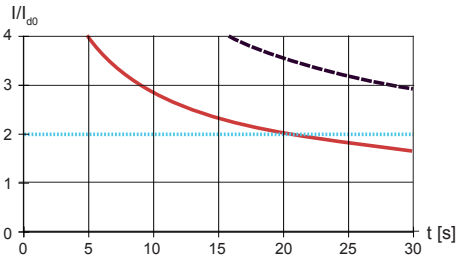
Due to the non-ideal thermal coupling, the temperature sensor follows rapid winding temperature changes only with delay, thus being unable to protect the winding if the thermal overload of the motor is transient and high. Therefore, additional protection is required (e.g. monitoring I^2 x t by the inverter electronic system) to protect the motor from fast-rising thermal overload.

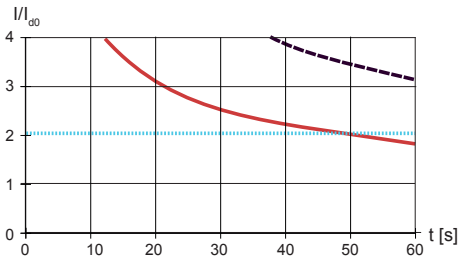
	**Attention overload**	The evaluation of the temperature sensor belongs to the monitoring of the motor winding. The temperature sensor follows rapit temperature changes only with delay. Especially the windings of small motors (AxSM.50 and BxSM.50) are very sensitive to overload.

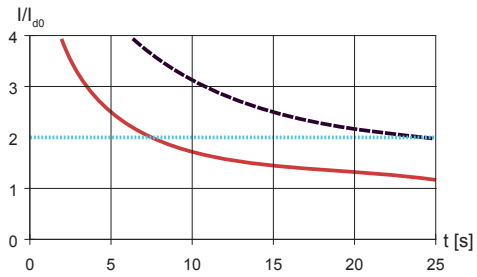
AxSM.50 and BxSM.50 with single PTC thermistor STM 150 E	CxSM.5x, DxSM.5x and ExSM.5x with triplex PTC thermistor STM 150 D
	
The built-in PTC thermistor is the basic version. Other temperature detectors such as KTY 84 or miniature thermal time-delay switches are available as an option.	

The maximum motor current must be limited to ensure that the temperature sensor trips quickly enough (see the following diagrams to adjust the recommended current limits). If a higher current limit needs to be adjusted, the current must not exceed the current-time values shown in the characteristics and the motor max. current Imax.

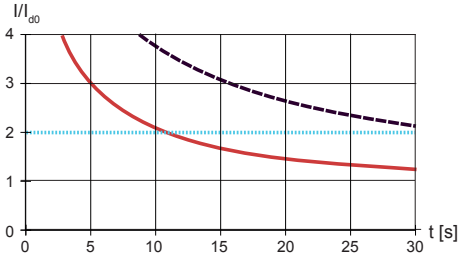
	The characteristics apply in case of a failure. They must not be applied for normal motor operation! The r.m.s. value of the motor current is not permitted to exceed the nominal continuous current IdN within any cycle!

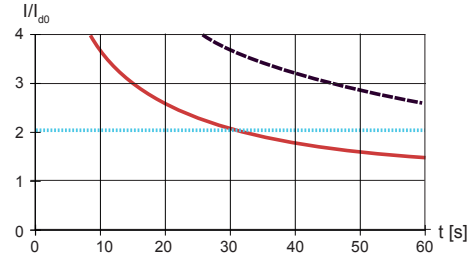
AxSM.50	BxSM.50
	
Cx.SM.50	**Dx.SM.50**
	
ExSM.50	**CxSM.51**





DxSM.51 | **ExSM.51**



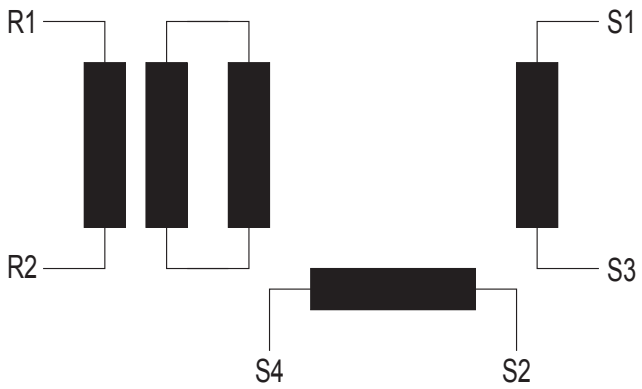


Legend	Motor at operating temperature
	recommended current limit
	Motor cold

2.6.7 Speed and shaft position measuring system / resolver

The SM.5 motors are equipped with 2-pole resolvers for speed and shaft position control.

Technical data of the resolver		
Number of poles		2
Transformation ratio K		0.5 ±5%
Input voltage/frequency		7 V / 10 kHz
Input current		65 mA max.
Electrical error		±10’ max.
Phase displacement		0° nom.
S1	Cos high	red
S2	Sin high	yellow
S3	Cos low	black
S4	Sin low	blue
R1	Excitation high	red/white
R2	Excitation low	black/white or yellow/white



$U_{S1-S3} = K * U_{R1-R2} * \cos \alpha$ | $U_{S2-S4} = K * U_{R1-R2} * \sin \alpha$

	Adjustment of the measuring system	The measuring system of synchronous motors must be adjusted to the respective inverter. Any mis-adjustment may lead to uncontrolled motor response or complete failure of the motor.

Other resolver pole numbers or other measuring systems are available (e.g. absolute sine-cosine encoders).

3. Operating Conditions

3.1 Degree of protection

The motors SM.5 series are generally designed to meet degree of protection IP 65 as specified in DIN EN 60034-5 (option separately driven fan: IP 54). See table below for the respective sealing.

Shaft sealing	Degree of protection	User information
Grease-packed groove (standard)	IP 64	The effect to moisture in the shaft and flange area must be kept to a minimum. No liquid may remain in the D end shield, if the motor is mounted with the "shaft end upward" (IM V3, IM V36).
Rotary shaft seal (Option)	IP 65	Suitable for the installation of non-sealed gear units to seal against oil.

	**Lubrication of the rotary shaft seal**	When using a rotary shaft seal, note that the sealing lip needs to be sufficiently lubricated and cooled with a high-quality mineral oil such as SAE 20 to ensure the proper functioning of the seal.Sufficient lubricant supply is required for proper heat dissipation. If the shaft seal is greased, the maximum permissible motor speed may need to be reduced. Regular regreasing is imperative! Excessive peripheral speeds destroy the sealing lipand its protective function is no longer guaranteed.

3.2 Cooling, altitude, ambient conditions

The rated power (rated torque) applies to continuous operation (duty type S1) at a coolant temperature of 40°C and an altitude of up to 1,000 m above sea level. It is determined by using defined aluminium test flanges (see table opposite).
If the motor flange is thermally insulated, it is not able to dissipate the motor heat. This requires a reduction of the rated motor torque.

Motor type	Test flange dimensions
Ax.SM.5	200 x 100 x 10
Bx.SM.5	232 x 232 x 19
Cx.SM.5	232 x 300 x 19
Dx.SM.5	370 x 370 x 19
Ex.SM.5	410 x 396 x 23

At higher temperatures or altitudes, the overload capability of the motors is reduced (see table opposite).

Altitude above sea level [m]	Coolant temperature [°C]					
	<30	30-40	45	50	55	60
1000	1.07	1.00	0.96	0.92	0.87	0.82
1500	1.04	0.97	0.93	0.89	0.84	0.79
2000	1.00	0.94	0.90	0.86	0.82	0.77
2500	0.96	0.90	0.86	0.83	0.78	0.74
3000	0.92	0.86	0.82	0.79	0.75	0.70
3500	0.88	0.82	0.79	0.75	0.71	0.67
4000	0.82	0.77	0.74	0.71	0.67	0.63

	**Fire- and combustion protection**	The motors can reach a surface temperature of more than 100°C. No temperature-sensitive parts may lay close to or be attached onto the motor. If necessary, protective measurements must be taken against touching.
	**Derating due to harmonics**	A derating can be necessary due to different clock frequencies of the power stages of the inverters and the associated different losses by the current harmonics.

3.3 Permissible axial and radial forces

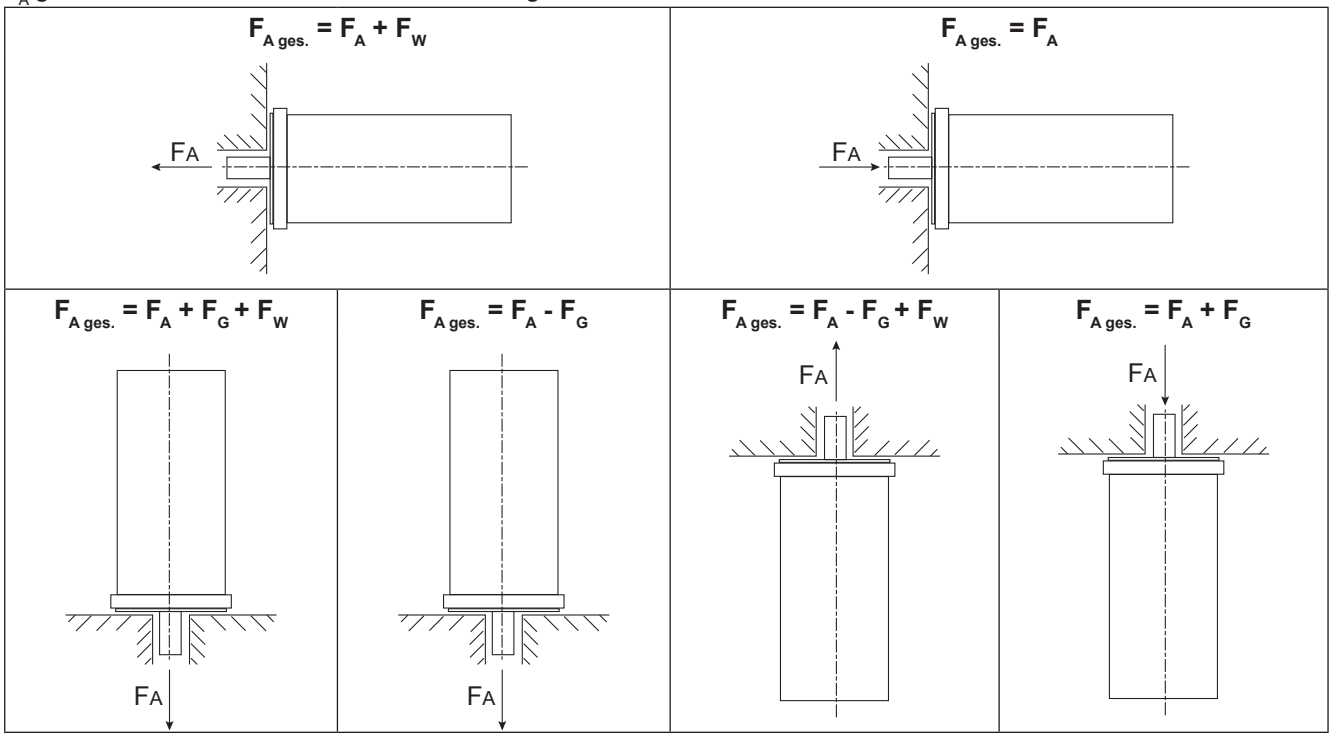
The maximum permissible axial and radial forces must not be exceeded in order to ensure smooth running of the motor.

3.3.1 Axial forces

The following forces $F_{A\ permiss.}$ are permitted in axial direction with the radial force FQ acting simultaneously:

Motor type	F_W [N]	F_G [N]	Axial force F_A permiss. [N] at speed n [rpm] (with $F_Q \neq 0$)							
			1000	1500	2.000	3.000	4.000	4.500	6.000	9.000
A1.SM.50	90	2			130	105	95		80	70
A2.SM.50		3								
A3.SM.50		4								
A4.SM.50		5								
B1.SM.50	110	5			230	195	175		150	130
B2.SM.50		7								
B3.SM.50		9								
C1.SM.5x	110	13			310	260	230		200	
C2.SM.5x		17								
C3.SM.5x		20								
C4.SM.5x		24								
D1.SM.5x	150	25			330	280		240		
D2.SM.5x		31								
D3.SM.5x		37								
D4.SM.5x		43								
E1.SM.5x	435	65	890	780	700	590	520			
E2.SM.5x		80								
E3.SM.5x		95								

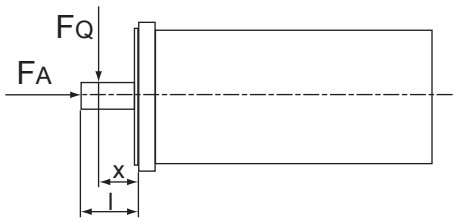
Depending on the mounting position of the motors and the direction of the effective axial force $F_{A,}$ the rotor inertial force F_G and the force of the undular washer F_W must be taken into consideration. The total effective axial force F_A ges is calculated as shown in the above figure.

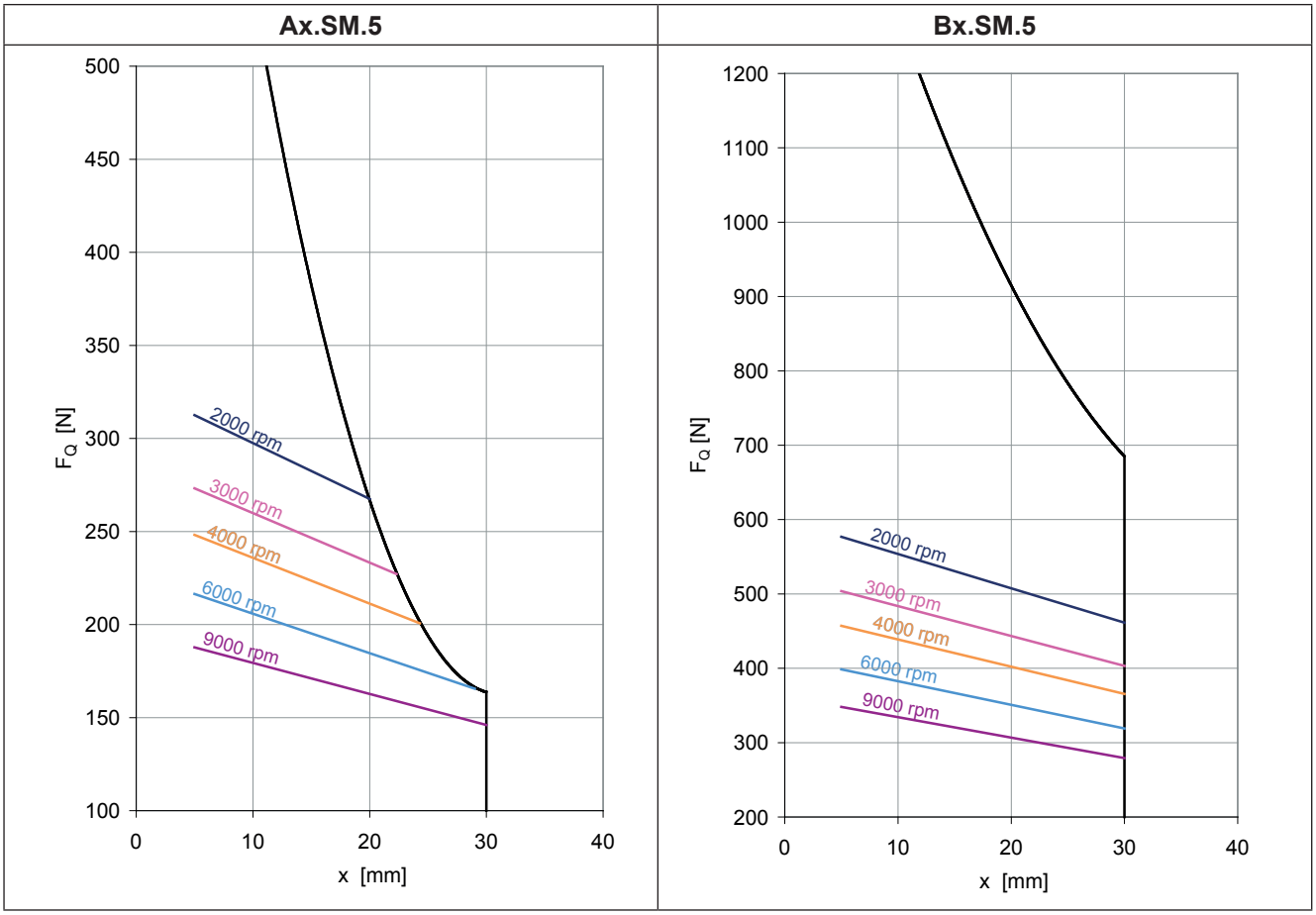


3.3.2 Radial forces

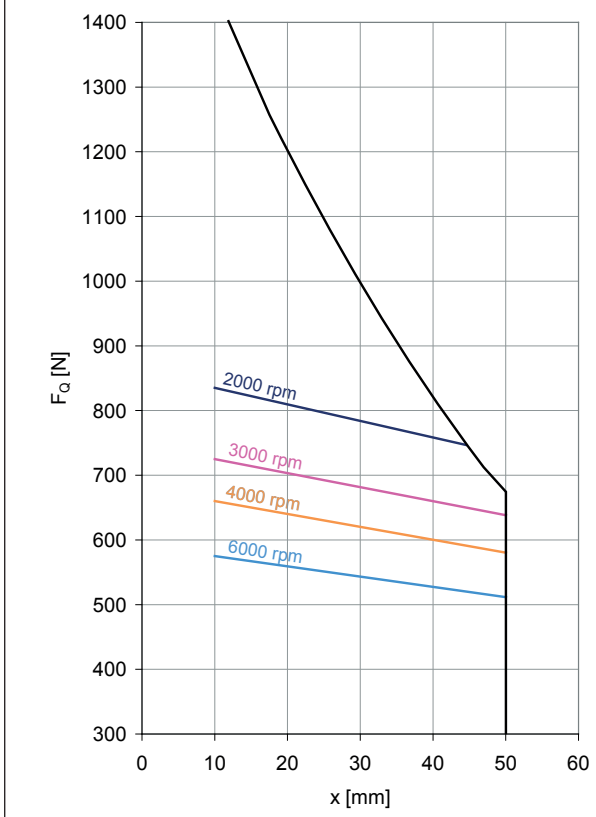
The endurance strength of the shaft and the bearing life (20.000 h) are decisive for the permissible radial load. Taking the endurance strength into consideration F_Q is not permitted to be exceeded even during dynamic processes (acceleration, braking).

F_A	Axial force
F_Q	Radial force
x	Length of the rotor shaft up to the center of the radial force
L	Length of the rotor shaft

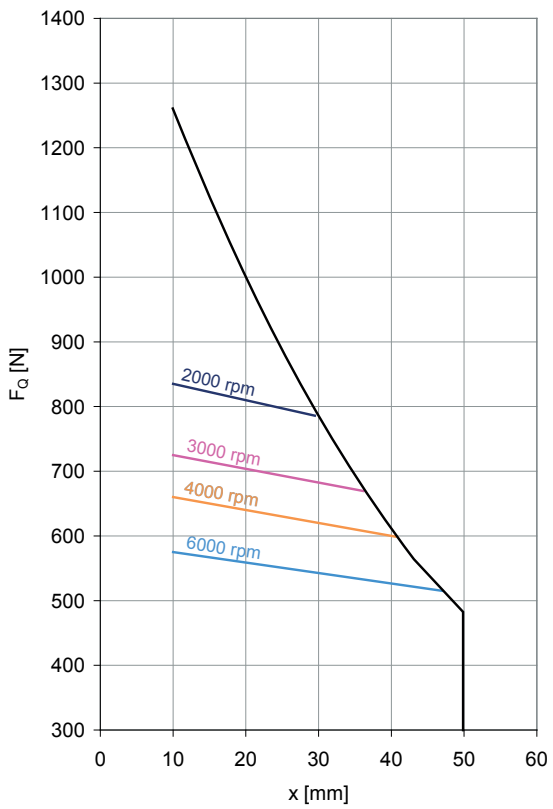




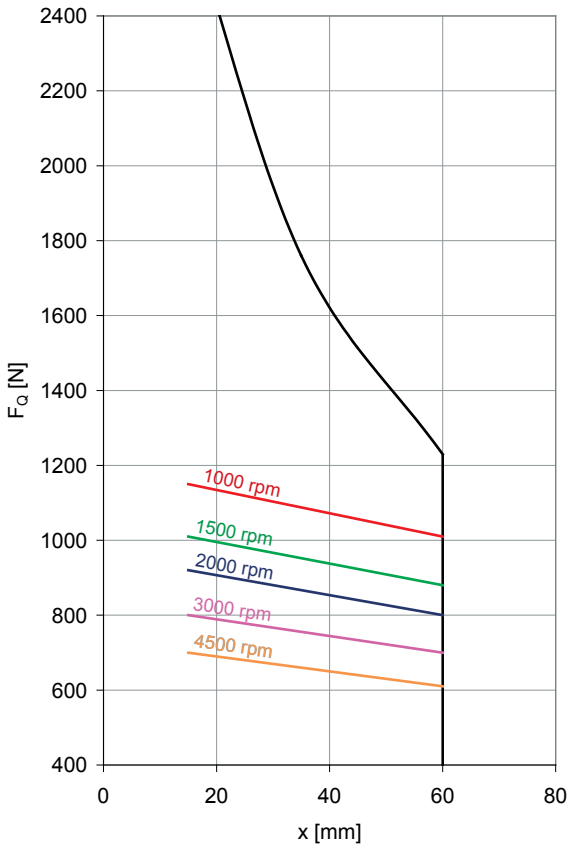
C1/C2.SM.5 and C3.SM.5 without brake



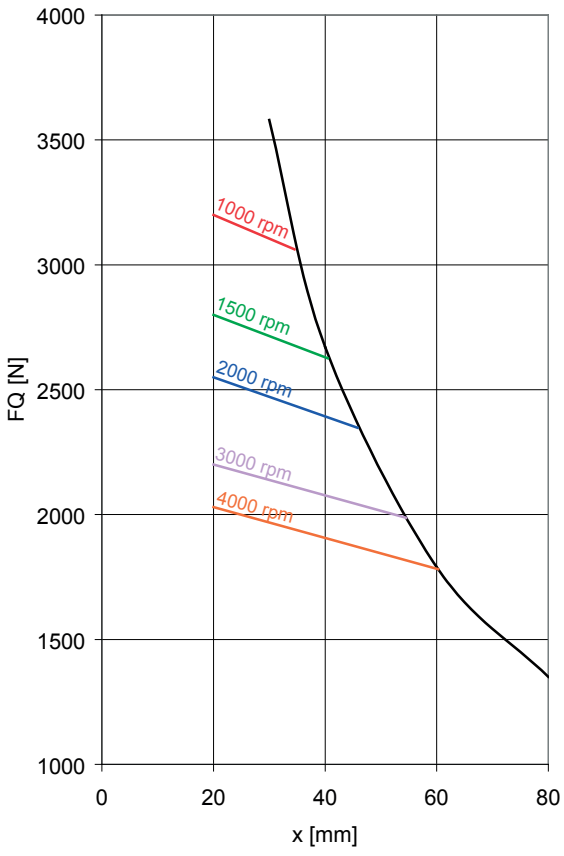
C3.SM.5 with brake and C4.SM.5



Dx.SM.5



Ex.SM.5



4. Connection

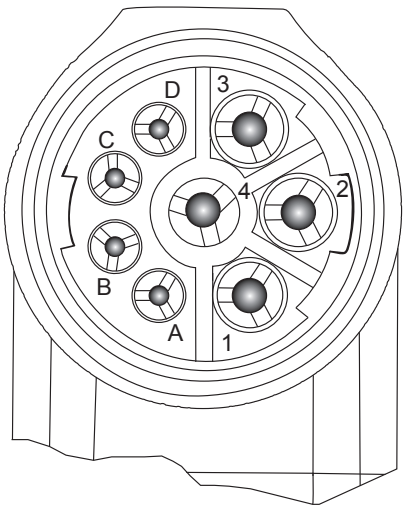
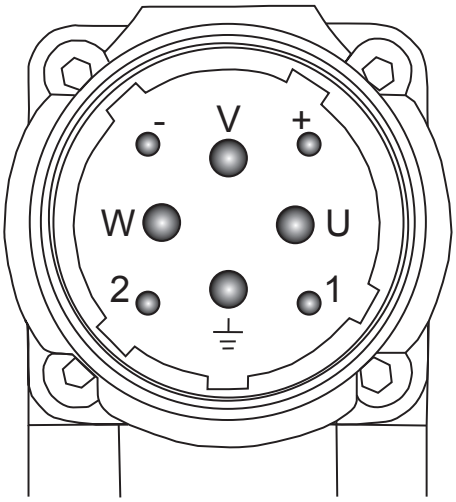
	The connection must be carried out in such a way that a permanently safe, electrical connection is maintained. Pay attention to a safe protective conductor connection. By turning the flange sockets any outgoing cable direction can be adjusted (rotatable by 90° each). In the case of improper execution of the work the type of protection IP65 is no longer warranted. If connector systems are used, then the type of protection IP65 is only achieved with correctly wired and firmly tightened mating connector.

4.1 Conductor cross-section

The recommended values for the dimensioning of the conductor cross-sections are given in the table. They are specified in DIN VDE 0113 (EN 60 204) „Electrical equipment of industrial machines“ for the current carrying capacitiy of PVC-insulated cables with copper conductor routed in cable ducts. The maximum permissible surrounding temperature is +40°C.

Conductor size [mm²]	perm. maximum current (actual value) [A]
1.5	13.5
2.5	18.3
4	24

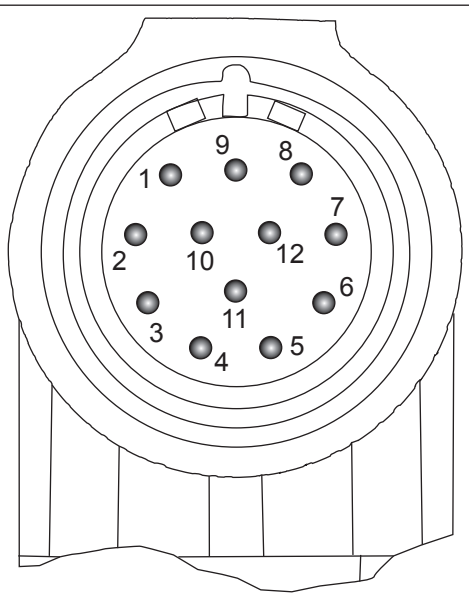
4.2 Power unit

Power unit connection		Ax…Dx.SM.5		Ex.SM.5	
•	Angle junction box				
•	rotatable				
•	8-pole				
•	Plug				
View of the connector pins at the motor					
Terminal assignment		1	U	U	U
		2	PE	V	V
		3	W	W	W
		4	V	⏚	PE
		A	Brake + (option)	+	Brake + (option)
		B	Brake - (option)	-	Brake - (option)
		C	Temperature detector +	1	Temperature detector +
		GB	Temperature detector -	2	Temperature detector -

Motor cable for	Ax…Dx.SM.5	Ex.SM.5
ready-made, shielded, trailing capable	00S4x19-yyyy	00S4x19-yyyy
	x - cross-section [mm²] 0 = 1.5 mm²; 1 = 2.5 mm²	x - cross-section [mm²] 3 = 4 mm²
	yyyy - line length [m]	

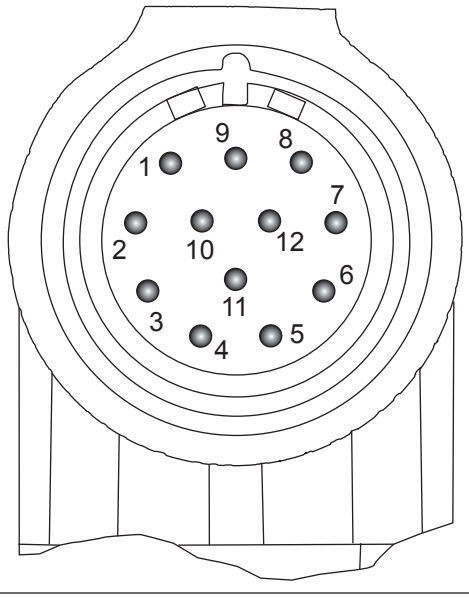
4.3 Encoder connection

4.3.1 Resolver

Resolver connector	View	No.	Signal	Color
• Angle socket		1	SIN-	red
• rotatable		2	COS+	pink
• 12-pole		5	REF+	yellow
• Plug		7	REF-	green
		10	SIN+	blue
		11	COS-	grey
View of the connector pins at the motor		All other contacts are not assigned.		

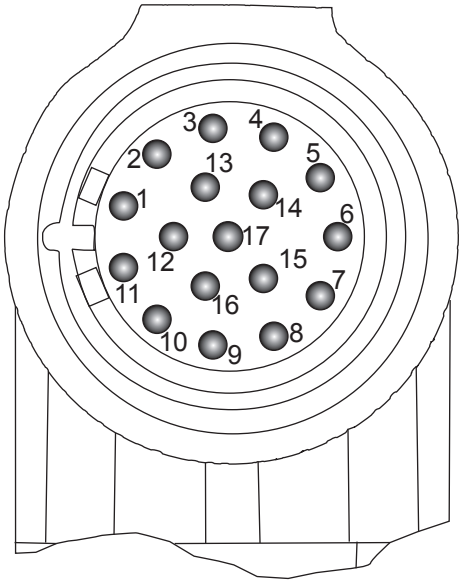
Encoder cable	A-Servo 00F50C1-0yyy	F5-Multi 00F50C1-1yyy
ready-made, shielded, trailing capable, yyy - line length [m]		

4.3.2 Hiperface

Hiperface connector	View	No.	Signal	Color
• Angle socket		4	REF_SIN-	red
• rotatable		5	REF_COS-	yellow
• 12-pole		6	Data+	grey
• Plug		7	Data-	pink
		8	SIN+	blue
		9	COS+	green
		10	+7.5 V	brown
		11	COM	white
View of the connector pins at the motor		All other contacts are not assigned.		

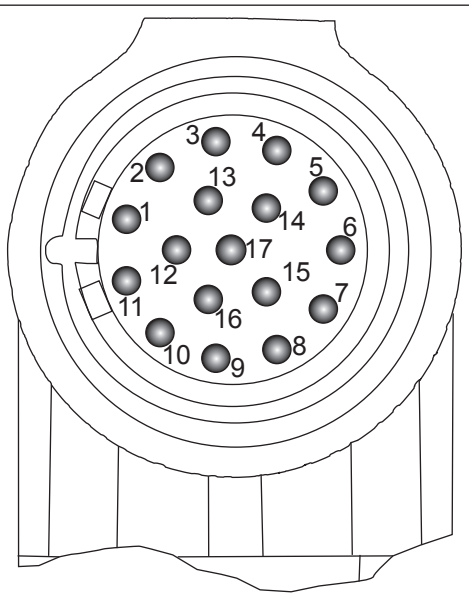
Encoder cable	F5-Multi 00S4809-yyyy
ready-made, shielded, trailing capable, yyyy - line length [m]	

4.3.3 EnDat

EnDat-connector	View	No.	Signal	Color
• Angle socket		7	+5V	white
• rotatable		8	Clock+	black
• 17-pole		9	Clock-	purple
• Plug		10	COM	brown
		12	B+	blue
		13	B-	red
		14	Data+	grey
		15	A+	green
		16	A-	yellow
		17	Data-	pink
View of the connector pins at the motor		All other contacts are not assigned.		

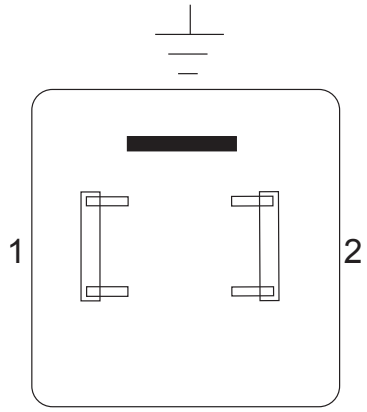
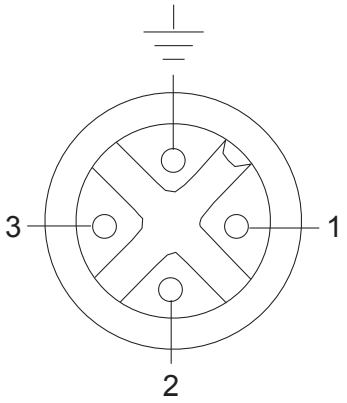
Encoder cable	00F50C1-4yyy
ready-made, shielded, trailing capable, yyy - line length [m]	

4.3.4 SIN/COS

SIN/COS-connector	View	No.	Signal	Color
• Angle socket		1	A+	green
• rotatable		2	A-	yellow
• 17-pole		3	R+	grey
• Plug		4	GB -	purple
		5	C+	white
		6	C-	brown
		7	COM	white/green
		10	+5V	grey/pink
		11	B+	blue
		12	B-	red
		13	R-	pink
		14	D+	black
View of the connector pins at the motor		All other contacts are not assigned.		

Encoder cable	00S4209-yyyy
ready-made, shielded, trailing capable, yyyy - line length [m]	

4.4 Separate ventilator connection

<table>
<tr><td>Separate ventilator connection</td><td colspan="3">Ax…Dx.SM.5</td><td colspan="3">Ex.SM.5</td></tr>
<tr><td>View of the connector pins at the motor</td><td colspan="3"> 
</td><td colspan="3"> 
</td></tr>
<tr><td rowspan="3">Terminal assignment</td><td>1</td><td>L1</td><td rowspan="2">1 x 230 V AC</td><td>1</td><td>U</td><td rowspan="2">3 x 400 V AC</td></tr>
<tr><td>2</td><td>N</td><td>2</td><td>V</td></tr>
<tr><td>⏚</td><td>PE</td><td>Protective conductor</td><td>3</td><td>W</td></tr>
<tr><td></td><td></td><td></td><td>⏚</td><td>PE</td><td>Protective conductor</td></tr>
</table>

5. Start-up

5.1 Preparations

Before initial operation and after major inspections, check the complete plant both from a mechanical and electrical point of view.
Examine that

- the installation and the operating conditions comply with the specified name plate data.
- the motor is properly installed and aligned.
- the driving elements are properly adjusted (e.g. proper belt tension, coupling properly aligned and balanced),
- the motor and its monitoring devices are properly wired.
- the earthing and equipotential bonding have been made as specified in the applicable regulations.
- all fastening screws, connecting elements and electrical connections are properly tightened.
- the key is safed unless prevented otherwise by driving elements such as pulleys, couplings etc.
- the separate ventilation is correctly connected and in proper service condition.
- the direction of rotation of the fan motor corresponds with the direction arrow on the fan housing.
- the cooling air flow is not impaired (the hot outlet cooling air must not be drawn in by the fan!).
- eventually existing brakes are O.K.

5.2 Initial start-up

The following measures are recommended to be taken after installing or inspecting the motors:

- Start the motor with no load.
- Check the mechanical running for any noise or vibrations on the bearings or end shields.
- If there is any abnormal noise or the motor runs unevenly, switch it off immediately and find out the cause.
- If the mechanical running improves immediately after the motor has been switched off, there is an electrical or magnetic cause. If this is not the case, there is a mechanical cause.
- If the mechanical running is smooth at no load, load the motor. Check the running smoothness, measure the voltage, current and power and record them. Measure and record these values also for the driven equipment, if possible.
- Monitor the temperatures of the bearings, windings etc. until they have stabilised and record the values (as far as this is possible with the available measuring equipment).

5.3 Operation

In case of changes as compared to the normal operation, e.g. increased temperature, noises, oscillations, find out the cause. In case of doubt switch off the motor!

6. Maintenance and repair

Careful and regular maintenance and inspections are required to recognise and remedy troubles in good times, before they lead to major damage.

	**Repairs**	Repairs may only be carried out by the manufacturer or an authorised repair agency. Unauthorised opening and tampering may lead to injuries to persons and property and may lead to a loss of warranty rights.

6.1 Maintenance intervals

	**Safety at maintenance**	Before starting any work on the motors, and particularly before opening any covers of active parts, make sure that the motor and plant have been properly isolated. This refers also to any additional or auxiliary circuits! The „5 safety rules“ to be applied according to DIN VDE 0105 are: • Disconnect the motor • Secure against restarting • Verify the safe isolation from supply • Earth and short (at voltages above 1000V) • Safeguard or cover adjacent live parts.

Since the operating conditions of the motors differ considerably, only general maintenance intervals to ensure trouble-free operation can be specified. They need to be adapted to the local conditions such as the actual level of contamination, numbers of starts, load, etc.The radial groove ball bearings of the motor are lubricated for life and are designed for nominal service life of 20,000 hours. Motors with shaft sealing ring must be mounted together with gears which prevent dry running of the shaft sealing ring. Otherwise it comes to screeching noises and overheating of the motor by increased friction.

•	depending on the local level of contamination	Clean the motor
•	depending on the operating mode every 50 to 500 operating hours	Regrease the optional rotary shaft seal ring (applies only to grease lubrication!)
•	after approx. 500 operating hours, but after 1 year at the latest	Retighten the electrical and mechanical connections.
		check for deterioration of running smoothness or bearing noise.

7. Technical Data

7.1 Servo motor AxSM50-xxxx

for inverter rated voltage 200 to 240 V AC						
Motor type			**A1**	**A2**	**A3**	**A4**
Rated speed	n_N	[rpm]	6000	6000	6000	6000
Stall torque	M_{d0}	[Nm]	0.47	0.66	0.87	1.14
Current at stall torque	I_{d0}	[A]	1.81	2.04	2.52	3.10
Number of poles	2p		6			
Nominal rating						
Rated torque	M_{dN}	[Nm]	0.43	0.62	0.80	1.05
Rated current	I_{dN}	[A]	1.66	1.92	2.54	3.29
Rated power	P_{dN}	[kW]	0.27	0.39	0.50	0.66
Voltage constant 1)	k_e	[V/1000rpm]	24.6	29.4	29.6	29.4
Winding resistance 2)	R_{u-v}	[Ω]	19.3	8.1	5.8	3.1
Winding inductance	L_{u-v}	mH	5.9	5.2	3.7	2.4
Maximum values						
max. torque	M_{max}	[Nm]	2.1	2.9	3.8	5.0
max. current (peak value)	I_{max}	[A]	8.9	10.1	13.2	17.4
max. speed	n_{max}	[rpm]	9000			
Mechanical data 3)						
Inertia	J_L	[kgcm²]	0.13	0.18	0.23	0.34
Mass	M	[kg]	1.0	1.2	1.4	1.9
Total length	l_{38}	[mm]	121	133	145	170

1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

for inverter rated voltage 400 to 480 V AC						
Motor type			**A1**	**A2**	**A3**	**A4**
Rated speed	n_N	[rpm]	6000	6000	6000	6000
Stall torque	M_{d0}	[Nm]	0.47	0.66	0.87	1.14
Current at stall torque	I_{d0}	[A]	0.94	1.24	1.43	1.55
Number of poles	2p		6			
Nominal rating						
Rated torque	M_{dN}	[Nm]	0.43	0.62	0.80	1.05
Rated current	I_{dN}	[A]	0.93	1.16	1.44	1.64
Rated power	P_{dN}	[kW]	0.27	0.39	0.50	0.66
Voltage constant 1)	k_e	[V/1000rpm]	44.1	48.2	50.6	58.7
Winding resistance 2)	R_{u-v}	[Ω]	37.4	24.0	17.8	12.6
Winding inductance	L_{u-v}	mH	19.0	13.1	11.5	9.6
Maximum values						
max. torque	M_{max}	[Nm]	2.1	2.9	3.8	5.0
max. current (peak value)	I_{max}	[A]	4.5	5.6	6.9	8.0
max. speed	n_{max}	[rpm]	9000			
Mechanical data 3)						
Inertia	J_L	[kgcm²]	0.13	0.18	0.23	0.34
Mass	M	[kg]	1.0	1.2	1.4	1.9
Total length	l_{38}	[mm]	121	133	145	170

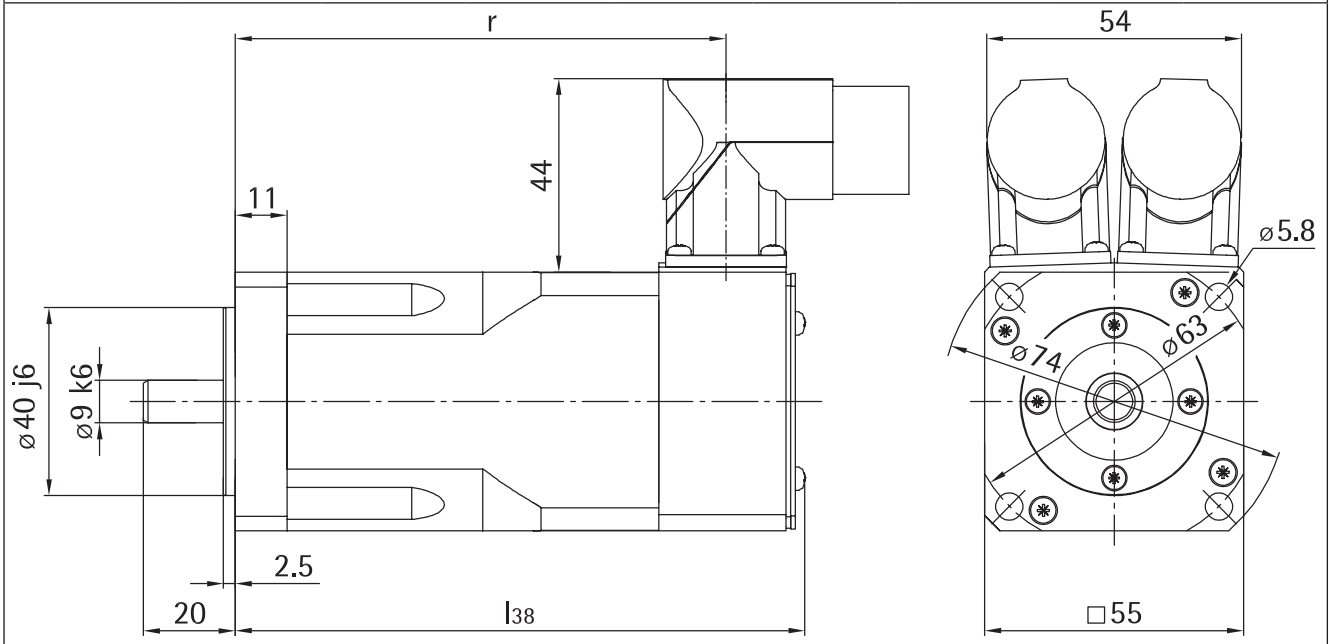
1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

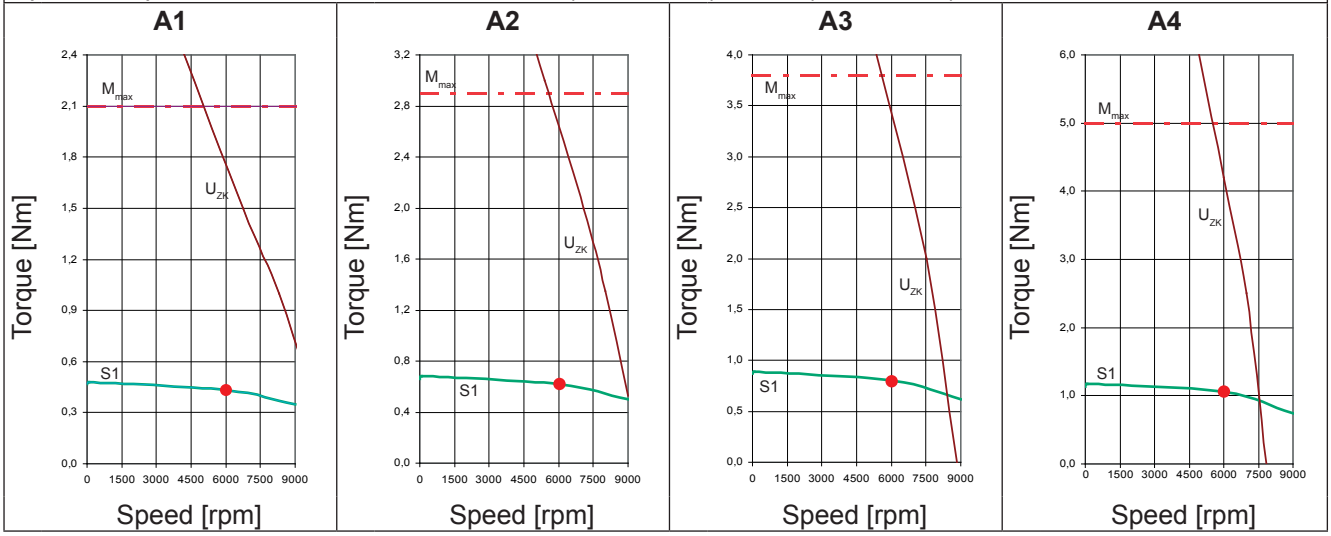
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	2
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	0.46
Mass	M	[kg]	0.18
Inertia	J_{Br}	[kgcm²]	0.07

Dimensions servo motor AxSM50-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
A1	121	105	156	136	145	129	180	160
A2	133	117	168	148	157	141	192	172
A3	145	129	180	160	169	153	204	184
A4	170	153	205	185	194	178	229	209

Speed-/torque characteristics for Ulink = 540 V (400 V class); 330 V (230 V class)



7.2 Servo motor BxSM50-xxxx

for inverter rated voltage 200 to 240 V AC												
Motor type			**B1**			**B2**			**B3**			
Rated speed	n_N	[rpm]	3000	4000	6000	3000	4000	6000	3000	4000	6000	
Stall torque	M_{d0}	[Nm]	0.92			1.8			2.6			
Current at stall torque	I_{d0}	[A]	1.6	2.0	2.8	2.8	3.9	4.8	3.9	4.7	7.1	
Number of poles	2p		6									
Nominal rating												
Rated torque	M_{dN}	[Nm]	0.9	0.87	0.76	1.8	1.75	1.46	2.64	2.46	2.15	
Rated current	I_{dN}	[A]	1.7	2.1	2.4	3.1	4.2	4.2	4.3	4.9	6.5	
Rated power	P_{dN}	[kW]	0.28	0.37	0.48	0.58	0.73	0.92	0.83	1.03	1.35	
Voltage constant 1)	k_e	[V/1000rpm]	47.8	37.5	27.6	50.6	36.1	29.9	52.6	43.4	28.6	
Winding resistance 2)	R_{u-v}	[Ω]	15	9.1	4.8	5.6	2.8	2.1	3.5	2.3	1.1	
Winding inductance	L_{u-v}	mH	25.8	15.8	8.6	13.0	6.6	4.5	9.2	6.3	2.7	
Maximum values												
max. torque	M_{max}	[Nm]	2.7			5.4			7.8			
max. current (peak value)	I_{max}	[A]	5.9	7.4	10.1	11.0	15.4	18.9	15.2	18.4	28.0	
max. speed	n_{max}	[rpm]	9000									
Mechanical data 3)												
Inertia	J_L	[kgcm²]	0.33			0.56			0.79			
Mass	M	[kg]	2.3			3.0			3.7			
Total length	l_{38}	[mm]	132			158			184			

1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

for inverter rated voltage 400 to 480 V AC												
Motor type			**B1**			**B2**			**B3**		
Rated speed	n_N	[rpm]	3000	4000	6000	3000	4000	6000	3000	4000	6000
Stall torque	M_{d0}	[Nm]	0.92			1.8			2.6		
Current at stall torque	I_{d0}	[A]	1.0	1.2	1.5	1.6	2.0	2.5	2.3	2.7	3.9
Number of poles	2p		6								
Nominal rating											
Rated torque	M_{dN}	[Nm]	0.9	0.87	0.76	1.83	1.75	1.5	2.6	2.5	2.3
Rated current	I_{dN}	[A]	1.0	1.2	1.3	1.7	2.1	2.3	2.6	2.9	3.6
Rated power	P_{dN}	[kW]	0.28	0.37	0.48	0.58	0.73	0.94	0.83	1.03	1.35
Voltage constant 1)	k_e	[V/1000rpm]	76.5	62.8	50.1	90.5	72.1	56	87	74.4	51.5
Winding resistance 2)	R_{u-v}	[Ω]	37.2	24.6	15.7	17.7	11.1	6.9	9.3	7.6	3.4
Winding inductance	L_{u-v}	mH	66.0	44.4	28.3	41.4	26.3	15.9	25.1	18.4	8.8
Maximum values											
max. torque	M_{max}	[Nm]	2.7			5.4			7.8		
max. current (peak value)	I_{max}	[A]	3.6	4.5	5.5	6.1	7.7	9.9	9.2	10.8	15,5
max. speed	n_{max}	[rpm]	9000								
Mechanical data 3)											
Inertia	J_L	[kgcm²]	0.30			0.56			0.79		
Mass	M	[kg]	2.3			3.0			3.7		
Total length	l_{38}	[mm]	132			158			184		

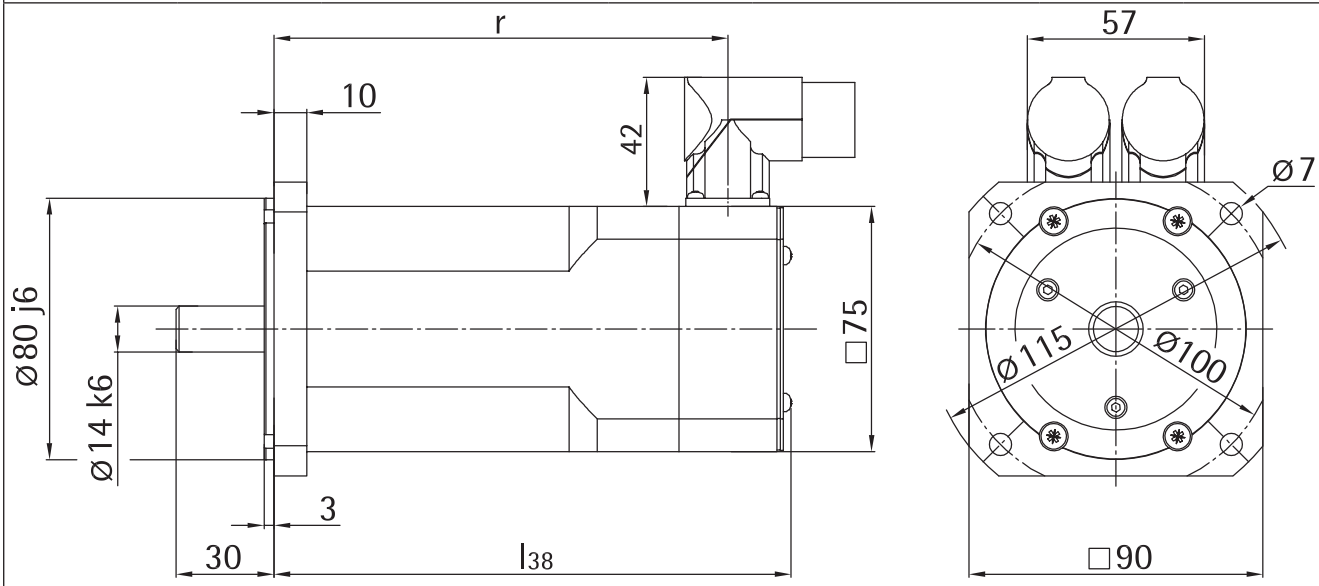
1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

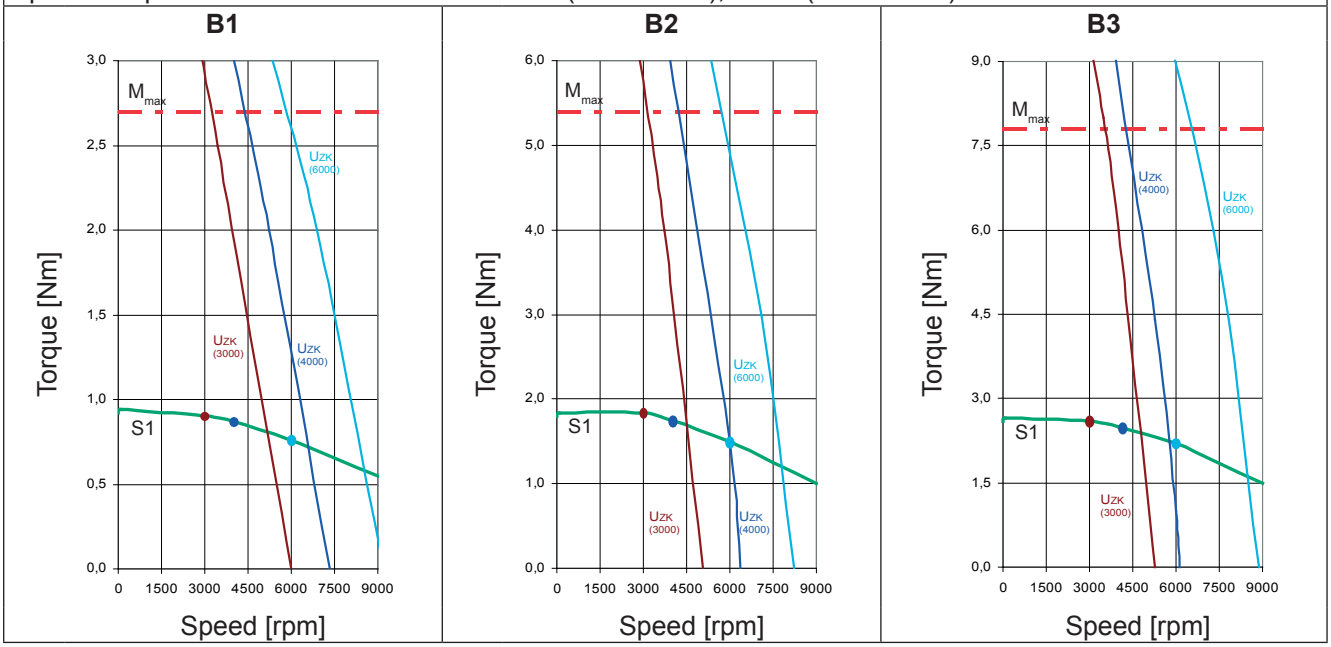
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	4.5
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	0.58
Mass	M	[kg]	0.28
Inertia	J_{Br}	[kgcm²]	0.18

Dimensions servo motor BxSM50-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
B1	132	113	174	148	164	145	206	180
B2	158	139	200	174	190	171	232	206
B3	184	165	226	200	216	197	258	232

Speed-/torque characteristics for Ulink = 540 V (400 V class); 330 V (230 V class)



7.3 Servo motor CxSM50-xxxx

for inverter rated voltage 200 to 240 V AC														
Motor type			**C1**			**C2**			**C3**			**C4**		
Rated speed	n_N	[rpm]	2000	3000	4000	2000	3000	4000	2000	3000	4000	2000	3000	4000
Stall torque	M_{d0}	[Nm]	3.9			5.7			7.1			8.5		
Current at stall torque	I_{d0}	[A]	4.3	6.2	7.7	6.2	8.8	11.7	8.9	13.8	17.3	8.8	12.9	16.1
Number of poles	2p		8											
Nominal rating														
Rated torque	M_{dN}	[Nm]	3.7	3.5	3.1	5.3	4.6	4.1	6.9	6.3	5.7	8.3	7.6	6.7
Rated current	I_{dN}	[A]	4.1	5.7	6.2	5.8	7.1	8.4	6.8	9.6	10.8	8.1	10.8	11.9
Rated power	P_{dN}	[kW]	0.8	1.1	1.3	1.1	1.4	1.7	1.4	2.0	2.4	1.7	2.4	2.8
Voltage constant 1)	k_e	[V/1000rpm]	80.0	55.0	44.4	79.5	56.0	42.0	87.9	56.9	45.7	89.5	60.9	48.8
Winding resistance 2)	R_{u-v}	[Ω]	4.1	1.8	1.2	2.3	1.3	0.7	1.8	0.7	0.5	1.4	0.6	0.4
Winding inductance	L_{u-v}	mH	9.8	4.6	3.0	6.1	3.0	1.7	5.5	2.3	1.5	4.3	2.0	1.3
Maximum values														
max. torque	M_{max}	[Nm]	12			17.5			22			26		
max. current (peak value)	I_{max}	[A]	15.3	22.4	27.6	14.8	30.6	40.8	25.5	39.4	49.3	29.7	43.5	54.4
max. speed	n_{max}	[rpm]	6000											
Mechanical data 3)														
Inertia	J_L	[kgcm²]	2.7			3.7			4.7			6.0		
Mass	M	[kg]	4.8			6.3			7.4			8.6		
Total length	l_{38}	[mm]	178			206			234			262		

1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

for inverter rated voltage 400 to 480 V AC														
Motor type			**C1**			**C2**			**C3**			**C4**		
Rated speed	n_N	[rpm]	2000	3000	4000	2000	3000	4000	2000	3000	4000	2000	3000	4000
Stall torque	M_{d0}	[Nm]	3.9			5.7			7.1			8.5		
Current at stall torque	I_{d0}	[A]	2.5	3.1	3.9	3.8	5.0	6.1	5.7	7.0	8.8	5.5	8.5	10.7
Number of poles	2p		8											
Nominal rating														
Rated torque	M_{dN}	[Nm]	3.8	3.5	3.1	5.5	4.8	4.2	6.9	6.4	5.7	8.3	7.6	6.8
Rated current	I_{dN}	[A]	2.5	2.8	3.1	3.7	4.2	4.5	4.3	4.9	5.5	4.2	6.0	6.6
Rated power	P_{dN}	[kW]	0.8	1.1	1.3	1.2	1.5	1.8	1.4	2.0	2.4	1.7	2.4	2.8
Voltage constant [1]	k_e	[V/1000rpm]	139	111.6	89	130	98.1	80.6	139	112.4	89.7	173	111.9	89.5
Winding resistance [2]	R_{u-v}	[Ω]	11.6	7.4	4.7	6.1	3.6	2.4	4.4	2.9	1.8	5.3	2.2	1.4
Winding inductance	L_{u-v}	mH	29.5	19.0	12.1	16.5	9.3	6.3	13.5	8.9	5.7	20.0	8.4	5.4
Maximum values														
max. torque	M_{max}	[Nm]	12			17.5			22			26		
max. current (peak value)	I_{max}	[A]	8,4	10.5	13.2	12.6	16.8	20.4	16.2	20.0	25.1	15.3	23.8	29.6
max. speed	n_{max}	[rpm]	6000											
Mechanical data [3]														
Inertia	J_L	[kgcm²]	2.7			3.7			4.7			6.0		
Mass	M	[kg]	4.8			6.3			7.4			8.6		
Total length	l_{38}	[mm]	178			206			234			262		

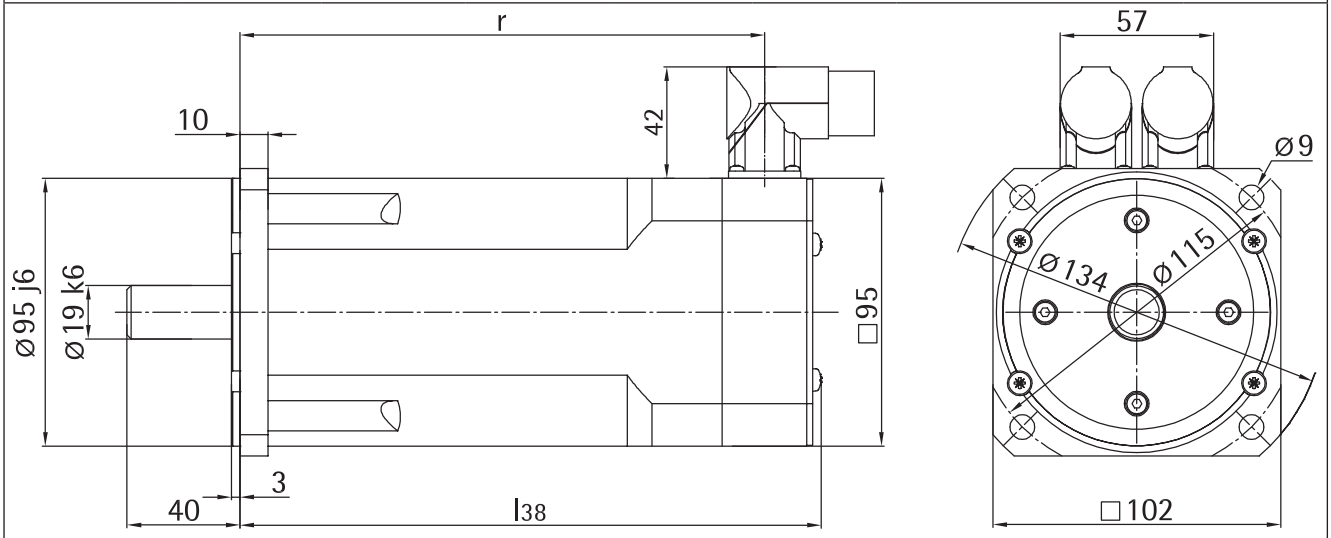
1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

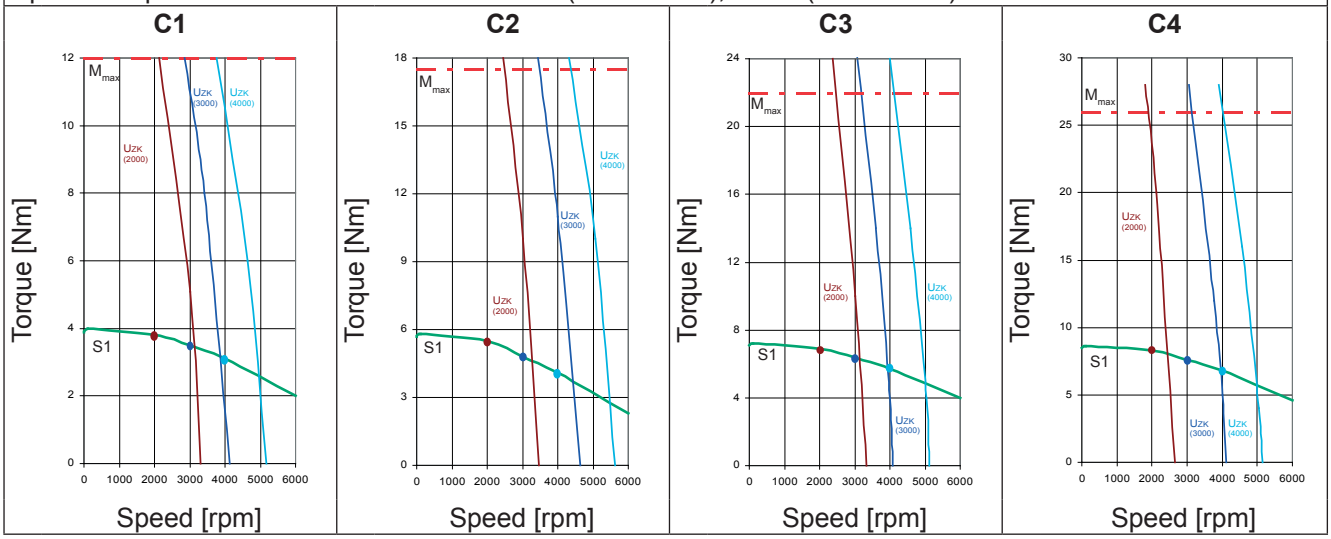
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	10
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	0.71
Mass	M	[kg]	0.57
Inertia	J_{Br}	[kgcm²]	1.01

dimensions servo motor CxSM50-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
C1	178	158	220	193	214	194	256	229
C2	206	186	248	221	242	222	284	257
C3	234	214	276	249	270	250	312	285
C4	262	242	304	277	298	278	340	313

Speed-/torque characteristics for Ulink = 540 V (400 V class); 330 V (230 V class)



7.4 Servo motor DxSM50-xxxx

for inverter rated voltage 400 to 480 V AC														
Motor type			**d1**			**d2**			**D3**			**D4**		
Rated speed	n_N	[rpm]	1500	2000	3000	1500	2000	3000	1500	2000	3000	1500	2000	3000
Stall torque	M_{d0}	[Nm]	8.2			11.6			15.3			18.4		
Current at stall torque	I_{d0}	[A]	3.6	4.6	6.0	5.6	6.9	8.9	6.8	8.8	11.2	8.2	10.4	14.0
Number of poles	2p		8											
Nominal rating														
Rated torque	M_{dN}	[Nm]	8.0	7.6	6.8	11.5	11.0	9.5	15.0	14.0	11.9	18.0	16.9	13.7
Rated current	I_{dN}	[A]	3.3	4.0	4.6	5.1	6.0	6.7	6.1	7.3	8.0	7.4	8.8	9.6
Rated power	P_{dN}	[kW]	1.3	1.6	2.1	1.8	2.3	3.0	2.4	2.9	3.8	2.8	3.5	4.3
Voltage constant 1)	k_e	[V/1000rpm]	212	167	128	195	158	123	214	166	129	212	167	124
Winding resistance 2)	R_{u-v}	[Ω]	8.0	4.9	3.0	4.0	2.6	1.6	3.2	2.0	1.2	2.4	1.5	0.9
Winding inductance	L_{u-v}	mH	35.0	21.5	12.7	19.0	12.6	7.5	15.3	9.2	5.6	9.4	5.8	3.2
Maximum values														
max. torque	M_{max}	[Nm]	25			36			47			57		
max. current (peak value)	I_{max}	[A]	12.1	15.5	20.1	19.0	23.3	30.1	22.7	29.4	37.7	27.2	35.3	47.4
max. speed	n_{max}	[rpm]	4500											
Mechanical data 3)														
Inertia	J_L	[kgcm²]	7.9			11.2			14.4			19.5		
Mass	M	[kg]	10.0			11.9			14.0			18.0		
Total length	l_{38}	[mm]	203			233			263			293		

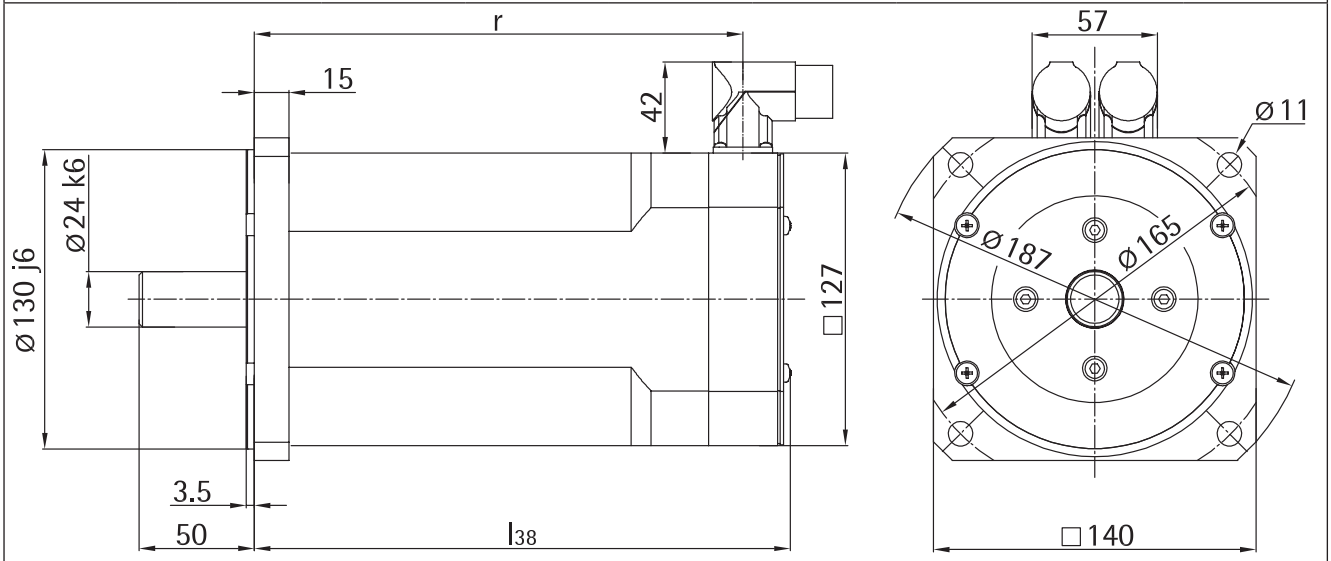
1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

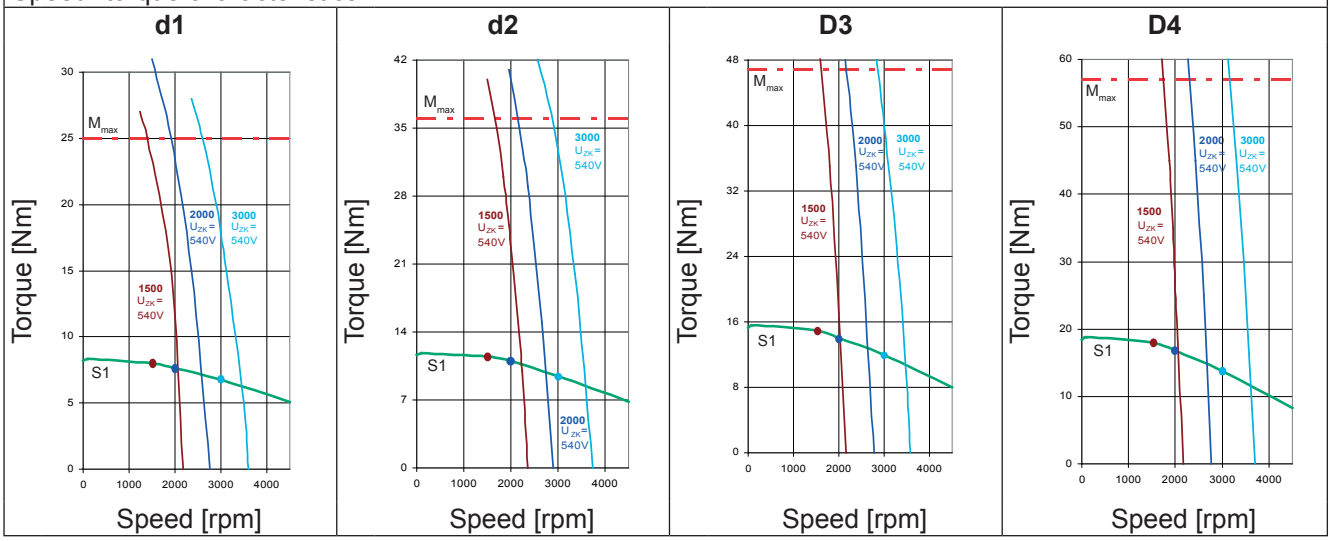
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	22
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	0.84
Mass	M	[kg]	1.15
Inertia	J_{Br}	[kgcm²]	2.76

Dimensions servo motor DxSM50-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
d1	203	182	245	217	237	216	279	251
d2	233	212	275	247	267	246	309	281
D3	263	242	305	277	297	276	339	311
D4	293	272	335	307	327	306	369	341

Speed-/torque characteristics

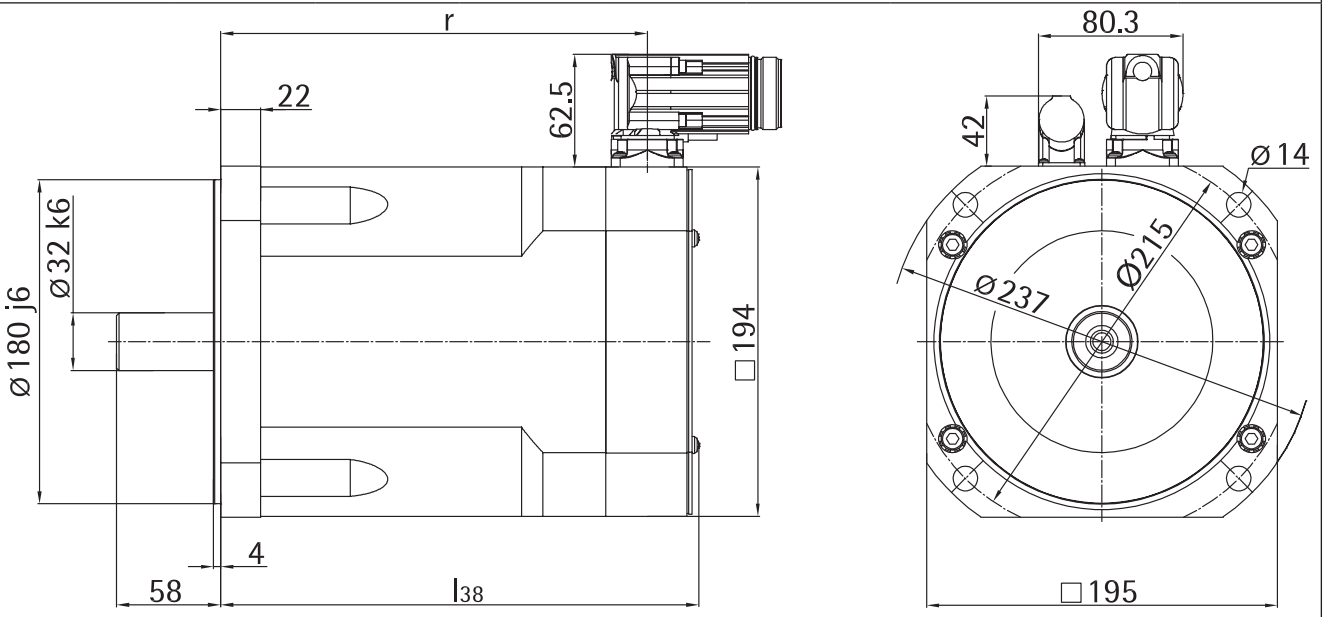


7.5 Servo motor ExSM50-xxxx

for inverter rated voltage 400 to 480 V AC											
Motor type			**E1**			**E2**			**E3**		
Rated speed	n_N	[rpm]	1000	2000	3000	1000	2000	3000	1000	2000	3000
Stall torque	M_{d0}	[Nm]	23.5			35.0			48.0		
Current at stall torque	I_{d0}	[A]	7.6	12.7	16.9	10.9	19.3	24.8	16.1	27.7	38.2
Number of poles	2p		6								
Nominal rating											
Rated torque	M_{dN}	[Nm]	23	19	14	34	28	19	47	40	27
Rated current	I_{dN}	[A]	6.9	9.7	9.4	9.8	14.2	12.4	14.5	20.8	19.6
Rated power	P_{dN}	[kW]	2.4	4.0	4.4	3.6	5.8	6.0	4.9	8.3	8.4
Voltage constant 1)	k_e	[V/1000rpm]	291.3	170.4	127.8	300	168.4	131.5	281.3	165	116.7
Winding resistance 2)	R_{u-v}	[Ω]	2.31	0.79	0.5	1.42	0.44	0.27	0.87	0.3	0.15
Winding inductance	L_{u-v}	mH	38.9	13.3	7.5	26.1	8.2	5.0	17.3	5.9	3.0
Maximum values											
max. torque	M_{max}	[Nm]	65			106			145		
max. current (peak value)	I_{max}	[A]	23.3	39.3	52.2	36.3	64.1	81.7	53.2	90.4	127.0
max. speed	n_{max}	[rpm]	4000								
Mechanical data 3)											
Inertia	J_L	[kgcm²]	57			79			102		
Mass	M	[kg]	24			26			29		
Total length	l_{38}	[mm]	266			294			322		
1) Peak value at operating temperature											
2) at 20°C											
3) with resolver, without holding brake											

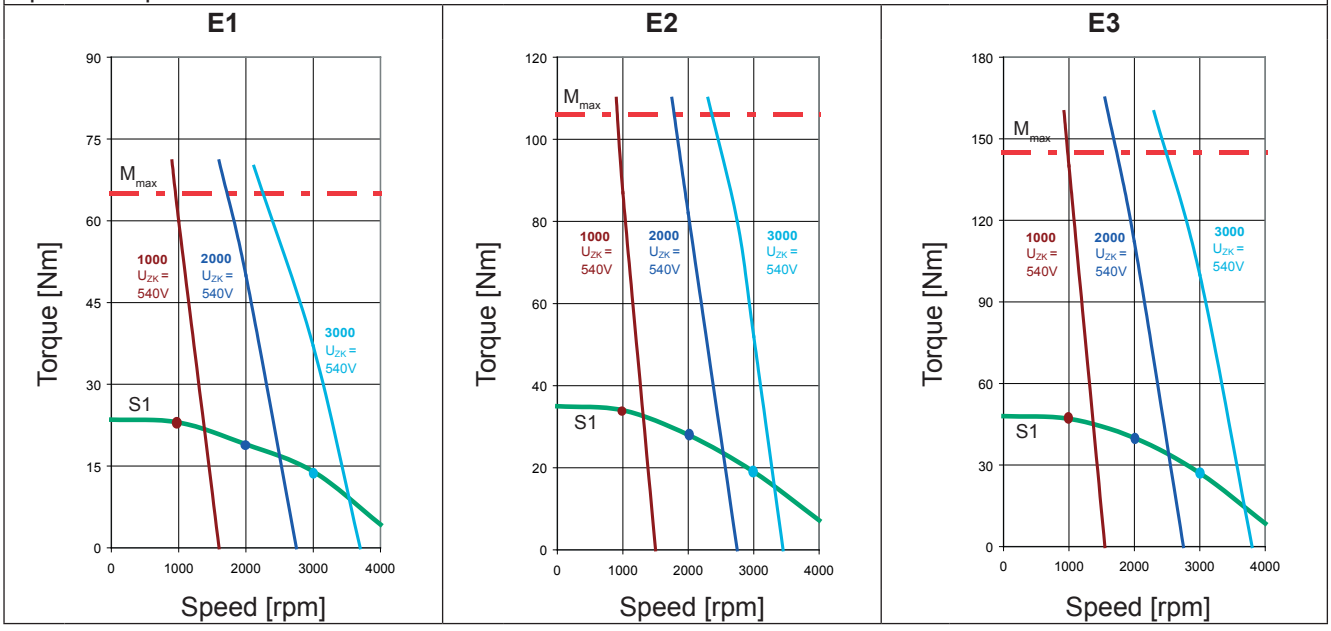
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	60
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	2.3
Mass	M	[kg]	3.4
Inertia	J_{Br}	[kgcm²]	20.1

Dimensions servo motor ExSM50-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
E1	266	237	293	264	300	271	327	298
E2	294	265	321	292	328	299	355	326
E3	322	293	349	320	356	327	383	354

Speed-/torque characteristics



7.6 Servo motor CxSM51-xxxx

for inverter rated voltage 400 to 480 V AC														
Motor type (with flange cooling)			**C1**			**C2**			**C3**			**C4**		
Rated speed	n_N	[rpm]	2000	3000	4000	2000	3000	4000	2000	3000	4000	2000	3000	4000
Stall torque	M_{d0}	[Nm]	5.0			7.4			9.2			11.1		
Current at stall torque	I_{d0}	[A]	3.2	4.0	5.0	4.9	6.5	7.9	7.4	9.1	11.4	7.1	11.0	13.7
Number of poles	2p		8											
Nominal rating														
Rated torque	M_{dN}	[Nm]	5.2	4.7	4.2	7.4	6.4	5.6	9.3	8.6	7.7	11.2	10.3	9.2
Rated current	I_{dN}	[A]	3.3	3.8	4.2	4.9	5.7	6.1	5.8	6.7	7.5	5.7	8.0	8.9
Rated power	P_{dN}	[kW]	1.1	1.5	1.8	1.6	2.0	2.4	1.9	2.7	3.2	2.3	3.2	3.8
Voltage constant 1)	k_e	[V/1000rpm]	139	111.6	88.9	131	98.1	80.6	139	112.4	89.7	173	111.9	89.5
Winding resistance 2)	R_{u-v}	[Ω]	11.6	7.4	4.7	6.1	3.6	2.4	4.4	2.9	1.8	5.3	2.2	1.4
Winding inductance	L_{u-v}	mH	29.5	19.0	12.1	16.5	9.3	6.3	13.5	8.9	5.7	20.0	8.4	5.4
Maximum values														
max. torque	M_{max}	[Nm]	12			17.5			22			26		
max. current (peak value)	I_{max}	[A]	8,4	10.5	13.2	12.6	16.8	20.4	16.2	20.0	25.1	15.3	23.8	29.6
max. speed	n_{max}	[rpm]	6000											
Mechanical data 3)														
Inertia	J_L	[kgcm²]	2.7			3.7			4.7			6.0		
Mass	M	[kg]	6.3			7.8			9.0			10.4		
Total length	l_{38}	[mm]	259			287			315			343		

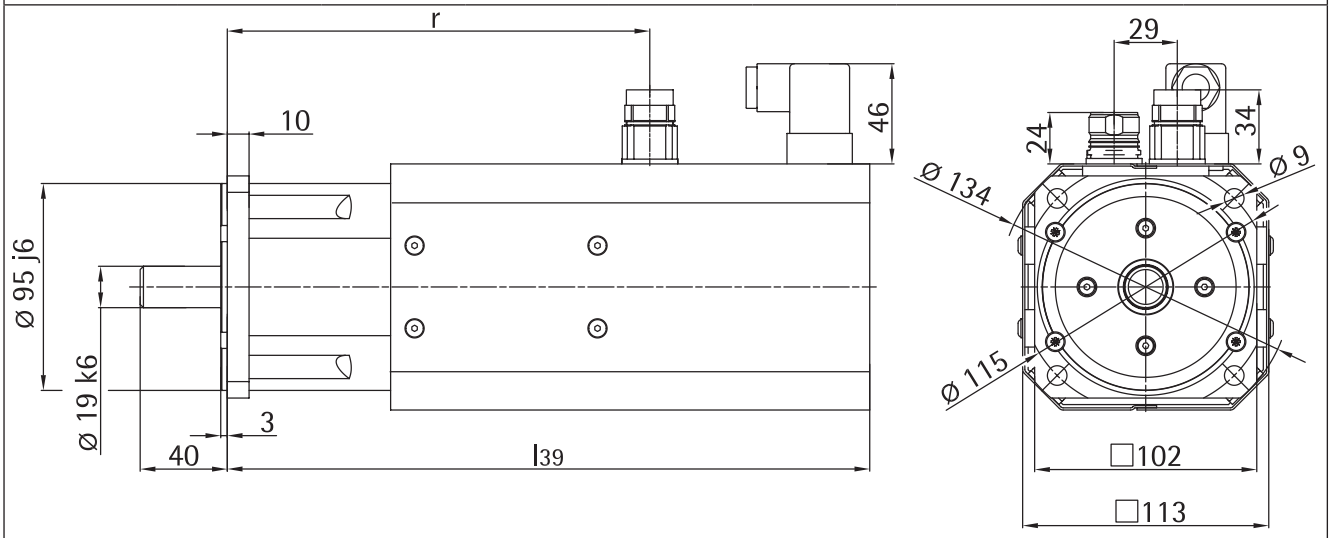
1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

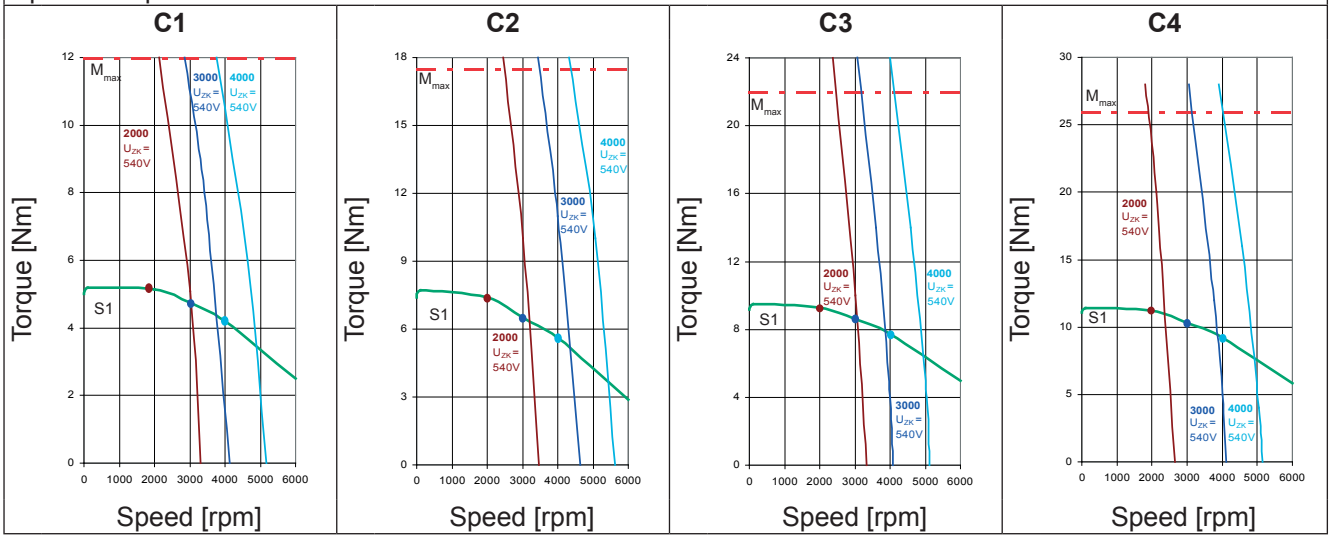
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	10
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	0.71
Mass	M	[kg]	0.57
Inertia	J_{Br}	[kgcm²]	1.01

Dimensions servo motor CxSM51-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
C1	259	158	301	193	295	194	337	229
C2	287	186	329	221	323	222	365	257
C3	315	214	357	249	351	250	393	285
C4	343	242	385	277	379	278	421	313

Speed-/torque characteristics



7.7 Servo motor DxSM51-xxxx

for inverter rated voltage 400 to 480 V AC														
Motor type			**d1**			**d2**			**D3**			**D4**		
Rated speed	n_N	[rpm]	1500	2000	3000	1500	2000	3000	1500	2000	3000	1500	2000	3000
Stall torque	M_{d0}	[Nm]	10.6			15.1			19.9			23.9		
Current at stall torque	I_{d0}	[A]	4.7	6.0	7.9	7.3	9.0	11.6	8.8	11.4	14.6	10.7	13.6	18.2
Number of poles	2p		8											
Nominal rating														
Rated torque	M_{dN}	[Nm]	10.8	10.3	9.1	15.6	14.9	12.8	20.2	18.9	16.1	24.3	22.8	18.5
Rated current	I_{dN}	[A]	4.4	5.4	6.2	6.9	8.1	9.1	8.2	9.9	10.9	9.9	11.9	12.9
Rated power	P_{dN}	[kW]	1.7	2.2	2.9	2.4	3.1	4.0	3.2	4.0	5.1	3.8	4.8	5.8
Voltage constant 1)	k_e	[V/1000rpm]	212	167	128	195	158	123	214	166	129	212	167	124
Winding resistance 2)	R_{u-v}	[Ω]	8.0	4.9	3.0	4.0	2.6	1.6	3.2	2.0	1.2	2.4	1.5	0.9
Winding inductance	L_{u-v}	mH	35.0	21.5	12.7	19.0	12.6	7.5	15.3	9.2	5.6	9.4	5.8	3.2
Maximum values														
max. torque	M_{max}	[Nm]	25			36			47			57		
max. current (peak value)	I_{max}	[A]	12.1	15.5	20.1	19.0	23.3	30.1	22.7	29.4	37.7	27.2	35.3	47.4
max. speed	n_{max}	[rpm]	4500											
Mechanical data 3)														
Inertia	J_L	[kgcm²]	7.9			11.2			14.4			19.5		
Mass	M	[kg]	11.9			13.8			16.2			20.4		
Total length	l_{38}	[mm]	285			315			345			375		

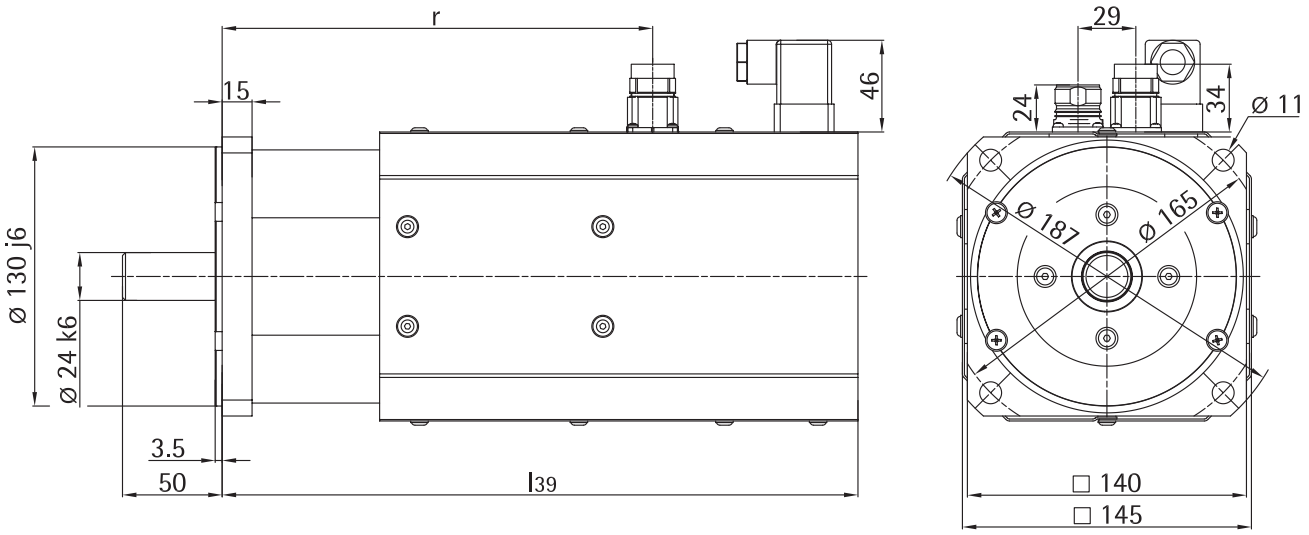
1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

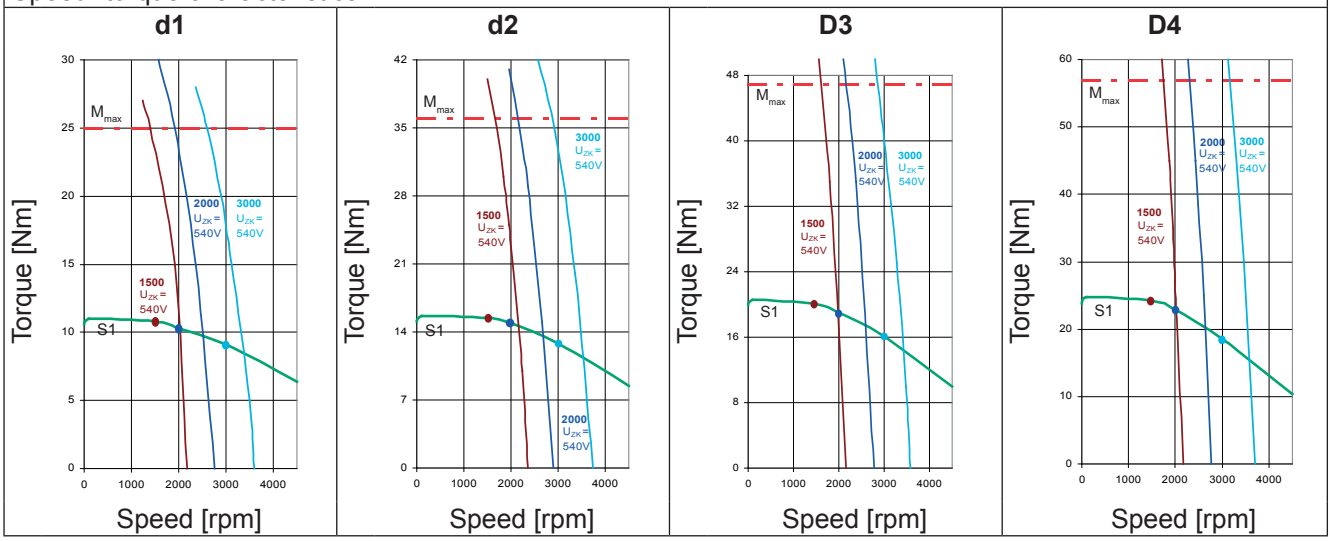
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	22
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	0.84
Mass	M	[kg]	1.15
Inertia	J_{Br}	[kgcm²]	2.76

Dimensions servo motor DxSM51-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
d1	285	182	327	217	319	216	361	251
d2	315	212	357	247	349	246	391	281
D3	345	242	387	277	379	276	421	311
D4	375	272	417	307	409	306	451	341

Speed-/torque characteristics



7.8 Servo motor ExSM51-xxxx

for inverter rated voltage 400 to 480 V AC												
Motor type			**E1**			**E2**			**E3**			
Rated speed	n_N	[rpm]	1000	2000	3000	1000	2000	3000	1000	2000	3000	
Stall torque	M_{d0}	[Nm]	30.6			45.5			62.5			
Current at stall torque	I_{d0}	[A]	9.9	17.1	22.8	14.4	25.5	32.5	21.4	36.9	51.6	
Number of poles	2p		6									
Nominal rating												
Rated torque	M_{dN}	[Nm]	30	28	24	45	40	34	62	57	48	
Rated current	I_{dN}	[A]	9.3	14.4	16.6	13.3	21.0	22.3	19.9	30.8	36.2	
Rated power	P_{dN}	[kW]	3.1	5.8	7.6	4.7	8.4	10.6	6.5	11.9	15.2	
Voltage constant 1)	k_e	[V/1000rpm]	291.3	170.4	127.8	299.9	168.4	131.5	281.3	165.0	116.7	
Winding resistance 2)	R_{u-v}	[Ω]	2.31	0.79	0.5	1.42	0.44	0.27	0.87	0.3	0.15	
Winding inductance	L_{u-v}	mH	38.9	13.3	7.5	26.1	8.2	5.0	17.3	5.9	3.0	
Maximum values												
max. torque	M_{max}	[Nm]	65			106			145			
max. current (peak value)	I_{max}	[A]	23.3	39.3	52.2	36.3	64.1	81.7	53.2	90.4	127.0	
max. speed	n_{max}	[rpm]	4000									
Mechanical data 3)												
Inertia	J_L	[kgcm²]	57			79			102			
Mass	M	[kg]	32			37			42			
Total length	l_{38}	[mm]	380			414			448			

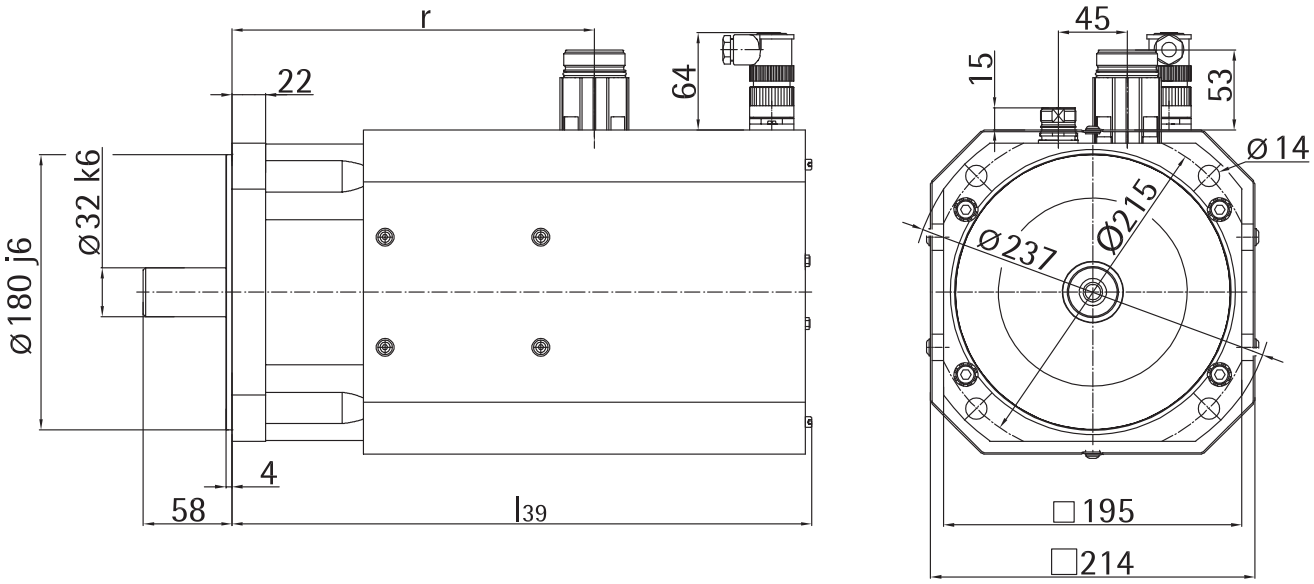
1) Peak value at operating temperature

2) at 20°C

3) with resolver, without holding brake

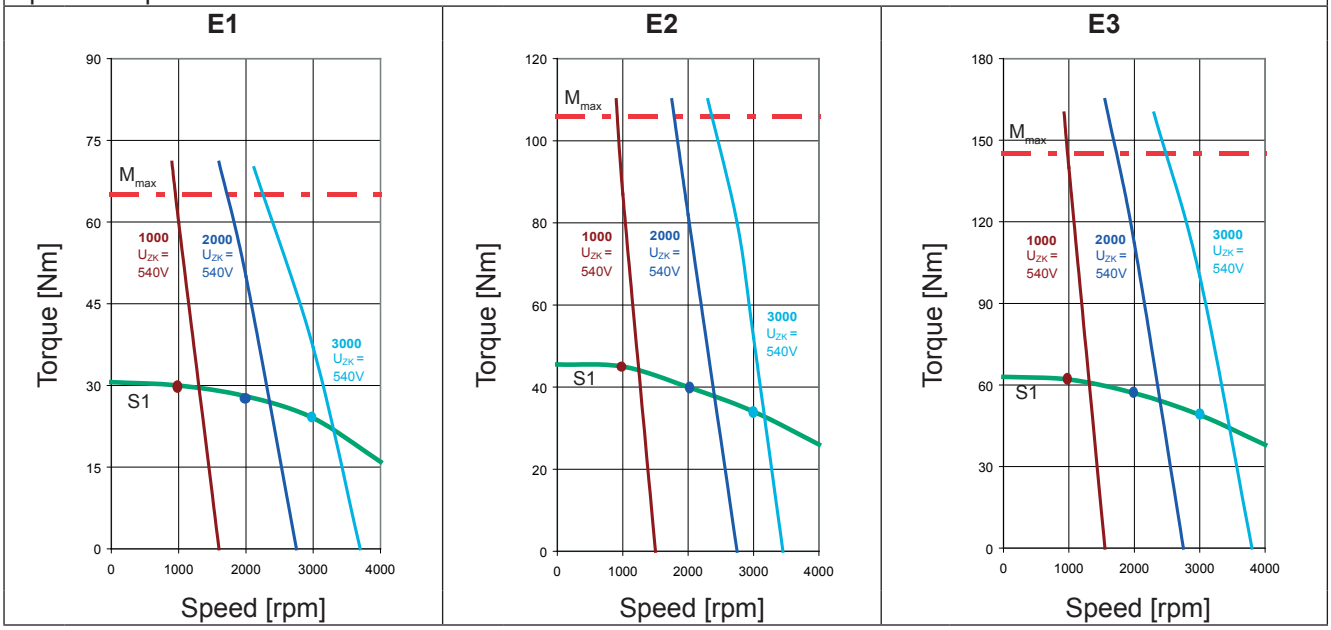
Technical data of the holding brake			
Holding torque	M_{Br}	[Nm]	70
Rated voltage	U_{Br}	[V DC]	24
Rated current (20°C)	I_{Br}	[A]	2.3
Mass	M	[kg]	3.4
Inertia	J_{Br}	[kgcm²]	5.9

Dimensions servo motor ExSM51-xxxx



Brake	without holding brake				with holding brake			
Encoder type	Resolver		Encoder		Resolver		Encoder	
Motor type	l38	R	l38	R	l38	R	l38	R
E1	380	237	414	264	414	271	448	298
E2	414	265	448	292	448	299	476	326
E3	448	293	476	320	476	327	504	354

Speed-/torque characteristics



8. Appendix

8.1 Certification

8.1.2 CE Marking

CE marked servo motors were developed and manufactured to comply with the regulations of the Low-Voltage Directive 2006/95/EC.
The servo motors must not be started until it is determined that the installation complies with the Machine directive (2006/42/EG) as well as the EMC-directive (2004/108/EC)(note EN 60204).
The servo motors meets the requirements of the Low-Voltage directive 2006/95/EC. The harmonized standards EN 60204-1, EN 60034, EN 292-1 and EN 292-2 were used..
An appropriate declaration of conformity is available if necessary via our internetportal.

8.1.3 UL Marking

	Acceptance according to UR and cUR is marked at KEB servo motors with the adjacent logo on the type plate as well as by the E-file.

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Mat.No.	00SM0EB-K013
Rev.	1C
Date	08/2009