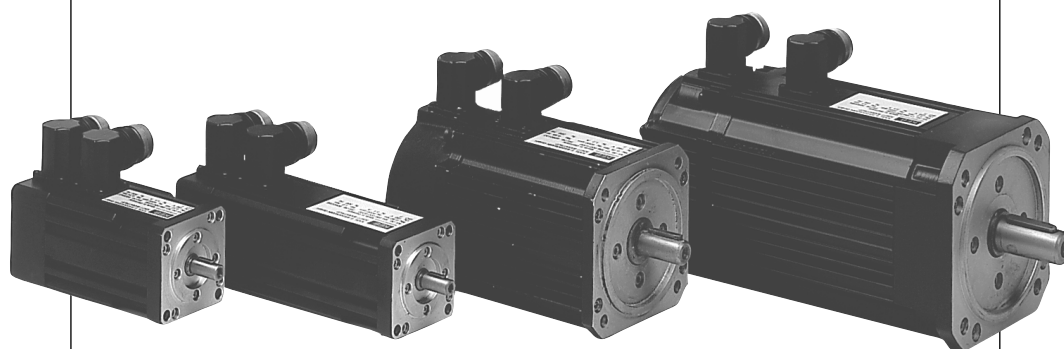


# INSTRUCTION MANUAL



## Dynamic Line I

**GB** Servo motors

Size A1...E3

|              |      |
|--------------|------|
| Mat.No.      | Rev. |
| 00SM0EB-K014 | 2B   |

**KEB**

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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 necessary 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.


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# General


## 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 explicitly permitted (observe additional instructions).


|   |  |   |
|---|--|---|
|  | <b>Operation within the limit values</b> | 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


|   |                                       |  |
|---|---------------------------------------|--|
|  | <b>Electrical qualified personnel</b> | 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. |
|---|---------------------------------------|--|


|   |                          |   |
|---|--------------------------|---|
|  | <b>Dangerous voltage</b> | During the operation (even at zero speed) the motors possess 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. |
|---|--------------------------|---|

|   |                           |   |
|---|---------------------------|---|
|  | <b>No mains operation</b> | 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. |
|---|---------------------------|---|

|   |                     |   |
|---|---------------------|---|
|  | <b>Hot surfaces</b> | 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. |
|---|---------------------|---|

|   |                           |  |
|---|---------------------------|--|
|  | <b>Secure feather key</b> | 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. |
|---|---------------------------|--|

|   |  |  |
|---|--|--|
|  | <b>Operation with integrated brake</b> | 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. |
|---|--|--|


|   |  |   |
|---|--|---|
|  | <b>Protection of the motor winding</b> | The temperature 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 fast arising 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 wooden cases

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

|   |                                 |   |
|---|---------------------------------|---|
|  | <b>Caution during transport</b> | 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 no 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<sup>-1</sup>) 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  |
| 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  |

further on next side

## General

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|   |                |             |            |
|---|----------------|-------------|------------|
| Cylindrical shaft ends for electrical machinery   | DIN 748 Part 3 |             | IEC 600 72 |
| Integrated thermal protection   |                | EN60 034-11 |            |
| Tolerances of shaft extension run-out and of mounting flanges for rotating electrical machinery | DIN 42 955     |             |            |
| Mounting flanges for electrical machinery   | DIN 42 948     |             |            |

### 1.6 EC Manufacturer's Declaration

CE marked motors were developed and manufactured to comply with the regulations of the Low-Voltage Directive 2006/95/EC.

The motors must not be started until it is determined that the installation complies with the machine directive (2006/42/EC) as well as the EC EMC Directive (2004/108/EC). If necessary, a manufacturer's declaration is available at KEB.

## 2. Product Description

### 2.1 Part code

**A 2 . S M . 0 0 0 - 6 2 0 0**

|                                 |  |  |
|---------------------------------|--|--|
| <b>Encoder</b>                  | 0: 2 pole resolver<br>Stegmann Hiperface Singleturn SRS 50/60 1024 increments<br>A: per revolution<br>Stegmann Hiperface Multiturn SRM 50/60 1024 increments<br>B: per revolution<br>Heidenhain EnDat Singleturn ECN 1113/1313 512<br>C: increments per revolution<br>Heidenhain EnDat Multiturn EQN 1125/1325 512 increments<br>D: per revolution<br>Heidenhain Sin/Cos encoder ERN 1387 2048 increments per<br>F: revolution<br>Heidenhain Sin/Cos encoder ERN 1185 512 increments per<br>H: revolution<br>Heidenhain EnDat Singleturn ECI 1317 32 increments per<br>I: revolution<br>Heidenhain EnDat Multiturn EQI 1329 32 increments per<br>J: revolution |  |
| <b>Connection</b>               | 0: Plug/plug rotatable angular flange socket<br>1: Terminal box<br>9: Plug size 1,5  |  |
| <b>Voltage</b>                  | 2: 190 V (200 V class)   | 4: 330 V (400V class)                            |
| <b>Speed</b>                    | 1: 1500 <sup>rpm</sup><br>2: 2000 <sup>rpm</sup><br>3: 3000 <sup>rpm</sup>   | 4: 4000 <sup>rpm</sup><br>6: 6000 <sup>rpm</sup> |
| <b>Design</b>                   | 0: Feather key (default)<br>1: Feather key, brake (default)<br>2: without feather key<br>3: without feather key, brake<br>4: Feather key, oil-tight flange IP65 (radial shaft sealing ring)<br>5: Feather key, brake, oil-tight flange IP65 (radial shaft sealing ring)<br>B: Oil-tight flange IP65 (radial shaft sealing ring)<br>C: Brake, oil-tight flange IP65 (radial shaft sealing ring)   |  |
| <b>Cooling</b>                  | 0: Self-cooling with flange B5 (1FT5 compatible)<br>1: Separate cooling with flange B5 (1FT5 compatible)<br>2: Self-cooling; foot<br>3: Separate cooling; foot   |  |
| <b>Motor type</b>               | 0: Three-phase synchronous motor Dynamic Line I  |  |
| <b>Unit type</b>                | SM: Servo motor  |  |
| <b>Size/construction length</b> | A1...E3  |  |

## Product Description

### 2.2 Overview of the motor

| Motor type    |           | Standstill-torque $M_{d10}$ [Nm] at | Rated torque $M_{dN}$ [Nm] dependent on the motor rated speed |           |           |           |           |           |
|---------------|-----------|-------------------------------------|---|-----------|-----------|-----------|-----------|-----------|
|               |           |                                     | 10 rpm  | 1.000 rpm | 2.000 rpm | 3.000 rpm | 4.000 rpm | 6.000 rpm |
| 200 V / 400 V | A1.SM.000 | 0.34                                |   |           |           |           | 0.32      |           |
|               | A2.SM.000 | 0.50                                |   |           |           |           | 0.48      |           |
|               | A3.SM.000 | 0.65                                |   |           |           |           | 0.6       |           |
|               | A4.SM.000 | 1.0                                 |   |           |           |           | 0.8       |           |
|               | B1.SM.000 | 0.65                                |   |           |           | 0.6       | 0.5       |           |
|               | B2.SM.000 | 1.5                                 |   |           |           | 1.3       | 1.0       |           |
|               | B3.SM.000 | 2.3                                 |   |           |           | 2.0       | 1.5       |           |
|               | C1.SM.000 | 0.95                                |   |           |           | 0.8       | 0.75      | 0.7       |
|               | C2.SM.000 | 2.7                                 |   |           |           | 2.4       | 2.2       | 2.0       |
|               | C3.SM.000 | 4.5                                 |   |           |           | 3.9       | 3.5       | 2.8       |
|               | C4.SM.000 | 6.0                                 |   |           |           | 5.0       | 4.5       | 3.0       |
|               | D1.SM.000 | 4.2                                 |   |           |           | 3.7       | 3.5       | 3.0       |
|               | D2.SM.000 | 7.0                                 |   |           |           | 6.1       | 5.8       | 3.8       |
|               | D3.SM.000 | 10.0                                |   |           |           | 8.4       | 7.6       | 5.0       |
|               | D4.SM.000 | 12                                  |   |           |           | 9.9       | 8.6       |           |
|               | E1.SM.000 | 8.5                                 |   |           | 7.0       | 6.5       | 5.2       |           |
| E2.SM.000     | 14.0      |                                     |   | 12.2      | 11.0      | 7.6       |           |           |
| E3.SM.000     | 19.0      |                                     |   | 16.5      | 14.6      | 8.7       |           |           |
| E4.SM.000     | 27.0      |                                     |   | 21.4      | 15.5      |           |           |           |
| 400 V         | F1.SM.000 | 25                                  | 22.5  | 21.5      | 20.0      | 16.0      |           |           |
|               | F2.SM.000 | 50                                  | 42.0  | 38.0      | 31.0      |           |           |           |
|               | F3.SM.000 | 70                                  | 61.0  | 52.0      | 33.0      |           |           |           |

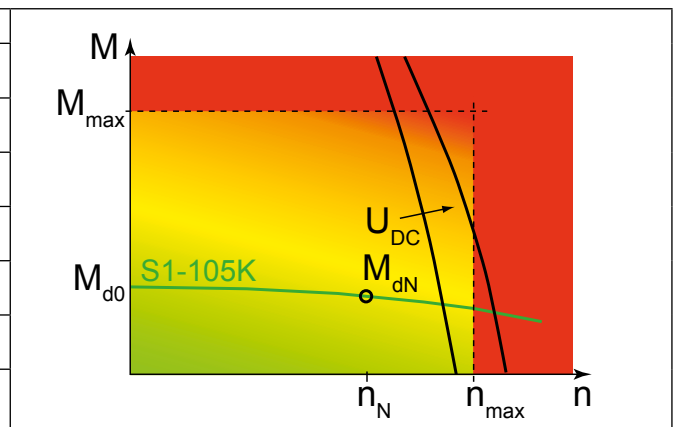


2.3 Standard design of the servo motors

|                               | default  | Option  |
|-------------------------------|--|---|
| Type                          | IM B5 (IM V1, IM V3)   |   |
| Degree of protection          | IP 65  |   |
| Shaft gland                   | IP 64  | IP 65   |
| 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:<br>Fixed bearing on D side            |
|                               |  | Size Ex:<br>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)<br>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    |



# Product Description

## 2.5 Project design

### 2.5.1 Selection of the servo motor

Calculate the following values before you select 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 ( $J_{Mot}$ ) can be accepted here with 1/5 inertia ( $J_{App}$ ) 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 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.

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

|                        |  |
|------------------------|--|
| 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:

|   |          |  |
|---|----------|--|
| $D_w = \frac{k \cdot 2 \cdot Mb}{F_{Rm}}$ | $D_w$    | effective circular diameter of the output components |
|   | $k$      | pretension factor                                    |
|   | $F_{Rm}$ | permissible lateral force                            |
|   | $Mb$     | acceleration torque of the drive                     |

### 2.5.4 Pretension factor

Empirical values for the pretension factor k:

|              |             |           |
|--------------|-------------|-----------|
| Pinion       | $k \approx$ | 1.5       |
| Toothed belt |             | 1.2...2.0 |
| V-belt       |             | 1.5...2.5 |
| 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**

|  |  |
|--|--|
| <p><b>Drive end of the motor</b><br/>                 In DINEN60034-7, the two ends of a motor are defined as follows:<br/> <b>D</b> (Drive End):<br/>                 Drive end (AS) of the motor.<br/> <b>N</b> (Non-Drive End):<br/>                 Non-drive end (BS) of the motor.</p> |  |
| <p><b>Direction of rotation of the motor</b><br/>                 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.</p>   |  |

**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.

|  |                          |  |
|--|--------------------------|--|
|  | <b>Use suitable tool</b> | Do not expose the motor to any impacts or blows. |
|--|--------------------------|--|


|         |                   |                  |    |                    |    |     |
|---------|-------------------|------------------|----|--------------------|----|-----|
|         |                   | <b>Shaft end</b> |    | <b>Feather key</b> |    |     |
|         | <b>Motor type</b> | d1               | L1 | B                  | L2 | L3  |
|         | Ax.SM.0           | Ø 9 k6           | 20 | 3                  | 12 | 4   |
|         | Bx.SM.0           | Ø 11 k6          | 23 | 4                  | 16 | 3.5 |
|         | Cx.SM.0           | Ø 14 k6          | 30 | 5                  | 22 | 4   |
|         | Dx.SM.0           | Ø 19 k6          | 40 | 6                  | 32 | 4   |
|         | Ex.SM.0           | Ø 24 k6          | 50 | 8                  | 32 | 4   |
| Fx.SM.0 | Ø 32 k6           | 58               | 10 | 50                 | 4  |     |


## Product Description

### 2.6.3 Winding and insulation system

The insulation materials we use ensure insulation class 155 (F) to EN60034. Therefore, the winding temperature rise may be max. 105K 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  $U_{link\ max.} = 840\ VDC$  (constant 690VDC).

|   |  |
|---|--|
|  | $U_{link\ max.}$ 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. |
|---|--|


|   |                           |   |
|---|---------------------------|---|
|  | <b>No mains operation</b> | 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)

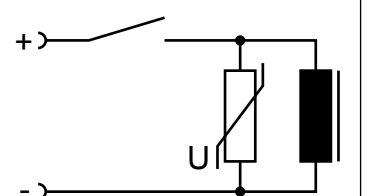
The optional built-in holding brake is used to fix the motor shaft when the motor is at standstill or de-energized. It is a permanent-field single-disc brake which operates on the closed-circuit principle, i.e. the brake is effective when the motor is de-energized, thus the motor shaft is held.

|  |   |   |
|--|---|---|
|  | <b>Holding brake is not a working brake</b> | 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.

|   |   |  |
|---|---|--|
|  | <b>Motor rotation in spite of an active brake</b> | 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 brake 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 1,000V. 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 | Degree of protection |
|------------|--------------------------------|---------------|----------------------|
| CxSM.51    | 230V (+10% / -10%) 50/60Hz     | 0.12A         | IP 54                |
| DxSM.51    | 230V (+10% / -10%) 50/60Hz     | 0.30A         | IP 54                |
| ExSM.51    | 3 x 400V (+10% / -10%) 50/60Hz | 0.15A         | IP 44                |


|   |                           |   |
|---|---------------------------|---|
|  | <b>Check external fan</b> | 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

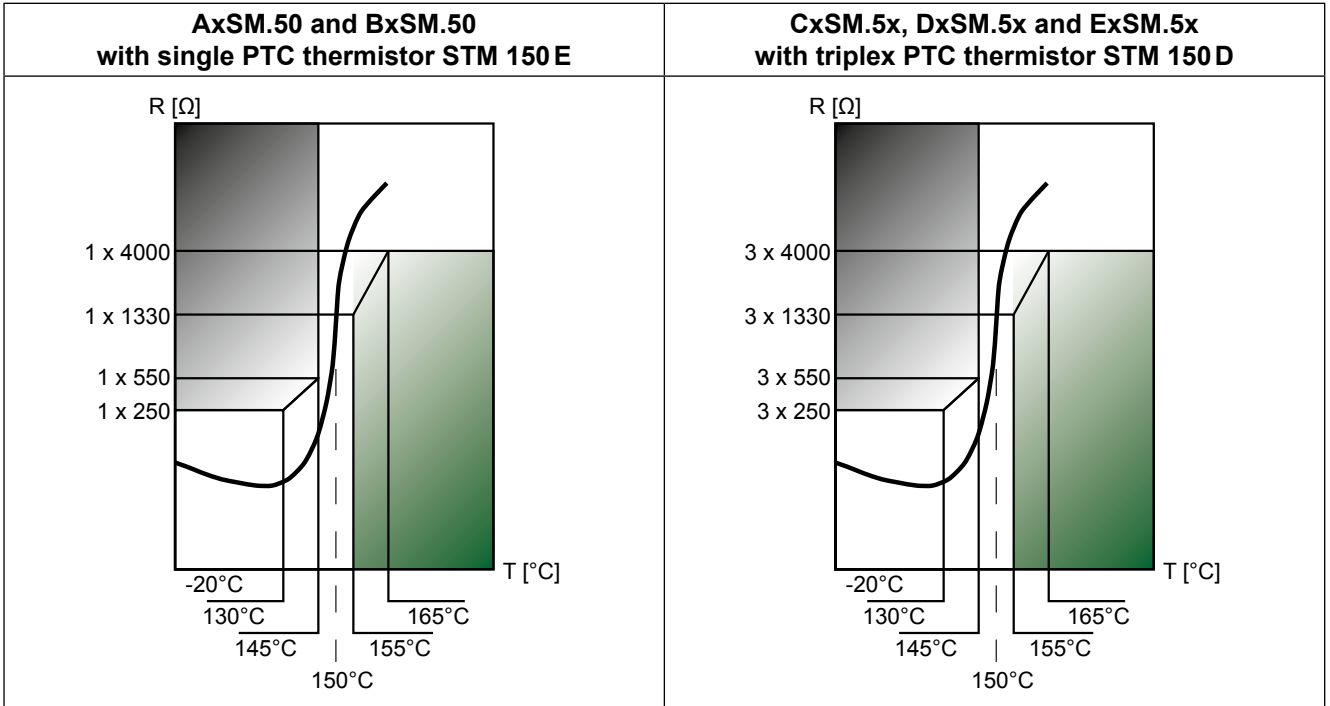
PTC thermistors are installed as standard in the NDE winding head to protect the motors against thermal overload when the temperature change is slow (temperature change in minutes or hours).

|  |                   |  |
|--|-------------------|--|
|  | <b>max. 30VDC</b> | The maximum operating voltage of the PTC thermistors must not exceed 30 VDC. |
|--|-------------------|--|

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  $I^2 \times t$  by the inverter electronic system) to protect the motor from fast-rising thermal overload.

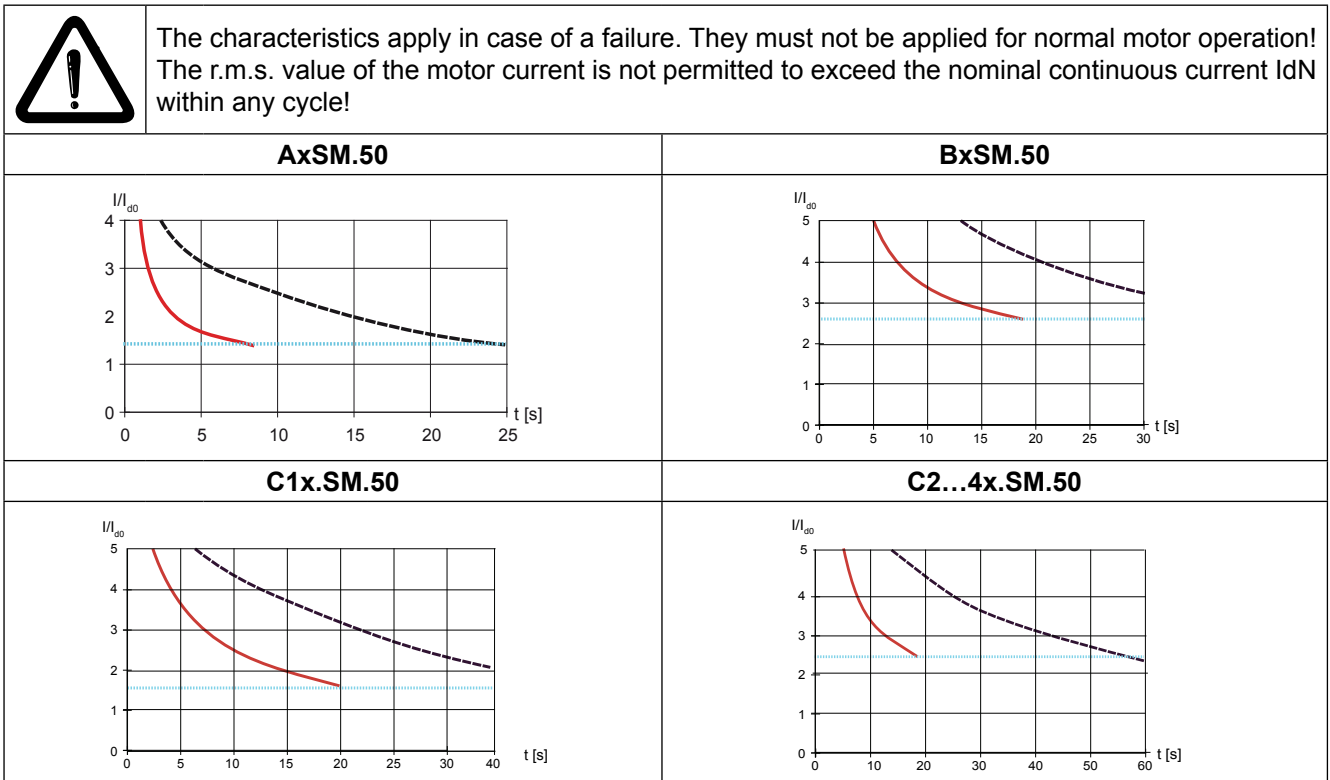
|   |                           |   |
|---|---------------------------|---|
|  | <b>Attention overload</b> | The evaluation of the temperature sensor belongs to the monitoring of the motor winding. The temperature sensor follows fast temperature changes only with delay. Especially the windings of small motors (AxSM.50 and BxSM.50) are very sensitive to overload. |
|---|---------------------------|---|

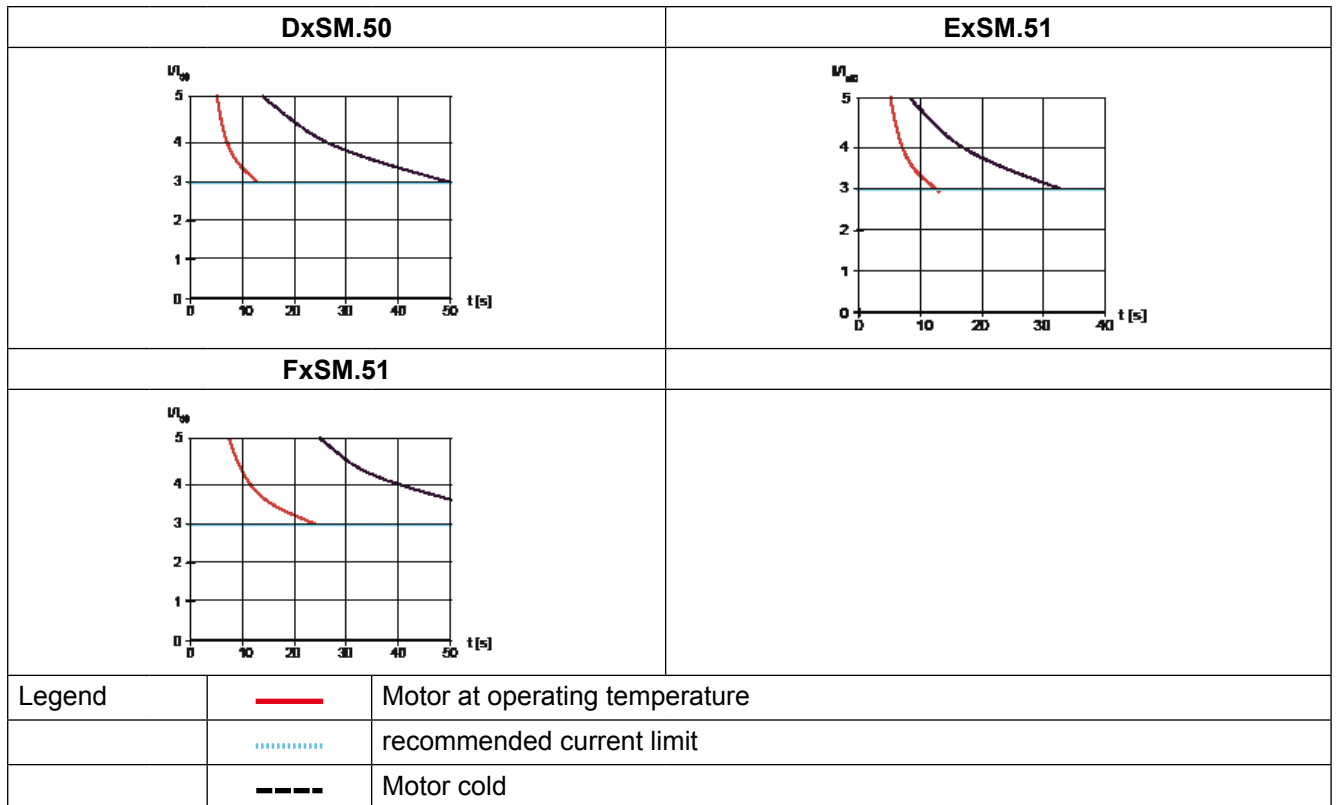
# Product Description



The built-in PTC thermistor is the basic version. Other temperature detectors such as KTY84 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  $I_{max}$ .





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 |

$$U_{S1-S3} = K * U_{R1-R2} * \cos \alpha$$

$$U_{S2-S4} = K * U_{R1-R2} * \sin \alpha$$

|  |   |  |
|--|---|--|
|  | <b>Adjustment of the measuring system</b> | 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 encoder; SIN-COS coder or Encoder).


# Operating Conditions

## 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.   |

|   |   |   |
|---|---|---|
|  | <b>Lubrication of the rotary shaft seal</b> | <p>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.</p> <p>If the shaft seal is greased, the maximum permissible motor speed may need to be reduced.</p> <p>Regular regreasing is imperative!</p> <p>Excessive peripheral speeds destroy the sealing lip and its protective function is no longer guaranteed.</p> |
|---|---|---|

### 3.2 Cooling, altitude, ambient conditions

| <p>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).</p> <p>Larger mounting flanges improve the heat dissipation conditions whereas smaller flanges deteriorate them. Since a large number of influencing factors have to be taken into account no reliable estimation of the required power reduction can be made.</p> <p>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.</p> | Motor type                   |      | Test flange dimensions   |       |      |      |      |      |
|---|------------------------------|------|--------------------------|-------|------|------|------|------|
|   | 55                           |      | 200 x 100 x 10           |       |      |      |      |      |
|   | 70                           |      | 230 x 150 x 15           |       |      |      |      |      |
|   | 92                           |      | 230 x 150 x 15           |       |      |      |      |      |
|   | 110                          |      | 230 x 150 x 15           |       |      |      |      |      |
|   | 140                          |      | 300 x 300 x 20           |       |      |      |      |      |
|   | 190                          |      | 300 x 300 x 20           |       |      |      |      |      |
| <p>At higher temperatures or altitudes, the overload capability of the motors is reduced (see table opposite).</p>  | 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 |      |

|   |  |  |
|---|--|--|
|  | <b>Fire- and combustion protection</b> | <p>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.</p> |
|---|--|--|



|  |                                  |   |
|--|----------------------------------|---|
|  | <b>Derating due to harmonics</b> | 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 Table

Indicated in the table:

- the highest permissible lateral force  $F_{Rm}$  at  $x=L/2$
- the highest permissible axial force  $F_{Am}$  for a lifetime of 20.000 hours.

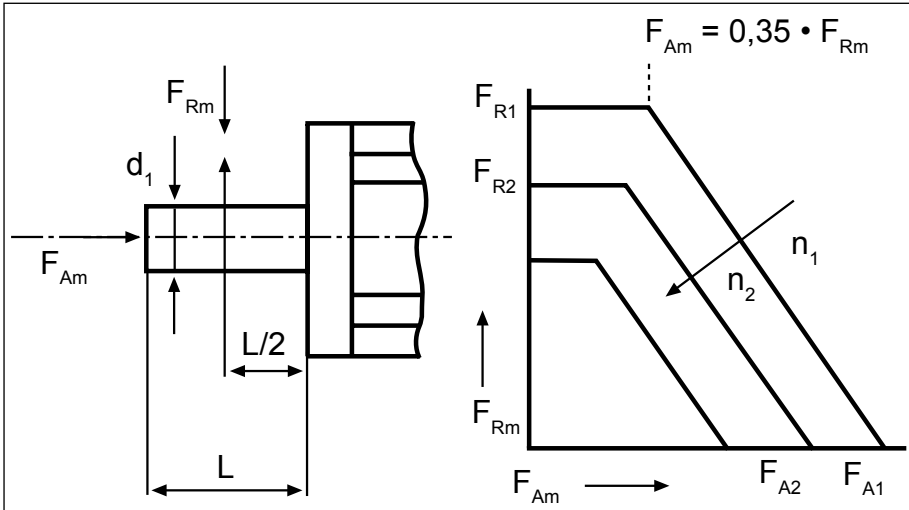
| Motor | Lateral force $F_{Rm}$ [N]<br>at speed n [rpm] |      |      |      | Axial force $F_{Am}$ [N]<br>at speed n [rpm] |      |      |      | $d_1$<br>L  | $F_G$<br>[N] | P<br>[mm] | C<br>[mm] | $F_{Rmax}$<br>[N] |
|-------|--|------|------|------|--|------|------|------|-------------|--------------|-----------|-----------|-------------------|
|       | 2000   | 3000 | 4000 | 6000 | 2000   | 3000 | 4000 | 6000 |             |              |           |           |                   |
| A1    | 310  | 260  | 240  | 210  | 250  | 200  | 170  | 140  | 9 k6<br>20  | 1            | 10        | 96        | 600               |
| A2    |  |      |      |      |  |      |      |      |             | 2            |           | 108       |                   |
| A3    |  |      |      |      |  |      |      |      |             | 3            |           | 121       |                   |
| A4    |  |      |      |      |  |      |      |      |             | 4            |           | 145       |                   |
| B1    | 400  | 340  | 300  | 270  | 310  | 260  | 220  | 180  | 11 j6<br>23 | 2            | 11        | 81        | 800               |
| B2    |  |      |      |      |  |      |      |      |             | 4            |           | 105       |                   |
| B3    |  |      |      |      |  |      |      |      |             | 6            |           | 141       |                   |
| C1    | 470  | 400  | 350  | 320  | 380  | 310  | 260  | 220  | 14 k6<br>30 | 3            | 17        | 131       | 1000              |
| C2    |  |      |      |      |  |      |      |      |             | 9            |           | 155       |                   |
| C3    |  |      |      |      |  |      |      |      |             | 14           |           | 189       |                   |
| C4    |  |      |      |      |  |      |      |      |             | 20           |           | 223       |                   |
| D1    | 720  | 640  | 550  | 490  | 590  | 500  | 420  | 350  | 19 k6<br>40 | 10           | 24        | 138       | 2000              |
| D2    |  |      |      |      |  |      |      |      |             | 17           |           | 168       |                   |
| D3    |  |      |      |      |  |      |      |      |             | 23           |           | 198       |                   |
| D4    |  |      |      |      |  |      |      |      |             | 30           |           | 228       |                   |
| E1    | 1100   | 1000 | 850  | -    | 900  | 770  | 650  | 560  | 24 k6<br>50 | 17           | 24        | 188       | 2300              |
| E2    |  |      |      |      |  |      |      |      |             | 30           |           | 218       |                   |
| E3    |  |      |      |      |  |      |      |      |             | 40           |           | 248       |                   |
| E4    |  |      |      |      |  |      |      |      |             | 60           |           | 293       |                   |
| F1    | 2300   | 1900 | 1800 | -    | 1800   | 1500 | 1400 | -    | 32 k6<br>58 | 85           | 31        | 280       | 6000              |
| F2    |  |      |      |      |  |      |      |      |             | 140          |           | 360       |                   |
| F3    |  |      |      |      |  |      |      |      |             | 200          |           | 440       |                   |

|            |  |       |                             |
|------------|--|-------|-----------------------------|
| $F_{Rm}$   | permissible lateral force              | L     | Length of the shaft end     |
| $F_{Rmax}$ | max. permissible dynamic lateral force | $F_G$ | Inertial force of the rotor |
| $F_{Am}$   | permissible axial force                | P     | Linear size P               |
| $d_1$      | Shaft diameter                         | C     | Linear size C               |

# Operating Conditions

### 3.3.2 Shaft strain

The endurance strength of the shaft and the lifetime of the bearing determine the permissible lateral force  $F_{Rm}$  at the Drive-End -side shaft end



### 3.3.3 Output component

The minimum effective pulley diameter of the driving element is calculated as follows:

|  |  |
|--|--|
| $D_w = \frac{k \cdot 2 \cdot M_b}{F_{Rm}}$ | $D_w$ : Effective pulley diameter of the driving element<br>$k$ : preloading factor<br>$F_{Rm}$ : permissible radial force<br>$M_b$ : acceleration torque of the drive |
|--|--|

### 3.3.4 Preloading factor

Empirical values for the preloading factor  $k$ :

|                            |                  |
|----------------------------|------------------|
| approx. $k = 1.5$          | for pinion       |
| approx. $k = 1.2$ to $2.0$ | for toothed belt |
| approx. $k = 2.2$ to $3.0$ | for flat belt    |

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

3.3.5 Horizontal standard

|   |   |
|---|---|
| If the lateral force $F_R$ is not applied at $x = L/2$ , different radial forces will arise:  | $F_{Rx} = F_{Rm} \cdot \frac{c + p + 0,5 \cdot L}{c + p + x}$ |
| If the axial force $F_{AR}$ is not applied at the shaft centre, its radial component is taken into consideration by using:  | $F_{AR} = F_{AY} \cdot \frac{y}{p + x}$                       |
| <p>The diagram shows a cross-section of a motor shaft. A horizontal dashed line represents the shaft's centerline. A vertical force <math>F_{AR}</math> is applied at a distance <math>y</math> from the centerline. A horizontal force <math>F_{Ay}</math> is applied at the same point. Two vertical forces, <math>F_{Rx}</math> and <math>F_{Rm}</math>, are applied to the shaft. <math>F_{Rm}</math> is applied at the center of the shaft, which is at a distance <math>L/2</math> from the left end. <math>F_{Rx}</math> is applied at a distance <math>x</math> from the left end. The total length of the shaft is <math>L</math>. The distance from the right end of the shaft to the centerline is <math>p</math>, and the distance from the right end to the point of application of <math>F_{Rx}</math> is <math>c</math>.</p> |   |

3.3.6 Vertical standard

|   |  |
|---|--|
| If the motor is mounted vertically, the permissible axial forces $F_{Am}$ (see table) are understood as acting upward.  | $F_{Am/new} = F_{Am} - F_G$  |
| If the forces act downward, the level of permissible axial forces $F_{Am}$ is reduced by the rotor forces of gravity $F_G$ :  | $F_G = mL \cdot g$   |
| If the axial force $F_{Am}$ acts away from the motor, a force $F_w$ has to be taken into account for safety reasons:  | <p><math>m_L</math>: rotor weight<br/> <math>g</math>: gravitation acceleration</p> $F_{Am/new} = F_{Am} - F_G - F_w$ $F_w [N] = 10 \times d_1 [mm]$ |
| <p>The left diagram shows a motor shaft with a downward force <math>F_G</math> and an upward force <math>F_{Am}</math>. The right diagram shows a motor shaft with a downward force <math>F_G</math> and an upward force <math>F_{Am}</math> applied at a different position.</p> |  |
| Motors of the series A1... F3 with built-in holding brake are not to be loaded with axial forces, since the working airgap of the holding brake is changed and the holding brake becomes inoperative by it.   |  |

# Connection

## 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 capacity of PVC-insulated cables with copper conductor routed in cable ducts. The maximum permissible surrounding temperature is +40°C.

| Conductor size [mm <sup>2</sup> ] | 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   |                        |
|---|---|------------------------|---|------------------------|
| <ul style="list-style-type: none"> <li>• Angle socket</li> <li>• rotatable</li> <li>• 8-pole</li> <li>• Plug</li> </ul> |   |                        |   |                        |
| View of the connector pins at the motor   |   |                        |   |                        |
| Terminal assignment   | 1   | U                      | U   | U                      |
|   | 2   | PE                     | V   | V                      |
|   | 3   | W                      | W   | W                      |
|   | 4   | V                      | $\perp$   | 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   | <b>Ax...Dx.SM.5</b>   |                        | <b>Ex.SM.5</b>  |                        |
| ready-made, shielded, trailing cable  | 00S4x19-yyyy  |                        | 00S4x19-yyyy  |                        |
|   | x - cross-section [mm <sup>2</sup> ]<br>0 = 1.5 mm <sup>2</sup> ; 1 = 2.5 mm <sup>2</sup> |                        | x - cross-section [mm <sup>2</sup> ]<br>2 = 4 mm <sup>2</sup> |                        |
|   | yyyy - line length [m]  |                        |   |                        |

4.3 Encoder connection

4.3.1 Resolver

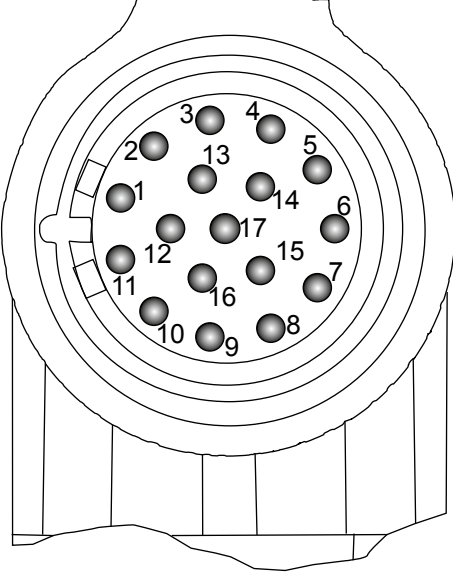
|  |                      |                                      |               |              |
|--|----------------------|--------------------------------------|---------------|--------------|
| Resolver connector   | <b>View</b>          | <b>No.</b>                           | <b>Signal</b> | <b>Color</b> |
| <ul style="list-style-type: none"> <li>• Angle socket</li> <li>• rotatable</li> <li>• 12-pole</li> <li>• Plug</li> </ul> |                      | 1                                    | SIN-          | red          |
|  |                      | 2                                    | COS+          | pink         |
|  |                      | 5                                    | REF+          | yellow       |
|  |                      | 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

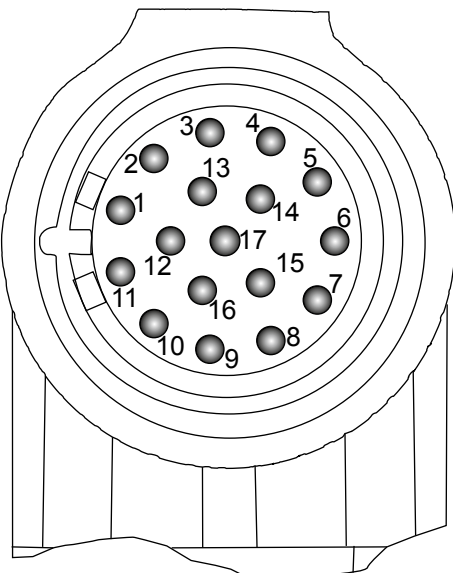
|  |             |                                      |               |              |  |
|--|-------------|--------------------------------------|---------------|--------------|--|
| Hiperface connector  | <b>View</b> | <b>No.</b>                           | <b>Signal</b> | <b>Color</b> |  |
| <ul style="list-style-type: none"> <li>• Angle socket</li> <li>• rotatable</li> <li>• 12-pole</li> <li>• Plug</li> </ul> |             | 4                                    | REF_SIN-      | red          |  |
|  |             | 5                                    | REF_COS-      | yellow       |  |
|  |             | 6                                    | Data+         | grey         |  |
|  |             | 7                                    | Data-         | pink         |  |
|  |             | 8                                    | SIN+          | blue         |  |
|  |             | 9                                    | COS+          | green        |  |
|  |             | 10                                   | +7.5V         | 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]   |             |                                      |               |              |  |

# Connection

## 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  |  |  |
| View of the connector pins at the motor |  | 12   | B+           | blue   |  |  |
|   |  | 13   | B-           | red    |  |  |
|   |  | 14   | Data+        | grey   |  |  |
|   |  | 15   | A+           | green  |  |  |
|   |  | 16   | A-           | yellow |  |  |
|   |  | 17   | Data-        | pink   |  |  |
|   |  | All other contacts are not assigned.                           |              |        |  |  |
|   |  | Encoder cable  | 00F50C1-yyyy |        |  |  |
|   |  | ready-made, shielded, trailing capable, yyyy - 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      |  |
| View of the connector pins at the motor                        |  | 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       |  |
|  |  | All other contacts are not assigned. |              |             |  |
|  |  | Encoder cable                        | 00S4209-yyyy |             |  |
| ready-made, shielded, trailing capable, yyyy - line length [m] |  |                                      |              |             |  |

4.4 Separate ventilator connection

| Separate ventilator connection          | Ax...Dx.SM.5 |    |                      | Ex.SM.5 |    |                      |
|---|--------------|----|----------------------|---------|----|----------------------|
| View of the connector pins at the motor |              |    |                      |         |    |                      |
| Terminal assignment                     | 1            | L1 | 1 x 230 V AC         | 1       | U  | 3 x 400 V AC         |
|   | 2            | N  |                      | 2       | V  |                      |
|   |              | PE | Protective conductor | 3       | W  |                      |
|   |              |    |                      |         | PE | Protective conductor |

### 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 saved 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.

|   |                       |   |
|---|-----------------------|---|
|  | <p><b>Repairs</b></p> | <p>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.</p> |
|---|-----------------------|---|

### 6.1 Maintenance intervals

|   |                                     |   |
|---|-------------------------------------|---|
|  | <p><b>Safety at maintenance</b></p> | <p>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!<br/>The „5 safety rules“ to be applied according to DIN VDE 0105 are:</p> <ul style="list-style-type: none"> <li>• Disconnect the motor</li> <li>• Secure against restarting</li> <li>• Verify the safe isolation from supply</li> <li>• Earth and short (at voltages above 1000V)</li> <li>• Safeguard or cover adjacent live parts.</li> </ul> |
|---|-------------------------------------|---|

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.

|   |  |  |
|---|--|--|
| <ul style="list-style-type: none"> <li>•</li> </ul> | <p>depending on the local level of contamination</p>                     | <p>Clean the motor</p>   |
| <ul style="list-style-type: none"> <li>•</li> </ul> | <p>depending on the operating mode every 50 to 500 operating hours</p>   | <p>Regrease the optional rotary shaft seal ring (applies only to grease lubrication!)</p>                                      |
| <ul style="list-style-type: none"> <li>•</li> </ul> | <p>after approx. 500 operating hours, but after 1 year at the latest</p> | <p>Retighten the electrical and mechanical connections<br/>Check for deterioration of running smoothness or bearing noise.</p> |

# Technical Data

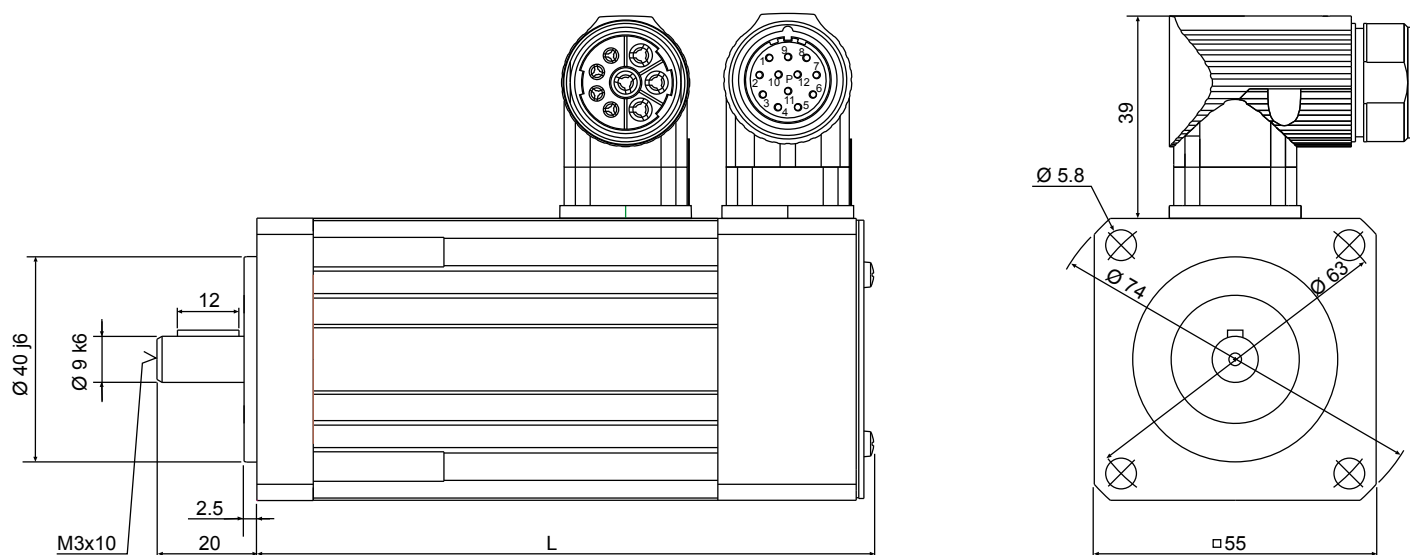
## 7. Technical Data

### 7.1 Self-cooling

| Servo motor                   |                   | Ax.SM.000-yyyy |      |      |      |      |      |      |      |
|-------------------------------|-------------------|----------------|------|------|------|------|------|------|------|
| Speed and voltage variant (y) | Size (x)          | A1             |      | A2   |      | A3   |      | A4   |      |
|                               |                   | 6200           | 6400 | 6200 | 6400 | 6200 | 6400 | 6200 | 6400 |
| Stall torque Md0              | Nm                | 0.34           |      | 0.50 |      | 0.65 |      | 1.0  |      |
| Current at stall torque Id0   | A                 | 1.2            | 0.85 | 1.50 | 1    | 2    | 1.2  | 3.2  | 1.6  |
| Nominal rating                |                   |                |      |      |      |      |      |      |      |
| Rated voltage UN              | V                 | 230            | 400  | 230  | 400  | 230  | 400  | 230  | 400  |
| Rated torque MN               | Nm                | 0.32           |      | 0.48 |      | 0.6  |      | 0.8  |      |
| Rated current IN              | A                 | 1.0            | 0.8  | 1.5  | 0.9  | 2.0  | 1.1  | 2.9  | 1.4  |
| Rated speed nN                | rpm               | 6000           |      | 6000 |      | 6000 |      | 6000 |      |
| Rated power PN                | W                 | 200            |      | 300  |      | 375  |      | 500  |      |
| Voltage constant kE 1)        | V/1000rpm         | 28.3           | 39.0 | 28.3 | 46.4 | 28.3 | 49.8 | 28.3 | 56.6 |
| Winding resistance Ru-v       | Ohm               | 21             | 40.5 | 8.7  | 25.8 | 6.1  | 18.9 | 3.3  | 13.1 |
| Winding inductance Lu-v       | mH                | 9.9            | 18.7 | 5.4  | 14.5 | 3.9  | 12.2 | 2.7  | 10.7 |
| Maximum values                |                   |                |      |      |      |      |      |      |      |
| max. torque Mmax              | Nm                | 1.7            |      | 2.5  |      | 3.2  |      | 5.0  |      |
| max. current Imax             | A                 | 7.1            | 5.0  | 9.0  | 6.0  | 10.8 | 6.5  | 17.0 | 8.5  |
| Mechanical data 2)            |                   |                |      |      |      |      |      |      |      |
| Inertia JL                    | kgcm <sup>2</sup> | 0.17           |      | 0.24 |      | 0.31 |      | 0.45 |      |
| Weight                        | kg                | 1.0            |      | 1.2  |      | 1.4  |      | 1.8  |      |

1) Peak value of motor EMC at 1000 rpm specified as phase-to-phase voltage.

2) With resolver; without holding brake



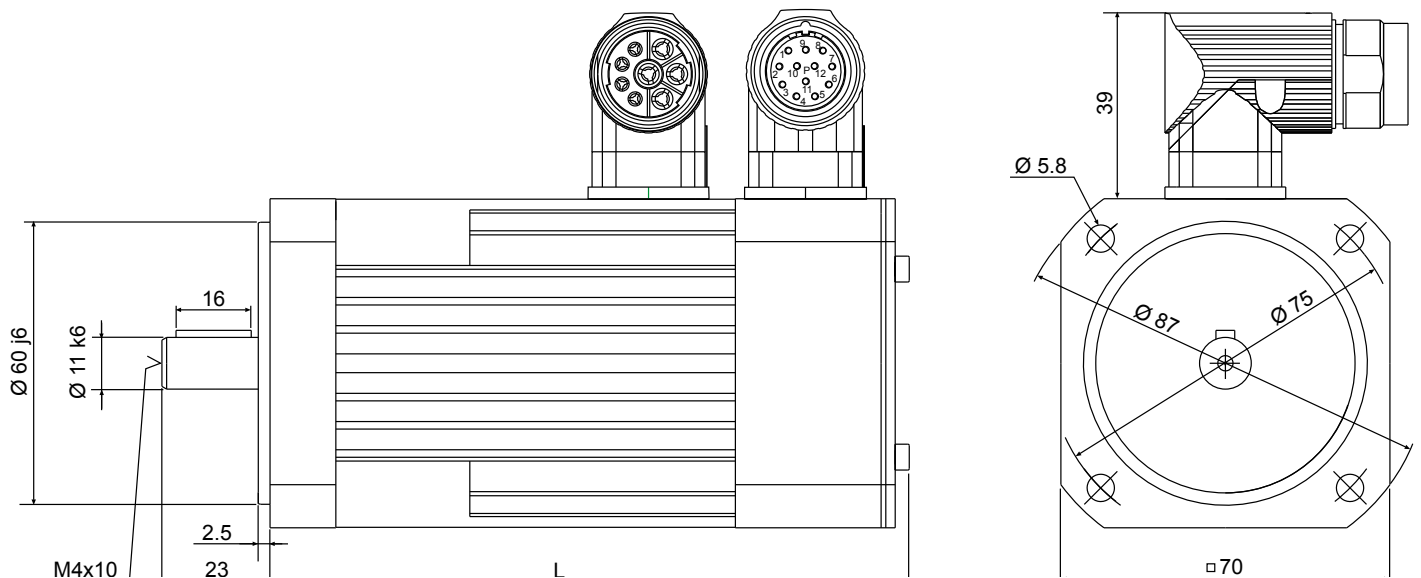
Length L

| Design system | without brake |          | with brake |          |
|---------------|---------------|----------|------------|----------|
|               | Resolver      | SIN/COS  | Resolver   | SIN/COS  |
| Encoder       | Resolver      | SIN/COS  | Resolver   | SIN/COS  |
| Size          | –             | ERN 1185 | –          | ERN 1185 |
| A1            | 121           | 156      | 145        | 180      |
| A2            | 133           | 168      | 157        | 192      |
| A3            | 145           | 180      | 169        | 204      |
| A4            | 170           | 205      | 194        | 229      |

| Servo motor                               |                   | Bx.SM.000-yyyy |      |      |      |      |      |      |      |      |      |      |      |
|---|-------------------|----------------|------|------|------|------|------|------|------|------|------|------|------|
| Size (x)<br>Speed and voltage variant (y) |                   | B1             |      |      |      | B2   |      |      |      | B3   |      |      |      |
|   |                   | 4200           | 4400 | 6200 | 6400 | 4200 | 4400 | 6200 | 6400 | 4200 | 4400 | 6200 | 6400 |
| Stall torque $M_{d0}$                     | Nm                | 0.65           |      |      |      | 1.5  |      |      |      | 2.3  |      |      |      |
| Current at stall torque $I_{d0}$          | A                 | 1.9            | 0.9  | 2.6  | 1.3  | 3.2  | 1.6  | 5.0  | 2.4  | 5.5  | 2.4  | 7.7  | 3.5  |
| Nominal rating                            |                   |                |      |      |      |      |      |      |      |      |      |      |      |
| Rated voltage $U_N$                       | V                 | 230            | 400  | 230  | 400  | 230  | 400  | 230  | 400  | 230  | 400  | 230  | 400  |
| Rated torque $M_N$                        | Nm                | 0.6            |      | 0.5  |      | 1.3  |      | 1.0  |      | 2.0  |      | 1.5  |      |
| Rated current $I_N$                       | A                 | 2.0            | 0.9  | 2.5  | 1.2  | 2.9  | 1.4  | 4.4  | 2.1  | 4.7  | 2.0  | 6.6  | 3.0  |
| Rated speed $n_N$                         | rpm               | 4000           |      | 6000 |      | 4000 |      | 6000 |      | 4000 |      | 6000 |      |
| Rated power $P_N$                         | W                 | 250            |      | 310  |      | 540  |      | 620  |      | 830  |      | 940  |      |
| Voltage constant $k_E$ <sup>1)</sup>      | V/1000rpm         | 29.4           | 67.7 | 21.8 | 45.4 | 39.2 | 80.9 | 25.2 | 53.0 | 37.2 | 85.4 | 26.3 | 59.1 |
| Winding resistance $R_{U-V}$              | Ohm               | 6.8            | 39.5 | 3.8  | 17   | 4    | 17.3 | 1.6  | 7    | 1.7  | 9.2  | 0.83 | 4.2  |
| Winding inductance $L_{U-V}$              | mH                | 11.5           | 61.1 | 6.3  | 27.4 | 11.5 | 48.8 | 4.8  | 21.0 | 5.6  | 29.4 | 2.8  | 14.1 |
| Maximum values                            |                   |                |      |      |      |      |      |      |      |      |      |      |      |
| max. torque $M_{max}$                     | Nm                | 3.1            |      |      |      | 7.2  |      |      |      | 11.0 |      |      |      |
| max. current $I_{max}$                    | A                 | 11.4           | 5.4  | 15.6 | 7.8  | 19.2 | 9.6  | 30.0 | 14.4 | 33.0 | 14.4 | 46.2 | 21.0 |
| Mechanical data <sup>2)</sup>             |                   |                |      |      |      |      |      |      |      |      |      |      |      |
| Inertia $J_L$                             | kgcm <sup>2</sup> | 0.22           |      |      |      | 0.36 |      |      |      | 0.57 |      |      |      |
| Weight                                    | kg                | 1.5            |      |      |      | 2.1  |      |      |      | 2.9  |      |      |      |

1) Peak value of motor EMC at 1000 rpm specified as phase-to-phase voltage.

2) With resolver; without holding brake



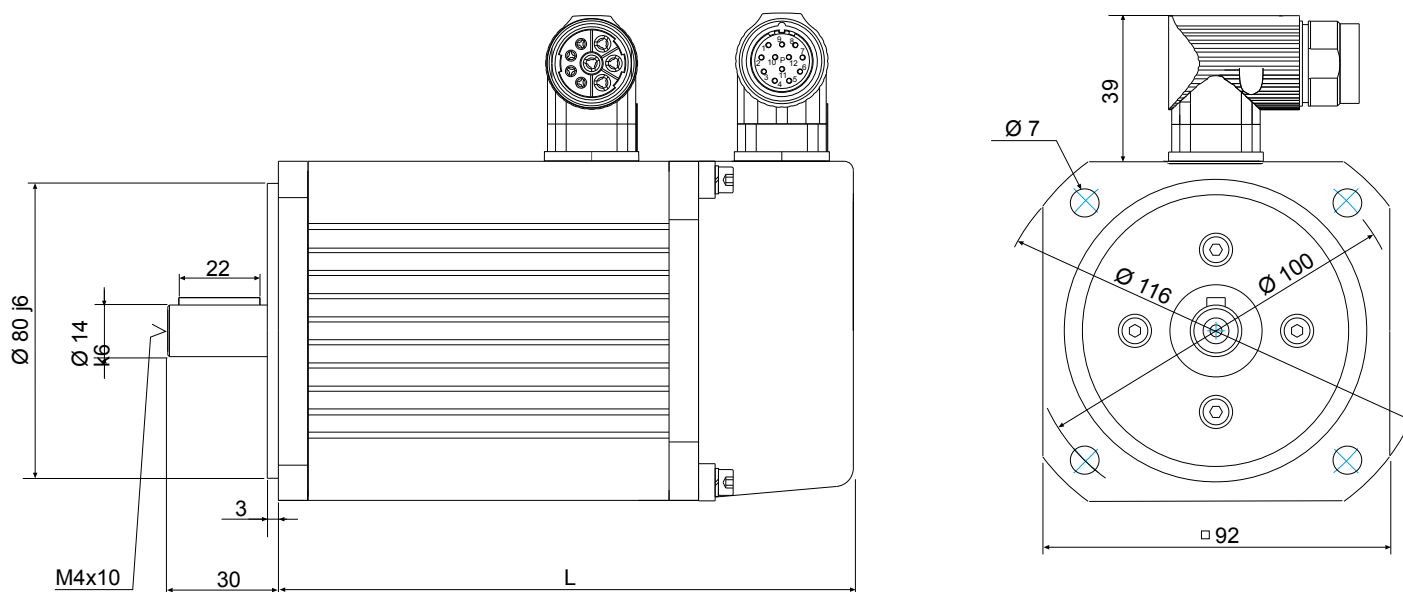
| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1185 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1185 | EQI   | SRS/M 50  | SRS/M 50/52K |
| B1            | 136           | 167      | 185   | 177       | 168          | 164        | 195      | 213   | 205       | 196          |
| B2            | 160           | 191      | 209   | 201       | 192          | 188        | 219      | 237   | 229       | 220          |
| B3            | 196           | 227      | 245   | 237       | 228          | 224        | 255      | 273   | 265       | 256          |

# Technical Data

| Servo motor                          |                   | Cx.SM.000-yyyy |      |      |      |      |      |      |       |      |      |
|--------------------------------------|-------------------|----------------|------|------|------|------|------|------|-------|------|------|
| Size (x)                             |                   | C1             |      |      |      |      | C2   |      |       |      |      |
| Speed and voltage variant (y)        |                   | 3200           | 3400 | 4200 | 4400 | 6200 | 6400 | 3200 | 3400  | 4200 | 4400 |
| Stall torque $M_{d0}$                | Nm                | 0.95           |      |      |      |      | 2.7  |      |       |      |      |
| Current at stall torque $I_{d0}$     | A                 | 1.5            | 0.8  | 2.0  | 1.1  | 3.0  | 1.6  | 3.2  | 1.9   | 4.3  | 2.5  |
| Nominal rating                       |                   |                |      |      |      |      |      |      |       |      |      |
| Rated voltage $U_N$                  | V                 | 230            | 400  | 230  | 400  | 230  | 400  | 230  | 400   | 230  | 400  |
| Rated torque $M_N$                   | Nm                | 0.8            |      | 0.75 |      | 0.7  |      | 2.4  |       | 2.2  |      |
| Rated current $I_{dN}$               | A                 | 1.4            | 0.75 | 1.8  | 0.9  | 2.4  | 1.3  | 3.0  | 1.8   | 3.6  | 2.1  |
| Rated speed $n_N$                    | rpm               | 3000           |      | 4000 |      | 6000 |      | 3000 |       | 4000 |      |
| Rated power $P_N$                    | kW                | 0.25           |      | 0.31 |      | 0.44 |      | 0.75 |       | 0.92 |      |
| Voltage constant $k_E$ <sup>1)</sup> | V/1000rpm         | 51.6           | 94.0 | 38.9 | 71.0 | 25.9 | 47.5 | 64.3 | 111.0 | 48.5 | 83.4 |
| Winding resistance $R_{U-V}$         | Ohm               | 20.5           | 74.9 | 12.1 | 39.4 | 5.1  | 18.9 | 4.2  | 13.1  | 2.3  | 6.9  |
| Winding inductance $L_{U-V}$         | mH                | 30.5           | 101  | 17.1 | 57.6 | 7.6  | 25.9 | 11.4 | 34.4  | 6.5  | 19.3 |
| Maximum values                       |                   |                |      |      |      |      |      |      |       |      |      |
| max. torque $M_{max}$                | Nm                | 4.3            |      |      |      |      | 12.2 |      |       |      |      |
| max. current $I_{max}$               | A                 | 7.5            | 4.0  | 10.0 | 5.4  | 15.0 | 8.0  | 16.0 | 9.4   | 21.5 | 12.4 |
| Mechanical data <sup>2)</sup>        |                   |                |      |      |      |      |      |      |       |      |      |
| Inertia $J_L$                        | kgcm <sup>2</sup> | 1.2            |      |      |      |      | 2.7  |      |       |      |      |
| Weight                               | kg                | 2.7            |      |      |      |      | 3.9  |      |       |      |      |

<sup>1)</sup> Peak value of motor EMC at 1000 rpm specified as phase-to-phase voltage.

<sup>2)</sup> With resolver; without holding brake



| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K |
| C1            | 156           | 193      | 193   | 163       | 173          | 192        | 229      | 229   | 199       | 209          |
| C2            | 180           | 217      | 217   | 187       | 197          | 226        | 263      | 263   | 233       | 243          |
| C3            | 214           | 251      | 251   | 221       | 231          | 260        | 297      | 297   | 267       | 277          |
| C4            | 248           | 285      | 285   | 255       | 265          | 294        | 331      | 331   | 301       | 311          |

**Cx.SM.000-yyyy**

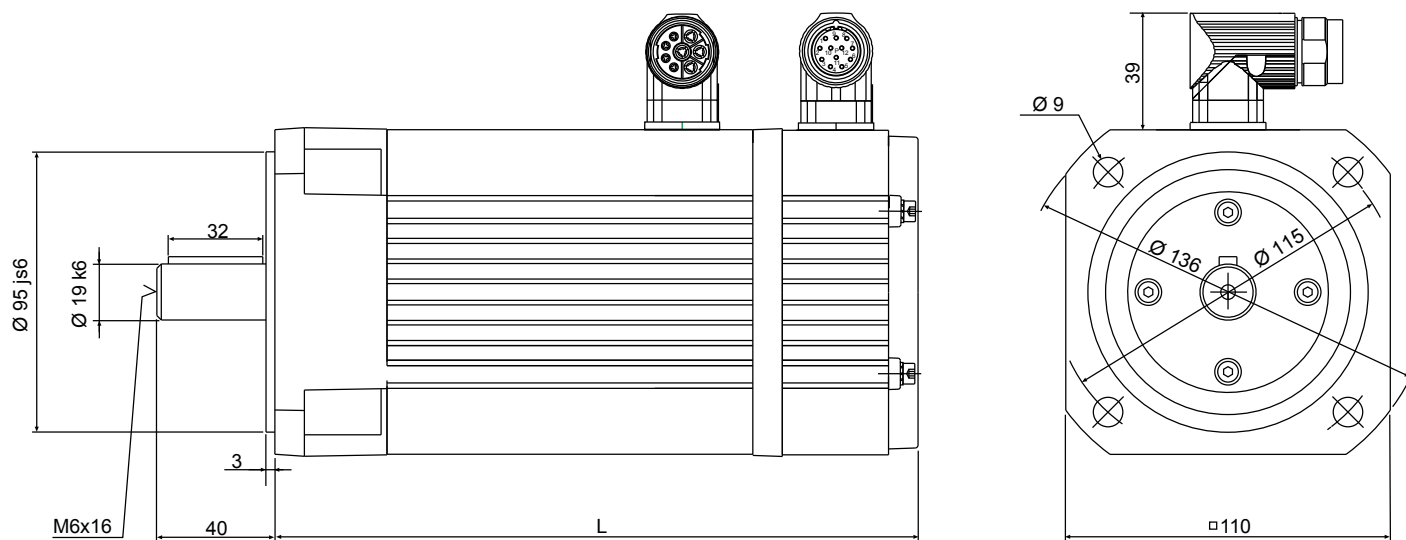
| <b>C2</b> |      | <b>C3</b> |       |      |      |      |      | <b>C4</b> |       |      |      |      |      |
|-----------|------|-----------|-------|------|------|------|------|-----------|-------|------|------|------|------|
| 6200      | 6400 | 3200      | 3400  | 4200 | 4400 | 6200 | 6400 | 3200      | 3400  | 4200 | 4400 | 6200 | 6400 |
| 2.7       |      | 4.5       |       |      |      |      |      | 6         |       |      |      |      |      |
| 6.5       | 3.7  | 5.1       | 2.9   | 6.7  | 3.8  | 9.9  | 5.6  | 7.1       | 4.2   | 9.1  | 5.5  | 13.7 | 7.8  |
| 230       | 400  | 230       | 400   | 230  | 400  | 230  | 400  | 230       | 400   | 230  | 400  | 230  | 400  |
| 2.0       |      | 3.9       |       | 3.5  |      | 2.8  |      | 5.0       |       | 4.5  |      | 3.0  |      |
| 5.3       | 3.0  | 4.6       | 2.7   | 5.5  | 3.1  | 6.7  | 3.8  | 6.3       | 3.7   | 7.3  | 4.4  | 7.9  | 4.5  |
| 6000      |      | 3000      |       | 4000 |      | 6000 |      | 3000      |       | 4000 |      | 6000 |      |
| 1,25      |      | 1.22      |       | 1.47 |      | 1.76 |      | 1.57      |       | 1.88 |      | 1.88 |      |
| 33.0      | 55.7 | 69.4      | 118.0 | 52.6 | 90.8 | 35.4 | 61.4 | 67.7      | 113.0 | 53.0 | 86.7 | 34.9 | 60.1 |
| 0.95      | 3.3  | 2         | 5.9   | 1.1  | 3.7  | 0.54 | 1.7  | 1.2       | 3.4   | 0.74 | 2.1  | 0.32 | 1.03 |
| 2.7       | 8.6  | 6.9       | 20.6  | 4    | 12.2 | 1.8  | 5.7  | 4.5       | 13.1  | 2.8  | 7.8  | 1.2  | 3.8  |
| 12,2      |      | 20.3      |       |      |      |      |      | 27.0      |       |      |      |      |      |
| 32.5      | 18.5 | 25.5      | 14.5  | 33.4 | 19.0 | 49.5 | 27.9 | 35.5      | 21.0  | 45.5 | 27.5 | 68.4 | 39.0 |
| 2.7       |      | 4.2       |       |      |      |      |      | 5.4       |       |      |      |      |      |
| 3.9       |      | 5.2       |       |      |      |      |      | 6.6       |       |      |      |      |      |

# Technical Data

| Servo motor                          |                   | Dx.SM.000-yyyy |       |      |      |      |      |      |       |      |      |
|--------------------------------------|-------------------|----------------|-------|------|------|------|------|------|-------|------|------|
| Size (x)                             |                   | D1             |       |      |      |      |      | D2   |       |      |      |
| Speed and voltage variant (y)        |                   | 3200           | 3400  | 4200 | 4400 | 6200 | 6400 | 3200 | 3400  | 4200 | 4400 |
| Stall torque $M_{d0}$                | Nm                | 4.2            |       |      |      |      |      | 7    |       |      |      |
| Current at stall torque $I_{d0}$     | A                 | 5.3            | 3.0   | 7.0  | 4.0  | 10.2 | 6.0  | 8.5  | 4.8   | 11.6 | 6.4  |
| Nominal rating                       |                   |                |       |      |      |      |      |      |       |      |      |
| Rated voltage $U_N$                  | V                 | 230            | 400   | 230  | 400  | 230  | 400  | 230  | 400   | 230  | 400  |
| Rated torque $M_N$                   | Nm                | 3.7            |       | 3.50 |      | 3.0  |      | 6.1  |       | 5.8  |      |
| Rated current $I_N$                  | A                 | 4.9            | 2.80  | 6.1  | 3.5  | 8.2  | 4.8  | 8.1  | 4.5   | 10.5 | 5.8  |
| Rated speed $n_N$                    | rpm               | 3000           |       | 4000 |      | 6000 |      | 3000 |       | 4000 |      |
| Rated power $P_N$                    | kW                | 1.2            |       | 1.5  |      | 1.9  |      | 1.9  |       | 2.4  |      |
| Voltage constant $k_E$ <sup>1)</sup> | V/1000rpm         | 66.5           | 117.0 | 50.5 | 87.7 | 34.5 | 58.4 | 66.9 | 119.8 | 48.9 | 89.0 |
| Winding resistance $R_{U-V}$         | Ohm               | 2.1            | 6.3   | 1.2  | 3.9  | 0.55 | 1.6  | 1    | 3.2   | 0.5  | 1.7  |
| Winding inductance $L_{U-V}$         | mH                | 7.7            | 23.8  | 4.5  | 13.4 | 2.1  | 6    | 4    | 12.8  | 2.2  | 7.05 |
| Maximum values                       |                   |                |       |      |      |      |      |      |       |      |      |
| max. torque $M_{max}$                | Nm                | 18.9           |       |      |      |      |      | 31,5 |       |      |      |
| max. current $I_{max}$               | A                 | 25.4           | 14.4  | 33.6 | 19.2 | 48.9 | 28.8 | 40.8 | 23.0  | 55.7 | 30.7 |
| Mechanical data <sup>2)</sup>        |                   |                |       |      |      |      |      |      |       |      |      |
| Inertia $J_L$                        | kgcm <sup>2</sup> | 4.8            |       |      |      |      |      | 7.4  |       |      |      |
| Weight                               | kg                | 6.3            |       |      |      |      |      | 7.9  |       |      |      |

<sup>1)</sup> Peak value of motor EMC at 1000 rpm specified as phase-to-phase voltage.

<sup>2)</sup> With resolver; without holding brake



| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K |
| D1            | 218           | 248      | 248   | 225       | 248          | 225        | 255      | 255   | 232       | 255          |
| D2            | 248           | 278      | 278   | 255       | 278          | 255        | 285      | 285   | 262       | 285          |
| D3            | 278           | 308      | 308   | 285       | 308          | 285        | 315      | 315   | 292       | 315          |
| D4            | 308           | 338      | 338   | 315       | 338          | 315        | 345      | 345   | 322       | 345          |

**Dx.SM.000-yyyy**

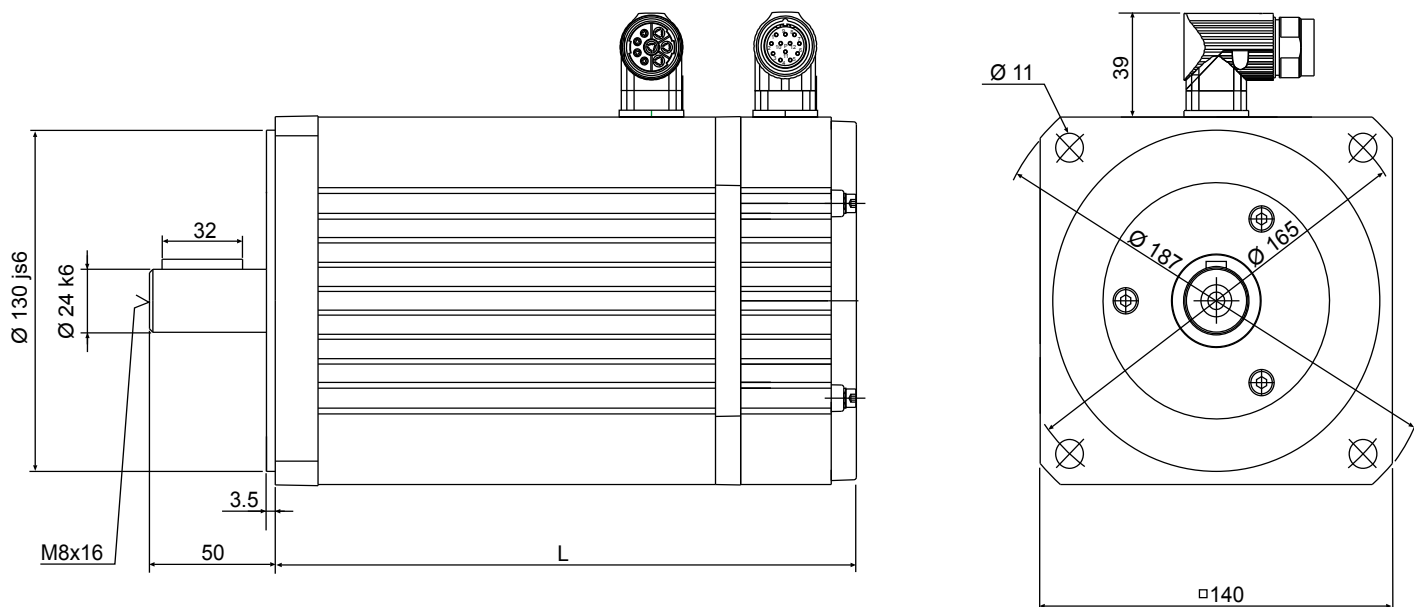
| <b>D2</b> |      | <b>D3</b> |       |      |      |       |      | <b>D4</b> |       |      |      |
|-----------|------|-----------|-------|------|------|-------|------|-----------|-------|------|------|
| 6200      | 6400 | 3200      | 3400  | 4200 | 4400 | 6200  | 6400 | 3200      | 3400  | 4200 | 4400 |
| 7         |      | 10        |       |      |      |       |      | 12        |       |      |      |
| 16.0      | 9.9  | 12.4      | 7.2   | 17.0 | 9.7  | 22.6  | 13.6 | 14.2      | 8.5   | 18.2 | 11.6 |
| 230       | 400  | 230       | 400   | 230  | 400  | 230   | 400  | 230       | 400   | 230  | 400  |
| 3.8       |      | 8.4       |       | 7.6  |      | 5.0   |      | 9.9       |       | 8.6  |      |
| 9.6       | 5.9  | 10.9      | 6.3   | 13.5 | 7.7  | 12.7  | 7.6  | 12.2      | 7.3   | 13.5 | 8.6  |
| 6000      |      | 3000      |       | 4000 |      | 6000  |      | 3000      |       | 4000 |      |
| 2.4       |      | 2.6       |       | 3.2  |      | 3.1   |      | 3.1       |       | 3.6  |      |
| 35.5      | 57.8 | 69.3      | 119.8 | 50.5 | 88.2 | 37.9  | 63.1 | 73.1      | 121.5 | 56.7 | 89.2 |
| 0.27      | 0.7  | 0.6       | 1.9   | 0.33 | 1.04 | 0.18  | 0.57 | 0.5       | 1.4   | 0.3  | 0.76 |
| 1.1       | 3.0  | 2.8       | 8.3   | 1.5  | 4.5  | 0.83  | 2.3  | 2.4       | 6.7   | 1.5  | 3.6  |
| 31.5      |      | 45.0      |       |      |      |       |      | 54.0      |       |      |      |
| 76.8      | 47.5 | 59.5      | 34.5  | 81.6 | 46.5 | 108.0 | 65.3 | 68.1      | 40.8  | 87.3 | 55.7 |
| 7.4       |      | 9.8       |       |      |      |       |      | 12.7      |       |      |      |
| 7.9       |      | 9.6       |       |      |      |       |      | 11.2      |       |      |      |

# Technical Data

| Servo motor                          |                   | Ex.SM.000-yyyy |       |      |       |      |       |       |       |       |       |
|--------------------------------------|-------------------|----------------|-------|------|-------|------|-------|-------|-------|-------|-------|
| Size (x)                             |                   | E1             |       |      |       |      | E2    |       |       |       |       |
| Speed and voltage variant (y)        |                   | 2200           | 2400  | 3200 | 3400  | 4200 | 4400  | 2200  | 2400  | 3200  | 3400  |
| Stall torque $M_{d0}$                | Nm                | 8.5            |       |      |       |      | 14    |       |       |       |       |
| Current at stall torque $I_{d0}$     | A                 | 5.3            | 3.1   | 8.0  | 4.7   | 10.7 | 6.2   | 8.6   | 4.7   | 13.3  | 7.5   |
| Nominal rating                       |                   |                |       |      |       |      |       |       |       |       |       |
| Rated voltage $U_N$                  | V                 | 230            | 400   | 230  | 400   | 230  | 400   | 230   | 400   | 230   | 400   |
| Rated torque $M_N$                   | Nm                | 7.0            |       | 6.5  |       | 5.2  |       | 12,2  |       | 11.0  |       |
| Rated current $I_N$                  | A                 | 4.4            | 2.6   | 6.4  | 3.8   | 6.9  | 4.0   | 7.5   | 4.1   | 10.4  | 5.8   |
| Rated speed $n_N$                    | rpm               | 2000           |       | 3000 |       | 4000 |       | 2000  |       | 3000  |       |
| Rated power $P_N$                    | kW                | 1.5            |       | 2    |       | 2.2  |       | 2.6   |       | 3.5   |       |
| Voltage constant $k_E$ <sup>1)</sup> | V/1000rpm         | 145.5          | 249.6 | 96.4 | 164.9 | 72.4 | 124.5 | 152.6 | 255.0 | 101.7 | 168.9 |
| Winding resistance $R_{u-v}$         | Ohm               | 3.5            | 10.2  | 1.5  | 4.4   | 0.85 | 2.6   | 1.37  | 4.3   | 0.6   | 2     |
| Winding inductance $L_{u-v}$         | mH                | 9.9            | 29.3  | 4.4  | 12.7  | 2.5  | 6.8   | 6.1   | 17.9  | 2.7   | 8.2   |
| Maximum values                       |                   |                |       |      |       |      |       |       |       |       |       |
| max. torque $M_{max}$                | Nm                | 42.0           |       |      |       |      | 70,0  |       |       |       |       |
| max. current $I_{max}$               | A                 | 28             | 16    | 42   | 25    | 57   | 33    | 46    | 25    | 71    | 40    |
| Mechanical data <sup>2)</sup>        |                   |                |       |      |       |      |       |       |       |       |       |
| Inertia $J_L$                        | kgcm <sup>2</sup> | 12.3           |       |      |       |      | 19.5  |       |       |       |       |
| Weight                               | kg                | 10.2           |       |      |       |      | 12.3  |       |       |       |       |

1) Peak value of motor EMC at 1000 rpm specified as phase-to-phase voltage.

2) With resolver; without holding brake



| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K |
| E1            | 231           | 263      | 263   | 238       | 245          | 276        | 308      | 308   | 283       | 290          |
| E2            | 261           | 293      | 293   | 268       | 275          | 306        | 338      | 338   | 313       | 320          |
| E3            | 291           | 323      | 323   | 298       | 305          | 336        | 368      | 368   | 343       | 350          |
| E4            | 336           | 368      | 368   | 343       | 350          | 381        | 413      | 413   | 388       | 395          |



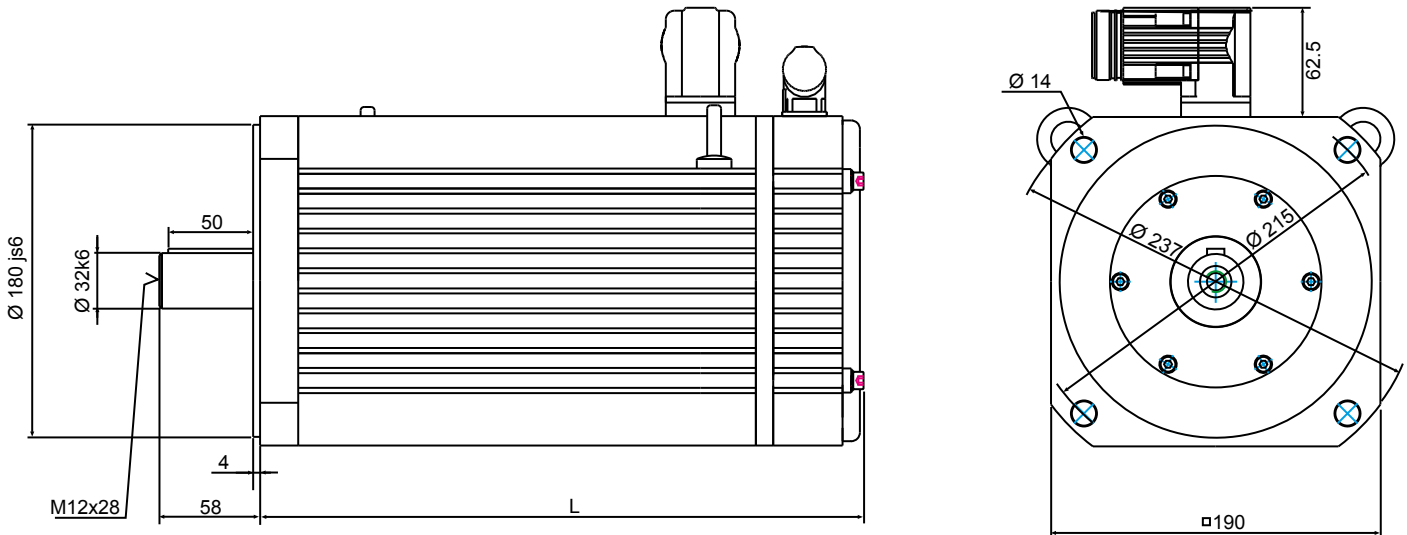
| Ex.SM.000-yyyy |       |       |       |      |       |      |       |       |       |       |       |
|----------------|-------|-------|-------|------|-------|------|-------|-------|-------|-------|-------|
| E2             |       | E3    |       |      |       |      |       | E4    |       |       |       |
| 4200           | 4400  | 2200  | 2400  | 3200 | 3400  | 4200 | 4400  | 2200  | 2400  | 3200  | 3400  |
| 14             |       | 19    |       |      |       |      |       | 27    |       |       |       |
| 17.8           | 10.0  | 11.7  | 6.8   | 17.6 | 10.3  | 21.9 | 13.5  | 16.5  | 9.9   | 23.2  | 14.4  |
| 230            | 400   | 230   | 400   | 230  | 400   | 230  | 400   | 230   | 400   | 230   | 400   |
| 7.6            |       | 16.5  |       | 14.6 |       | 8.7  |       | 21.4  |       | 15.5  |       |
| 9.7            | 5.4   | 10.6  | 6.1   | 14.0 | 8.3   | 10.4 | 6.4   | 13.0  | 7.8   | 13.3  | 8.3   |
| 4000           |       | 2000  |       | 3000 |       | 4000 |       | 2000  |       | 3000  |       |
| 3.2            |       | 3.5   |       | 4.6  |       | 3.6  |       | 4.5   |       | 4.9   |       |
| 79.8           | 128.1 | 143.1 | 247.9 | 95.5 | 162.2 | 76.2 | 124.0 | 152.6 | 259.5 | 110.5 | 177.1 |
| 0.38           | 1.14  | 0.85  | 2.6   | 0.38 | 1.11  | 0.24 | 0.64  | 0.57  | 1.7   | 0.29  | 0.81  |
| 1.7            | 4.7   | 4.2   | 9.9   | 1.9  | 5.1   | 1.3  | 3.0   | 2.5   | 7.2   | 1.3   | 3.4   |
| 70,0           |       | 85.0  |       |      |       |      |       | 121.0 |       |       |       |
| 94             | 53    | 56    | 33    | 84   | 49    | 105  | 65    | 79    | 47    | 111   | 69    |
| 19.5           |       | 26.7  |       |      |       |      |       | 36    |       |       |       |
| 12.3           |       | 15.5  |       |      |       |      |       | 20.4  |       |       |       |

# Technical Data

| Servo motor                          |                   | Fx.SM.000-yyy |       |       |      |       |       |       |       |       |       |
|--------------------------------------|-------------------|---------------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| Size (x)                             |                   | F1            |       |       |      | F2    |       |       | F3    |       |       |
| Speed and voltage variant (y)        |                   | 1400          | 2400  | 3400  | 4400 | 1400  | 2400  | 3400  | 1400  | 2400  | 3400  |
| Stall torque $M_{d0}$                | Nm                | 25            |       |       |      | 50    |       |       | 70    |       |       |
| Current at stall torque $I_{d0}$     | A                 | 8.2           | 11.1  | 17.0  | 22.2 | 17.0  | 22.3  | 32.2  | 23.1  | 30.8  | 46.2  |
| <b>Nominal rating</b>                |                   |               |       |       |      |       |       |       |       |       |       |
| Rated voltage $U_N$                  | V                 | 400           |       |       |      | 400   |       |       | 400   |       |       |
| Rated torque $M_N$                   | Nm                | 22.5          | 21.5  | 20.0  | 16.0 | 42.0  | 38.0  | 31.0  | 61.0  | 52.0  | 33.0  |
| Rated current $I_N$                  | A                 | 7.5           | 9.7   | 13.8  | 14.8 | 14.5  | 17.2  | 20.6  | 20.9  | 23.7  | 22.9  |
| Rated speed $n_N$                    | rpm               | 1500          | 2000  | 3000  | 4000 | 1500  | 2000  | 3000  | 1500  | 2000  | 3000  |
| Rated power $P_N$                    | kW                | 3.5           | 4.5   | 6.3   | 6.7  | 6.6   | 7.9   | 9.7   | 9.6   | 10.9  | 10.4  |
| Voltage constant $k_E$ <sup>1)</sup> | V/1000rpm         | 267.6         | 198.8 | 130.0 | 99.4 | 254.0 | 194.2 | 134.5 | 261.1 | 195.7 | 130.5 |
| Winding resistance $R_{U-V}$         | Ohm               | 2.36          | 1.36  | 0.58  | 0.34 | 0.81  | 0.48  | 0.23  | 0.51  | 0.3   | 0.13  |
| Winding inductance $L_{U-V}$         | mH                | 29.7          | 16.4  | 7     | 4.1  | 12.8  | 7.5   | 3.6   | 6.8   | 3.8   | 1.7   |
| <b>Maximum values</b>                |                   |               |       |       |      |       |       |       |       |       |       |
| max. torque $M_{max}$                | Nm                | 88.0          |       |       |      | 175.0 |       |       | 245.0 |       |       |
| max. current $I_{max}$               | A                 | 29            | 39    | 60    | 78   | 60    | 78    | 113   | 81    | 108   | 162   |
| <b>Mechanical data</b> <sup>2)</sup> |                   |               |       |       |      |       |       |       |       |       |       |
| Inertia $J_L$                        | kgcm <sup>2</sup> | 84            |       |       |      | 147   |       |       | 210   |       |       |
| Weight                               | kg                | 30.5          |       |       |      | 44.0  |       |       | 57.5  |       |       |

<sup>1)</sup> Peak value of motor EMC at 1000 rpm specified as phase-to-phase voltage.

<sup>2)</sup> With resolver; without holding brake



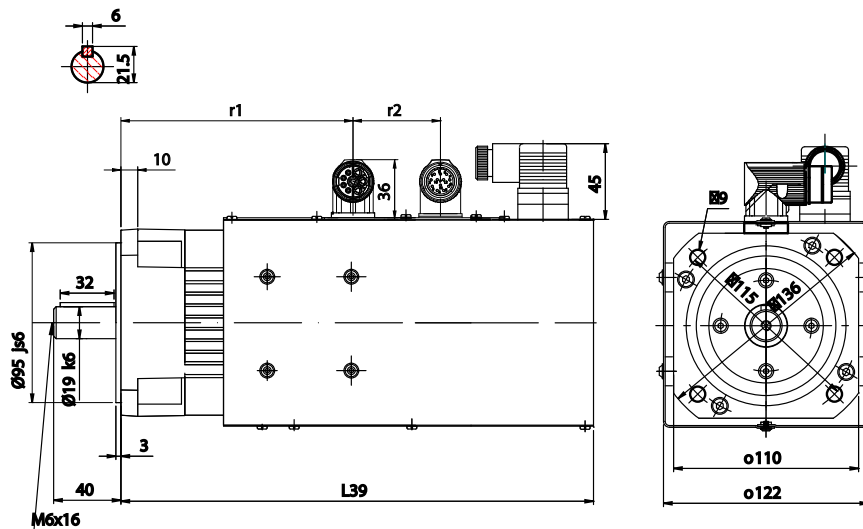
| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K |
| F1            | 348           | 395      | 395   | 355       | 358          | 348        | 395      | 395   | 355       | 358          |
| F2            | 428           | 475      | 475   | 466       | 438          | 428        | 475      | 475   | 435       | 438          |
| F3            | 508           | 555      | 555   | 546       | 518          | 508        | 555      | 555   | 515       | 518          |

7.2 Separate cooling

| Servo motor                                |                   | Dx.SM.000-yyyy |      |      |      |      |      |      |      |      |      |      |
|--|-------------------|----------------|------|------|------|------|------|------|------|------|------|------|
| Size (x)                                   |                   | D1             |      |      | D2   |      |      | D3   |      |      | D4   |      |
| Speed and voltage variant (y)              |                   | 3400           | 4400 | 6400 | 3400 | 4400 | 6400 | 3400 | 4400 | 6400 | 3400 | 4400 |
| Stall torque $M_{d0}$                      | Nm                | 6.2            |      |      | 10.5 |      |      | 14.5 |      |      | 18.0 |      |
| Current at stall torque $I_{d0}$           | A                 | 4.1            | 5.4  | 8.1  | 6.8  | 9.2  | 14.2 | 10.4 | 14.1 | 19.7 | 12.3 | 16.8 |
| <b>Nominal rating</b>                      |                   |                |      |      |      |      |      |      |      |      |      |      |
| Rated voltage $U_N$                        | V                 | 400            |      |      | 400  |      |      | 400  |      |      | 400  |      |
| Rated torque $M_N$                         | Nm                | 5.5            | 5.1  | 4.2  | 8.7  | 8.4  | 7.5  | 12.2 | 12   | 10.5 | 15.6 | 15.5 |
| Rated current $I_N$                        | A                 | 4.2            | 5.0  | 6.7  | 6.4  | 8.4  | 11.7 | 9.2  | 12.2 | 16.0 | 11.5 | 14.7 |
| Rated speed $n_N$                          | rpm               | 3000           | 4000 | 6000 | 3000 | 4000 | 6000 | 3000 | 4000 | 6000 | 3000 | 4000 |
| Rated power $P_N$                          | kW                | 1.7            | 2.1  | 2.6  | 2.7  | 3.5  | 4.7  | 3.8  | 5.0  | 6.6  | 4.9  | 6.5  |
| Voltage constant $k_E$ <sup>1)</sup>       | V/1000rpm         | 82.7           | 62.0 | 41.3 | 84.7 | 62.9 | 40.9 | 84.7 | 62.4 | 44.6 | 85.9 | 63.1 |
| Winding resistance $R_{u-v}$               | Ohm               | 6.3            | 3.9  | 1.6  | 3.2  | 1.7  | 0.7  | 1.9  | 1.04 | 0.57 | 1.4  | 0.76 |
| Winding inductance $L_{u-v}$               | mH                | 23.8           | 13.4 | 6.0  | 12.8 | 7.05 | 3.0  | 8.3  | 4.5  | 2.3  | 6.7  | 3.6  |
| <b>Maximum values</b>                      |                   |                |      |      |      |      |      |      |      |      |      |      |
| max. torque $M_{max}$                      | Nm                | 18.9           |      |      | 31.5 |      |      | 45.0 |      |      | 54.0 |      |
| max. current $I_{max}$                     | A                 | 20.4           | 27.2 | 40.7 | 32.5 | 43.4 | 67.2 | 48.8 | 65.8 | 92.3 | 57.7 | 78.8 |
| <b>Mechanical information<sup>2)</sup></b> |                   |                |      |      |      |      |      |      |      |      |      |      |
| Inertia $J_L$                              | kgcm <sup>2</sup> | 4.8            |      |      | 7.4  |      |      | 9.8  |      |      | 12.7 |      |
| Weight                                     | kg                | 7.7            |      |      | 9.6  |      |      | 11.5 |      |      | 13.4 |      |

<sup>1)</sup> Peak value of motor EMC at 1000 rpm specified as phase-to-phase voltage.

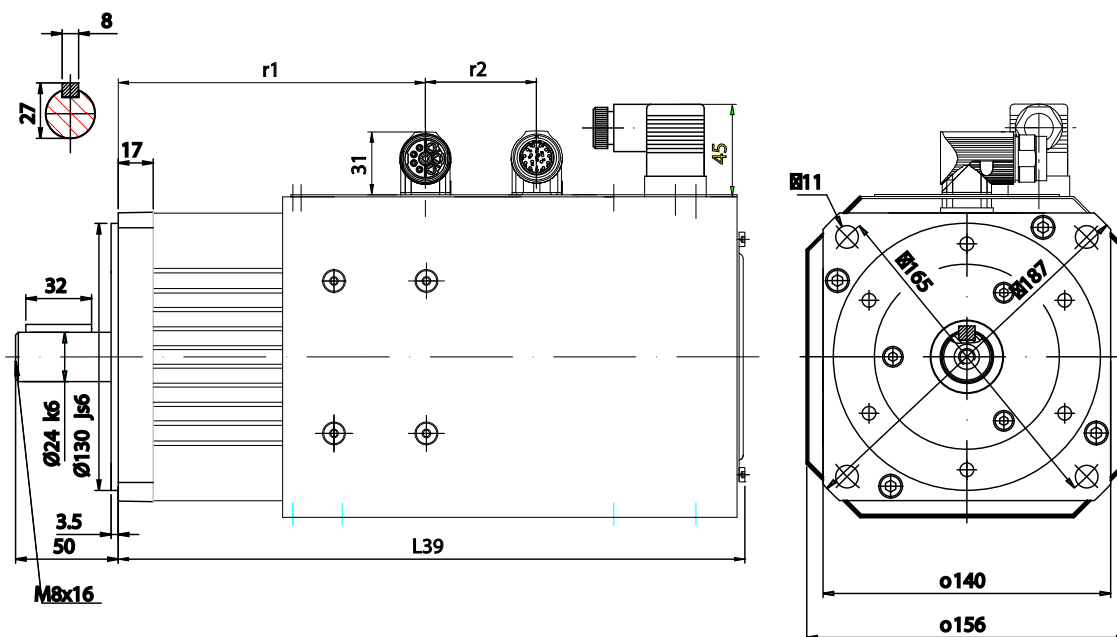
<sup>2)</sup> With resolver; without holding brake



| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K |
| D1            | 280           | 321      | 328   | 321       | 321          | 287        | 328      | 328   | 328       | 328          |
| D2            | 310           | 351      | 358   | 351       | 351          | 317        | 358      | 358   | 358       | 358          |
| D3            | 340           | 380      | 388   | 380       | 380          | 347        | 388      | 388   | 388       | 388          |
| D4            | 370           | 410      | 418   | 410       | 410          | 377        | 418      | 418   | 418       | 418          |

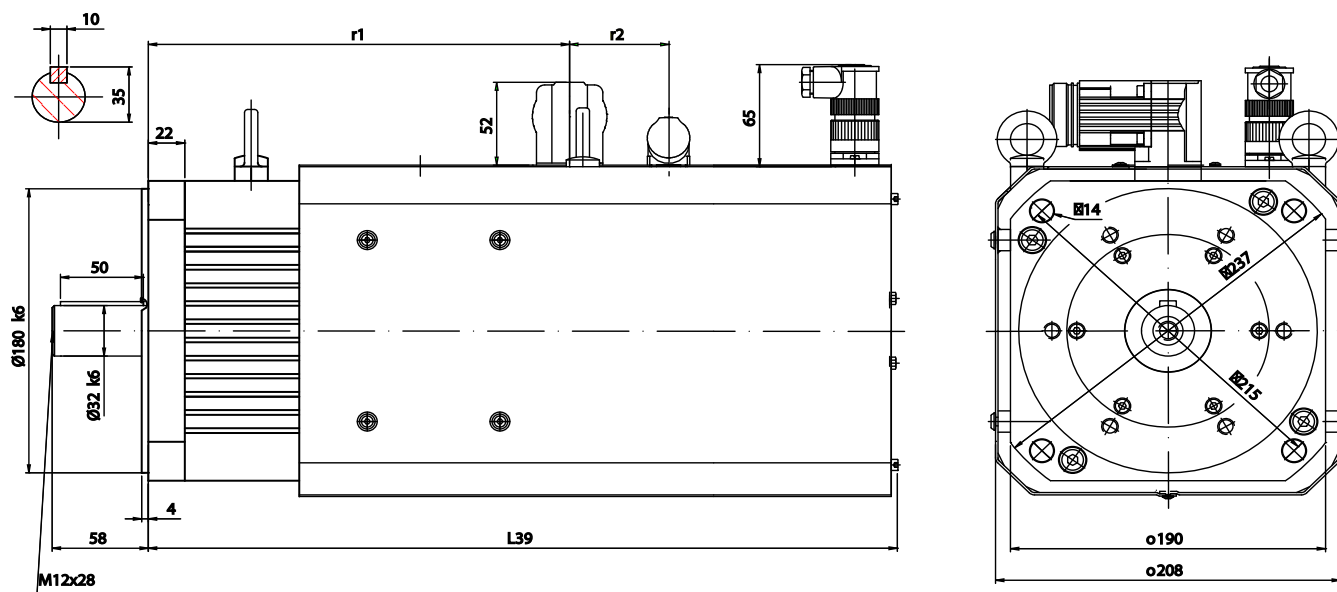
# Technical Data

| Servo motor                                |                   | Ex.SM.000-yyyy |      |      |       |      |      |       |      |      |       |      |
|--|-------------------|----------------|------|------|-------|------|------|-------|------|------|-------|------|
| Size (x)                                   |                   | E1             |      |      | E2    |      |      | E3    |      |      | E4    |      |
| Speed and voltage variant (y)              |                   | 2400           | 3400 | 4400 | 2400  | 3400 | 4400 | 2400  | 3400 | 4400 | 2400  | 3400 |
| Stall torque $M_{d0}$                      | Nm                | 12.9           |      |      | 21.5  |      |      | 30    |      |      | 42    |      |
| Current at stall torque $I_{d0}$           | A                 | 7.1            | 10.1 | 12.8 | 10.7  | 15.5 | 20.0 | 14.1  | 21.6 | 23.1 | 21.4  | 27.8 |
| <b>Nominal rating</b>                      |                   |                |      |      |       |      |      |       |      |      |       |      |
| Rated voltage $U_N$                        | V                 | 400            |      |      | 400   |      |      | 400   |      |      | 400   |      |
| Rated torque $M_N$                         | Nm                | 11.2           | 10.3 | 9.3  | 18.7  | 17.1 | 15.5 | 26    | 23.8 | 21.6 | 33    | 31.6 |
| Rated current $I_N$                        | A                 | 6.5            | 8.5  | 9.7  | 9.8   | 13.0 | 15.2 | 12.9  | 18.0 | 17.5 | 17.7  | 22.0 |
| Rated speed $n_N$                          | rpm               | 2000           | 3000 | 4000 | 2000  | 3000 | 4000 | 2000  | 3000 | 4000 | 2000  | 3000 |
| Rated power $P_N$                          | kW                | 2.4            | 3.2  | 3.9  | 3.9   | 5.4  | 6.5  | 5.5   | 7.5  | 9    | 6.9   | 10   |
| Voltage constant $k_E$ <sup>1)</sup>       | V/1000rpm         | 106.3          | 74.4 | 58.4 | 115.1 | 79.7 | 62.0 | 123.9 | 80.6 | 74.3 | 112.9 | 86.9 |
| Winding resistance $R_{U-V}$               | Ohm               | 4.5            | 2.2  | 1.4  | 2.4   | 1.1  | 0.66 | 1.6   | 0.68 | 0.58 | 0.84  | 0.50 |
| Winding inductance $L_{U-V}$               | mH                | 24.2           | 11.9 | 7.3  | 15.0  | 7.2  | 4.3  | 11.7  | 4.9  | 4.2  | 6.7   | 4.0  |
| <b>Maximum values</b>                      |                   |                |      |      |       |      |      |       |      |      |       |      |
| max. torque $M_{max}$                      | Nm                | 42             |      |      | 70    |      |      | 85    |      |      | 121   |      |
| max. current $I_{max}$                     | A                 | 23             | 35   | 47   | 35    | 57   | 75   | 46    | 70   | 92   | 67    | 98   |
| <b>Mechanical information<sup>2)</sup></b> |                   |                |      |      |       |      |      |       |      |      |       |      |
| Inertia $J_L$                              | kgcm <sup>2</sup> | 12.3           |      |      | 19.5  |      |      | 26.7  |      |      | 36.0  |      |
| Weight                                     | kg                | 12.2           |      |      | 15    |      |      | 17.8  |      |      | 22    |      |



| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K |
| E1            | 305           | 347      | 347   | 305       | 347          | 350        | 392      | 392   | 350       | 392          |
| E2            | 335           | 377      | 377   | 335       | 377          | 380        | 422      | 422   | 380       | 422          |
| E3            | 365           | 407      | 407   | 365       | 407          | 410        | 452      | 452   | 410       | 452          |
| E4            | 410           | 452      | 452   | 410       | 452          | 455        | 497      | 497   | 455       | 497          |

| Servo motor                                |                   | Fx.SM.000-yyyy |       |      |      |       |       |      |       |       |      |
|--|-------------------|----------------|-------|------|------|-------|-------|------|-------|-------|------|
| Size (x)                                   |                   | F1             |       |      |      | F2    |       |      | F3    |       |      |
| Speed and voltage variant (y)              |                   | 1400           | 2400  | 3400 | 4400 | 1400  | 2400  | 3400 | 1400  | 2400  | 3400 |
| Stall torque $M_{d0}$                      | Nm                | 39             |       |      |      | 75    |       |      | 110   |       |      |
| Current at stall torque $I_{d0}$           | A                 | 12.3           | 16.6  | 25.4 | 33.2 | 25.5  | 33.5  | 48.3 | 34.8  | 46    | 69   |
| <b>Nominal rating</b>                      |                   |                |       |      |      |       |       |      |       |       |      |
| Rated voltage $U_N$                        | V                 | 400            |       |      |      | 400   |       |      | 400   |       |      |
| Rated torque $M_N$                         | Nm                | 35.4           | 35    | 31.7 | 28   | 64    | 63    | 58.2 | 92.8  | 90    | 85   |
| Rated current $I_N$                        | A                 | 11.8           | 15.8  | 21.9 | 25.5 | 22.1  | 28.5  | 38.7 | 31.8  | 41.1  | 56   |
| Rated speed $n_N$                          | rpm               | 1500           | 2000  | 3000 | 4000 | 1500  | 2000  | 3000 | 1500  | 2000  | 3000 |
| Rated power $P_N$                          | kW                | 5.6            | 7.3   | 10   | 11.8 | 10.1  | 13.2  | 18.3 | 14.6  | 18.9  | 26.8 |
| Voltage constant $k_E$ <sup>1)</sup>       | V/1000rpm         | 189.2          | 140.6 | 91.9 | 70.3 | 179.6 | 137.3 | 95.1 | 184.6 | 138.4 | 92.3 |
| Winding resistance $R_{U-V}$               | Ohm               | 2.36           | 1.36  | 0.58 | 0.34 | 0.81  | 0.48  | 0.23 | 0.51  | 0.3   | 0.13 |
| Winding inductance $L_{U-V}$               | mH                | 29.7           | 16.4  | 7.0  | 4.1  | 12.8  | 7.5   | 3.6  | 6.8   | 3.8   | 1.7  |
| <b>Maximum values</b>                      |                   |                |       |      |      |       |       |      |       |       |      |
| max. torque $M_{max}$                      | Nm                | 88             |       |      |      | 175   |       |      | 245   |       |      |
| max. current $I_{max}$                     | A                 | 41             | 55    | 85   | 110  | 85    | 111   | 160  | 115   | 153   | 229  |
| <b>Mechanical information<sup>2)</sup></b> |                   |                |       |      |      |       |       |      |       |       |      |
| Inertia $J_L$                              | kgcm <sup>2</sup> | 84             |       |      |      | 147   |       |      | 210   |       |      |
| Weight                                     | kg                | 36             |       |      |      | 51    |       |      | 65    |       |      |

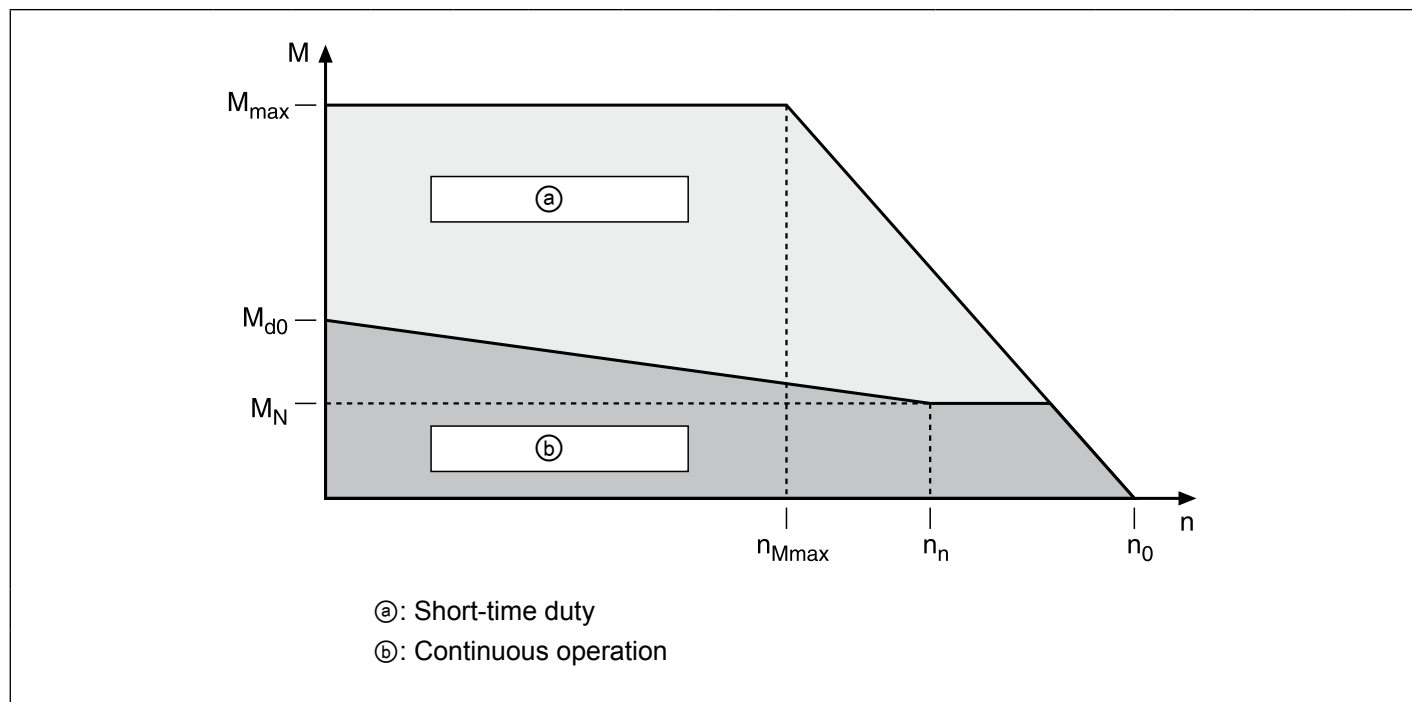


| Length L      |               |          |       |           |              |            |          |       |           |              |
|---------------|---------------|----------|-------|-----------|--------------|------------|----------|-------|-----------|--------------|
| Design system | without brake |          |       |           |              | with brake |          |       |           |              |
| Encoder       | Resolver      | SIN/COS  | EnDat | Hiperface |              | Resolver   | SIN/COS  | EnDat | Hiperface |              |
| Size          | -             | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K | -          | ERN 1387 | EQI   | SRS/M 50  | SRS/M 50/52K |
| F1            | 452           | 486      | 486   | 452       | 486          | 452        | 486      | 486   | 452       | 486          |
| F2            | 532           | 566      | 566   | 532       | 566          | 532        | 566      | 566   | 532       | 566          |
| F3            | 612           | 646      | 646   | 612       | 646          | 612        | 646      | 646   | 612       | 646          |

# Technical Data

## 7.3 Torque-speed-characteristic

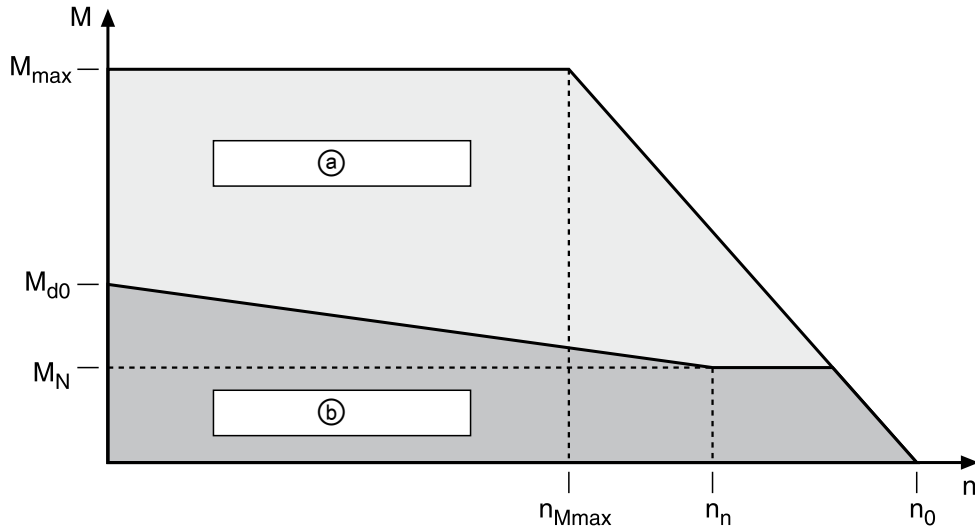
### 7.3.1 Motors of the 230 V class



| Part Number    | $M_{max}$ | $M_{d0}$<br>[Nm] | $M_N$<br>[Nm] | $n_N$ | $n_{Mmax}$<br>[rpm] | $n_0$ |
|----------------|-----------|------------------|---------------|-------|---------------------|-------|
| A1.SM.000-6200 | 1.7       | 0.34             | 0.32          | 6000  | 5950                | 9500  |
| A2.SM.000-6200 | 2.5       | 0.5              | 0.48          | 6000  | 6950                | 9500  |
| A3.SM.000-6200 | 3.2       | 0.65             | 0.6           | 6000  | 7100                | 9500  |
| A4.SM.000-6200 | 5         | 1                | 0.8           | 6000  | 7850                | 9500  |
| B1.SM.000-4200 | 3.1       | 0.65             | 0.6           | 4000  | 5250                | 9100  |
| B1.SM.000-6200 | 3.1       | 0.65             | 0.5           | 6000  | 7250                | 12300 |
| B2.SM.000-4200 | 7.2       | 1.5              | 1.3           | 4000  | 3450                | 6850  |
| B2.SM.000-6200 | 7.2       | 1.5              | 1             | 6000  | 6000                | 10650 |
| B3.SM.000-4200 | 11        | 2.3              | 2             | 4000  | 4700                | 7200  |
| B3.SM.000-6200 | 11        | 2.3              | 1.5           | 6000  | 5950                | 10200 |
| C1.SM.000-3200 | 4.3       | 0.95             | 0.8           | 3000  | 1800                | 5200  |
| C1.SM.000-4200 | 4.3       | 0.95             | 0.75          | 4000  | 2850                | 6900  |
| C1.SM.000-6200 | 4.3       | 0.95             | 0.7           | 6000  | 5350                | 10350 |
| C2.SM.000-3200 | 12.2      | 2.7              | 2.4           | 3000  | 2550                | 4150  |
| C2.SM.000-4200 | 12.2      | 2.7              | 2.2           | 4000  | 3950                | 5500  |
| C2.SM.000-6200 | 12.2      | 2.7              | 2             | 6000  | 6150                | 8150  |
| C3.SM.000-3200 | 20.3      | 4.5              | 3.9           | 3000  | 2600                | 3850  |
| C3.SM.000-4200 | 20.3      | 4.5              | 3.5           | 4000  | 3850                | 5100  |
| C3.SM.000-6200 | 20.3      | 4.5              | 2.8           | 6000  | 5550                | 7600  |
| C4.SM.000-3200 | 27        | 6                | 5             | 3000  | 2600                | 3950  |
| C4.SM.000-4200 | 27        | 6                | 4.5           | 4000  | 3600                | 5050  |
| C4.SM.000-6200 | 27        | 6                | 3             | 6000  | 6300                | 7650  |

| Part Number    | $M_{max}$ | $M_{d0}$<br>[Nm] | $M_N$<br>[Nm] | $n_N$ | $n_{Mmax}$<br>[rpm] | $n_0$ |
|----------------|-----------|------------------|---------------|-------|---------------------|-------|
| D1.SM.000-3200 | 18.9      | 4.2              | 3.7           | 3000  | 2550                | 4000  |
| D1.SM.000-4200 | 18.9      | 4.2              | 3.5           | 4000  | 3850                | 5300  |
| D1.SM.000-6200 | 18.9      | 4.2              | 3             | 6000  | 5350                | 7750  |
| D2.SM.000-3200 | 31.5      | 7                | 6.1           | 3000  | 2750                | 4000  |
| D2.SM.000-4200 | 31.5      | 7                | 5.8           | 4000  | 4000                | 5450  |
| D2.SM.000-6200 | 31.5      | 7                | 3.8           | 6000  | 6300                | 7550  |
| D3.SM.000-3200 | 45        | 10               | 8.4           | 3000  | 2850                | 3850  |
| D3.SM.000-4200 | 45        | 10               | 7.6           | 4000  | 3950                | 5300  |
| D3.SM.000-6200 | 45        | 10               | 5             | 6000  | 5600                | 7050  |
| D4.SM.000-3200 | 54        | 12               | 9.9           | 3000  | 2850                | 3650  |
| D4.SM.000-4200 | 54        | 12               | 8.6           | 4000  | 3550                | 4700  |
| E1.SM.000-2200 | 42        | 8.5              | 7             | 2000  | 1500                | 2250  |
| E1.SM.000-3200 | 42        | 8.5              | 6.5           | 3000  | 2250                | 3450  |
| E1.SM.000-4200 | 42        | 8.5              | 5.2           | 4000  | 3400                | 4600  |
| E2.SM.000-2200 | 70        | 14               | 12.2          | 2000  | 1450                | 2150  |
| E2.SM.000-3200 | 70        | 14               | 11            | 3000  | 2150                | 3250  |
| E2.SM.000-4200 | 70        | 14               | 7.6           | 4000  | 3300                | 4150  |
| E3.SM.000-2200 | 85        | 19               | 16.5          | 2000  | 1450                | 2300  |
| E3.SM.000-3200 | 85        | 19               | 14.6          | 3000  | 3450                | 3450  |
| E3.SM.000-4200 | 85        | 19               | 8.7           | 4000  | 3400                | 4350  |
| E4.SM.000-2200 | 121       | 27               | 21.4          | 2000  | 1700                | 2150  |
| E4.SM.000-3200 | 121       | 27               | 15.5          | 3000  | 2500                | 3000  |

7.3.2 Motors of the 400 V class



Ⓐ: Short-time duty  
 Ⓑ: Continuous operation

| Part Number    | M <sub>max</sub> | M <sub>d0</sub> [Nm] | M <sub>N</sub> [Nm] | n <sub>N</sub> | n <sub>Mmax</sub> [rpm] | n <sub>0</sub> |
|----------------|------------------|----------------------|---------------------|----------------|-------------------------|----------------|
| A1.SM.000-6400 | 1.7              | 0.34                 | 0.32                | 6000           | 7550                    | 11950          |
| A2.SM.000-6400 | 2.5              | 0.5                  | 0.48                | 6000           | 6900                    | 10050          |
| A3.SM.000-6400 | 3.2              | 0.65                 | 0.6                 | 6000           | 6600                    | 9350           |
| A4.SM.000-6400 | 5                | 1                    | 0.8                 | 6000           | 6000                    | 8250           |
| B1.SM.000-4400 | 3.1              | 0.65                 | 0.6                 | 4000           | 2800                    | 6850           |
| B1.SM.000-6400 | 3.1              | 0.65                 | 0.5                 | 6000           | 5200                    | 10250          |
| B2.SM.000-4400 | 7.2              | 1.5                  | 1.3                 | 4000           | 1850                    | 5750           |
| B2.SM.000-6400 | 7.2              | 1.5                  | 1                   | 6000           | 4800                    | 8800           |
| B3.SM.000-4400 | 11               | 2.3                  | 2                   | 4000           | 3100                    | 5450           |
| B3.SM.000-6400 | 11               | 2.3                  | 1.5                 | 6000           | 4500                    | 7850           |
| C1.SM.000-3400 | 4.3              | 0.95                 | 0.8                 | 3000           | 1500                    | 4950           |
| C1.SM.000-4400 | 4.3              | 0.95                 | 0.75                | 4000           | 2850                    | 6550           |
| C1.SM.000-6400 | 4.3              | 0.95                 | 0.7                 | 6000           | 4750                    | 9800           |
| C2.SM.000-3400 | 12.2             | 2.7                  | 2.4                 | 3000           | 2500                    | 4150           |
| C2.SM.000-4400 | 12.2             | 2.7                  | 2.2                 | 4000           | 4000                    | 5550           |
| C2.SM.000-6400 | 12.2             | 2.7                  | 2                   | 6000           | 6150                    | 8350           |
| C3.SM.000-3400 | 20.3             | 4.5                  | 3.9                 | 3000           | 2650                    | 3950           |
| C3.SM.000-4400 | 20.3             | 4.5                  | 3.5                 | 4000           | 3850                    | 5100           |
| C3.SM.000-6400 | 20.3             | 4.5                  | 2.8                 | 6000           | 5450                    | 7600           |
| C4.SM.000-3400 | 27               | 6                    | 5                   | 3000           | 2750                    | 4100           |
| C4.SM.000-4400 | 27               | 6                    | 4.5                 | 4000           | 3950                    | 5350           |
| C4.SM.000-6400 | 27               | 6                    | 3                   | 6000           | 6300                    | 7750           |
| D1.SM.000-3400 | 18.9             | 4.2                  | 3.7                 | 3000           | 2500                    | 3950           |
| D1.SM.000-4400 | 18.9             | 4.2                  | 3.5                 | 4000           | 3850                    | 5300           |
| D1.SM.000-6400 | 18.9             | 4.2                  | 3                   | 6000           | 5600                    | 7950           |
| D2.SM.000-3400 | 31.5             | 7                    | 6.1                 | 3000           | 2650                    | 3900           |
| D2.SM.000-4400 | 31.5             | 7                    | 5.8                 | 4000           | 3650                    | 5200           |

| Part Number    | M <sub>max</sub> | M <sub>d0</sub> [Nm] | M <sub>N</sub> [Nm] | n <sub>N</sub> | n <sub>Mmax</sub> [rpm] | n <sub>0</sub> |
|----------------|------------------|----------------------|---------------------|----------------|-------------------------|----------------|
| D2.SM.000-6400 | 31.5             | 7                    | 3.8                 | 6000           | 6550                    | 8050           |
| D3.SM.000-3400 | 45               | 10                   | 8.4                 | 3000           | 2850                    | 3850           |
| D3.SM.000-4400 | 45               | 10                   | 7.6                 | 4000           | 3900                    | 5250           |
| D3.SM.000-6400 | 45               | 10                   | 5                   | 6000           | 5900                    | 7350           |
| D4.SM.000-3400 | 54               | 12                   | 9.9                 | 3000           | 3000                    | 3800           |
| D4.SM.000-4400 | 54               | 12                   | 8.6                 | 4000           | 4150                    | 5200           |
| E1.SM.000-2400 | 42               | 8.5                  | 7                   | 2000           | 1550                    | 2300           |
| E1.SM.000-3400 | 42               | 8.5                  | 6.5                 | 3000           | 2350                    | 3500           |
| E1.SM.000-4400 | 42               | 8.5                  | 5.2                 | 4000           | 3550                    | 4600           |
| E2.SM.000-2400 | 70               | 14                   | 12.2                | 2000           | 1550                    | 2250           |
| E2.SM.000-3400 | 70               | 14                   | 11                  | 3000           | 2500                    | 3400           |
| E2.SM.000-4400 | 70               | 14                   | 7.6                 | 4000           | 3600                    | 4500           |
| E3.SM.000-2400 | 85               | 19                   | 16.5                | 2000           | 1800                    | 2300           |
| E3.SM.000-3400 | 85               | 19                   | 14.6                | 3000           | 2750                    | 3550           |
| E3.SM.000-4400 | 85               | 19                   | 8.7                 | 4000           | 3850                    | 4650           |
| E4.SM.000-2400 | 121              | 27                   | 21.4                | 2000           | 1700                    | 2200           |
| E4.SM.000-3400 | 121              | 27                   | 15.5                | 3000           | 2650                    | 3250           |
| F1.SM.000-1400 | 88               | 25                   | 22.5                | 1500           | 600                     | 1700           |
| F1.SM.000-2400 | 88               | 25                   | 21.5                | 2000           | 1200                    | 2300           |
| F1.SM.000-3400 | 88               | 25                   | 20                  | 3000           | 1800                    | 3550           |
| F1.SM.000-4400 | 88               | 25                   | 16                  | 4000           | 2850                    | 4650           |
| F2.SM.000-1400 | 175              | 50                   | 42                  | 1500           | 950                     | 1800           |
| F2.SM.000-2400 | 175              | 50                   | 38                  | 2000           | 1300                    | 2400           |
| F2.SM.000-3400 | 175              | 50                   | 31                  | 3000           | 2300                    | 3450           |
| F3.SM.000-1400 | 245              | 70                   | 61                  | 1500           | 1200                    | 1750           |
| F3.SM.000-2400 | 245              | 70                   | 52                  | 2000           | 1700                    | 2350           |
| F3.SM.000-3400 | 245              | 70                   | 33                  | 3000           | 2900                    | 3550           |

## Technical Data

### 7.4 Options

#### 7.4.1 Holding brake

| <b>Motor type</b> |                      | <b>Ax.SM.001-xx00</b> | <b>Bx.SM.001-xx00</b> | <b>Cx.SM.001-xx00</b> |
|-------------------|----------------------|-----------------------|-----------------------|-----------------------|
| Holding torque    | [Nm]                 | 2.0                   | 4.5                   | 9                     |
| Inertia           | [kgcm <sup>2</sup> ] | 0.067                 | 0.183                 | 0.6                   |
| max. speed        | [rpm]                | 10.000                | 10.000                | 10.000                |
| Weight            | [kg]                 | 0.18                  | 0.30                  | 0.50                  |
| Rated voltage     | [V]                  | 24 (+6%, -10%)        |                       |                       |
| Rated current     | [A]                  | 0.46                  | 0.50                  | 0.75                  |
| Drop-out time t2  | [ms]                 | 25                    | 35                    | 40                    |
| On delay t11      | [ms]                 | 2                     | 2                     | 2                     |
| Operate time t1   | [ms]                 | 8                     | 7                     | 7                     |
| Power             | [W]                  | 11                    | 12                    | 18                    |
| Type              |                      | 03.P1.330-0567        | 05.P1.320-0487        | 06.P1.320-0087        |

| <b>Motor type</b> |                      | <b>Dx.SM.001-xx00</b> | <b>Ex.SM.001-xx00</b> | <b>Fx.SM.001-xx00</b> |
|-------------------|----------------------|-----------------------|-----------------------|-----------------------|
| Holding torque    | [Nm]                 | 11                    | 36                    | 72                    |
| Inertia           | [kgcm <sup>2</sup> ] | 2.3                   | 5.9                   | 17.6                  |
| max. speed        | [rpm]                | 6.000                 | 10.000                | 4.000                 |
| Weight            | [kg]                 | 0.78                  | 1,95                  | 3.8                   |
| Rated voltage     | [V]                  | 24 (+6%, -10%)        |                       |                       |
| Rated current     | [A]                  | 0.83                  | 1.1                   | 1.67                  |
| Drop-out time t2  | [ms]                 | 25                    | 90                    | 140                   |
| On delay t11      | [ms]                 | 3                     | 3                     | 5                     |
| Operate time t1   | [ms]                 | 25                    | 22                    | 25                    |
| Power             | [W]                  | 20                    | 26                    | 40                    |
| Type              |                      | 08.P1.320-0357        | 08.P1.320-0057        | 09.P1.320-0017        |

The indicated switching times are reached with adjusted nominal air gap (Xmin). There are average values, whose leakage is dependent on the power supply and coil temperature. The marking of the switching times corresponds to DIN VDE 580.



## 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/EC) 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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| Rev.    | 2B           |
| Date    | 02/2011      |