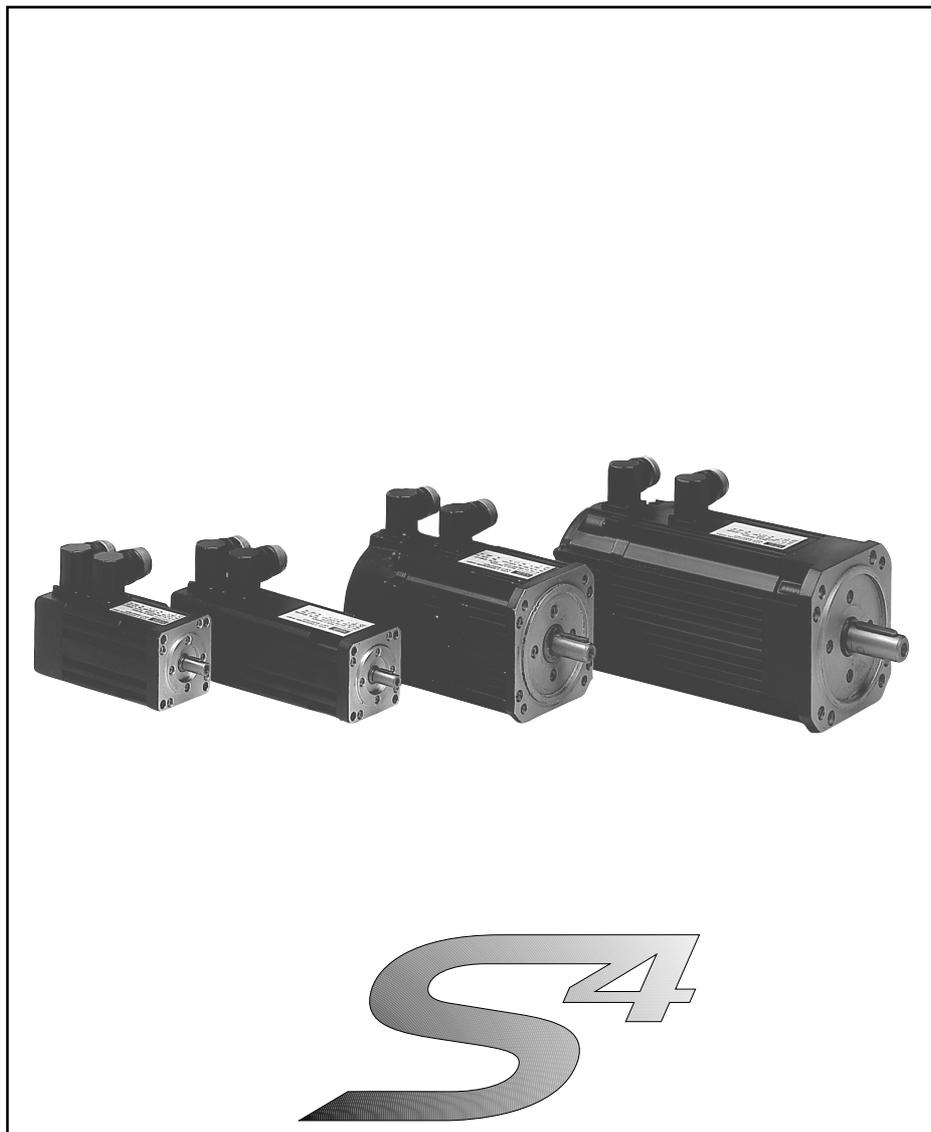


# BETRIEBSANLEITUNG

INSTRUCTION MANUAL



**KEB Servomotore**  
KEB Servos

**Größe A1 . . . F3**  
Size A1 ... F3



Diese Betriebsanleitung beschreibt die Servomotoren A1 ... F3 und muß jedem Anwender zugänglich gemacht werden. Vor jeglichen Arbeiten muß sich der Anwender mit dem Gerät vertraut machen. Den **Sicherheits- und Warnhinweisen** in dieser Anleitung und in der Beschreibung für den Servosteller sowie in weiterer Dokumentation ist für einen sicheren Betrieb unbedingt Folge zu leisten.

This Instruction Manual describes the Servo Motors A1 ... F3 and must be made available to every user. Prior to performing any work the user must familiarize himself with the unit. The **safety and warning notes** listed in this instruction manual and in the description of the servo controller as well as in other documentation must be observed at any rate to ensure a safe operation.

Die in dieser Betriebsanleitung verwendeten Pictogramme entsprechen folgender Bedeutung:

Below the meaning of the pictograms used in this manual:



**Gefahr / Warnung / Vorsicht**

Wird verwendet, wenn Leben oder Gesundheit des Benutzers gefährdet sind oder erheblicher Sachschaden auftreten kann.



**Danger / Warning / Caution**

Used when life or health of the user are exposed to danger or when the possibility of severe damage to the material exists.



**Achtung**

Unbedingt beachten! Besondere Hinweise für den sicheren und störungsfreien Betrieb.



**Attention**

Observe at all costs! Special instructions for a safe and trouble-free operation.



**Information**

Hilfestellung, Tip



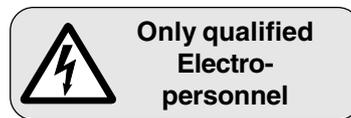
**Information**

Assistance, Tips



Alle Arbeiten zum Transport, Anschluß, zur Inbetriebnahme und Instandhaltung sind von qualifizierten, verantwortlichen Fach-

personal auszuführen. Unsachgemäßes Verhalten kann schwere Personen- und Sachschäden verursachen. Ein sicherer und störungsfreier Betrieb ist nur bei Einhaltung der jeweils gültigen Vorschriften gemäß DIN VDE 0100, DIN VDE 0113, DIN VDE 0160, DIN VDE 0875 sowie einschlägiger örtlicher Bestimmungen gegeben.



The KEB COMBIVERT is operated with voltages that can cause a severe electric shock dangerous to life. Therefore the installation of the unit as well as of the available accessories is only permissible by qualified electro-personnel. A safe and trouble-free operation is only possible when the valid regulations according to DIN VDE 0100, IEC1000, EN 60204-1, EN 55014, EN 50082-2 as well as the relevant regulations for your area are observed.

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## 1. Introduction

### 1.1 Intended Use

The synchronous servo motors KEB COMBIVERT SM serve for the operation on digital servo controllers KEB COMBIVERT S4 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).

## 2. Safety Notes



- All works on the installation are to be carried out in a **de-energized** state.
- In the case of synchronous motors with rotating rotor a high voltage is applied onto the motor connections.
- After mounting the motor check the faultless function of the brake (if available).
- Repairs may be carried out only by the manufacturer or repair places authorized by him. Unauthorized **opening** and improper tampering can lead to bodily injuries or damages to property.
- Before starting up motors with **featherkey** in the shaft end, the featherkey must be **secured** against flinging out, if this is not already prevented through output components like belt pulley, clutches or similar elements.
- The motors are not intended for direct connection to the three-phase system. They must be operated by a servo controller. A direct power connection can lead to the destruction of the motor.
- 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.
- The optional built-in deadlock holding brake is only designed for a limited number of emergency stops. The use as a working brake is not permitted.
- For motors with plug connection and built-in brake you must install the varistor required for the brake wiring at commissioning.
- The **thermistor** 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.

### 3. Transport, Storage

After final tests all motors leave the factory in perfect condition. On delivery check the motor for outside damages. If you should determine transport damages, then a notice of damage is to be issued in the presence of the carrier. If necessary, **stop the commissioning** of these motors.

Screwed-in ring bolts are designed for the weight of the motors, i.e. the attachment of additional loads is prohibited.

The storage is only permitted in **closed, dry, dust-free, ventilated and non-vibrating** environments. Before commissioning measure the insulation resistance. In case of values  $\leq 1 \text{ k}\Omega$  per volt of rated voltage dry the winding. (voltage of insulation resistance meter: 1000 V). After a longer storage (> 3 months) operate the motor at slow speed ( $\leq 100 \text{ min}^{-1}$ ) in both directions, so that the lubrication can spread evenly in the bearings.

Damages that occur as a result of improper handling are not subject to our warranty.

### 4. Installation

When installing the motor make sure of even supporting surface, solid foot or flange mounting and exact alignment in case of direct coupling. Turn the motor shaft by **hand** and listen for abnormal slipping noises.

#### 4.1 Type of Protection

The motors of the series A1...F3 are designed in the type of protection IP65, shaft gland IP64 (in case of separately ventilated machines ventilator only IP44). Optional available is the shaft gland in type of protection IP65 with shaft sealing ring. The only exception is the built-on version "Shaft end upwards" (IM V3, IM V36), as here no liquid may remain in the D-side flange bearing end-shield. In the case of terminal box designs observe the correct sealing of the outgoing cables.

By turning the flange sockets or the terminal box any outgoing cable direction can be adjusted (rotatable by  $90^\circ$  each).

**Attention:** 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.

### 4.2 Ambient Temperature/ Cooling

Ambient temperature:  $-5^{\circ}$  . . .  $40^{\circ}\text{C}$

Set-up height:  $\leq 1000$  m above sea level

The motor must be mounted in such a manner that the ventilation is **not obstructed**, i.e. sufficient heat dissipation through convection and radiation must be ensured.

If the motor is equipped with a separate ventilator, it must be connected correctly. The exhaust air of neighbouring units may not be sucked in again directly. For three-phase separate ventilator connection the correct direction of rotation is to be checked (direction arrow towards ventilator housing).

### 4.3 Output Components

The rotor of the motor is dynamically balanced through a full featherkey in the shaft end according to DIN 6885 Sheet 1.

For motors with built-in radial sealing ring (option) only a reduced maximum speed is permissible according to the instruction manual.

For putting on or taking off output components (gear wheels, belt pulleys, clutches and similar parts) suitable devices are to be used. The bracing must be carried out on the D-side shaft end.

**Attention:** Servo motors are precision drive components, no shocks or impacts may arrive at the motor.

## 5. Electrical Connection

All work may be carried out only by qualified technical personnel on the motor at rest in de-energized status and secured against restarting. Verify the safe isolation from supply!

The connections for motor, PTC thermistor and, if necessary, holding brake are available in the terminal box. There you also find a connection diagram (Attention: Observe the correct polarity at the connection of the holding brake!). 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. No foreign bodies, dirt or moisture are allowed in the terminal box. Close unused cable entry openings and the box itself in a dust and watertight manner.

For versions with plug connection a separate terminal assignment is attached. Please take detailed information regarding the electrical connection with terminal assignment and plug assignment of the separate ventilator and the measuring system from the instruction manual of the servo controller.

## 6. Operation and Maintenance

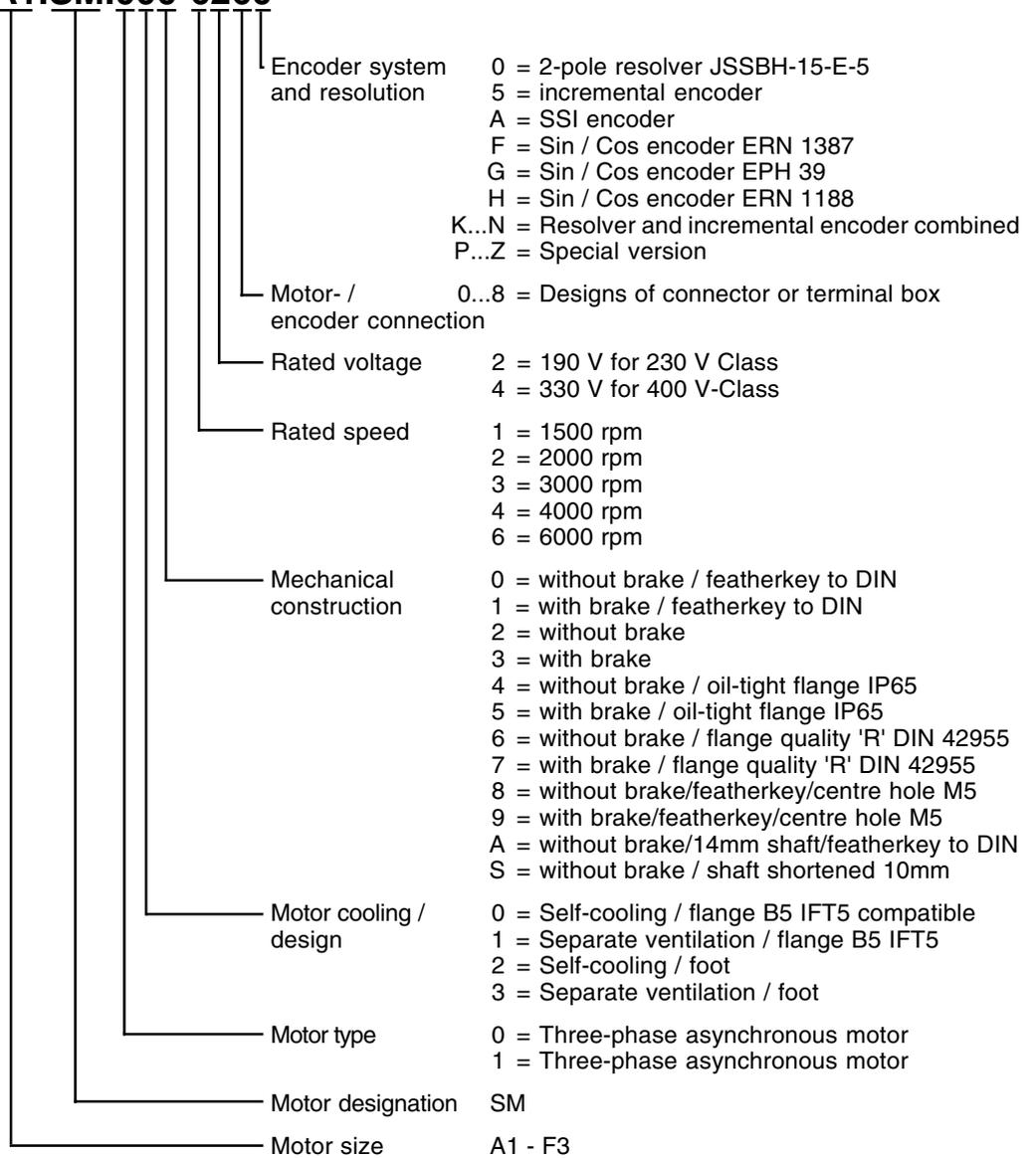
In case of changes as compared to the normal operation, e.g. increased temperature, noises, oscillations, find out the cause, if necessary, contact the manufacturer. In case of doubt switch off the motor!

The maintenance of the motor is limited to the cleaning of the motor surface.

The radial groove ball bearings of the motor are lubricated for life and are designed for a nominal service life of 20.000 hours.

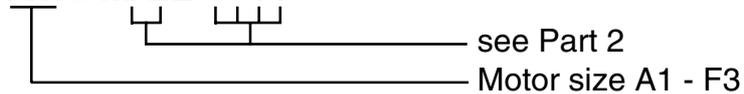
**7. Part Code Servo A1.SM.000-6260  
Controller**

**Servomotor**



**KEB COMBIVERT S4**

**A1.S4.D2E-6011**



**8. Technical Data**

In the following you find the technical data of the servo motors A1...F3. To each servo motor a controller, recommended by KEB, is assigned. In each case the quoted rated specifications refer to the respective combination. However, depending on the application other combinations may be possible as well.

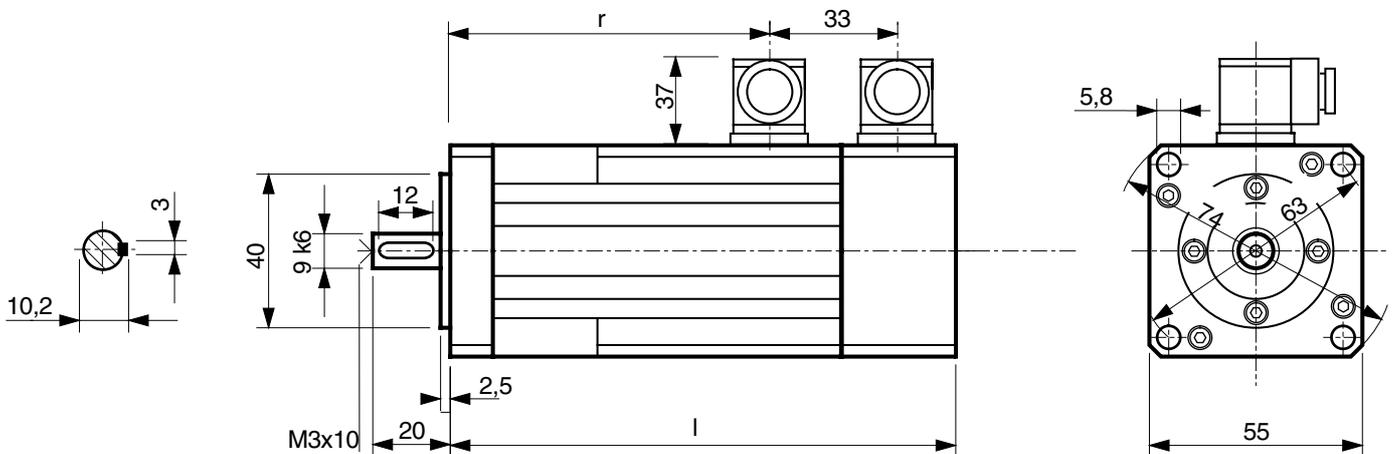


When selecting the servo motor pay attention to the specified mains voltage and rated speed.

# Technical Data

Servo Motor: xx.SM.000-yyyy									
Speed and voltage variants (y)	Size (x)	A1		A2		A3		A4	
		6200	6400	6200	6400	6200	6400	6200	6400
Stall torque $M_{d0}$	Nm	<b>0,34</b>		<b>0,50</b>		<b>0,65</b>		<b>1,0</b>	
<b>Ratings</b>									
Rated torque $M_{dN}$	Nm	0,32		0,48		0,6		0,8	
Rated speed $n_N$	min <sup>-1</sup>	6000		6000		6000		6000	
Voltage constant $k_E$	V/1000min <sup>-1</sup>	20,0	27,6	20,0	32,8	20,0	35,2	20,0	40,0
Winding resistance $R_{u-v}$	Ohm	21	40,5	8,7	25,8	6,1	18,9	3,3	13,1
Winding inductivity $L_{u-v}$	mH	9,9	18,7	5,4	14,5	3,9	12,2	2,7	10,7
<b>Mechanical specifications</b>									
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	0,17		0,24		0,31		0,45	
Overall length $l$ <sup>1)</sup>	mm	121		133		145		170	
Partial length $r$ <sup>2)</sup>	mm	72		95		97		121	
Mass m	kg	1,0		1,2		1,4		1,8	

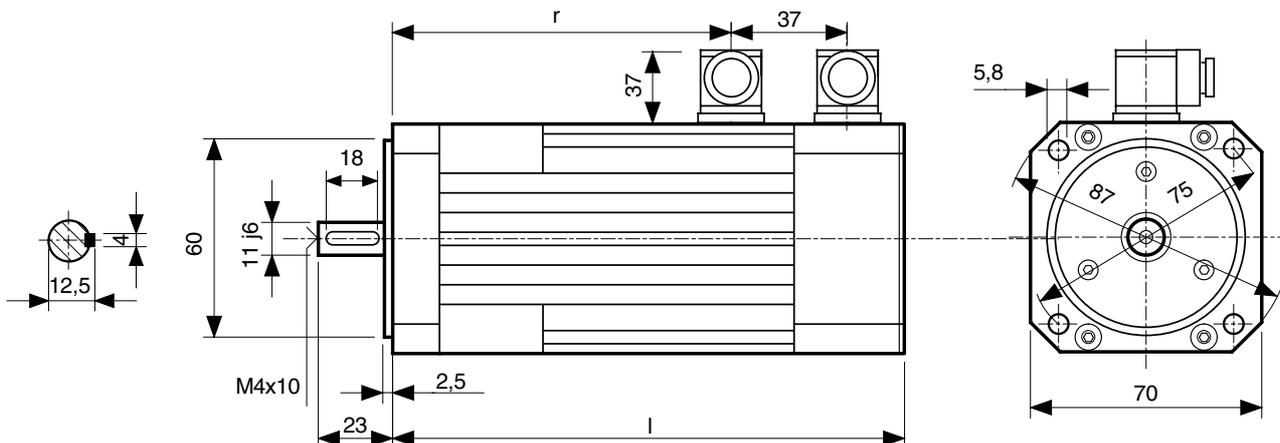
Servo Controller									
Recommended controller size *)		03	07	03	07	05	07	05	07
Controller housing		D							
Rated voltage <sup>3)</sup>	V	230	400	230	400	230	400	230	400
Line frequency	Hz	50 / 60 ± 2Hz							
Line phases		1/3	3	1/3	3	1/3	3	1/3	3
Rated input current	A	4,8/2,6	3	4,8/2,6	3	4,8/2,6	3	12,8/7	3
Max. perm. mains fuse	A	16/10	10	16/10	10,0	16/10	10,0	16/10	10,0
Rated power $P_N$	W	200		300		375		500	
Rated current $I_{dN}$	A	1,3	0,9	1,7	1,1	2,3	1,3	3,4	1,7
Stall current $I_{d0}$	A	1,2	0,85	1,5	1,0	2,0	1,2	3,2	1,6
Line cross section <sup>4)</sup>	mm <sup>2</sup>	1,5 (14 awg)							



Servo Motor: xx.SM.000-yyyy												
Size (x)		B1				B2				B3		
Speed and voltage variants (y)		4200	4400	6200	6400	4200	4400	6200	6400	4200	4400	6400
Stall torque $M_{d0}$	Nm	<b>0,65</b>				<b>1,5</b>				<b>2,3</b>		
<b>Ratings</b>												
Rated torque $M_{dN}$	Nm	0,6		0,5		1,3		1,0		2,0		1,5
Rated speed $n_N$	min <sup>-1</sup>	4000		6000		4000		6000		4000		6000
Voltage constant $k_E$	V/1000min <sup>-1</sup>	20,8	48	15,4	32	27,7	57	17,8	38	26,3	60	41,8
Winding resistance $R_{U-V}$	Ohm	6,8	40	3,8	17,0	4,0	17	1,6	7,0	1,7	9,2	4,2
Winding inductivity $L_{U-V}$	mH	11,5	61	6,3	27	11,5	49	4,8	21,0	5,6	29	14,1
<b>Mechanical specifications</b>												
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	0,22				0,36				0,57		
Overall length $l$ <sup>1)</sup>	mm	136				160				195		
Partial length $r$ <sup>2)</sup>	mm	91				105				141		
Mass $m$	kg	1,5				2,1				2,9		

Servo Controller												
Recommended controller size *)		05	07	05	07	05	07	05	10	05	10	10
Controller housing		D										
Mains voltage <sup>3)</sup>	V	230	400	230	400	230	400	230	400	230	400	400
Line frequency	Hz	50 / 60 ± 2Hz										
Line phases		<b>1/3</b>	<b>3</b>	<b>1/3</b>	<b>3</b>	<b>1/3</b>	<b>3</b>	<b>1/3</b>	<b>3</b>	<b>1/3</b>	<b>3</b>	<b>3</b>
Rated input current	A	4,8/2,6	3	12,7/7	3	12,7/7	3	12,7/7	3	12,7/7	3	7
Max. perm. mains fuse	A	16/10	10	16/10	10	16/10	10	16/10	10	16/10	10	10
Rated power $P_N$	W	250		310		540		620		830		940
Rated current $I_{dN}$	A	2,0	0,9	2,5	1,2	2,9	1,4	4,4	2,1	4,7	2,0	3,0
Stall current $I_{d0}$	A	1,9	0,9	2,6	1,3	3,2	1,6	5,0	2,4	5,5	2,4	3,5
Line cross section <sup>4)</sup>	mm <sup>2</sup>	1,5 (14 awg)										

- <sup>1)</sup> With the attachment of a brake or a measuring system the dimension  $l$  is increased by the respective length.
- <sup>2)</sup> With the attachment of a brake the dimension  $r$  is increased by the respective length.
- <sup>3)</sup> At 230V rated voltage the mains voltage is = 180...264V ± 0% and at 400V = 305...500V ± 0%
- <sup>4)</sup> Recommended minimum cross section of the power feeding cable at rated power and a cable length up to 30 m.
- <sup>5)</sup> Specify the peak value of motor EMK at 1000 min<sup>-1</sup> as line-to-line voltage.
- <sup>7)</sup> Assignment for attaining the values in the Torque-Speed Characteristic.



## Technical Data

Servo Motor: xx.SM.000-yyyy										
Speed and voltage variant (y)	Size (x)	C1						C2		
		3200	3400	4200	4400	6200	6400	3200	3400	4200
Stall torque $M_{d0}$	Nm	<b>0,95</b>						<b>2,7</b>		
<b>Ratings</b>										
Rated torque $M_{dN}$	Nm	0,8		0,75		0,7		2,4		2,2
Rated speed $n_N$	min <sup>-1</sup>	3000		4000		6000		3000		4000
Voltage constant $k_E$	V/1000min <sup>-1</sup>	36,5	66,5	27,5	50,2	18,3	33,6	45,5	78,8	34,3
Winding resistance $R_{U-V}$	Ohm	20,5	74,9	12,1	39,4	5,1	18,9	4,2	13,1	2,3
Winding inductivity $L_{U-V}$	mH	30,5	101	17,1	57,6	7,6	25,9	11,4	34,4	6,5
<b>Mechanical specifications</b>										
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	1,2						2,7		
Overall length $l$ <sup>1)</sup>	mm	156						180		
Partial length $r$ <sup>2)</sup>	mm	85						110		
Mass $m$	kg	2,7						3,9		

Servo Controller										
Recommended controller size *)		05	07	05	07	05	07	05	07	05
Controller housing		D								
Mains voltage <sup>3)</sup>	V	230	400	230	400	230	400	230	400	230
Line frequency	Hz	50 / 60 ± 2Hz								
Line phases		<b>1/3</b>	<b>3</b>	<b>1/3</b>	<b>3</b>	<b>1/3</b>	<b>3</b>	<b>1/3</b>	<b>3</b>	<b>1/3</b>
Rated input current	A	4,8/2,6	3	4,8/2,6	3	12,8/7	3	12,8/7	3	12,8/7
Max. perm. mains fuse	A	16/10	10	16/10	10	16/10	10	16/10	10	16/10
Rated power $P_N$	kW	0,25		0,31		0,44		0,75		0,92
Rated current $I_{dN}$	A	1,3	0,72	1,8	0,9	2,4	1,3	2,7	1,6	3,6
Stall current $I_{d0}$	A	1,5	0,8	2	1,1	3	1,6	3,2	1,9	4,3
Line cross section <sup>4)</sup>	mm <sup>2</sup>	1,5 (14 awg)								

<sup>1)</sup> With the attachment of a brake or a measuring systems the dimension  $l$  is increased by the respective length.

<sup>2)</sup> With the attachment of a brake the dimension  $r$  is increased by the respective length.

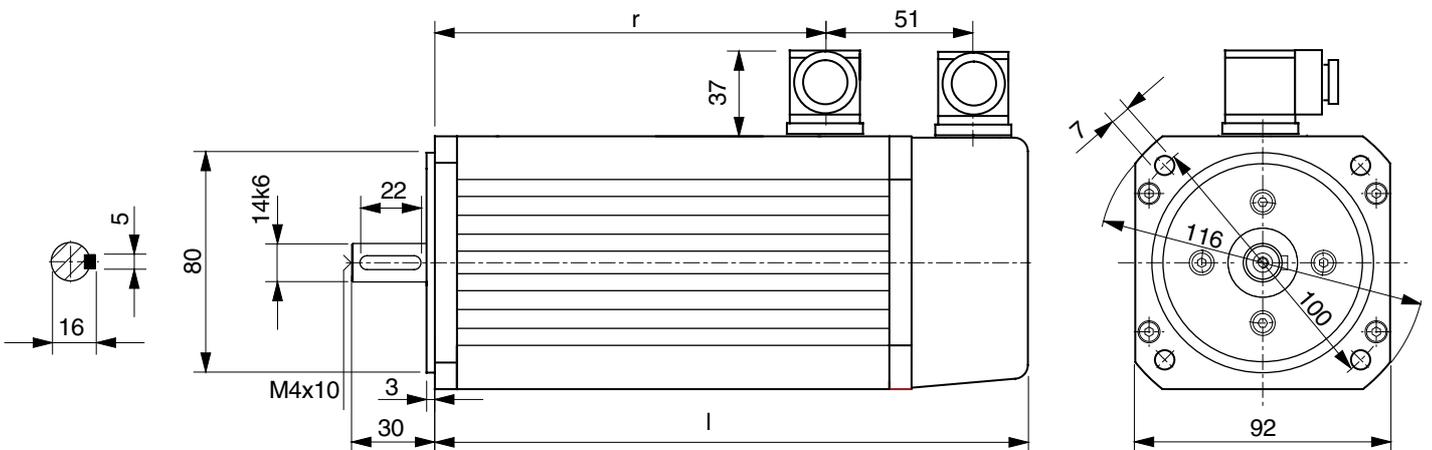
<sup>3)</sup> At 230 V rated voltage the mains voltage is = 180...264V ± 0% and at 400V = 305...500V ± 0%

<sup>4)</sup> Recommended minimum cross section of the power feeding cable at rated power and a cable length up to 30 m.

<sup>5)</sup> Specify the peak value of motor EMK at 1000 min<sup>-1</sup> as line-to-line voltage.

<sup>6)</sup> Assignment for attaining the values in the Torque-Speed Characteristic.

Servo Motor: xx.SM.000-yyyy											
Speed and voltage variants (y)	Size (x)	C2			C3			C4			
		4400	6200	6400	3200	3400	4400	6400	3400	4400	6400
Stall torque $M_{d0}$	Nm	2,7			4,5			6			
<b>Ratings</b>											
Rated torque $M_{dN}$	Nm	2,2	2		3,9	3,5	2,8	5	4,5	3	
Rated speed $n_N$	min <sup>-1</sup>	4000	6000		3000	4000	6000	3000	4000	6000	
Voltage constant $k_E$	V/1000min <sup>-1</sup>	59	22,3	39,4	49,1	83,5	64,2	43,4	79,7	61,3	42,5
Winding resistance $R_{U-V}$	Ohm	6,9	0,95	3,3	2	5,9	3,7	1,7	3,4	2,1	1,03
Winding inductivity $L_{U-V}$	mH	19,3	2,7	8,6	6,9	20,6	12,2	5,7	13,1	7,8	3,8
<b>Mechanical specifications</b>											
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	2,7			4,2			5,4			
Overall length $l$ <sup>1)</sup>	mm	180			214			248			
Partial length $r$ <sup>2)</sup>	mm	110			144			178			
Mass $m$	kg	3,9			5,2			6,6			
<b>Servo Controller</b>											
Recommended controller size *)		07	05	10	05	10	10	10	10	10	12
Controller housing		D									E
Mains voltage <sup>3)</sup>	V	400	230	400	230	400	400	400	400	400	400
Line frequency	Hz	50 / 60 ± 2Hz									
Line phases		3	1/3	3	1/3	3	3	3	3	3	3
Rated input current	A	3	12,8/7	7	12,8/7	7	7	7	3	7	18,2
Max. perm. mains fuse	A	10	16/10	10	16/10	10	10	10	10	10	20
Rated power $P_N$	kW	0,92	1,25		1,22		1,47	1,76	1,57	1,88	1,88
Rated current $I_{dN}$	A	2,1	5,3	3	4,2	2,4	3,1	3,8	3,4	4,4	4,5
Stall current $I_{d0}$	A	2,5	6,5	3,7	5,1	2,9	3,8	5,6	4,2	5,5	7,8
Line cross section <sup>4)</sup>	mm <sup>2</sup>	1,5 (14 awg)									2,5



## Technical Data

		D1				D2		
Size (x)	Speed and voltage variants (y)	3200	3400	4400	6400	3400	4400	6400
Stall torque $M_{d0}$	Nm	4,2				7		
<b>Ratings</b>								
Rated torque $M_{dN}$	Nm	3,7	3,5	3	6,1	5,8	3,8	
Rated speed $n_N$	min <sup>-1</sup>	3000	4000	6000	3000	4000	6000	
Voltage constant $k_E$	V/1000min <sup>-1</sup>	47	82,7	62	41,3	84,7	62,9	40,9
Winding resistance $R_{U-V}$	Ohm	2,1	6,3	3,9	1,6	3,2	1,7	0,66
Winding inductivity $L_{U-V}$	mH	7,7	23,8	13,4	6	12,8	7,05	3
<b>Mechanical specifications</b>								
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	4,8				7,4		
Overall length $l$ <sup>1)</sup>	mm	218				248		
Partial length $r$ <sup>2)</sup>	mm	138				168		
Mass m	kg	6,3				7,9		

Servo Controller								
Recommended controller size *)		05	10	10	10	10	12	12
Controller housing		D					E	
Mains voltage <sup>3)</sup>	V	230	400					
Line frequency	Hz	50 / 60 ± 2Hz						
Line phases		1/3	3					
Rated input current	A	12,8/7	7					18,2
Max. perm. mains fuse	A	16/10	10					20
Rated power $P_N$	k W	1,2	1,2	1,5	1,9	1,9	2,4	2,4
Rated current $I_{dN}$	A	4,9	2,8	3,5	4,8	4,5	5,8	5,9
Stall current $I_{d0}$	A	5,3	3	4	6	4,8	6,4	9,9
Line cross section <sup>4)</sup>	mm <sup>2</sup>	1,5 (14 awg)						2,5 (12)

<sup>1)</sup> With the attachment of a brake of a measuring system the dimension  $l$  is increased by the respective length.

<sup>2)</sup> With the attachment of a brake the dimension  $r$  is increased by the respective length.

<sup>3)</sup> At 230 V rated voltage the mains voltage is = 180...264V ± 0% and at 400V = 305...500V ± 0%

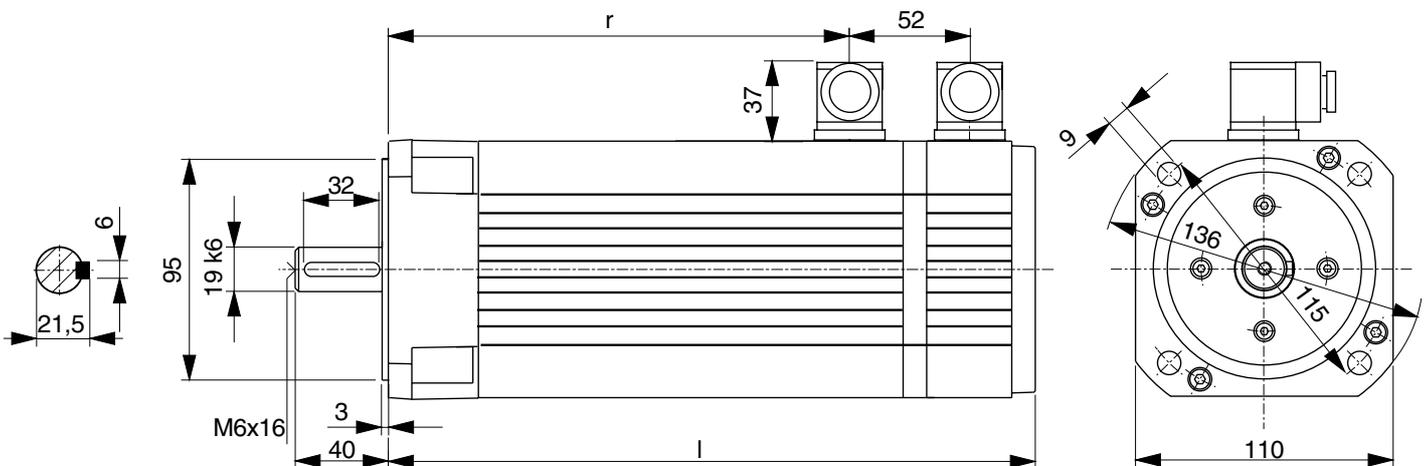
<sup>4)</sup> Recommended minimum cross section of the power feeding cable at rated power and a cable length up to 30 m.

<sup>5)</sup> Specify the peak value of motor EMK at 1000 min<sup>-1</sup> as line-to-line voltage.

<sup>7)</sup> Assignment for attaining the values in the Torque-Speed Characteristic.

Servo Motor: xx.SM.000-yyyy						
Size (x) Speed and voltage variants (y)		D3			D4	
		3400	4400	6400	3400	4400
Stall torque $M_{d0}$	Nm	10			12	
<b>Ratings</b>						
Rated torque $M_{dN}$	Nm	8,4	7,6	5	9,9	8,6
Rated speed $n_N$	min <sup>-1</sup>	3000	4000	6000	3000	4000
Voltage constant $k_E$	V/1000min <sup>-1</sup>	84,7	62,4	44,6	85,9	63,1
Winding resistance $R_{U-V}$	Ohm	1,9	1,04	0,57	1,4	0,76
Winding inductivity $L_{U-V}$	mH	8,3	4,5	2,3	6,7	3,6
<b>Mechanical specifications</b>						
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	9,8			12,7	
Overall length $l$ <sup>1)</sup>	mm	278			308	
Partial length $r$ <sup>2)</sup>	mm	198			228	
Mass $m$	kg	9,6			11,2	

Servo controller						
Recommended controller size *)		12	12	12	12	12
Controller housing		E				
Mains voltage <sup>3)</sup>	V	400				
Line frequency	Hz	50 / 60 ± 2Hz				
Line phases		3				
Rated input current	A	18,2				
Max. perm. mains fuse	A	20				
Rated power $P_N$	k W	2,6	3,2	3,1	3,1	3,6
Rated current $I_{dN}$	A	6,3	7,7	7,6	7,3	8,6
Stall current $I_{d0}$	A	7,2	9,7	13,6	8,5	11,6
Line cross section <sup>4)</sup>	mm <sup>2</sup>	2,5 (12 awg)				



## Technical Data

Servo Motor: xx.SM.000-yyyy								
Size (x)		E1				E2		
Speed and voltage variants (y)		2200	2400	3400	4400	2400	3400	4400
Stall torque $M_{d0}$	Nm	8,5				14		
<b>Ratings</b>								
Rated torque $M_{dN}$	Nm	7	6,5	5,2	12,2	11	7,6	
Rated speed $n_N$	1000min <sup>-1</sup>	2	3	4	2	3	4	
Voltage constant $k_E$	V/1000min <sup>-1</sup>	83	142,3	94	71	145,4	96,3	73,1
Winding resistance $R_{U-V}$	Ohm	3,5	10,2	4,4	2,6	4,3	2	1,14
Winding inductivity $L_{U-V}$	mH	9,9	29,3	12,7	6,8	17,9	8,2	4,7
<b>Mechanical specifications</b>								
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	12,3				19,5		
Overall length $l$ <sup>1)</sup>	mm	231				261		
Partial length $r$ <sup>2)</sup>	mm	150				180		
Mass $m$	kg	10,2				12,3		

Servo Controller								
Recommended controller size *)		05	10	10	12	10	12	12
Controller housing		D	D	D	E	D	E	E
Mains voltage <sup>3)</sup>	V	230	400					
Line frequency	Hz	50 / 60 ± 2Hz						
Line phases		1/3	3					
Rated input current	A	12,8/7	7	7	18,2	7	18,2	
Max. perm. mains fuse	A	16/10	10	10	20	10	20	
Rated power $P_N$	kW	1,5	1,5	2	2,2	2,6	3,5	3,2
Rated current $I_{dN}$	A	5,3	3,1	4,5	4,8	4,9	7	6,5
Stall current $I_{d0}$	A	6,4	3,7	5,6	7,4	5,6	9	12
Line cross section <sup>4)</sup>	mm <sup>2</sup>	1,5 (14 awg)			2,5 (12)	1,5 (14)	2,5 (12 awg)	

<sup>1)</sup> With the attachment of a brake or a measuring system the dimension  $l$  is increased by the respective length.

<sup>2)</sup> With the attachment of a brake the dimension  $r$  is increased by the respective length.

<sup>3)</sup> At 230 V rated voltage the mains voltage is = 180...264V ± 0% and at 400V = 305...500V ± 0%

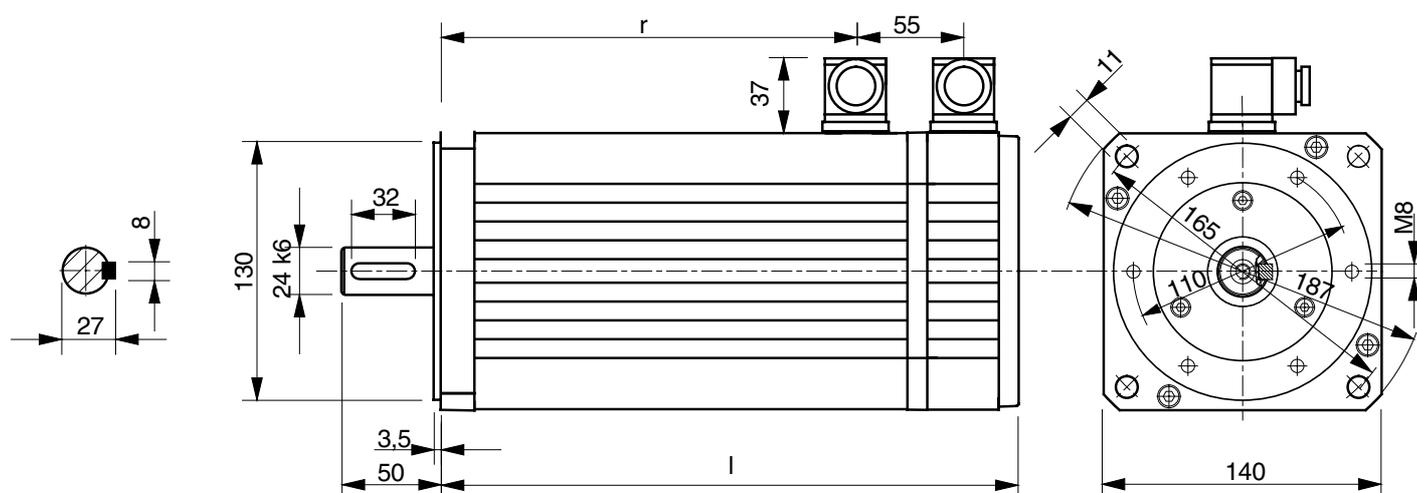
<sup>4)</sup> Recommended minimum cross section of the power feeding cable at rated power and a cable length up to 30 m.

<sup>5)</sup> Specify the peak value of motor EMK at 1000 min<sup>-1</sup> as line-to-line voltage.

<sup>\*)</sup> Assignment for attaining the values in the Torque-Speed Characteristic.

Servo Motor: xx.SM.000-yyyy						
Speed and voltage variants (y)	Size (x)	E3			E4	
		2400	3400	4400	2400	3400
Stall torque $M_{d0}$	Nm	19			27	
<b>Ratings</b>						
Rated torque $M_{dN}$	Nm	16,5	14,6	8,7	21,4	15,5
Rated speed $n_N$	1000min <sup>-1</sup>	2	3	4	2	3
Voltage constant $k_E$	V/1000min <sup>-1</sup>	141,4	92,5	70,7	148	101
Winding resistance $R_{U-V}$	Ohm	2,6	1,11	0,64	1,7	0,81
Winding inductivity $L_{U-V}$	mH	9,9	5,1	3	7,2	3,4
<b>Mechanical specifications</b>						
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	26,7			36	
Overall length $l$ <sup>1)</sup>	mm	291			336	
Partial length $r$ <sup>2)</sup>	mm	210			255	
Mass m	kg	15,5			20,4	

Servo Controller						
Recommended controller size *)		12	16	12	16	16
Controller housing		E	G	E	G	G
Mains voltage <sup>3)</sup>	V	400				
Line frequency	Hz	50 / 60 ± 2Hz				
Line phases		3				
Rated input current	A	18,2				24
Max. perm. mains fuse	A	20				25
Rated power $P_N$	kW	3,5	4,6	3,6	4,5	4,9
Rated current $I_{dN}$	A	7,3	9,9	7,7	9,4	9,9
Stall current $I_{d0}$	A	8,1	12,4	16,2	11,9	17,3
Line cross section <sup>4)</sup>	mm <sup>2</sup>	2,5 (12 awg)				4 (8 awg)



# Technical Data

Servo Motor: xx.SM.000-yyyy											
Speed and voltage variants (y)	Size (x)	F1				F2			F3		
		1400	2400	3400	4400	1400	2400	3400	1400	2400	3400
Stall torque $M_{d0}$	Nm	25				50			70		
<b>Ratings</b>											
Rated torque $M_{dN}$	Nm	22,5	21,5	20	16	42	38	31	61	52	33
Rated speed $n_N$	min <sup>-1</sup>	1500	2000	3000	4000	1500	2000	3000	1500	2000	3000
Voltage constant $k_E$	V/1000min <sup>-1</sup>	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 inductivity $L_{U-V}$	mH	29,7	16,4	7	4,1	12,8	7,5	3,6	6,8	3,8	1,7
<b>Mechanical specifications</b>											
Rotor moment of inertia $J_L$	kgcm <sup>2</sup>	84				147			210		
Overall length $l$ <sup>1)</sup>	mm	348				428			508		
Partial length $r$ <sup>2)</sup>	mm	254				334			414		
Mass m	kg	30,5				44			57,5		

Servo Controller											
Recommended controller size *)		12	12	18	18	18	18	18	18	18	18
Controller housing		E				H					
Mains voltage <sup>3)</sup>	V	400									
Line frequency	Hz	50 / 60 ± 2Hz									
Line phases		3									
Rated input current	A	18,2		24			55,5				
Max. perm. mains fuse	A	20		25			80				
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
Rated current $I_{dN}$	A	7,5	9,7	13,8	14,8	14,5	17,2	20,6	20,9	23,7	22,9
Stall current $I_{d0}$	A	8,2	11,1	17	22,2	17	22,3	32,2	23,1	30,8	46,2
Line cross section <sup>4)</sup>	mm <sup>2</sup>	2,5 (12 awg)		4 (8 awg)			10 (6 awg)				

<sup>1)</sup> With the attachment of a brake of a measuring system the dimension  $l$  is increased by the respective length.

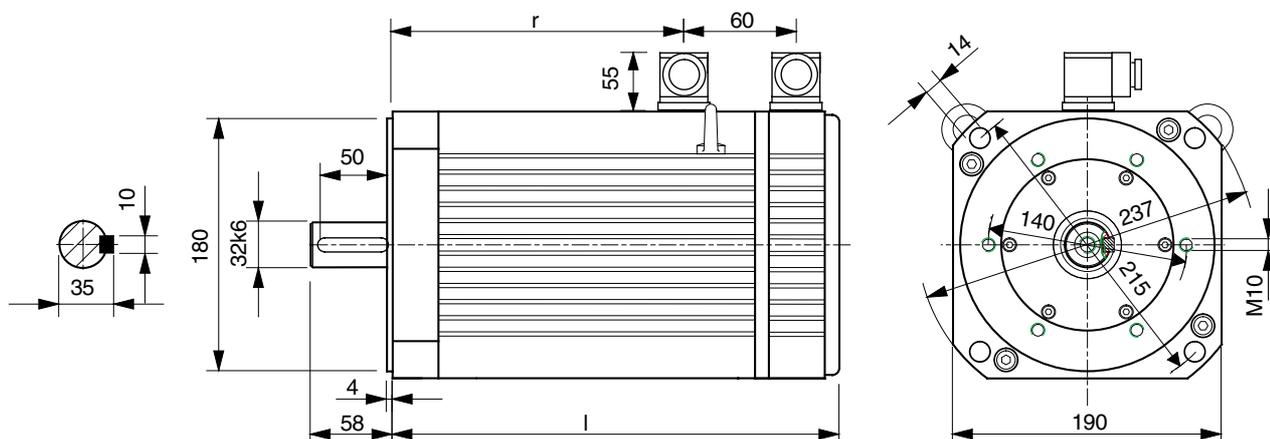
<sup>2)</sup> With the attachment of a brake the dimension  $r$  is increased by the respective length.

<sup>3)</sup> At 230 V rated voltage the mains voltage is = 180...264V ± 0% and at 400V = 305...500V ± 0%

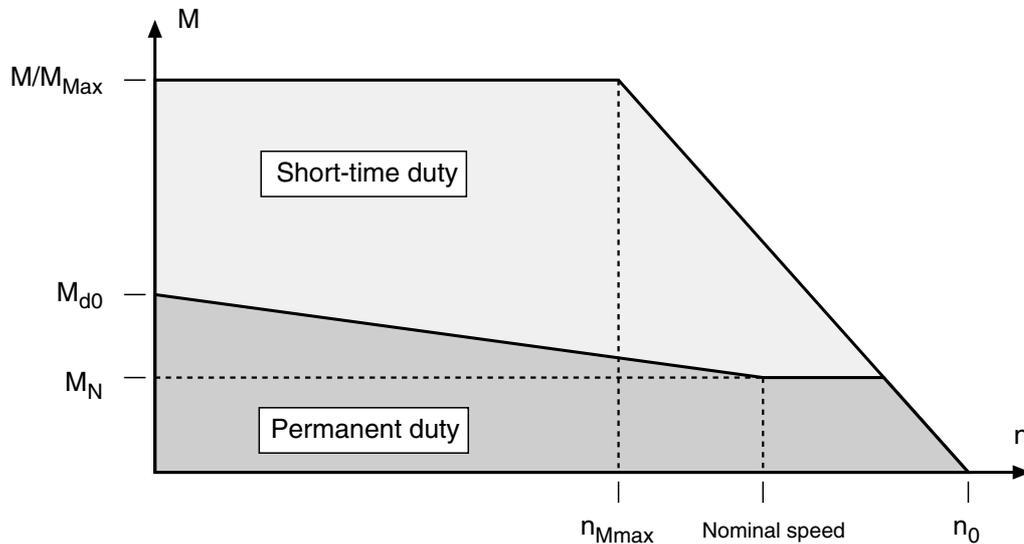
<sup>4)</sup> Recommended minimum cross section of the power feeding cable at rated power and a cable length up to 30.

<sup>5)</sup> Specify the peak value of motor EMK at 1000 min<sup>-1</sup> as line-to-line voltage.

<sup>6)</sup> Assignment for attaining the values in the Torque-Speed Characteristic.



## 9. Torque-Speed Characteristics



Part-No.	$M_{max} / M_N$	$M_{d0} / [Nm]$	$M_N / [Nm]$	Controller	$n_{Mmax} / [rpm]$	$n_0 / [rpm]$
A1.SM.000-6200	5,0	0,34	0,32	03.S4	5650	10250
A1.SM.000-6400	5,0	0,34	0,32	07.S4	8650	13000
A2.SM.000-6200	5,0	0,5	0,48	03.S4	7400	10250
A2.SM.000-6400	5,0	0,5	0,48	07.S4	7800	10950
A3.SM.000-6200	5,0	0,65	0,6	05.S4	7500	10250
A3.SM.000-6400	5,0	0,65	0,6	07.S4	7450	10200
A4.SM.000-6200	4,7	1	0,8	05.S4	7800	10250
A4.SM.000-6400	5,0	1	0,8	07.S4	6400	9000
<b>B Series</b>						
B1.SM.000-4200	5,0	0,65	0,6	05.S4	6000	9850
B1.SM.000-4400	5,0	0,65	0,6	07.S4	3450	7500
B1.SM.000-6200	5,0	0,65	0,5	05.S4	8250	13300
B1.SM.000-6400	5,0	0,65	0,5	07.S4	6100	11200
B2.SM.000-4200	5,0	1,5	1,3	05.S4	3450	7400
B2.SM.000-4400	5,0	1,5	1,3	07.S4	2350	6250
B2.SM.000-6200	3,6	1,5	1	05.S4	9050	11500
B2.SM.000-6400	5,0	1,5	1	10.S4	3950	9600
B3.SM.000-4200	3,4	2,3	2	05.S4	5550	7750
B3.SM.000-4400	5,0	2,3	2	10.S4	2800	5950
B3.SM.000-6400	5,0	2,3	1,5	10.S4	3750	8600
<b>C Series</b>						
C1.SM.000-3200	5,0	0,95	0,8	05.S4	2450	5600
C1.SM.000-3400	5,0	0,95	0,8	07.S4	2200	5400
C1.SM.000-4200	5,0	0,95	0,75	05.S4	3400	7450
C1.SM.000-4400	5,0	0,95	0,75	07.S4	3450	7150
C1.SM.000-6200	5,0	0,95	0,7	05.S4	6200	11200
C1.SM.000-6400	5,0	0,95	0,7	07.S4	5650	10700
C2.SM.000-3200	5,0	2,7	2,4	05.S4	2750	4500
C2.SM.000-3400	5,0	2,7	2,4	07.S4	2750	4550
C2.SM.000-4200	4,4	2,7	2,2	05.S4	3950	5950
C2.SM.000-4400	5,0	2,7	2,2	07.S4	3850	6100
C2.SM.000-6200	3,0	2,7	2	05.S4	7300	9150
C2.SM.000-6400	5,0	2,7	2	10.S4	5950	9100

## Torque-Speed Characteristics

Part-No.	M <sub>max</sub> / M <sub>N</sub>	M <sub>d0</sub> / [Nm]	M <sub>N</sub> / [Nm]	Controller	n <sub>Mmax</sub> / [rpm]	n <sub>0</sub> / [rpm]
<b>C3.SM.000-3200</b>	3,8	4,5	3,9	<b>05.S4</b>	3050	4150
<b>C3.SM.000-3400</b>	5,0	4,5	3,9	<b>10.S4</b>	2850	4300
<b>C3.SM.000-4400</b>	5,0	4,5	3,5	<b>10.S4</b>	3700	5600
<b>C3.SM.000-6400</b>	5,0	4,5	2,8	<b>10.S4</b>	5900	8250
<b>C4.SM.000-3400</b>	5,0	6	5	<b>10.S4</b>	3150	4500
<b>C4.SM.000-4400</b>	5,0	6	4,5	<b>10.S4</b>	4050	5850
<b>C4.SM.000-6400</b>	5,0	6	3	<b>12.S4</b>	6550	8450
<b>D1.SM.000-3200</b>	3,3	4,2	3,7	<b>05.S4</b>	3050	4350
<b>D1.SM.000-3400</b>	5,0	4,2	3,7	<b>10.S4</b>	2350	4350
<b>D1.SM.000-4400</b>	5,0	4,2	3,5	<b>10.S4</b>	3350	5800
<b>D1.SM.000-6400</b>	4,6	4,2	3	<b>10.S4</b>	5650	8700
<b>D2.SM.000-3400</b>	4,9	7	6,1	<b>10.S4</b>	2600	4250
<b>D2.SM.000-4400</b>	5,0	7	5,8	<b>12.S4</b>	3600	5700
<b>D2.SM.000-6400</b>	5,0	7	3,8	<b>12.S4</b>	6700	8800
<b>D3.SM.000-3400</b>	5,0	10	8,4	<b>12.S4</b>	2750	4250
<b>D3.SM.000-4400</b>	4,9	10	7,6	<b>12.S4</b>	4000	5750
<b>D3.SM.000-6400</b>	5,0	10	5	<b>12.S4</b>	6200	8050
<b>D4.SM.000-3400</b>	5,0	12	9,9	<b>12.S4</b>	3750	4150
<b>D4.SM.000-4400</b>	4,4	12	8,6	<b>12.S4</b>	4300	5700
<b>E1.SM.000-2200</b>	3,0	8,5	7	<b>05.S4</b>	1750	2450
<b>E1.SM.000-2400</b>	7,1	8,5	7	<b>10.S4</b>	900	2500
<b>E1.SM.000-3400</b>	4,9	8,5	6,5	<b>10.S4</b>	2300	3800
<b>E1.SM.000-4400</b>	5,0	8,5	5,2	<b>12.S4</b>	3550	5050
<b>E2.SM.000-2400</b>	4,5	14	12,2	<b>10.S4</b>	1550	2450
<b>E2.SM.000-3400</b>	5,0	14	11	<b>12.S4</b>	2250	3700
<b>E2.SM.000-4400</b>	5,0	14	7,6	<b>12.S4</b>	3550	4900
<b>E3.SM.000-2400</b>	5,0	19	16,5	<b>12.S4</b>	1650	2500
<b>E3.SM.000-3400</b>	5,0	19	14,6	<b>16.S4</b>	2550	3850
<b>E3.SM.000-4400</b>	4,9	19	8,7	<b>12.S4</b>	4050	5050
<b>E4.SM.000-2400</b>	5,0	27	21,4	<b>16.S4</b>	1650	2400
<b>E4.SM.000-3400</b>	5,0	27	15,5	<b>16.S4</b>	2750	3550
<b>F1.SM.000-1400</b>	5,0	25	22,5	<b>12.S4</b>	450	1900
<b>F1.SM.000-2400</b>	3,9	25	21,5	<b>12.S4</b>	1150	2550
<b>F1.SM.000-3400</b>	5,0	25	20	<b>18.S4</b>	1400	3900
<b>F1.SM.000-4400</b>	5,0	25	16	<b>18.S4</b>	2400	5100
<b>F2.SM.000-1400</b>	5,0	50	42	<b>18.S4</b>	750	2000
<b>F2.SM.000-2400</b>	4,4	50	38	<b>18.S4</b>	1300	2600
<b>F2.SM.000-3400</b>	3,6	50	31	<b>18.S4</b>	2400	3750
<b>F3.SM.000-1400</b>	3,6	70	61	<b>18.S4</b>	1250	1950
<b>F3.SM.000-2400</b>	3,2	70	52	<b>18.S4</b>	1900	2600
<b>F3.SM.000-3400</b>	3,3	70	33	<b>18.S4</b>	3200	3900

## 10. Axial and Lateral Force

The table specifies:

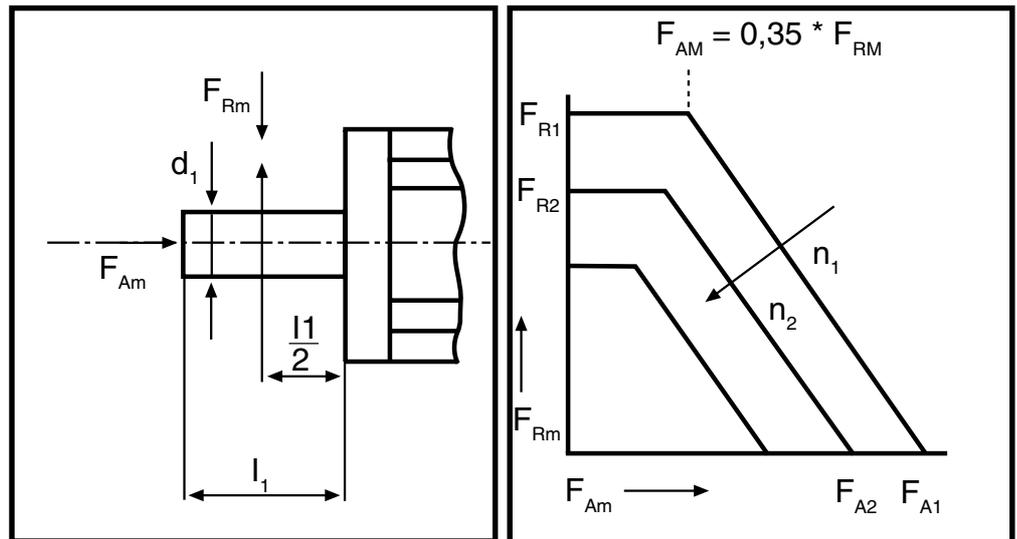
- the largest permissible lateral force  $F_{Rm}$  at  $x=l_1/2$
- the largest permissible axial force  $F_{Am}$  for a service life of 20000 hours.

Motor	Lateral force $F_{Rm}$ [N] at speed $n$ [ $\text{min}^{-1}$ ]				Axial force $F_{Am}$ [N] at speed $n$ [ $\text{min}^{-1}$ ]				$d_1$ $l_1$	$F_G$ [N]	P [mm]	C [mm]	$F_{Rmax}$ [N]
	2000	3000	4000	6000	2000	3000	4000	6000					
A1	310	260	240	210	250	200	170	140	9 k6 20	1	10	96	600
A2										2		108	
A3										3		121	
A4										4		145	
B1	400	340	300	270	310	260	220	180	9 k6 20	2	11	81	800
B2										4		105	
B3										6		141	
C1	470	400	350	320	380	310	260	220	9 k6 20	3	17	131	1000
C2										9		155	
C3										14		189	
C4										20		223	
D1	720	640	550	490	590	500	420	350	9 k6 20	10	24	138	2000
D2										17		168	
D3										23		198	
D4										30		228	
E1	1100	1000	850	760	900	770	650	560	9 k6 20	17	24	188	2300
E2										30		218	
E3										40		248	
E4										60		293	
F1	2300	1900	1800	-	1800	1500	1400	-	9 k6 20	85	31	280	6000
F2										140		360	
F3										200		440	

## 10.1 Shaft Load

The permissible axial and lateral forces are listed in the table on page 42.

The endurance strength of the shaft and the service life of the bearings determine the permissible lateral force  $F_{Rm}$  on the D(AS)-side shaft end.



## 10.2 Output Component

The smallest possible effective circular diameter of the output component can be computed as follows:

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

$D_w$ : effective circular diameter of output component  
 $k$ : pretension factor  
 $F_{Rm}$ : permissible lateral force  
 $M_b$ : acceleration torque of the drive

## 10.3 Pretension Factor

Empirical values for the pretension factor  $k$ :

- ca.  $k = 1,5$  for pinion
- ca.  $k = 1,2$  to  $2,0$  for toothed belt
- ca.  $k = 2,2$  to  $3,0$  for flat belt

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

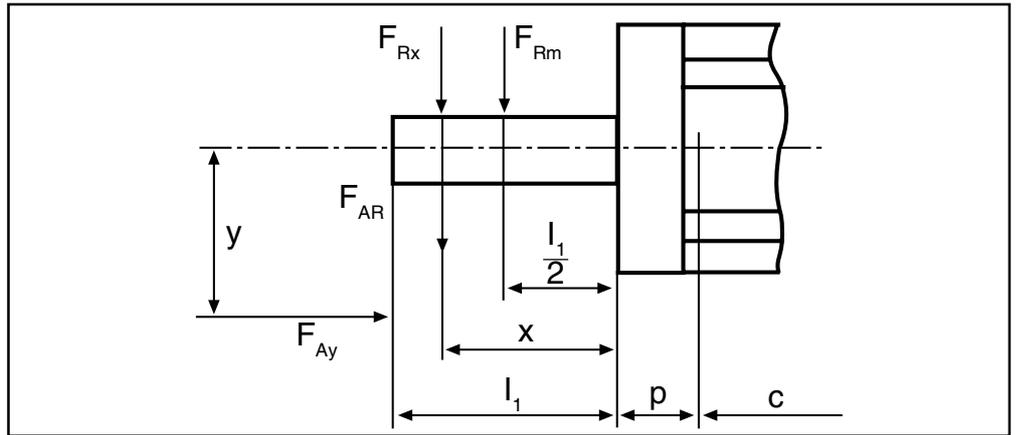
**10.4 Horizontal Position of Use**

If the lateral force  $F_R$  does not take effect at  $x = l_1 / 2$ , changed radial forces occur.

$$F_{Rx} = F_{Rm} * \frac{c + p + 0,5 * l_1}{c + p + x}$$

If the radial force  $F_{AR}$  is not working on the centre of the shaft then the radial parts of this force take effect:

$$F_{AR} = F_{Ay} * \frac{y}{p + x}$$



**10.5 Vertical Position of Use**

If the motor is installed vertically, the permissible axial forces  $F_{Am}$  (see table page 41) for the force direction upward apply.

$$F_{Am/new} = F_{Am} - F_G$$

For the force direction downward the permissible axial force  $F_{Am}$  is becoming smaller by the mass force  $F_G$  of the rotor:

$$F_G = m_l * g$$

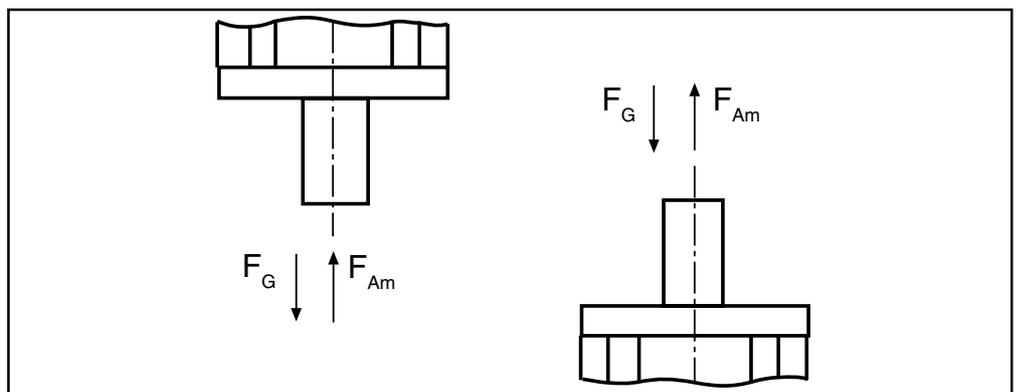
$m_l$ : mass of rotor

$g$ : gravitational acceleration

If the axial force  $F_{Am}$  is working away from the motor then the force  $F_w$  must be taken into account for safety reasons:

$$F_{Am/new} = F_{Am} - F_G - F_w$$

$$F_w [NM] = 10 * d_l [mm]$$



The motors of the series A1...F3 with built-in holding brake are not to be loaded with axial forces, as this causes a change of the working airgap of the holding brake thereby making the brake inoperative.

## 11. Options

### 11.1 Holding Brake

Motor type	Ax.SM.001-xx00	Bx.SM.001-xx00	Cx.SM.001-xx00
Holding torque [Nm]	2,0	2,5	9
Moment of inertia [kgcm <sup>2</sup> ]	0,067	0,38	0,6
max. speed [min <sup>-1</sup> ]	10.000	10.000	10.000
Mass [kg]	0,18	0,30	0,50
Rated voltage [V]	24 (+6%, -10%)	24 (+6%, -10%)	24 (+6%, -10%)
Rated current [A]	0,46	0,50	0,75
Length* [mm]	24	28	46
Type	7D.052.00-4000	86.64.106-E000	06.P1.320-0087

Motor type	Dx.SM.001-xx00	Ex.SM.001-xx00	Fx.SM.001-xx00
Holding torque [Nm]	11	36	85
Moment of inertia [kgcm <sup>2</sup> ]	2,3	5,9	17,6
max. speed [min <sup>-1</sup> ]	10.000	10.000	4.000
Mass [kg]	0,78	1,63	3,8
Rated voltage [V]	24 (+6%, -10%)	24 (+6%, -10%)	24 (+6%, -10%)
Rated current [A]	0,84	1,1	1,5
Length* [mm]	8	45	0
Type	7D.051.00-4000	08.P1.320-0057	09.P1.320-0017

\*) When installing a brake this length must be added to the dimensions of the motor to obtain the overall length. The brake for the F-motor does not affect the overall dimensions.





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