

## PacDrive™ SM Servo motor

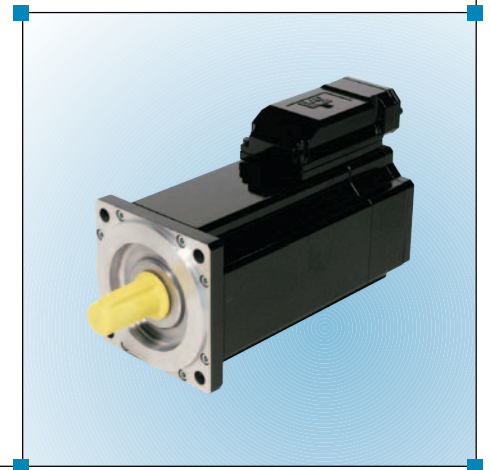
### High dynamic AC servo motors

The rotary AC servo motors of the SM series meet the highest requirements for dynamism and accuracy. Three sizes with three to four lengths each offer the right solution for almost every application. A resolver or SinCos® motor feedback system with HIPERFACE® interface supplies all necessary position information. The SM Series' connector technology combines the robustness of a clamp box with the serviceability of a standard plug in system. No special tools are needed for cable preparation. The SM Servo Drives are available in three different flange sizes:

- SM-070
- SM-100
- SM-140

### The technical data at a glance:

- designed to meet the highest requirements for dynamism and accuracy
- compact size
- high power density
- low rotor inertia
- small cogging torque
- high resistance against winding damages



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This Technical Data Sheet does not replace the Operating manual.

For a complete description of the PacDrive SM-Motor see the Operating manual PacDrive SM-Motor

For planning and project activities see the PacDrive Projecting manual

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# Technical Data

## General Technical Data

Designation	Description
Motor type	Rotary synchronous servomotor, permanently excited
Magnetic material	Neodymium-iron-boron (NdFeB)
Insulation system (according to DIN VDE 0530)	Heat class F (155 °C)
Mounting orientation (according to IN 42 950)	IM B5, IM V1, IM V3
Protection class (according to EN 60529)	IP65 (in IM B5 and IM V1 shaft seal required) IP60 (in IM V3 shaft seal required)
Cooling	Self-cooling, rated ambient temperature up to 40 °C
Temperature monitoring	Three-code posistor in the stator coil, switching temperature 130 °C
Shaft end	Cylindrical shaft end according to DIN 748 without key way
Concentric accuracy, coaxiality, axial run (according to DIN 42 955)	Tolerance N (normal)
Balancing class (according to VDI 2060)	G 2.5
Built-in measuring system	SinCos <sup>®</sup> SRS 50 or SRM 50 (single - or multiturn version with Hiperface <sup>®</sup> Interface), Resolver
Connection system	Terminal box

Table 1-1: General technical data

Options	Description
Shaft with key way	Feather groove with round front according to DIN 6885 T1, rotor with „half“ key way balanced
Brake	Electromagnetic permanent-magnet holding brake
Stainless steel shaft	
Shaft Seal	Viton radial shaft seal on the flange side
Cooling	air and water cooling (in preparation)

Table 1-2: General technical data (Options)

## SM-070

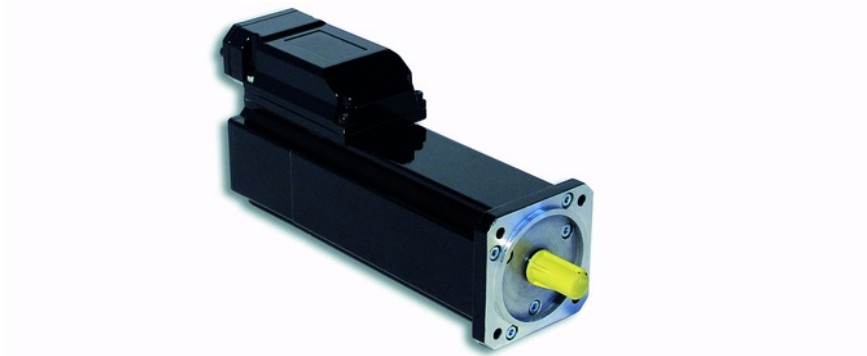


Fig. 2-1: View of the SM-070 motor

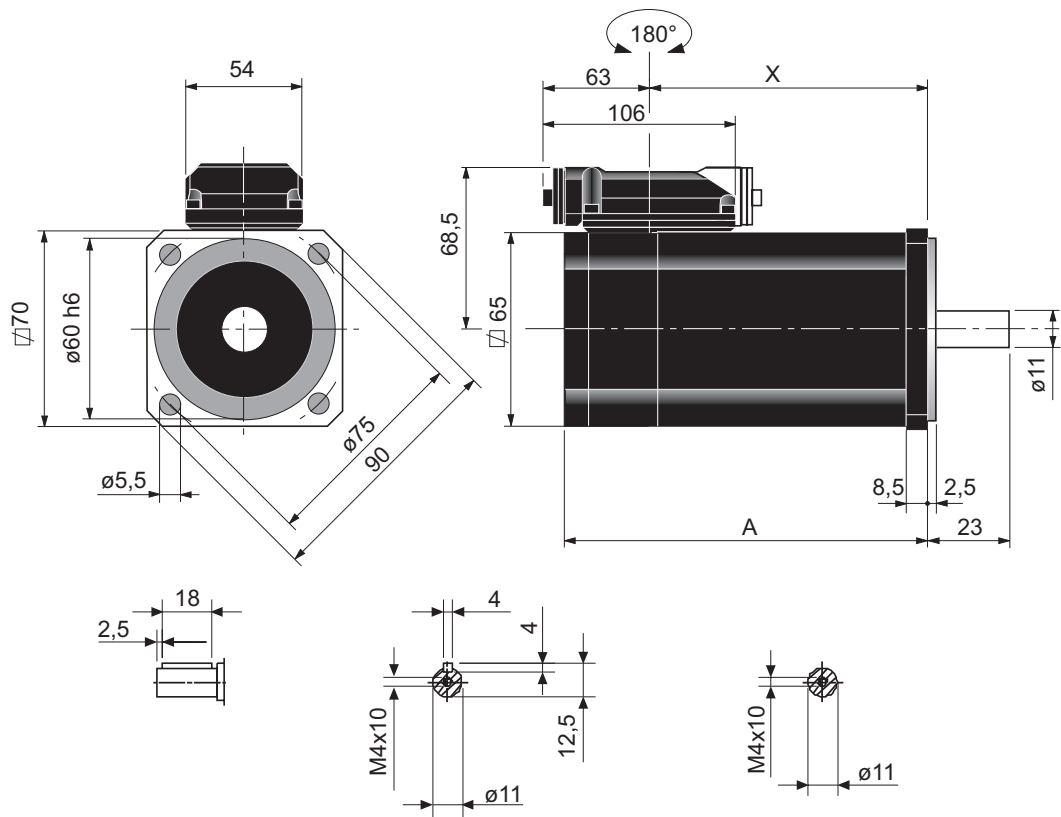
### Technical Data

Winding data for 6000 rpm with 3 AC 400 V

	Reference Data	mnemonic	60 010	60 020	Unit
<b>Physical Data</b>	Standstill torque (standard) - motor with surface ventilation	$M_{0M}$	1.1 -	2.0 2.7	[Nm]
	Rated speed	$n_N$	6000	6000	[rpm]
	Cut-off power	$P_{ECKM}$	0.7	1.2	[kW]
	Peak torque	$M_{SM}$	4.7	7.7	[Nm]
	Max. mechanical limit rpm	$n_{limit}$	700	700	[rad/s]
	Motor moment of inertia	$J_M$	0.48	0.79	[kgm <sup>2</sup> ]
	Acceleration at $M_{SM}$	$A_{SM}$	129175	125230	[rad/s <sup>2</sup> ]
	Max. shock (all directions)	S	200	200	[m/s <sup>2</sup> ]
	Max. vibration (radial)	$V_R$	200	200	[m/s <sup>2</sup> ]
	Max. vibration (axial)	$V_A$	40	40	[m/s <sup>2</sup> ]
<b>Thermal Data</b>	Mass	m	2.75	4.25	[kg]
	Run-up time	$t_{bSM}$	5	5	[ms]
	Thermal time constant	$t_A$	46	43	[min]
<b>Electrical Data</b>	Operating threshold thermo contact	$T_{TK}$	130	130	[°C]
	Number of poles	PZ	4	4	
	Circuit of the motor windings		Y	Y	
	Torque constant (20°C)	$K_{M20}$	0.86	0.85	[Nm/A]
	Torque constant (120°C)	$K_{M120}$	0.78	0.78	[Nm/A]
	Winding resistance (120°C)	$R_{W120}$	12.39	4.69	[Ohm]
	Winding inductivity (20°C)	$L_W$	21.9	10.8	[mH]
	EMC at 1000 rpm	EMC	52	52	[V]
	Standstill current - motor with surface ventilation	$I_{0M}$	1.43 -	2.53 3.46	[A]
	Peak current	$I_{SM}$	6.0	9.9	[A]

Table 2-3: Technical Data SM-070

## Dimensions



MSM\_MasszeichnungSM070\_us0006.fh8

Fig. 2-2: Dimensional drawing of SM-070

Dimensions	xx010	xx020	Unit
A	201 (7.91)	261 (10.28)	[mm] ([inch])
X	152 (5.98)	212 (8.35)	[mm] ([inch])

Table 2-4: Dimensions of SM-070 without brake

Dimensions	xx010	xx020	Unit
A	230 (9.06)	290 (11.42)	[mm] ([inch])
X	181 (7.13)	241 (9.49)	[mm] ([inch])

Table 2-5: Dimensions of SM-070 with brake

**Tolerances** Shaft diameter: j6

Feather groove, round end according to DIN 6885 T1, tolerance field N9.

Rotor balanced with half feather key.

## SM-100

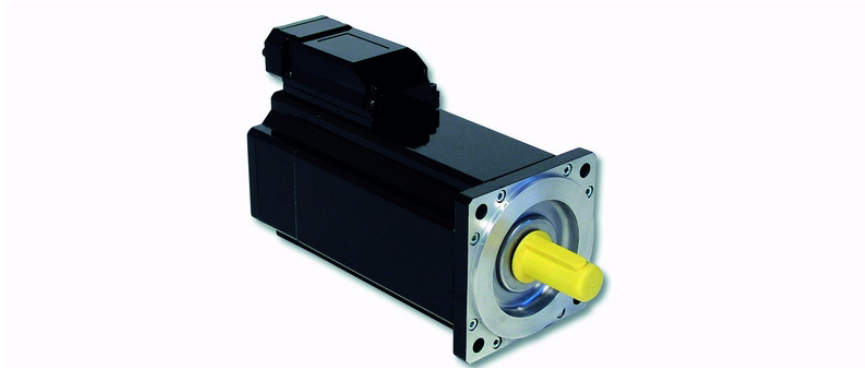


Fig. 2-3: View of the SM-100 motor

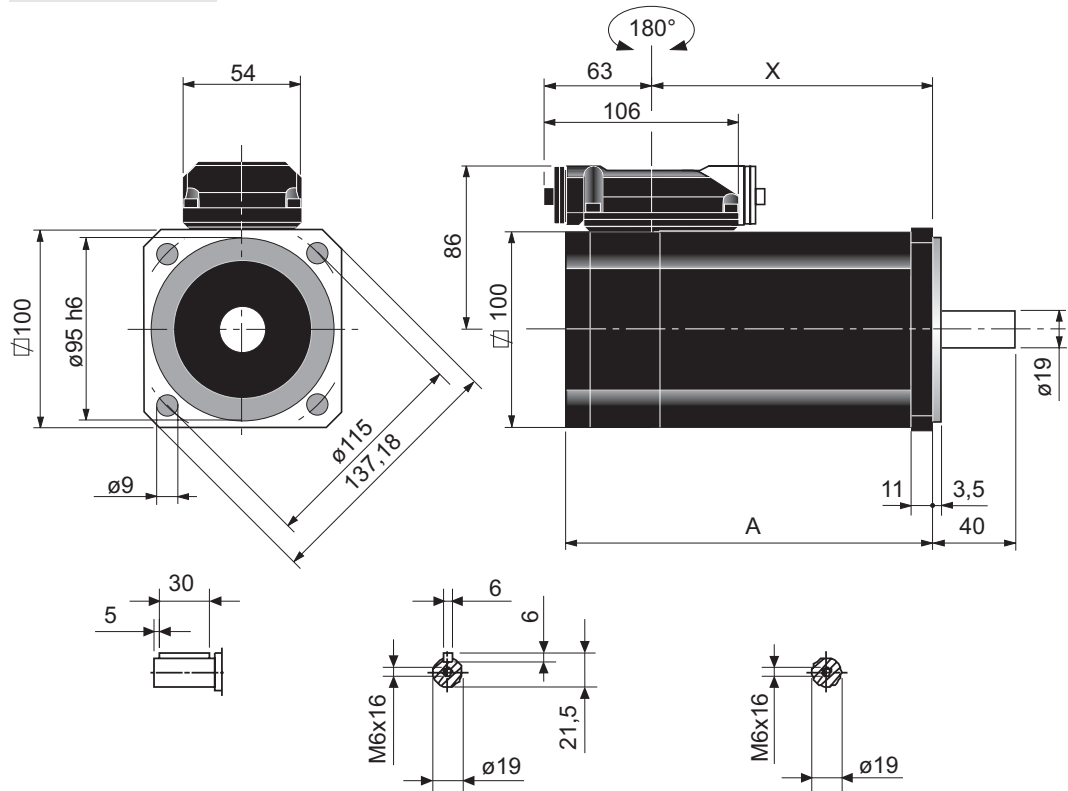
### Technical Data

Winding data with 3 AC 400 V

	Reference Data	mnemonic	50 030	40 050	40 080	30 080	Unit
<b>Physical Data</b>	Standstill torque (standard) - motor with surface ventilation	$M_{0M}$	2.6	4.8 8.0	8.0 13.0	8.2 14.0	[Nm]
	Rated speed	$n_N$	5000	4000	4000	3000	[rpm]
	Cut-off power	$P_{ECKM}$	1.4	2.0	3.4	2.6	[kW]
	Peak torque	$M_{SM}$	10	16	30	27	[Nm]
	Max. mechanical limit rpm	$n_{limit}$	700	700	700	700	[rad/s]
	Motor moment of inertia	$J_M$	2.28	3.64	6.54	6.54	[kgm <sup>2</sup> ]
	Acceleration at $M_{SM}$	$A_{SM}$	55885	54308	47188	49168	[rad/s <sup>2</sup> ]
	Max. shock (all directions)	S	200	200	200	200	[m/s <sup>2</sup> ]
	Max. vibration (radial)	$V_R$	200	200	200	200	[m/s <sup>2</sup> ]
	Max. vibration (axial)	$V_A$	50	40	40	40	[m/s <sup>2</sup> ]
<b>Thermal Data</b>	Mass	m	4.9	7	11.2	11.2	[kg]
	Run-up time	$t_{bSM}$	9	8	9	6	[ms]
	Thermal time constant	$t_A$	44	54	51	56	[min]
	Operating threshold thermo contact	$T_{TK}$	130	130	130	130	[°C]
<b>Electrical Data</b>	Number of poles	PZ	8	8	8	8	
	Circuit of the motor windings		Y	Y	Y	Y	
	Torque constant (20°C)	$K_{M20}$	1.00	1.27	1.32	1.65	[Nm/A]
	Torque constant (120°C)	$K_{M120}$	0.91	1.15	1.2	1.5	[Nm/A]
	Winding resistance (120°C)	$R_{W120}$	5.61	2.94	1.39	2.07	[Ohm]
	Winding inductivity (20°C)	$L_W$	9.08	7.29	3.97	6.20	[mH]
	EMK at 1000 rpm	EMK	60	77	80	100	[V]
	Standstill current - motor with surface ventilation	$I_{0M}$	2.87 -	4.19 -	6.68 10.9	5.48 9.33	[A]
Peak current	$I_{SM}$	11	14	25 (22)	18	[A]	

Table 2-6: Technical Data SM-100

## Dimensions



MSM\_MasszeichnungSM100\_us0006.fh8

Fig. 2-4: Dimensional drawing of SM-100

Dimensions	xx030	xx050	xx080	Unit
A	196 (7.72)	240 (9.45)	328 (12.91)	[mm] ([inch])
X	147 (5.79)	191 (7.52)	279 (10.98)	[mm] ([inch])

Table 2-7: Dimensions of SM-100 without brake

Dimensions	xx030	xx050	xx080	Unit
A	231 (9.09)	275 (10.83)	363 (14.29)	[mm] ([inch])
X	182 (7.17)	226 (8.90)	279 (10.98)	[mm] ([inch])

Table 2-8: Dimensions of SM-100 with brake

**Tolerances** Shaft diameter: j6

Feather groove, round end according to DIN 6885 T1, tolerance field N9.

Rotor balanced with half feather key.

## SM-140



Fig. 2-5: View of the SM-140 motor

### Technical Data

Winding data for 3000 rpm with 3 AC 400 V

Reference Data	mnemonic	30 120	30 210	30 290	30 370	Unit	
<b>Physical Data</b>	Standstill torque (standard) - motor with surface ventilation	M <sub>0M</sub> 11 17	20 35	29 46	36 57	[Nm]	
	Rated speed	n <sub>N</sub>	3000	3000	3000	[rpm]	
	Cut-off power	P <sub>ECKM</sub>	3.4	6.5	8.6	11	[kW]
	Peak torque	M <sub>SM</sub>	45	76	103	126	[Nm]
	Max. mechanical limit rpm	n <sub>limit</sub>	700	700	700	700	[rad/s]
	Motor moment of inertia	J <sub>M</sub>	10.3	18.1	24.9	33.1	[kgm <sup>2</sup> ]
	Acceleration at M <sub>SM</sub>	A <sub>SM</sub>	46889	52473	53027	51485	[rad/s <sup>2</sup> ]
	Max. shock (all directions)	S	200	200	200	200	[m/s <sup>2</sup> ]
	Max. vibration (radial)	V <sub>R</sub>	200	200	200	200	[m/s <sup>2</sup> ]
	Max. vibration (axial)	V <sub>A</sub>	40	40	40	40	[m/s <sup>2</sup> ]
	Mass	m	10	14	18	22	[kg]
<b>Thermal Data</b>	Run-up time	t <sub>bSM</sub>	7	6	6	6	[ms]
	Thermal time constant	t <sub>A</sub>	70	88	91	98	[min]
	Operating threshold thermo contact	T <sub>TK</sub>	130	130	130	130	[°C]
<b>Electrical Data</b>	Number of poles	PZ	8	8	8	8	
	Circuit of the motor windings		Y	Y	Y	Y	
	Torque constant (20°C)	K <sub>M20</sub>	1.70	1.78	1.80	1.78	[Nm/A]
	Torque constant (120°C)	K <sub>M120</sub>	1.55	1.62	1.64	1.62	[Nm/A]
	Winding resistance (120°C)	R <sub>W120</sub>	1.65	0.57	0.36	0.24	[Ohm]
	Winding inductivity (20°C)	L <sub>W</sub>	9.64	3.4	1.89	1.23	[mH]
	EMC at 1000 rpm	EMC	103	108	109	108	[V]
	Standstill current - motor with surface ventilation	I <sub>0M</sub>	7.04 11	12.7 22	16.8 28.1	21.8 35.6	[A]
	Peak current	I <sub>SM</sub>	29	47	63	78	[A]

Table 2-9: Technical Data SM-140 30



## Technical Data

Winding data for 2000 rpm with 3 AC 400 V

	Reference Data	mnemonic	20210	Unit
<b>Physical Data</b>	Standstill torque (standard) - motor with surface ventilation	$M_{0M}$	21	[Nm]
	Rated speed	$n_N$	2000	[rpm]
	Cut-off power	$P_{ECKM}$	4.4	[kW]
	Peak torque	$M_{SM}$	78	[Nm]
	Max. mechanical limit rpm	$n_{limit}$	700	[rad/s]
	Motor moment of inertia	$J_M$	18.1	[kgm <sup>2</sup> ]
	Acceleration at $M_{SM}$	$A_{SM}$	53303	[rad/s <sup>2</sup> ]
	Max. shock (all directions)	S	200	[m/s <sup>2</sup> ]
	Max. vibration (radial)	$V_R$	200	[m/s <sup>2</sup> ]
	Max. vibration (axial)	$V_A$	40	[m/s <sup>2</sup> ]
	Mass	m	14	[kg]
<b>Thermal Data</b>	Run-up time	$t_{bSM}$	4	[ms]
	Thermal time constant	$t_A$	91	[min]
<b>Electrical Data</b>	Operating threshold thermo contact	$T_{TK}$	130	[°C]
	Number of poles	PZ	8	
	Circuit of the motor windings		Y	
	Torque constant (20°C)	$K_{M20}$	2.59	[Nm/A]
	Torque constant (120°C)	$K_{M120}$	2.36	[Nm/A]
	Winding resistance (120°C)	$R_{W120}$	1.14	[Ohm]
	Winding inductivity (20°C)	$L_W$	7.19	[mH]
	EMC at 1000 rpm	EMC	157	[V]
	Standstill current - motor with surface ventilation	$I_{0M}$	8.97	[A]
Peak current	$I_{SM}$	33	[A]	

Technical Data SM-140 20 (Data apply to flanged on motor at aluminium plate)

## Dimensions

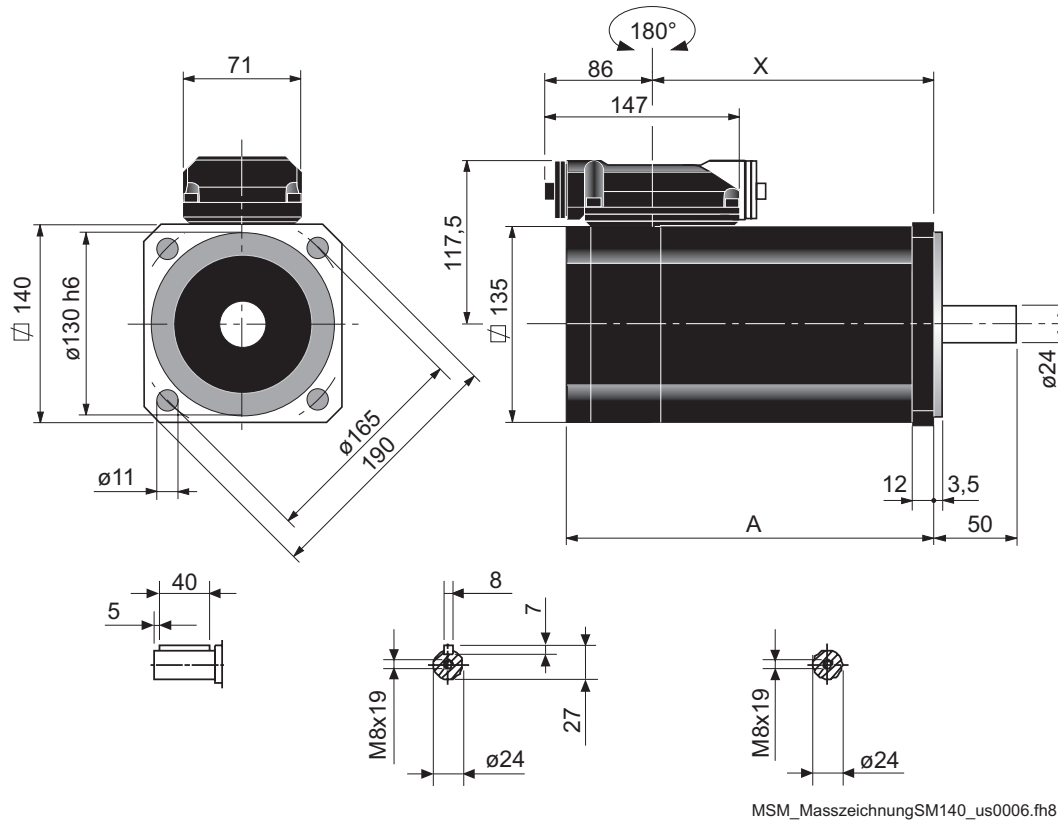


Fig. 2-6: Dimensional drawing of SM-140

Dimensions	xx120	xx210	xx290	xx370	Unit
A	248 (9.76)	310 (12.20)	372 (14.65)	434 (17.09)	[mm] ([inch])
X	178 (7.01)	240 (9.45)	302 (11.89)	364 (14.33)	[mm] ([inch])

Table 2-10: Dimensions of SM-140 without brake

Dimensions	xx120	xx210	xx290	xx370	Unit
A	288 (11.34)	350 (13.78)	412 (16.22)	474 (18.66)	[mm] ([inch])
X	218 (8.58)	280 (11.02)	342 (13.46)	404 (15.91)	[mm] ([inch])

Fig. 2-7: Dimensions of SM-140 with brake

- Tolerances** Shaft diameter: j6  
 Feather groove, round end according to DIN 6885 T1, tolerance field N9.  
 Rotor balanced with half feather key.

## Electrical Connections

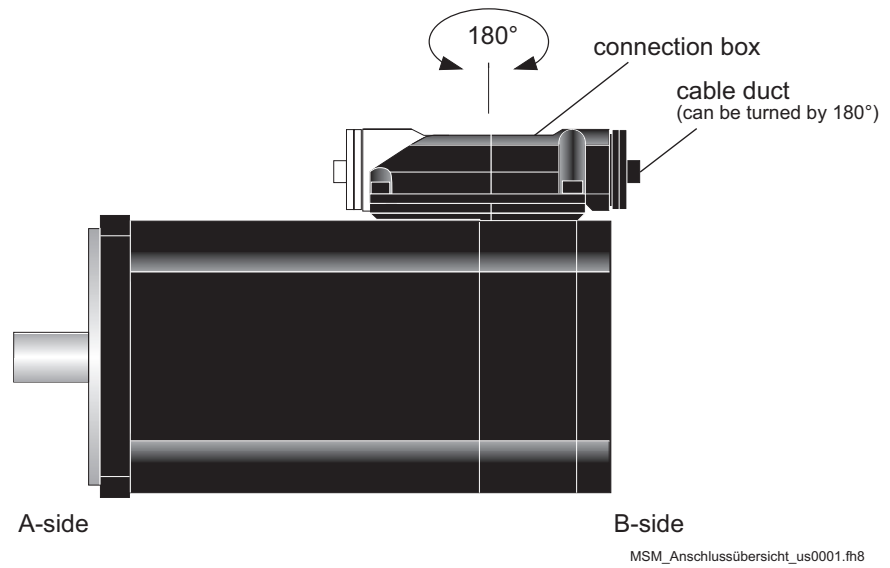


Fig. 2-8: Overview of connections with SM Motor - 1

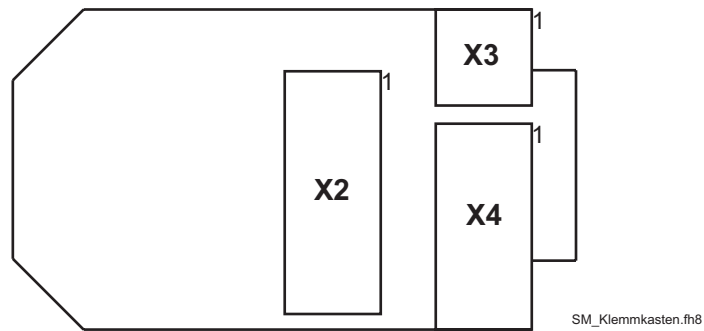


Fig. 2-9: Overview of connections with SM Motor - 2 (connection box)

## X2 - motor

Pin	Designation (lead no.)	Meaning	Range	Max. cross section
1	U (1)		3 AC 0 - 480 V	2.5 mm <sup>2</sup>
2	V (2)		3 AC 0 - 480 V	2.5 mm <sup>2</sup>
3	W (3)		3 AC 0 - 480 V	2.5 mm <sup>2</sup>
4	PE	motor earth conductor		2.5 mm <sup>2</sup>

Table 2-11: Connection X2 - SM motor



**NOTE**

For SM 140 XX 120 and SM 140 XX 210, the X2 connector plug has a different shape and size.  
 For SM 140 XX 290 and SM 140 XX 370, X2 is a screw clamp, so that also a motor cable with 4 mm<sup>2</sup> can be connected.

**X3 - brake / motor temperature**

Pin	Designation (lead no.)	Meaning	Range	Max. cross section
1	temp (5)	PTC motor temperature		1.5 mm <sup>2</sup>
2	temp (6)	PTC motortemperature		1.5 mm <sup>2</sup>
3	br- (7)	holding brake	DC 0 V	1.5 mm <sup>2</sup>
4	br+ (8)	holding brake	DC 24 V	1.5 mm <sup>2</sup>

Table 2-12: Connection X3 - SM motor



**NOTE**

For SM motors SM 140 or higher, the X3 has a different size.



**CAUTION!**

Poles may be interchanged on the connector plug!  
 Motor may be damaged!

- Make sure the pin numbers are allocated correctly!

**X4 - encoder (SinCos)**

Pin	Designation	Meaning	Range	Max. cross section
1	Us	supply voltage	DC 7 - 12 V	0.25 mm <sup>2</sup>
2	GND	supply voltage	DC 0 V	0.25 mm <sup>2</sup>
3	REFSIN	sinus reference signal		0.25 mm <sup>2</sup>
4	SIN	sinus trace		0.25 mm <sup>2</sup>
5	REFCOS	cosine reference signal		0.25 mm <sup>2</sup>
6	COS	cosine trace		0.25 mm <sup>2</sup>
7	RS485-	parameter channel -		0.25 mm <sup>2</sup>
8	RS485+	parameter channel +		0.25 mm <sup>2</sup>

Table 2-13: Connection X4 - SM motor (SinCos encoder)



**CAUTION!**

Poles may be interchanged on the connector plug!  
 Motor may be damaged!

- Make sure the pin numbers are allocated correctly!

**X4 - encoder (Resolver)**

Pin	Designation	Meaning	Range	Max. cross section
1		reserves		0.25 mm <sup>2</sup>
2		reserves		0.25 mm <sup>2</sup>
3	SIN -	Sinus -		0.25 mm <sup>2</sup>
4	SIN +	Sinus +		0.25 mm <sup>2</sup>
5	COS -	Cosinus -		0.25 mm <sup>2</sup>
6	COS +	Cosinus +		0.25 mm <sup>2</sup>
7	EXCT -	exciter signal -		0.25 mm <sup>2</sup>
8	EXCT +	exciter signal +		0.25 mm <sup>2</sup>

Table 2-14: Connection X4 - SM motor (Resolver)



**CAUTION!**

Poles may be interchanged on the connector plug!  
 Motor may be damaged!

- Make sure the pin numbers are allocated correctly!

**SM Motor with surface ventilation**

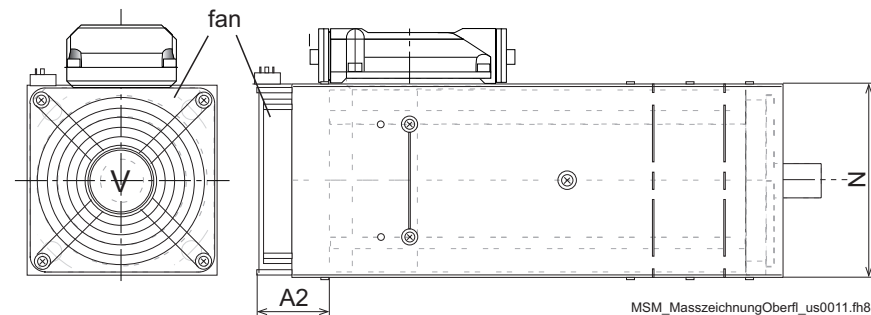


Fig. 2-10: Dimensional drawing of SM-Motor with surface ventilation

If an SM Motor has surface ventilation, the motor gets longer. Add the size A2 to the size A of the „standard motor“.

SM motor	Size A2	Size N	Unit
SM 070	approx. 59 (2.32)	approx. 110 (4.33)	[mm] ([inch])
SM 100	approx. 59 (2.32)	approx. 145 (5.71)	[mm] ([inch])
SM 140	approx. 70 (2.76)	approx. 170 (6.69)	[mm] ([inch])

Table 2-15: Dimensions of SM Motor with surface ventilation



### Sizes SP 060 and SP 075

Size		SP 060		SP 075	
Number of gears		1	2	1	2
D1	g6	60	60	70	70
D2		30	30	38	38
D3	k6	16	16	22	22
D4	4x	5.5	5.5	6.6	6.6
D5		68	68	85	85
D6	F7	14	14	19	19
D7		measure depends on the motor			
D8		measure depends on the motor			
D9		measure depends on the motor			
D10		58.5	58.5	74	74
L1	+/- 2	129	149	156	182.5
L2		28	28	36	36
L3		20	20	20	20
L4		6	6	7	7
L5		60	80	71	97.5
L6	min. max.	15 30	15 30	23 40	23 40
L7	+0.5	4	4	4	4
L8		9.4	9.4	14	14
L9		9	9	12	12
L10		44	64	51	77.5
L11	+/- 1	62	62	76	76
L12		2	2	2	2
L13	+/- 1	60	60	80	80
L14*		25	25	32	32
L15		2	2	2	2
L16	h9	5	5	6	6
L17		18	18	24.5	24.5
L18**		10	10	12	12
L19		48.3	68.3	57	83.5
L20		-	-	-	-
a		0.025	0.025	0.025	0.025
B		8	8	15	15
C		1xM6	1xM6	1xM8x1	1xM8x1
D		-		-	
E		feather groove according to DIN 6885 sheet 1, form A			
M		M5	M5	M8	M8
t		12.5	12.5	19	19

Table 2-16: Gearbox dimensions

\* (on L14) In case of reversing operation and high gear strain, we recommend smooth drive shafts.

\*\* (on L18) The dimensions may differ in case of very small motors.

**Sizes SP 100, SP 140 und SP 180**

Size		SP 100		SP 140		SP 180	
Number of gears		1	2	1	2	1	2
D1	g6	90	90	130	130	160	160
D2		55	55	70	70	90	90
D3	k6	32	32	40	40	55	55
D4	4x	9	9	11	11	13	13
D5		120	120	165	165	215	215
D6	F7	28	28	35	35	48	48
D7		measure depends on the motor					
D8		measure depends on the motor					
D9		measure depends on the motor					
D10		99	99	124	124	180	180
L1	+/- 2	202	234.5	256.5	296.5	297	315.5
L2		58	58	82	82	82	82
L3		30	30	30	30	30	30
L4		10	10	12	12	15	15
L5		76	108.5	102	142	132.5	158
L6	min. max.	30	30	32	32	45	45
		50	50	60	60	82	82
L7	+0,5	5	5	6	6	6	6
L8		18	18	18	18	24.5	18
L9		19	19	21	21	25	21
L10		50	82.5	66.5	106.5	84.5	122.5
L11	+/- 1	101	101	141	141	182	182
L12		2	2	3	3	3	3
L13	+/- 1	100	100	140	140	190	140
L14*		50	50	70	70	70	70
L15		4	4	5	5	6	6
L16	h9	10	10	12	12	16	16
L17		35	35	43	43	59	59
L18**		17	17	19	19	26	19
L19		57	89.5	74.5	114.5	100.5	130.5
L20		5	5	6	6	12	12
L21		28	28	30.5	30.5	37.5	30.5
a		0.025	0.025	0.04	0.04	0.04	0.04
B		18	18	20	20	20	20
C		3xM12x1.5		3xM12x1.5		3xM12x1.5	
D		1xM8x1		1xM8x1		1xM8x1	
E		feather groove according to DIN 6885 sheet 1, form A					
M		M12	M12	M16	M16	M20	M20
t		28	28	36	36	42	42

Table 2-17: Gearbox dimensions

\* (on L14) In case of reversing operation and high gear strain, we recommend smooth drive shafts.

\*\* (on L18) The dimensions may differ in case of very small motors.



## SM Motor

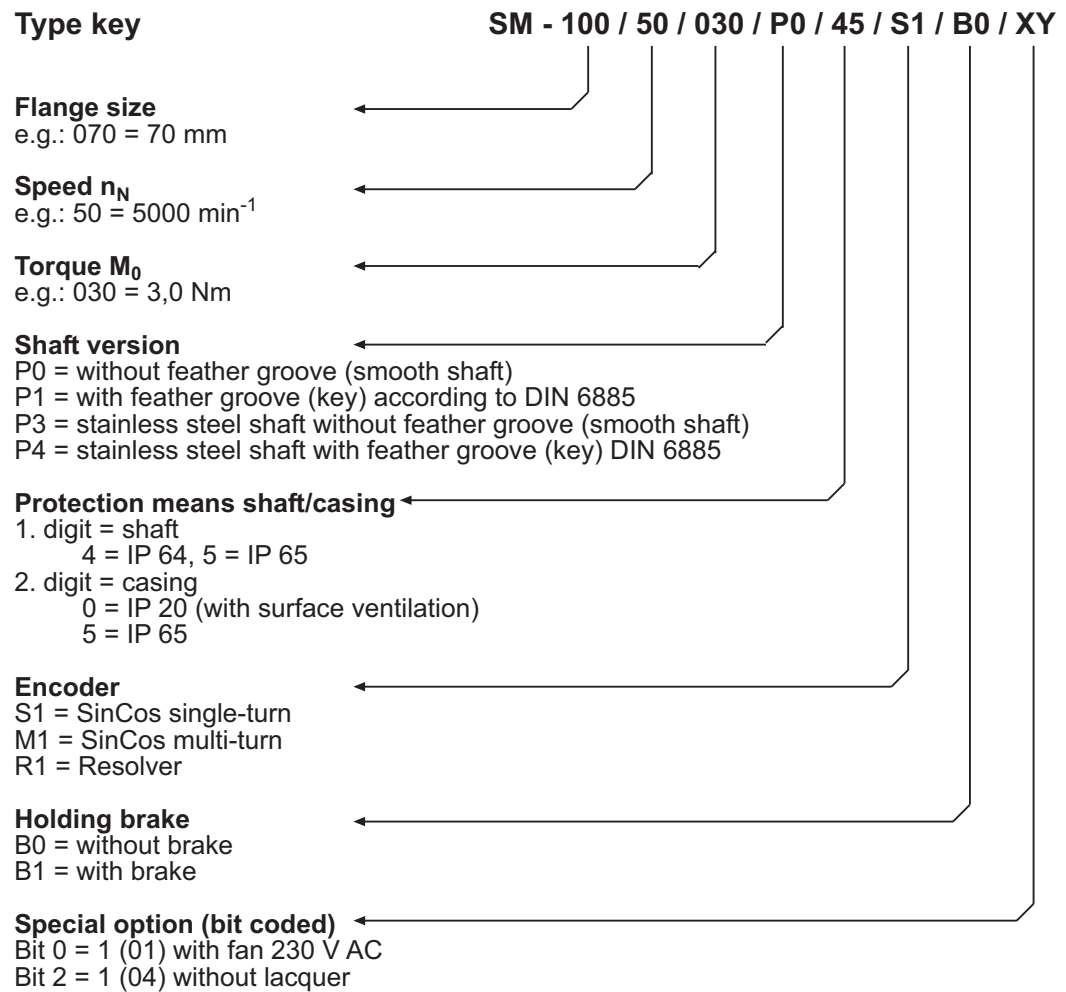


Fig. 2-12: Type key legend for SM motor

