



torque motors

1FW6



SIEMENS

Synchronous motors

Torque motors for SINAMICS S120

1FW6 standard type built-in torque motors Water cooling

Overview



1FW6 built-in torque motors are liquid-cooled, multi-pole permanently excited AC synchronous motors with hollow-shaft rotor. The 1FW6 motors are supplied as built-in components that are held together in the delivered state by transport locks. For a complete drive unit, an additional bearing and shaft encoder are required.

Each frame size is available in 4 axis lengths. The stator and rotor are equipped with flanges at each end with centering surfaces and threaded holes for installation in the machine.

Please note that when 1FW6 direct motors (torque motors) are used in fork heads for machine tools or robots, a license for US patent US5584621 and the associated international patent protection may be required.

Benefits

- No elasticity in the drive train
- High availability, since there are no gear components subject to wear in the drive train
- High torque for a compact design and small size
- Low moment of inertia
- Direct coupling to the machine using flanges

Application

In conjunction with the SINAMICS S120 drive system, the built-in torque motors can be used as direct drive for the following machine applications:

- Rotary indexing machines, rotary tables, swivel axes
- Rotary axes (A, B, C axis in 5-axis machine tools)
- Turret indexing and cylinder indexing for single-spindle and multi-spindle machines
- Dynamic tool magazines
- Rotating spindles in milling machines
- Roller drives and cylinder drives
- Handling

Design

The 1FW6 built-in torque motor comprises the following components:

Stator

Iron core with a 3-phase AC winding. To improve dissipation of the heat loss, the motor should be force-cooled by means of a liquid cooler (main cooler).

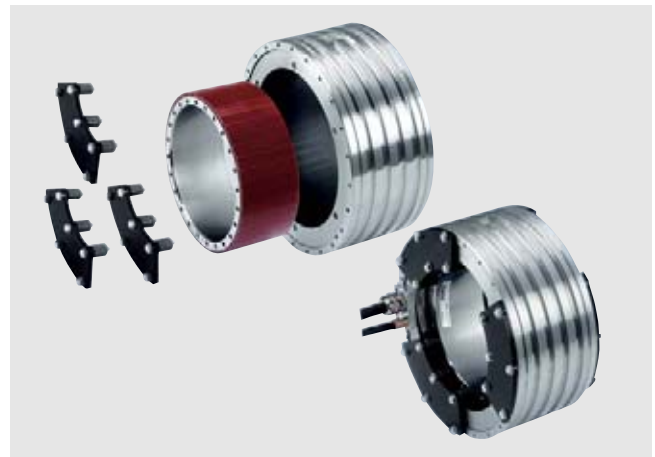
Rotor

Cylindrical hollow shaft made of steel with permanent magnets fixed to the circumference.

If the main cooler and precision cooler are used together in a heat exchanger, a cooling connection adapter (accessory) can be ordered separately for easy connection.

Cooler types

- Motors with jacket cooling
The coolant inlet and outlet must be provided by the machine manufacturer in the surrounding construction.



Motor components of sizes 1FW6090/1FW6130 with jacket cooling (transport locks, rotor, stator)

- Motors with integrated cooling
These motors feature a ready-to-connect, integrated dual-circuit cooling system and are therefore thermally insulated against the mechanical axis construction to a considerable extent.



Motor components of sizes 1FW6160 to 1FW6290 with integrated cooling (transport locks, rotor, stator)

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Water cooling

Design (continued)

The design of the cooler system is dependent on the size (external diameter) of the motor.

Motor type	Cooling method
1FW6090/1FW6130	Jacket cooling
1FW6160 to 1FW6290	Integrated cooling

Integration

The motors which must be fed from the SINAMICS S120 drive system are designed for operation on a 600 V DC-link voltage level and require a sinusoidal current.

The 1FW6 built-in torque motors are supplied with one power cable and one signal cable (temperature sensors) with free cable ends, 2 m (6.56 ft) in length.

The cable connection protrudes from the front face of the stator and the free cable end must be connected to a terminal box provided by the machine manufacturer. The length of the power and signal cables from the motor to the drive system must not exceed 50 m (164 ft).

Technical specifications

Product name	1FW6 built-in torque motors
Type of motor	Synchronous motor with permanent magnet rotor, multi-pole (rotor pole number from 44 to 98)
Max. motor voltage (stabilized terminal voltage)	720 V 3 AC
Torque ripple	≤ 1.5% M_0
Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class F for a coolant inlet temperature of 40 °C (104 °F)
Type (cf. ISO)	Individual components: Stator, rotor
Degree of protection in accordance with IEC 60034-5	IP21
Coolant inlet temperature, max.	35°C (95 °F)
Pressure in cooling circuit, max.	10 bar (static)
Temperature monitoring	2 x PTC thermistor drilled hole with response threshold 130/150 °C (266/302 °F) (DIN 44081/44082) and 1 x KTY84 thermistor (IEC 34-11) in the stator
Paint finish	No paint finish
Encoder system (not included in scope of supply)	The encoder must be selected according to the mechanical and converter-specific boundary conditions
Connection, electrical	Free cable ends with $l = 2$ m (6.56 ft) for power connection and sensor connection
Option	Power and signal cables (for connecting to the SME91 module) with connector

1FW6 standard type built-in torque motors
SME91 Sensor Module External

Overview



The SME91 Sensor Module External enables motor and position encoder sensors to be connected in the vicinity of the motor in the case of drives with built-in motors. The SME91 is responsible for protecting the motor and outputting the current operating temperature/overtemperature to the drive/converter system without time delay.

Benefits

- Motor protection
- Fault-free transmission to the drive/converter system
- Low cabling overhead
- PU-molded PCB in the housing, making the module extremely rugged and suitable for direct use in the machine

Application

The SME91 is suitable for 1FN linear motors and 1FW6 torque motors to which external position measuring systems and commutation equipment cannot be connected for reasons of space.

Integration

The SME91 Sensor Module External for 1FN1/1FN3 linear motors and 1FW6 torque motors can be used on the SINAMICS S120 drive system via SMC20 or on the SIMODRIVE 611 converter system.

Technical specifications

Product name	SME91 Sensor Module External
Degree of protection in accordance with EN 60529 (IEC 60529)	IP67
Permissible air humidity in accordance with DIN 40040	5 ... 85% (without condensation)
Weight, approx.	0.721 kg (1.59 lb)
Dimensions (W x H x D) (without sockets or cable gland)	150 mm x 64 mm x 34 mm (5.91 in x 2.52 in x 1.34 in)

Selection and Ordering Data

Designation	Order No.
SME91 Sensor Module External for connecting an absolute position measuring system	1FN1910-0AA20-1AA0
• 1 x connection for temperature sensors, 7-pole	

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Water cooling

Selection and Ordering Data

Maximum torque	Static torque 1) 3)	Rated torque 2) 3)	Max. speed at maximum torque 2)	Max. speed at rated torque 2)	1FW6 built-in torque motors	Moment of inertia of rotor	Weight, approx. stator + rotor
M_{max}	M_0	M_{rated}	n_{max} at M_{max}	n_{max} at M_{rated}	Order No.	J	m
Nm (lb _f -in)	Nm (lb _f -in)	Nm (lb _f -in)	rpm	rpm	Standard type	kgm ² (lb _f -in-s ²)	kg (lb)
179 (1584.3)	119 (1053.3)	113 (1000.1)	46	140	1FW6090-0 P B05-0FC2	0.0152 (0.1345)	9.2 (20.3)
		109 (964.7)	140	250	1FW6090-0 P B05-0KC2	0.0152 (0.1345)	9.2 (20.3)
251 (2221.6)	166 (1469.2)	154 (1363)	120	220	1FW6090-0 P B07-0KC2	0.022 (0.1947)	12.2 (26.9)
		142 (1256.8)	270	430	1FW6090-0 P B07-1JC2	0.022 (0.1947)	12.2 (26.9)
358 (3168.6)	238 (2106.5)	231 (2044.5)	8.7	82	1FW6090-0 P B10-0KC2	0.0309 (0.2735)	17.2 (37.9)
		216 (1911.8)	170	270	1FW6090-0 P B10-1JC2	0.0309 (0.2735)	17.2 (37.9)
537 (4752.9)	357 (3159.7)	338 (2991.6)	78	150	1FW6090-0 P B15-1JC2	0.0465 (0.4115)	27.2 (60)
		319 (2823.4)	200	310	1FW6090-0 P B15-2JC2	0.0465 (0.4115)	27.2 (60)
439 (3885.5)	258 (2283.5)	241 (2133)	47	130	1FW6130-0 P B05-0KC2	0.0637 (0.5637)	13.2 (29.1)
		217 (1920.6)	180	310	1FW6130-0 P B05-1JC2	0.0637 (0.5637)	13.2 (29.1)
614 (5434.4)	361 (3195.1)	344 (3044.7)	21	96	1FW6130-0 P B07-0KC2	0.0892 (0.7894)	18.2 (40.1)
		324 (2867.7)	110	200	1FW6130-0 P B07-1JC2	0.0892 (0.7894)	18.2 (40.1)
878 (7771)	516 (4567)	484 (4283.8)	50	120	1FW6130-0 P B10-1JC2	0.127 (1.1239)	25.2 (55.6)
		450 (3982.9)	150	250	1FW6130-0 P B10-2JC2	0.127 (1.1239)	25.2 (55.6)
1320 (11683.1)	775 (6859.4)	744 (6585)	14	78	1FW6130-0 P B15-1JC2	0.191 (1.6903)	38.2 (84.2)
		714 (6319.5)	77	150	1FW6130-0 P B15-2JC2	0.191 (1.6903)	38.2 (84.2)

Cooling method:

Jacket cooling (only for 1FW6090/1FW6130), axial cable outlet

P

Dimension drawings

For motor	Dimensions in mm (in)				
Type	D ₁	D ₂	D ₃	L ₁	L ₂
1FW6, type IM B5, water cooling					
1FW6090-0.B05	230 (9.06)	140 (5.51)	170 (6.69)	90 (3.54)	51 (2.01)
1FW6090-0.B07	230 (9.06)	140 (5.51)	170 (6.69)	110 (4.33)	71 (2.8)
1FW6090-0.B10	230 (9.06)	140 (5.51)	170 (6.69)	140 (5.51)	101 (3.98)
1FW6090-0.B15	230 (9.06)	140 (5.51)	170 (6.69)	190 (7.48)	151 (5.94)
1FW6130-0.B05	310 (12.2)	220 (8.66)	254 (10.0)	90 (3.54)	51 (2.01)
1FW6130-0.B07	310 (12.2)	220 (8.66)	254 (10.0)	110 (4.33)	71 (2.8)
1FW6130-0.B10	310 (12.2)	220 (8.66)	254 (10.0)	140 (5.51)	101 (3.98)
1FW6130-0.B15	310 (12.2)	220 (8.66)	254 (10.0)	190 (7.48)	151 (5.94)
1FW6160-0.B05	440 (17.32)	280 (11.02)	328 (12.91)	110 (4.33)	60 (2.36)
1FW6160-0.B07	440 (17.32)	280 (11.02)	328 (12.91)	130 (5.12)	80 (3.15)
1FW6160-0.B10	440 (17.32)	280 (11.02)	328 (12.91)	160 (6.3)	110 (4.33)
1FW6160-0.B15	440 (17.32)	280 (11.02)	328 (12.91)	210 (8.27)	160 (6.3)
1FW6190-0.B05	502 (19.76)	342 (13.46)	389 (15.31)	110 (4.33)	60 (2.36)
1FW6190-0.B07	502 (19.76)	342 (13.46)	389 (15.31)	130 (5.12)	80 (3.15)
1FW6190-0.B10	502 (19.76)	342 (13.46)	389 (15.31)	160 (6.3)	110 (4.33)
1FW6190-0.B15	502 (19.76)	342 (13.46)	389 (15.31)	210 (8.27)	160 (6.3)
1FW6230-0.B05	576 (22.68)	416 (16.38)	463 (18.23)	110 (4.33)	60 (2.36)
1FW6230-0.B07	576 (22.68)	416 (16.38)	463 (18.23)	130 (5.12)	80 (3.15)
1FW6230-0.B10	576 (22.68)	416 (16.38)	463 (18.23)	160 (6.3)	110 (4.33)
1FW6230-0.B15	576 (22.68)	416 (16.38)	463 (18.23)	210 (8.27)	160 (6.3)
1FW6290-0.B15	730 (28.74)	522 (20.55)	580 (22.83)	220 (8.66)	170 (6.69)

Synchronous motors

Torque motors for SINAMICS S120

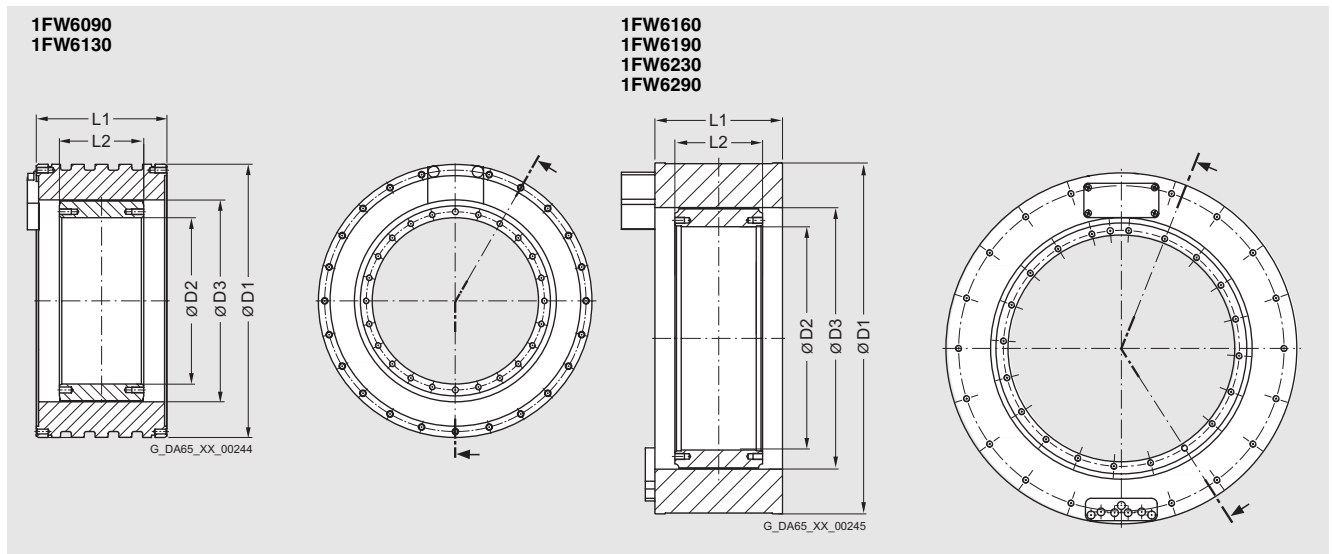
1FW6 standard type built-in torque motors
Water cooling

Selection and Ordering Data

Motor type (continued)	Static current 1) 3)	Rated current 2) 3)	Maximum current ²⁾	Calculated power $P_{el, max}$	SINAMICS Motor Module		Power cable with complete shield		
					Required rated current	Order No. For complete Order No., see "SINAMICS S120 drive system".	Cable cross-section		Order No.
					I_{rated}/I_{max}		Motor mm ²	Sensor mm ²	
	A	A	A	kW (HP)	A				
1FW6090-OPB05-0F..	5.9	5.6	9.5	6.55 (8.78)	5/10 ⁴⁾	6SL312 ■ - ■ TE15-0A..	Pre-assembled cables available soon.		
1FW6090-OPB05-0K..	8.2	7.4	13	8.12 (10.88)	9/18	6SL312 ■ - ■ TE21-0A..			
1FW6090-OPB07-0K..	10	9.5	16	10.3 (13.81)	9/18 ⁴⁾	6SL312 ■ - ■ TE21-0A..			
1FW6090-OPB07-1J..	16	13	26	14.1 (18.9)	18/36	6SL312 ■ - ■ TE21-8A..			
1FW6090-OPB10-0K..	8.2	7.9	13	9.43 (12.64)	9/18	6SL312 ■ - ■ TE21-0A..			
1FW6090-OPB10-1J..	16	14	26	15.3 (20.51)	18/36	6SL312 ■ - ■ TE21-8A..			
1FW6090-OPB15-1J..	16	15	26	17.1 (22.92)	18/36	6SL312 ■ - ■ TE21-8A..			
1FW6090-OPB15-2J..	26	23	43	24.1 (32.31)	30/56	6SL312 ■ - 1 TE23-0A..			
1FW6130-OPB05-0K..	9.7	9	18	12.2 (16.35)	9/18 ⁴⁾	6SL312 ■ - ■ TE21-0A..			
1FW6130-OPB05-1J..	17	14	32	18.3 (24.53)	18/36	6SL312 ■ - ■ TE21-8A..			
1FW6130-OPB07-0K..	10	10	20	14.2 (19.03)	9/18 ⁴⁾	6SL312 ■ - ■ TE21-0A..			
1FW6130-OPB07-1J..	17	15	32	19.7 (26.41)	18/36	6SL312 ■ - ■ TE21-8A..			
1FW6130-OPB10-1J..	17	16	32	21.4 (28.69)	18/36	6SL312 ■ - ■ TE21-8A..			
1FW6130-OPB10-2J..	28	24	53	30.6 (41.02)	30/56	6SL312 ■ - 1 TE23-0A..			
1FW6130-OPB15-1J..	19	18	36	25.4 (34.05)	18/36 ⁴⁾	6SL312 ■ - ■ TE21-8A..			
1FW6130-OPB15-2J..	28	26	54	34.1 (45.71)	30/56	6SL312 ■ - 1 TE23-0A..			

Cooling: Internal air cooling	0
External air cooling	1
Motor Module: Single Motor Module	1
Double Motor Module	2

Dimension drawings



- 1) Torque and current at low speeds.
- 2) The values refer to a supply voltage of 400 V 3 AC ±10% (converter DC link voltage 600 V DC).
- 3) In case of water cooling with inlet temperature of 35 °C (95 °F) and maximum rotor flange temperature of 60 °C (140 °F).
- 4) Selection optimized to Motor Module. The next higher Motor Module offers 100% torque utilization.

Synchronous motors

Torque motors for SINAMICS S120

1FW6 standard type built-in torque motors

Water cooling

Selection and Ordering Data

Maximum torque	Static torque ^{1) 3)}	Rated torque ^{2) 3)}	Max. speed at maximum torque ²⁾	Max. speed at rated torque ²⁾	1FW6 built-in torque motors	Moment of inertia of rotor	Weight, approx. stator + rotor
M_{max}	M_0	M_{rated}	n_{max} at M_{max}	n_{max} at M_{rated}	Order No.	J	m
Nm (lb _f -in)	Nm (lb _f -in)	Nm (lb _f -in)	rpm	rpm	Standard type	kgm ² (lb _f -in-s ²)	kg (lb)
716 (6337.2)	467 (4133.3)	431 (3814.7)	84	140	1FW6160-0 ■ B05-1JC2	0.19 (1.6815)	36.3 (80)
		404 (3575.7)	150	250	1FW6160-0 ■ B05-2JC2	0.19 (1.6815)	36.3 (80)
1000 (8850.8)	653 (5779.6)	620 (5487.5)	53	96	1FW6160-0 ■ B07-1JC2	0.258 (2.2833)	48.3 (106.5)
		594 (5257.4)	100	170	1FW6160-0 ■ B07-2JC2	0.258 (2.2833)	48.3 (106.5)
1430 (12656.6)	933 (8257.8)	903 (7992.3)	29	60	1FW6160-0 ■ B10-1JC2	0.36 (3.1859)	66.3 (146.2)
		878 (7771)	65	110	1FW6160-0 ■ B10-2JC2	0.36 (3.1859)	66.3 (146.2)
2150 (19029.2)	1400 (12391.1)	1350 (11948.6)	34	66	1FW6160-0 ■ B15-2JC2	0.531 (4.6993)	95.3 (210.1)
		1280 (11329)	97	160	1FW6160-0 ■ B15-5GC2	0.531 (4.6993)	95.3 (210.1)
990 (8762.3)	672 (5947.7)	633 (5602.6)	54	97	1FW6190-0 ■ B05-1JC2	0.358 (3.1682)	42.8 (94.4)
		605 (5354.7)	96	160	1FW6190-0 ■ B05-2JC2	0.358 (3.1682)	42.8 (94.4)
1390 (12302.6)	941 (8328.6)	905 (8010)	33	63	1FW6190-0 ■ B07-1JC2	0.468 (4.1417)	55.8 (123)
		879 (7779.9)	64	110	1FW6190-0 ■ B07-2JC2	0.468 (4.1417)	55.8 (123)
1980 (17524.6)	1340 (11860.1)	1310 (11594.6)	14	38	1FW6190-0 ■ B10-1JC2	0.678 (6.0002)	75.8 (167.1)
		1290 (11417.5)	39	70	1FW6190-0 ■ B10-2JC2	0.678 (6.0002)	75.8 (167.1)
2970 (26286.9)	2020 (17878.6)	1970 (17436.1)	17	40	1FW6190-0 ■ B15-2JC2	0.998 (8.8322)	107.8 (237.7)
		1890 (16728)	62	100	1FW6190-0 ■ B15-5GC2	0.998 (8.8322)	107.8 (237.7)
1320 (11683.1)	841 (7443.5)	799 (7071.8)	34	69	1FW6230-0 ■ B05-1JC2	0.622 (5.5046)	44.8 (98.8)
		774 (6850.5)	59	110	1FW6230-0 ■ B05-2JC2	0.622 (5.5046)	44.8 (98.8)
1840 (16285.5)	1180 (10443.9)	1140 (10089.9)	19	45	1FW6230-0 ■ B07-1JC2	0.843 (7.4604)	58.8 (129.7)
		1120 (9912.9)	38	73	1FW6230-0 ■ B07-2JC2	0.843 (7.4604)	58.8 (129.7)
2630 (23277.6)	1680 (14869.3)	1630 (14426.8)	21	46	1FW6230-0 ■ B10-2JC2	1.18 (10.4428)	81.8 (180.4)
		1520 (13453.2)	74	130	1FW6230-0 ■ B10-5GC2	1.18 (10.4428)	81.8 (180.4)
3950 (34960.7)	2520 (22304)	2440 (21596)	19	43	1FW6230-0 ■ B15-4CC2	1.73 (15.3102)	117.8 (259.8)
		2380 (21064.9)	44	80	1FW6230-0 ■ B15-5GC2	1.73 (15.3102)	117.8 (259.8)
8570 (75851.4)	4760 (42129.8)	4590 (40625.2)	28	53	1FW6290-0 ■ B15-7AC2	4.40 (38.9393)	214.6 (473.2)

Cooling method:

Integrated cooling (only for 1FW6160 to 1FW6290)

Axial cable outlet

Radial cable outlet to outside

W
V

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Water cooling

Selection and Ordering Data

Motor type (continued)	Static current 1) 3)	Rated current 2) 3)	Maxi- mum current 2)	Calculated power	SINAMICS Motor Module		Power cable with complete shield	
	I_0	I_{rated}	I_{max}	$P_{el, max}$	Required rated current	Order No.	Cable cross-section	Order No.
	A	A	A	kW (HP)	I_{rated}/I_{max}	For complete Order No., see "SINAMICS S120 drive system".	Motor mm ²	Sensor mm ²
1FW6 160-0.B05-1J..	17	16	31	15.1 (20.24)	18/36	6SL312 ■ - ■ TE21-8A..	Pre-assembled cables available soon.	
1FW6 160-0.B05-2J..	28	24	49	20 (26.81)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 160-0.B07-1J..	17	16	31	16.7 (22.39)	18/36	6SL312 ■ - ■ TE21-8A..		
1FW6 160-0.B07-2J..	28	25	49	21.8 (29.22)	30/56	6SL312 ■ - 1 TE23-8A..		
1FW6 160-0.B10-1J..	17	17	31	19 (25.47)	18/36	6SL312 ■ - ■ TE21-8A..		
1FW6 160-0.B10-2J..	28	26	49	24.4 (32.71)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 160-0.B15-2J..	28	26	49	28.2 (37.8)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 160-0.B15-5G..	56	50	98	42.6 (57.1)	60/113	6SL312 ■ - 1 TE26-0A..		
1FW6 190-0.B05-1J..	18	17	31	16.3 (21.85)	18/36	6SL312 ■ - ■ TE21-8A..		
1FW6 190-0.B05-2J..	27	24	47	20.6 (27.61)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 190-0.B07-1J..	18	17	31	18.2 (24.4)	18/36	6SL312 ■ - ■ TE21-8A..		
1FW6 190-0.B07-2J..	27	25	47	22.7 (30.43)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 190-0.B10-1J..	18	17	31	20.7 (27.75)	18/36	6SL312 ■ - ■ TE21-8A..		
1FW6 190-0.B10-2J..	27	26	47	25.7 (34.45)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 190-0.B15-2J..	27	26	47	30.1 (40.35)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 190-0.B15-5G..	54	50	95	44.1 (59.12)	60/113	6SL312 ■ - 1 TE26-0A..		
1FW6 230-0.B05-1J..	16	15	31	17.3 (23.19)	18/36	6SL312 ■ - ■ TE21-8A..		
1FW6 230-0.B05-2J..	24	22	45	21 (28.15)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 230-0.B07-1J..	16	16	31	19.4 (26.01)	18/36	6SL312 ■ - ■ TE21-8A..		
1FW6 230-0.B07-2J..	24	22	45	23.6 (31.64)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 230-0.B10-2J..	24	23	45	27.1 (36.33)	30/56	6SL312 ■ - 1 TE23-0A..		
1FW6 230-0.B10-5G..	54	48	100	42 (56.3)	60/113	6SL312 ■ - 1 TE26-0A..		
1FW6 230-0.B15-4C..	33	32	63	38 (50.94)	45/85	6SL312 ■ - 1 TE24-5A..		
1FW6 230-0.B15-5G..	53	49	100	47.4 (63.54)	60/113	6SL312 ■ - 1 TE26-0A..		
1FW6 290-0.B15-7A..	64	61	130	65.2 (87.4)	85/141	6SL312 ■ - 1 TE28-5A..		

Cooling:

Internal air cooling
External air cooling

0
1

Motor Module:

Single Motor Module
Double Motor Module

1
2

Accessories

Designation	Order No.
Cooling connection adapter for	
• Torque motors 1FW6160 to 1FW6230	1FW6160-1BA00-0AA0
• Torque motors 1FW6290	1FW6290-1BA00-0AA0

1) Torque and current at low speeds.

2) The values refer to a supply voltage of 400 V 3 AC ±10% (converter DC link voltage 600 V DC).

3) In case of water cooling with inlet temperature of 35 °C (95 °F) and maximum rotor flange temperature of 60 °C (140 °F).



You can find information about this product at Internet website:



www.siemens.com/torquemotors

You can find your local partner under:

www.siemens.com/automation/partner

Or just mail to our infobox:



info@lms.siemens.de

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