

AC motors

Overview

Technical definitions

Regulations, standards and specifications

The motors comply with the appropriate standards and regulations, see table below.

As a result of the fact that in many countries the national regulations have been completely harmonized with the international IEC 60034-1 recommendation, there are no longer any differences with respect to coolant temperatures, temperature classes and temperature rise limits.

The motors listed below are UL-approved by "Underwriters Laboratories Inc.®" and also comply with Canadian URc standards: 1FK7, 1FT6, 1FT7, 1FW3, 1PH7 (without brake), 1PL6, PH4.

1FS6 EX motors are CSA - approved.

Title	DIN/VDE	DIN IEC
General specifications for rotating electrical machines	DIN VDE 0530 Part 1	DIN IEC 60034-1
Terminal designations and direction of rotation for electrical machines	DIN VDE 0530 Part 8	DIN IEC 60034-8
Types of rotating electrical machines	DIN VDE 0530 Part 7	DIN IEC 60034-7
Cooling methods of rotating electrical machines	DIN VDE 0530 Part 6	DIN IEC 60034-6
Degrees of protection of rotating electrical machines	DIN VDE 0530 Part 5	DIN IEC 60034-5
Vibration severity of rotating electrical machines	DIN VDE 0530 Part 14	DIN IEC 60034-14
Noise limit values for rotating electrical machines	DIN VDE 0530 Part 9	DIN IEC 60034-9
Cylindrical shaft extensions for electrical machines	DIN 748 Part 3	DIN IEC 60072

The most common degrees of protection for AC motors in accordance with IEC 60034-5

A suitable degree of protection must be selected to protect the machine against the following hazards depending on the relevant operating and environmental conditions:

- Ingress of water, dust and solid foreign objects;
- contact with or approach to rotating parts inside a motor and
- contact with or approach to live parts.

Degrees of protection of electric motors are specified by a code. This comprises of 2 letters, 2 digits and, if required, an additional letter.

IP (International Protection)

Code letter designating the degree of protection against contact and the ingress of solid foreign objects and water

0 to 6

1st digit designating the degree of touch protection and protection against ingress of solid foreign objects

0 to 8

2nd digit designating the degree of protection against ingress of water (no oil protection)

W, S and M

Additional code letters for special degrees of protection

Most motors are supplied with the following degrees of protection:

Motor	Degree of protection	1st digit Touch protection	Protection against foreign objects	2nd digit Protection against water
Internally cooled	IP23	Protection against finger contact	Protection against medium-sized, solid foreign above 12 mm (0.47 in) Ø	Protection against spray water up to 60° from the vertical
Surface-cooled	IP54	Complete protection against accidental contact	Protection against harmful dust deposits	Splash water from any direction
	IP55			Jet-water from any direction
	IP64	Complete protection against accidental contact	Protection against dust ingress	Splash water from any direction
	IP65 ¹⁾			Jet-water from any direction
	IP67 ¹⁾			Motor under specified pressure and time conditions under water
IP68 ¹⁾			Motor can be completely submersed in water under conditions which the manufacturer must specify	

¹⁾ DIN VDE 0530 Part 5 or EN 60034 Part 5 specifies that there are only 5 degrees of protection for the first digit code and 8 degrees of protection for the second digit code in relation to rotating electrical machinery. However, IP6 is included in DIN 40050 which generally applies to electrical equipment.

Synchronous motors

1FK7 motors

Overview



1FK7 motors are extremely compact, permanent-magnet synchronous motors. The available options, gearboxes and encoders, together with the expanded product range, mean that the 1FK7 motors can be optimally adapted to any application. They therefore also satisfy the permanently increasing demands of state-of-the-art machine generations.

1FK7 motors can be combined with the SINAMICS S120 drive system to create a powerful system with high functionality. The integrated encoder systems for speed and position control can be selected depending on the application.

The motors are designed for operation without external cooling as the heat is dissipated through the motor surface. 1FK7 motors have a high overload capability.

Benefits

1FK7 Compact motors offer:

- Space-saving installation due to extremely high power density
- For universal applications
- Wide range of motors

1FK7 High Dynamic motors offer:

- Extremely high dynamic response due to low rotor moment of inertia

Applications

- Machine tools
- Robots and manipulators
- Wood, glass, ceramics and stone working
- Packaging, plastics and textile machines
- Auxiliary axes

¹⁾ 1FK701 only available in degree of protection IP54 and anthracite paint finish, no rating plate in NDE cover, planetary gearbox not available.

²⁾ Shaft extension run-out, concentricity of centering ring and shaft, and perpendicularity of flange to shaft.

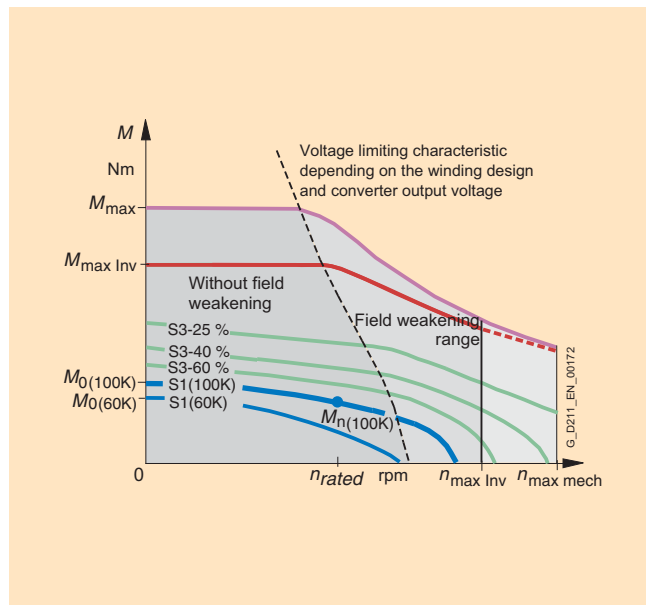
³⁾ Traversing range 4096 revolutions

Technical specifications

Type of motor	Perm.-magnet syn. motor
Magnet material	Rare-earth magnet material
Insulation of the stator winding in accordance with EN 60034-1 (IEC 60034-1)	Temperature class 155 (F) for a winding temperature rise of $\Delta T = 100$ K at an ambient temperature of 40 °C (104 °F)
Cooling	Natural cooling
Temperature monitoring	KTY84 temperature sensor in the stator winding
Type in accordance with EN 60034-7 (IEC 60034-7)	IM B5 (IM V1, IM V3)
Degree of protection ¹⁾ in accord. with EN 60034-5 (IEC 60034-5)	IP64
Shaft extension on the drive end in accordance with DIN 748-3 (IEC 60072-1)	Plain shaft
Shaft and flange accuracy ²⁾ in accordance with DIN 42955 (IEC 60072-1)	Tolerance N
Vibration magnitude in accord. with EN 60034-14 (IEC 60034-14)	Grade A (maintained up to rated speed)
Max. sound pressure level L_{pA} (1 m (3.28 ft)) in accord. with DIN EN ISO 1680	<ul style="list-style-type: none"> • 1FK701 to 1FK704 55 dB • 1FK706 65 dB • 1FK708 to 1FK710 70 dB
Built-in encoder systems for motors without DRIVE-CLiQ interface	<ul style="list-style-type: none"> • Incremental encoder sin/cos 1 V_{pp} 2048 S/R • Absolute encoder, multi-turn, ³⁾ with EnDat interface: <ul style="list-style-type: none"> - 2048 S/R for 1FK704 to 1FK710 - 512 S/R for 1FK701 to 1FK703 - 32 S/R for 1FK704 to 1FK710 - 16 S/R for 1FK701 to 1FK703 • Multi-pole resolver (number of poles corresp. to number of pole pairs of the motor) • 2-pole resolver
Built-in encoder systems for motors with DRIVE-CLiQ interface	<ul style="list-style-type: none"> • 22 bit incremental encoder (2048 S/R internal) • Absolute encoder: <ul style="list-style-type: none"> - 22 bit single-turn (2048 S/R internal) + 12 bit multi-turn ³⁾ for 1FK704 to 1FK710 - 20 bit single-turn (512 S/R internal) + 12 bit multi-turn ³⁾ for 1FK702 to 1FK703 - 16 bit single-turn (32 S/R internal) + 12 bit multi-turn ³⁾ for 1FK704 to 1FK710 - 15 bit single-turn (16 S/R internal) + 12 bit multi-turn ³⁾ for 1FK702 to 1FK703 • 15 bit resolver • 14 bit resolver
Connection	Connectors for signals and power can be rotated (270°)
Paint finish ¹⁾	Unpainted
2nd rating plate ¹⁾	Attached in the NDE cover
3rd rating plate	Enclosed separately
Options ¹⁾	<ul style="list-style-type: none"> • Shaft ext. at the drive end with fitted key and keyway (half-key balancing) • Built-in holding brake • Degree of protection IP65, drive end flange IP67 • Planetary gearbox, assembled (requirement: plain shaft extension, degree of protection IP64 for LP+ and IP65 for SP+) • Anthracite finish RAL 7016

S/R = signals/revolution

Characteristics



Torque characteristic of a synchronous motor operating on a converter with field weakening (example characteristic)

Options

Order code	Option description	1FK7 Compact	1FK7 High Dynamic
M03	Version for Zone 2 hazardous areas (in accordance with EN 50021/IEC 60079-15)	■	■
M39	Version for Zone 22 hazardous areas (in accordance with EN 50281/IEC 61241)	■	■
N05	Non-standard shaft extension (dimensions as for 1FT5 motors)	■	■
N25	Permanent magnet brake instead of spring-operated brake	–	■
K23	Special finish for "Worldwide" climate comprising primer and paint finish (anthracite RAL 7016 paint finish or selectable with Option X0.)	■	■
K24	Primed (unpainted)	■	■
X01	Jet black finish RAL 9005	■	■
X02	Cream finish RAL 9001	■	■
X03	Reseda green finish RAL 6011	■	■
X04	Pebble gray finish RAL 7032	■	■
X05	Sky blue finish RAL 5015	■	■
X06	Light ivory finish RAL 1015	■	■
X08	White aluminum RAL 9006, suitable for food grade applications	■	■
X27	Pearl dark grey RAL 9023 paint finish	■	■

■ Option available

M03**Version for Zone 2 hazardous areas (according to IEC EN 60079-15)**

Combustible or explosive gases or vapors occur only rarely or briefly in Zone 2 areas. The type of protection designation is EEx nA II ("non sparking").

The special conditions for operating 1FK7 motors in Zone 2 areas, in particular the reduction in permissible operating speeds, are described in detail in Appendix 610.40063.01 to the EC Declaration of Conformity 664.20025.21.

M39**Version for Zone 22 hazardous areas (according to IEC EN 61241-1)**

Combustible or potentially explosive dust (non-conductive dust) occurs only rarely or briefly in Zone 22 areas. The type of protection designation is Ex 3D T 150 °C.

The special conditions for operating 1FK7 motors in Zone 22 areas are described in detail in Appendix 610.40071.01 to the EC Declaration of Conformity 664.20031.21.

Note regarding M03 and M39 options:

When used in Zone 2 or Zone 22, 1FK7 motors are only designed for encoder connection through connectors. A version with a DRIVE-CLiQ interface on the motor is not possible. Connection to SINAMICS S120 is only possible via SMC (Sensor Module Cabinet-Mounted).

N05**Non-standard shaft extension (dimensions as for 1FT5 motors)**

1FK7 motors are shipped with the following shaft dimensions that are compatible with 1FT5 motors:

- SH 36: 11 x 23 mm (0.43 x 0.91 in)
- SH 48: 14 x 30 mm (0.55 x 1.18 in)
- SH 63: 19 x 40 mm (0.75 x 1.57 in)
- SH 80: 24 x 50 mm (0.94 x 1.97 in)
- SH 100: 32 x 58 mm (1.26 x 2.28 in)

Note:

1FK7 motors of SH 63 with option N05 do not have a compatible flange with 1FT5 motors of SH 63.

Q90**Food-grade gear oil**

Only for 1FK7 Compact with helical and bevel gears

Synchronous motors

1FK7 Compact motors
Natural cooling

Selection and ordering data

Rated speed	Shaft height	Rated power	Static torque	Rated torque ¹⁾	Rated current	1FK7 Compact synchronous motor Natural cooling	Number of pole pairs	Rotor moment of inertia (without brake)	Weight (without brake)	
n_{rated}	SH	P_{rated} at $\Delta T=100$ K	M_0 at $\Delta T=100$ K	M_{rated} at $\Delta T=100$ K	I_{rated} at $\Delta T=100$ K	Order No.		J	m	
rpm		kW (HP)	Nm (lb _f -ft)	Nm (lb _f -ft)	A			10^{-4} kgm ² (10^{-3} lb _f -in-s ²)	kg (lb)	
2000	100	4.29 (5.75)	27 (19.9)	20.5 (15.1)	9.6	1FK7101-5AC71-1 ■■■	4	79.9 (70.7)	21 (46.3)	
		5.23 (7.01)	36 (26.6)	25 (18.4)	11.5	1FK7103-5AC71-1 ■■■	4	105 (92.9)	29 (63.9)	
		7.75 (10.4)	48 (35.4)	37 (27.3)	16	1FK7105-5AC71-1 ■■■	4	156 (138)	39 (86.2)	
3000	48	0.82 (1.1)	3.0 (2.2)	2.6 (1.9)	1.95	1FK7042-5AF71-1 ■■■	4	3.01 (2.66)	4.9 (10.8)	
		2.29 (3.1)	11 (8.2)	7.3 (5.4)	5.6	1FK7063-5AF71-1 ■■■	4	15.1 (13.3)	11.5 (25.4)	
	63	1.48 (2.0)	6.0 (4.4)	4.7 (3.5)	3.7	1FK7060-5AF71-1 ■■■	4	7.95 (7.04)	7.0 (15.4)	
		2.29 (3.1)	11 (8.2)	7.3 (5.4)	5.6	1FK7063-5AF71-1 ■■■	4	15.1 (13.3)	11.5 (25.4)	
	80	2.14 (2.9)	8.0 (5.9)	6.8 (5.0)	4.4	1FK7080-5AF71-1 ■■■	4	15.0 (13.2)	10 (22.1)	
		3.3 (4.4)	16 (11.8)	10.5 (7.7)	7.4	1FK7103-5AF71-1 ■■■	4	27.3 (24.1)	14 (30.9)	
	100	3.77 (5.1)	18 (13.3)	12.0 (8.8)	8.0	1FK7100-5AF71-1 ■■■	4	55.3 (48.9)	19 (41.9)	
			27 (19.9)	15.5 (11.4)	11.8	1FK7101-5AF71-1 ■■■	4	79.9 (70.7)	21 (46.3)	
		5.37 (7.2) ²⁾	36 (26.6)	20.5 (15.1) ²⁾	16.5 ²⁾	1FK7103-5AF71-1 ■■■	4	105 (92.9)	29 (63.9)	
		8.17 (11.0)	48 (35.4)	26.0 (19.2)	18	1FK7105-5AF71-1 ■■■	4	156 (138)	39 (86.2)	
		4500	63	1.74 (2.3)	6.0 (4.4)	3.7 (2.7)	4.1	1FK7060-5AH71-1 ■■■	4	7.95 (7.04)
	80	2.09 (2.8) ³⁾	11 (8.2)	5.0 (3.7) ³⁾	6.1 ³⁾	1FK7063-5AH71-1 ■■■	4	15.1 (13.3)	11.5 (25.4)	
2.39 (3.2) ³⁾		8.0 (5.9)	5.7 (4.2) ³⁾	5.6 ³⁾	1FK7080-5AH71-1 ■■■	4	15.0 (13.2)	10 (22.1)		
6000	20	3.04 (4.1) ⁴⁾	16 (11.8)	8.3 (6.1) ⁴⁾	9 ⁴⁾	1FK7083-5AH71-1 ■■■	4	27.3 (24.1)	14 (30.9)	
		0.05 (0.1)	0.18 (0.1)	0.08 (0.1)	0.85	1FK7011-5AK71-1 ■■■ 3	4	0.064 (0.06)	0.9 (2.0)	
28	0.10 (0.1)	0.35 (0.3)	0.16 (0.1)	0.85	1FK7015-5AK71-1 ■■■ 3	4	0.083 (0.08)	1.1 (2.4)		
		0.43 (0.6)	0.85 (0.6)	0.6 (0.4)	1.4	1FK7022-5AK71-1 ■■■	3	0.28 (0.25)	1.8 (4.0)	
36	0.50 (0.7)	1.1 (0.8)	0.8 (0.6)	1.3	1FK7032-5AK71-1 ■■■	3	0.61 (0.54)	2.7 (6.0)		
		0.63 (0.8)	1.6 (1.2)	1.0 (0.7)	1.3	1FK7034-5AK71-1 ■■■	3	0.9 (0.80)	3.7 (8.2)	
48	0.69 (0.9)	1.6 (1.2)	1.1 (0.8)	1.7	1FK7040-5AK71-1 ■■■	4	1.69 (1.50)	3.5 (7.7)		
		1.02 (1.4) ⁵⁾	3.0 (2.2)	1.95 (1.4) ⁵⁾	3.1 ⁵⁾	1FK7042-5AK71-1 ■■■	4	3.01 (2.66)	4.9 (10.8)	

Encoder systems for motors
without DRIVE-CLiQ interface:

Incremental encoder sin/cos 1 V_{pp} 2048 S/R
 Absolute encoder EnDat 2048 S/R ¹⁾ (not for 1FK701 to 1FK703)
 Absolute encoder EnDat 512 S/R ¹⁾ (only for 1FK702 to 1FK703)
 Absolute encoder EnDat 32 S/R ¹⁾ (not for 1FK701 to 1FK703)
 Absolute encoder EnDat 16 S/R ¹⁾ (only for 1FK701 to 1FK703)
 Multi-pole resolver
 2-pole resolver

A
E
H
G
J
S
TEncoder systems for motors
with DRIVE-CLiQ interface ⁸⁾:

22 bit incremental encoder
(not for 1FK701)
 22 bit absolute encoder, single-turn + 12 bit multi-turn ¹⁾
(not for 1FK701 to 1FK703)
 20 bit absolute encoder, single-turn + 12 bit multi-turn ¹⁾
(only for 1FK702/1FK703)
 16 bit absolute encoder, single-turn + 12 bit multi-turn ¹⁾
(not for 1FK701 to 1FK703)
 15 bit absolute encoder, single-turn + 12 bit multi-turn ¹⁾
(only for 1FK702/1FK703)
 15 bit resolver (not for 1FK701)
 14 bit resolver (not for 1FK701)

D
F
L
K
V
U
P

Shaft extension:

Fitted key and keyway
 Fitted key and keyway
 Plain shaft
 Plain shaft

Shaft and flange accuracy:

Tolerance N
 Tolerance N
 Tolerance N
 Tolerance N

Holding brake:

without
 with
 without
 with

A
B
G
H

Degree of protection:

IP64 (not for 1FK701)
 IP65 and DE flange IP67 (not for 1FK701)
 IP64 (IP54 for 1FK701) and anthracite paint finish
 IP65 and DE flange IP67, anthracite paint finish (not for 1FK701)
 IP65 and DE flange IP67, anthracite paint finish and
 metal rating plate on motor (not for 1FK701)

0
2
3
5
8

To select the degree of protection and type, see selection guides.

Servomotors

Synchronous motors for SINAMICS S120

1FK7 Compact motors Natural cooling

Selection and ordering data

Rated speed	Shaft height	Rated power	Static torque	Rated torque ¹⁾	Rated current	1FK7 Compact synchronous motor	Number of pole pairs	Moment of inertia of rotor (without brake)	Weight (without brake)
n_{rated}	SH	$P_{\text{rated at } \Delta T=100 \text{ K}}$	M_0 at $\Delta T=100 \text{ K}$	$M_{\text{rated at } \Delta T=100 \text{ K}}$	$I_{\text{rated at } \Delta T=100 \text{ K}}$	Order No.	p	J	m
rpm		kW (HP)	Nm (lb _f -ft)	Nm (lb _f -ft)	A			10 ⁻⁴ kgm ² (10 ⁻³ lb _f -in-s ²)	kg (lb)
Natural cooling									
4500	63	1.74 (2.33)	6 (4.43)	3.7 (2.73)	4.1	1FK7060-5AH71-1 ■ ■ ■	4	7.95 (7.04)	7.0 (15.4)
		2.09 (2.81) ²⁾	11 (8.11)	5 (3.69) ²⁾	6.1 ²⁾	1FK7063-5AH71-1 ■ ■ ■	4	15.1 (13.3)	11.5 (25.4)
	80	2.39 (3.21) ²⁾	8 (5.90)	5.7 (4.20) ²⁾	5.6 ²⁾	1FK7080-5AH71-1 ■ ■ ■	4	15 (13.2)	10 (22.1)
		3.04 (4.08) ³⁾	16 (11.8)	8.3 (6.12) ³⁾	9 ³⁾	1FK7083-5AH71-1 ■ ■ ■	4	27.3 (24.1)	14 (30.9)
6000	20	0.05 (0.07)	0.18 (0.13)	0.08 (0.06)	0.85	1FK7011-5AK71-1 ■ ■ ■ 3	4	0.064 (0.06)	0.9 (2.0)
		0.10 (0.13)	0.35 (0.26)	0.16 (0.12)	0.85	1FK7015-5AK71-1 ■ ■ ■ 3	4	0.083 (0.08)	1.1 (2.4)
	28	0.38 (0.51)	0.85 (0.63)	0.6 (0.44)	1.4	1FK7022-5AK71-1 ■ ■ ■	3	0.28 (0.25)	1.8 (4.0)
	36	0.50 (0.67)	1.1 (0.81)	0.8 (0.59)	1.3	1FK7032-5AK71-1 ■ ■ ■	3	0.61 (0.54)	2.7 (6.0)
		0.63 (0.84)	1.6 (1.18)	1 (0.74)	1.3	1FK7034-5AK71-1 ■ ■ ■	3	0.9 (0.80)	3.7 (8.2)
	48	0.69 (0.93)	1.6 (1.18)	1.1 (0.81)	1.7	1FK7040-5AK71-1 ■ ■ ■	4	1.69 (1.50)	3.5 (7.7)
		1.02 (1.37) ⁴⁾	3 (2.21)	1.95 (1.44) ⁴⁾	3.1 ⁴⁾	1FK7042-5AK71-1 ■ ■ ■	4	3.01 (2.66)	4.9 (10.8)
Encoder systems for motors without DRIVE-CLiQ interface:		IC2048S/R encoder				A			
		AM2048S/R encoder (not for 1FK701 ... 1FK703) ¹⁾				E			
		AM512S/R encoder (only for 1FK702/1FK703) ¹⁾				H			
		AM32S/R encoder (not for 1FK701 ... 1FK703) ¹⁾				G			
		AM16S/R encoder (only for 1FK701 ... 1FK703) ¹⁾				J			
		Multi-pole resolver				S			
		2-pole resolver				T			
Encoder systems for motors with DRIVE-CLiQ interface:⁵⁾		IC22DQ encoder (not for 1FK701)				D			
		AM22DQ encoder (not for 1FK701 ... 1FK703) ¹⁾				F			
		AM20DQ encoder (only for 1FK702/1FK703) ¹⁾				L			
		AM16DQ encoder (not for 1FK701 ... 1FK703) ¹⁾				K			
		AM15DQ encoder (only for 1FK702/1FK703) ¹⁾				V			
		R15DQ resolver (not for 1FK701)				U			
		R14DQ resolver (not for 1FK701)				P			
Shaft extension:		Shaft and flange accuracy:		Holding brake:					
Fitted key and keyway		Tolerance N		Without		A			
Fitted key and keyway		Tolerance N		With		B			
Plain shaft		Tolerance N		Without		G			
Plain shaft		Tolerance N		With		H			
Degree of protection:		IP64 (not for 1FK701)				0			
		IP65 and DE flange IP67 (not for 1FK701)				2			
		IP64 (IP54 for 1FK701) and anthracite paint finish				3			
		IP65, DE flange IP67 and anthracite paint finish (not for 1FK701)				5			

To select the type of construction and degree of protection, see Technical definitions.