

linear motors

1FN1/1FN3



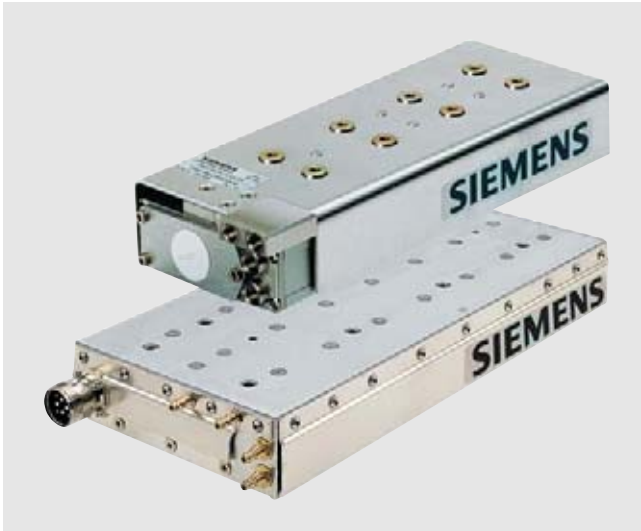
SIEMENS

Synchronous motors

Linear motors for SINAMICS S120

1FN1/1FN3 linear motors
Water cooling

Overview



In combination with the SINAMICS S120, 1FN1/1FN3 linear motors provide an optimally tuned linear direct drive system for the requirements of modern machine construction.

The motors comprise a primary section and a secondary section with magnets made of rare-earth material. The primary section has fixed dimensions, while the secondary section is made up of individual elements (segments) to suit the required traversing range. Through parallel operation of the motors, feedrate force and length can be scaled beyond the available spectrum.

Benefits

- Outstanding dynamic response and very high traversing velocity
- Excellent precision
- Simple installation
- Drive components are free of wear thanks to contactless drive force transmission

The main advantage of linear direct drive technology is the extensive avoidance of the effects of elasticity, play, and friction, as well as natural oscillation in the drive train. This results in a higher dynamic response and increased precision. If suitable measuring systems are used and the temperature conditions are appropriate, the motors can be positioned in the nanometer range.

Design

The simple mechanical construction without transmission elements, such as ballscrew, coupling or belt, enhances the reliability of the drive components.

Heat loss occurs almost exclusively in the primary section and is dissipated via an integrated liquid cooling system. The Thermo-Sandwich dual-circuit cooling system (integral in 1FN1, optional for 1FN3) permits both a thermal decoupling of the motor from the machine, and also a low-cost cooling concept.

The stainless metal encapsulation of the primary section ensure the high mechanical ruggedness and resistance to soiling required for use in machine tools, as well as high resistance to corrosive liquids. In addition, the motor places minimal demands on the preparation of mounting surfaces thanks to the large air gap. The mounting tolerances for the air gap are ± 0.3 mm (0.012 in).

Construction variants

1FN linear motors are available as single-sided or double-sided motors.

- Single-sided motors
The single-sided version consists of a primary section with standard winding that is mounted parallel to the associated secondary section.
- Double-sided motors
The secondary section of the double-sided version lies between two primary sections (one primary section with standard winding and one with complementary winding). The construction as double-sided motor is particularly suitable for applications with movable secondary section and small traversing paths with fast acceleration (e.g. non-circular machining).

Application 1FN1 linear motors

- Grinding
- Ultra-precision machining

Application 1FN3 linear motors

Version for peak loads

Used in connection with machine axes that are accelerated for a short time (e.g. S3 operation), or if high power is required for short intervals.

Typical applications:

- High-dynamic and flexible machine tool construction
- Laser machining
- Handling

Version for continuous load

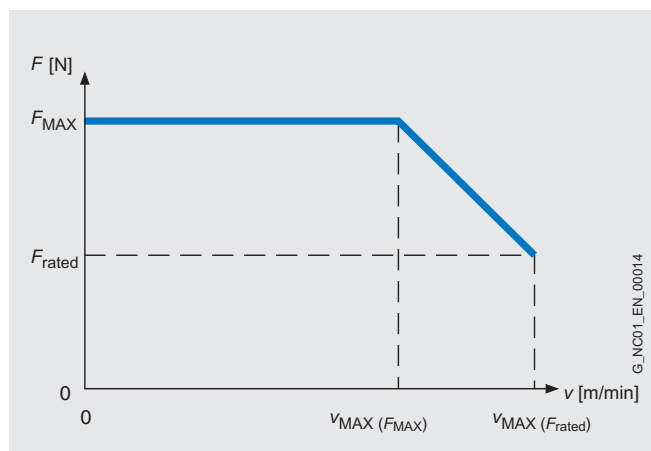
Used in connection with machine axes with constant changing of acceleration (e.g. S1 operation), with high process/weight forces or in operation without water cooling.

Typical applications:

- Non-circular machining
- Vertical axes without counterweight, quills
- Handling, cartesian robots

Technical specifications

The 1FN1/1FN3 linear motors have an overload range available for acceleration processes. The maximum force F_{MAX} can only be utilized up to a maximum velocity $v_{MAX(F_{MAX})}$; up to velocity $v_{MAX(F_{rated})}$, only the feedrate force F_{rated} is available.



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Technical specifications

Product name	1FN1 linear motors	1FN3 linear motors
Type of motor	Permanently excited synchronous linear motor	
Magnet material	Rare-earth magnet material	
Insulation of stator winding in accordance with EN (IEC) 60034-1	Temperature class F for a winding temperature of 130 °C (266 °F) for 1FN1072 to 1FN1126 140 °C (284 °F) for 1FN1184 to 1FN1246	120 °C (248 °F)
Overload ratio ($F_{MAX}:F_{rated}$) up to max.	2.25	2.75
Degree of protection in accordance with EN 60034-5 (IEC 60034-5)	IP65	
Cooling method	Water cooling	
Water cooler connections	Fast-fit connector for all primary section coolers	G 1/8 internal thread on all primary and secondary section coolers
Temperature influence on surrounding construction with precision cooling, max.	+2 K	+4 K
Permissible coolant inlet temperature	35 °C (95 °F) (prevent condensation) > 35 °C (95 °F) with reduction of rated motor force	
Temperature monitoring integrated in the primary section winding	Temperature switch (NC contact) KTY 84 temperature sensor	2 monitoring circuits (Temp-S with PTC thermistor) and Temp-F with KTY 84 temperature sensor (for 1FN3050, Temp-S only)
Available configurations	–	Different gradations thanks to modular construction
Cover for secondary section	Segmented, non-exchangeable	Exchangeable through all segments or segment by segment
2nd rating plate	Enclosed separately	
Recommended measuring systems	See "Overview of Measuring Systems"	
Type of connection	Connectors or cable outlet for power and temperature monitoring	Terminal box with cable gland Optional: accessory for connector and cable connection

1FN1/1FN3 linear motors Measuring systems

Overview

Recommended linear measuring systems for 1FN linear motors	LC 182/LC 481 absolute encoder EnDat encapsulated	LS 186 incremental encoder sin/cos 1 V _{pp} encapsulated	LS 486 incremental encoder sin/cos 1 V _{pp} encapsulated	LIDA 185/LIDA 485 incremental encoder sin/cos 1 V _{pp} open	Renishaw RG2 incremental encoder sin/cos 1 V _{pp} open	
Signal cycle	μm	20/20	20	20	40/20	20
Max. permissible acceleration in measuring direction	m/s ² (ft/s ²)	50 (164.04)	50 (164.04)	50 (164.04)	200 (656.16) ¹⁾	300 (984.24) ¹⁾
Max. permissible traversing velocity	m/min (ft/min)	120 (393.7)	120 (393.7)	120 (393.7)	480 (1574.78)	300 (984.24)
Maximum measuring length	mm (in)	3040 (119.68)	3040 (119.68)	2040 (80.31)	30,040 (1182.67)	50,000 (1968.50)
Output signal		EnDat/1 V _{pp}	1 V _{pp}	1 V _{pp}	1 V _{pp}	1 V _{pp}

Temperature sensors

In order to monitor the motor temperature, the temperature sensors (Temp-S and Temp-F) are decoupled from the power cable and connected to the SINAMICS S120 via the SME91 module, in conjunction with an SMC20 Sensor Module Cabinet-Mounted.

As with SIMODRIVE 611 digital/universal HRS, the motor temperature can be evaluated with the thermistor motor protection device 3RN1013-1GW10.

The 1FN3050-2W/-1NE/-2NC motors only have Temp-S sensors.

1) Refers to the measuring head.

Synchronous motors

Linear motors for SINAMICS S120

1FN1 standard type linear motors

Water cooling

Selection and Ordering Data

Feedrate force		Maximum velocity ³⁾		1FN1 linear motors Water cooling		Weight approx.		
$F_{rated}^{1)2)}$	F_{MAX}	v_{MAX} at F_{MAX}	v_{MAX} at F_{rated}	Primary section Order No.	Secondary section Order No.	Primary section	Secondary section	
N (lb _f)	N (lb _f)	m/min (ft/min)	m/min (ft/min)			kg (lb)	-0AA0 kg (lb)	-1AA0 kg (lb)
790 (177.6)	1720 (386.7)	97 (318.3)	203 (666.1)	1FN1072-3 A F7 -0AA0	1FN1070-0AA00- AAO	10.1 (22.3)	3 (6.6)	7.5 (16.5)
1580 (355.2)	3450 (775.6)	96 (315)	202 (662.9)	1FN1076-3 A F7 1 -0AA0	1FN1070-0AA00- AAO	17.5 (38.6)	3 (6.6)	7.5 (16.5)
1475 (331.6)	3250 (730.6)	72 (236.3)	163 (534.9)	1FN1122-5 C7 1 -0AA0	1FN1120-0AA00- AAO	23.2 (51.2)	6.8 (15)	15.9 (35.1)
		105 (344.6)	214 (702.2)	1FN1122-5 F7 1 -0AA0				
2200 (494.6)	4850 (1090.3)	89 (292.1)	189 (620.2)	1FN1124-5 C7 1 -0AA0	1FN1120-0AA00- AAO	31.9 (70.3)	6.8 (15)	15.9 (35.1)
		101 (331.3)	208 (682.6)	1FN1124-5 F7 1 -0AA0				
2950 (663.2)	6500 (1461.2)	71 (233)	162 (531.6)	1FN1126-5 C7 1 -0AA0	1FN1120-0AA00- AAO	40.7 (89.7)	6.8 (15)	15.9 (35.1)
		104 (341.3)	213 (699)	1FN1126-5 A F7 1 -0AA0				
3600 (809.3)	7920 (1780.5)	74 (242.8)	162 (531.6)	1FN1184-5 A C7 1 -0AA0	1FN1180-0AA00- AAO	44.5 (98.1)	10 (22.1)	23.3 (51.4)
		100 (328.2)	204 (669.4)	1FN1184-5 A F7 1 -0AA0				
4800 (1079)	10600 (2382.9)	68 (223.1)	152 (498.8)	1FN1186-5 A C7 1 -0AA0	1FN1180-0AA00- AAO	57.7 (127.2)	10 (22.1)	23.3 (51.4)
		100 (328.2)	204 (669.4)	1FN1186-5 A F7 1 -0AA0				
4950 (1112.8)	10900 (2450.3)	65 (213.3)	149 (488.9)	1FN1244-5 A C7 1 -0AA0	1FN1240-0AA00- AAO	60.1 (132.5)	11.9 (26.2)	27.7 (61.1)
		100 (328.2)	203 (666.1)	1FN1244-5 A F7 1 -0AA0				
6600 (1483.7)	14500 (3259.6)	67 (219.9)	151 (495.5)	1FN1246-5 A C7 1 -0AA0	1FN1240-0AA00- AAO	76 (167.6)	11.9 (26.2)	27.7 (61.1)
Power connector for pre-assembled cables				A				
Cable outlet, not pre-assembled				K				
Length: 3 m (9.84 ft)								
Standard winding for single-sided variant					1			
Complementary winding for double-sided version (special secondary section for double-sided motors available on request)					2			
Length:						0		
215.4 mm (8.48 in) (for 1FN1070: 225 mm (8.86 in)).						1		
503.4 mm (19.82 in) (for 1FN1070: 563.4 mm (22.18 in)).								

Dimension drawings

Primary section	Dimensions in mm (in)				Secondary section	Dimensions in mm (in)			
	Type	b_M	h_M	Primary section length L_P		Type	b_S	h_S	Secondary section length L_{S1N} L_{S2N}
1FN1, water cooling									
1FN1072	137.0 (5.39)	80.7 (3.18)	320.3 (12.61)	1FN1070-0AA00-0AA0	125 (4.92)	20.2 (0.8)	225.6 (8.88)	241.0 (9.49)	
				1FN1070-0AA00-1AA0	125 (4.92)	20.2 (0.8)	564.0 (22.2)	579.5 (22.81)	
1FN1076	137.0 (5.39)	80.7 (3.18)	545.9 (21.49)						
1FN1122	198.8 (7.83)	106.7 (4.2)	407.8 (16.06)	1FN1120-0AA00-0AA0	180 (7.09)	30.2 (1.19)	216.0 (8.5)	234.0 (9.21)	
				1FN1120-0AA00-1AA0	180 (7.09)	30.2 (1.19)	504.0 (19.84)	522.0 (20.55)	
1FN1124	198.8 (7.83)	106.7 (4.2)	551.8 (21.72)						
1FN1126	198.8 (7.83)	106.7 (4.2)	695.8 (27.39)						
1FN1184	258.8 (10.19)	106.7 (4.2)	551.8 (21.72)	1FN1180-0AA00-0AA0	246 (9.69)	30.2 (1.19)	216.0 (8.5)	232.4 (9.15)	
				1FN1180-0AA00-1AA0	246 (9.69)	30.2 (1.19)	504.0 (19.84)	520.4 (20.49)	
1FN1186	258.8 (10.19)	106.7 (4.2)	695.8 (27.39)						
1FN1244	318.8 (12.55)	106.7 (4.2)	551.8 (21.72)	1FN1240-0AA00-0AA0	306 (12.05)	30.2 (1.19)	216.0 (8.5)	231.3 (9.11)	
				1FN1240-0AA00-1AA0	306 (12.05)	30.2 (1.19)	504.0 (19.84)	519.3 (20.44)	
1FN1246	318.8 (12.55)	106.7 (4.2)	695.8 (27.39)						

1) For water cooling with inlet temperature 35 °C (95 °F).

2) A reduction of up to 30% must be expected in case of motor standstill, at very low speeds, or with very short traverse paths.

3) Velocity values refer to a converter DC link voltage of 600 V DC.

4) Motor Modules are designed for feedrate force F_{rated} . If feedrate force F_{MAX} is utilized, the next largest Motor Module must be used.

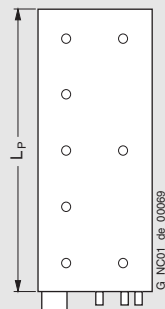
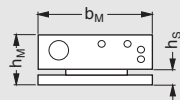
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1FN1 standard type linear motors
Water cooling

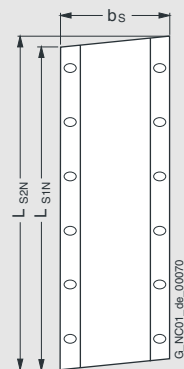
Selection and Ordering Data

Motor type (continued) Primary section	Motor phase current		Calculated power P_{calc} kW (HP)	SINAMICS Motor Module		Power cable with complete shield Motor connection via power connector		
	$I_{rated}^{1)}$ A	I_{MAX} A		Required rated current I_{rated}/I_{MAX} A	Order No. For complete Order No., see "SINAMICS S120 drive system".	Power con- nector Size	Cable cross- section Motor mm ² Sensor mm ²	Order No. Pre-assembled cable
1FN1072-3AF7-...	5.6	14	7.9 (10.59)	9/18	6SL312 ■ - ■ TE21-0A..	Pre-assembled cables available soon.		
1FN1076-3AF71-...	11.1	28	15.7 (21.05)	18/36	6SL312 ■ - ■ TE21-8A..			
1FN1122-5.C71-...	8.9	22.4	12.5 (16.76)	9/18 ⁴⁾	6SL312 ■ - ■ TE21-0A..			
1FN1122-5.F71-...	11.3	28	14.3 (19.17)	18/36	6SL312 ■ - ■ TE21-8A..			
1FN1124-5.C71-...	15	37.5	19.9 (26.68)	18/36 ⁴⁾	6SL312 ■ - ■ TE21-8A..			
1FN1124-5.F71-...	16.2	40.8	21.0 (28.15)	18/36 ⁴⁾	6SL312 ■ - ■ TE21-8A..			
1FN1126-5.C71-...	17.7	44.8	24.9 (33.38)	18/36 ⁴⁾	6SL312 ■ - ■ TE21-8A..			
1FN1126-5AF71-...	22.1	56	28.4 (38.07)	30/56	6SL312 ■ - 1 TE23-0A..			
1FN1184-5AC71-...	22.6	54.1	29.0 (38.87)	30/56	6SL312 ■ - 1 TE23-0A..			
1FN1184-5AF71-...	26.1	65.5	32.3 (43.30)	30/56 ⁴⁾	6SL312 ■ - 1 TE23-0A..			
1FN1186-5AC71-...	27.2	67.9	37.0 (49.60)	30/56 ⁴⁾	6SL312 ■ - 1 TE23-0A..			
1FN1186-5AF71-...	34.8	86.9	43.1 (57.77)	60/113	6SL312 ■ - 1 TE26-0A..			
1FN1244-5AC71-...	28	69.9	38.0 (50.94)	30/56 ⁴⁾	6SL312 ■ - 1 TE23-0A..			
1FN1244-5AF71-...	36.3	90.8	43.8 (58.71)	60/113	6SL312 ■ - 1 TE26-0A..			
1FN1246-5AC71-...	37.7	93.7	50.3 (67.43)	60/113	6SL312 ■ - 1 TE26-0A..			
Cooling:								
Internal air cooling								0
External air cooling								1
Motor Module:								
Single Motor Module								1
Double Motor Module								2

Dimension drawings



Primary section



Secondary section