

4. HIWIN LMFA linear motors

4.1 Special characteristics of the LMFA linear motors

The HIWIN LMFA synchronous linear motors are the cooled power packs of linear actuators. The UL-certified motors are fitted with a highly efficient cooling system. This enables even higher continuous forces and due to forced cooling, no additional process heat is introduced during machine construction. The linear motors in the LMFA series achieve extremely high thrust and acceleration. In addition, an extremely high synchronism is achieved through the optimised configuration of the permanent magnets in the stator. The benefits of the LMFA linear motors make them the preferred choice in fields with very high loads as well as in applications in which no additional process heat must be introduced.



Key features of the LMFA linear motors:

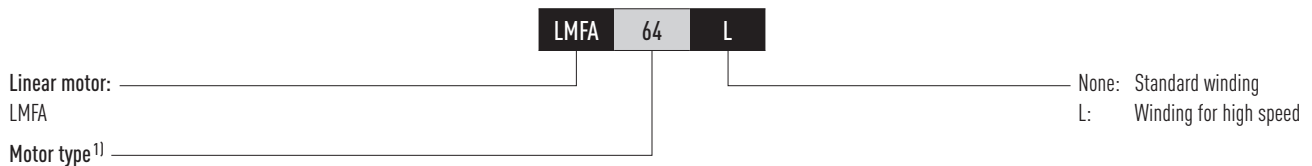
- Efficient cooling system
- Extremely high thrust
- High acceleration
- UL-certified
- High synchronous run
- Full epoxy encapsulation of permanent magnets in the stator
- Optional: version with Hall sensor

Typical fields of application of the LMFA linear motors:

- Machine tools
- Portal milling machines
- Sheet metal forming machines

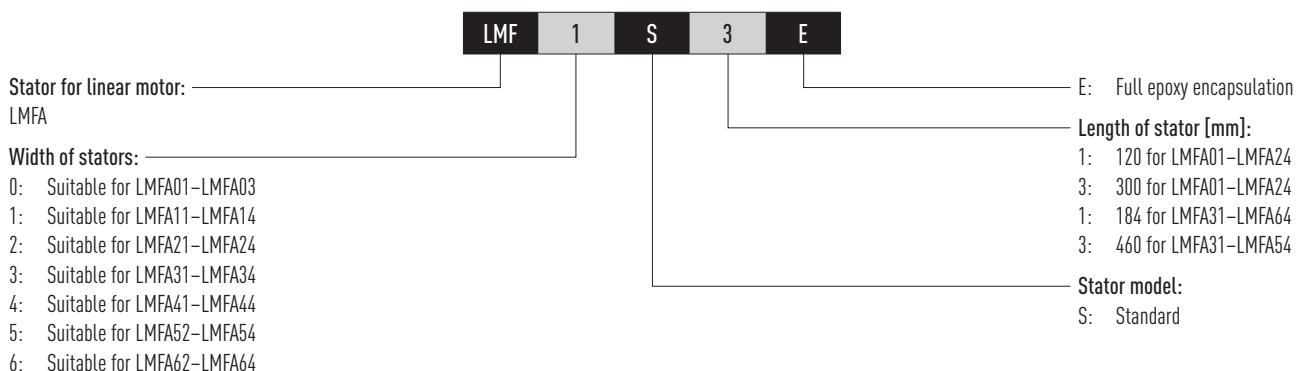
4.2 Order code LMFA linear motors

4.2.1 Order code of primary part (forcer)



¹⁾ See Table 4.1 (LMFA0), Table 4.2 (LMFA1), Table 4.3 (LMFA2), Table 4.4 (LMFA3), Table 4.5 (LMFA4), Table 4.6 (LMFA5), Table 4.7 (LMFA6)

4.2.2 Order code of magnet track (stator)

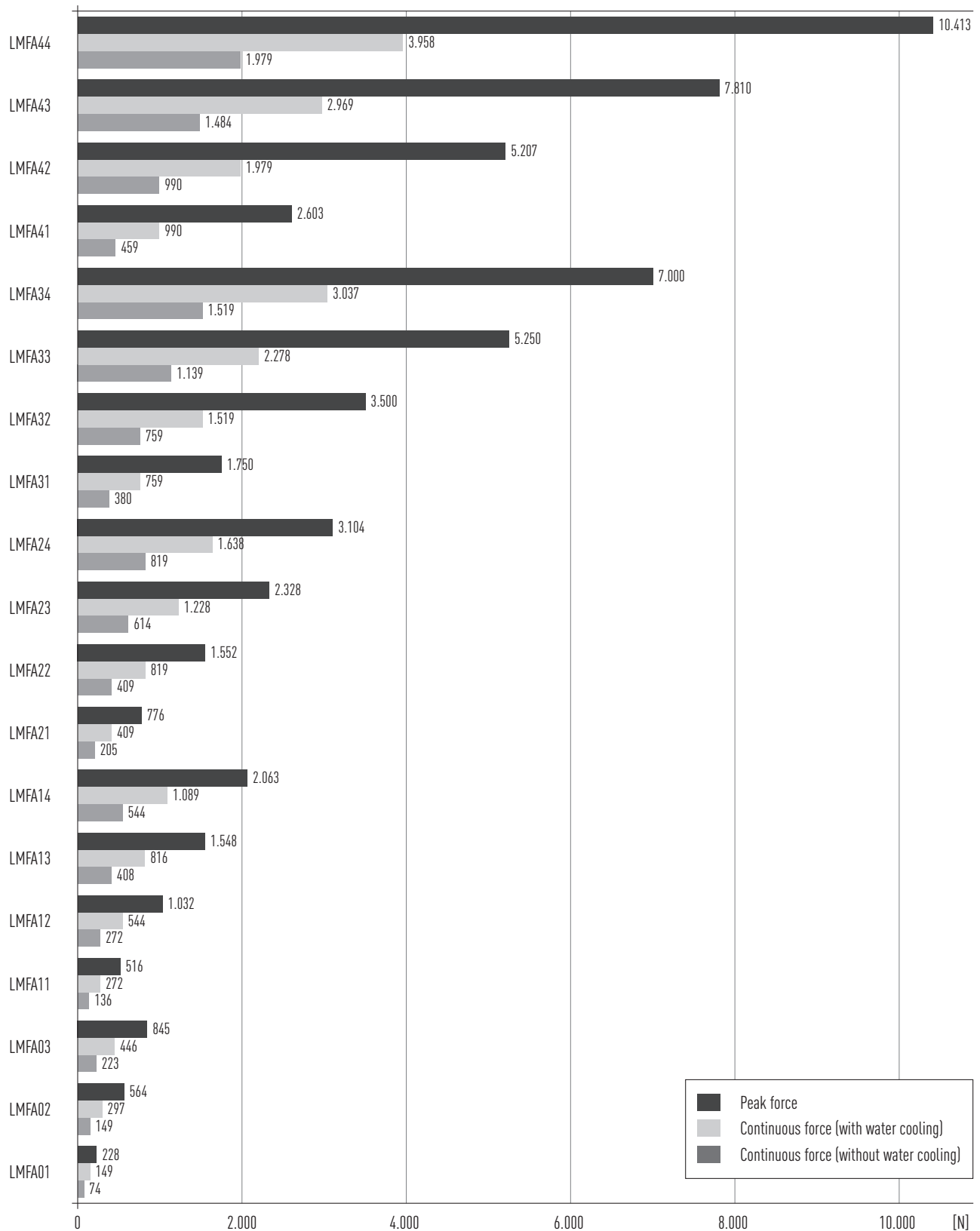


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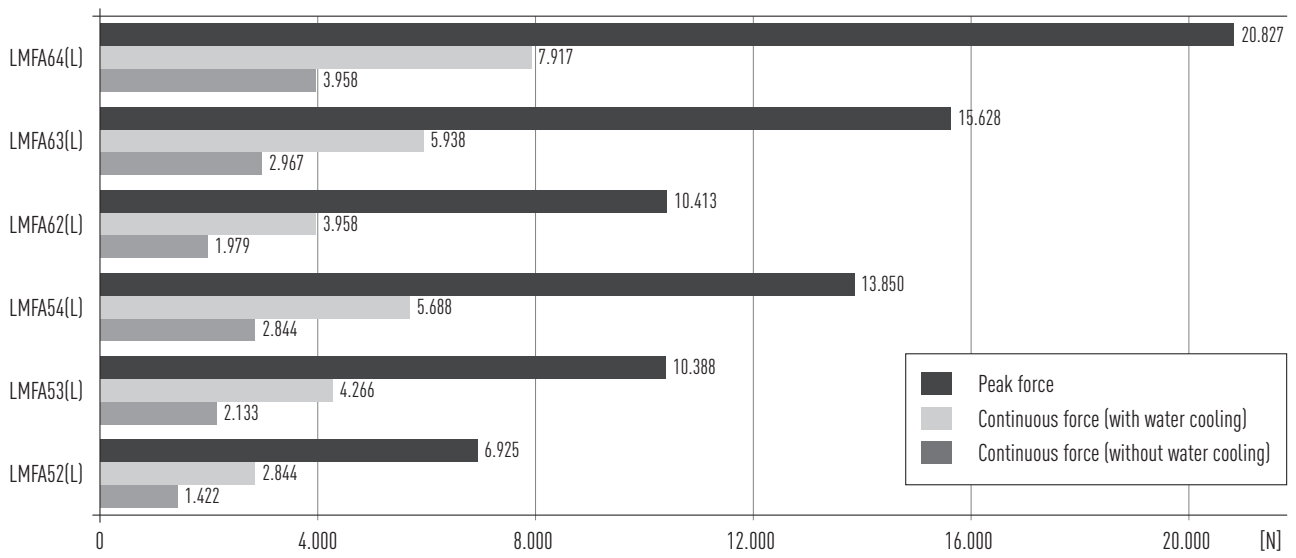
HIWIN LMFA linear motors

4.3 Force chart for LMFA linear motors

Force chart for linear motors LMFA0, LMFA1, LMFA2, LMFA3, LMFA4



Force chart for linear motors LMFA5, LMFA6



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4.4 LMFA linear motor specifications

4.4.1 LMFA0 linear motor specifications

Force-velocity curves (DC bus voltage: 750 VDC)

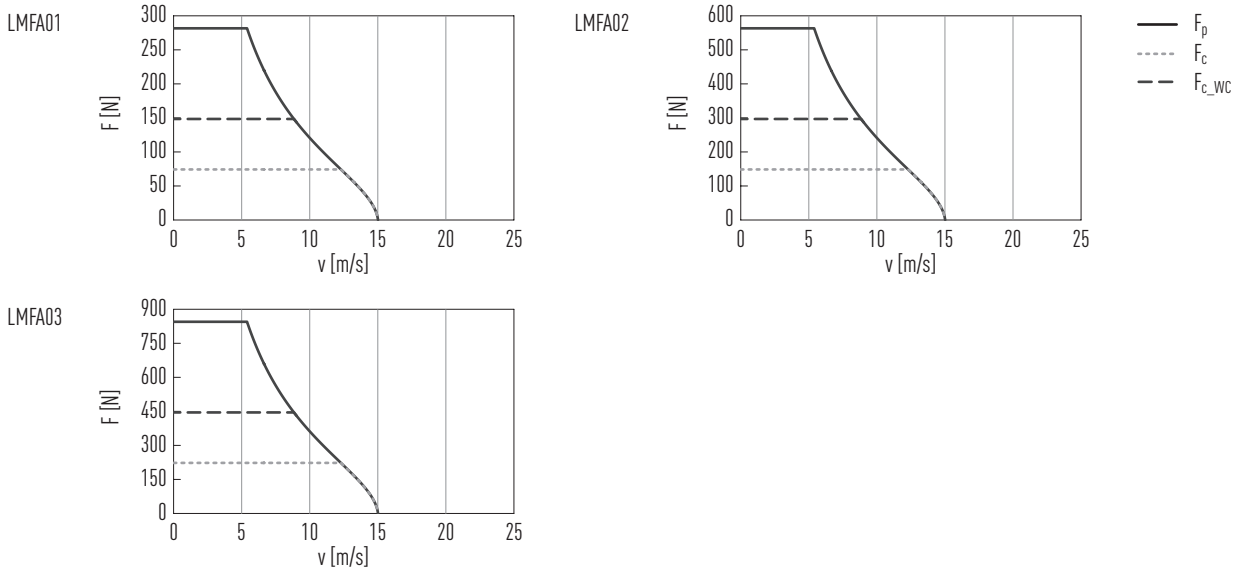


Table 4.1 Technical data for LMFA0

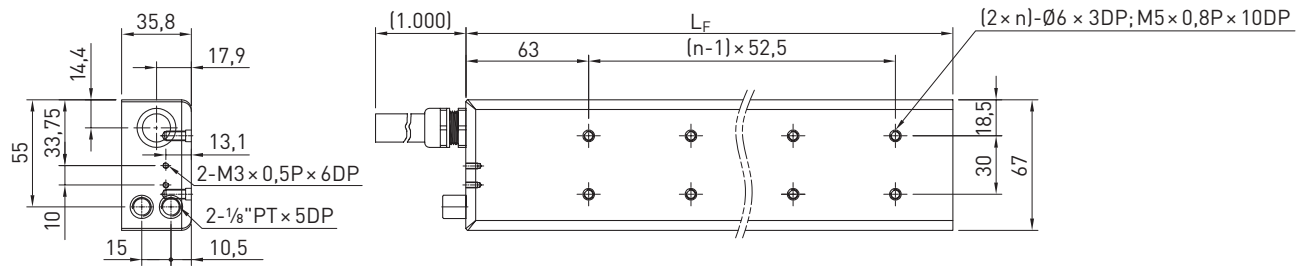
	Symbol	Unit	LMFA01	LMFA02	LMFA03
Forces and electrical parameters					
Continuous force at T _{max}	F _c	N	74	149	223
Peak force at T _{max} (WC)	F _{c_WC}	N	149	297	446
Continuous current at T _{max}	I _c	A _{eff}	1.4	2.7	4.1
Continuous current at T _{max} (WC)	I _{c_WC}	A _{eff}	2.7	5.4	8.1
Peak force (for 1 s)	F _p	N	282	564	845
Peak current (for 1 s)	I _p	A _{eff}	8.4	16.7	25.1
Force constant	K _f	N/A _{eff}	55.1	55.1	55.1
Attraction force	F _a	N	457	914	1,372
Electrical time constant	K _e	ms	7.2	7.2	7.2
Resistance ¹⁾	R ₂₅	Ω	11.7	5.9	3.9
Inductance ¹⁾	L	mH	84.2	42.1	28.1
Back EMF constant	K _u	V _{eff} /(m/s)	31.8	31.8	31.8
Motor constant	K _m	N/√W	13.1	18.6	22.8
Thermal resistance	R _{th}	°C/W	2.25	1.13	0.75
Thermal resistance (WC)	R _{th_WC}	°C/W	0.56	0.28	0.19
Thermal switch			1 × PT1000 + 1 × (3 PTC SNM 120 in series)		
Max. DC bus voltage		V	750		
Mechanical parameters					
Pole pair pitch	2τ	mm	30		
Max. winding temperature	T _{max}	°C	120		
Mounting holes (forcer)	n		2	4	6
Weight of forcer	M _F	kg	1.5	2.3	3.1
Length of forcer	L _F	mm	145	250	355
Unit mass of stator	M _S	kg/m	3.7		
Stator length/mounting holes	L _S	mm	120 mm/N = 2; 300 mm/N = 5		

WC: with water cooling

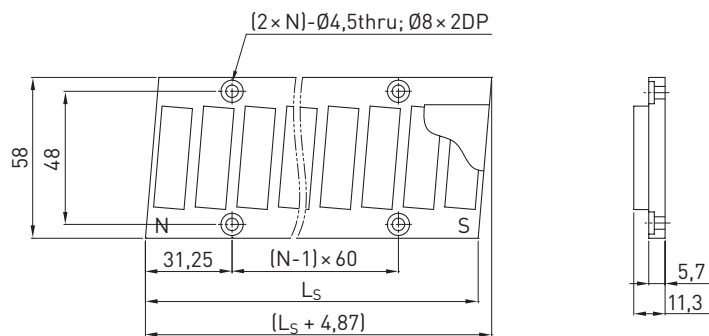
All specifications are in $\pm 10\%$ of tolerance at $25^{\circ}C$ ambient temperature

¹⁾ Line to line

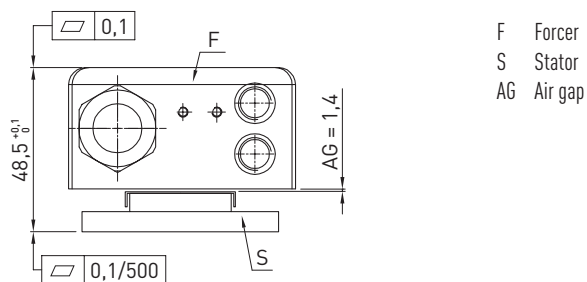
Dimensions offorcer



Dimensions of stator



Mounting tolerances



Stator versions available



Epoxy: Full epoxy encapsulation of permanent magnets

Stainless steel cover plate (upon request):
Additional stainless steel cover plate for magnet tracks

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4.4.2 LMFA1 linear motor specifications

Force-velocity curves (DC bus voltage: 750 VDC)

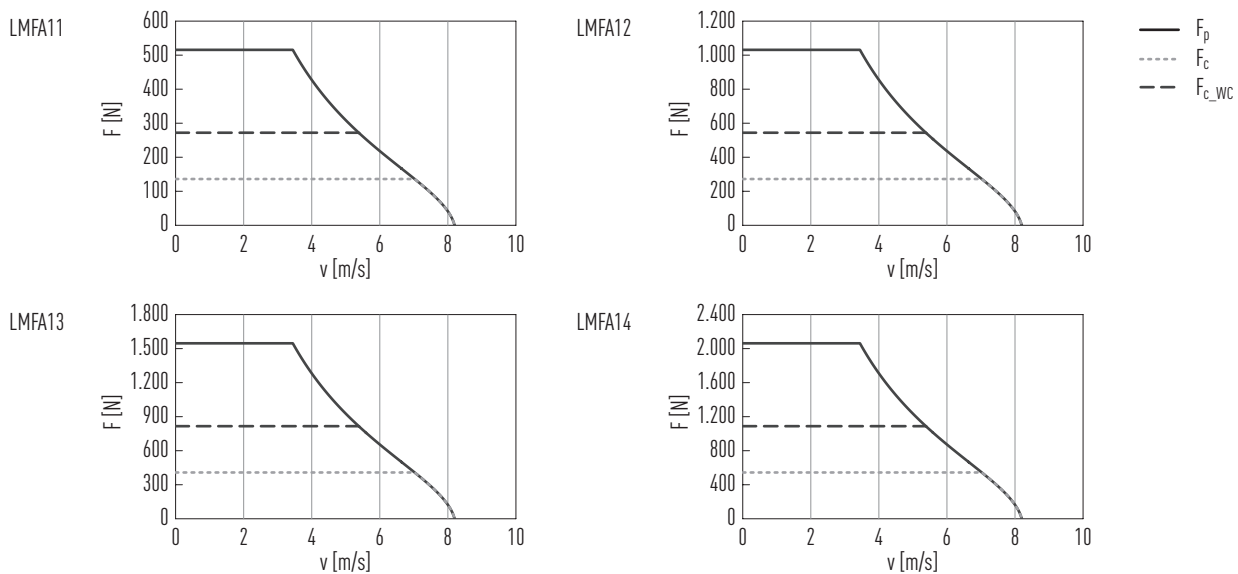


Table 4.2 Technical data for LMFA1

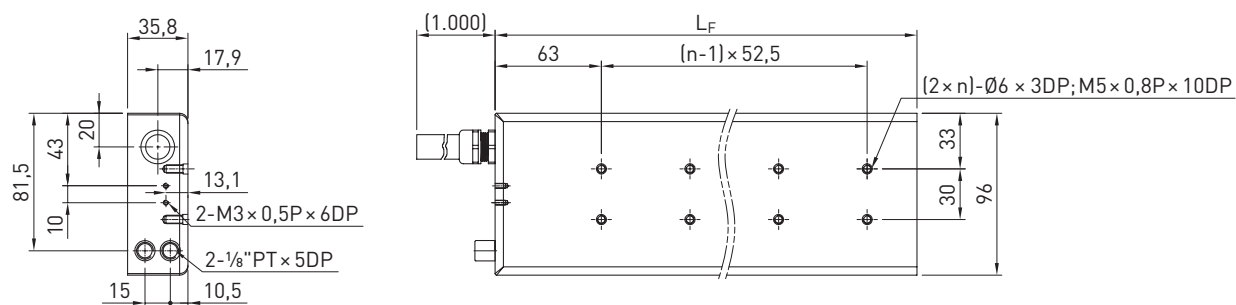
	Symbol	Unit	LMFA11	LMFA12	LMFA13	LMFA14
Forces and electrical parameters						
Continuous force at T _{max}	F _c	N	136	272	408	544
Continuous force at T _{max} (WC)	F _{c_WC}	N	272	544	816	1,089
Continuous current at T _{max}	I _c	A _{eff}	1.4	2.7	4.0	5.4
Continuous current at T _{max} (WC)	I _{c_WC}	A _{eff}	2.7	5.4	8.1	10.8
Peak force (for 1 s)	F _p	N	516	1,032	1,548	2,063
Peak current (for 1 s)	I _p	A _{eff}	8.4	16.7	25.1	33.5
Force constant	K _f	N/A _{eff}	100.8	100.8	100.8	100.8
Attraction force	F _a	N	837	1,674	2,511	3,348
Electrical time constant	K _e	ms	7.2	7.2	7.2	7.2
Resistance ¹⁾	R ₂₅	Ω	16.9	8.4	5.6	4.2
Inductance ¹⁾	L	mH	121.9	60.9	40.6	30.5
Back EMF constant	K _u	V _{eff} /(m/s)	58.2	58.2	58.2	58.2
Motor constant	K _m	N/√W	20.0	28.3	34.7	40.1
Thermal resistance	R _{th}	°C/W	1.56	0.78	0.52	0.39
Thermal resistance (WC)	R _{th_WC}	°C/W	0.39	0.20	0.13	0.10
Thermal switch			1 × PT1000 + 1 × { 3 PTC SNM 120 in series}			
Max. DC bus voltage		V	750			
Mechanical parameters						
Pole pair pitch	2τ	mm	30			
Max. winding temperature	T _{max}	°C	120			
Mounting holes (forcer)	n		2	4	6	8
Weight of forcer	M _F	kg	2.4	4.0	5.6	7.6
Length of forcer	L _F	mm	145	250	355	460
Unit mass of stator	M _S	kg/m	5.8			
Stator length/mounting holes	L _S	mm	120 mm/N = 2; 300 mm/N = 5			

WC: with water cooling

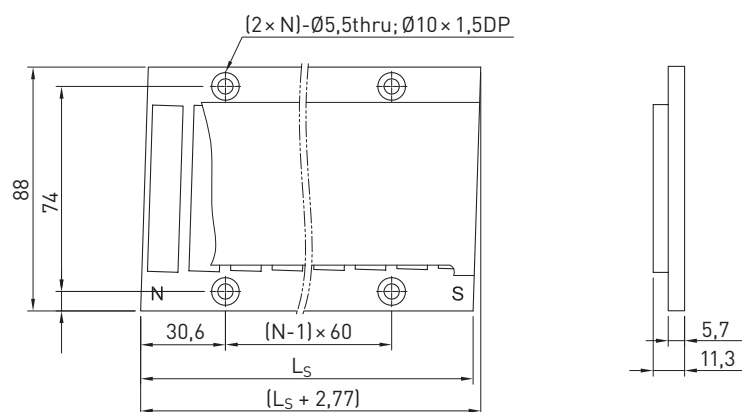
All specifications are in $\pm 10\%$ of tolerance at 25 °C ambient temperature

¹⁾ Line to line

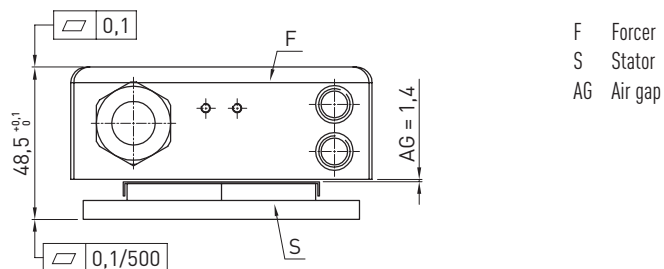
Dimensions of forcer



Dimensions of stator



Mounting tolerances



Stator versions available



Epoxy: Full epoxy encapsulation of permanent magnets

Stainless steel cover plate (upon request):
Additional stainless steel cover plate for magnet tracks

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4.4.3 LMFA2 linear motor specifications

Force-velocity curves (DC bus voltage: 750 VDC)

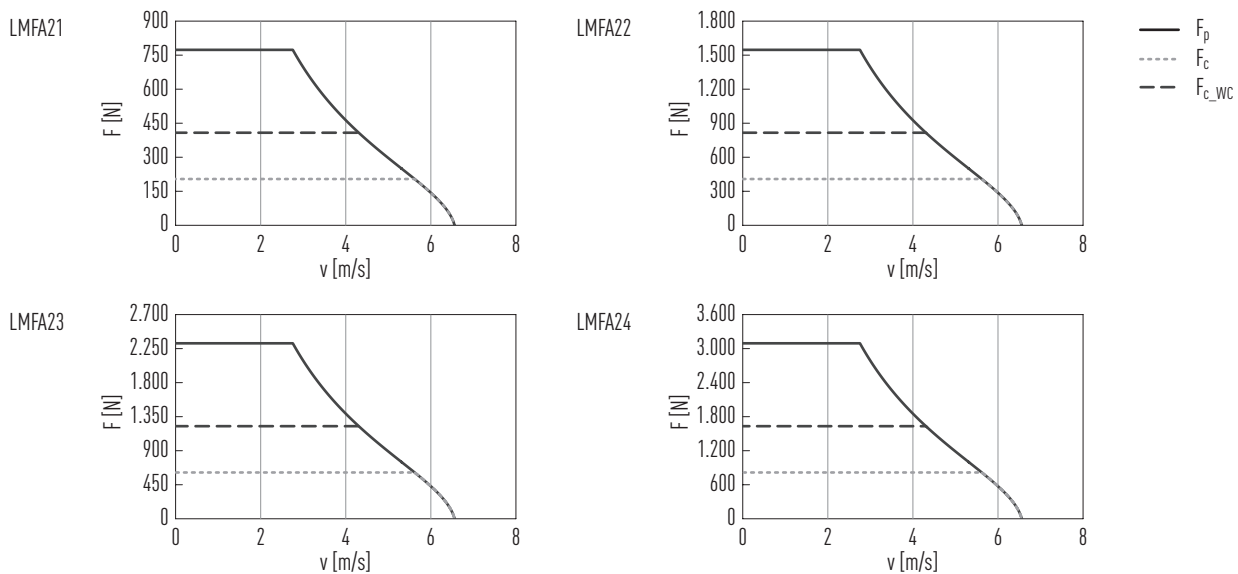


Table 4.3 Technical data for LMFA2

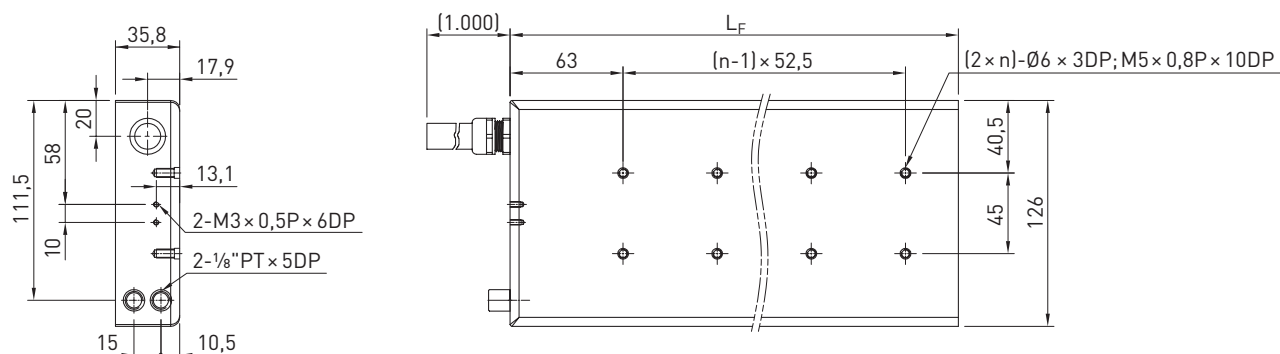
	Symbol	Unit	LMFA21	LMFA22	LMFA23	LMFA24
Forces and electrical parameters						
Continuous force at T _{max}	F _c	N	205	409	614	819
Continuous force at T _{max} (WC)	F _{c_WC}	N	409	819	1,228	1,638
Continuous current at T _{max}	I _c	A _{eff}	1.4	2.7	4.1	5.4
Continuous current at T _{max} (WC)	I _{c_WC}	A _{eff}	2.7	5.4	8.1	10.8
Peak force (for 1 s)	F _p	N	776	1,552	2,328	3,104
Peak current (for 1 s)	I _p	A _{eff}	8.4	16.7	25.1	33.5
Force constant	K _f	N/A _{eff}	151.6	151.6	151.6	151.6
Attraction force	F _a	N	1,259	2,518	3,777	5,036
Electrical time constant	K _e	ms	7.2	7.2	7.2	7.2
Resistance ¹⁾	R ₂₅	Ω	24.8	12.4	8.3	6.2
Inductance ¹⁾	L	mH	178.6	89.3	59.5	44.6
Back EMF constant	K _u	V _{eff} /(m/s)	87.5	87.5	87.5	87.5
Motor constant	K _m	N/√W	24.9	35.2	43.1	49.7
Thermal resistance	R _{th}	°C/W	1.06	0.53	0.35	0.27
Thermal resistance (WC)	R _{th_WC}	°C/W	0.27	0.13	0.09	0.07
Thermal switch			1 × PT1000 + 1 × { 3 PTC SNM 120 in series}			
Max. DC bus voltage		V	750			
Mechanical parameters						
Pole pair pitch	2τ	mm	30			
Max. winding temperature	T _{max}	°C	120			
Mounting holes (forcer)	n		2	4	6	8
Weight of forcer	M _F	kg	3.2	5.5	8.0	10.4
Length of forcer	L _F	mm	145	250	355	460
Unit mass of stator	M _S	kg/m	9.8			
Stator length/mounting holes	L _S	mm	120 mm/N = 2; 300 mm/N = 5			

WC: with water cooling

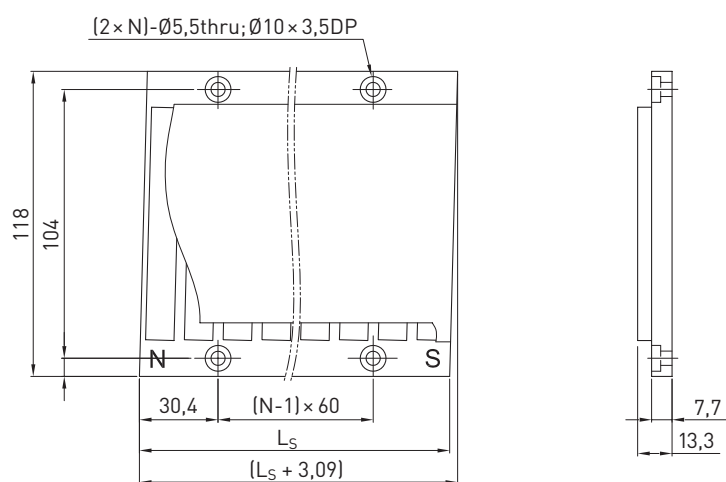
All specifications are in $\pm 10\%$ of tolerance at 25 °C ambient temperature

¹⁾ Line to line

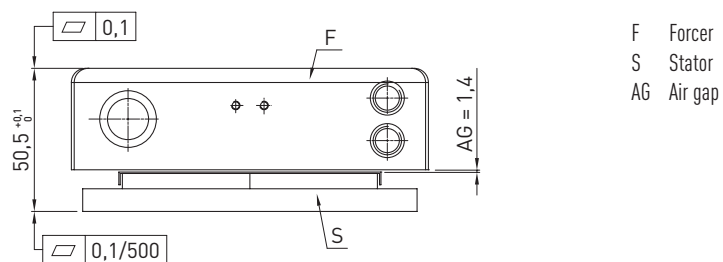
Dimensions offorcer



Dimensions of stator



Mounting tolerances



Stator versions available



Epoxy: Full epoxy encapsulation of permanent magnets

Stainless steel cover plate (upon request):
Additional stainless steel cover plate for magnet tracks

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4.4.4 LMFA3 linear motor specifications

Force-velocity curves (DC bus voltage: 750 VDC)

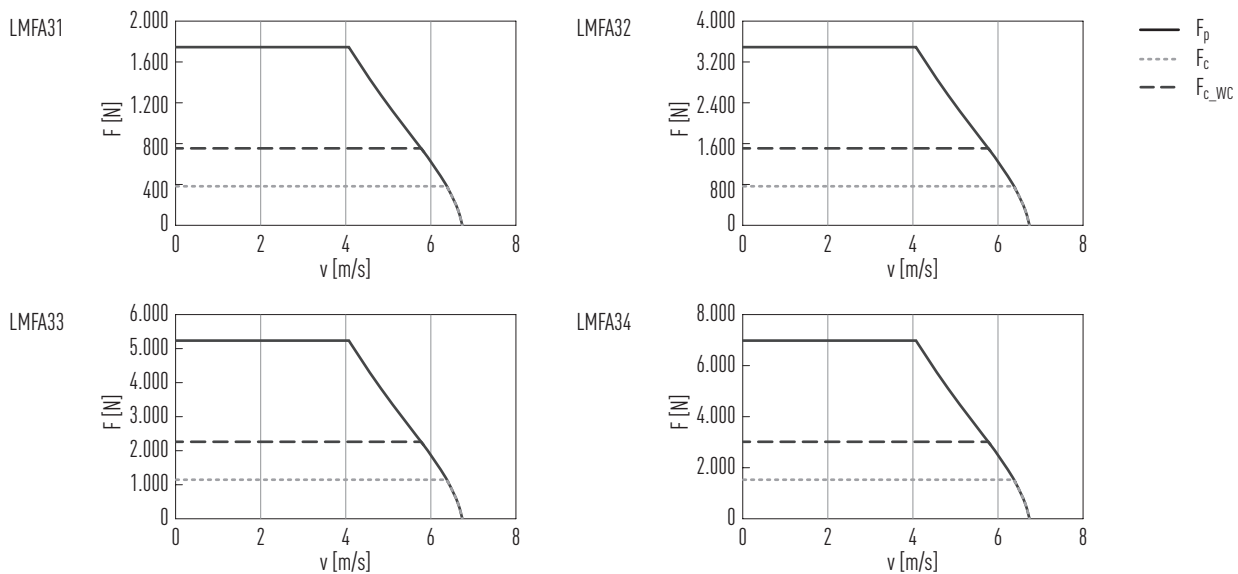


Table 4.4 Technical data for LMFA3

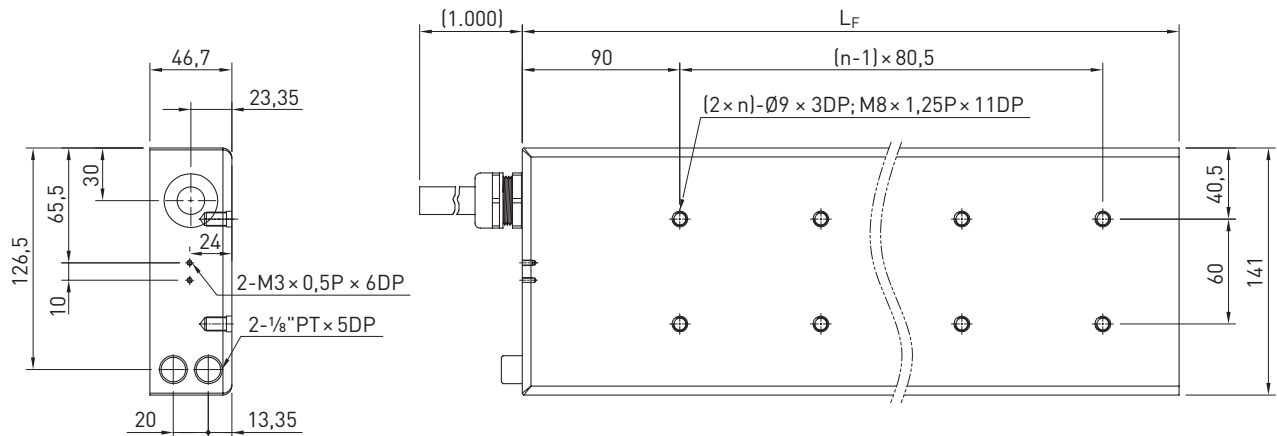
	Symbol	Unit	LMFA31	LMFA32	LMFA33	LMFA34
Forces and electrical parameters						
Continuous force at T _{max}	F _c	N	380	759	1,139	1,519
Continuous force at T _{max} (WC)	F _{c_WC}	N	759	1,519	2,278	3,037
Continuous current at T _{max}	I _c	A _{eff}	3.1	6.2	9.3	12.4
Continuous current at T _{max} (WC)	I _{c_WC}	A _{eff}	6.2	12.4	18.6	24.7
Peak force (for 1 s)	F _p	N	1,750	3,500	5,250	7,000
Peak current (for 1 s)	I _p	A _{eff}	19.2	38.4	57.5	76.7
Force constant	K _f	N/A _{eff}	122.7	122.7	122.7	122.7
Attraction force	F _a	N	3,430	6,860	10,290	13,720
Electrical time constant	K _e	ms	11.3	11.3	11.3	11.3
Resistance ¹⁾	R ₂₅	Ω	4.3	2.1	1.4	1.1
Inductance ¹⁾	L	mH	48.3	24.2	16.1	12.1
Back EMF constant	K _u	V _{eff} /(m/s)	70.9	70.9	70.9	70.9
Motor constant	K _m	N/√W	48.4	68.5	83.9	96.9
Thermal resistance	R _{th}	°C/W	1.17	0.59	0.39	0.29
Thermal resistance (WC)	R _{th_WC}	°C/W	0.29	0.15	0.10	0.07
Thermal switch			1 × PT1000 + 1 × {3 PTC SNM 120 in series}			
Max. DC bus voltage		V	750			
Mechanical parameters						
Pole pair pitch	2τ	mm	46			
Max. winding temperature	T _{max}	°C	120			
Mounting holes (forcer)	n		2	4	6	8
Weight of forcer	M _F	kg	6.4	11.7	17.3	22.5
Length of forcer	L _F	mm	214	375	536	697
Unit mass of stator	M _S	kg/m	16.2			
Stator length/mounting holes	L _S	mm	184 mm/N = 2; 460 mm/N = 5			

WC: with water cooling

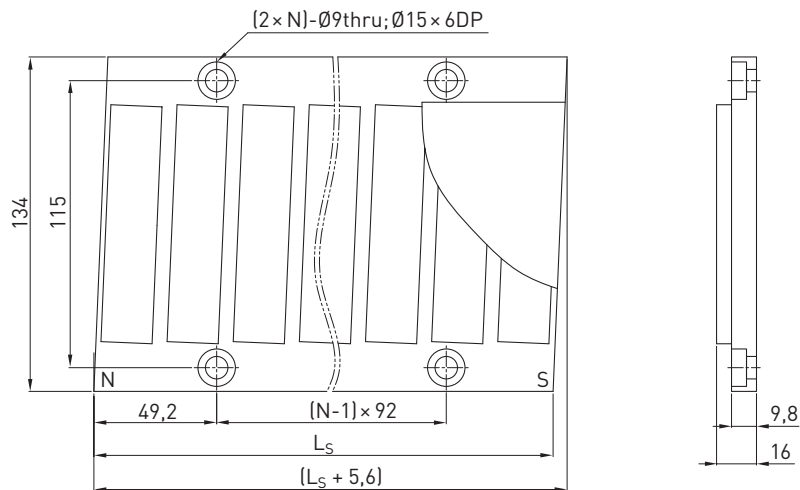
All specifications are in $\pm 10\%$ of tolerance at 25 °C ambient temperature

¹⁾ Line to line

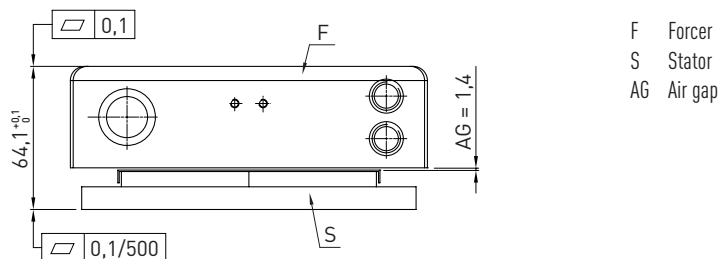
Dimensions offorcer



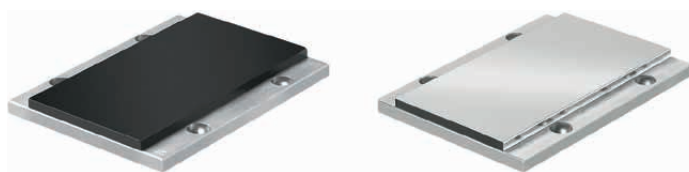
Dimensions of stator



Mounting tolerances



Stator versions available



Epoxy: Full epoxy encapsulation of permanent magnets

Stainless steel cover plate (upon request):
Additional stainless steel cover plate for magnet tracks

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4.4.5 LMFA4 linear motor specifications

Force-velocity curves (DC bus voltage: 750 VDC)

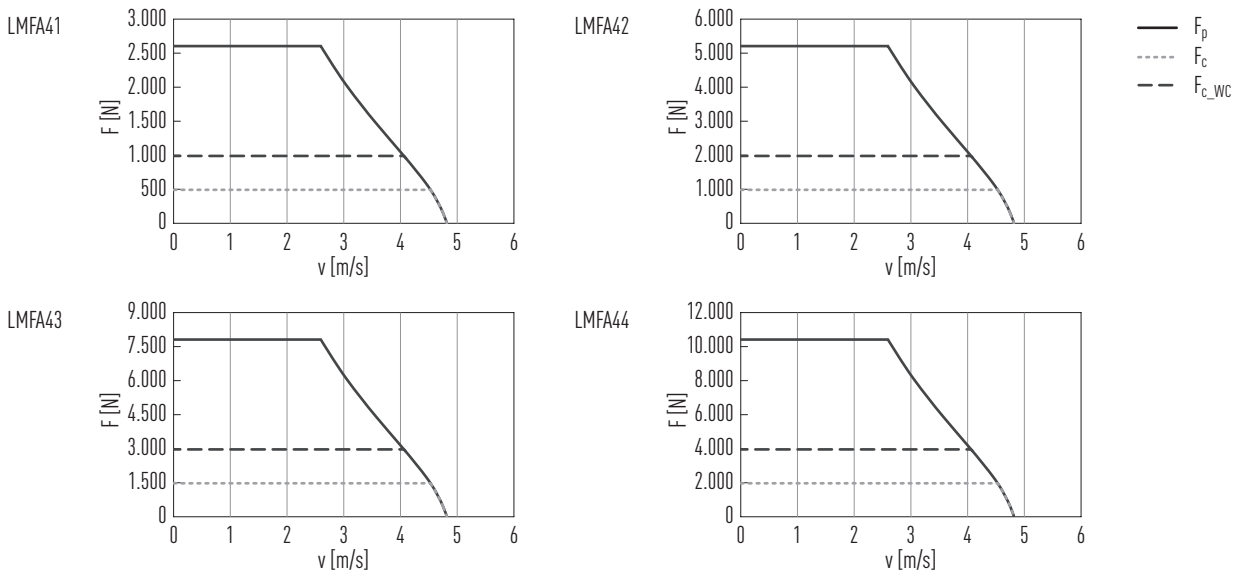


Table 4.5 Technical data for LMFA4

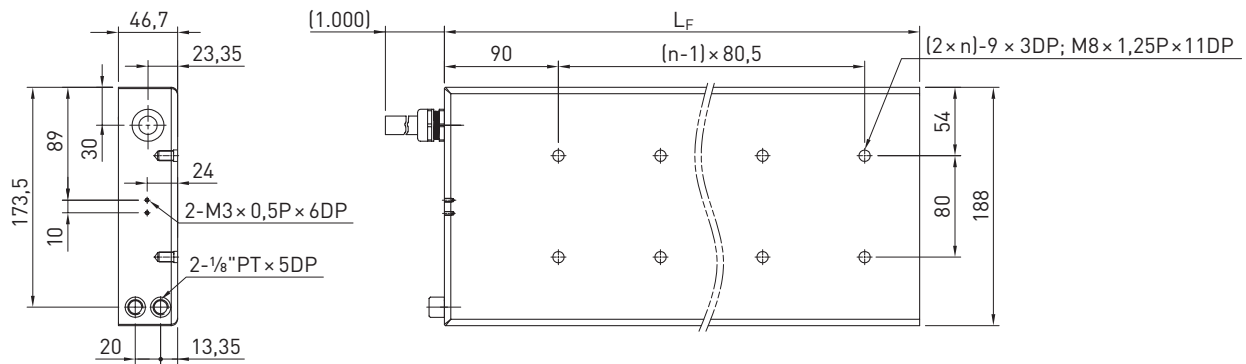
	Symbol	Unit	LMFA41	LMFA42	LMFA43	LMFA44
Forces and electrical parameters						
Continuous force at T _{max}	F _c	N	495	990	1,484	1,979
Continuous force at T _{max} (WC)	F _{c_WC}	N	990	1,979	2,969	3,958
Continuous current at T _{max}	I _c	A _{eff}	2.9	5.8	8.7	11.5
Continuous current at T _{max} (WC)	I _{c_WC}	A _{eff}	5.8	11.5	17.3	23.1
Peak force (for 1 s)	F _p	N	2,603	5,207	7,810	10,413
Peak current (for 1 s)	I _p	A _{eff}	17.9	35.8	53.5	71.6
Force constant	K _f	N/A _{eff}	171.4	171.4	171.4	171.4
Attraction force	F _a	N	5,145	10,290	15,435	20,580
Electrical time constant	K _e	ms	12.0	12.0	12.0	12.0
Resistance ¹⁾	R ₂₅	Ω	6.0	3.0	2.0	1.5
Inductance ¹⁾	L	mH	72.0	36.0	24.0	18.0
Back EMF constant	K _u	V _{eff} /(m/s)	98.9	98.9	98.9	98.9
Motor constant	K _m	N/√W	57.1	80.8	98.9	114.2
Thermal resistance	R _{th}	°C/W	0.96	0.48	0.32	0.24
Thermal resistance (WC)	R _{th_WC}	°C/W	0.24	0.12	0.08	0.06
Thermal switch			1 × PT1000 + 1 × {3 PTC SNM 120 in series}			
Max. DC bus voltage		V	750			
Mechanical parameters						
Pole pair pitch	2τ	mm	46			
Max. winding temperature	T _{max}	°C	120			
Mounting holes (forcer)	n		2	4	6	8
Weight of forcer	M _F	kg	9.5	16.2	23.0	29.0
Length of forcer	L _F	mm	214	375	536	697
Unit mass of stator	M _S	kg/m	22.3			
Stator length/mounting holes	L _S	mm	184 mm/N = 2; 460 mm/N = 5			

WC: with water cooling

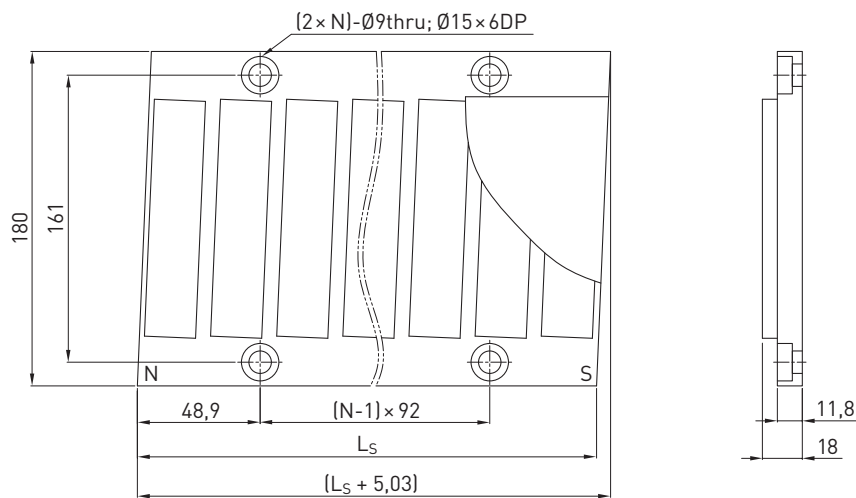
All specifications are in $\pm 10\%$ of tolerance at 25 °C ambient temperature

¹⁾ Line to line

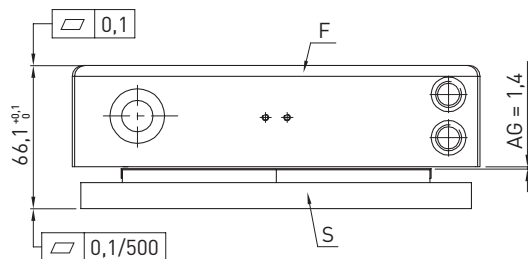
Dimensions of forcer



Dimensions of stator



Mounting tolerances



F Forcer
S Stator
AG Air gap

Stator versions available



Epoxy: Full epoxy encapsulation of permanent magnets

Stainless steel cover plate (upon request):
Additional stainless steel cover plate for magnet tracks

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4.4.6 LMFA5 linear motor specifications

Force-velocity curves (DC bus voltage: 750 VDC)

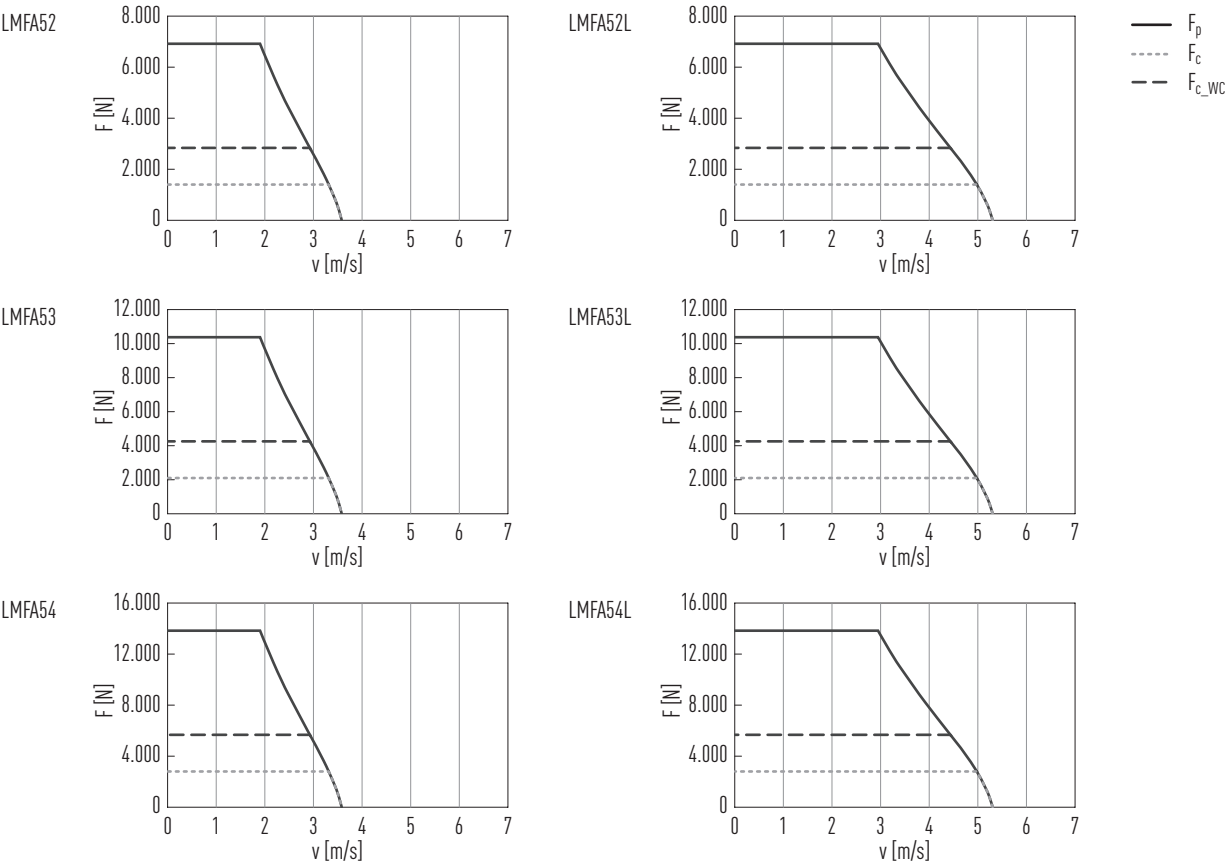


Table 4.6 Technical data for LMFA5

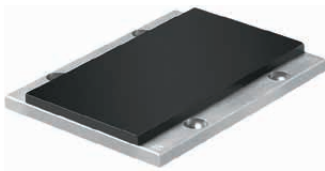
	Symbol	Unit	LMFA52	LMFA52L	LMFA53	LMFA53L	LMFA54	LMFA54L
Forces and electrical parameters								
Continuous force at T _{max}	F _c	N	1,422		2,133		2,844	
Continuous force at T _{max} (WC)	F _{c_WC}	N	2,844		4,266		5,688	
Continuous current at T _{max}	I _c	A _{eff}	6.2	9.1	9.3	13.7	12.4	18.3
Continuous current at T _{max} (WC)	I _{c_WC}	A _{eff}	12.4	18.3	18.6	27.4	24.7	36.5
Peak force (for 1 s)	F _p	N	6,925		10,388		13,850	
Peak current (for 1 s)	I _p	A _{eff}	38.4	56.6	57.5	84.9	76.7	113.2
Force constant	K _f	N/A _{eff}	229.9	155.7	229.9	155.7	229.9	155.7
Attraction force	F _a	N	13,700		20,550		27,400	
Electrical time constant	K _e	ms	12.2	12.4	12.2	12.4	12.2	12.4
Resistance ¹⁾	R ₂₅	Ω	3.9	1.8	2.6	1.2	2.0	0.9
Inductance ¹⁾	L	mH	47.7	21.9	31.8	14.6	23.9	10.9
Back EMF constant	K _u	V _{eff} /(m/s)	132.7	89.9	132.7	89.9	132.7	89.9
Motor constant	K _m	N/√W	95.0	95.6	116.4	117.1	134.4	135.2
Thermal resistance	R _{th}	°C/W	0.32	0.33	0.21	0.22	0.16	0.16
Thermal resistance (WC)	R _{th_WC}	°C/W	0.08	0.08	0.05	0.05	0.04	0.04
Thermal switch			1 × PT1000 + 1 × {3 PTC SNM 120 in series}					
Max. DC bus voltage		V	750					
Mechanical parameters								
Pole pair pitch	2τ	mm	46					
Max. winding temperature	T _{max}	°C	120					
Mounting holes (forcer)	n		4		6		8	
Weight of forcer	M _F	kg	23.8		32.3		40.8	
Length of forcer	L _F	mm	375		536		697	
Unit mass of stator	M _S	kg/m	25					
Stator length/mounting holes	L _S	mm	184 mm/N = 2; 460 mm/N = 5					

WC: with water cooling

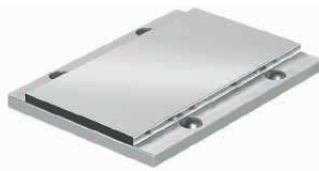
 All specifications are in $\pm 10\%$ of tolerance at 25°C ambient temperature

¹⁾ Line to line

Stator versions available



Epoxy: Full epoxy encapsulation of permanent magnets

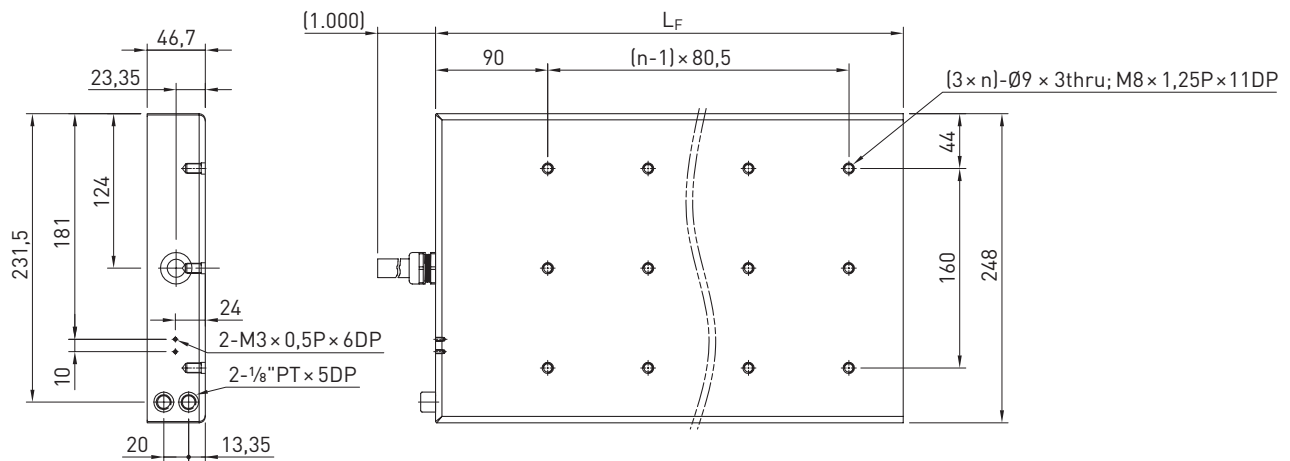


Stainless steel cover plate (upon request):
Additional stainless steel cover plate for magnet tracks

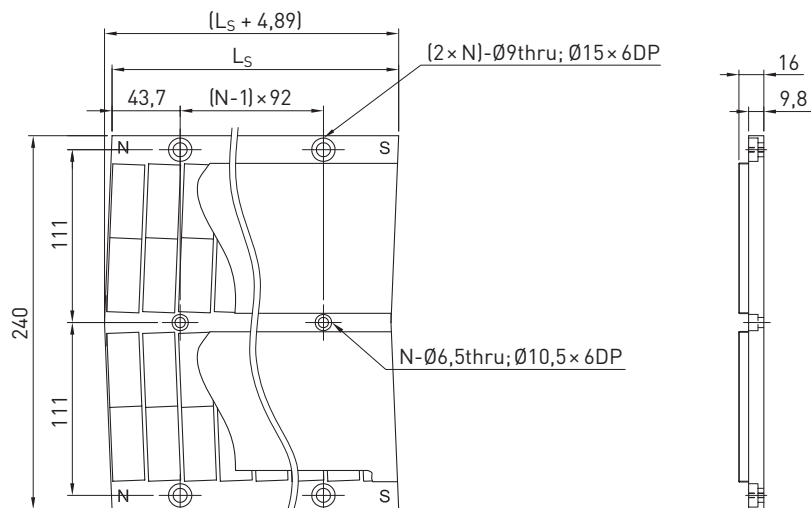
Linear Motors & Distance Measuring Systems

HIWIN LMFA linear motors

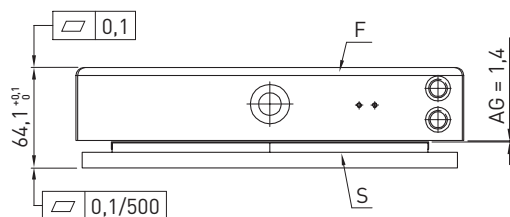
Dimensions of forcer



Dimensions of stator



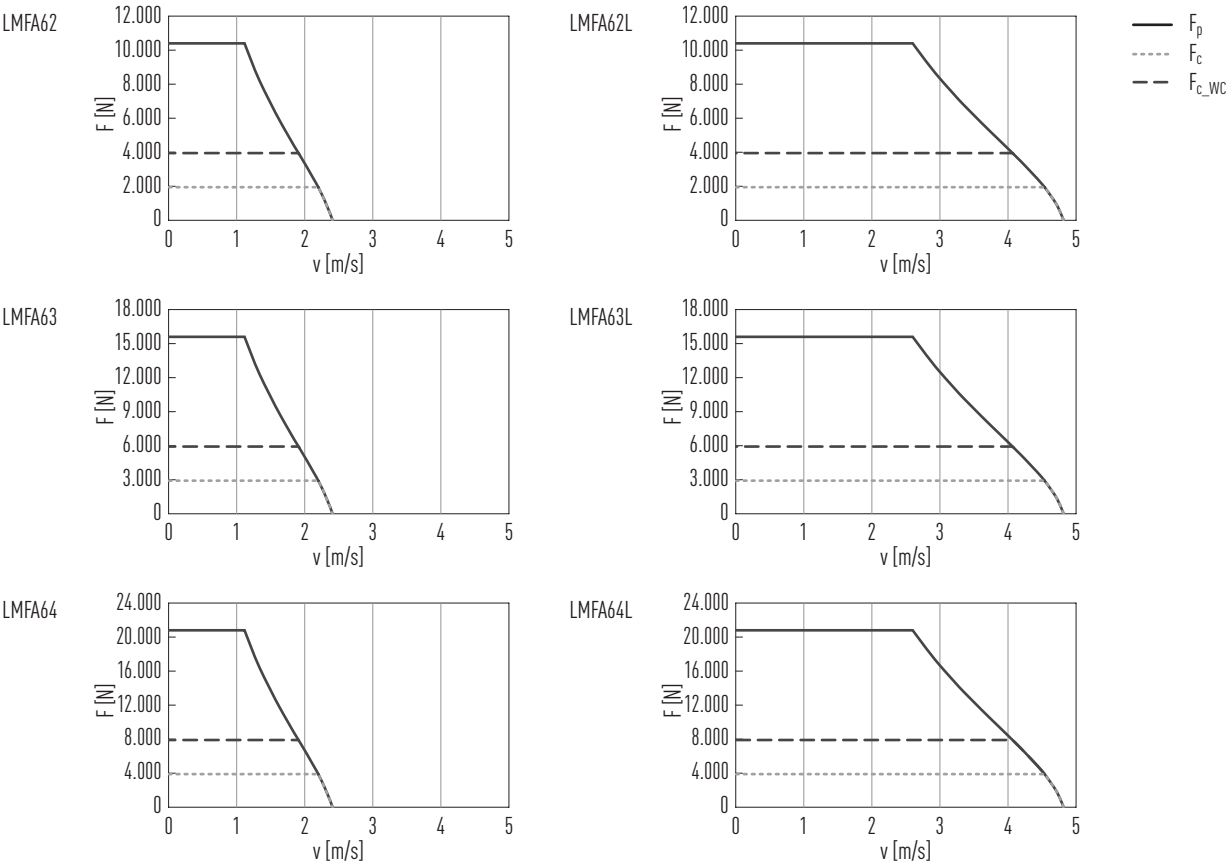
Mounting tolerances



F Forcer
S Stator
AG Air gap

4.4.7 LMFA6 linear motor specifications

Force-velocity curves (DC bus voltage: 750 VDC)



Linear Motors & Distance Measuring Systems

HIWIN LMFA linear motors

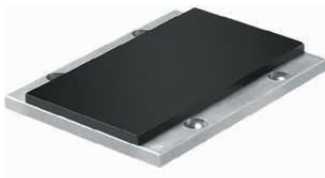
Table 4.7 Technical data for LMFA6								
	Symbol	Unit	LMFA62	LMFA62L	LMFA63	LMFA63L	LMFA64	LMFA64L
Forces and electrical parameters								
Continuous force at T _{max}	F _c	N	1,979		2,969		3,958	
Continuous force at T _{max} (WC)	F _{c_WC}	N	3,958		5,938		7,917	
Continuous current at T _{max}	I _c	A _{eff}	5.8	11.5	8.7	17.3	11.5	23.1
Continuous current at T _{max} (WC)	I _{c_WC}	A _{eff}	11.5	23.1	17.3	34.6	23.1	46.2
Peak force (for 1 s)	F _p	N	10,413		15,620		20,827	
Peak current (for 1 s)	I _p	A _{eff}	35.8	71.6	53.7	107.4	71.3	142.6
Force constant	K _f	N/A _{eff}	342.7	171.4	342.7	171.4	342.7	171.4
Attraction force	F _a	N	20,580		30,870		41,160	
Electrical time constant	K _e	ms	12.0					
Resistance ¹⁾	R ₂₅	Ω	6.0	1.5	4.0	1.0	3.0	0.8
Inductance ¹⁾	L	mH	72.0	18.0	48.0	12.0	36.0	9.0
Back EMF constant	K _u	V _{eff} /(m/s)	197.9	98.9	197.9	98.9	197.9	98.9
Motor constant	K _m	N/√W	114.2		139.9		161.6	
Thermal resistance	R _{th}	°C/W	0.24		0.16		0.12	
Thermal resistance (WC)	R _{th_WC}	°C/W	0.06		0.04		0.03	
Thermal switch			1 × PT1000 + 1 × (3 PTC SNM 120 in series)					
Max. DC bus voltage		V	750					
Mechanical parameters								
Pole pair pitch	2τ	mm	46					
Max. winding temperature	T _{max}	°C	120					
Mounting holes (forcer)	n		4		6		8	
Weight of forcer	M _F	kg	32.2		44.2		56.2	
Length of forcer	L _F	mm	375		536		697	
Unit mass of stator	M _S	kg/m	40.1					
Stator length/mounting holes	L _S	mm	184 mm/N = 2					

WC: with water cooling

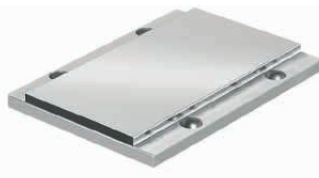
All specifications are in ± 10 % of tolerance at 25 °C ambient temperature

¹⁾ Line to line

Stator versions available

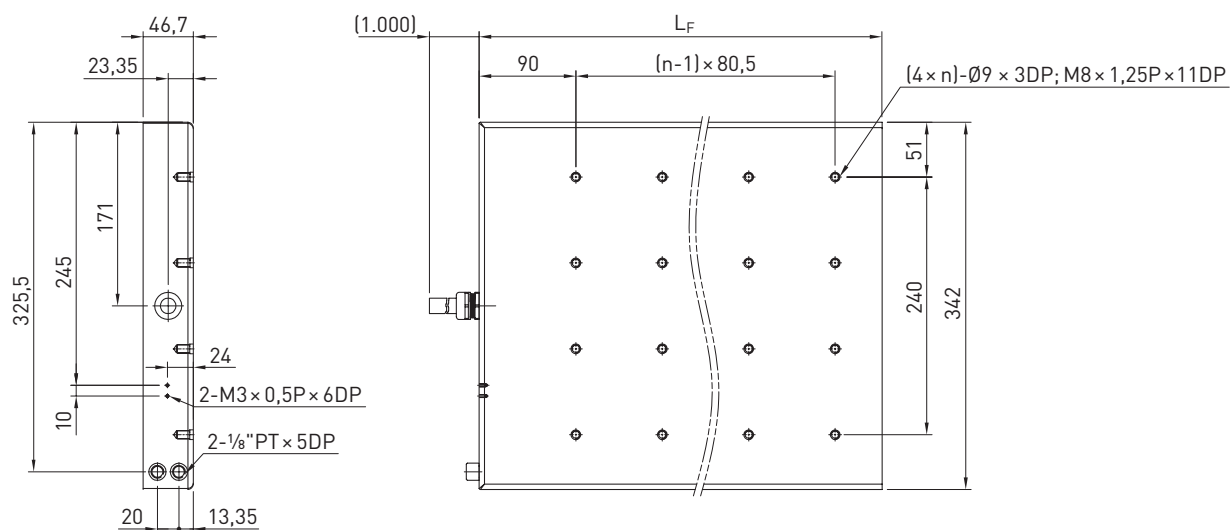


Epoxy: Full epoxy encapsulation of permanent magnets

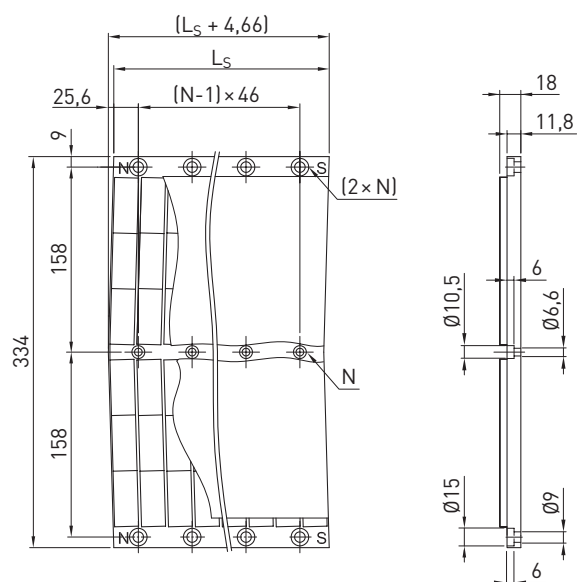


Stainless steel cover plate (upon request):
Additional stainless steel cover plate for magnet tracks

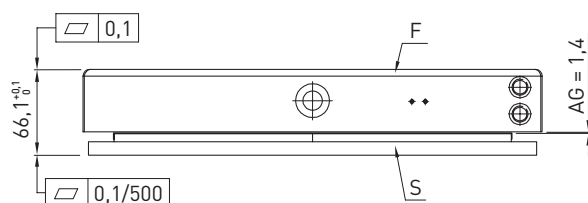
Dimensions of forcer



Dimensions of stator



Mounting tolerances



F Forcer
S Stator
AG Air gap