5. HIWIN LMFP linear motors

5.1 Special characteristics of the LMFP linear motors

Like their cousins from the LMFA series, the enclosed HIWIN LMFP synchronous linear motors represent the cooled power packs among the linear drives. The decisive difference here is the fully encapsulated design in accordance with protection class IP65, thanks to which LMFP linear motors can also withstand difficult ambient conditions where others reach their limits. They achieve very high continuous forces, extremely high thrust forces and accelerations and, thanks to liquid cooling, do not introduce any additional process heat into your system.
LMFP linear motors are therefore the first choice for applications where very high loads encounter difficult ambient conditions with liquids or dust.

Key features of the LMFP linear motors:
- Sealed design: Protection class IP65
- Efficient cooling system
- Extremely high thrust
- High acceleration
- High synchronous run
- Full epoxy encapsulation of permanent magnets in the stator
- Optional: version with Hall sensor

Typical fields of application of the LMFP linear motors:
- Machine tools
- Portal milling machines
- Sheet metal forming machines

5.2 Order code LMFP linear motors

5.2.1 Order code of primary part (forcer)

LMFP	64	–Q40

Linear motor:
LMFP

Motor type [1)]

[1)] See Table 5.1 (LMFP2), Table 5.2 (LMFP3), Table 5.3 (LMFP4), Table 5.4 (LMFP5), Table 5.5 (LMFP6)

Standard winding:
F40: LMFP24
Q10: LMFP31, LMFP41
Q20: LMFP32, LMFP42, LMFP52, LMFP62
Q30: LMFP33, LMFP43, LMFP53, LMFP63
Q40: LMFP34, LMFP44, LMFP54, LMFP64
Winding for high speed:
Q40: LMFP52, LMFP62
Q60: LMFP53, LMFP63
Q80: LMFP54, LMFP64

5.2.2 Order code of magnet track (stator)

LMF	1	S	3	E

Stator for linear motor:
LMFP

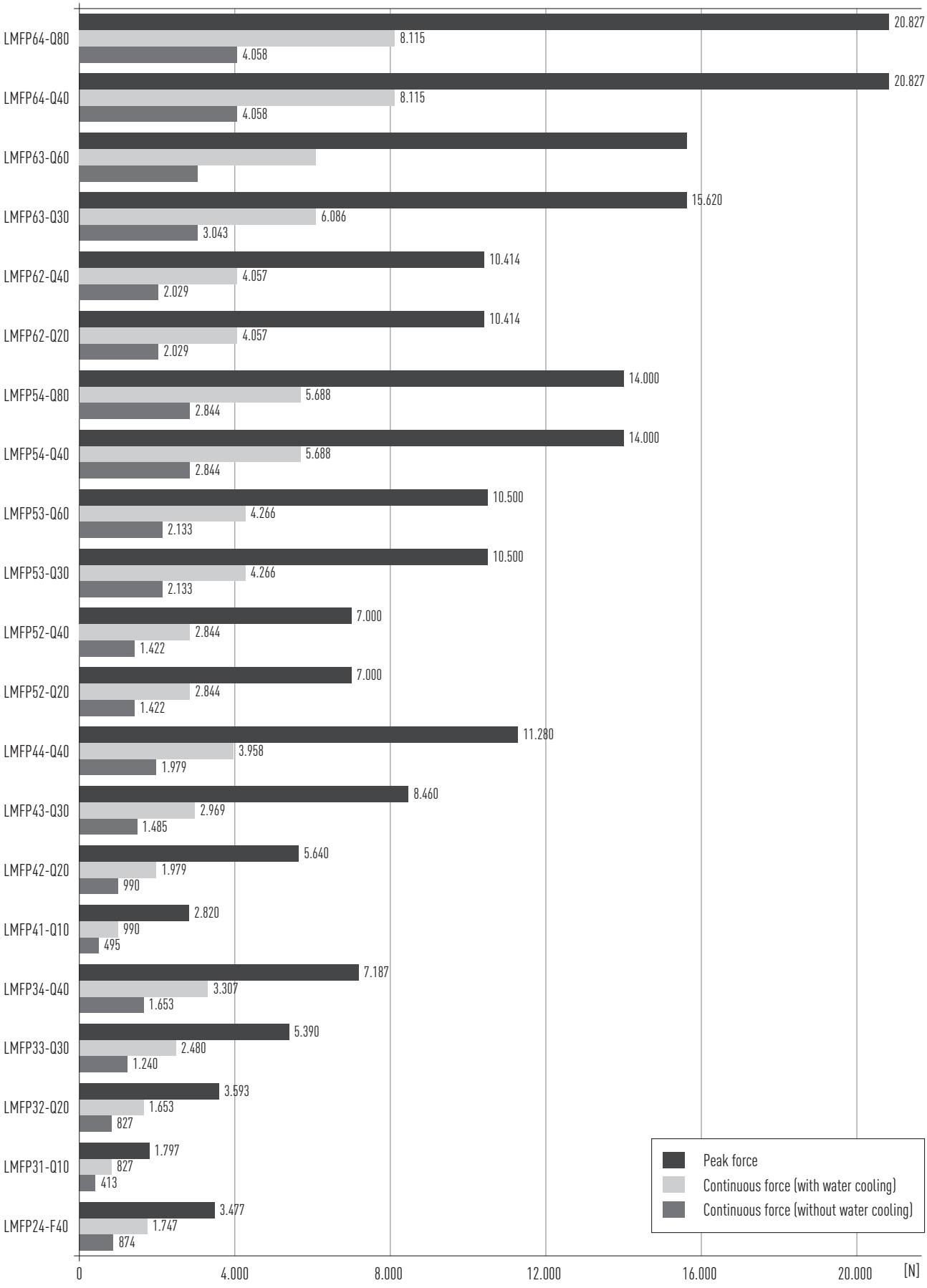
Width of stators:
2: Suitable for LMFP24
3: Suitable for LMFP31–LMFP34
4: Suitable for LMFP41–LMFP44
5: Suitable for LMFP52–LMFP54
6: Suitable for LMFP62–LMFP64

E: Full epoxy encapsulation

Length of stator [mm]:
1: 120 for LMFP24
3: 300 for LMFP24
1: 184 for LMFP31–LMFP64
3: 460 for LMFP31–LMFP54

Stator model:
S: Standard

5.3 Force chart for LMFP linear motors



5.4 LMFP linear motor specifications

5.4.1 LMFP2 linear motor specifications

Force-velocity curves (DC bus voltage: 600 VDC)

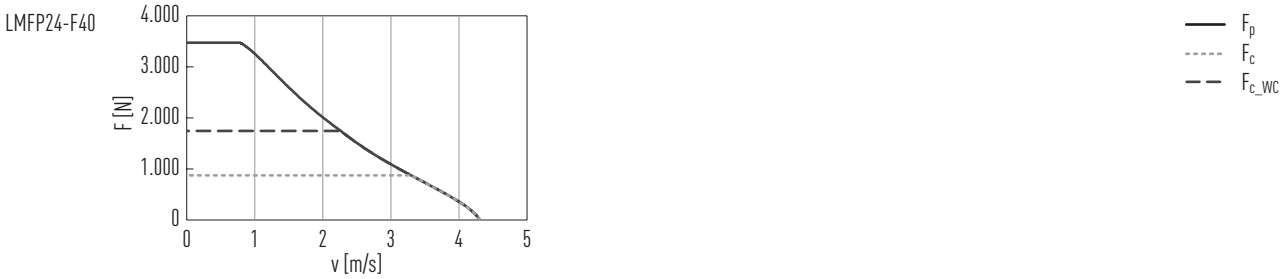
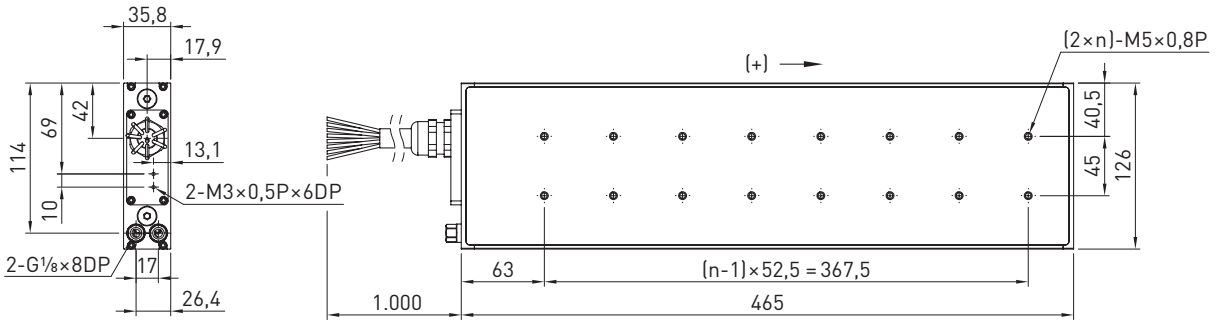


Table 5.1 **Technical data for LMFP2**

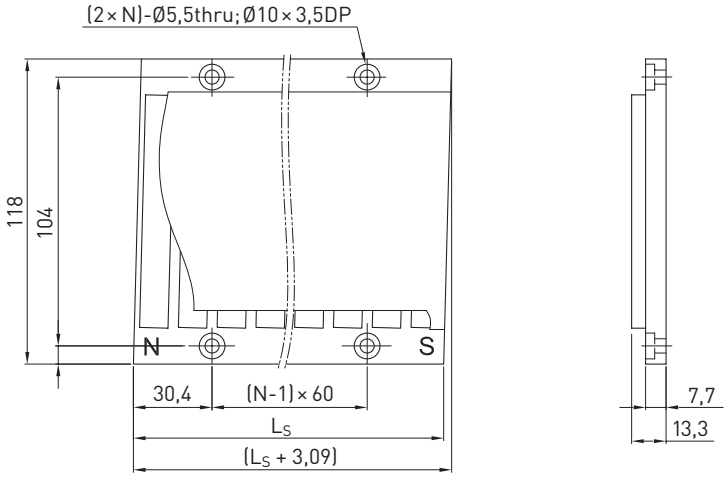
	Symbol	Unit	LMFP24-F40
Forces and electrical parameters			
Continuous force at T_{max}	F_c	N	874
Peak force at T_{max} (WC)	F_{c_WC}	N	1,747
Continuous current at T_{max}	I_c	A_{eff}	5.7
Continuous current at T_{max} (WC)	I_{c_WC}	A_{eff}	11.4
Peak force (for 1 s)	F_p	N	3,477
Peak current (for 1 s)	I_p	A_{eff}	32.8
Force constant	K_f	N/A_{eff}	153.6
Attraction force	F_a	N	4,583
Electrical time constant	K_e	ms	8.1
Resistance [1)]	R_{25}	Ω	7.1
Inductance [1)]	L	mH	57.6
Back EMF constant	K_u	$V_{eff}/(m/s)$	88.7
Motor constant	K_m	$N/\sqrt{W}$	47
Thermal resistance	R_{th}	°C/W	0.2
Thermal resistance (WC)	R_{th_WC}	°C/W	0.05
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		16
Weight of forcer	M_F	kg	11
Length of forcer	L_F	mm	465
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
Total height	H	mm	50.5

WC: with water cooling
All specifications are in ± 10 % of tolerance at 25 °C ambient temperature
[1)] Line to line

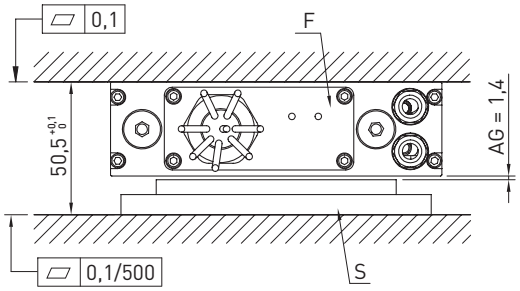
Dimensions of forcer



Dimensions of stator



Mounting tolerances



F Forcer
S Stator
AG Air gap

5.4.2 LMFP3 linear motor specifications

Force-velocity curves (DC bus voltage: 600 VDC)

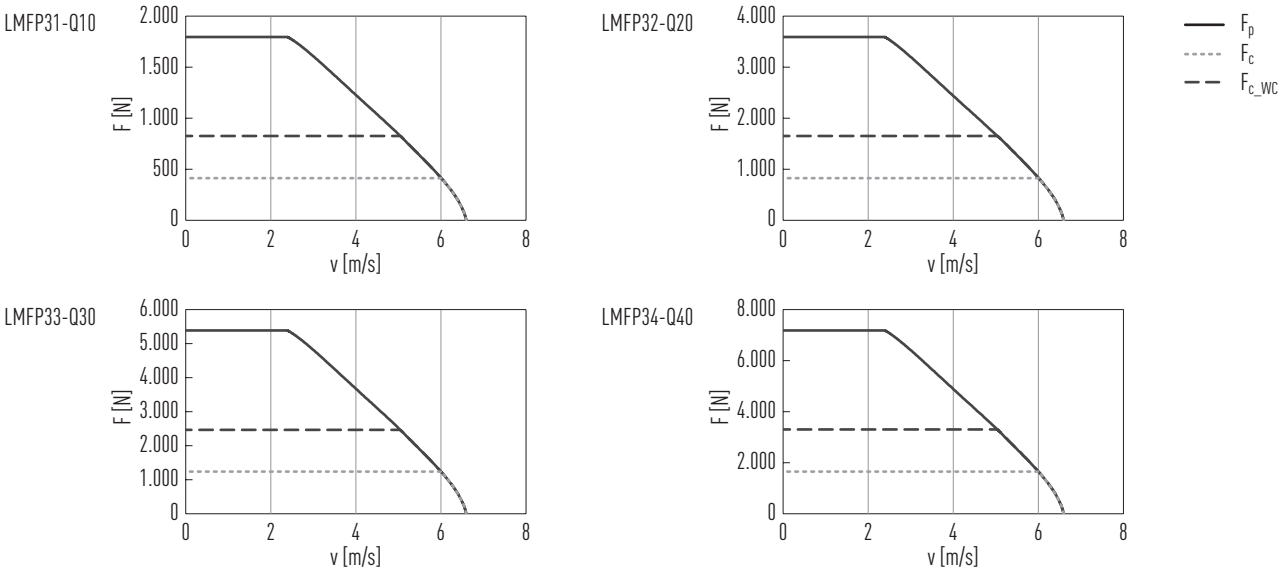
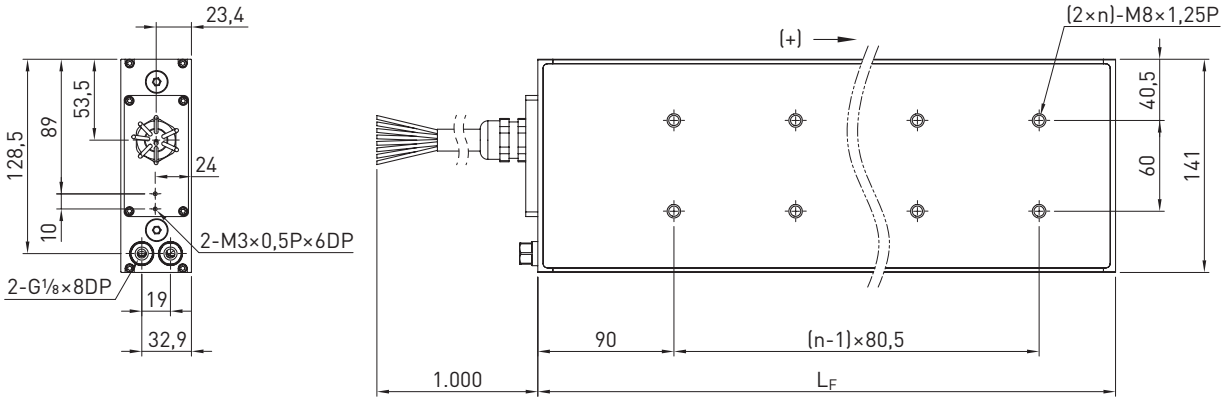


Table 5.2 **Technical data for LMFP3**

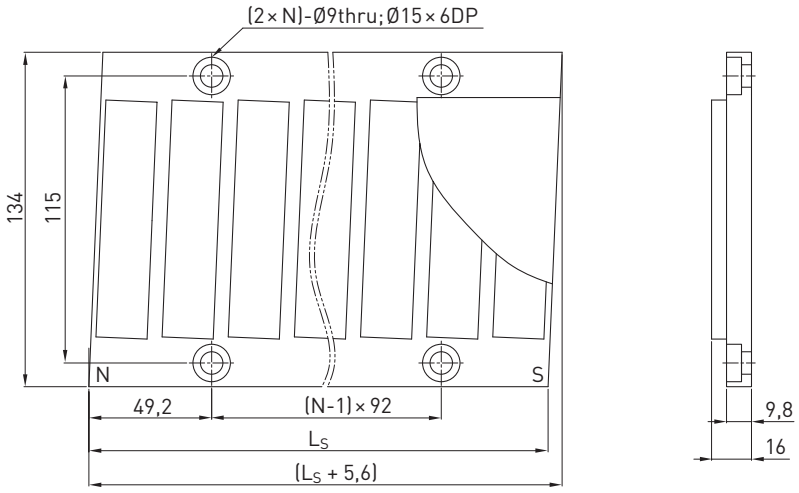
	Symbol	Unit	LMFP31-Q10	LMFP32-Q20	LMFP33-Q30	LMFP34-Q40
Forces and electrical parameters						
Continuous force at T_{max}	F_c	N	413	827	1,240	1,653
Peak force at T_{max} (WC)	F_{c_WC}	N	827	1,653	2,480	3,307
Continuous current at T_{max}	I_c	A_{eff}	4.1	8.2	12.4	16.5
Continuous current at T_{max} (WC)	I_{c_WC}	A_{eff}	8.2	16.5	24.7	33.0
Peak force (for 1 s)	F_p	N	1,797	3,593	5,390	7,187
Peak current (for 1 s)	I_p	A_{eff}	25.6	51.2	76.8	102.4
Force constant	K_f	N/A_{eff}	100.3	100.3	100.3	100.3
Attraction force	F_a	N	3,121	6,243	9,364	12,485
Electrical time constant	K_e	ms	12	12	12	12
Resistance [1]	R_{25}	Ω	3.6	1.8	1.2	0.9
Inductance [1]	L	mH	43.2	21.6	14.4	10.8
Back EMF constant	K_u	V_{eff}/(m/s)	57.9	57.9	57.9	57.9
Motor constant	K_m	N/√W	43.3	61.4	74.5	86.2
Thermal resistance	R_{th}	°C/W	0.77	0.38	0.26	0.19
Thermal resistance (WC)	R_{th_WC}	°C/W	0.19	0.09	0.06	0.05
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	6.9	12.1	17.8	23.1
Length of forcer	L_F	mm	221	382	543	704
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			
Total height	H	mm	64.1			

WC: with water cooling
All specifications are in ± 10 % of tolerance at 25 °C ambient temperature
[1] Line to line

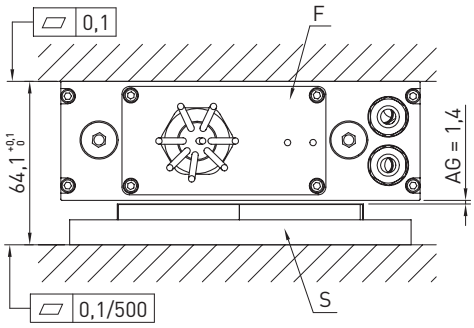
Dimensions of forcer



Dimensions of stator



Mounting tolerances



F Forcer
S Stator
AG Air gap

5.4.3 LMFP4 linear motor specifications

Force-velocity curves (DC bus voltage: 600 VDC)

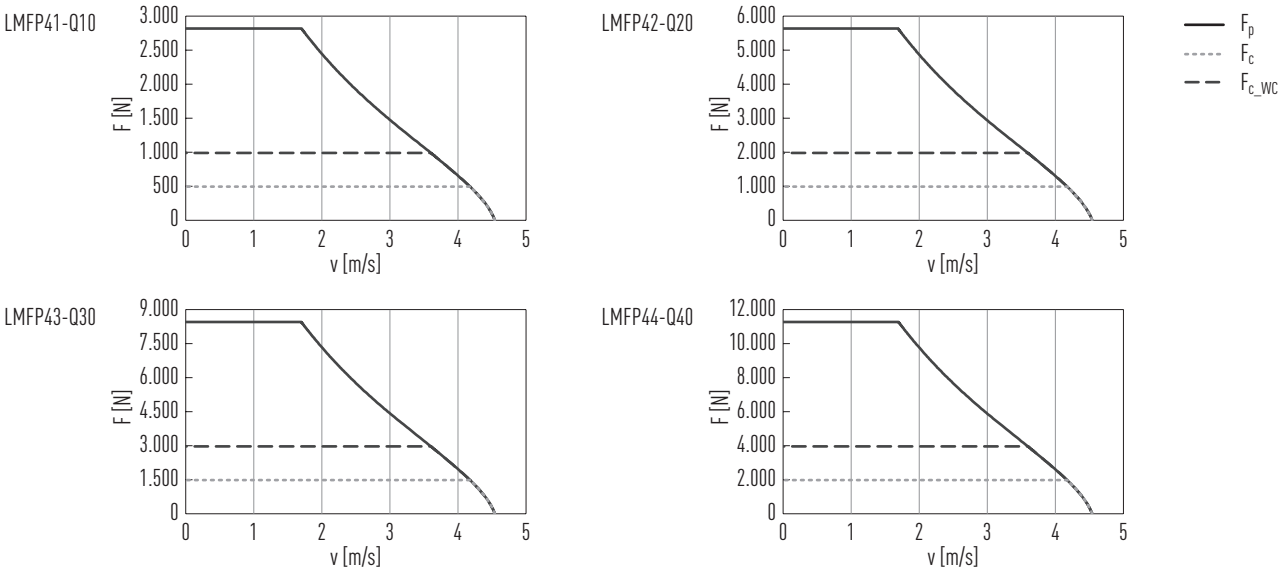
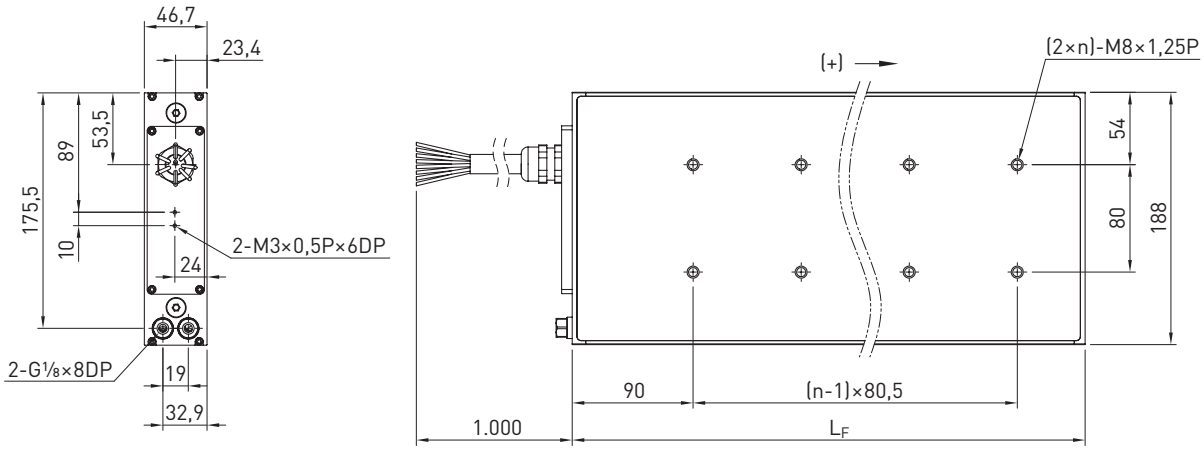


Table 5.3 **Technical data for LMFP4**

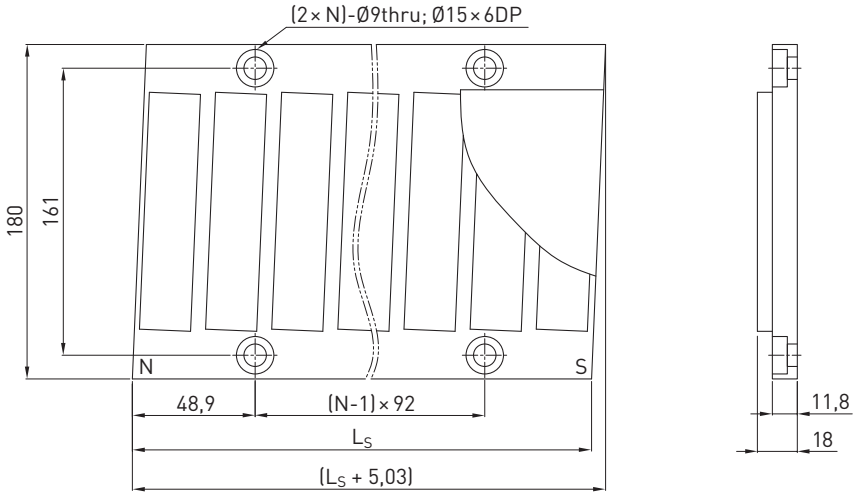
	Symbol	Unit	LMFP41-Q10	LMFP42-Q20	LMFP43-Q30	LMFP44-Q40
Forces and electrical parameters						
Continuous force at T_{max}	F_c	N	495	990	1,485	1,979
Peak force at T_{max} (WC)	F_{c_WC}	N	990	1,979	2,969	3,958
Continuous current at T_{max}	I_c	A_{eff}	3.4	6.8	10.2	13.6
Continuous current at T_{max} (WC)	I_{c_WC}	A_{eff}	6.8	13.6	20.4	27.2
Peak force (for 1 s)	F_p	N	2,820	5,640	8,460	11,280
Peak current (for 1 s)	I_p	A_{eff}	22.7	45.5	68.2	90.9
Force constant	K_f	N/A_{eff}	145.7	145.7	145.7	145.7
Attraction force	F_a	N	4,682	9,363	14,045	18,727
Electrical time constant	K_e	ms	12.6	12.4	12.6	12.4
Resistance [1]	R_{25}	Ω	5.1	2.6	1.7	1.3
Inductance [1]	L	mH	64.5	32.3	21.5	16.1
Back EMF constant	K_u	$V_{eff}/(m/s)$	84.1	84.1	84.1	84.1
Motor constant	K_m	$N/\sqrt{W}$	52.6	73.7	91.2	104.2
Thermal resistance	R_{th}	°C/W	0.78	0.38	0.26	0.19
Thermal resistance (WC)	R_{th_WC}	°C/W	0.20	0.10	0.07	0.05
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	9.9	16.7	25.0	29.8
Length of forcer	L_F	mm	221	382	543	704
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			
Total height	H	mm	66.1			

WC: with water cooling
All specifications are in ± 10 % of tolerance at 25 °C ambient temperature
[1] Line to line

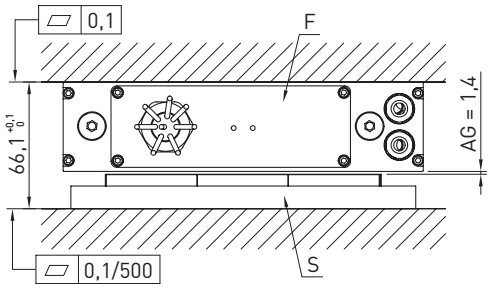
Dimensions of forcer



Dimensions of stator



Mounting tolerances

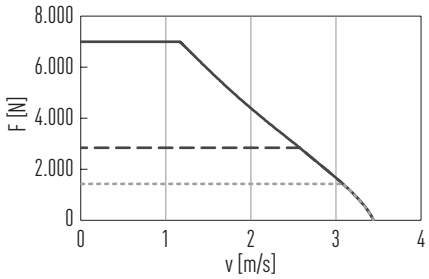


F Forcer
S Stator
AG Air gap

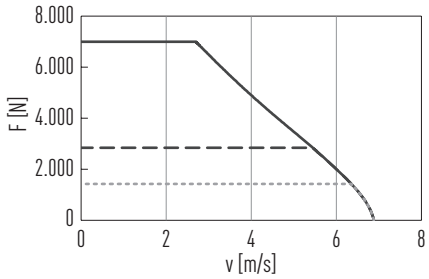
5.4.4 LMFP5 linear motor specifications

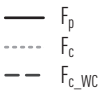
Force-velocity curves (DC bus voltage: 600 VDC)

LMFP52-Q20

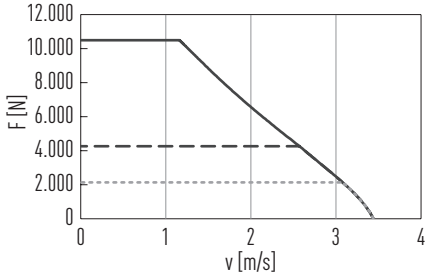


LMFP52-Q40

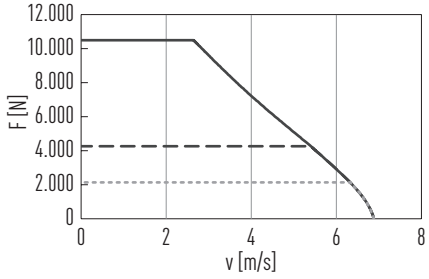




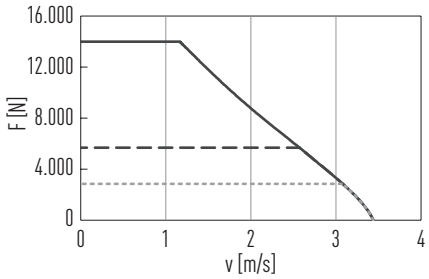
LMFP53-Q30



LMFP53-Q60



LMFP54-Q40



LMFP54-Q80

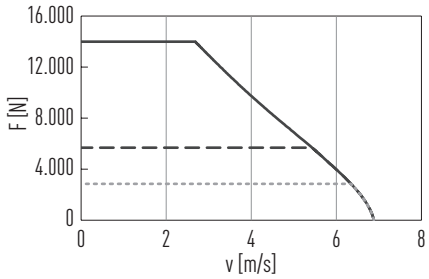
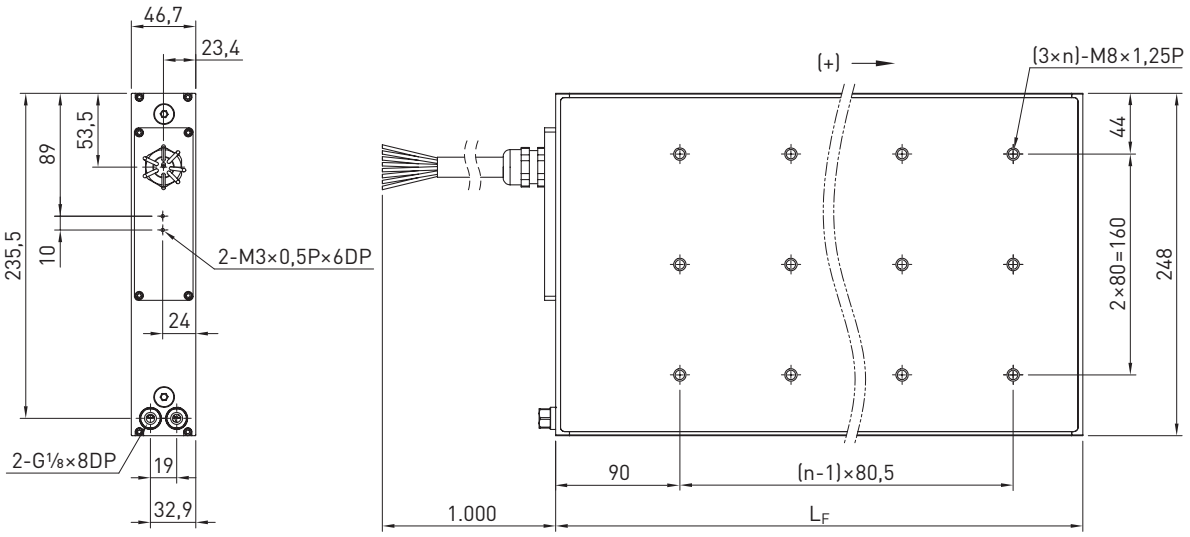


Table 5.4 **Technical data for LMFP5**

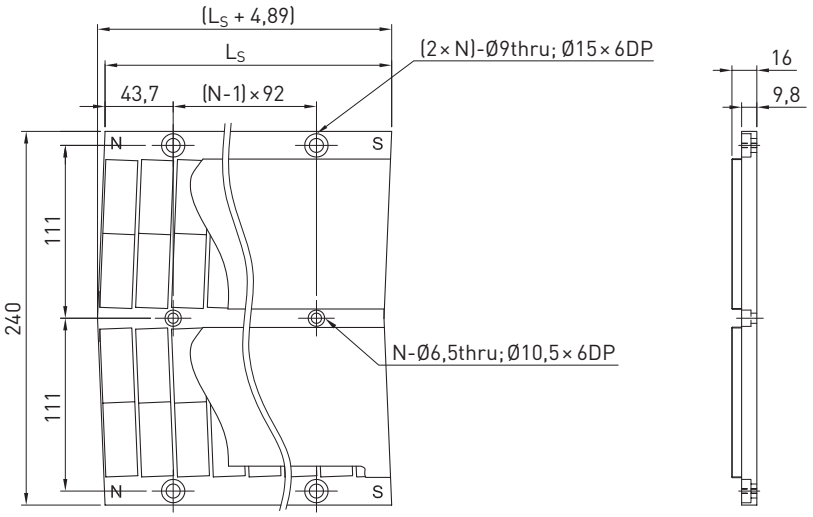
	Symbol	Unit	LMFP52-Q20	LMFP52-Q40	LMFP53-Q30	LMFP53-Q60	LMFP54-Q40	LMFP54-Q80
Forces and electrical parameters								
Continuous force at T_{max}	F_c	N	1,422	1,422	2,133	2,133	2,844	2,844
Peak force at T_{max} (WC)	F_{c_WC}	N	2,844	2,844	4,266	4,266	5,688	5,688
Continuous current at T_{max}	I_c	A_{eff}	7.4	14.8	11.1	22.2	14.8	29.6
Continuous current at T_{max} (WC)	I_{c_WC}	A_{eff}	14.8	29.6	22.2	44.4	29.6	59.2
Peak force (for 1 s)	F_p	N	7,000	7,000	10,500	10,500	14,000	14,000
Peak current (for 1 s)	I_p	A_{eff}	46.3	92.7	69.5	139.0	92.7	185.3
Force constant	K_f	N/A_{eff}	192.3	96.1	192.3	96.1	192.3	96.1
Attraction force	F_a	N	12,467	12,467	18,700	18,700	24,933	24,933
Electrical time constant	K_e	ms	12.6	13.4	12.4	12.0	12.6	13.5
Resistance [1]	R_{25}	Ω	3.4	0.8	2.3	0.6	1.7	0.4
Inductance [1]	L	mH	42.9	10.7	28.6	7.2	21.5	5.4
Back EMF constant	K_u	$V_{eff}/(m/s)$	111.0	55.5	111.0	55.5	111.0	55.5
Motor constant	K_m	$N/\sqrt{W}$	85.1	87.7	103.5	101.3	120.3	124
Thermal resistance	R_{th}	°C/W	0.25	0.26	0.16	0.16	0.13	0.14
Thermal resistance (WC)	R_{th_WC}	°C/W	0.06	0.07	0.04	0.04	0.03	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	4	6	6	8	8
Weight of forcer	M_F	kg	24.8	24.8	33.5	33.5	42.3	42.3
Length of forcer	L_F	mm	382	382	543	543	704	704
Unit mass of stator	M_S	kg/m	25					
Stator length/mounting holes	L_S	mm	184 mm/N = 2; 276 mm/N = 3; 460 mm/N = 5					
Total height	H	mm	64.1					

WC: with water cooling
All specifications are in ± 10 % of tolerance at 25 °C ambient temperature
[1] Line to line

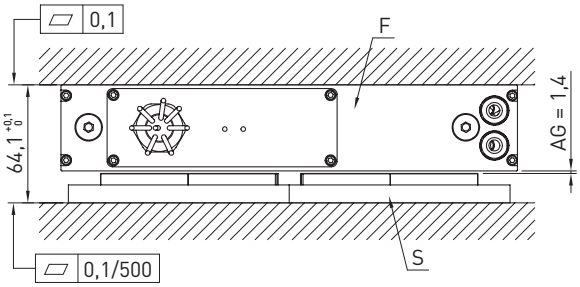
Dimensions of forcer



Dimensions of stator



Mounting tolerances

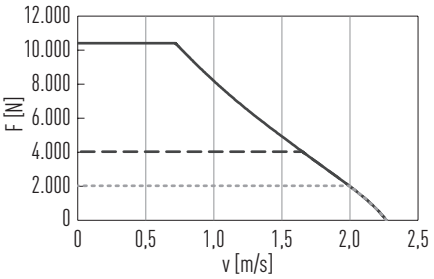


F Forcer
S Stator
AG Air gap

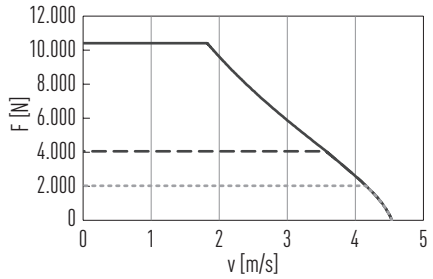
5.4.5 LMFP6 linear motor specifications

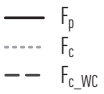
Force-velocity curves (DC bus voltage: 600 VDC)

LMFP62-Q20

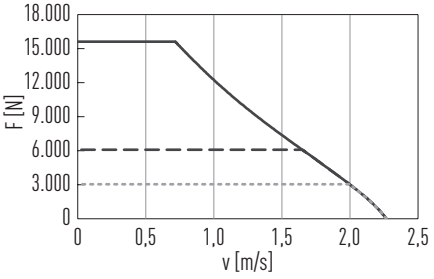


LMFP62-Q40

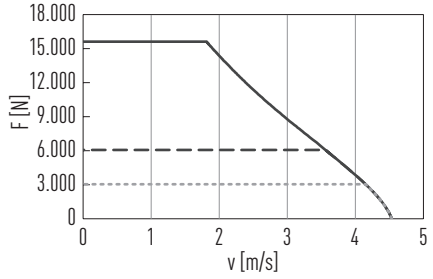




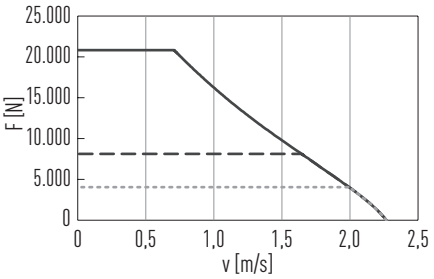
LMFP63-Q30



LMFP63-Q60



LMFP64-Q40



LMFP64-Q80

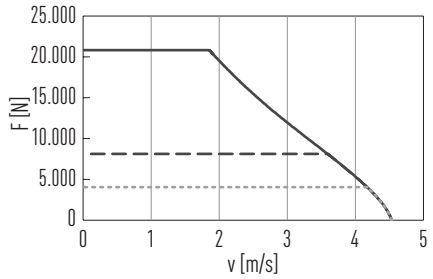
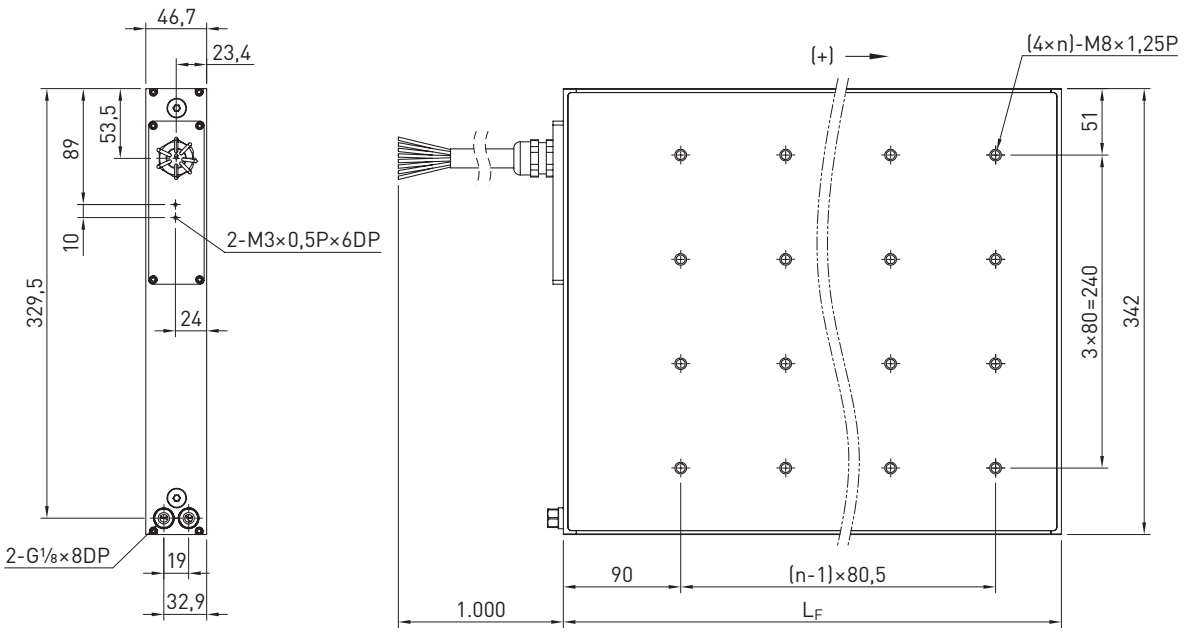


Table 5.5 **Technical data for LMFP6**

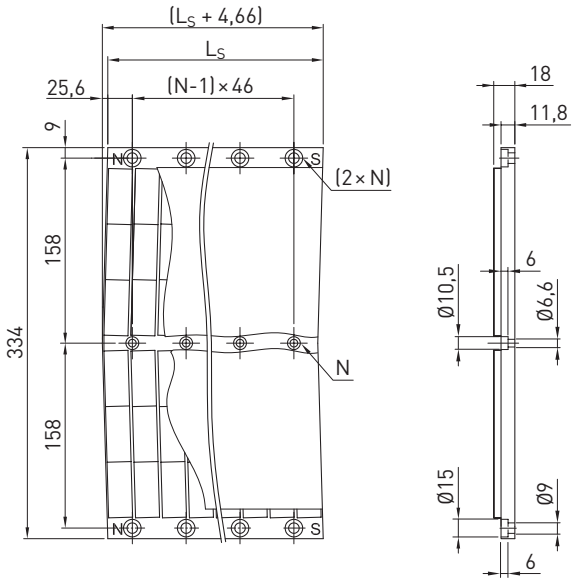
	Symbol	Unit	LMFP62-Q20	LMFP62-Q40	LMFP63-Q30	LMFP63-Q60	LMFP64-Q40	LMFP64-Q80
Forces and electrical parameters								
Continuous force at T_{max}	F_c	N	2,029	2,029	3,043	3,043	4,058	4,058
Peak force at T_{max} (WC)	F_{c_WC}	N	4,057	4,057	6,086	6,086	8,115	8,115
Continuous current at T_{max}	I_c	A_{eff}	7.0	13.9	10.4	20.9	13.9	27.8
Continuous current at T_{max} (WC)	I_{c_WC}	A_{eff}	13.9	27.8	20.9	41.7	27.8	55.7
Peak force (for 1 s)	F_p	N	10,414	10,414	15,620	15,620	20,827	20,827
Peak current (for 1 s)	I_p	A_{eff}	41.9	83.8	62.9	125.7	83.8	167.6
Force constant	K_f	N/A_{eff}	291.7	145.8	291.7	145.8	291.7	145.8
Attraction force	F_a	N	18,727	18,727	28,091	28,091	37,454	37,454
Electrical time constant	K_e	ms	12.6	12.4	12.6	11.9	12.4	13.3
Resistance [1]	R_{25}	Ω	5.1	1.3	3.4	0.9	2.6	0.6
Inductance [1]	L	mH	64.3	16.1	42.9	10.7	32.2	8.0
Back EMF constant	K_u	$V_{eff}/(m/s)$	168.4	84.2	168.4	84.2	168.4	84.2
Motor constant	K_m	$N/\sqrt{W}$	104.8	104.5	129.6	125.3	147.8	153.9
Thermal resistance	R_{th}	°C/W	0.18	0.18	0.12	0.12	0.09	0.10
Thermal resistance (WC)	R_{th_WC}	°C/W	0.05	0.05	0.03	0.03	0.02	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		16	16	24	24	32	32
Weight of forcer	M_F	kg	33.4	33.4	46.7	46.7	57.6	57.6
Length of forcer	L_F	mm	382	382	543	543	704	704
Unit mass of stator	M_S	kg/m	40.1					
Stator length/mounting holes	L_S	mm	184 mm/N = 4					
Total height	H	mm	66.1					

WC: with water cooling
All specifications are in ± 10 % of tolerance at 25 °C ambient temperature
[1] Line to line

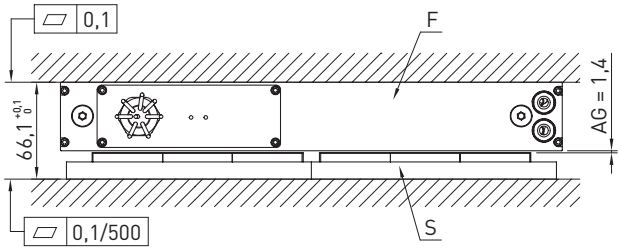
Dimensions of forcer



Dimensions of stator



Mounting tolerances



F Forcer
S Stator
AG Air gap