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Linear Motors & Positioning Measurement Systems

3. HIWIN LMC linear motors

3.1 Special characteristics of the LMC linear motors

The HIWIN LMC synchronous linear motors are the dynamic sprinters of linear actuators. With the light, ironless forcer and the U-shaped design of the stators with opposing magnets, no cogging torques occur between forcers and stators, and no magnetic forces are introduced into the guiding system. The linear motors in the LMC series thus achieve extremely high synchronism and high acceleration due to the minimal forcer mass. The LMC linear motors are optionally available as a vacuum system. The benefits of the LMC linear motors make them the preferred choice in fields where small masses with a maximum number of cycles need to be positioned very precisely. Due to their very high synchronism, the LMC linear motors are also suitable for application in testing and measuring machines.

Key features of the LMC linear motors:

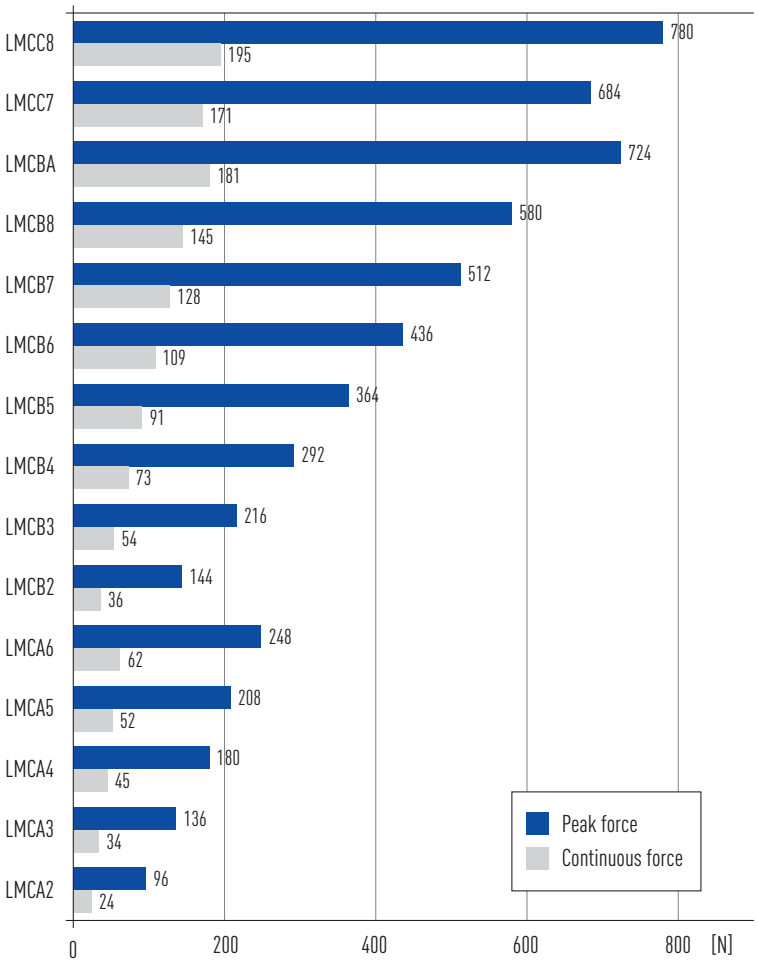
- Extremely dynamic
- No cogging, thus highest synchronous operation
- No magnetic pull in the guiding system
- Optional: design for vacuum applications

Typical fields of application of the LMC linear motors:

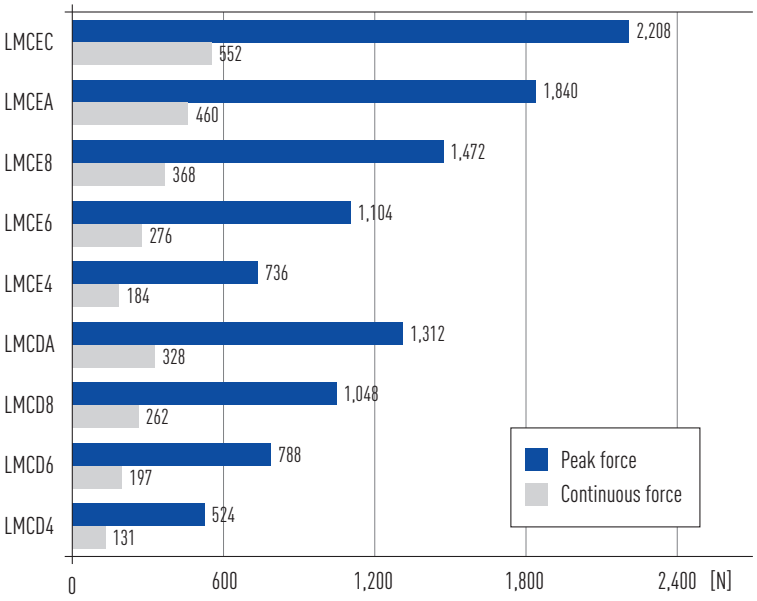
- Pick-and-place machines in semiconductor technology
- Air bearing axes
- Wafer structuring
- Pick-and-place machines
- High-precision measuring and testing machines
- Semiconductors

3.2 Force chart for LMC linear motors

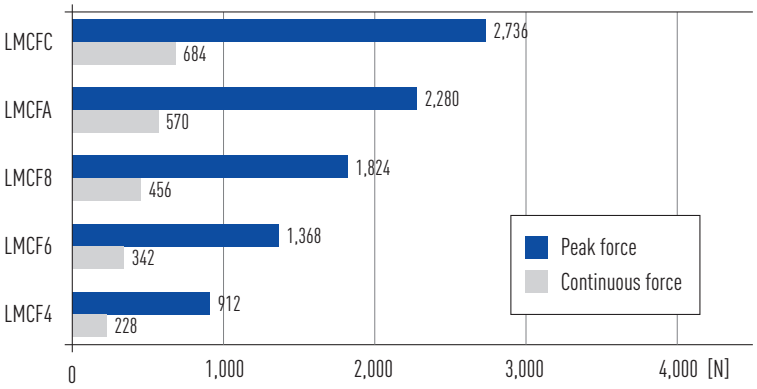
Force chart for linear motors LMCA, LMCB, LMCC



Force chart for linear motors LMCD, LMCE



Force chart for linear motors LMCF



3.3 Order code LMC linear motors

3.3.1 Order code of primary part (forcer)

LMC	A2

Linear motor:
LMC

Motor type[1)]

[1)] See Table 3.1 (LMCA, LMCB, LMCC), Table 3.2 (LMCD, LMCE), Table 3.3 (LMCF)

3.3.2 Order code of magnet track (stator)

LMC	A	S	1

Stator for linear motors:
LMC

Height of stator:
A: Suitable for LMCA
B: Suitable for LMCB
C: Suitable for LMCC
D: Suitable for LMCD
E: Suitable for LMCE
F: Suitable for LMCF

Length of stator [mm]:
LMCA, LMCB, LMCC: 0: 128
3: 320
LMCD, LMCE, LMCF: 1: 120
2: 300

Stator model:
S: Standard
C: Customer specific

3.4 LMC linear motor specifications

3.4.1 LMCA, LMCB, LMCC linear motor specifications

Force-velocity curves (DC bus voltage: 330 VDC)

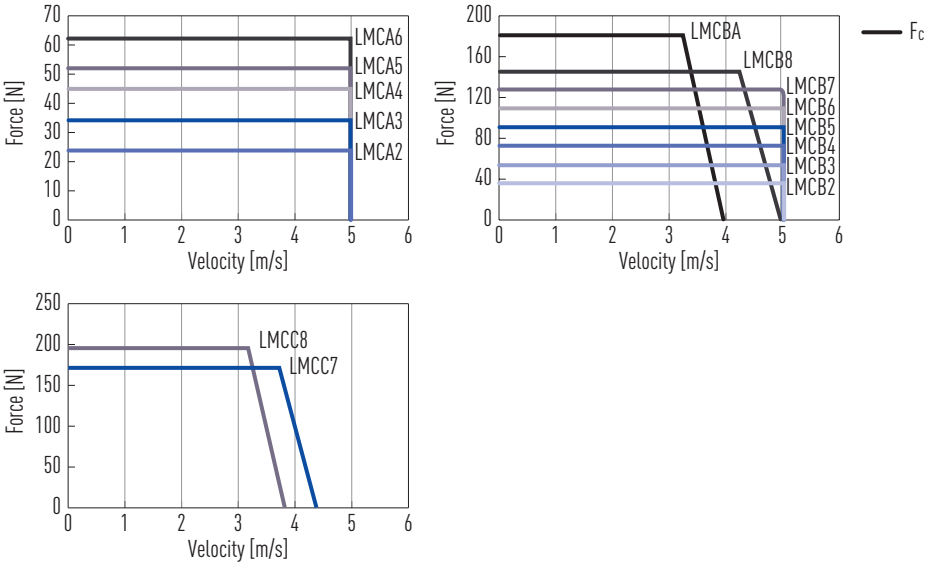
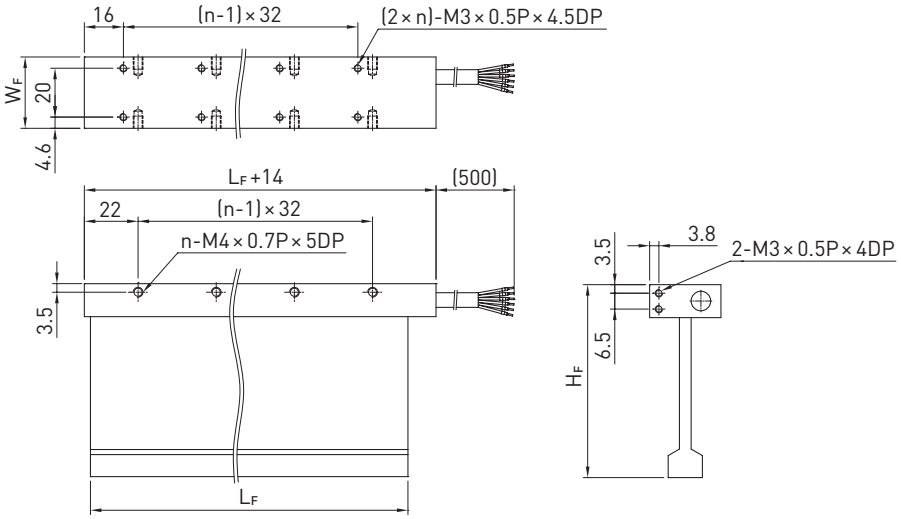


Table 3.1 **Technical data for LMCA, LMCB, LMCC**

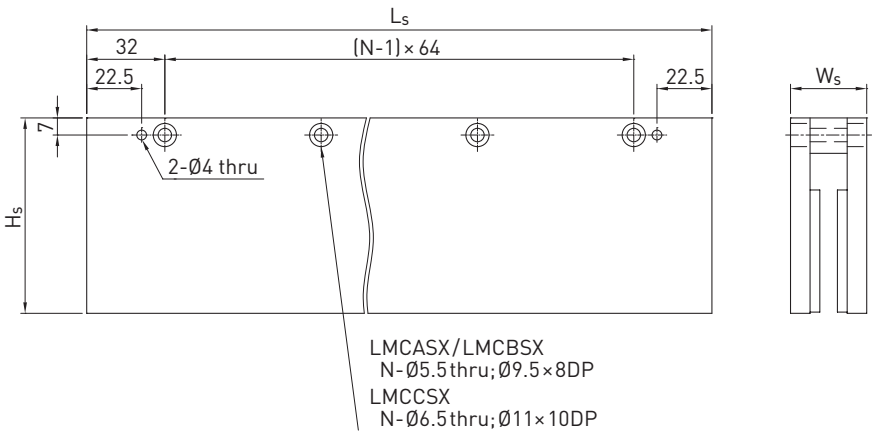
	Symbol	Unit	LMCA2	LMCA3	LMCA4	LMCA5	LMCA6	LMCB2	LMCB3	LMCB4	LMCB5	LMCB6	LMCB7	LMCB8	LMCBA	LMCC7	LMCC8
Forces and electrical parameters																	
Continuous force at T_{max}	F_c	N	24	34	45	52	62	36	54	73	91	109	128	145	181	171	195
Continuous current at T_{max}	I_c	A_{eff}	2.3	2.1	2.1	1.8	1.8	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Peak force (for 1 s)	F_p	N	96	136	180	208	248	144	216	292	364	436	512	580	724	684	780
Peak current (for 1 s)	I_p	A_{eff}	9.2	8.4	8.4	7.2	7.2	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Force constant	K_f	N/A_{eff}	10.6	15.8	21.2	28.2	33.8	18.1	27.2	36.3	45.4	54.5	63.5	72.5	90.6	85.4	97.5
Electrical time constant	K_e	ms	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
Resistance [1]	R_{25}	Ω	2.7	4.1	5.4	6.7	8.2	3.6	5.4	7.1	9.0	10.7	12.6	14.6	17.9	15.8	18.2
Inductance [1]	L	mH	1.0	1.4	1.9	2.3	2.8	1.4	1.9	2.6	3.2	3.8	4.4	5.0	6.2	5.5	6.3
Back EMF constant	K_u	$V_{eff}/(m/s)$	5.9	8.8	11.9	14.5	17.4	10.1	15.2	20.0	24.8	29.3	34.7	40.0	50.0	45.4	51.9
Motor constant	K_m	$N/\sqrt{W}$	5.2	6.5	7.5	9.1	9.8	7.7	9.5	11.2	12.4	13.6	14.7	15.5	17.5	17.6	18.7
Thermal resistance	R_{th}	°C/W	2.80	2.21	1.68	1.84	1.50	2.77	1.85	1.41	1.11	0.93	0.79	0.68	0.56	0.63	0.55
Thermal switch			3 PTC SNM 100 in series														
Max. DC bus voltage		V	330														
Mechanical parameters																	
Max. bending radius of motor cable	R_{bend}	mm	37.5														
Pole pair pitch	2τ	mm	32														
Max. winding temperature	T_{max}	°C	100														
Mounting holes (forcer)	n		2	3	4	5	6	2	3	4	5	6	7	8	10	7	8
Weight of forcer	M_F	kg	0.15	0.23	0.31	0.38	0.45	0.2	0.29	0.38	0.48	0.58	0.68	0.72	0.88	0.74	0.76
Width of forcer	W_F	mm	29.2														
Length of forcer	L_F	mm	66	98	130	162	194	66	98	130	162	194	226	258	322	226	258
Height of forcer	H_F	mm	59					79								99	
Unit mass of stator	M_S	kg/m	7					12								21	
Width of stator	W_S	mm	31.2													35.2	
Length of stator/Dimension N	L_S	mm	128 mm/N = 2; 320 mm/N = 5														
Height of stator	H_S	mm	60					80								103	
Total height (forcer + stator)	H	mm	74.5					94.5								117.5	

All the specifications in the table (except dimensions) are in ± 10 % of tolerance at 25 °C ambient temperature; [1] Line to line

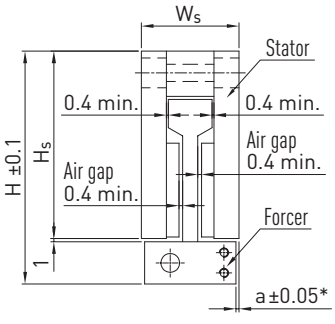
Dimensions of forcer



Dimensions of stator



Mounting tolerances



*LMCA, LMCB: a = 1
*LMCC: a = 3

3.4.2 LMCD, LMCE linear motor specifications

Force-velocity curves (DC bus voltage: 330 VDC)

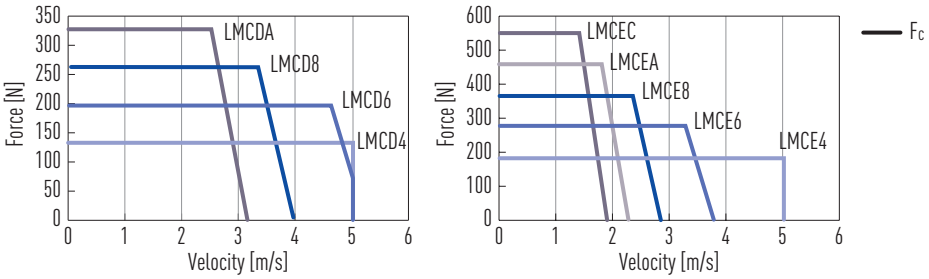
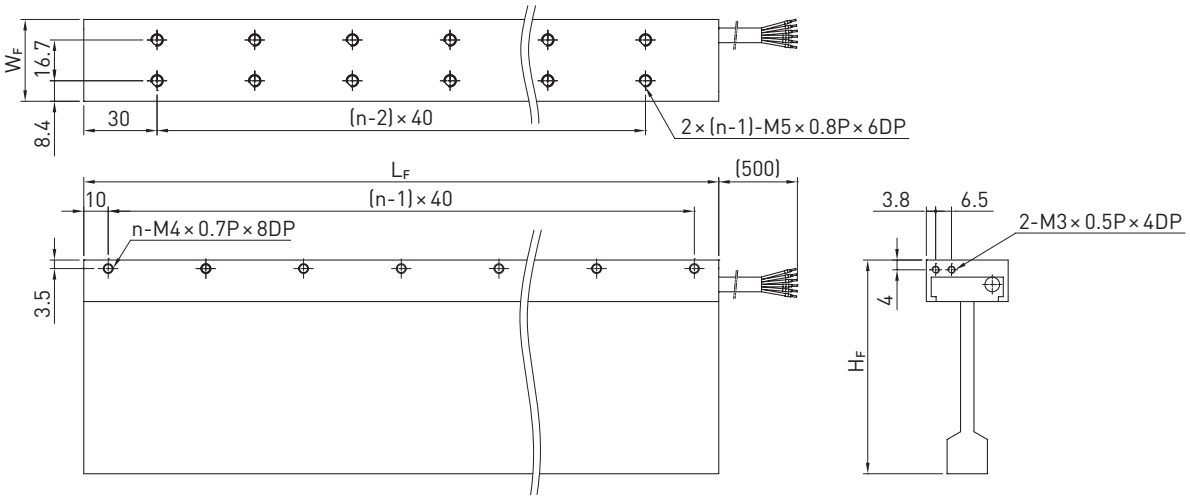


Table 3.2 **Technical data for LMCD, LMCE**

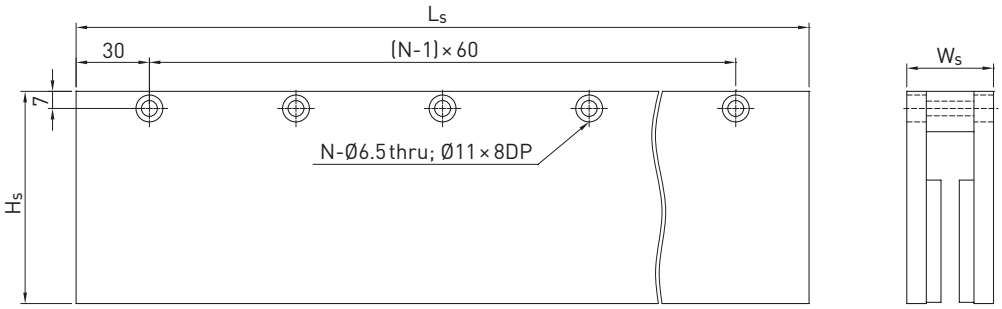
	Symbol	Unit	LMCD4	LMCD6	LMCD8	LMCDA	LMCE4	LMCE6	LMCE8	LMCEA	LMCEC
Forces and electrical parameters											
Continuous force at T_{max}	F_c	N	131	197	262	328	184	276	368	460	552
Continuous current at T_{max}	I_c	A_{eff}	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Peak force (for 1 s)	F_p	N	524	788	1,048	1,312	736	1,104	1,472	1,840	2,208
Peak current (for 1 s)	I_p	A_{eff}	13	13	13	13	13	13	13	13	13
Force constant	K_f	N/A_{eff}	40.3	60.6	80.6	100.9	56.6	84.9	113.2	141.5	169.8
Electrical time constant	K_e	ms	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Resistance [1]	R_{25}	Ω	4.6	7.1	9.0	11.6	5.6	8.4	11.0	13.8	16.7
Inductance [1]	L	mH	2.3	3.5	4.7	5.8	2.9	4.4	5.9	7.3	8.8
Back EMF constant	K_u	$V_{eff}/(m/s)$	25	38	50	63	35	53	70	88	106
Motor constant	K_m	$N/\sqrt{W}$	14.6	17.8	20.0	22.2	19.1	23.4	27.0	30.2	33.2
Thermal resistance	R_{th}	°C/W	0.82	0.53	0.42	0.33	0.68	0.45	0.34	0.27	0.23
Thermal switch			3 PTC SNM 100 in series								
Max. DC bus voltage		V	330								
Mechanical parameters											
Max. bending radius of motor cable	R_{bend}	mm	37.5								
Pole pair pitch	2τ	mm	60								
Max. winding temperature	T_{max}	°C	100								
Mounting holes (forcer)	n		7	10	13	16	7	10	13	16	19
Weight of forcer	M_F	kg	0.88	1.32	1.76	2.20	1.23	1.84	2.46	3.08	3.70
Width of forcer	W_F	mm	33.5								
Length of forcer	L_F	mm	260	380	500	620	260	380	500	620	740
Height of forcer	H_F	mm	87.5				107.5				
Unit mass of stator	M_S	kg/m	16				20				
Width of stator	W_S	mm	35.5								
Length of stator/Dimension N	L_S	mm	120 mm/N = 2; 300 mm/N = 5								
Height of stator	H_S	mm	86.8				106.8				
Total height (forcer + stator)	H	mm	105				125				

All the specifications in the table (except dimensions) are in ± 10 % of tolerance at 25 °C ambient temperature
[1] Line to line

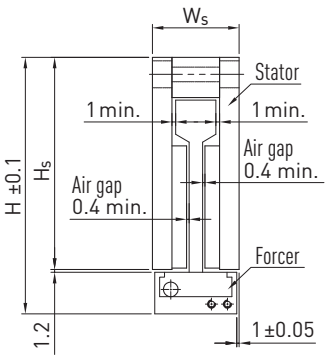
Dimensions of forcer



Dimensions of stator



Mounting tolerances



3.4.3 LMCF linear motor specifications

Force-velocity curves (DC bus voltage: 330 VDC)

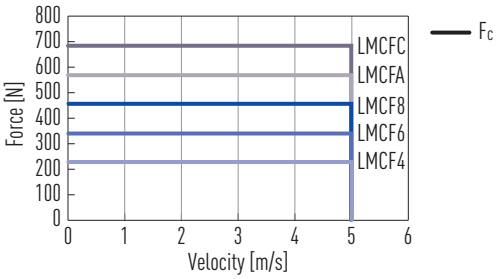
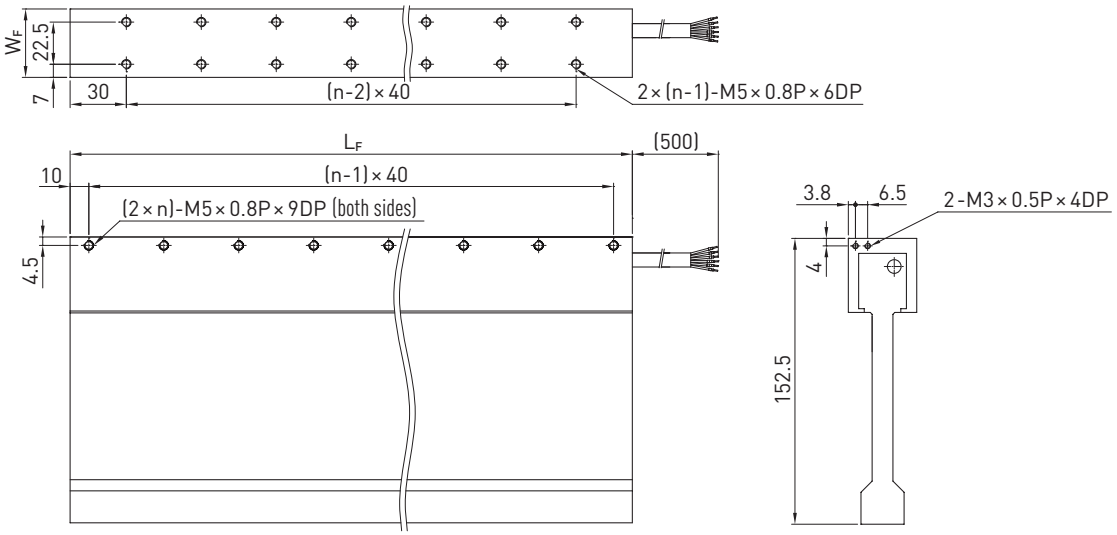


Table 3.3 **Technical data for LMCF**

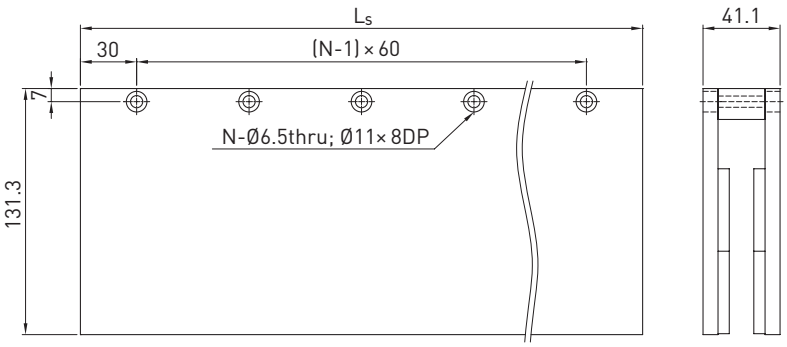
	Symbol	Unit	LMCF4	LMCF6	LMCF8	LMCFA	LMCFC
Forces and electrical parameters							
Continuous force at T_{max}	F_c	N	228	342	456	570	684
Continuous current at T_{max}	I_c	A_{eff}	3.8	5.7	7.6	9.5	11.4
Peak force (for 1 s)	F_p	N	912	1,368	1,824	2,280	2,736
Peak current (for 1 s)	I_p	A_{eff}	15.2	22.8	30.4	38.0	45.6
Force constant	K_f	N/A_{eff}	60	60	60	60	60
Electrical time constant	K_e	ms	1	1	1	1	1
Resistance [1]	R_{25}	Ω	3.3	2.2	1.7	1.3	1.1
Inductance [1]	L	mH	3.3	2.2	1.7	1.3	1.1
Back EMF constant	K_u	$V_{eff}/(m/s)$	34.4	34.4	34.4	34.4	34.4
Motor constant	K_m	$N/\sqrt{W}$	27.0	33.0	37.7	43.0	46.2
Thermal resistance	R_{th}	°C/W	0.84	0.56	0.41	0.34	0.27
Thermal switch			3 PTC SNM 100 in series				
Max. DC bus voltage		V	330				
Mechanical parameters							
Max. bending radius of motor cable	R_{bend}	mm	57.5				
Pole pair pitch	2τ	mm	60				
Max. winding temperature	T_{max}	°C	100				
Mounting holes (forcer)	n		7	10	13	16	19
Weight of forcer	M_F	kg	2.5	3.75	5	6.25	7.5
Width of forcer	W_F	mm	36.5				
Length of forcer	L_F	mm	260	380	500	620	740
Height of forcer	H_F	mm	152.5				
Unit mass of stator	M_S	kg/m	25.6				
Width of stator	W_S	mm	41.1				
Length of stator/Dimension N	L_S	mm	120 mm/N = 2; 300 mm/N = 5				
Height of stator	H_S	mm	131.3				
Total height (forcer + stator)	H	mm	172				

All the specifications in the table (except dimensions) are in ± 10 % of tolerance at 25 °C ambient temperature
[1] Line to line

Dimensions of forcer



Dimensions of stator



Mounting tolerances