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LINEAR MOTOR





Definition



Magnet Plate

① ② ③
LMU (010/020/030/040/050) - MP 90

① Series

LMF Flat-type Linear Motor (Ironcore)
LMU U-type Linear Motor (Ironless)
LMUS U-type Linear Motor (Ironless)_Special

② Height

010 51.9mm
020 58.5mm
030 83.4mm
040 115.3mm
050 157mm

③ Length

xx Magnet Plate Length

Coil Plate

① ② ③ ④ ⑤ ⑥
LMU(010/020/030/040/050) - CP 193 A R C

① Series

LMF Flat-type Linear Motor (Ironcore)
LMU U-type Linear Motor (Ironless)
LMUS U-type Linear Motor (Ironless)_Special

② Height

010 51.9mm
020 58.5mm
030 83.4mm
040 115.3mm
050 157mm

③ Length

xx Coil Plate Length

④ Winding Options

A Series
B Parallel
C Four Parallel

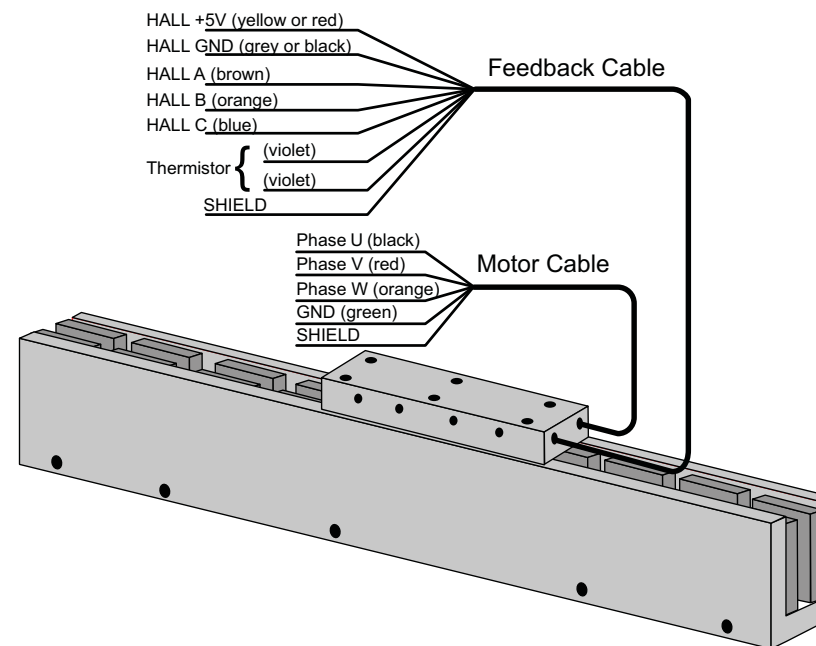
⑤ Hall Options

R Hall
S Thermistor
T Thermistor, Hall
Blank No Hall-effect device

⑥ Cooling Options

C Air Cooling
Blank No Cooling

Motor Wiring



Cable Diameter and Wire Gauge

Motor	Motor		Feedback	
	Cable Diameter	Wire Gauge	Cable Diameter	Wire Gauge
	mm	AWG[mm ²]	mm	AWG[mm ²]
LMU010,LMU020,LMU030	4.5	22 [0.30]	5	26 [0.12]
LMU040	8.2	16 [1.31]	5	26 [0.12]
LMU050	10.4	14 [2.08]	5	26 [0.12]



The LMU010 is the smallest of LMU series linear motor. It is a very efficient drive system that was developed to fit in the smallest possible space. This is most appropriate linear motor for the mimiturization of equipment in various fields.

Standard Specifications

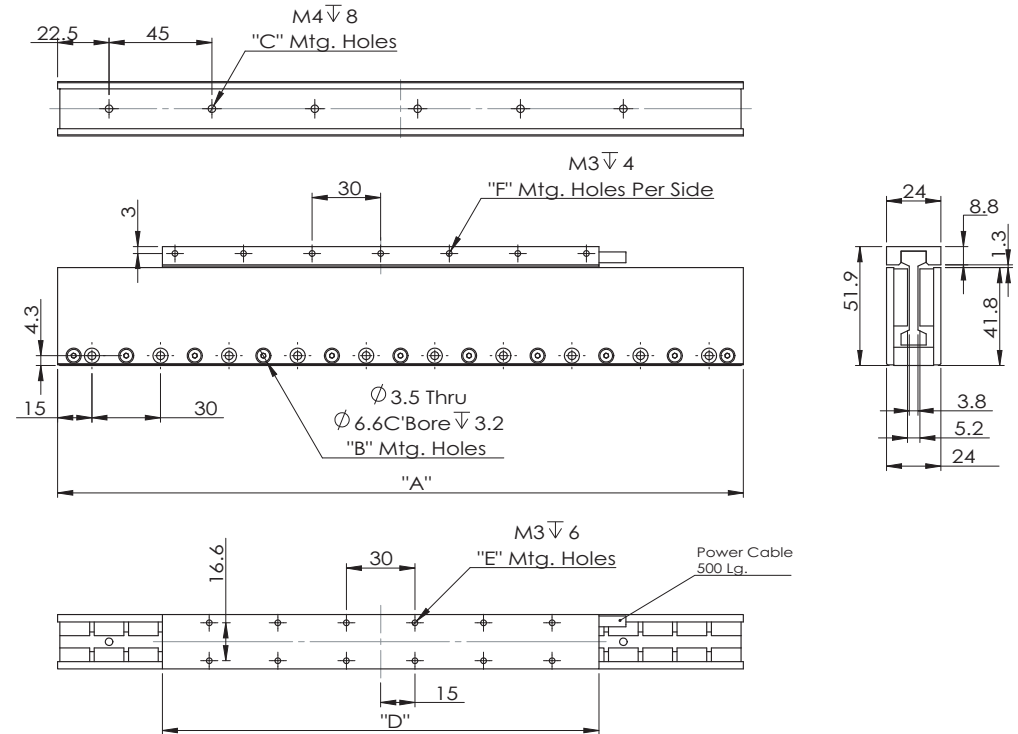
Insulation Capacity	: AC1500V 1min
Operating Range	: 0~25°C
Cooling Method	: Self-cool
Insulation Resistance	: DC500V 100MΩ or more
Operating range (in controlled environment)	: 20~80%(No condensation)
Maximum temperature	: 125°C

Specification

Parameter	Unit	LMU010-CP71	LMU010-CP131	LMU010-CP191	LMU010-CP252
Performance Specifications					
Continuous Force	N	30	58	80	105
Peak Force	N	210	406	560	735
Electrical Specifications					
BEMF Constant(line-line,peak)	V/(m/s)	12.28	24.57	36.85	49.14
Continuous Current	Arms	1.99	1.92	1.76	1.74
Peak Current,Stall	Arms	13.90	13.43	12.35	12.16
Force Constant	N/Arms	15.11	30.22	45.33	60.44
Motor Constant	N/√W	4.30	7.29	9.04	11.08
Resistance,25°C (line-line)	Ω	6.06	12.13	18.19	24.26
Inductance,(line-line)	mH	0.85	1.70	2.55	3.40
Thermal Resistance	°C/W	2.21	1.38	1.1	0.9
Maximum Bus Voltage	V _{DC}	340	340	340	340
Machanical Specifications					
Coil Weight	kg	0.1	0.18	0.27	0.38
Coil Length	mm	71	131	191	252
Magnet Track Weight	kg/m	4.28			
Magnetic Pole Pitch (NN)	mm	30			

Notes:

- 1.Performance is dependent upon heat sink configuration, system cooling conditions,and ambient temperature.
- 2.Values shown @ 100°C rise above a 25°C ambient temperature,with motor mounted to the specified aluminum heat sink.
- 3.Peak force assumes correct rms current;consult SMJ.
- 4.Force constant and motor constant specified at stall.
- 5.All performance and electrical specifications±10%.

Dimensions(mm)**Magnet Plate**

Model No.	A	B	C
LMU010-MP90	90	3	2
LMU010-MP150	150	5	3
LMU010-MP300	300	10	6

Coil Plate

Model No.	D	E	F
LMU010-CP71	71	4	3
LMU010-CP131	131	8	4
LMU010-CP191	191	12	7
LMU010-CP252	252	16	9



LINEAR MOTOR LMU020



This series of linear motor is well suited for applications that require precision positioning, high speed, quick acceleration such as Semiconductor manufacturing equipment. It is also able to be utilized in limited work spaces. It is the most appropriate linear motor design for the reduction of manufacturing equipment size.

Standard Specifications

Insulation Capacity	: AC1500V 1min
Operating Range	: 0~25°C
Cooling Method	: Self-cool
Insulation Resistance	: DC500V 100MΩ or more
Operating range (in controlled environment)	: 20~80%(No condensation)
Maximum temperature	: 125°C

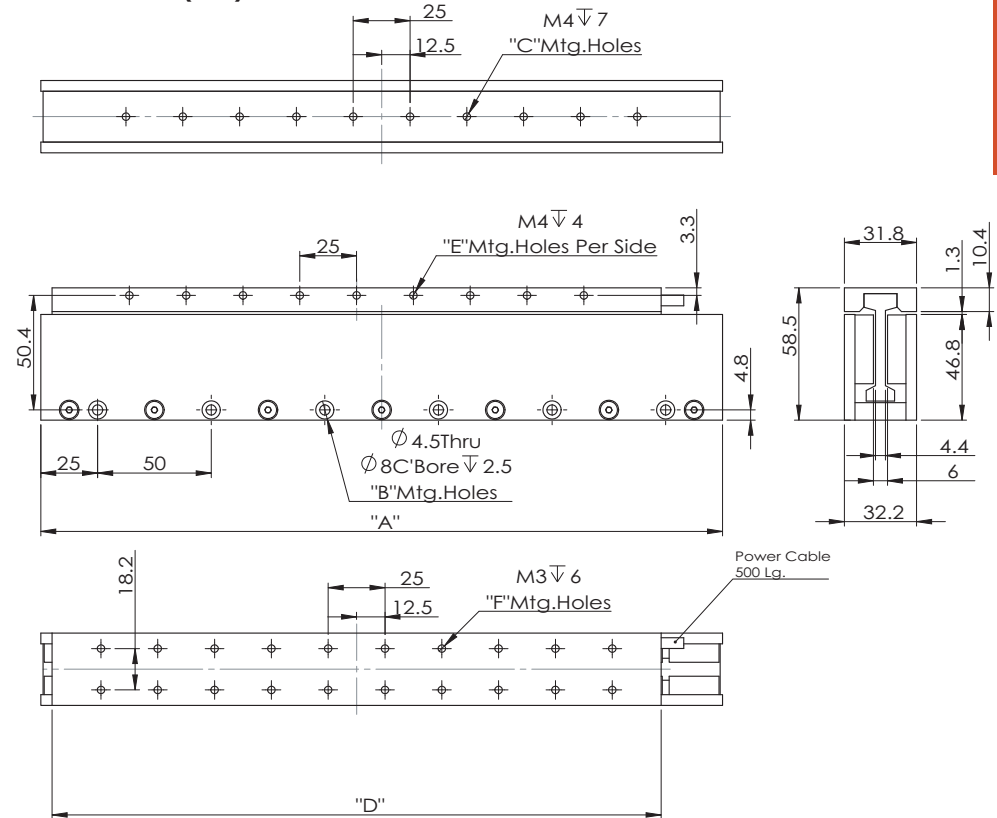
Specification

Parameter	Unit	LMU020-CP93	LMU020-CP143	LMU020-CP193	LMU020-CP268
Performance Specifications					
Continuous Force	N	55	85	110	135
Peak Force	N	385	595	770	945
Electrical Specifications					
BEMF Constant(line-line,peak)	V/(m/s)	12.76	21.28	29.79	42.55
Continuous Current	Arms	3.50	3.25	3.00	2.58
Peak Current,Stall	Arms	24.52	22.74	21.02	18.06
Force Constant	N/Arms	15.7	26.17	36.64	52.34
Motor Constant	N/√W	5.66	8.20	10.29	11.52
Resistance,25°C (line-line)	Ω	2.89	4.82	6.75	9.65
Inductance,(line-line)	mH	0.83	1.33	1.9	3.4
Thermal Resistance	°C/W	1.62	1.12	0.93	0.87
Maximum Bus Voltage	V _{DC}	340	340	340	340
Machanical Specifications					
Coil Weight	kg	0.16	0.26	0.34	0.52
Coil Length	mm	93	143	193	268
Magnet Track Weight	kg/m	6.59			
Magnetic Pole Pitch (NN)	mm	50			

Notes:

- 1.Performance is dependent upon heat sink configuration, system cooling conditions,and ambient temperature.
- 2.Values shown @ 100°C rise above a 25°C ambient temperature,with motor mounted to the specified aluminum heat sink.
- 3.Peak force assumes correct rms current;consult SMJ.
- 4.Force constant and motor constant specified at stall.
- 5.All performance and electrical specifications±10%.

Dimensions(mm)



Magnet Plate

Model No.	A	B	C
LMU020-MP150	150	3	4
LMU020-MP300	300	6	10
LMU020-MP600	600	12	22

Coil Plate

Model No.	D	E	F
LMU020-CP93	93	2	4
LMU020-CP143	143	5	8
LMU020-CP193	193	7	12
LMU020-CP268	268	9	20



This model is suitable for a wide range of field such as Semiconductor production equipment and assembly robots.

Standard Specifications

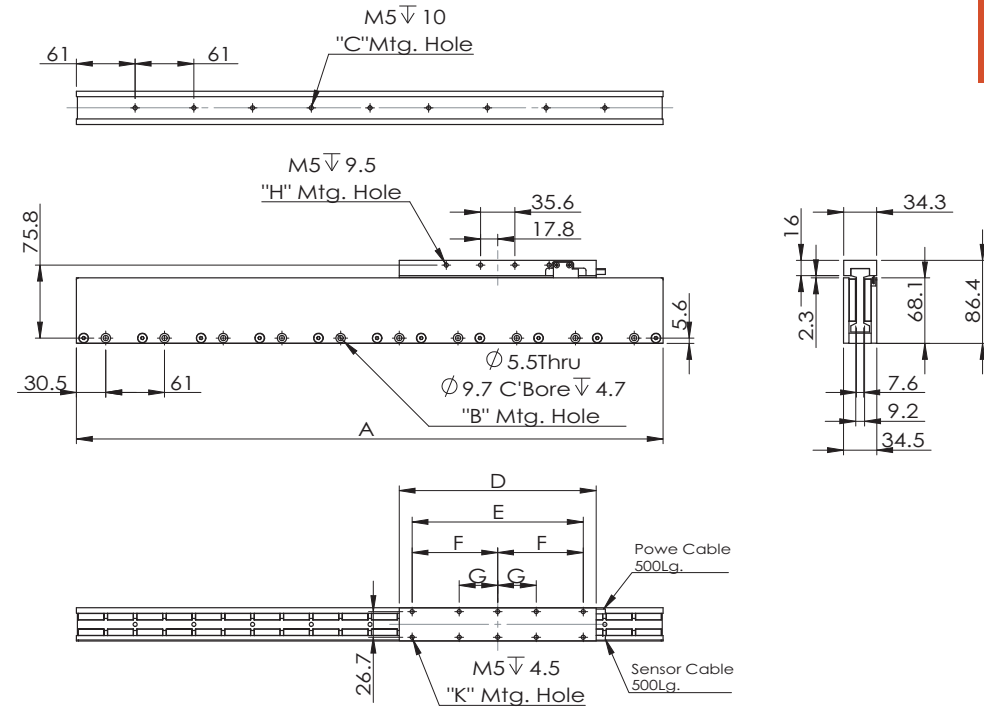
Insulation Capacity	: AC1500V 1min
Operating Range	: 0~25°C
Cooling Method	: Self-cool
Insulation Resistance	: DC500V 100MΩ or more
Operating range	: 20~80%(No condensation)
Maximum temperature	: 125°C

Specification

Parameter	Unit	LMU030-CP143		LMU030-CP204		LMU030-CP265		LMU030-CP387	
		A	B	A	B	A	B	A	B
Performance Specifications									
Continuous Force	N	110.5		153.3		197.2		257.3	
Peak Force	N	692.7		1006.4		1206.6		1590.4	
Electrical Specifications									
BEMF Constant(line-line,peak)	V/(m/s)	40.97	20.49	66.50	33.25	88.93	44.46	134.46	67.23
Continuous Current	Arms	2.19	4.38	1.87	3.75	1.80	3.61	1.56	3.11
Peak Current,Stall	Arms	13.75	27.49	12.30	24.61	11.03	22.06	9.62	19.23
Force Constant	N/Arms	50.39	25.2	81.8	40.9	109.39	54.69	165.38	82.69
Motor Constant	N/v/W	10.53		14.11		16.39		20.17	
Resistance,25°C (line-line)	Ω	10.9	2.7	16	4	21.2	5.3	32	8
Inductance,(line-line)	mH	8.7	2.18	12.8	3.2	16.8	4.2	24.8	6.2
Thermal Resistance	°C/W	0.91		0.85		0.69		0.61	
Maximum Bus Voltage	V _{DC}	340		340		340		340	
Machanical Specifications									
Coil Weight	kg	0.6		0.9		1.1		1.7	
Coil Length	mm	143.8		204.7		265.7		387.6	
Magnet Track Weight	kg/m	10.12							
Magnetic Pole Pitch (NN)	mm	60.96							

Notes:

- 1.Performance is dependent upon heat sink configuration, system cooling conditions,and ambient temperature.
- 2.Values shown @ 100°C rise above a 25°C ambient temperature,with motor mounted to the specified aluminum heat sink.
- 3.Peak force assumes correct rms current;consult SMJ.
- 4.Force constant and motor constant specified at stall.
- 5.All performance and electrical specifications±10%.

Dimensions(mm)**Magnet Plate**

Model No.	A	B	C
LMU030-MP244	243.8	4	3
LMU030-MP305	304.8	5	4
LMU030-MP610	609.6	10	9

Coil Plate

Model No.	D	E	F	G	H	K
LMU030-CP143	143.8	116.8	58.4	NA	4	6
LMU030-CP204	204.7	177.8	88.9	NA	4	6
LMU030-CP265	265.7	238.8	119.4	NA	6	6
LMU030-CP387	387.6	360.6	180.3	96.5	9	10



This model is suitable for applications where high amount of force, high speed, and quick acceleration are required for operation, such as large scale production equipment and precision positioning equipment.

Standard Specifications

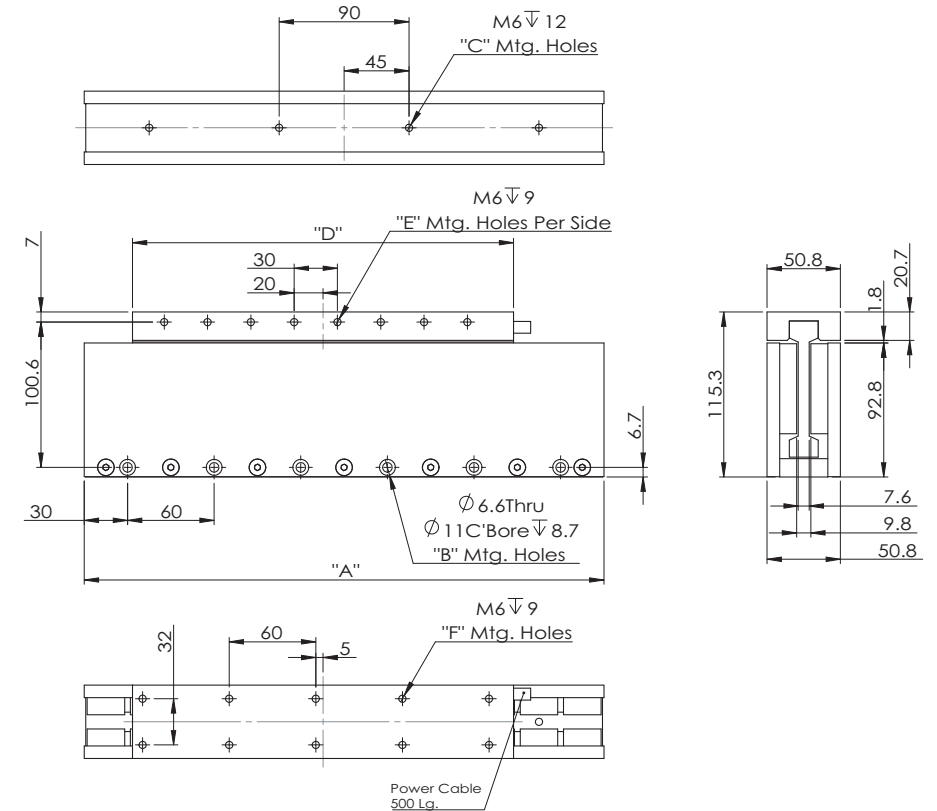
Insulation Capacity	: AC1500V 1min
Operating Range	: 0~25°C
Cooling Method	: Self-cool
Insulation Resistance	: DC500V 100MΩ or more
Operating range (in controlled environment)	: 20~80%(No condensation)
Maximum temperature	: 125°C

Specification

Parameter	Unit	LMU040-CP144		LMU040-CP204		LMU040-CP264		LMU040-CP384		LMU040-CP504	
		A	B	A	B	A	B	A	B	A	B
Performance Specifications											
Continuous Force	N	200		250		335		440		600	
Peak Force	N	1400		1750		2345		3080		4200	
Electrical Specifications											
BEMF Constant(line-line,peak)	V/(m/s)	73.51	36.76	110.27	55.14	147.02	73.51	110.27	55.14	147.02	73.51
Continuous Current	Arms	2.21	4.42	1.84	3.69	1.85	3.70	3.24	6.49	3.32	6.64
Peak Current,Stall	Arms	15.48	30.97	12.90	25.80	12.97	25.93	22.71	45.41	23.22	46.45
Force Constant	N/Arms	90.42	45.21	135.63	67.82	180.84	90.42	135.63	67.82	180.84	90.42
Motor Constant	N/√W	21.47		24.01		27.76		28.34		32.57	
Resistance,25°C (line-line)	Ω	14.16	3.54	21.24	5.31	28.32	7.08	10.62	2.66	14.16	3.54
Inductance,(line-line)	mH	9.6	2.4	15.2	3.8	18.4	4.6	7.2	1.8	10.8	2.7
Thermal Resistance	°C/W	0.89		0.78		0.58		0.42		0.3	
Maximum Bus Voltage	V _{DC}	340		340		340		340		340	
Machanical Specifications											
Coil Weight	kg	1.1		1.6		2.1		3.1		4.2	
Coil Length	mm	144		204		264		284		504	
Magnet Track Weight	kg/m	21.8									
Magnetic Pole Pitch (NN)	mm	60									

Notes:

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- 3.Peak force assumes correct rms current;consult SMJ.
- 4.Force constant and motor constant specified at stall.
- 5.All performance and electrical specifications±10%.

Dimensions(mm)**Magnet Plate**

Model No.	A	B	C
LMU040-MP240	240	4	2
LMU040-MP300	300	5	4
LMU040-MP600	600	10	6

Coil Plate

Model No.	D	E	F
LMU040-CP144	144	4	6
LMU040-CP204	204	6	6
LMU040-CP264	264	8	10
LMU040-CP384	384	12	14
LMU040-CP504	504	16	18



With in the LMU series, this model has the most force.

This model is suitable for applications where high amount of force, high speed, and quick acceleration are required for operation, such as large scale production equipment and precision positioning equipment.

Standard Specifications

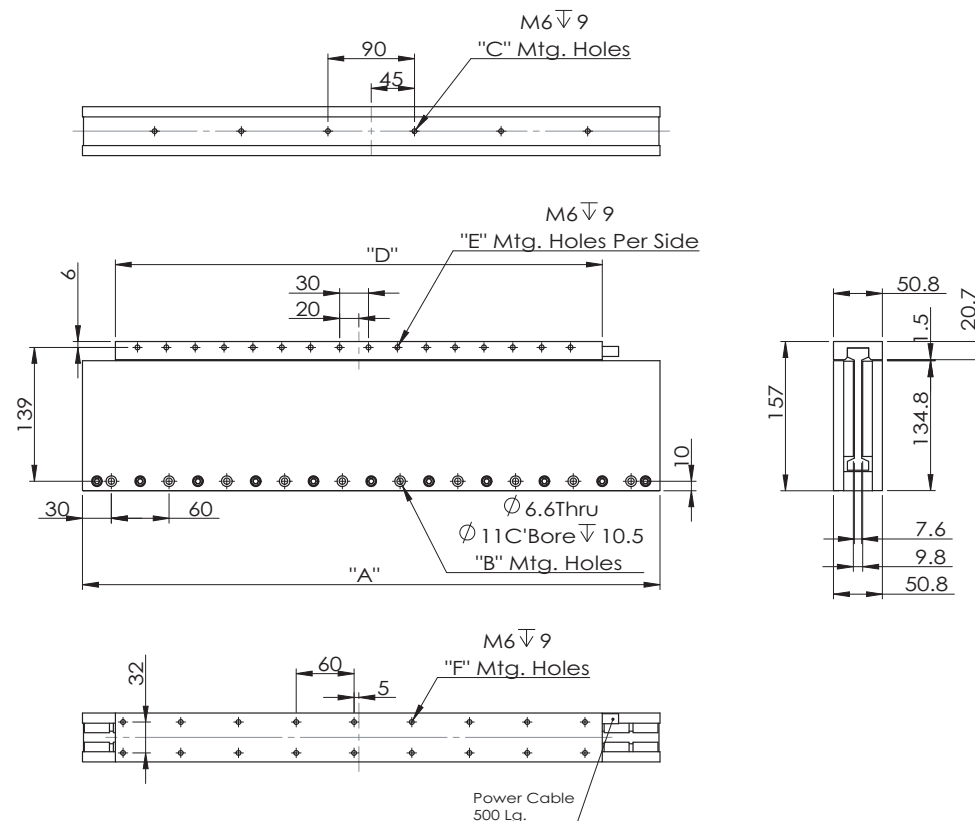
Insulation Capacity	: AC1500V 1min
Operating Range	: 0~25°C
Cooling Method	: Self-cool
Insulation Resistance	: DC500V 100MΩ or more
Operating range (in controlled environment)	: 20~80%(No condensation)
Maximum temperature	: 125°C

Specification

Parameter	Unit	LMU050-CP384		LMU050-CP504	
		A	B	B	C
Performance Specifications					
Continuous Force	N	550		700	
Peak Force	N	3850		4900	
Electrical Specifications					
BEMF Constant(line-line,peak)	V/(m/s)	189.21	94.60	126.14	63.07
Continuous Current	Arms	2.36	4.73	4.51	9.02
Peak Current,Stall	Arms	16.54	33.09	31.58	63.16
Force Constant	N/Arms	232.73	116.36	155.15	77.58
Motor Constant	N/√W	37.06		48.30	
Resistance,25°C (line-line)	Ω	13.35	3.34	4.05	1.11
Inductance,(line-line)	mH	12	3	4	1
Thermal Resistance	°C/W	0.4		0.39	
Maximum Bus Voltage	V _{DC}	340		340	
Machanical Specifications					
Coil Weight	kg	3.4		4.45	
Coil Length	mm	384		504	
Magnet Track Weight	kg/m	38.1			
Magnetic Pole Pitch (NN)	mm	60			

Notes:

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- 2.Values shown @ 100°C rise above a 25°C ambient temperature,with motor mounted to the specified aluminum heat sink.
- 3.Peak force assumes correct rms current;consult SMJ.
- 4.Force constant and motor constant specified at stall.
- 5.All performance and electrical specifications±10%.

Dimensions(mm)**Magnet Plate**

Model No.	A	B	C
LMU050-MP240	240	4	2
LMU050-MP300	300	5	4
LMU050-MP600	600	10	6

Coil Plate

Model No.	D	E	F
LMU050-CP384	384	12	14
LMU050-CP504	504	16	18



The LMUS010 series linear motor is a very efficient drive system that was developed to fit in the smallest possible space. This is most appropriate linear motor for the mimiturization of equipment in various fields.

Standard Specifications

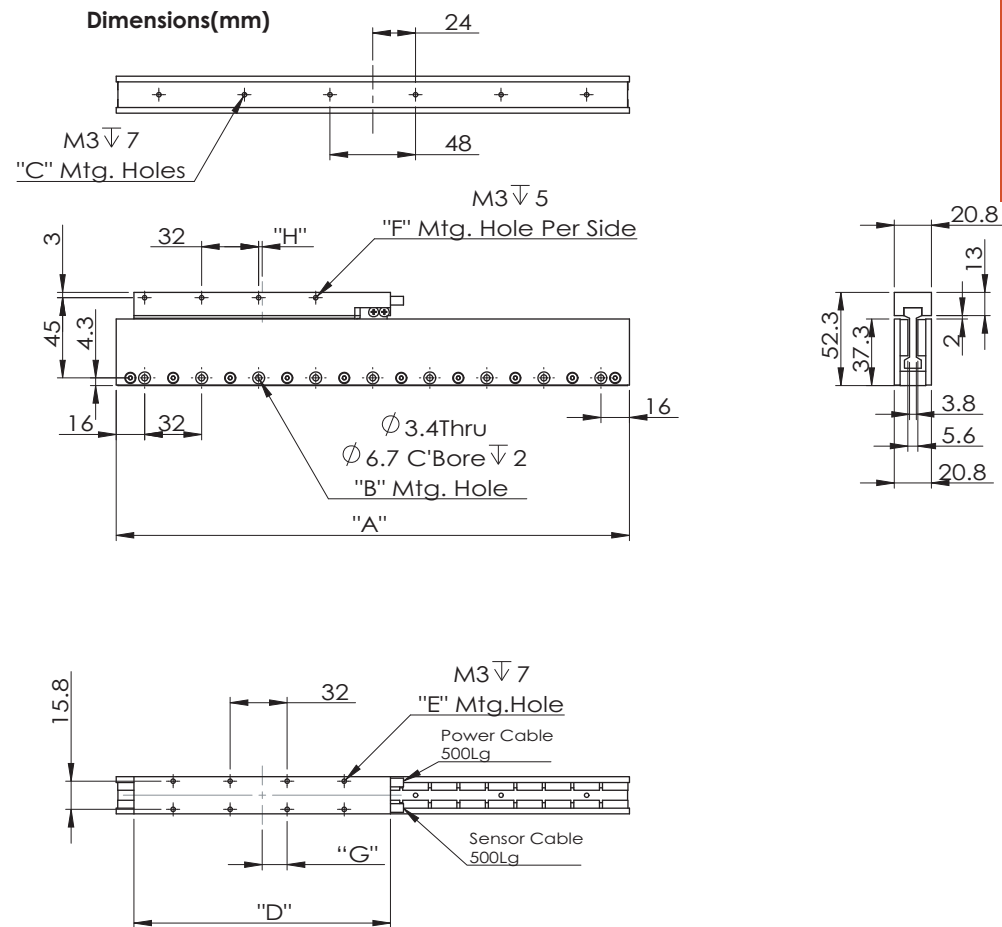
Insulation Capacity	: AC1500V 1min
Operating Range	: 0~25°C
Cooling Method	: Self-cool
Insulation Resistance	: DC500V 100MΩ or more
Operating range (in controlled environment)	: 20~80%(No condensation)
Maximum temperature	: 125°C

Specification

Parameter	Unit	LMUS010-CP96	LMUS010-CP144	
Performance Specifications				
Continuous Force	N	23	39.8	
Peak Force	N	161.9	231.8	
Electrical Specifications				
BEMF Constant(line-line,peak)	V/(m/s)	9.00	15.90	
Continuous Current	Arms	2.08	2.03	
Peak Current,Stall	Arms	14.63	11.85	
Force Constant	N/Arms	11.07	19.56	
Motor Constant	N/√W	3.35	4.53	
Resistance,25°C (line-line)	Ω	5.4	9.2	
Inductance,(line-line)	mH	0.70	1.10	
Thermal Resistance	°C/W	2.12	1.29	
Maximum Bus Voltage	V _{DC}	340	340	
Machanical Specifications				
Coil Weight	kg	0.12	0.2	
Coil Length	mm	96	144	
Magnet Track Weight	kg/m	3.33		
Magnetic Pole Pitch (NN)	mm	32		

Notes:

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- 4.Force constant and motor constant specified at stall.
- 5.All performance and electrical specifications±10%.



Magnet Plate

Model No.	A	B	C
LMUS010-MP128	128	4	2
LMUS010-MP224	224	7	4
LMUS010-MP256	256	8	4
LMUS010-MP288	288	9	4

Coil Plate

Model No.	D	E	F	G	H
LMUS010-CP96	96	6	2	22	26
LMUS010-CP144	144	8	4	14	2



To select Linear Motor



Capacity selection

△Conditions of Use

Load weight	M_L	[kg]
Strokw	S	[mm]
Maximum speed	V_m	[m/s]
Acceleration time	T_a	[sec]
Fixed speed time	T_b	[sec]
Deceleration time	T_c	[sec]
1 cycle time	T	[sec]

△Motor characteristics

Continuous Force	F	[N]
Peak Force	F_m	[N]
Coil plate weight	M_p	[kg]

△Effective force calculation

Force required for movement [N]

$$F_L = \mu(M_L + M_p)g + F_n$$

μ : Friction coefficient 0.01

g : Gravitational acceleration 9.8m/s²

F_n : Wire hindrance 1.0N

Limit acceleration time [s]

$$T_a = \frac{(M_L + M_p) \times V_m \times K}{F_m - F_L}$$

K : Safety factor 1.3

Force required for acceleration [N]

$$F_a = \frac{V_m}{T_a} \times (M_L + M_p) + F_L$$

Force required for deceleration [N]

$$F_d = \frac{V_m}{T_c} \times (M_L + M_p) - F_L$$

Effective force [N]

$$F_{rms} = \sqrt{\frac{F_a^2 \times T_a + F_L^2 \times T_b + F_d^2 \times T_c}{T}}$$

△Temperature rise

Temperature rise	Tr	°C
Thermal resistance	Rt	°C/W
Effective force	F_{rms}	N
Motor Constant	Mc	N/√W

We assume the ambient temperature is 20°C, then this should be added to the coil to get the final coil temperature rise:

$$Tr = Rt \times \left(\frac{F_{rms}}{Mc} \right)^2$$

NOTE: Typically temperature over 100°C

Should be avoided.

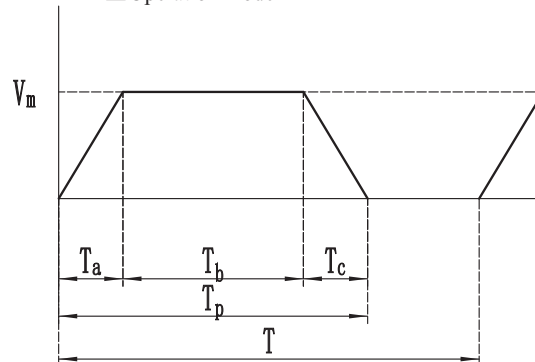
△Drive Voltage minimum

Drive Voltage minimum		V
Peak current	I_p	Arms
Coil resistance	R_c	Ω
Maximum speed	V_m	m/s
BEMF Constant	$BEMF$	V/(m/s)

Drive_Voltage_minimum=

$$I_p \times R_c + V_m \times BEMF$$

△Operation mode



Example

△Conditions of Use

Load weight	M_L	10	[kg]
Strokw	S	300	[mm]
Maximum speed	V_m	1	[m/s]
Acceleration time	T_a	0.1	[sec]
Fixed speed time	T_b	0.5	[sec]
Deceleration time	T_c	0.1	[sec]
1 cycle time	T	1	[sec]

△Motor characteristics

LMU020-CP143

Continuous Force	85	[N]
Peak Force	595	[N]
Coil plate weight	0.26	[kg]

$$F_L = 0.01 \times (10 + 0.26) \times 9.8 + 1$$

$$= 2 [N]$$

$$T_a = \frac{(10 + 0.26) \times 1 \times 1.3}{595 - 2}$$

$$= 0.022 [s]$$

$$F_a = \frac{1}{0.1} \times (10 + 0.26) + 2$$

$$= 104.6 [N]$$

$$F_d = \frac{1}{0.1} \times (10 + 0.26) - 2$$

$$= 100.6 [N]$$

$$F_{rms} = \sqrt{\frac{104.6^2 \times 0.1 + 2^2 \times 0.5 + 100.6^2 \times 0.1}{1}}$$

$$= 45.9 [N]$$

$$F > F_{rms}$$

△Temperature rise

Thermal resistance	1.12	°C/W
Motor Constant	8.24	N/√W

$$Tr = 1.12 \times \left(\frac{45.9}{8.24} \right)^2$$

$$= 34.75 \text{ °C}$$

$$34.75 + 20 = 54.75 \text{ °C} < 100 \text{ °C}$$

△Drive Voltage minimum

LMU020-CP143

Peak current	22.74	Arms
Coil resistance	4.82	Ω
Maximum speed	1	m/s
BEMF Constant	21.28	V/(m/s)

Drive_Voltage_minimum

$$= 22.74 \times 4.82 + 1 \times 21.28$$

$$= 130.88 [V]$$

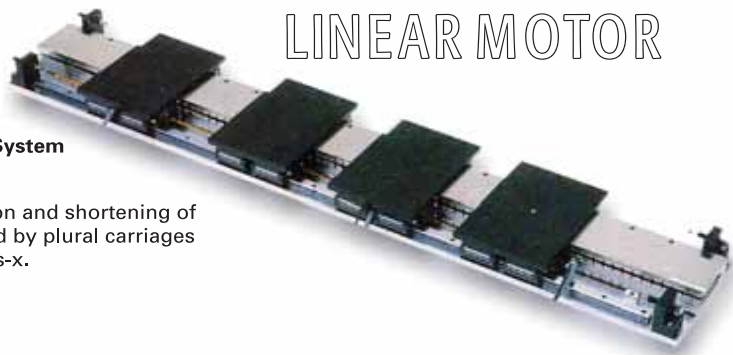
FOUR CARRIAGES LINEAR MOTOR

Applications

High Precision Printing System

Specialites

Printing with high precision and shortening of printing time are attained by plural carriages control on the single axis-x.



Example of Multi-Module

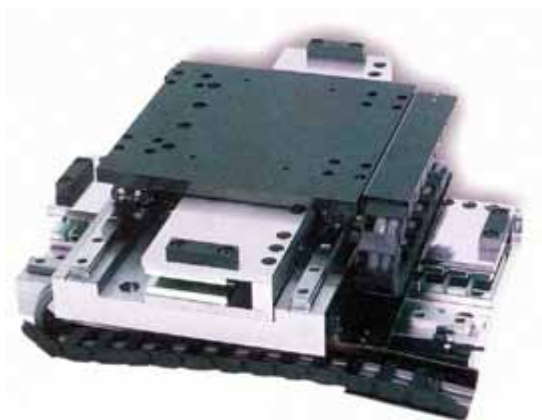
Applications

High Precision Printing System

Specialites

Printing with high precision and shortening of printing time are attained by plural carriages control on the single axis-x.

Line Motor Application



X-Y LINEAR MOTOR

Applications

High Precision Printing System

Specialites

Printing with high precision and shortening of printing time are attained by plural carriages control on the single axis-x.



ONE UNIT LINEAR MOTOR