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SMJ

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MULTI-MODULE
LINEAR MOTOR

We propose new generation Linear motor system for new millennium

For long years, MINDONG had been involved in study and development, test and produce, and design for motor and linear motor.
MULTI-MODULE LINEAR MOTOR for new generation meet uses for various kinds of necessities.

1. Simple & compact structure

More effective motor power transmission will be gained by direct drive structure which is simpler than ball-screw that requires complicated structure.

2. High rigidity & precision

Possible to remove disordef like backlash, and an error or delay of detection and control system. And more, full-closed control system shorten its positioning time and attain more precise positioning.

3. Control the plural carriages on the single axis-x

Setting many movements on the single axis-results in precise control that is impossble by ball-screw.

4. Excellent acceleration · speed performance

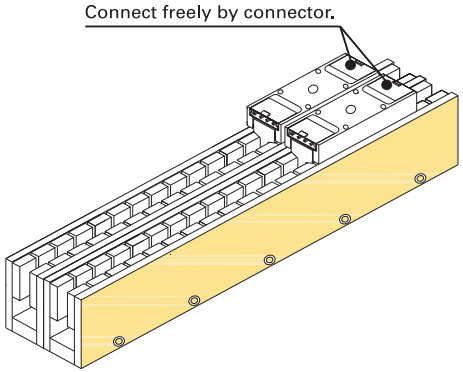
High or low speed positioning and smooth constant speed can be brought out by removing the structure of changing power system which ball-screw has.
And excellent acceleration is born by effective transmission.

Specialities of Multi- module Linear Motor

① *Flexible setting for performance*

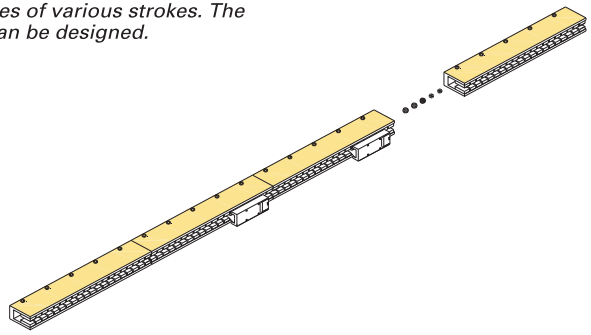
Connecting coil plates one another results in free choice of performance. Addition of performance is also possible.

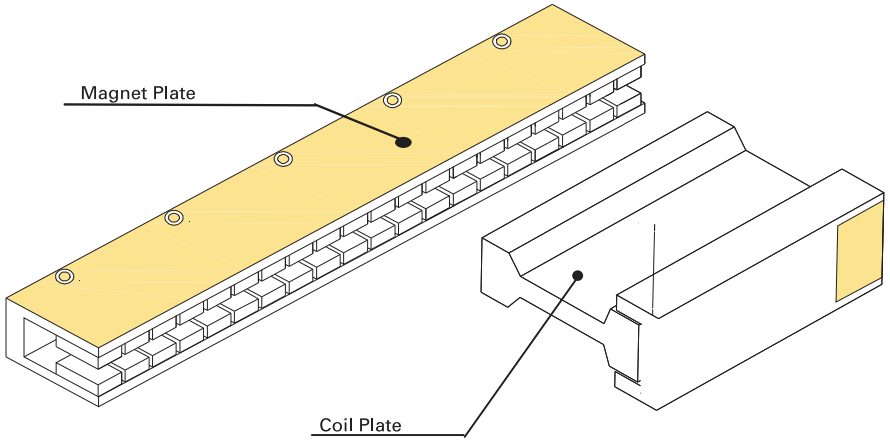
For example,double force will be gained by connecting two of the Multi-Module which have same force.



② *Various long strokes*

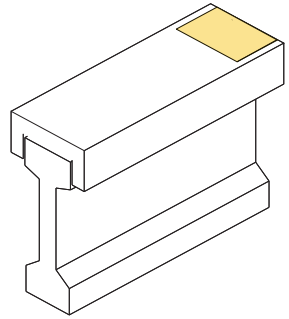
Modularized magnet plate meets usees of various strokes. The plural carriages on the single axis-x can be designed.





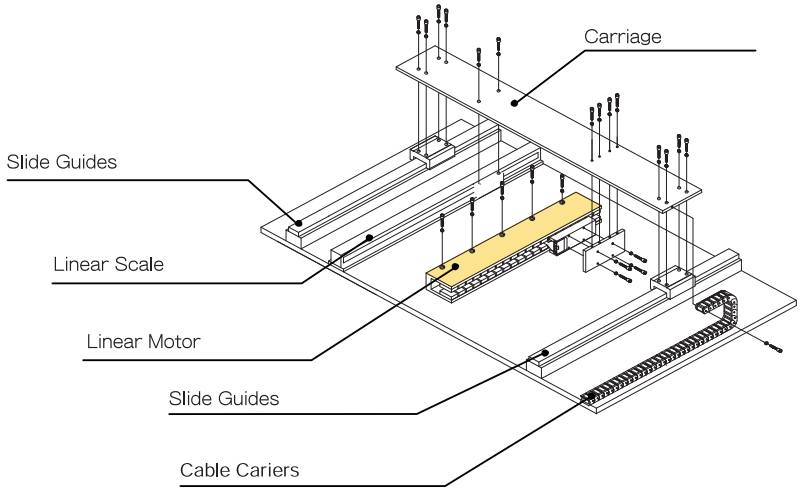
③ *High response performance*

The best performance of mechanism can be gained by coreless coil and double both sides magnet which have no power of magnetic absorption. High acceleration_high response characteristic are realized by moving-coil which make it light and compact size. Smooth movement of driving with small ripple is made possible by coreless coil, that is cogingless.

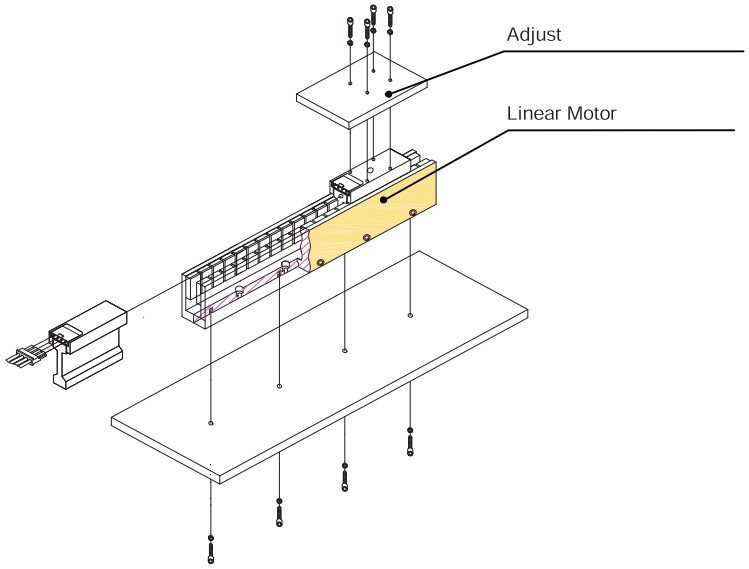


Iustalltion reference chart

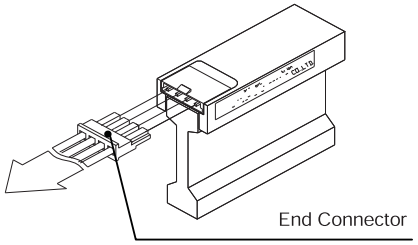
● Horizontal putting



● Length putting



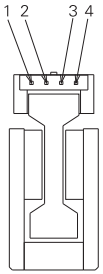
● Connector details

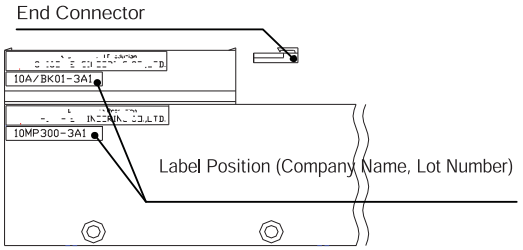


Each Connecting Wire (U, V, W, FG) run to the motor's controller.

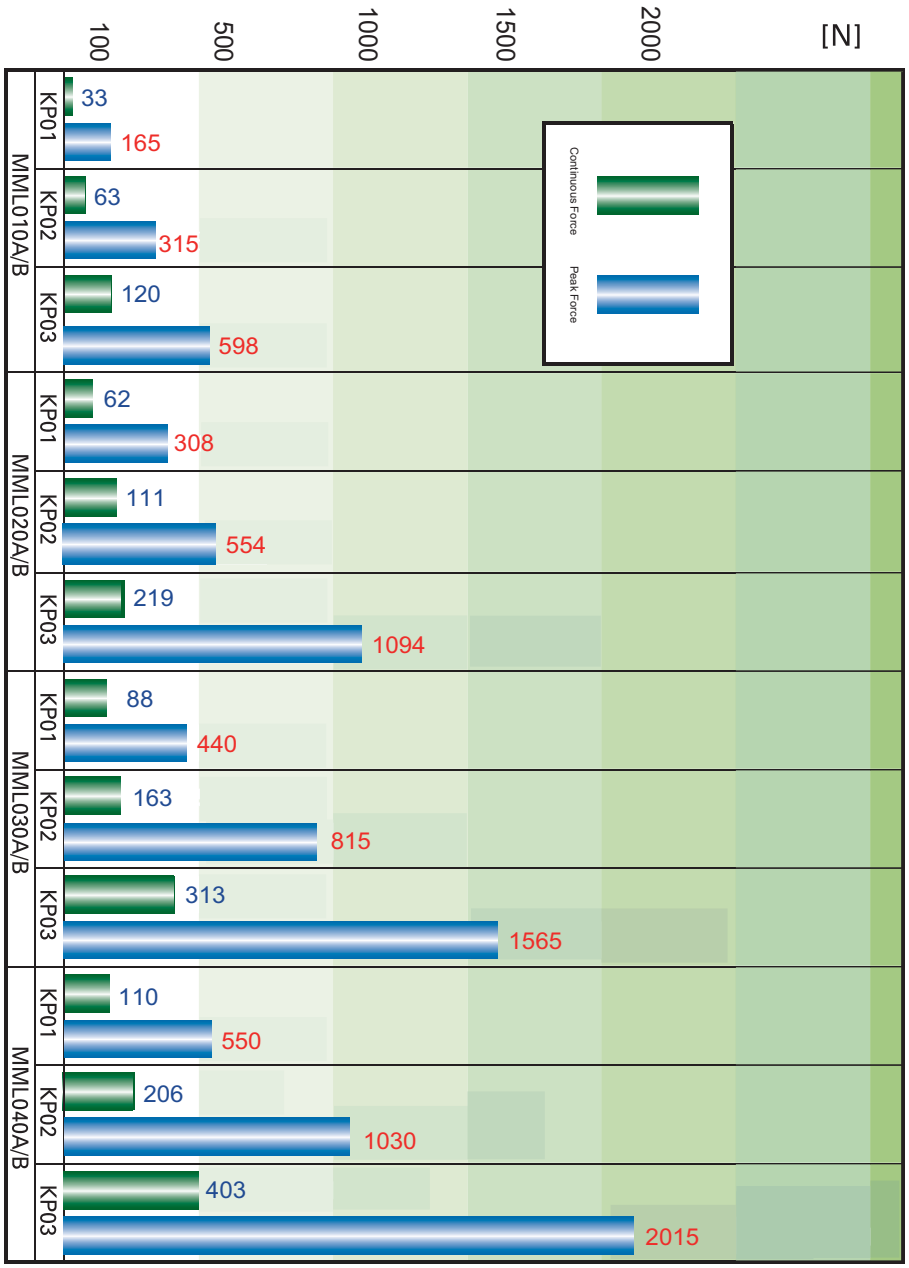
● Each Connector pin arrangement

Pin No.	Name
1	U
2	V
3	W
4	FG





Force reference chart



Definition of MML model name

● Coil Plate

MML 010 A S - KP 01 D

- MML: Series name — Multi-ModuleLinear motor
- 010: Height
  - 010 : 59mm
  - 020 : 84mm
  - 030 : 109mm
  - 040 : 134mm
  - 050: 120mm
- A: A : 100V / B : 200V / C : 48V
- S: S : Temperature signal / : No temperature signal
- KP: KP : Coil Plate / MP : Magnet Plate
- 01: Length
  - 01 : 78mm
  - 02 : 138mm
  - 03 : 258mm
  - 04: 367mm
- D: D : Double connectors / : Single connector

● Magnet Plate

MML 010 - MP 300

- MML: Series name — Multi-Module Linear motor
- 010: Height
  - 010 : 51mm
  - 020 : 78mm
  - 030 : 106mm
  - 040 : 135mm
  - 050: 110mm
- MP: KP : Coil Plate / MP : Magnet Plate
- 300: Length
  - 150 : 150mm
  - 300 : 300mm
  - 336: 336mm

MML010△-KP□□、MML010-MP□□□

The MML010 is the smallest of the MML 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 miniturization of equipment in various fields.

Standard Specifications

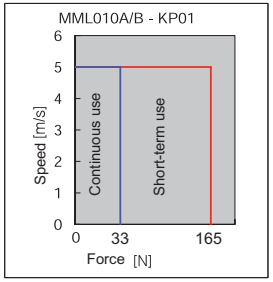
Insulation Capacity : AC1500V 1min
Operating Range : 0 ~ 40℃
Cooling method : Self-cool
Insulation Resistance : DC500V 100MΩ or more
Operating range (in controlled environment) : 20 ~ 80% (No condensation)
Maximum temperature : 120℃

Specification

Item	Unit	MML010△-KP01	
		A	B
Continuous Force	N	28	
Continuous Current	Arms	2.4	1.2
Peak Force	N	165	
Peak Current	Arms	14.4	7.2
Weight of Coil Plate	kg	0.17	
Force constant	N/Arms	11.6	23.2
Motor Constant	N/√W	5.8	5.8
Back EMF (line to line)	Vrms/(m/s)	6.5	13.0
Coil Resistance (phase to phase)	Ω	4.0	16.0
Inductance (line to line)	mH	1.21	4.84
Thermal Resistance(included heat sink)	K/W	1.43	
Thermal Resistance(not included heat sink)	K/W	1.71	

*1: A =Low Voltage Model, B = High Voltage Model. The△mark in the chart signifies that either A or B models could be suitable.
*2: The value given for the Peak Force and Peak Current may differ depending on the Peak Current of the Servo Controller utilized. Given Values are for heat sink (Aluminum) equiped Coil Plates. (Heat Sink size: 200×200×15mm)
*3: Given value is after the electrical wiring temperature has reached 100°C.

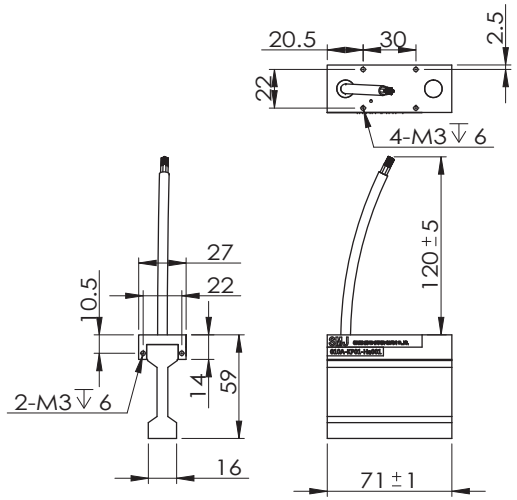
Force/Speed Characteristics



The above characteristics may vary depending on the Voltage supply from the Servo Controller to the motor.
Listed characteristics for the Linear Motor's Input Voltage is calculated at AC85V for Type A, AC170V for Type B.
For further details, please contact our Sales Department.

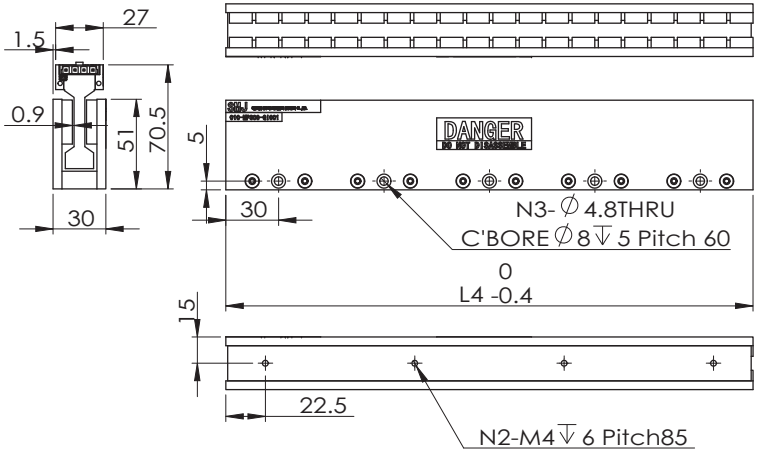
Dimensions unit : mm

● Coil Plate



Terminal definitions U: Red V: Green W: Black GND: White

● Magnet Plate



Type	Size[mm]	Qty[pcs]	
	L4	N2	N3
MP150	150	2	2
MP300	300	4	5

MML010△○ -KP□□、MML010-MP□□□

The MML010 is the smallest of the MML 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 miniturization of equipment in various fields.

Standard Specifications

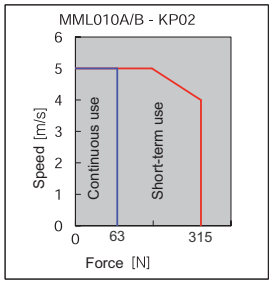
Insulation Capacity : AC1500V 1min
Operating Range : 0 ~ 40℃
Cooling method : Self-cool
Insulation Resistance : DC500V 100MΩ or more
Operating range (in controlled environment) : 20 ~ 80% (No condensation)
Maximum temperature : 120℃

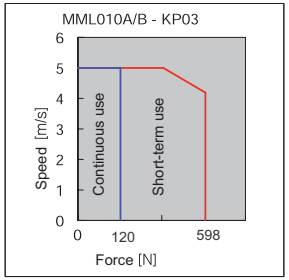
Specification

Item	Unit	MML010△○-KP02		MML010△○-KP03	
		A	B	A	B
Continuous Force	N	56		108	
Continuous Current	Arms	2.4	1.2	4.7	2.4
Peak Force	N	315		598	
Peak Current	Arms	13.70	6.90	26.2	13.1
Weight of Coil Plate	kg	0.31		0.61	
Force constant	N/Arms	23.0	46.0	22.8	45.6
Motor Constant	N/√W	8.1	8.1	11.4	11.4
Back EMF (line to line)	Vrms/(m/s)	12.9	25.8	12.8	25.6
Coil Resistance (phase to phase)	Ω	8.0	32.0	4.0	16.0
Inductance (line to line)	mH	2.43	9.72	1.21	4.84
Thermal Resistance(included heat sink)	K/W	0.79		0.43	
Thermal Resistance(not included heat sink)	K/W	0.95		0.51	

*1: A =Low Voltage Model, B = High Voltage Model. The△mark in the chart signifies that either A or B models could be suitable. The ○ mark in the chart signifies that either S or nothing .
*2: The value given for the Peak Force and Peak Current may differ depending on the Peak Current of the Servo Controller utilized. Given Values are for heat sink (Aluminum) equiped Coil Plates. (Heat Sink size: 200×200×15mm)
*3: Given value is after the electrical wiring temperature has reached 100°C.

Force/Speed Characteristics

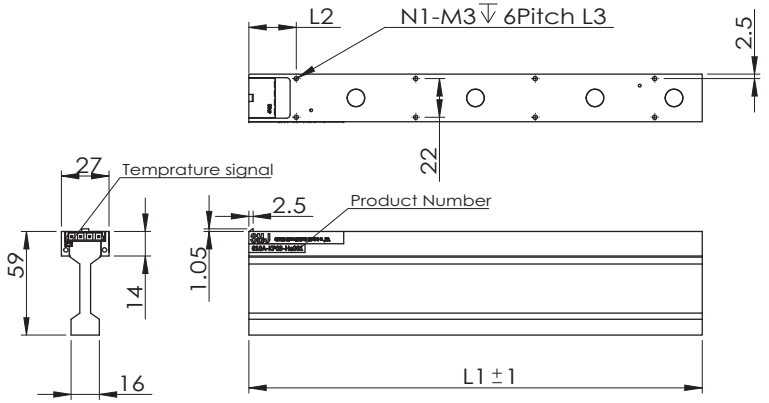




The above characteristics may vary depending on the Voltage supply from the Servo Controller to the motor.
Listed characteristics for the Linear Motor's Input Voltage is calculated at AC85V for Type A, AC170V for Type B.
For further details, please contact our Sales Department.

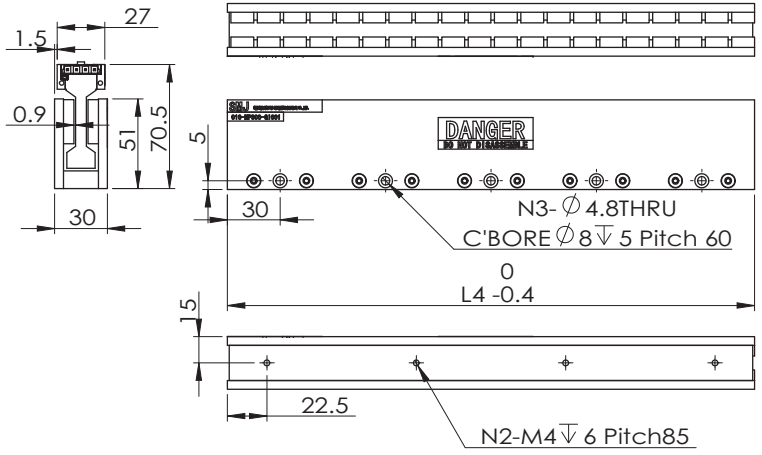
Dimensions unit : mm

● Coil Plate



Type	Size[mm]			Qty[pcs]
	L1	L2	L3	N1
KP02	138	32	37	6
KP03	258	27	68	8

● Magnet Plate



Type	Size[mm]	Qty[pcs]	
	L4	N2	N3
MP150	150	2	2
MP300	300	4	5

MML020△○-KP□□、MML020-MP□□□

This Series of Linear Motor is well suited for applications that require Precision Positioning, High Speed, Quick Acceleration such as Semi-conductor manufacturing equipment. It is also able to be uilized in limited work spaces. It is the most appropriate Linear Motor design for the reduction of manufacturing equipment size.

Standard Specifications

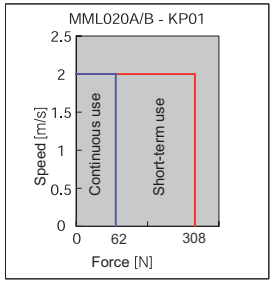
Insulation Capacity : AC1500V 1 min
Operating Range : 0 ~ 40℃
Cooling method : Self-cool
Insulation Resistance :DC500V 100MΩ or more
Operating range (in controlled environment) : 20 ~ 80% No condensation
Maximum temperature : 120℃

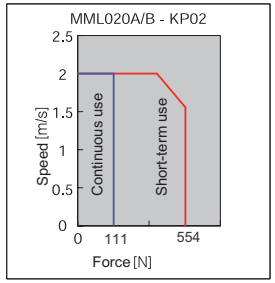
Specification

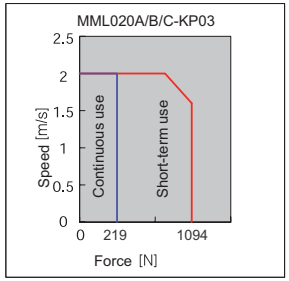
Item	Unit	MML020△○-KP01		MML020△○-KP02		MML020△○-KP03		
		A	B	A	B	A	B	C
Continuous Force	N	55		111		219		
Continuous Current	Arms	2.4	1.2	2.4	1.2	4.9	2.4	9.7
Peak Force	N	308		554		1094		
Peak Current	Arms	13.4	6.7	12.2	6.2	24.4	12.1	48.5
Weight of Coil Plate	kg	0.22		0.43		0.8		
Force constant	N/Arms	22.9	44.5	45.5	90.8	44.9	89.7	22.5
Motor Constant	N/√W	9.5	9.4	13.3	13.4	18.6	18.5	19.2
Back EMF (line to line)	Vrms/(m/s)	13.2	26.2	26.3	52.4	25.9	51.8	13
Coil Resistance (phase to phase)	Ω	5.8	22.4	11.7	45.9	5.8	23.4	1.38
Inductance (line to line)	mH	1.85	7.4	3.66	14.6	1.83	7.44	0.46
Thermal Resistance(included heat sink)	K/W	1.14		0.67		0.34		
Thermal Resistance(not included heat sink)	K/W	1.36		0.80		0.41		

*1: A =Low Voltage Model, B = High Voltage Model.
The ○ mark in the chart signifies that either S or nothing . The △ mark in the chart signifies that A or B or C models could be suitable.
*2: The value given for the Peak Force and Peak Current may differ depending on the Peak Current of the Servo Controller utilized.
Given Values are for heat sink (Aluminum) equiped Coil Plates. (Heat Sink size: 200×200×15mm)
*3: Given value is after the electrical wiring temperature has reached 100°C.

Force/Speed Characteristics

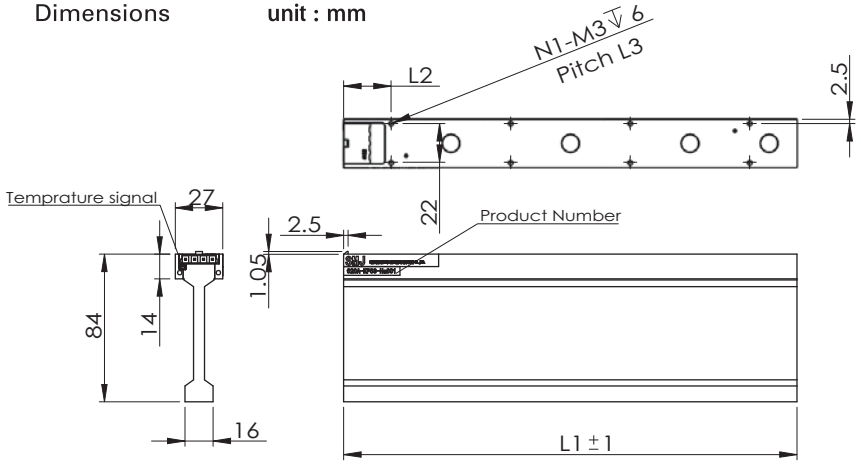






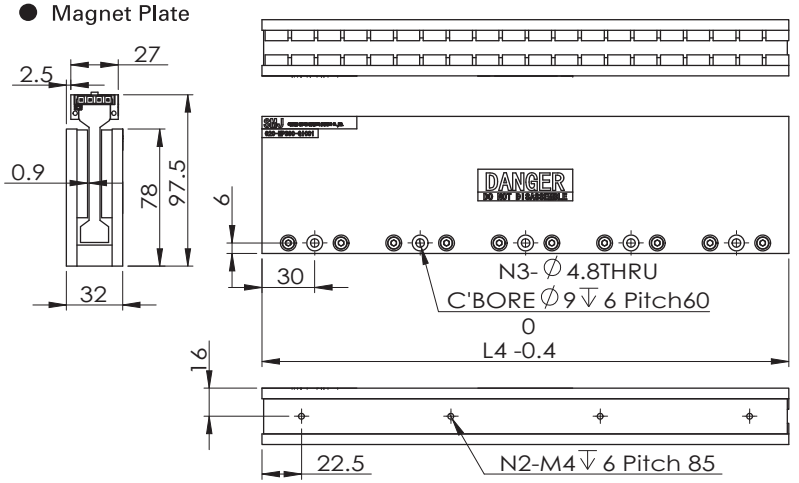
The above characteristics may vary depending on the Voltage supply from the Servo Controller to the motor.
Listed characteristics for the Linear Motor's Input Voltage is calculated at AC85V for Type A, AC170V for Type B.
For further details, please contact our Sales Department.

Dimensions unit : mm



Type	Size[mm]			Qty[pcs]
	L1	L2	L3	N1
KP01	78	24	30	4
KP02	138	32	37	6
KP03	258	27	68	8

● Magnet Plate



Type	Size[mm]	Qty[pcs]	
	L4	N2	N3
MP150	150	2	2
MP195	195	2	3
MP300	300	4	5
MP660	660	8	11

MML030△○-KP□□、MML030-MP□□□

This Model is suitable for a wide range of fields such as
Semiconductor Production Equipment and Assembly Robots

Standard Specifications

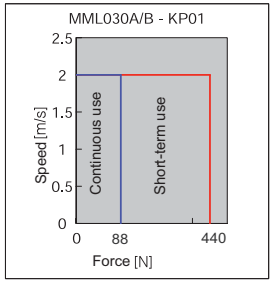
Insulation Capacity : AC1500V 1min
Operating Range : 0 ~ 40℃
Cooling method : Self-cool
Insulation Resistance :DC500V 100MΩ or more
Operating range (in controlled environment) : 20 ~ 80% No condensation
Maximum temperature : 120℃

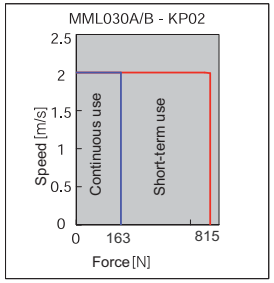
Specification

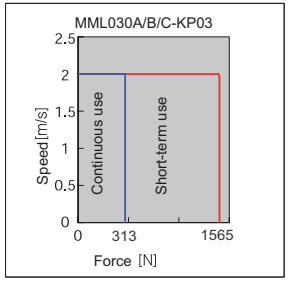
Item	Unit	MML030△○-KP01		MML030△○-KP02		MML030△○-KP03		
		A	B	A	B	A	B	C
Continuous Force	N	82		163		313		
Continuous Current	Arms	2.4	1.2	3.66	1.8	7.0	3.5	10.3
Peak Force	N	440		815		1565		
Peak Current	Arms	13.0	6.5	18.0	9.0	35	17.5	51.5
Weight of Coil Plate	kg	0.26		0.53		1.06		
Force constant	N/Arms	34.0	68.4	45.4	88.9	45	88.9	30.4
Motor Constant	N/√W	12.4	12.5	18.9	18.2	26.4	25.7	27.2
Back EMF (line to line)	Vrms/(m/s)	19.6	39.2	26.2	51.3	26.0	51.3	17.6
Coil Resistance (phase to phase)	Ω	7.5	30.0	5.8	23.9	2.9	12.0	1.25
Inductance (line to line)	mH	2.4	9.5	2.1	8.0	1.05	4.0	0.44
Thermal Resistance(included heat sink)	K/W	0.88		0.48		0.26		
Thermal Resistance(not included heat sink)	K/W	1.06		0.59		0.31		

*1: A =Low Voltage Model, B = High Voltage Model.
The ○ mark in the chart signifies that either S or nothing . The △ mark in the chart signifies that A or B or C models could be suitable.
*2: The value given for the Peak Force and Peak Current may differ depending on the Peak Current of the Servo Controller utilized.
Given Values are for heat sink (Aluminum) equiped Coil Plates. (Heat Sink size: 200×200×15mm)
*3: Given value is after the electrical wiring temperature has reached 100°C.

Force/Speed Characteristics



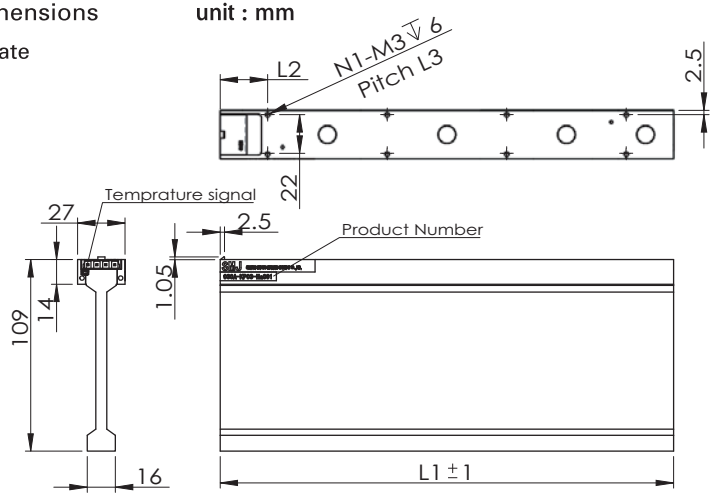




The above characteristics may vary depending on the Voltage supply from the Servo Controller to the motor.
Listed characteristics for the Linear Motor's Input Voltage is calculated at AC85V for Type A, AC170V for Type B.
For further details, please contact our Sales Department.

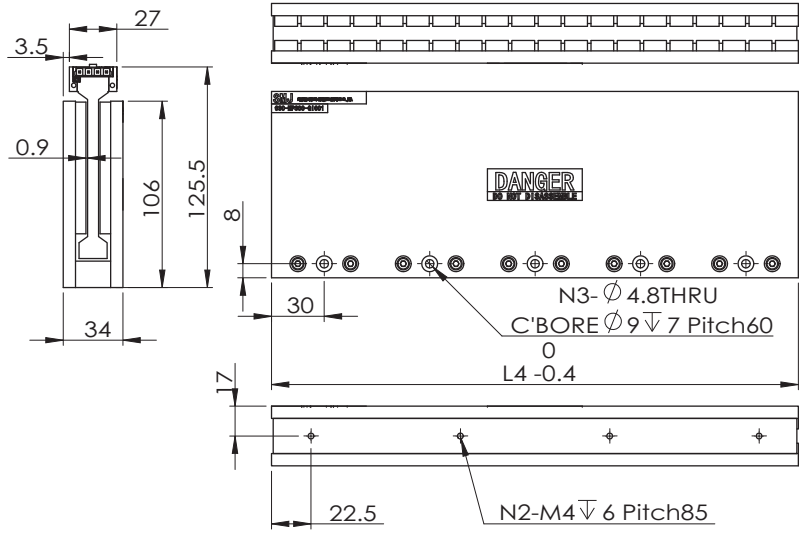
Dimensions unit : mm

● Coil Plate



Type	Size[mm]			Qty[pcs]
	L1	L2	L3	N1
KP01	78	24	30	4
KP02	138	32	37	6
KP03	258	27	68	8

● Magnet Plate



Type	Size[mm]	Qty[pcs]	
	L4	N2	N3
MP150	150	2	2
MP300	300	4	5

MML040△○-KP□□、MML040-MP□□□

Within the MML series, this model has the most Force. It is ideally suited for applications where high amounts of force, high speed, and quick acceleration are required for operation, such as Large Scale Production Equipment and Precision Positioning Equipment.

Standard Specifications

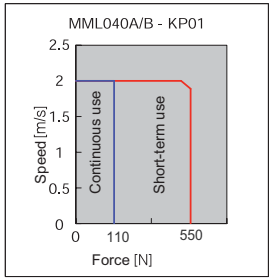
Insulation Capacity : AC1500V 1min
Operating Range : 0 ~ 40℃
Cooling method : Self-cool
Insulation Resistance :DC500V 100MΩ or more
Operating range (in controlled environment) : 20 ~ 80% No condensation
Maximum temperature : 120℃

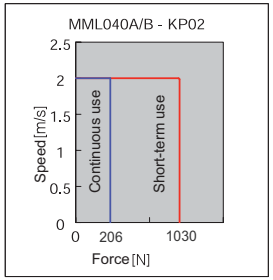
Specification

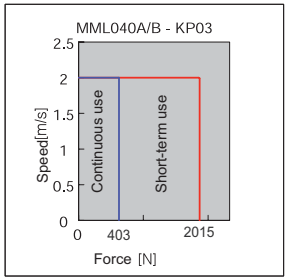
Item	Unit	MML040△○-KP01		MML040△○-KP02		MML040△○-KP03	
		A	B	A	B	A	B
Continuous Force	N	110		206		403	
Continuous Current	Arms	2.4	1.2	4.6	2.3	9.0	4.5
Peak Force	N	550		1030		2015	
Peak Current	Arms	12.0	6.0	23.0	11.5	45.0	22.5
Weight of Coil Plate	kg	0.31		0.63		1.26	
Force constant	N/Arms	45.7	89.8	44.8	90.4	44.8	90.6
Motor Constant	N/√W	15.0	14.7	20.7	21.0	28.9	29.7
Back EMF (line to line)	Vrms/(m/s)	26.4	52.8	25.9	52.2	25.9	52.3
Coil Resistance (phase to phase)	Ω	9.3	37.4	4.7	18.5	2.4	9.3
Inductance (line to line)	mH	3.0	11.8	1.5	6.1	0.75	3.0
Thermal Resistance(included heat sink)	K/W	0.62		0.34		0.18	
Thermal Resistance(not included heat sink)	K/W	0.74		0.42		0.22	

*1: A =Low Voltage Model, B = High Voltage Model. The△mark in the chart signifies that either A or B models could be suitable. The ○ mark in the chart signifies that either S or nothing .
*2: The value given for the Peak Force and Peak Current may differ depending on the Peak Current of the Servo Controller utilized. Given Values are for heat sink (Aluminum) equiped Coil Plates. (Heat Sink size: 200×200×15mm)
*3: Given value is after the electrical wiring temperature has reached 100°C.

Force/Speed Characteristics



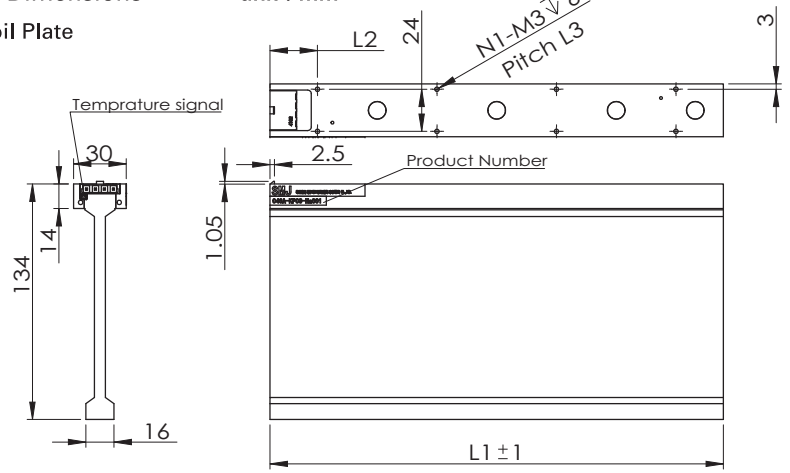




The above characteristics may vary depending on the Voltage supply from the Servo Controller to the motor.
Listed characteristics for the Linear Motor's Input Voltage is calculated at AC85V for Type A, AC170V for Type B.
For further details, please contact our Sales Department.

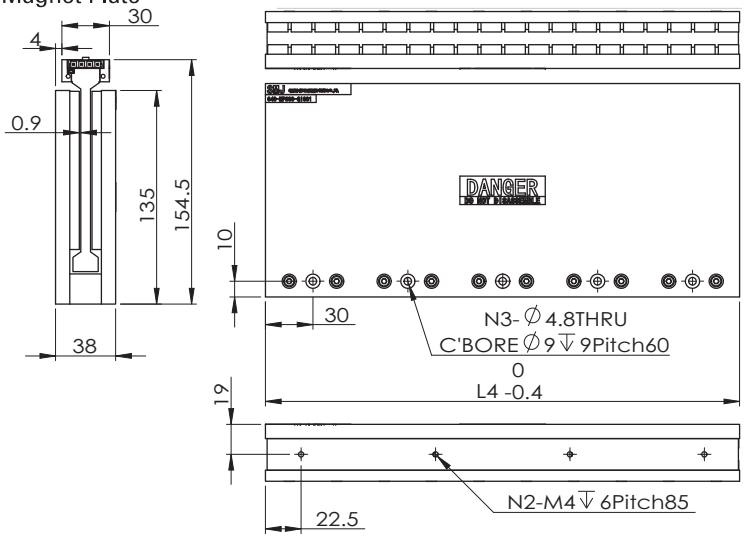
Dimensions unit : mm

● Coil Plate



Type	Size[mm]			Qty[pcs]
	L1	L2	L3	N1
KP01	78	24	30	4
KP02	138	32	37	6
KP03	258	27	68	8

● Magnet Plate



Type	Size[mm]	Qty[pcs]	
	L4	N2	N3
MP150	150	2	2
MP300	300	4	5

16

MML050△-KP□□、MML050-MP□□□

Within the MML series, this model has the most Force. It is ideally suited for applications where high amounts of force, high speed, and quick acceleration are required for operation, such as Large Scale Production Equipment and Precision Positioning Equipment.

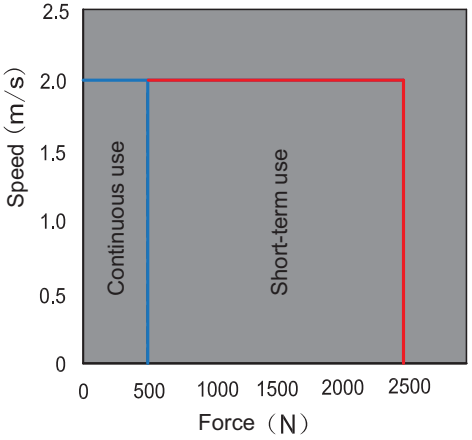
Standard Specifications

Insulation Capacity : AC1500V 1min
Operating Range : 0 ~ 40℃
Cooling method : Self-cool
Insulation Resistance :DC500V 100MΩ or more
Operating range (in controlled environment) : 20 ~ 80% No condensation
Maximum temperature : 120℃

Specification

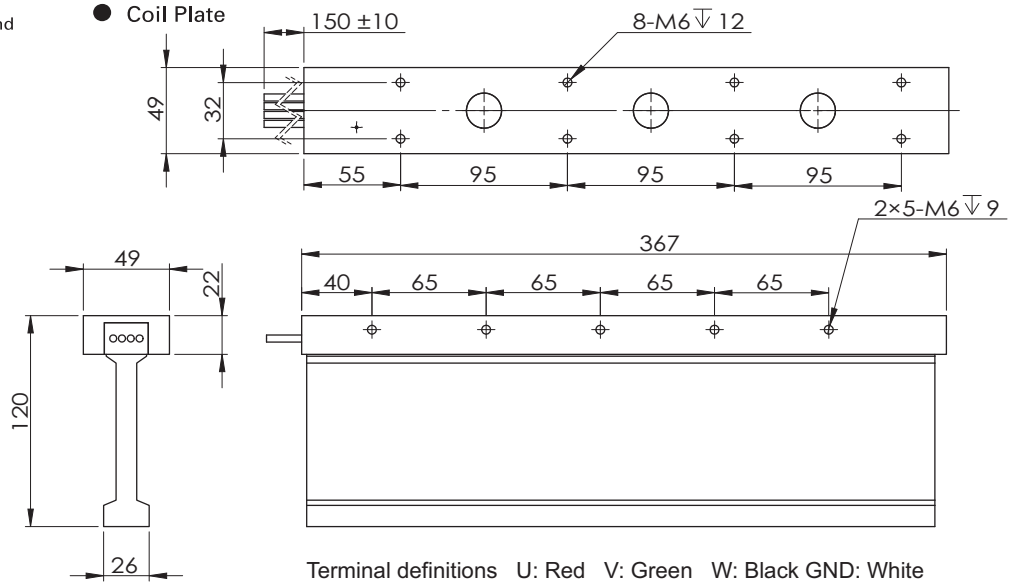
Item	Unit	MML050-KP04
Continuous Force	N	502
Continuous Current	Arms	7.6
Peak Force	N	2510
Peak Current	Arms	37.8
Weight of Coil Plate	kg	3.7
Force constant	N/Arms	66.4
Back EMF (line to line)	Vrms/(m/s)	38.3
Coil Resistance (phase to phase)	Ω	2.65
Inductance (line to line)	mH	2.2

Force/Speed Characteristics



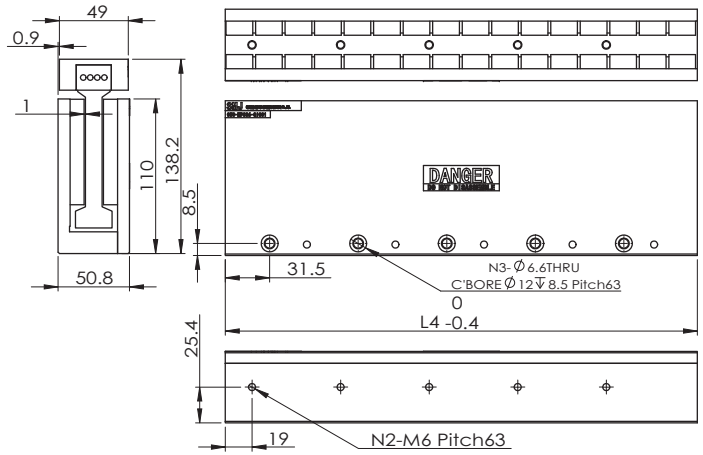
Dimensions unit : mm

● Coil Plate



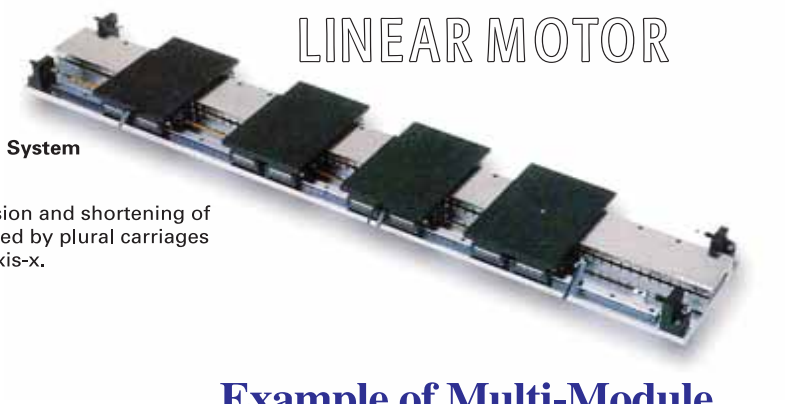
Terminal definitions U: Red V: Green W: Black GND: White

● Magnet Plate



Type	Size[mm]	Qty[pcs]	
	L4	N2	N3
MP168	168	3	3
MP336	336	5	5

FOUR CARRIAGES LINEAR MOTOR



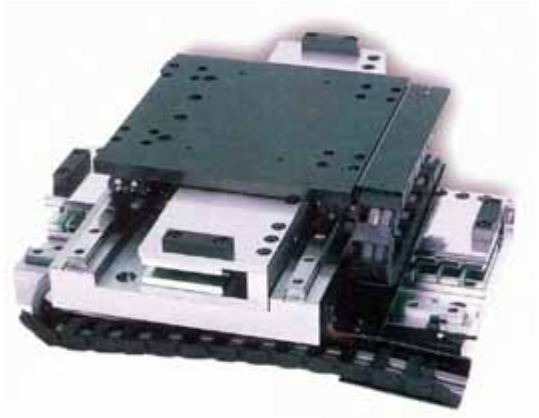
Applications

High Precision Printing System

Specialites

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

Example of Multi-Module



X-Y LINEAR MOTOR

Applications

High Precision Printing System

Specialites

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

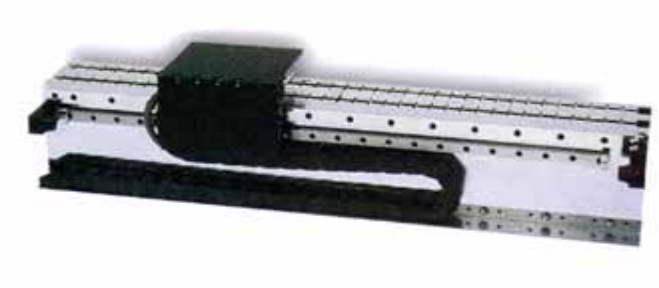
Applications

High Precision Printing System

Specialites

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

Line Motor Application



ONE UNIT 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]
Mover 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 9.8 m/s^2

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]

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

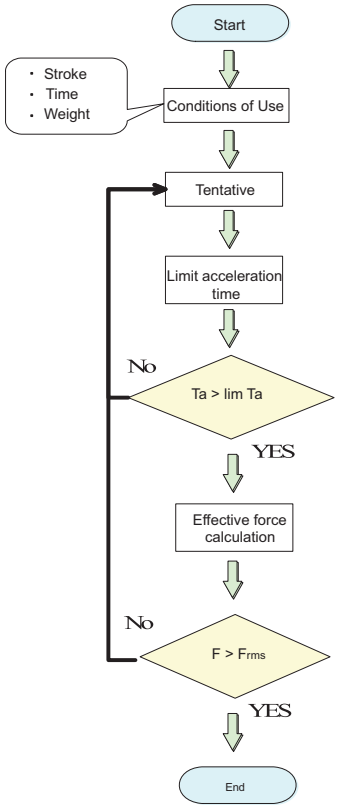
Force required for deceleration [N]

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

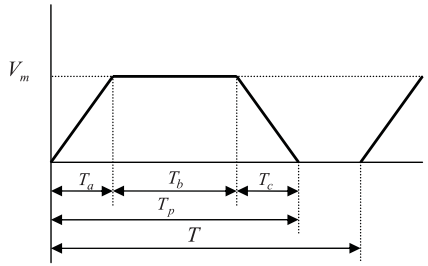
Effective force [N]

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

○ Select the process



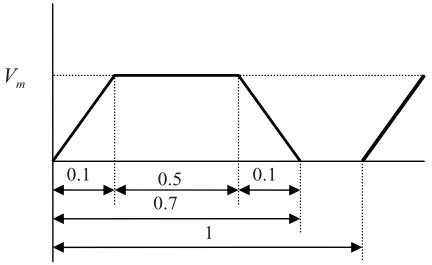
○ Operation mode



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]



○ Tentative

MML010A-KP02×1
MML010A-MP300×2

Determine whether the following conditions are met .

① Stroke
② Time
③ Force

・MML010A-KP02

Continuous Force	63	[N]
Peak Force	315	[N]
Mover weight	0.31	[kg]

① Stroke

The effective travel of MML010A-MP300×2 is 342mm,so MML010A-MP300×2 is ok.

② Time

$$F_L=0.01\times(10+0.31)\times9.8+1.0$$
$$=2[N]$$

$$T_a=\frac{(10+0.31)\times1.0\times1.3}{315-2}$$
$$=0.043[s]$$

③ Force

$$F_a=\frac{1.0}{0.1}\times(10+0.31)+2$$
$$=105.1[N]$$

$$F_d=\frac{1.0}{0.1}\times(10+0.31)-2$$
$$=101.1[N]$$

$$F_{rms}=\sqrt{\frac{105.1^2\times0.1+2^2\times0.5+101.1^2\times0.1}{1.0}}$$
$$=46.1[N]$$

F > F_{rms}

1. Stroke (mm)

	KP01×1	KP02×1	KP03×1
MP150×1	72	12	—
MP300×1	222	162	42
KP01×1＋MP300×1	372	312	192
MP300×2	522	462	342

2. Weight of coil plate (kg)

	KP01	KP02	KP03
MML010A/B	0.17	0.31	0.61
MML020A/B	0.22	0.43	0.80
MML030A/B	0.26	0.53	1.06
MML040A/B	0.31	0.63	1.26

3. Weight of magnet plate (kg)

	MP150	MP300
MML010A/B	1.1	2.2
MML020A/B	2.0	4.0
MML030A/B	3.0	6.0
MML040A/B	4.5	9.0