

## LM-PD-X SERIES

Linear Motion Technology

### LM-PD-X Coil Assembly Model

Coil Assembly Model	LM-PD-X2			LM-PD-X4			LM-PD-X6			LM-PD-X8			LM-PD-X10		
Winding code	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3
<b>Performance<sup>(1)</sup></b>															
Peak force(N) <sup>(1)(2)</sup>	1025			1892.3			2779.3			3469.2			4336.5		
Continuous force with heat sink(N) <sup>(1)(2)</sup>	256.2			473.1			694.8			867.3			1084.1		
Continuous force without heat sink(N) <sup>(2)(3)</sup>	177.4			354.8			517.4			670.2			788.4		
Peak power(W) <sup>(1)(2)</sup>	3028.5			5161			7422.2			8673.3			10841.6		
Continuous power(W) <sup>(1)(2)</sup>	189.3			322.6			463.9			542.1			677.6		
<b>Mechanical</b>															
Coil assembly length(mm)	146			266			386			506			626		
Coil assembly weight(kg) <sup>(2)</sup>	1.3			2.8			4.3			5.8			7.3		
Magnetic way weight(kg/m) <sup>(2)</sup>	29.8			29.8			29.8			29.8			29.8		
Pole pitch(mm)	60			60			60			60			60		
<b>Electrical<sup>(4)</sup></b>															
Continuous current with heat sink(A <sub>pk</sub> ) <sup>(1)(2)</sup>	2.6	5.2	2.4	4.7	9.6	2.4	4.7	14.4	2.2	4.4	8.8	2.2	4.4	11.0	11.0
Continuous current without heat sink(A <sub>pk</sub> ) <sup>(2)(3)</sup>	1.8	3.6	1.8	3.6	7.2	1.8	3.5	10.8	1.7	3.4	6.8	1.6	3.2	8.0	8.0
Peak current <sup>(1)(2)</sup>	10.4	20.8	9.6	19.2	38.4	9.4	18.8	56.4	8.8	17.6	35.2	8.8	17.6	44.0	44.0
Force constant(N/A <sub>pk</sub> ) <sup>(2)</sup>	98.6	49.3	197.1	98.6	49.3	295.7	147.8	49.3	394.2	197.1	98.6	492.8	246.4	98.6	98.6
Back EMF constant(V <sub>pk(1)}</sub> /m/s) <sup>(2)</sup>	114.6	57.3	229.2	114.6	57.3	343.8	171.9	57.3	458.4	229.2	114.6	573	286.5	114.6	114.6
Resistance(Ohms) <sup>(2)</sup>	28	7	56	14	3.5	84	21	2.3	112	28	7	140	35	5.6	5.6
Inductance(mH) <sup>(2)</sup>	30.32	7.58	60.64	15.16	3.79	90.96	22.74	2.53	121.28	30.32	7.58	151.6	37.9	6.06	6.06
Time constant(ms) <sup>(2)</sup>	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Thermal resistance with heat sink(°C/W) <sup>(1)(2)</sup>	0.4			0.2			0.1			0.1			0.1		
Thermal resistance without heat sink(°C/W) <sup>(2)(3)</sup>	0.9			0.4			0.3			0.2			0.2		
Heat sink(mm)	800x900x12			800x900x12			800x900x12			800x900x12			800x900x12		
Motor constant(N/√W) <sup>(2)</sup>	18.6			26.3			32.3			37.3			41.6		
Ph-PE dielectric strength <sup>(2)</sup>	≥ 5KV(AC)			≥ 5KV(AC)			≥ 5KV(AC)			≥ 5KV(AC)			≥ 5KV(AC)		
Ph-PE insulation resistance <sup>(2)</sup>	≥ 1KV(DC)			≥ 1KV(DC)			≥ 1KV(DC)			≥ 1KV(DC)			≥ 1KV(DC)		

(1) Value applies to the static sinusoidal drive, under specific heat sink and temperatures from 25°C to 110°C. Actual performance depends on heat sink configuration, system cooling conditions and the ambient temperature.  
 (2) The tolerance of all performance and electrical specification is ±10%.  
 (3) The value applies to the static sinusoidal drive at temperatures from 25°C up to 110°C, without heat sink.  
 (4) The above "without heat sink" figure assumes a working condition of 1atm at a 25°C ambient temperature, with the stationary linear motor not in contact with any other objects, relying only on air convection for cooling. As all heat conductive objects in direct contact with the linear motor, including the sliding plate, linear guide, and base, can be considered a type of heat sink, the "with heat sink" figure should be taken as the primary reference for actual application design.

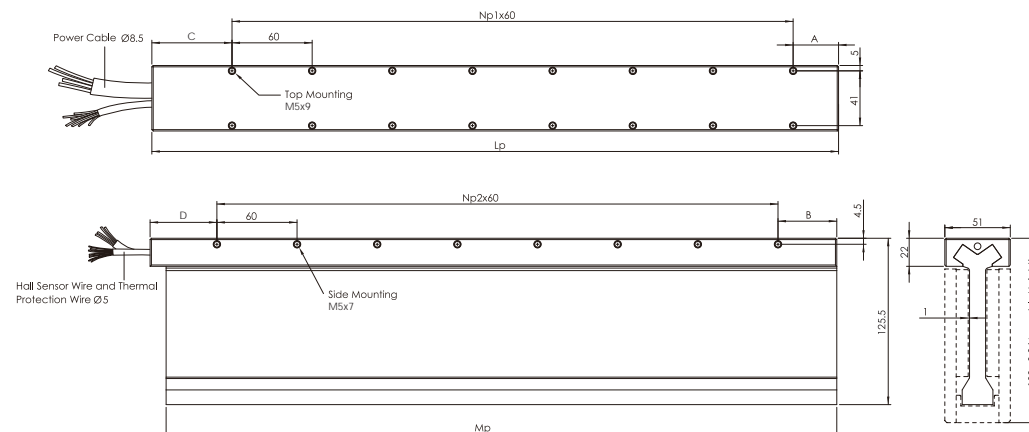
### LM-PD-X Coil Assembly

	Np1	Np2	Lp	Mp	A	B	C	D
LM-PD-X2	1	1	146	143	26	36	60	50
LM-PD-X4	3	3	266	263	26	36	60	50
LM-PD-X6	5	5	386	383	26	36	60	50
LM-PD-X8	7	7	506	503	26	36	60	50
LM-PD-X10	9	9	626	623	26	36	60	50

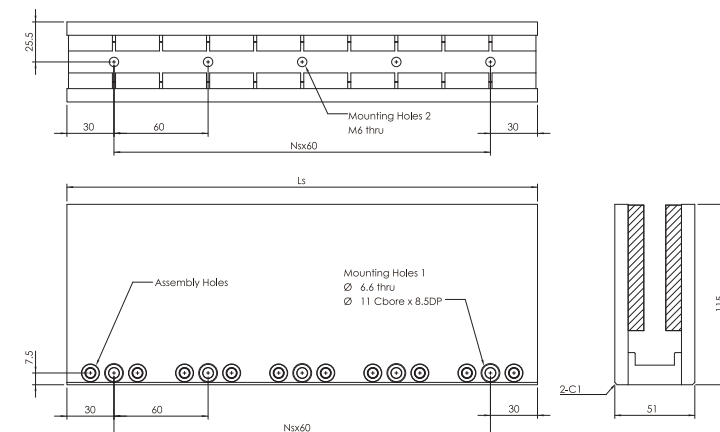
### LM-SD-X Magnetic Way

	Ns	Ls
LM-SD-X0	1	120
LM-SD-X1	4	300
LM-SD-X2	7	480

### LM-PD-X Coil Assembly

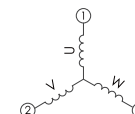


### LM-SD-X Magnetic Way



### OUTPUT CABLE (All cable standard length is 400 mm)

Motor Wire Table				Hall Sensor Wire Table and Thermal Protection Wire Table				
Pin Number	Function	Cross section	Color	Function	Cable Dia.	Color	Function	Cable Dia.
White (1)	U phase	1.5 mm <sup>2</sup>	Pink	Hall A U phase	0.14 mm <sup>2</sup>	Brown	Thermal sensor	0.14 mm <sup>2</sup>
Yellow (2)	V phase	1.5 mm <sup>2</sup>	Yellow	Hall B V phase	0.14 mm <sup>2</sup>	Blue		
Brown (3)	W phase	1.5 mm <sup>2</sup>	Green	Hall C W phase	0.14 mm <sup>2</sup>		Shielding	
Green	PE + shielding	1.5 mm <sup>2</sup>	Grey	Hall IC + 5V	0.14 mm <sup>2</sup>			
			White	GND	0.14 mm <sup>2</sup>			



## Sizing Example

Condition 1: Motion profile containing cruising section

Driver maximum output voltage : 300Vdc

Driver continuous output current : 2A

Driver peak output current : 5A

Max. velocity :  $V_{max} = 2$  [m/s]

Cruising time :  $t_2 = 3$  [s]

Load mass :  $m = 5$  [kg]

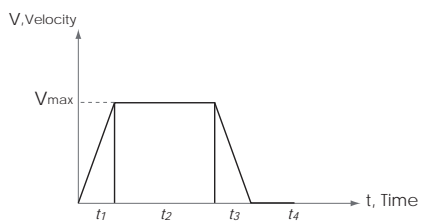
Decelerating time :  $t_3 = 0.2$  [s]

Acceleration :  $a = 10$  [m/s<sup>2</sup>]

Dwell time :  $t_4 = 2$  [s]

Accelerating time :  $t_1 = 0.2$  [s]

Friction Force :  $f = 5$  [N]



Symbol	Parameter	Metric	Imperial
$t_1$	Accelerating time	s	s
$t_2$	Cruising time	s	s
$t_3$	Decelerating time	s	s
$t_4$	Dwell time	s	s
$V_{max}$	Max. velocity	m/S	in/S

### Step1: Thrust force calculation

$$F_1 = ma + f = 5 \times 10 + 5 = 55 \text{ [N]}$$

$$F_2 = f = 5 \text{ [N]}$$

$$F_3 = ma - f = 5 \times 10 - 5 = 45 \text{ [N]}$$

$$F_4 = 0 \text{ [N]}$$

$$F_{rms} = \sqrt{\frac{F_1^2 \times t_1 + F_2^2 \times t_2 + F_3^2 \times t_3 + F_4^2 \times t_4}{t_1 + t_2 + t_3 + t_4}}$$

$$= \sqrt{\frac{55^2 \times 0.2 + 5^2 \times 3 + 45^2 \times 0.2 + 0}{0.2 + 3 + 0.2 + 2}} = 14.2 \text{ [N]}$$

$$F_{max} = F_1 = 55 \text{ [N]}$$

$$\text{Safety factor} = 1.5$$

Motor required peak force needs to be greater than

$$F_{max} \times 1.5 = 55 \times 1.5 = 82.5 \text{ [N]}$$

Motor required continuous force needs to be greater than

$$F_{rms} \times 1.5 = 14.2 \times 1.5 = 21.3 \text{ [N]}$$

Hence choose LM-PA-X2

(Peak Force= 123.8[N], Continuous force = 31[N])

### Step2: Wiring selection

If W1 model is chosen

$$I_{rms} = F_{rms} / K_f = 21.3 / 17.2 = 1.24 \text{ [A]}$$

$$I_{max} = F_{max} / k_f = 82.5 / 17.2 = 4.8 \text{ [A]}$$

$$\text{Required voltage} = V_{max} \times K_e + I_{max} \times R$$

$$= 2 \times 20 + 4.8 \times 17 = 121.6 \text{ [V]}$$

$$\text{Take safety factor} = 1.3$$

$$\text{Required supply voltage } 121.6 \times 1.3 = 158.1 \text{ [V]}$$

Driver :

Continuous output current 2A > 1.24A

Peak output current 5A > 4.8A

Max. output voltage 300V > 158.1V

W1 model matches requirements.

LM-PA-X2-W1 will be applicable.

Condition 2 : Motion Profile without cruising velocity section

Driver maximum output voltage : 80Vdc

Driver continuous output current : 2A

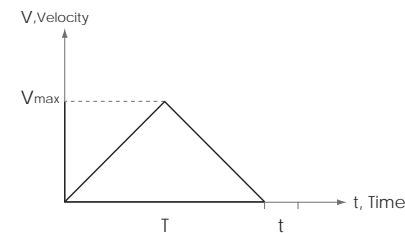
Driver peak output current : 4A

Load mass : 5 [kg]

Moving Time :  $T = 1$  [s]

Stroke :  $S = 1$  [m]

Friction Force :  $f = 5$  [N]



Symbol	Parameter	Metric	Imperial
$t$	Stop time	s	s
$T$	Moving time	s	s
$V_{max}$	Max. velocity	m/s	in/s
$a$	Acceleration	m/s <sup>2</sup>	in/s <sup>2</sup>
$s$	Stroke	m	in

### Step1: Thrust force calculation

$$a = 4S/T^2 = 4 \times 1/1 = 4 \text{ m/s}^2$$

$$F_1 = ma + f = 5 \times 4 + 5 = 25 \text{ [N]}$$

$$F_2 = ma - f = 5 \times 4 - 5 = 15 \text{ [N]}$$

$$F_3 = 0 \text{ [N]}$$

$$F_{rms} = \sqrt{\frac{F_1^2 \times t_1 + F_2^2 \times t_2 + F_3^2 \times t_3}{t_1 + t_2 + t_3}}$$

$$F_{rms} = \sqrt{\frac{25^2 \times 0.5 + 15^2 \times 0.5 + 0}{0.5 + 0.5 + 0}} = 18.8 \text{ [N]}$$

$$F_{max} = F_1 = 25 \text{ [N]}$$

$$\text{Safety factor} = 1.5$$

Motor required peak force needs to be greater than

$$F_{max} \times 1.5 = 25 \times 1.5 = 37.5 \text{ [N]}$$

Motor required continuous force needs to be greater than

$$F_{rms} \times 1.5 = 18.8 \times 1.5 = 28.2 \text{ [N]}$$

Hence choose LM-PA-X4

(Peak Force= 151.4[N], Continuous force = 37.8[N])

### Step2: Wiring selection

If W1 model is chosen

$$I_{rms} = F_{rms} / K_f = 18.8 / 34.4 = 0.55 \text{ [A]}$$

$$I_{max} = F_{max} / K_f = 25 / 34.4 = 0.73 \text{ [A]}$$

$$V_{max} = T/2 \times a = 1/2 \times 4 = 2 \text{ [m/s]}$$

$$\text{Required voltage} = V_{max} \times K_e + I_{max} \times R$$

$$= 2 \times 40 + 0.73 \times 34 = 104.8 \text{ [V]}$$

Take safety factor = 1.3

$$\text{Required supply voltage } 104.8 \times 1.3 = 136.2 \text{ [V]}$$

Driver :

Continuous output current 2A > 0.55A

Peak output current 4A > 0.73A

Max. output voltage 80V < 136.2V

Max. velocity cannot be reached with W1.

If W2 model is chosen

$$I_{rms} = F_{rms} / K_f = 18.8/17.2 = 1.1 \text{ [A]}$$

$$I_{max} = F_{max} / K_f = 25/17.2 = 1.45 \text{ [A]}$$

$$\text{Required voltage} = V_{max} \times K_e + I_{max} \times R$$

$$= 2 \times 20 + 1.45 \times 8.5 = 52.3 \text{ [V]}$$

Take safety factor = 1.3

$$\text{Required supply voltage } 52.3 \times 1.3 = 68 \text{ [V]}$$

Driver :

Continuous output current 2A > 1.1A

Peak output current 4A > 1.45A

Max. output voltage 80V > 68V

W2 model matches requirements.

LM-PA-X4-W2 will be applicable.

Note: For other calculation constraints or special requirements please contact [cpc](#).

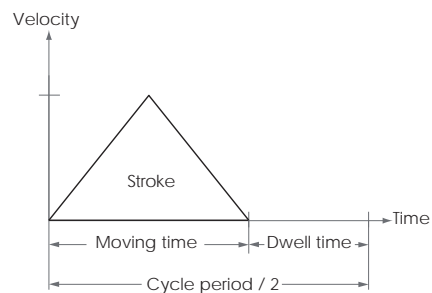
Sizing Form

Customer Name /	Filling Date (DD/MM/YEAR) /
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1. Point-to-point motion without constant velocity

Property: Specific travel distance in specific time  
Application: Pick and place, carriage etc.

a. Known Motion Condition	
(1) Load mass	kg
(2) Effective stroke	m
(3) Moving time	s
(4) Dwell time	s



b. Driver Condition	
(1) Max. output voltage	V
(2) Continuous current	A
(3) Peak current	A

c. Encoder	
(1) <input type="checkbox"/> Analog <input type="checkbox"/> Digital	
(2) Resolution	μm

f. Motion Direction	
(1) <input type="checkbox"/> Horizontal	
(2) <input type="checkbox"/> Vertical	
(3) <input type="checkbox"/> Tilt _____ degrees	

d. Working Environment	
(1) <input type="checkbox"/> Room temperature	
(2) <input type="checkbox"/> Constant temperature _____°C	
(3) <input type="checkbox"/> Vacuum _____ Torr	
(4) <input type="checkbox"/> Clean room _____ level	

g. Installation Method	
(1) <input type="checkbox"/> Lying flat	
(2) <input type="checkbox"/> Vertically standing	
(3) <input type="checkbox"/> Wall mount	

e. Motion Precision	
(1) Positioning accuracy	μm
(2) Repetitive accuracy	μm

h. Space Restrictions	
(1) <input type="checkbox"/> None	
(2) <input type="checkbox"/> Yes _____mm x _____mm x _____mm	

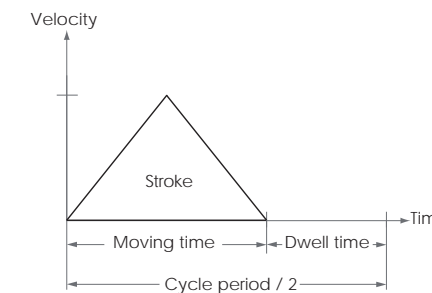
Sizing Form

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2. Point-to-Point Motion without constant velocity

Property: Specific travel distance in specific time  
Application: Pick and place, carriage etc.

a. Known Motion Condition	
(1) Load mass	kg
(2) Effective stroke	m
(3) Frequency	Hz
(4) Dwell time	s



b. Driver Condition	
(1) Max. output voltage	V
(2) Continuous current	A
(3) Peak current	A

c. Encoder	
(1) <input type="checkbox"/> Analog <input type="checkbox"/> Digital	
(2) Resolution	μm

f. Motion Direction	
(1) <input type="checkbox"/> Horizontal	
(2) <input type="checkbox"/> Vertical	
(3) <input type="checkbox"/> Tilt _____ Degrees	

d. Working Environment	
(1) <input type="checkbox"/> Room temperature	
(2) <input type="checkbox"/> Constant temperature _____°C	
(3) <input type="checkbox"/> Vacuum _____ Torr	
(4) <input type="checkbox"/> Clean room _____ level	

g. Installation Method	
(1) <input type="checkbox"/> Lying flat	
(2) <input type="checkbox"/> Vertically standing	
(3) <input type="checkbox"/> Wall mount	

e. Motion Precision	
(1) Positioning accuracy	μm
(2) Repetitive accuracy	μm

h. Space Restrictions	
(1) <input type="checkbox"/> None	
(2) <input type="checkbox"/> Yes _____mm x _____mm x _____mm	

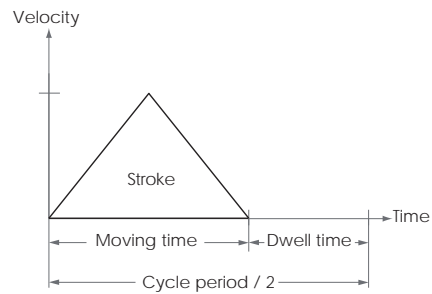
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3. Point-to-Point Motion without constant velocity

Property: Specific travel distance in specific time  
Application: Pick and place, carriage etc.

a. Known Motion Condition	
(1) Load mass	kg
(2) Effective stroke	m
(3) Acceleration	m/s <sup>2</sup>
(4) Dwell time	s



b. Driver Condition	
(1) Max. output voltage	V
(2) Continuous current	A
(3) Peak current	A

c. Encoder	
(1) <input type="checkbox"/> Analog <input type="checkbox"/> Digital	
(2) Resolution	μm

f. Motion Direction	
(1) <input type="checkbox"/> Horizontal	
(2) <input type="checkbox"/> Vertical	
(3) <input type="checkbox"/> Tilt _____ degrees	

d. Working Environment	
(1) <input type="checkbox"/> Room temperature	
(2) <input type="checkbox"/> Constant temperature _____°C	
(3) <input type="checkbox"/> Vacuum _____ Torr	
(4) <input type="checkbox"/> Clean room _____ level	

g. Installation Method	
(1) <input type="checkbox"/> Lying flat	
(2) <input type="checkbox"/> Vertically standing	
(3) <input type="checkbox"/> Wall mount	

e. Motion Precision	
(1) Positioning accuracy	μm
(2) Repetitive accuracy	μm

h. Space Restrictions	
(1) <input type="checkbox"/> None	
(2) <input type="checkbox"/> Yes _____mm x _____mm x _____mm	

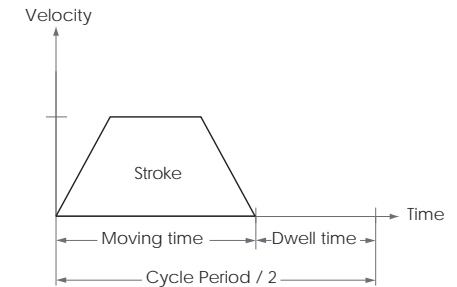
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4. Point-to-Point Motion with constant velocity

Property: Work performed under constant velocity  
Application: Scanning, inspection, cutting etc.

a. Motion Condition	
(1) Load mass	kg
(2) Effective stroke	m
(3) Moving time	s
(4) Dwell time	s
(5) Acceleration	m/s <sup>2</sup>



b. Driver Condition	
(1) Max. output voltage	V
(2) Continuous current	A
(3) Peak current	A

c. Encoder	
(1) <input type="checkbox"/> Analog <input type="checkbox"/> Digital	
(2) Resolution	μm

f. Motion Direction	
(1) <input type="checkbox"/> Horizontal	
(2) <input type="checkbox"/> Vertical	
(3) <input type="checkbox"/> Tilt _____ degrees	

d. Working Environment	
(1) <input type="checkbox"/> Room Temperature	
(2) <input type="checkbox"/> Constant Temperature _____°C	
(3) <input type="checkbox"/> Vacuum _____ Torr	
(4) <input type="checkbox"/> Clean room _____ level	

g. Installation Method	
(1) <input type="checkbox"/> Lying flat	
(2) <input type="checkbox"/> Vertically standing	
(3) <input type="checkbox"/> Wall mount	

e. Motion Precision	
(1) Positioning accuracy	μm
(2) Repetitive accuracy	μm

h. Space Restrictions	
(1) <input type="checkbox"/> None	
(2) <input type="checkbox"/> Yes _____mm x _____mm x _____mm	

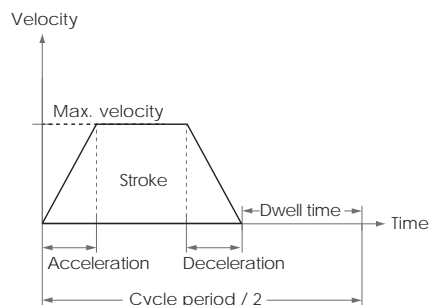
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Contact Person /	Telephone /
E-mail /	Fax /

5. Point-to-point motion with constant velocity

Property: Work performed under constant velocity  
Application: Scanning, inspection, cutting etc.

a. Motion Condition	
(1) Load mass	kg
(2) Effective stroke	m
(3) Max. velocity	m/s
(4) Acceleration time	s
(5) Dwell time	s



b. Driver Condition	
(1) Max. output voltage	V
(2) Continuous current	A
(3) Peak current	A

c. Encoder	
(1) <input type="checkbox"/> Analog <input type="checkbox"/> Digital	
(2) Resolution	μm

d. Working Environment	
(1) <input type="checkbox"/> Room temperature	
(2) <input type="checkbox"/> Constant temperature _____°C	
(3) <input type="checkbox"/> Vacuum _____ Torr	
(4) <input type="checkbox"/> Clean room _____ level	

e. Motion Precision	
(1) Positioning accuracy	μm
(2) Repetitive accuracy	μm

f. Motion Direction	
(1) <input type="checkbox"/> Horizontal	
(2) <input type="checkbox"/> Vertical	
(3) <input type="checkbox"/> Tilt _____ degrees	

g. Installation Method	
(1) <input type="checkbox"/> Lying flat	
(2) <input type="checkbox"/> Vertically standing	
(3) <input type="checkbox"/> Wall mount	

h. Space Restrictions	
(1) <input type="checkbox"/> None	
(2) <input type="checkbox"/> Yes _____mm x _____mm x _____mm	

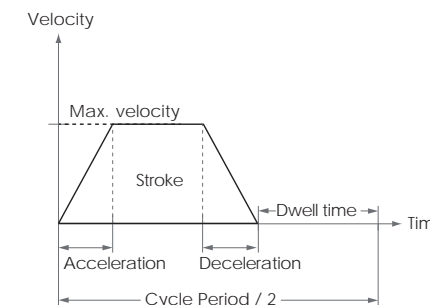
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Contact Person /	Telephone /
E-mail /	Fax /

6. Point-to-Point Motion with constant velocity section

Property: Work performed under constant velocity  
Application: Scanning, inspection, cutting etc.

a. Motion Condition	
(1) Load mass	kg
(2) Effective stroke	m
(3) Moving time	s
(4) Acceleration	m/s <sup>2</sup>
(5) Dwell time	s



b. Driver Condition	
(1) Max. output voltage	V
(2) Continuous current	A
(3) Peak current	A

c. Encoder	
(1) <input type="checkbox"/> Analog <input type="checkbox"/> Digital	
(2) Resolution	μm

d. Working Environment	
(1) <input type="checkbox"/> Room temperature	
(2) <input type="checkbox"/> Constant temperature _____°C	
(3) <input type="checkbox"/> Vacuum _____ Torr	
(4) <input type="checkbox"/> Clean room _____ level	

e. Motion Precision	
(1) Positioning accuracy	μm
(2) Repetitive accuracy	μm

f. Motion Direction	
(1) <input type="checkbox"/> Horizontal	
(2) <input type="checkbox"/> Vertical	
(3) <input type="checkbox"/> Tilt _____ degrees	

g. Installation Method	
(1) <input type="checkbox"/> Lying flat	
(2) <input type="checkbox"/> Vertically standing	
(3) <input type="checkbox"/> Wall mount	

h. Space Restrictions	
(1) <input type="checkbox"/> None	
(2) <input type="checkbox"/> Yes _____mm x _____mm x _____mm	