HIWIN®

Motion Control and System Technology

Linear Motor System

Technical Information

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HIWIN®

Motion Control and System Technology

High speed | High precision | Multifunctional integration | Ecology first | Humanistic technology

TAIWAN EXCELLENCE 2005

TAIWAN EXCELLENCE
GOLD AWARD 2005

Ballscrew

- For Heavy-Load Drive

TAIWAN EXCELLENCE 2004

TAIWAN EXCELLENCE
2004

Positioning Guideway

TAIWAN EXCELLENCE 2004

TAIWAN EXCELLENCE
GOLD AWARD 2004

Linear Synchronous Motor

- Coreless Type (LMC)

TAIWAN EXCELLENCE 2002

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2002

Linear Actuator

- LAN for Hospital
- LAM for Industrial
- LAS Compact Size
- LAK Controller

TAIWAN EXCELLENCE 2003

TAIWAN EXCELLENCE 2010

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GOLD AWARD 2003, 2010

Single Axis Robot

- For Semiconductor & Electronic (KK Series)
- For Automation (KS, KA Series)

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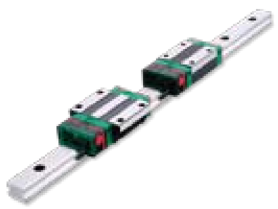
Linear Motor Air Bearing Platform



TAIWAN EXCELLENCE 2008

TAIWAN EXCELLENCE 2007

TAIWAN EXCELLENCE
GOLD AWARD 2008
TAIWAN EXCELLENCE
SILVER AWARD 2007, 2002

Linear Guideway

HG/EG/RG/MG Type

- Ecological & Economical lubrication Module E2
- Low Noise (Q1)
- Air Jet (A1)

Positioning Measurement System

TAIWAN EXCELLENCE 2008

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TAIWAN EXCELLENCE
GOLD AWARD 2009, 2008
TAIWAN EXCELLENCE
SILVER AWARD 2006, 2001, 1993

Ballscrews

Ground/Rolled

- High Speed (High Dm-N Value/Super S Series)
- Heavy Load (Cool type II)
- Ecological & Economical lubrication Module E2
- Rotating Nut (R1)

Linear Motor X-Y Robot

TAIWAN EXCELLENCE 2006

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SILVER AWARD 2006

TMS Direct-Driver Positioning System

Linear Motor Gantry

Positioning Systems

Customized Positioning Systems

The standardized positioning axes presented in this catalogue make it possible to handle many kinds of positioning tasks. For positioning tasks, that cannot be solved using standard axes, HIWIN engineers are available to work out an optimized solution for customers. The inquiry form at the end of this catalogue serves to help our application engineers make a preliminary design.

A sampling of customized solutions is shown here. In several examples, mechanics are not the only parts customized. For instance, with the planar motors, special software is developed in order to obtain optimal integration of the positioning system to the production process.

1.1 Examples

Economical Pick & Place and Inspection

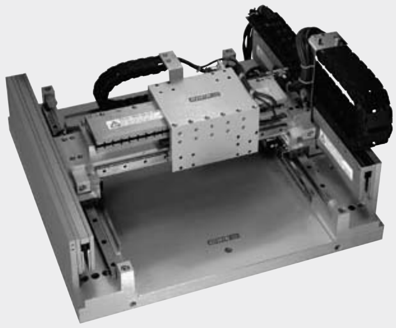
XY gantry systems are economical for many applications. Gantry axes are assembled from standard components.

- Standard axes of the LMX1L series
- Repeatability ± 2 µm
- Delivery with base frame

Microshapes and Macroshapes

Milling of microstructures with cutting tools and lasers are application areas in which gantry systems excel. They are also very economical to implement.

- Coreless motors LMC
- Repeatability ± 2 µm
- Technology proven through countless worldwide installations

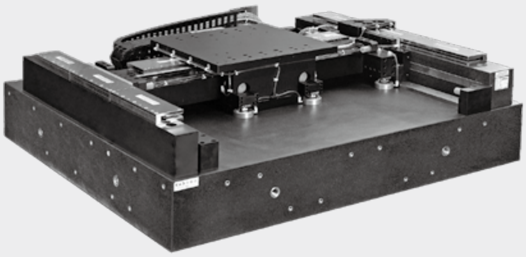


Planar Motors

Servo-planar motors provide an excellent technological platform for inspection tasks. During inspection of circuit boards, optical sensors are integrated to completely monitor the printed conductive tracks and SMD components.

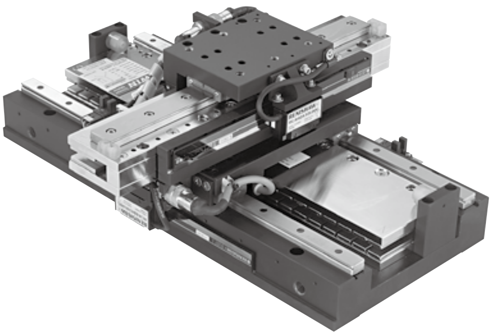
- Virtually no wear due to an air-cushion bearing
- Guaranteed levelness for the complete stroke path (up to 1000 mm x 1000 mm)
- Repeatability ± 3 µm

Positioning Systems
Customized Positioning Systems



Wafer Quality Control and Mask Production at the Highest Level
High precision cross stages with air-bearings are the prerequisites for surface monitoring and mask production, to find even the smallest errors, to produce precision masks, in wafer production for the electronics, chip and flat panel industries.

- Flatness ±2 µm
- Repeatability ±0.5 µm
- Accuracy ±1.5 µm

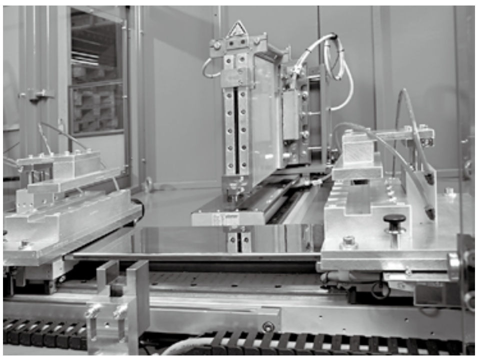


Microsystem Technology and Wafer Processing
Absolute precision and suitability for clean room conditions are the prerequisites for every drive in microsystem technology and wafer processing. Linear motor cross stages meet these requirements.

- Stroke 200 mm x 200 mm, optional 300 mm x 300 mm
- Levelness ± 4 µm across the complete stroke
- Repeatability ± 1 µm across both axes
- Accuracy ± 4 µm across both axes
- Clean room suitability class 100; optional class 10

Laser Scanners
Extremely smooth motion and long operating life are a must for optical inspection systems such as laser scanners. Linear motor stages with air bearings fulfill these requirements.

- Frictionless air cushions
- Coreless linear motors are not effected by cogging.
- Stroke up to 1,500 mm



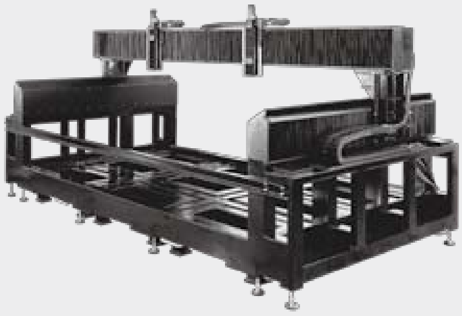
Horizontal High-Speed Hot Weld Machine for Welding Synthetic Materials
Linear motor stages of the LMX1L series with absolute position measurement offer:

- No commutation required at power up
- No “drawing” of the synthetic material when removed from the heated plate
- Welding is controlled by time, force and path
- Lower changeover times due to higher speeds

Water Jet Application

LMS double forcer linear stage provides 2.5m stroke and carries two HIWIN KK stages on the Z-axis. The lower 2 axes are also equipped with LMS high thrust liner motors and run under synchronization.

- No commutation required at power up
- Large stroke
- Delivered with base frame, cover and high end motion controller



Total Solution for AOI Industry

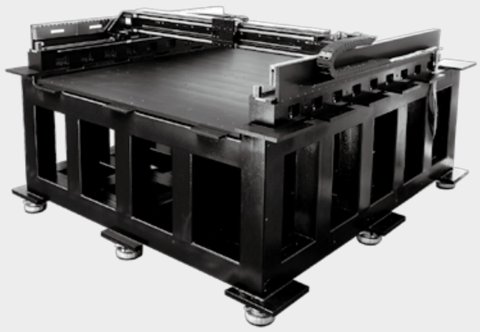
LMC linear stage provides smooth motion for the special needs in AOI applications. With the LMS linear stage mounted to the upper axis, the ballscrew driven Z-axis integrated with a CCD camera can attain high speeds.

- Repeatability ±1 μm
- Velocity ripple below 1.5 %
- Delivery with base frame and cover

Custom Made Stage for Glass Working

The linear motor stage is designed to carry a working head to move above the flat table. The customer's working head is for cutting double layer glasses.

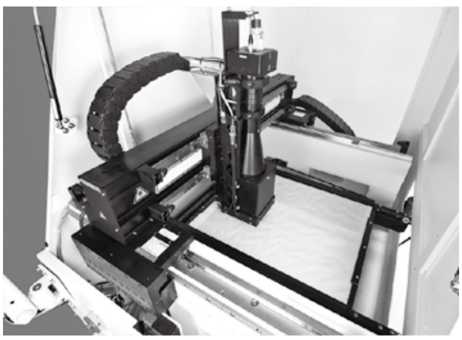
- Gantry structure linear motor positioning stage for Gen. 5 glass
- 1300 mm x 1450 mm stroke
- Smooth motion
- Sinusoidal commutation and no cogging
- LMC series motors
- Repeatablility ± 2μm
- Rigid base structure



Helping Customers with Motion Service

This is another AOI application, where customer need high performance cost ratio.

- 534 x 534 mm^2 stroke
- LMS27 and LMS13 gantry
- Special synchrnous control for gantry
- Steel base frame
- Integrating PCB conveyor, PLC, IPC for customers
- Sub-micron repeatability
- Promising move and settle time 40mm within 200ms to +/-1.5um



Positioning Systems

Customized Positioning Systems

1.2 Glossary

Acceleration
This is the speed change per time unit, i.e., acceleration = speed / time or a = v / t.

Acceleration time
This is defined as the time a drive requires from start until achieving maximum speed.

Accuracy
This, or actually the better terminology, the inaccuracy, corresponds to the deviation between target and actual position. The accuracy along an axis is defined as the remaining difference of target and actual position, after other linear deviations are excluded. Such systematic or linear deviations can be caused by cosine error, angle deviation, ball screw error, thermal expansion, etc. For all target positions of interest in an application, it is calculated with the following formula:
Maximum of sum of systematic target-actual-difference + 2 sigma (standard deviation)
Please do not confuse accuracy with repeatablity.

Attraction force F_a
This is created between the primary and secondary parts of the iron-core linear motors which must be taken up by the guide.

Back emf constant
(see also Chapter 1.3, K_v)
This is the ratio of the back emf voltage (rms) to the motor rotational speed or linear speed (rpm or m/s). The back emf is the electromagnetic force, which is created at the movement of the coil in the magnetic field of permanent magnets, e.g. in a servomotor.

Continuous torque, continuous force
(see also Chapter 1.3, F_c)
Or also nominal torque, nominal force. This is the torque or force, that rotary or linear motors can produce in continuous operation (duty cycle = 100%).

Continuous current
(also see Chapter 1.3, I_c)
It is a current that flows over longer time into motor. The maximum allowed current into each coil is also called nominal current. It is characterized when the generated heat results in motor warming of up to 80 °C.

Eccentricity
This is the deviation of the center point of rotation of rotary tables from their position during rotation. It is created by centering and bearing tolerances.

Force, torque
Force (in linear movements) or torque (in rotational movements) is given for defined conditions, e.g., as continuous force or torque at:
- 20 °C ambient temperature
- 80 °C winding temperature
- 100% duty cycle

or as peak force or peak torque.

Force constant K_f
(see also Chapter 1.3, K_f)
This is a coil specific constant. The motor output force can be calculated by multiplying the force constant of the motor by input current: $F = I \times K_f$

Guide deviation
This is the deviation from the axis of stroke. It depends on horizontal straightness (also straightness) and vertical straightness (also flatness).

Horizontal straightness
It is a measure for horizontal straightness when moving in X-axis. If there is deviation in horizontal straightness, there would be positioning error in Y-axis, as the system moves along X-axis.

Motor constant K_m
(see also Chapter 1.3, K_m)
This designates the ratio of generated force and dissipation power and consequently is a measure of efficiency for a motor.

Peak current I_p
(see also Chapter 1.3, I_p)
This current is applied to coils for a short time to generate peak force. HIWIN defines it to be the following: For iron core type motors, I_p is 2 times the allowed continuous current. For coreless types, it is 3 times the allowed continuous current. The maximum time for applying peak current is 1 second. After that, motor has to cool down to nominal operating temperature, before further peak current could be applied again.

Peak torque, peak force F_p

The peak torque (for rotary motion) or peak force (for linear motion) is the maximum force that a motor can generate for approximately one second with peak current I_p. While applying I_p into motor, it is operating near the non-linear range of motor. This is especially useful for acceleration and braking.

Repeatability

Repeatablity may not be confused with absolute accuracy. A linear axis can have medium accuracy, but have good repeatability. Uni-directional repeatability can be measured in a way, that a target position is approached multiple times from an appropriately large enough enough distance and the same approaching direction. In this way, the backlash will not have any effect. For measurement of bi-directional repeatability, the target position is approached from different directions, in which case the backlash will take effect.

Resolution

It is the smallest distance, that the position measuring system will detect. The reachable step size is, in principle, larger than resolution due to other additional factors.

Step size

Also called resolution. It is the smallest possible movement of a system. It depends on encoder, amplifier, mechanical construction, backlash, etc.

Stiffness

This corresponds to the mechnical resistance to deformation a part or an assembly can provide under external static load. (static stiffness) Or, it is the elastic resistance to deformation a part or an assembly can provide under external dynamic load. (dynamic stiffness)

Torque

This is a measurement of the rotational movement in a body and consequently a vectorial direction that can be expressed in the following cross product:

$\vec{M} = \vec{r} \times \vec{F}_1$

The torque is expressed in the equation Nm = kg x m²/s².

Vertical straightness

It is a measure for vertical straightness when moving in X-axis. If there is deviation in vertical straightness, there would be positioning error in Z-axis, as the system moves along X-axis.

Winding resistance R_{25}

This is the coil-specific dimension of is the winding resistance at 25 °C. At 80° C, the winding resistance increases to approximately 1.2 x R_{25}.

Winding temperature T_{max}
(see also Chapter 1.3, T)

This is the permitted winding temperature. The actual motor temperature is dependent on the installation, cooling and operating conditions and consequently can only be determined in a concrete case and cannot be calculated.

Wobbling

It is a term for rotary motor. Wobble is the angular deviation of rotating axis from theoretical axis of rotation as the motor turns. The reason for it is possibly bearing tolerances.

Positioning Systems
Customized Positioning Systems

1.3 Typical Dimensions

1.3.1 Coil-Independent Dimensions

F_a Relatively constant attracting force between motor primary and secondary part. The force is taken by a mechanical guide.

F_c Motor force available as continuous force in nominal operation and results in warming to 70-80 °C.

F_p Short term motor force, which is available at applying I_p to the coils and operate near the non-linear area. Without cooling means, it will cause a very strong temperature rising of coils.

K_m Motor constant, which is the ratio of generated force to dissipation power and is cosequently an index of motor efficiency.

P_v The generated power in a motor coil, which results in time dependent temperature rise according to supplied current and ambient cooling conditions. In the non-linear operating area of current (I_p), P_v is especially high due to quadratic relation to current, whereas in the linear area of current (I_c), it results in relative low warming. P_v can be calculated with motor constant K_m and force as below: $P_v = F/K_m^2$

P_{vp} Peak power at Ip

P_c Continuous power at Ic

T Permissible temperature of motor winding, which is monitored with help of sensor or thermal switch. The motor surface temparature depends on:

- The actual assembly condition (position stage size)
- Heat dissipation condition (cooling means)
- Actual operation

So the actual temperature can only be determined with the above informations.

1.3.2 Coil-Dependent Dimensions

I_c The current for generating continuous force

I_p The peak current for generationg short term peak force

K_f Coil characteristic value for calculation of force with the formula: $F = I \times K_f$

K_v Coil characteristic value, which results armature back emf dependent of velocity when motor works as generator. : $U_g = K_v \times v$

R_{25} Winding resistance at 25 °C; this increases to approx., 1.2 times the value at 80 °C.

2 Linear Motor Stages

Positioning Systems

Linear Motor Stages

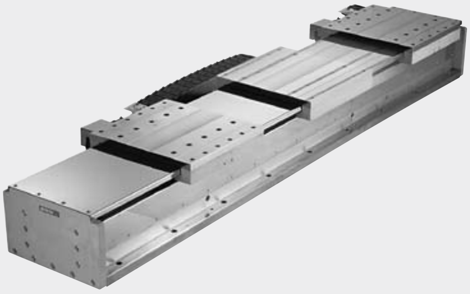
2.1 Product Overview

LMX1E-C Page 14

- Complete linear stage with coreless motor, type LMC
- Excellent for applications with a high degree of synchronous operation requirements
- Also for use as cross table
- Stroke is measured via optical encoder incrementally or absolutely
- Total length to 4,000 mm

LMX1L-S Page 19

- Complete linear stage with iron-core motor, type LMS
- Specially suited for applications with high demands on continuous power
- Also for use as cross table
- Stroke is measured via optical or magnetic encoder incrementally or absolutely depending on requirements
- Total length to 4,000 mm

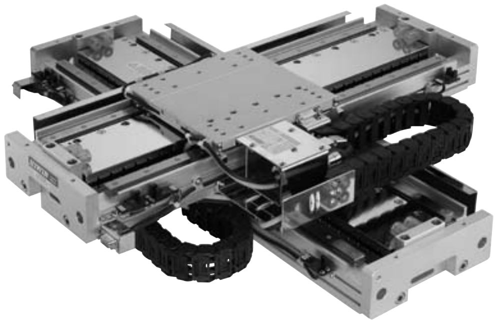


LMX1L-SC Page 27

- Complete linear stage with iron-core motor, type LMSC
- Sandwich design makes high power density possible without static load of the guideways by attraction force
- Stroke is measured via optical or magnetic encoder incrementally or absolutely depending on requirements
- Total length to 4,000 mm

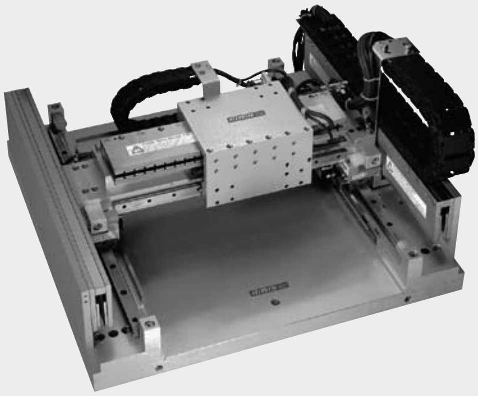
Cross Tables Page 29

- Combination of linear stages of the LMX series
- With iron-core or coreless motors



Gantry Systems Page 33

- Standardized gantry systems with iron-core or coreless motors



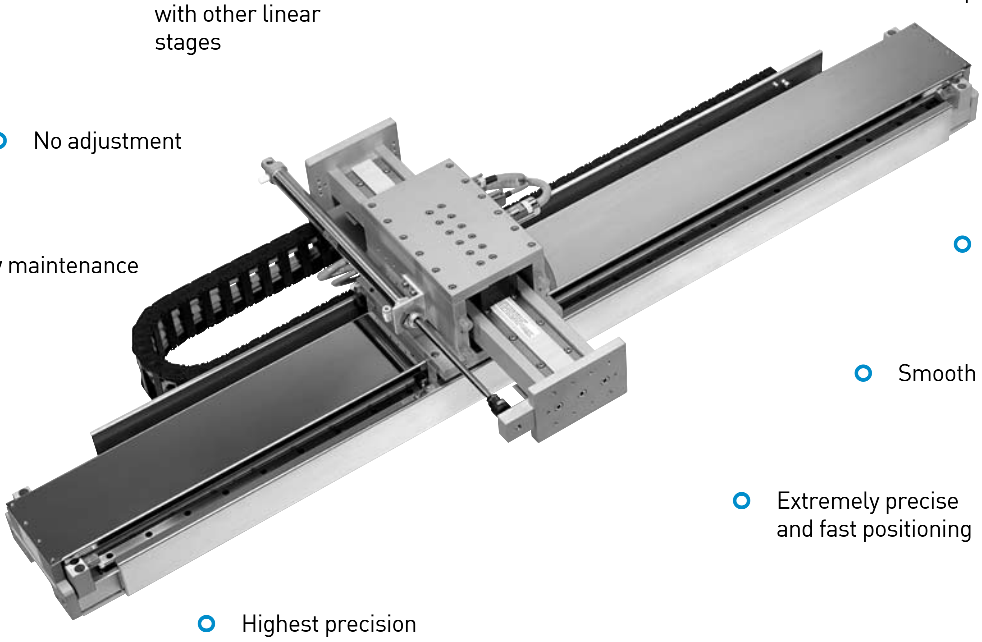
Positioning Systems

Linear Motor Stages

2.2 Typical Properties of Linear Motor Stages

HIWIN linear motor stages are directly driven axes with linear motors, which are designed as a plug and play solution. Standardized cable chains and customized cable guides are possible as an option. They are complete axes with distance measurement system, linear guide way, limit switch and optionally covers as protection against ambient influences. An arresting brake can be added as an option.

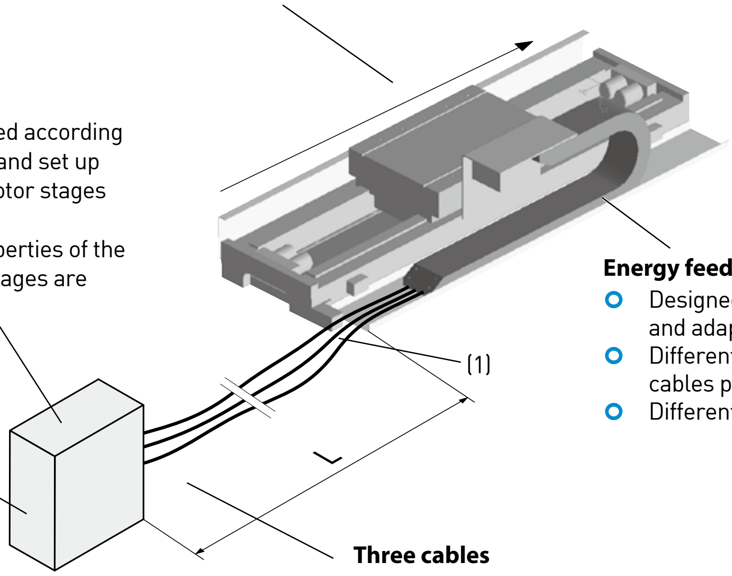
Due to the direct drive, the linear stages are backlash-free, very dynamic, low maintenance and can be equipped with several blocks.
The linear stages are provided as a complete solution including drivers on request. Customers can select the drive manufacturer of their choice. We supply the required electronic parameters for adaptation of the linear motor.



2.3 Scope of Delivery

Positive (+) movement direction
The movement direction is defined via the position of the reference switch.
As a standard, it is on the opposite side as the limit switch plug (1).

Driver
(also refer to page 74)
A suitable driver is selected according to customer applications and set up according to the linear motor stages to be supplied.
The dynamic running properties of the respective linear motor stages are thus ensured.



Energy feed
- Designed to customer specifications and adapted to local conditions
- Different dimensions for additional cables possible
- Different mounting positions possible

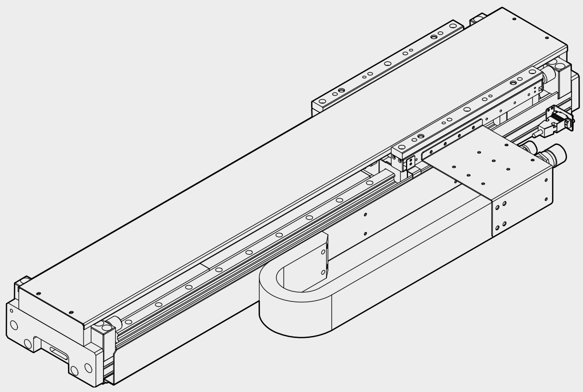
Possible interfaces
- CANopen
- Serial via RS232
- 10 V analog
- Pulse/Direction; CW/CCW
- Others on request

Three cables
- Electric power cable
- Encoder cable
- Limit switch cable

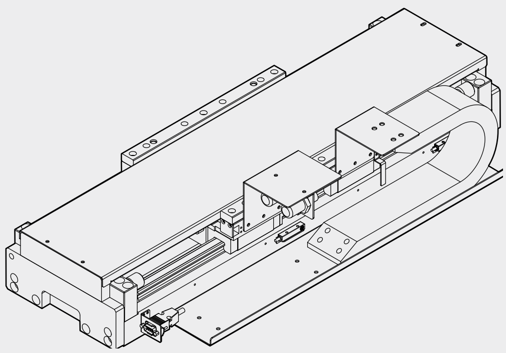
Cable length extending from forcer is 3m, 5m and 7m. the cable are certified according to CE and UL regulations.

Standard linear motor stages
Different models: see pages 14-34.

2.3.1 Cable Chain Orientation



Horizontal orientation

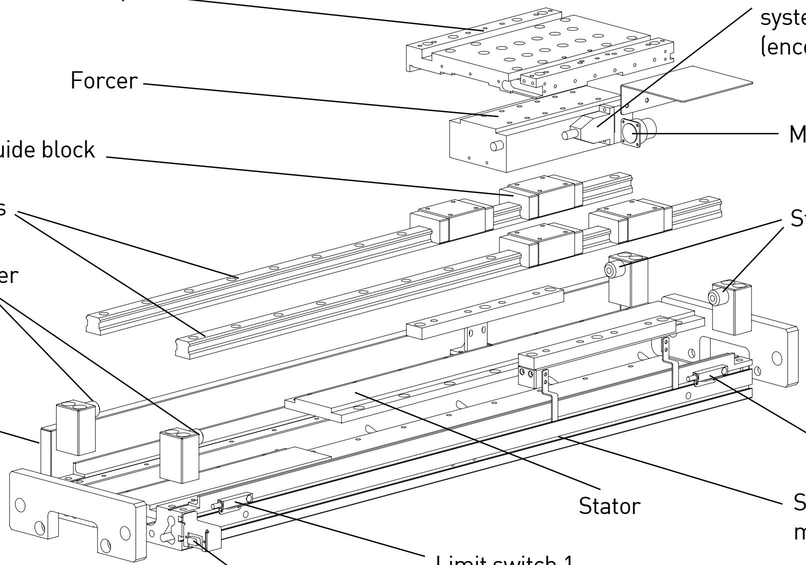


Vertical orientation

Positioning Systems

Linear Motor Stages

2.4 System Configuration



General Specifications of Linear Motor Stages

Name	Motor Type	v_{max} without payload [m/s]	a_{max} without payload [m/s²]	Total Length L_{max} [mm]	Repeatability [mm]	Accuracy [mm/300 mm]	Straightness [mm/300 mm]	Flatness [mm/300 mm]	Page
LMX1E-C ...	**LMC**	3	50	4000	+/- 0.001*	+/- 0.005*	+/- 0.005	+/- 0.005	14
LMX1L-S ...	**LMS**	3	50	4000	+/- 0.001*	+/- 0.005*	+/- 0.005	+/- 0.005	19
LMX1L-SC ...	**LMSC**	2	50	4000	+/- 0.001*	+/- 0.005*	+/- 0.005	+/- 0.005	27

* Values apply to the optical, incremental distance measurement system with 40μm periods of the sin/cos signal.

The distance measurement system is either digital or analog, depending on the customer's request. As a standard, digital encoder with 1μm resolution is provided.
The permissible operating voltage depends on the used linear motor type.

2.5 Structure of Order Number

2.5.1 Structure of Order Number of Single-Axis Series

LMX1 L S23 -1 - 0872 - G 2 0 0 - XXXXXXXX

Stage type	Motor type	Quantity of Forcer	Stroke [mm]	Encoder-Type	Limit switch	Cover	Cable chain	Customized drawing number
L– Iron-core motors E– Corelss motors C– Customized	Sxx – Iron-core linear motor Cxx – Coreless linear motor SCx– Iron-core linear Linear motor in sandwich form			A– Optical, period 40 μm, analog 1Vpp sin/cos B– Optical, period 20 μm, analog 1Vpp sin/cos D– Magnetic, period 1mm, analog 1Vpp sin/cos E– Magnetic, digital TTL, resolution 1μm G– Optical, digital TTL, resolution 1 μm (standard)	0– None 1– Inductive, PNP 2– Optical, NPN (standard)	0– None (standard) A– Metal sheet B– Bellow	0– None (standard) 1– For horizontal orientation, size 15x30 2– For vertical orientation, size 15x30 C- Customized	Multi-Forcer, hall sensor, mass compensation, special brake, special mounting holes

2.5.2 Structure of Order Number of Cross Tables

LMX2 L S23 S27 - 232 - 280 G 2 0 0 - XXXXXXXX

Stage type	Motor type of upper axis	Motor type of lower axis	Stroke of upper axis [mm]	Stroke of lower axis [mm]	Encoder-Type	Limit switch	Cover	Cable chain	Customized drawing number
L– Iron-core motors E– Corelss motors C– Customized	Sxx – Iron-core linear motor Cxx – Coreless linear motor SCx– Iron-core linear Linear motor in sandwich form	Sxx – Iron-core linear motor Cxx– Coreless linear motor			A– Optical, period 40 μm, analog 1Vpp sin/cos B– Optical, period 20 μm, analog 1Vpp sin/cos D– Magnetic, period 1mm, analog 1Vpp sin/cos E– Magnetic, digital TTL, resolution 1μm G– Optical, digital TTL, resolution 1 μm (standard)	0– None 1– Inductive, PNP 2– Optical, NPN (standard)	0– None (standard) A– Metal sheet B– Bellow	0– None (standard) 1– For horizontal orientation, size 15x30 2– For vertical orientation, size 15x30 C- Customized	Multi-Forcer, hall sensor, mass compensation, special brake, special mounting holes

2.5.3 Structure of Order Number of Gantry Type Series

LMG2 A S13 S27 - 300 - 400 G 2 0 0 - XXXXXXXX

Driving of lower axis	Stage type	Motor type of upper axis	Motor type of lower axis	Stroke of upper axis [mm]	Stroke of lower axis [mm]	Encoder-Type	Limit switch	Cover	Cable chain	Customized drawing number
2- Single 3- Two sides	A– Standard C – Customized	Sxx – Iron-core linear motor Cxx – Coreless linear motor	Sxx – Iron-core linear motor Cxx– Coreless linear motor			A– Optical, period 40 μm, analog 1Vpp sin/cos B– Optical, period 20 μm, analog 1Vpp sin/cos D– Magnetic, period 1mm, analog 1Vpp sin/cos E– Magnetic, digital TTL, resolution 1μm G– Optical, digital TTL, resolution 1 μm (standard)	0– None 1– Inductive, PNP 2– Optical, NPN (standard)	0– None (standard) A– Metal sheet B– Bellow	0– None (standard) 1– For horizontal orientation, size 15x30 2– For vertical orientation, size 15x30 C- Customized	Multi-Forcer, hall sensor, mass compensation, special brake, special mounting holes

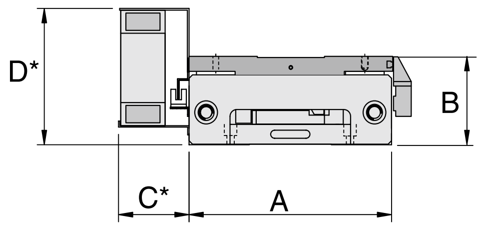
Positioning Systems

Linear Motor Stages

2.6 Linear Motor Stages LMX1E-C

Linear motor stages LMX1E-C are equipped with a coreless motor and well suited for applications with a high degree of synchronous operation requirements. They can also be used in cross tables. They are distinguished by their low profile design. The travel is measured via optical encoder incrementally. The linear motor stages LMX1E-C have very high dynamics and are available in overall lengths up to 4,000 mm.

- Max. acceleration 100 m/s^2
- Max. speed 5 m/s
- Length up to 4,000 mm



* Dimensions C and D are customer-specific

Specifications for Linear Motor Stages LMX1E-C

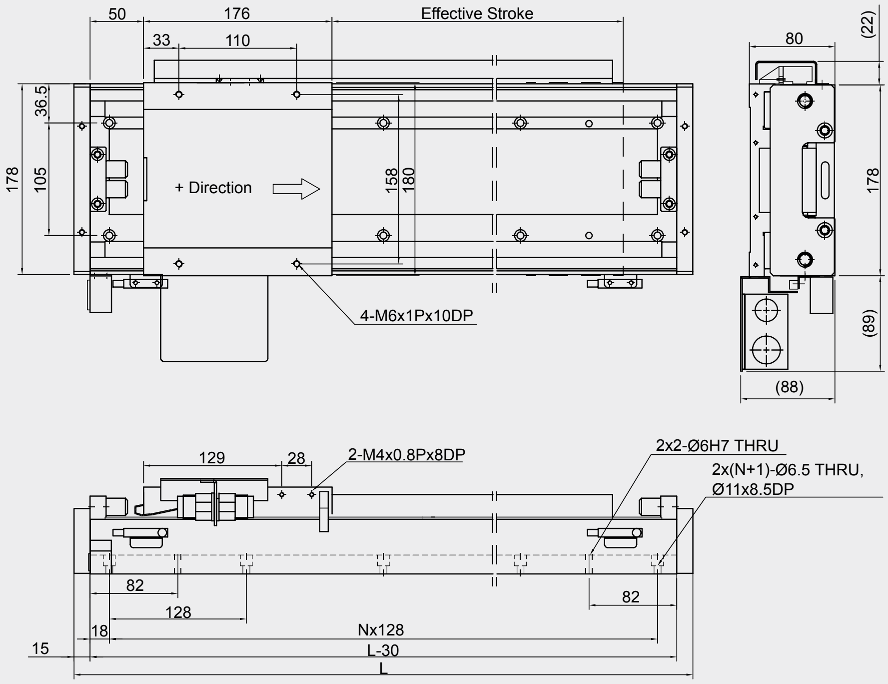
Type (Order code) xxxx=Stroke [mm]	Motor Type	F_c [N]	F_p [N]	Mass of Slider [kg]	Length of forcer [mm]	v_{max} without payload [m/s]	a_{max} without payload [m/s^2]	Dimension A [mm]	Dimension B [mm]
LMX1E-CB5-1-xxxx-G200	LMC B5	91	273	2	178	3	50	178	80
LMX1E-CB6-1-xxxx-G200	LMC B6	109	327	3	208	3	50	178	80
LMX1E-CB8-1-xxxx-G200	LMC B8	145	435	4.2	272	3	50	178	80
LMX1E-CB5-1-xxxx-G2A0	LMC B5	91	273	2.3	178	3	50	178	95/105
LMX1E-CB6-1-xxxx-G2A0	LMC B6	109	327	3.3	208	3	50	178	95/105
LMX1E-CB8-1-xxxx-G2A0	LMC B8	145	435	4.5	272	3	50	178	95/105

Note: F_c = continuous force, 100% operating time
F_p = peak force (1 s)
Electric parameters for the linear motors: see page 48.
Mass of slider includes forcer, forcer plate, guide blocks.

2.6.1 Linear Motor Stages LMX1E-C without Cover

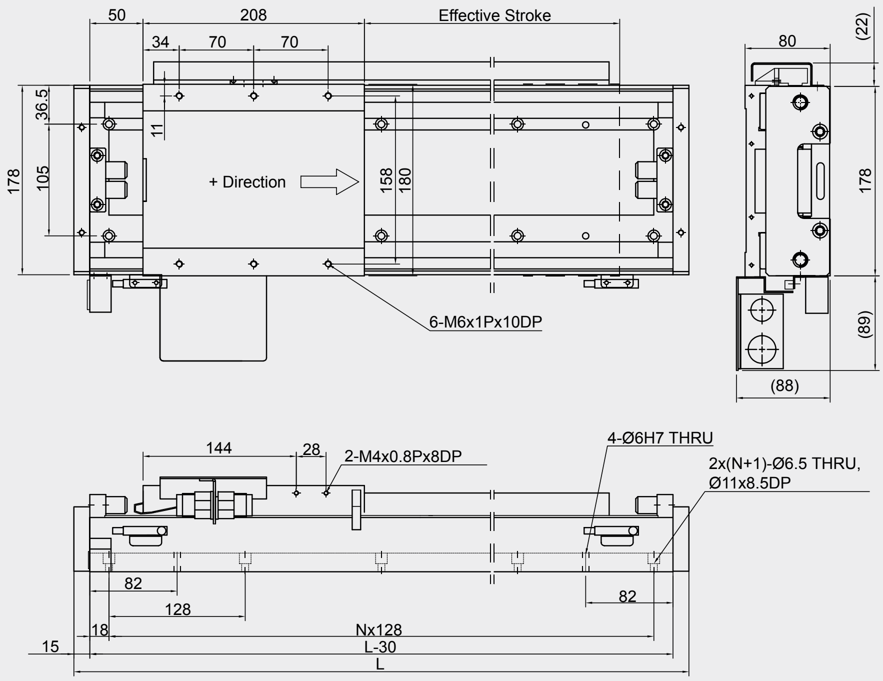
Dimensions and weight of the linear motor stage LMX1E-CB5 without cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]
144	450	3	19
272	578	4	22.5
400	706	5	26
528	834	6	30
656	962	7	33
784	1090	8	36.5
912	1218	9	40.5
1040	1346	10	44
1296	1602	12	51
1552	1858	14	58.5
1808	2114	16	66



Dimensions and weight of the linear motor stage LMX1E-CB6 without cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]
112	450	3	19
240	578	4	23
368	706	5	26.5
496	834	6	30
624	962	7	34
752	1090	8	37.5
880	1218	9	41
1008	1346	10	45
1264	1602	12	52
1520	1858	14	59.5
1776	2114	16	66.5

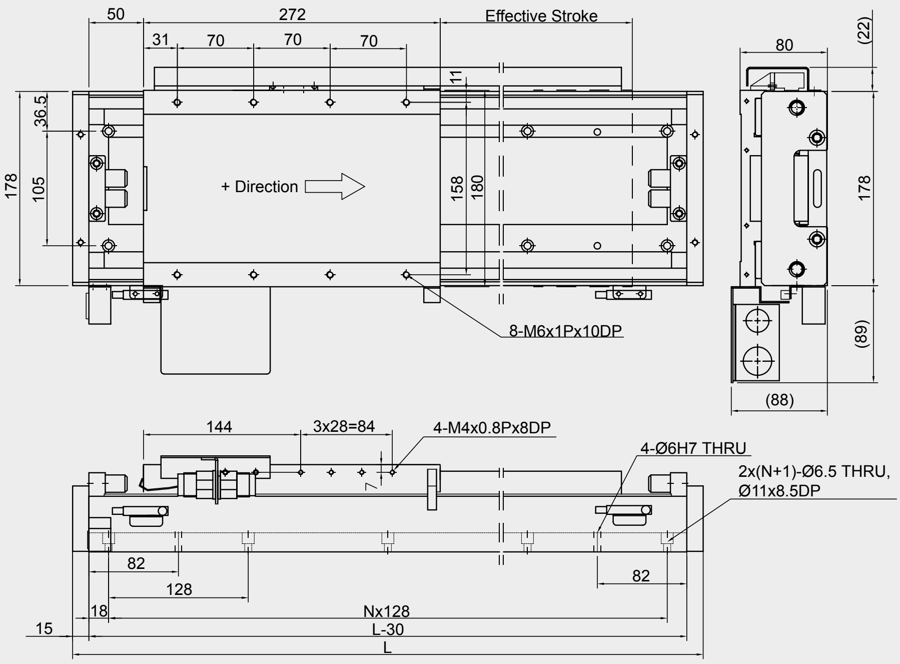


Positioning Systems

Linear Motor Stages

Dimensions and weight of the linear motor stage LMX1E-CB8 without cover

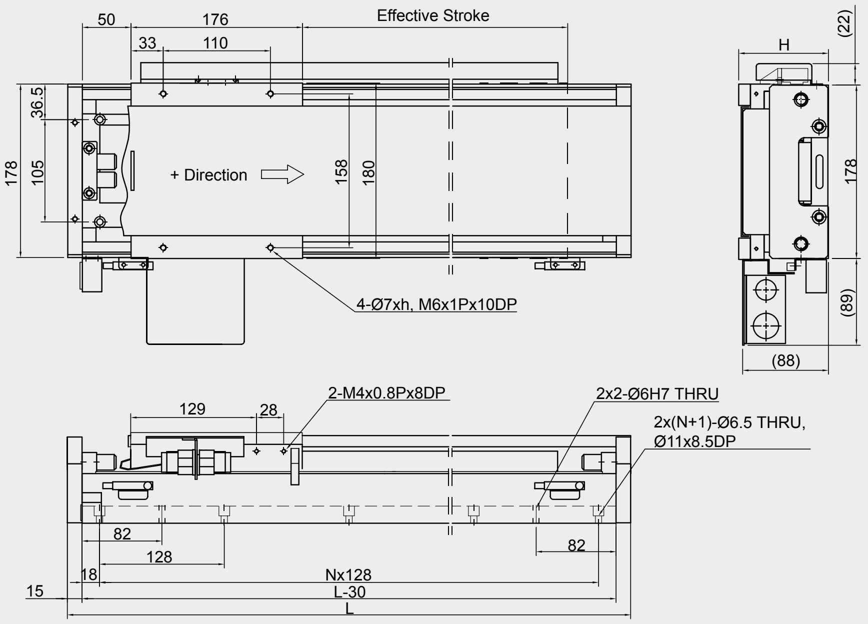
Stroke [mm]	Total length L [mm]	N	Mass [kg]
176	578	4	24.5
304	706	5	28
432	834	6	32
560	962	7	35.5
688	1090	8	39
816	1218	9	43
944	1346	10	46
1200	1602	12	53.5
1456	1858	14	61
1712	2114	16	68



2.6.2 Linear Motor Stages LMX1E-C with Cover

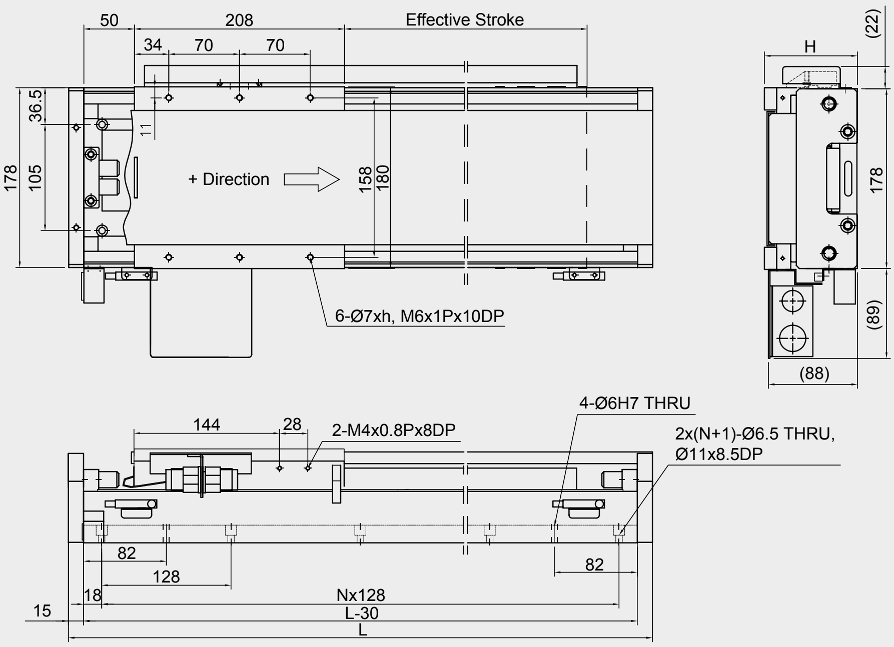
Dimensions and weight of the linear motor stage LMX1E-CB5 with cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
144	450	3	20.5	95	15
272	578	4	24.5	95	15
400	706	5	28	95	15
528	834	6	32	95	15
656	962	7	36	95	15
784	1090	8	40	95	15
912	1218	9	44	95	15
1040	1346	10	48	95	15
1296	1602	12	56	105	25
1552	1858	14	64	105	25
1808	2114	16	72	105	25



Dimensions and weight of the linear motor stage LMX1E-CB6 with cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
112	450	3	21	95	15
240	578	4	25	95	15
368	706	5	29	95	15
496	834	6	33	95	15
624	962	7	37	95	15
752	1090	8	41	95	15
880	1218	9	45	95	15
1008	1346	10	49	95	15
1264	1602	12	56	105	25
1520	1858	14	64.5	105	25
1776	2114	16	72.5	105	25

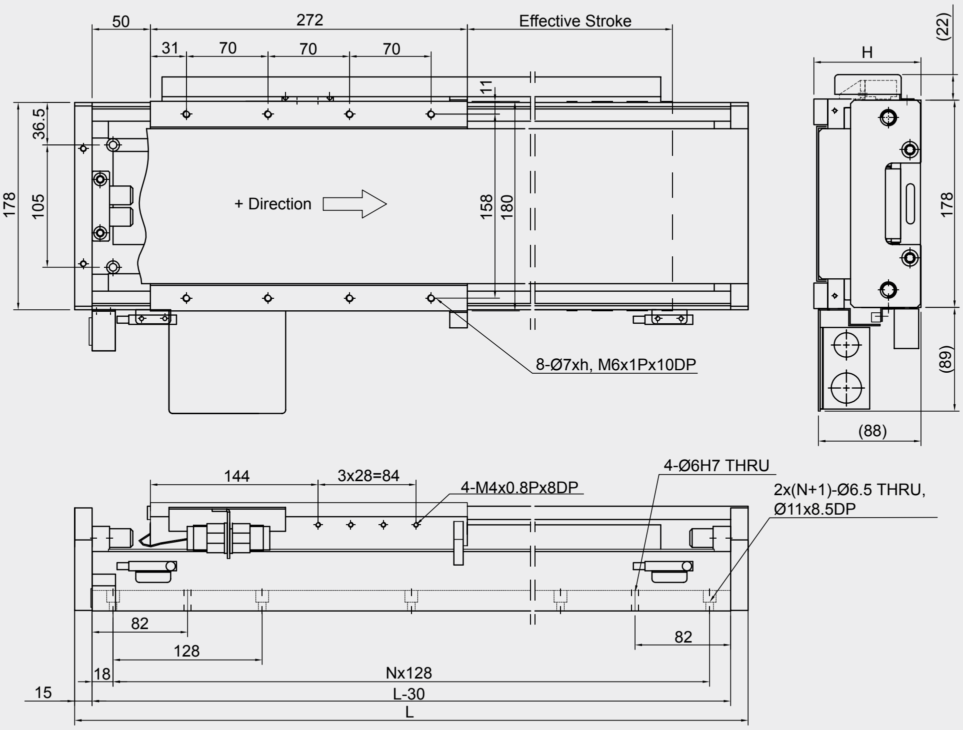


Positioning Systems

Linear Motor Stages

Dimensions and weight of the linear motor stage LMX1E-CB8 with cover

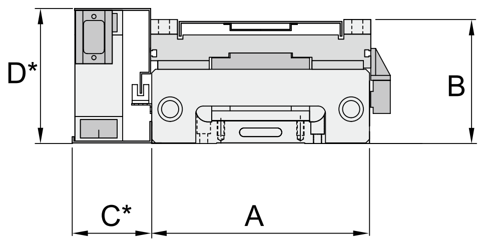
Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
176	578	4	26.5	95	15
304	706	5	30.5	95	15
432	834	6	34.5	95	15
560	962	7	38.5	95	15
688	1090	8	42	95	15
816	1218	9	46	95	15
944	1346	10	50	95	15
1200	1602	12	58	105	25
1456	1858	14	66	105	25
1712	2114	16	74	105	25



2.7 Linear Motor Stages LMX1L-S

Linear motor stages LMX1L-S are equipped with an iron-core motor, which provides substantial continuous power. They can also be used in cross tables. The travel is measured via optical or magnetic encoders incrementally or absolutely. The linear motor stages LMX1L-S have a very compact design and are available in overall lengths up to 4,000 mm.

- Max. acceleration 50 m/s²
- Max. speed 4 m/s
- Length up to 4,000 mm



* Dimensions C and D are customer-specific

Specifications for Linear Motor Stages LMX1L-S

Type (Order code) xxxx=Stroke [mm]	Motor Type	F_c [N]	F_p [N]	Mass of Slider [kg]	Length of forcer [mm]	v_{max} [m/s]	a_{max} [m/s²]	Dimension A [mm]	Dimension B [mm]
LMX1L- S23 -1-xxxx-G200	LMS 23	213	427	7.5	200	3	50	178	90
LMX1L- S27 -1-xxxx-G200	LMS 27	339	679	9.5	280	3	50	178	90
LMX1L- S37 -1-xxxx-G200	LMS 37	475	950	12	280	3*	50	202	95
LMX1L- S37L-1-xxxx-G200	LMS 37L	475	950	12	280	3	50	202	95
LMX1L- S47 -1-xxxx-G200	LMS 47	651	1302	18	280	2.5*	50	232	95
LMX1L- S47L-1-xxxx-G200	LMS 47L	651	1302	18	280	3	50	232	95
LMX1L- S57 -1-xxxx-G200	LMS 57	781	1562	22	280	2	50	252	100
LMX1L- S57L-1-xxxx-G200	LMS 57L	781	1562	22	280	3	50	252	100
LMX1L- S67 -1-xxxx-G200	LMS 67	950	1900	26	280	2	50	272	100
LMX1L- S67L-1-xxxx-G200	LMS 67L	950	1900	26	280	3	50	272	100
LMX1L- S23 -1-xxxx-G2A0	LMS 23	213	427	7.8	200	3	50	178	102/111
LMX1L- S27 -1-xxxx-G2A0	LMS 27	339	679	9.9	280	3	50	178	102/111
LMX1L- S37 -1-xxxx-G2A0	LMS 37	475	950	12.5	280	3*	50	202	107/116
LMX1L- S37L-1-xxxx-G2A0	LMS 37L	475	950	12.5	280	3	50	202	107/116
LMX1L- S47 -1-xxxx-G2A0	LMS 47	651	1302	18.8	280	2.5*	50	232	107/116
LMX1L- S47L-1-xxxx-G2A0	LMS 47L	651	1302	18.8	280	3	50	232	107/116
LMX1L- S57 -1-xxxx-G2A0	LMS 57	781	1562	23	280	2*	50	252	112/121
LMX1L- S57L-1-xxxx-G2A0	LMS 57L	781	1562	23	280	3	50	252	112/121
LMX1L- S67 -1-xxxx-G2A0	LMS 67	950	1900	27	280	2*	50	272	112/121
LMX1L- S67L-1-xxxx-G2A0	LMS 67L	950	1900	27	280	3	50	272	112/121

Note: F_c = continuous force, 100% operating time
F_p = peak force (1 s)
Electric parameters for the linear motors: see page 42
* Limited by back emf constant of the motor coil

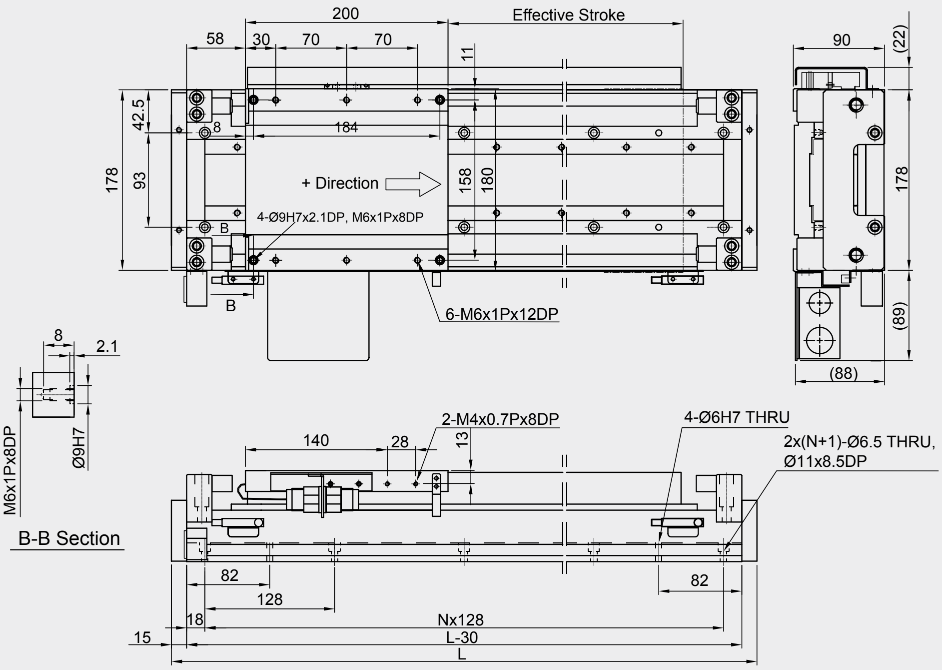
Positioning Systems

Linear Motor Stages

2.7.1 Linear Motor Stages LMX1L-S without Cover

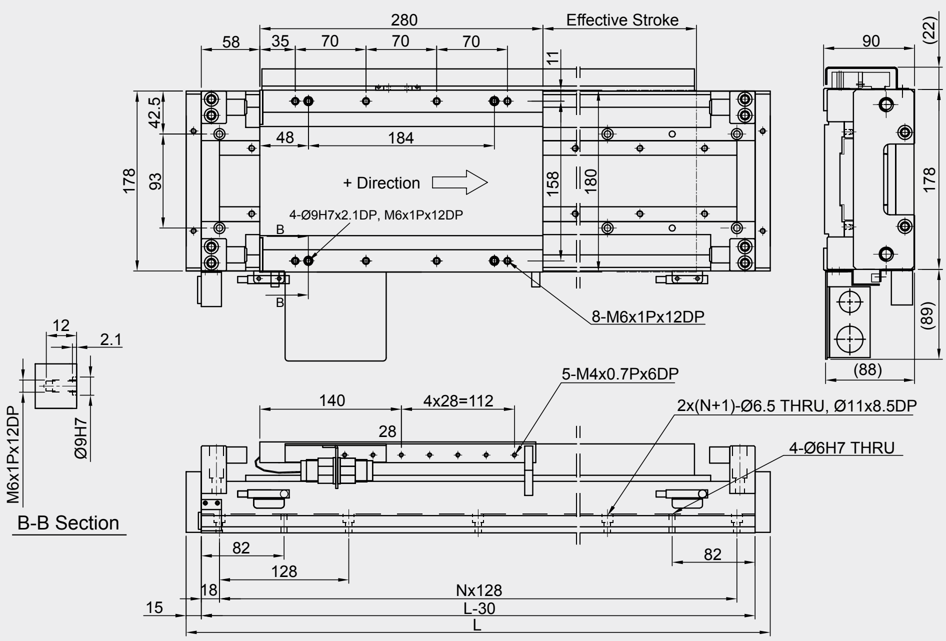
Dimensions and weight of the linear motor stage LMX1L-S23 without cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]
104	450	3	21
232	578	4	23.5
360	706	5	27
488	834	6	31
616	962	7	34
744	1090	8	37
872	1218	9	40
1000	1346	10	43
1256	1602	12	50
1512	1858	14	56
1768	2114	16	62



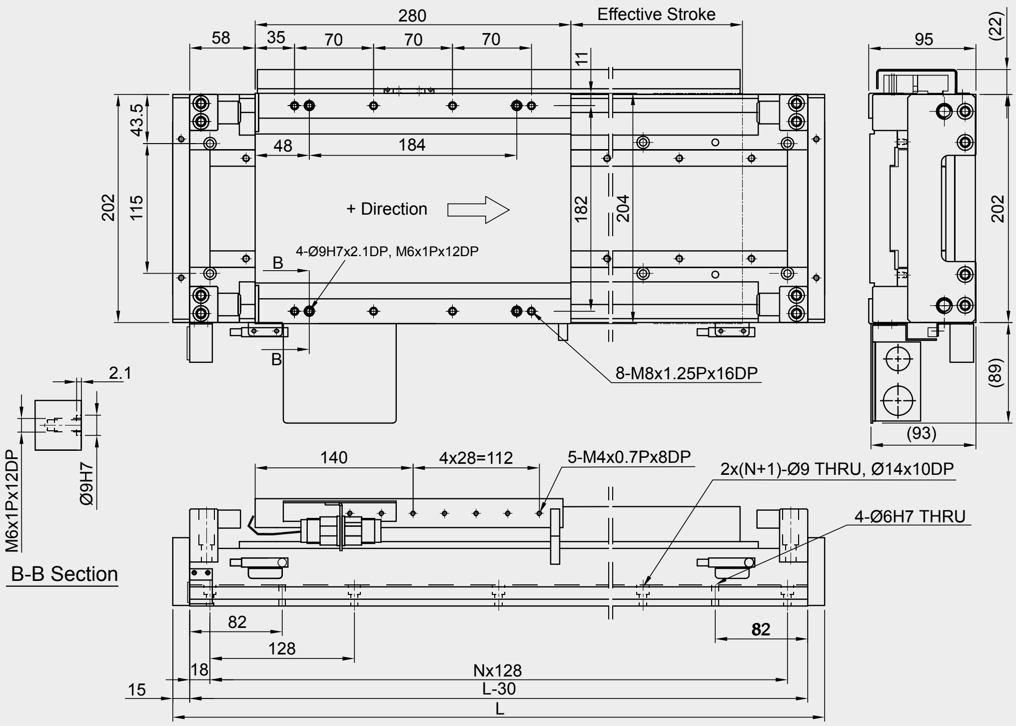
Dimensions and weight of the linear motor stage LMX1L-S27 without cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]
152	578	4	27
280	706	5	30
408	834	6	33.5
536	962	7	37
664	1090	8	40
792	1218	9	43
920	1346	10	46
1176	1602	12	52
1432	1858	14	58
1688	2114	16	64



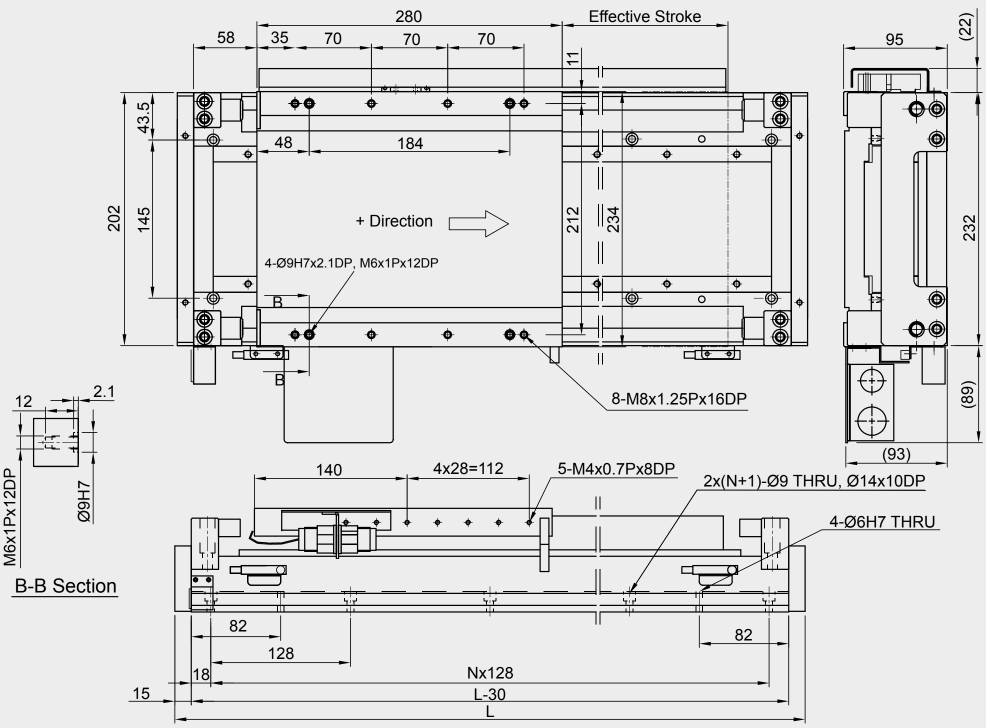
Dimensions and weight of the linear motor stages LMX1L-S37 and LMX1L-S37L without cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]
152	578	4	33
280	706	5	36
408	834	6	40
536	962	7	43
664	1090	8	47
792	1218	9	50
920	1346	10	54
1176	1602	12	62
1432	1858	14	70
1688	2114	16	78



Dimensions and weight of the linear motor stages LMX1L-S47 and LMX1L-S47L without cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]
152	578	4	38
280	706	5	41
408	834	6	46
536	962	7	50
664	1090	8	55
792	1218	9	58
920	1346	10	63
1176	1602	12	71
1432	1858	14	80
1688	2114	16	88

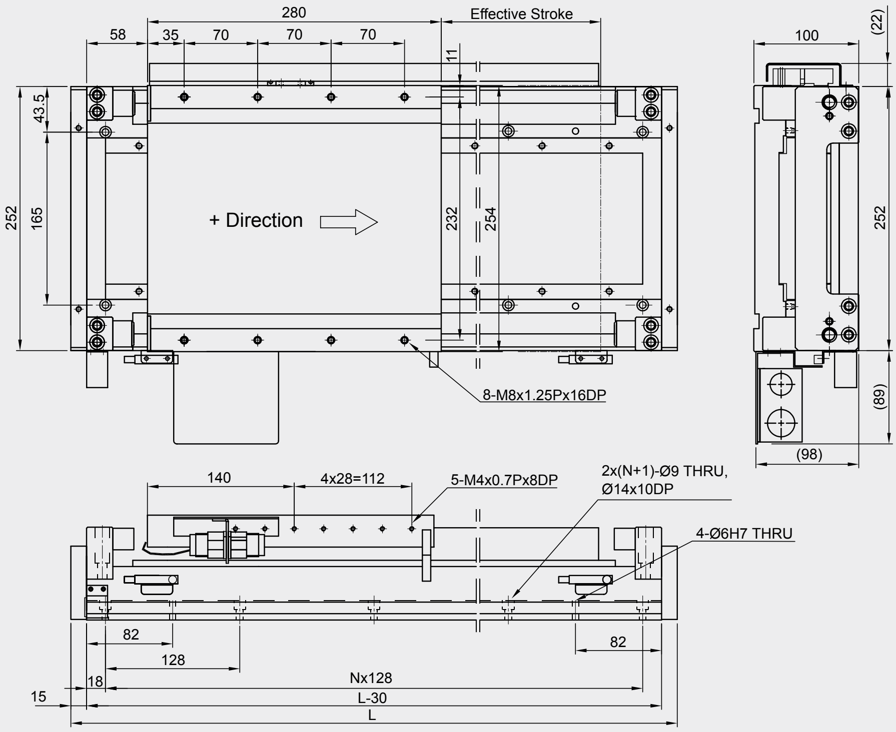


Positioning Systems

Linear Motor Stages

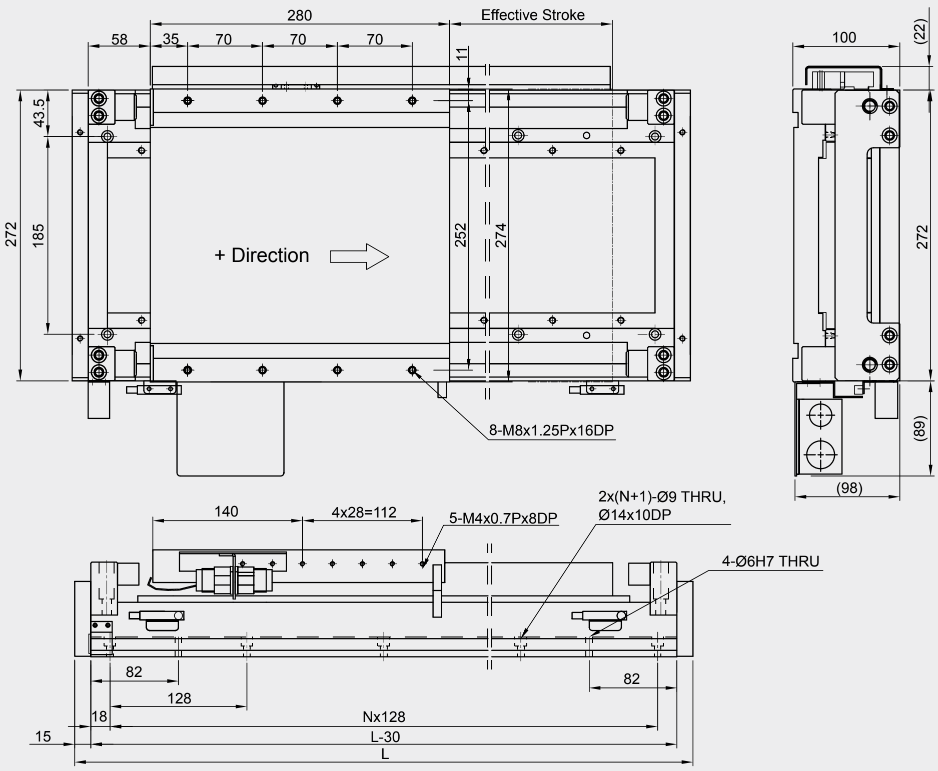
Dimensions and weight of the linear motor stages LMX1L-S57 and LMX1L-S57L without cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]
152	578	4	47
280	706	5	51
408	834	6	57
536	962	7	63
664	1090	8	69
792	1218	9	73
920	1346	10	80
1176	1602	12	90
1432	1858	14	100
1688	2114	16	110



Dimensions and weight of the linear motor stages LMX1L-S67 and LMX1L-S67L without cover

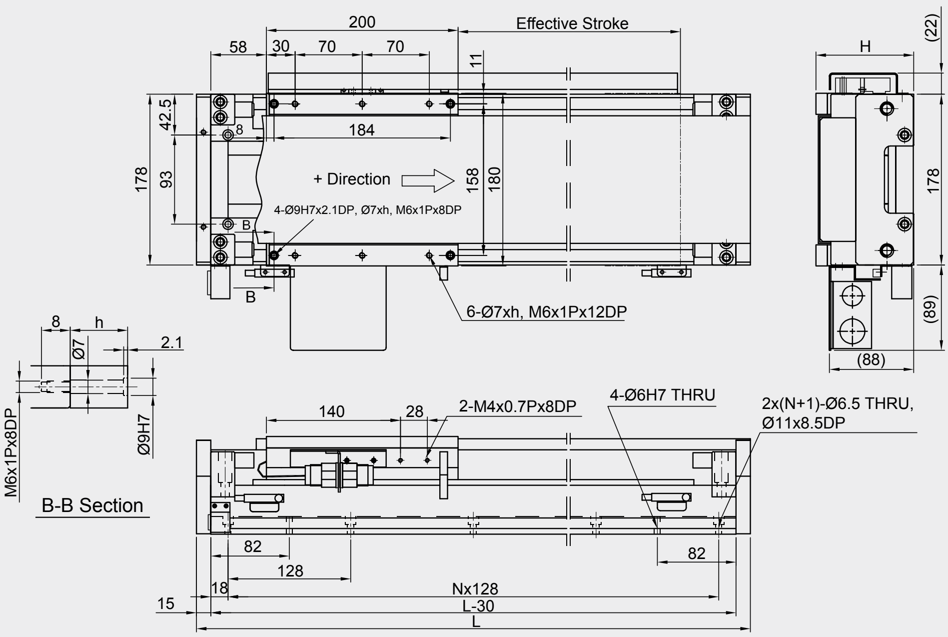
Stroke [mm]	Total length L [mm]	N	Mass [kg]
152	578	4	50
280	706	5	55
408	834	6	61
536	962	7	68
664	1090	8	74
792	1218	9	78
920	1346	10	86
1176	1602	12	97
1432	1858	14	107
1688	2114	16	118



2.7.2 Linear Motor Stages LMX1L-S with Cover

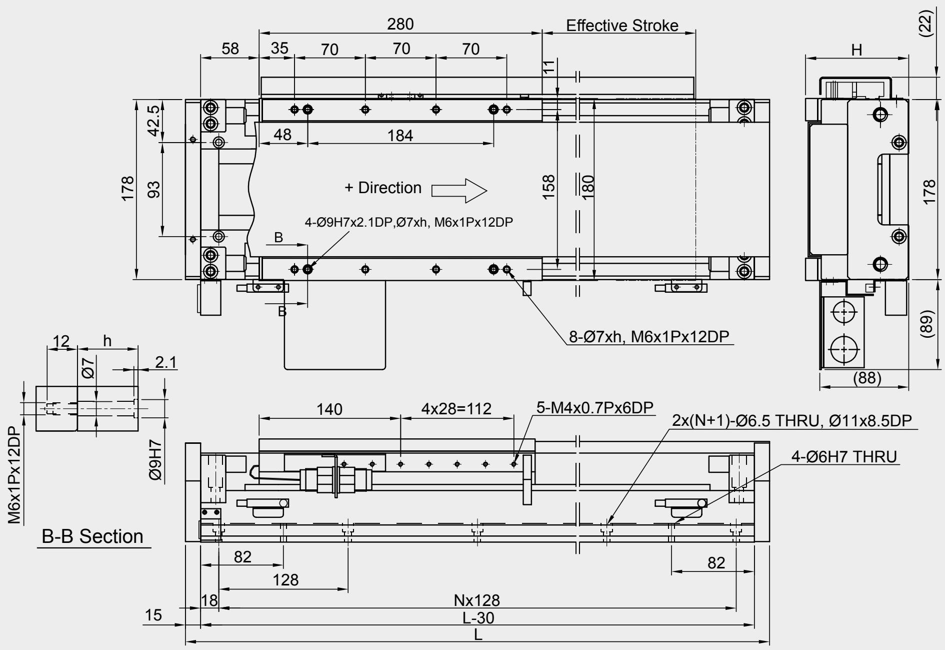
Dimensions and weight of the linear motor stage LMX1L-S23 with cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
104	450	3	23	102	12
232	578	4	26	102	12
360	706	5	29.5	102	12
488	834	6	34	102	12
616	962	7	37	102	12
744	1090	8	40	102	12
872	1218	9	43.5	102	12
1000	1346	10	46.5	102	12
1256	1602	12	54	111	21
1512	1858	14	60.5	111	21
1768	2114	16	67	111	21



Dimensions and weight of the linear motor stage LMX1L-S27 with cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
152	578	4	29.5	102	12
280	706	5	32.5	102	12
408	834	6	36	102	12
536	962	7	40	102	12
664	1090	8	43	102	12
792	1218	9	47	102	12
920	1346	10	50	102	12
1176	1602	12	56	111	21
1432	1858	14	62.5	111	21
1688	2114	16	69	111	21

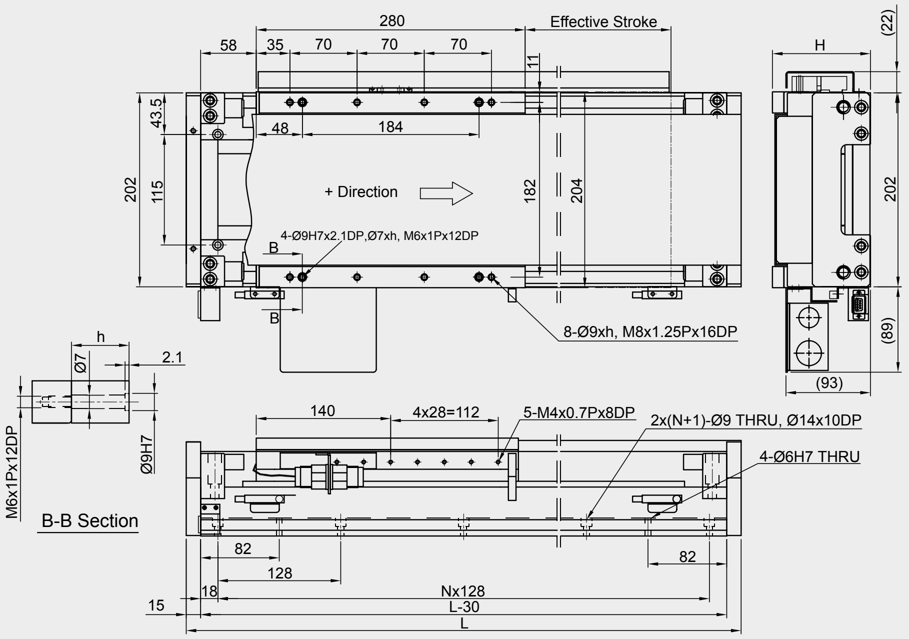


Positioning Systems

Linear Motor Stages

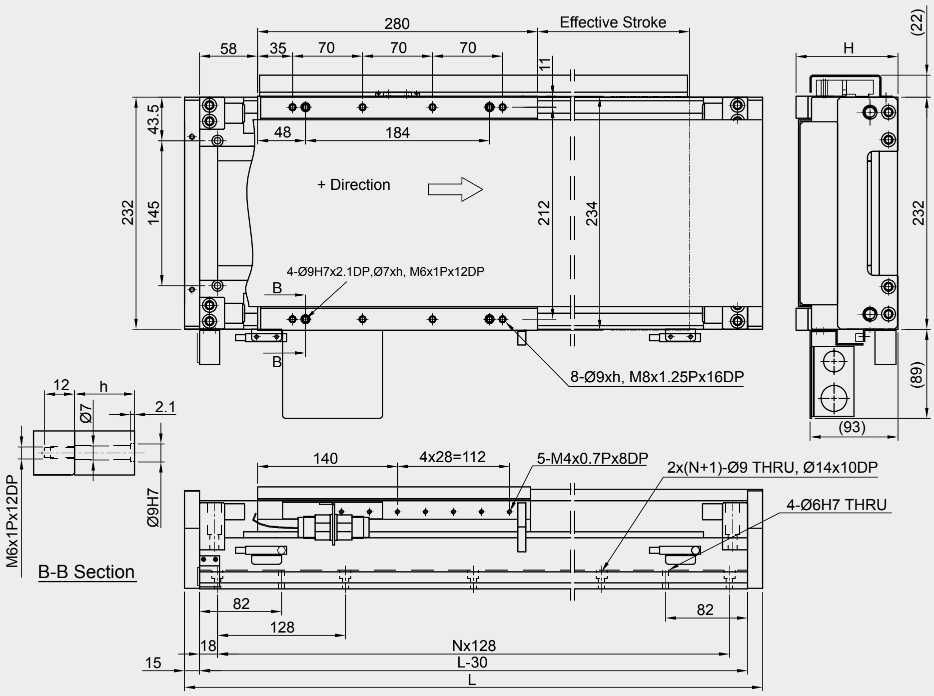
Dimensions and weight of the linear motor stages LMX1L-S37 and LMX1L-S37L with cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
152	578	4	36	107	12
280	706	5	40	107	12
408	834	6	44	107	12
536	962	7	47	107	12
664	1090	8	51	107	12
792	1218	9	55	107	12
920	1346	10	59	107	12
1176	1602	12	68	116	21
1432	1858	14	76	116	21
1688	2114	16	85	116	21



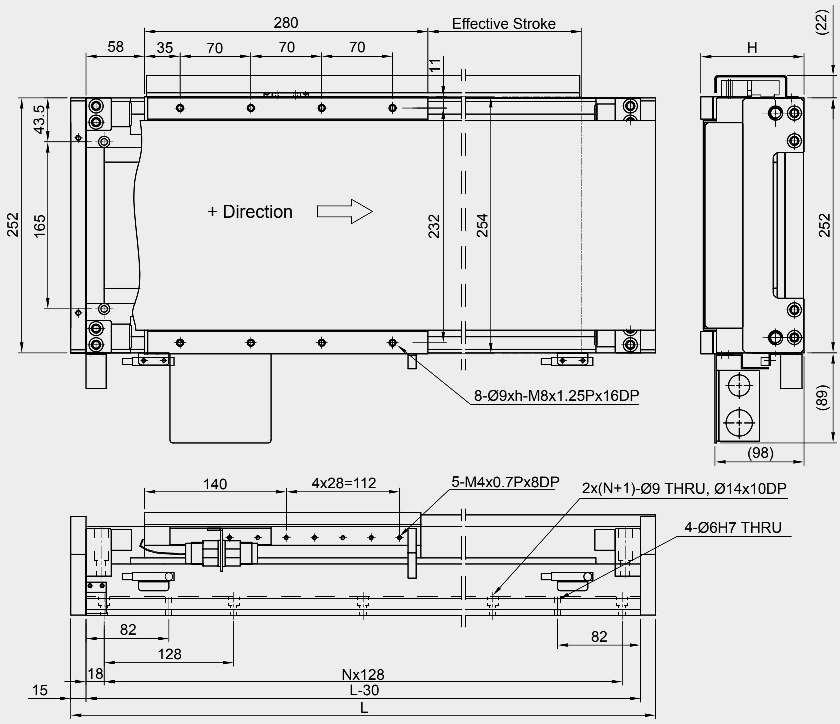
Dimensions and weight of the linear motor stages LMX1L-S47 and LMX1L-S47L with cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
152	578	4	36	107	12
280	706	5	40	107	12
408	834	6	44	107	12
536	962	7	47	107	12
664	1090	8	51	107	12
792	1218	9	55	107	12
920	1346	10	59	107	12
1178	1602	12	68	116	21
1432	1858	14	76	116	21
1688	2114	16	85	116	21



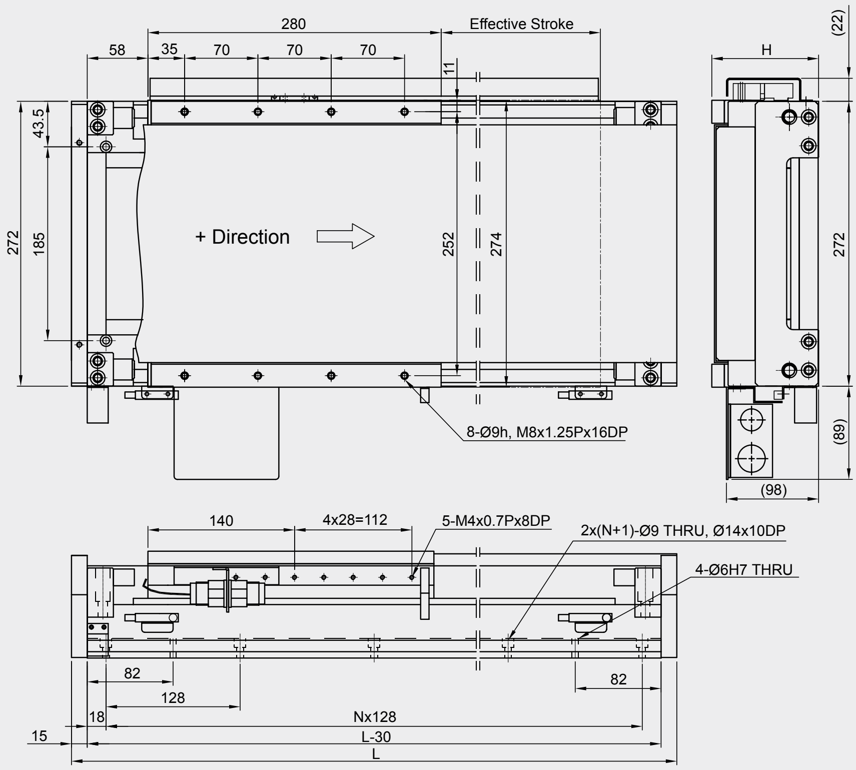
Dimensions and weight of the linear motor stages LMX1L-S57 and LMX1L-S57L with cover

Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
152	578	4	48.5	112	12
280	706	5	53	112	12
408	834	6	59	112	12
536	962	7	65.5	112	12
664	1090	8	72	112	12
792	1218	9	76	112	12
920	1346	10	83.5	112	12
1176	1602	12	94	121	21
1432	1858	14	104	121	21
1688	2114	16	114.5	121	21



Dimensions and weight of the linear motor stages LMX1L-S67 and LMX1L-S67L with cover

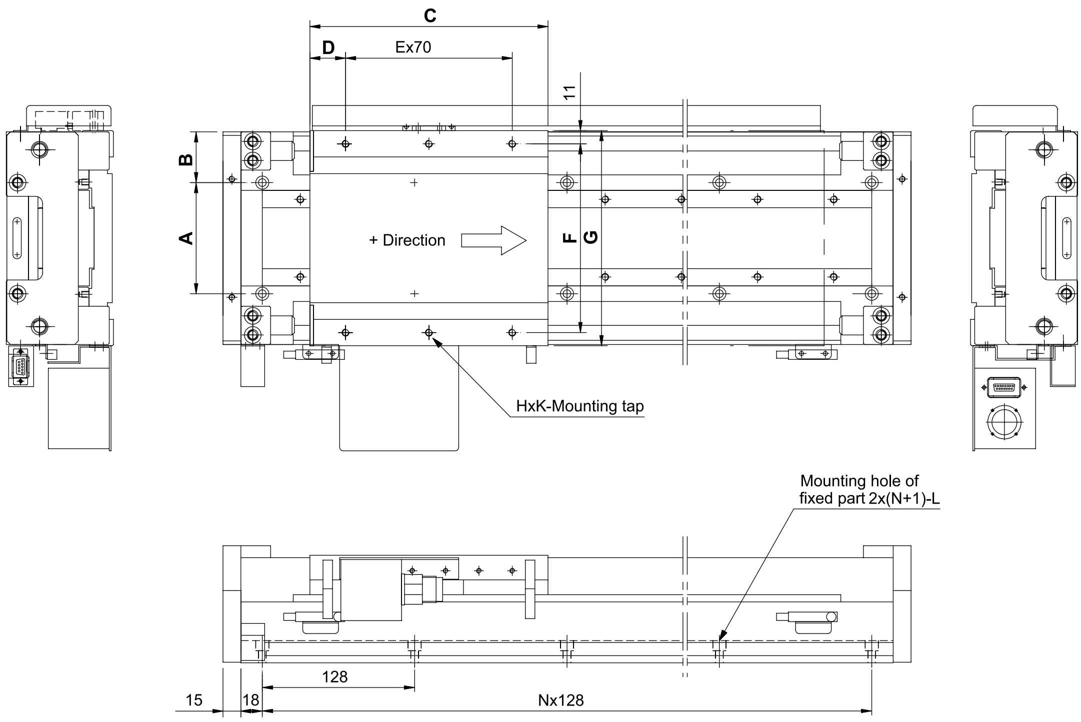
Stroke [mm]	Total length L [mm]	N	Mass [kg]	H [mm]	h [mm]
152	578	4	51.5	112	12
280	706	5	57	112	12
408	834	6	63	112	12
536	962	7	71	112	12
664	1090	8	77	112	12
792	1218	9	81.5	112	12
920	1346	10	90	112	12
1176	1602	12	101	121	21
1432	1858	14	111.5	121	21
1688	2114	16	123	121	21



Positioning Systems

Linear Motor Stages

2.7.3 Installation Dimensions for Linear Motor Stages LMX1L-S



Values A-L

	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	K [mm]	L [mm]
LMX1L-S23	93	42.5	200	30	2	158	180	6	M6 x 1P/12DP	Ø 6.5/THRU, Ø 11/8.5DP
LMX1L-S27	93	42.5	280	35	3	158	180	8	M6 x 1P/12DP	Ø 6.5/THRU, Ø 11/8.5DP
LMX1L-S37	115	43.5	280	35	3	182	204	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP
LMX1L-S37L	115	43.5	280	35	3	182	204	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP
LMX1L-S47	145	43.5	280	35	3	212	234	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP
LMX1L-S47L	145	43.5	280	35	3	212	234	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP
LMX1L-S57	165	43.5	280	35	3	232	254	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP
LMX1L-S57L	165	43.5	280	35	3	232	254	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP
LMX1L-S67	185	43.5	280	35	3	252	274	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP
LMX1L-S67L	185	43.5	280	35	3	252	274	8	M8 x 1.25P/15DP	Ø 9/THRU, Ø 14/10DP

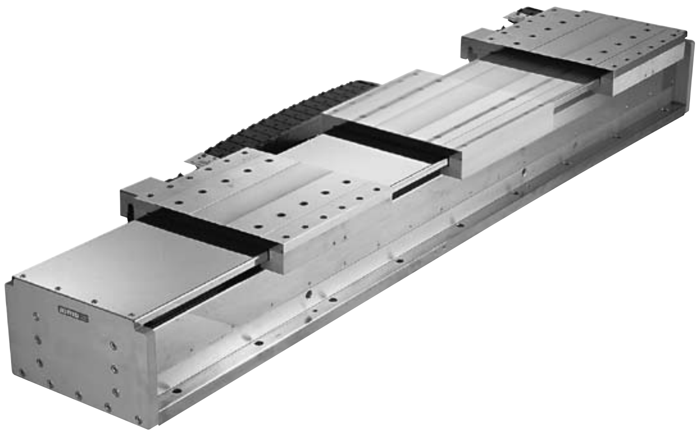
Value N and stroke

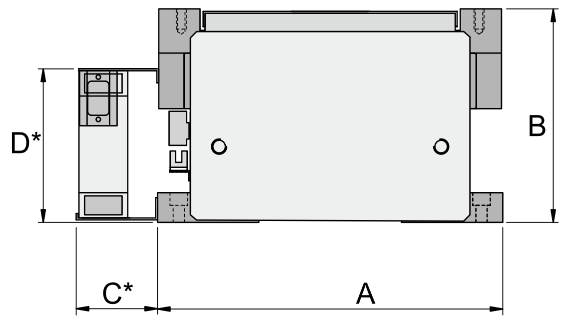
LMX1L-S23		LMX1L-S27(L) to -S67(L)	
Stroke [mm]	N	Stroke [mm]	N
104	3	152	4
232	4	280	5
360	5	408	6
488	6	536	7
616	7	664	8
744	8	792	9
872	9	920	10
1000	10	1176	12
1256	12	1432	14
1512	14	1688	16
1768	16	1948	18

2.8 Linear Motor Stages LMX1L-SC

Linear motor stages LMX1L-SC are complete axes with iron-core motors. Due to the special design of the motor with arrangement of the forcer between two stators (sandwich construction), the attraction forces are canceled. This relieves the load especially on the guide rails.

- Very high power density
- Due to the sandwich construction of the motor, no attraction forces are created, so that the guides are not subject to static loads.
- The travel is measured via optical or magnetic encoders incrementally or absolutely.
- Total length to 4,000 mm
- Max. acceleration 50 m/s²
- Max. speed 4 m/s





* Dimensions C and D are customer-specific

Specifications for Linear Motor Stages LMX1L-SC

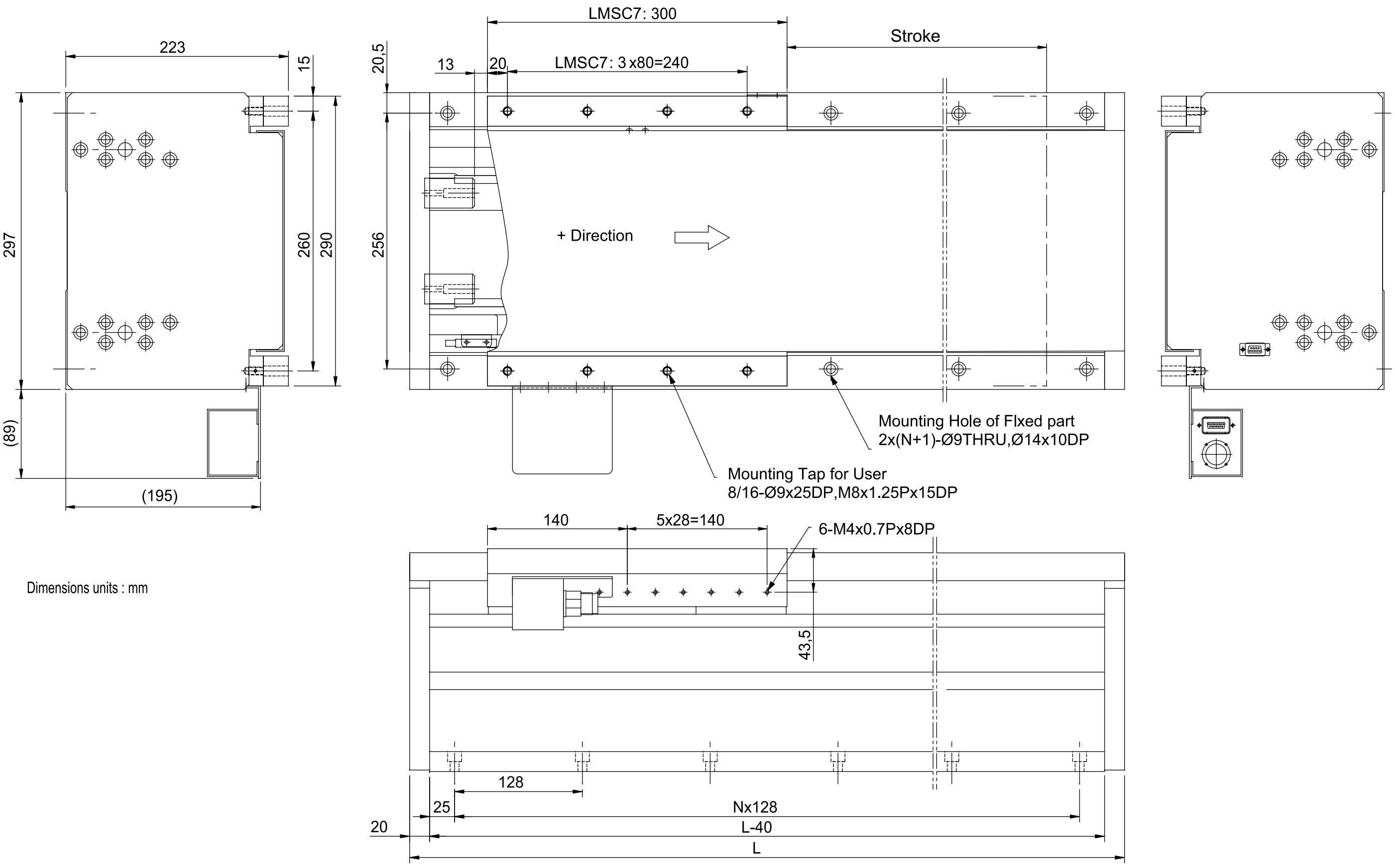
Type (Order code) xxxx=Stroke [mm]	Motor Type	F_c [N]	F_p [N]	Mass of Slider [kg]	Length of forcer [mm]	v_{max} [m/s]	a_{max} [m/s²]	Dimension A [mm]	Dimension B [mm]
LMX1L-SC7 -1-xxxx-G2A0	LMSC7	950	1900	25	300	2*	50	297	223
LMX1L-SC7L -1-xxxx-G2A0	LMSC7L	950	1900	25	300	3	50	297	223

Note: F_c = continuous force, 100% operating time
F_p = peak force (1 s)
Electric parameters for the linear motors: see page 46
* Limited by back emf constant of the motor coil

Positioning Systems

Linear Motor Stages

Installation dimensions for linear motor stages LMX1L-SC



Dimensions units : mm

Dimensions and weight of the linear motor stages LMX1L-SC7 and LMX1L-SC7L, both with cover

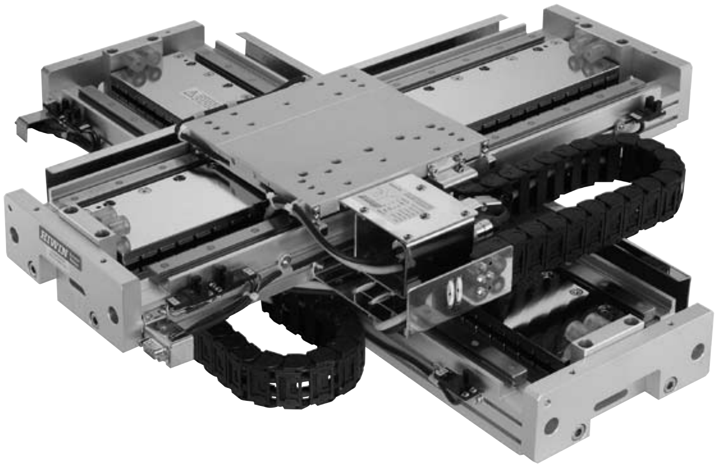
Stroke [mm]	Total length L [mm]	N	Mass [kg]
388	858	6	120
516	986	7	135
644	1124	8	150
772	242	9	165
900	1370	10	179
1156	1626	12	208
1412	1882	14	237
1668	2138	16	267
1924	2394	18	297
2180	2650	20	327

2.9 Cross Tables

The linear motor stages of the LMX1 series can be combined to form cross tables.
The structure of the order number shows that almost every combination of LMX1 linear motor stages is possible.
A cross table with LMX1E-C linear motor stages is shown in 2.9.1.
2.9.2 shows a cross table with LMX1L-S linear motor stages.

2.9.1 Cross Table LMX2E-CB5-CB8

- Equipped with coreless linear motors
- Slight inertia and fast acceleration
- No cogging
- Especially rigid aluminum frame with low profile
- Simple assembly



Specifications for Cross Table LMX2E-CB5-CB8

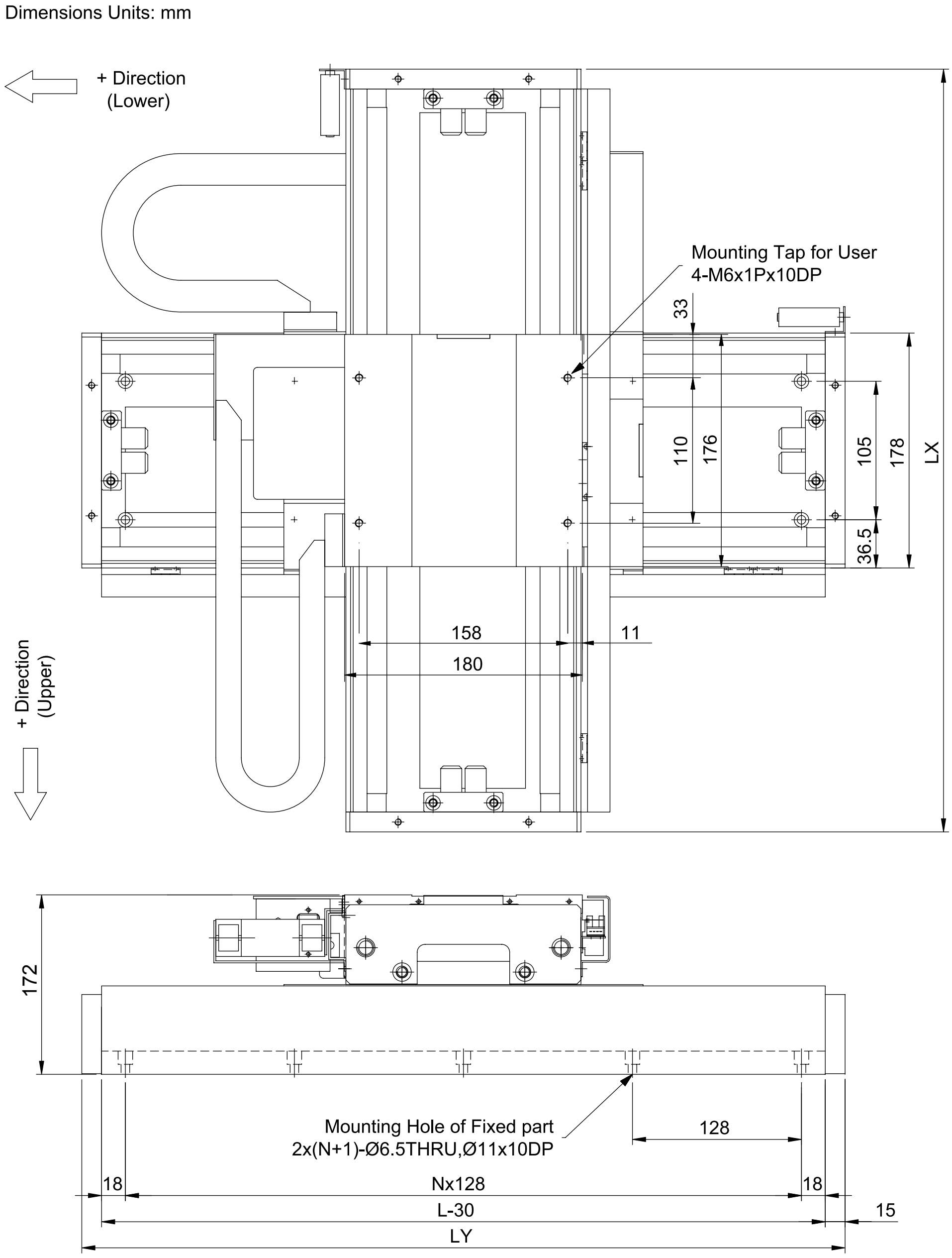
Type (Order code) xxxx=Stroke [mm]	Orthogo-nality [arc-sec]	Repeat-ability [mm]	v_{max} [m/s]	a_{max} [m/s^2]	Motor Type	F_c [N]	F_p [N]	Mass of Slider [kg]
LMX2E-CB5 CB8-xxxx-xxxx-G20	+/- 10	+/- 0.002	3	50	Upper axis: LMC B5	91	273	2.5
					Lower axis: LMC B8	145	435	Mass of upper axis + 4

Note: F_c = continuous force, 100% operating time
F_p = peak force (1 s)
Electric parameters for the linear motors: see page 48

Positioning Systems

Linear Motor Stages

Dimensions of Cross Table LMX2E-CB5-CB8

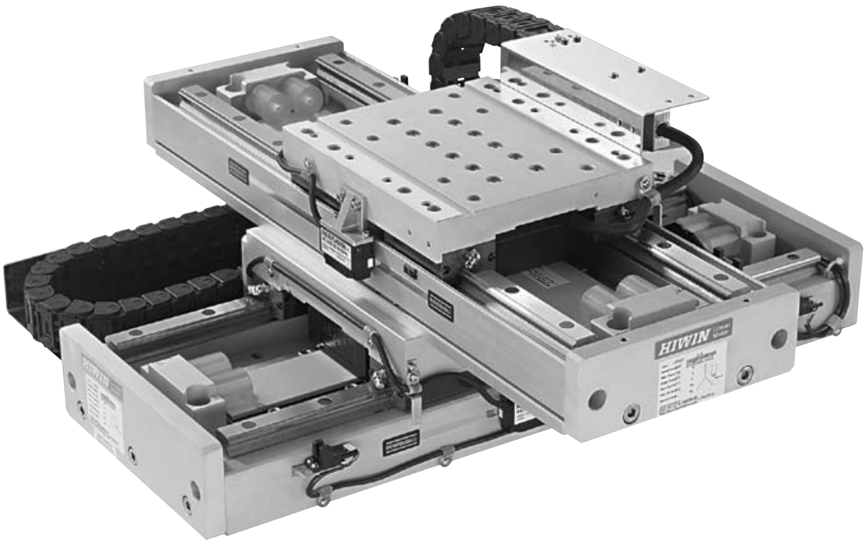


Dimensions and weight of cross table LMX2E-CB5-CB8 with three examples of strokes

Type (Order code)	Stroke (upper/lower) [mm]	Total length (LX x LY) [mm]	N	Mass (upper axis) [kg]	Mass (XY axis) [kg]
LMX2E-CB5-CB8-144-179-G20	144 x 179	450 x 578	4	19	42
LMX2E-CB5-CB8-272-304-G20	272 x 304	578 x 706	5	22.5	49.5
LMX2E-CB5-CB8-400-432-G20	400 x 432	706 x 834	6	26	57

2.9.2 Cross Table LMX2L-S23-S27

- Equipped with iron-core linear motors
- Higher thrust and fast acceleration
- Especially rigid aluminum frame with low profile
- Simple assembly



Specifications for Cross Table LMX2L-S23-S27

Type (Order code) xxxx=Stroke [mm]	Orthogo-nality [arc-sec]	Repeat-ability [mm]	v_{max} [m/s]	a_{max} [m/s²]	Motor Type	F_c [N]	F_p [N]	Mass of Slider [kg]
LMX2L-S23-S27-xxxx-xxxx-G20	+/- 10	+/- 0.002	3	50	Upper axis: LMS 23	213	427	7.5
					Lower axis: LMS 27	339	679	Mass of upper axis + 9.5

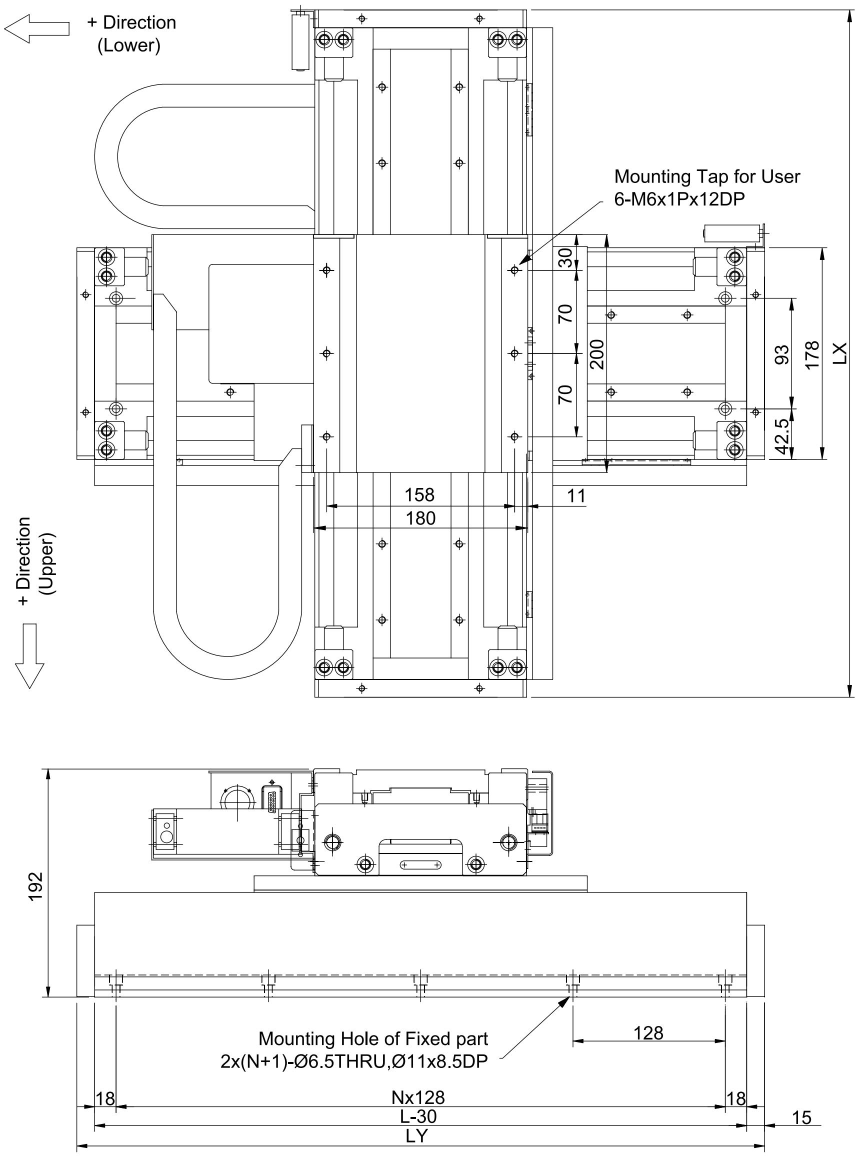
Note: F_c = continuous force, 100% duty cycle
F_p = peak force (1 s)
Electric parameters for the linear motors: see page 42

Positioning Systems

Linear Motor Stages

Dimensions of Cross Table LMX2L-S23-S27

Dimensions Units: mm



Dimensions and mass of cross table LMX2L-S23-S27 with three examples of strokes

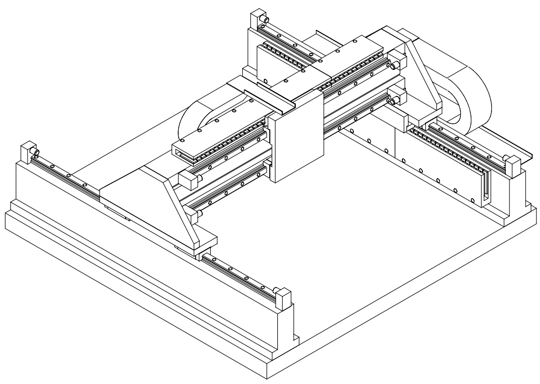
Type (Order code)	Stroke (upper/lower) [mm]	Total length (LX x LY) [mm]	N	Mass (upper axis) [kg]	Mass (XY axis) [kg]
LMX2L-S23-S27-232-280-G20	232 x 280	578 x 706	5	26	58.5
LMX2L-S23-S27-360-408-G20	360 x 408	706 x 834	6	29.5	65.5
LMX2L-S23-S27-488-536-G20	488 x 536	834 x 962	7	29.5	70

2.10 Gantry Systems

The standardized gantry system of the LMG2A series are systems with one-sided supporting guide rail. The type LMG2A-C is equipped with coreless linear motors. The type LMG2A-S is driven by iron-core linear motors.

2.10.1 Gantry-System LMG2A-CB6 CC8

- Equipped with coreless linear motors
- Slight inertia and fast acceleration
- No cogging
- Rigid aluminum bridge
- Simple assembly



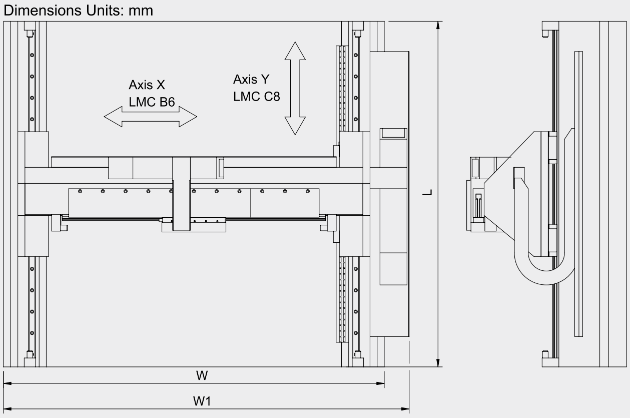
Specifications for Gantry System LMG2A-CB6 CC8

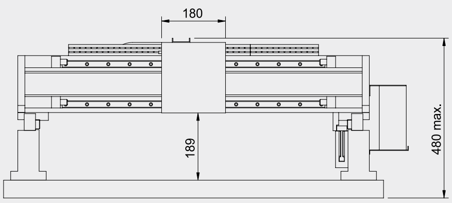
Type (Order code) xxxx=Stroke [mm]	Orthogonality [arc-sec]	Repeatability [mm]	v_{max} [m/s]	a_{max} [m/s²]	Motor Type	F_c [N]	F_p [N]	Mass of Slider [kg]
LMG2A-CB6 CC8-xxxx-xxxx-G2	+/- 10	+/- 0.002/0.004	3	50	Upper axis: LMC B6	109	327	3
					Lower axis: LMC C8	195	585	Mass of upper axis + 3.5

Note: F_c = continuous force, 100% duty cycle
F_p = peak force (1 s)
Electric parameters for the linear motors: see page 48

Dimensions of Gantry System LMG2A-CB6 CC8

Dimensions Units: mm





Dimensions of Gantry System LMG2A-CB6 CC8 with four examples of strokes

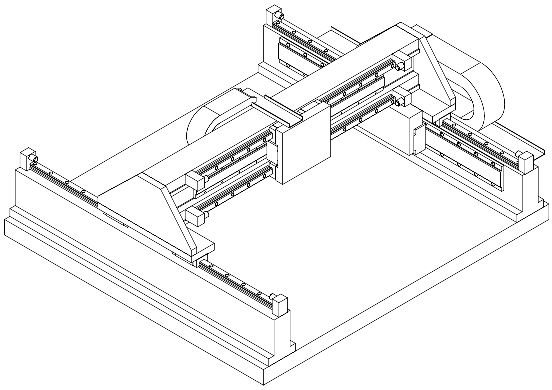
Type (Order code)	Stroke X Axis [mm]	Stroke Y Axis [mm]	Dimensions W [mm]	W1 [mm]	L [mm]
LMG2A-CB6 CC8-0300-0400-G2	300	400	870	940	870
LMG2A-CB6 CC8-0500-0500-G2	500	500	1070	1140	970
LMG2A-CB6 CC8-0750-0750-G2	750	750	1390	1390	1220
LMG2A-CB6 CC8-0750-1000-G2	750	1000	1390	1390	1470

Positioning Systems

Linear Motor Stages

2.10.2 Gantry System LMG2A-S13 S27

- Equipped with iron-core linear motors
- Higher thrust and fast acceleration
- Less cogging, and constant speed
- Rigid aluminum bridge
- Simple assembly



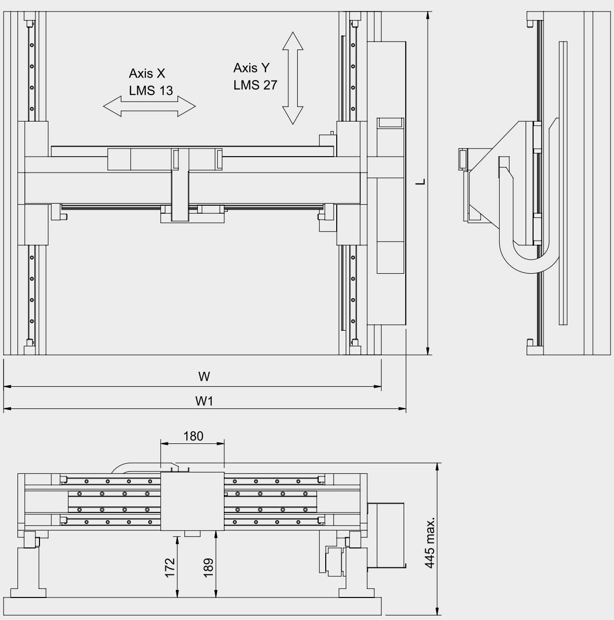
Specifications for Gantry System LMG2A-S13 S27

Type (Order code) xxx = Stroke [mm]	Ortho-gonality [arc-sec]	Repeat-ability [mm]	v_{max} [m/s]	a_{max} [m/s²]	Motor type	F_c [N]	F_p [N]	Mass of Slider [kg]
LMG2A-S13 S27-xxxx-xxxx-G2	+/- 10	+/- 0.002/0.004	3	50	Upper axis: LMS 13	180	360	5
					Lower axis: LMS 27	339	679	Mass of upper axis + 7

Note: F_c = continuous force, 100% duty cycle
F_p = peak force (1 s)
Electric parameters for the linear motors: see page 42

Dimensions of Gantry System LMG2A-S13 S27

Dimensions Units: mm



Dimensions of Gantry System LMG2A-S13 S27 with four examples of strokes

Type (Order code)	Stroke X Axis [mm]	Stroke Y Axis [mm]	Dimensions W [mm]	W1 [mm]	L [mm]
LMG2A-S13 S27-0300-0400-G2	300	400	870	940	870
LMG2A-S13 S27-0500-0500-G2	500	500	1070	1140	970
LMG2A-S13 S27-0750-0750-G2	750	750	1320	1390	1220
LMG2A-S13 S27-0750-1000-G2	750	1000	1320	1390	1470

3 Planar Motor

Positioning Systems
Planar Motor

3 Planar Motor

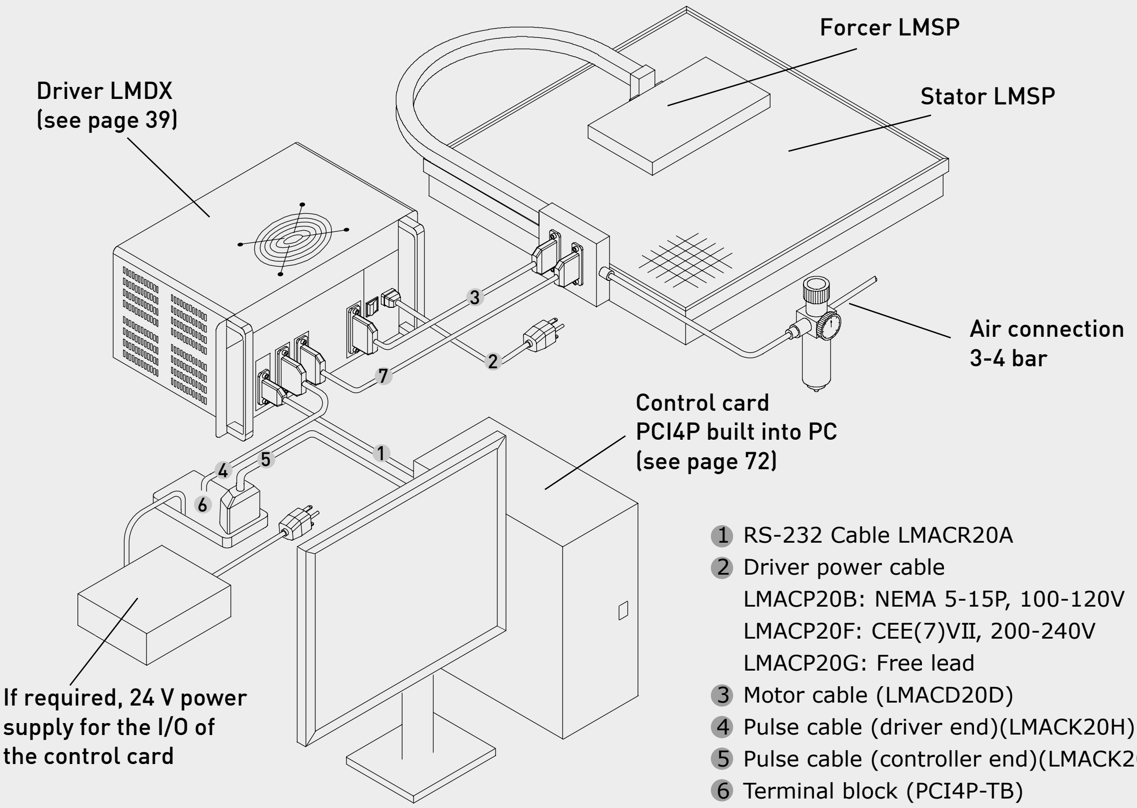
XY movements on an air bearing through a planar-servo motor with integrated distance measurement. Can be operated upside down.

3.1 Planar Servo Motor LMSP

The planar motor LMSP has integrated distance measurement sensors and works with position control (closed loop).

- XY table
- Closed loop thanks to integrated distance measurement
- Air bearing free of wear
- No externally measurable magnetic fields
- Very low heat generation
- Can be mounted upside down
- Stator area up to 1000 x 1000 mm

Configuration of LMSP with servo driver LMDX



1. RS-232 Cable LMACR20A
2. Driver power cable
   LMACP20B: NEMA 5-15P, 100-120V
   LMACP20F: CEE(7)VII, 200-240V
   LMACP20G: Free lead
3. Motor cable (LMACD20D)
4. Pulse cable (driver end)(LMACK20H)
5. Pulse cable (controller end)(LMACK20M)
6. Terminal block (PCI4P-TB)
7. Encoder cable (LMACE20C)

Dimensions of Planar Servo Motor LMSP

(Values X_f see Table 3.1, values X_s see Table 3.2)

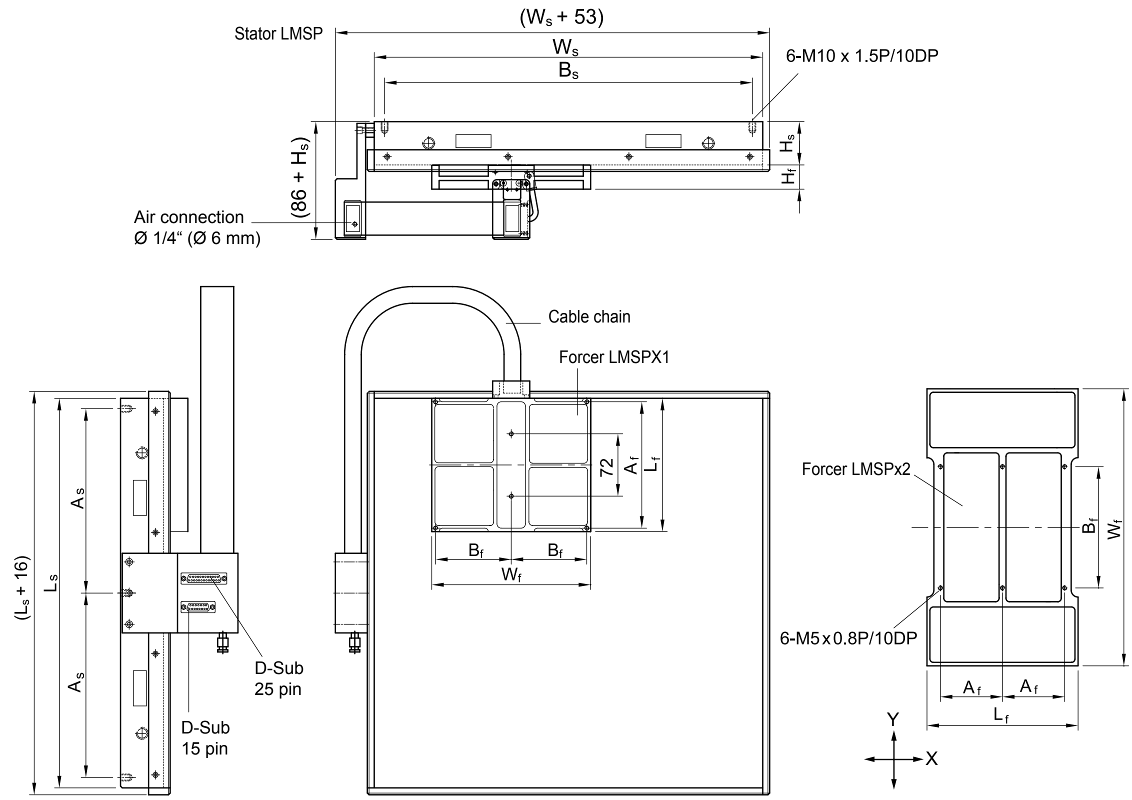


Table 3.1 Specifications for Planar Servo Motor LMSP

		Symbol	Unit	LMSPX1	LMSPX2
Performance	**Max. thrust**	T_m	N	75	140
	Resolution	R_s	mm	0.001	0.001
	Repeatability (unidirectional)	R_p	mm	0.002	0.002
	Accuracy (every 300mm)	A_c	mm	±0.015	±0.015
	Max. speed	V	m/s	0.9	0.8
	Max. load	-	kg	12.2	24.3
Forcer	**Length**	L_f	mm	154	175
	Width	W_f	mm	184	320
	Height	H_f	mm	28	30
	Air pressure	P_a	kg/cm^2	3-4	3-4
	Air flow rate	F_a	l/min	6.4	11
	Mass	M_f	kg	1.8	3.7
	Fixing distance	A_f x B_f	mm x mm	146 x 87.5	72 x 140

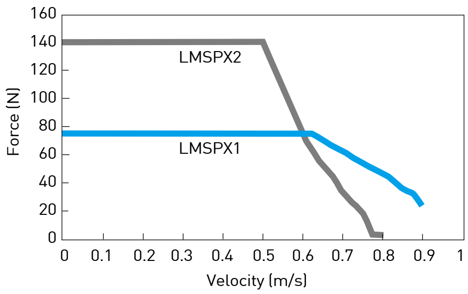
Positioning Systems

Planar Motor

Table 3.2 **Dimensions and weight of the stators LMSP-P1 to LMSP-P6**

		Unit	P1	P2	P3	P4	P5	P6
Stator dimensions	**L_s x W_s**	mm	350 x 330	450 x 450	600 x 450	600 x600	1000 x 600	850 x 850
Max. Stroke	**LMSPX1**	mm	190 x 140	290 x 260	440 x 260	440 x 410	840 x 410	690 x 660
(one Forcer)	**LMSPX2**	mm		270 x 125	420 x 125	420 x 275	820 x 275	670 x 525
Stator height	**H_s**	mm	50	50	70	70	100	120
Mass of Stator		kg	27	36	52	66	120	250
Fixing Distance	**A_s x B_s**	mm	165 x 310	213 x 426	288 x 426	288 x 576	(318-324-318) x 280	400 x 400
No. of mounting holes			6	6	6	6	10	9

LMSP series F-V Curve



Structure of Order Number

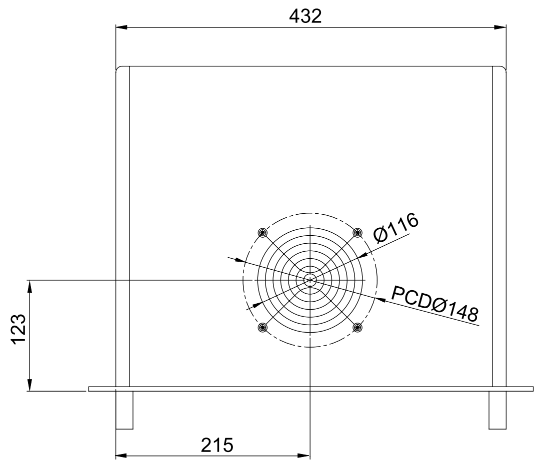
LMSPX 11 P1

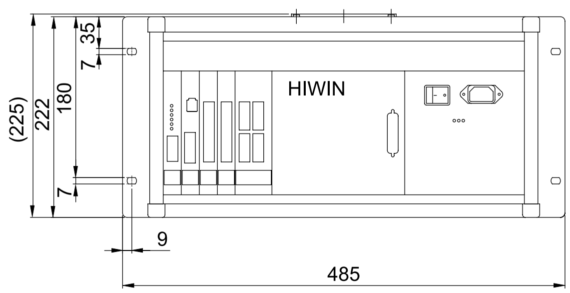
Series	Forcer	Number of forcers	Stator
	1		**P1**
	2		**P2**
			P3
			P4
			P5
			P6

3.2 Servo Driver LMDX

The servor driver LMDX for the planar servo motor LMSP is available in two different voltage versions and with an optional digital I/O interface card.

Dimensions of Servo Driver LMDX





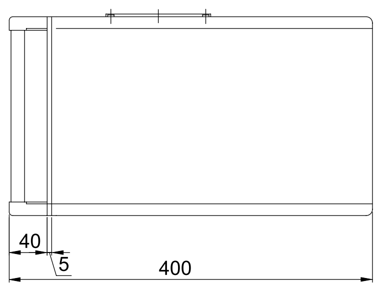


Table 3.3 Specifications for Servo Driver LMDX

		Unit	Value
Power supply	**Voltage**	V_{AC}	95-125 (LMDX1) 200-240 (LMDX2)
	Frequency **Output**	Hz VA	50/60 500 (max.)
Output current		A	3 (max.)
Interface	**Parameter setting: RS-232**		9600 Baud, 8 data bits, 2 stop bits, odd parity
	Digital I/O signal		DXIO plug-in card: 8 inputs: including HOME and RESET 6 outputs: including IN-POSITION, ALARM, SVON DXIO16 plug-in card (option): 16 inputs, 16 outputs
	Pulse command	Pulse	STEP/DIR
Resolution		µm/pulse	min. 1 (set by parameter)
Mass		kg	13.3
Max. operation temperature		°C	50

4 Linear Motor Components

Positioning Systems

Linear Motor Components

4.1 Linear Motors, LMS Series

HIWIN synchronous linear motors LMS are the power packs of linear drives.
They are especially distinguished by very high power density and minimum cogging force.
The three-phase motors are composed of a primary part (forcer) with a coiled stack of sheets and a secondary part with permanent magnets (stators). With the combination of several stators, many stroke combinations are possible.

- 3-phase
- High thrust
- Excellent acceleration
- Low cogging
- Many stroke lengths
- Several forcers possible on one stator

Force Chart for Linear Motors, LMS Series

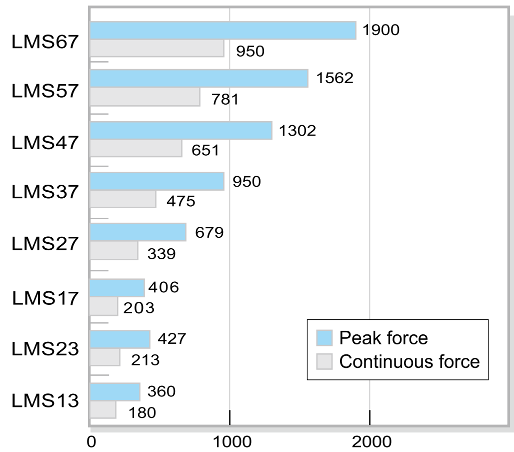


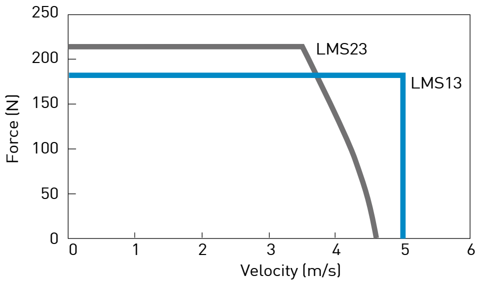
Table 4.1 **Specifications for Linear Motors, LMS Series**

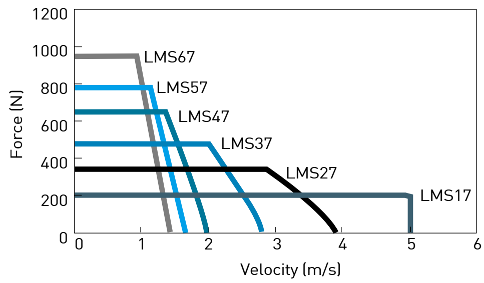
	Symbol	Unit	LMS13	LMS23	LMS17	LMS27	LMS37	LMS37L	LMS47	LMS47L	LMS57	LMS57L	LMS67	LMS67L
Continuous force	F_c	N	180	213	203	339	475	475	651	651	781	781	950	950
Continuous current	I_c	A (rms)	4.1	3.5	3.5	3.5	3.5	7.0	3.5	7.0	3.5	7.0	3.5	7.0
Peak force for 1 sec.	F_p	N	360	427	406	679	950	950	1302	1302	1562	1562	1900	1900
Peak current for 1 sec.	I_p	A (rms)	8.2	7.0	7.0	7.0	7.0	14.0	7.0	14.0	7.0	14.0	7.0	14.0
Force constant	K_f	N/A (rms)	44	61	58	97	136	68	186	93	223	112	271	136
Attraction force	F_a	N	805	1350	1221	2036	2850	2850	4071	4071	4885	4885	5700	5700
Max. winding temp.	T_{max}	°C	100	100	100	100	100	100	100	100	100	100	100	100
Electrical time constant	K_e	ms	10.0	11.7	10.0	10.3	10.5	10.0	11.1	11.5	11.2	11.3	11.4	11.1
Resistance (line to line at 25 °C)	R_{25}	Ω	3.4	4.6	3.8	6.2	8.6	2.0	11.2	2.6	13.0	3.2	14.8	3.8
Inductance (line to line)	L	mH	34	54	38	64	90	20	124	30	146	36	168	42
Pole pair pitch	2τ	mm	32	32	32	32	32	32	32	32	32	32	32	32
Bend radius of motor cable	R_{bend}	mm	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	40	40	40	40
Back emf constant (line to line)	K_v	Vrms/(m/s)	26	43	31	51	71	36	101	51	121	61	141	71
Motor constant (at 25 °C)	K_m	$N/\sqrt{W}$	19.4	23.2	24.3	31.8	37.8	39.2	45.4	47.1	50.5	50.9	57.6	56.8
Thermal resistance	R_{th}	°C/W	0.87	0.89	1.07	0.66	0.47	0.51	0.36	0.39	0.31	0.32	0.28	0.27
Thermal switch			100°C, Bimetal (opener), DC 12V/6A, DC 24V/3A											
Max. DC bus voltage		V	500											
Mass of forcer	M_f	kg	1.8	2.7	2.7	4.1	5.9	5.9	8.0	8.0	9.4	9.4	10.8	10.8
Unit mass of stator	M_s	kg/m	4.2	6.2	4.2	6.2	8.2	8.2	11.5	11.5	13.7	13.7	15.9	15.9
Width of stator	W_s	mm	60	80	60	80	100	100	130	130	150	150	170	170
Length of stator / Dimension N	L_s	mm	128mm/N=1, 192mm/N=2, 320mm/N=4											
Stator mounting distance	A_s	mm	45	65	45	65	85	85	115	115	135	135	155	155
Total height	H	mm	55.2	55.2	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4	57.4

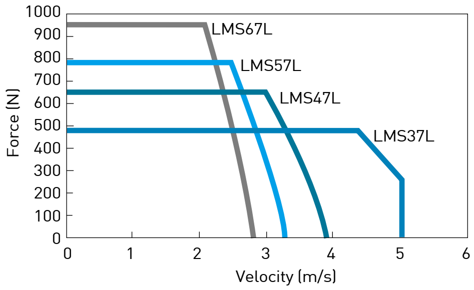
Note: Values in the table refer to operation without forced cooling
Except dimensions, all the specifications in the table are in ± 10% of tolerance.

LMS series F-V curves

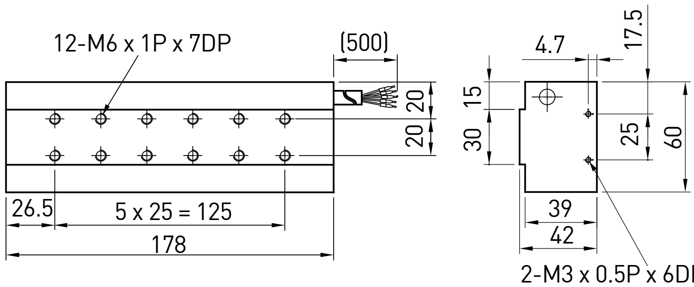
Force vs. Velocity curves are calculated with DC bus voltage=300 VDC



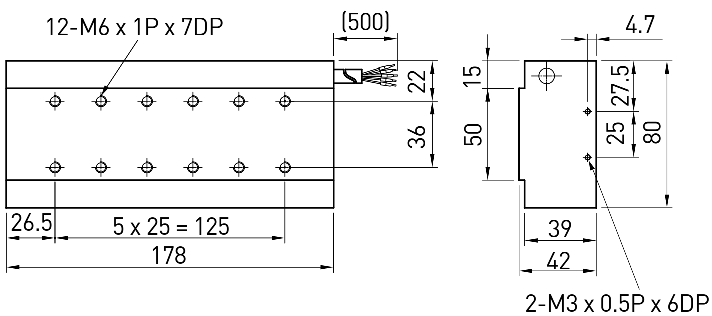




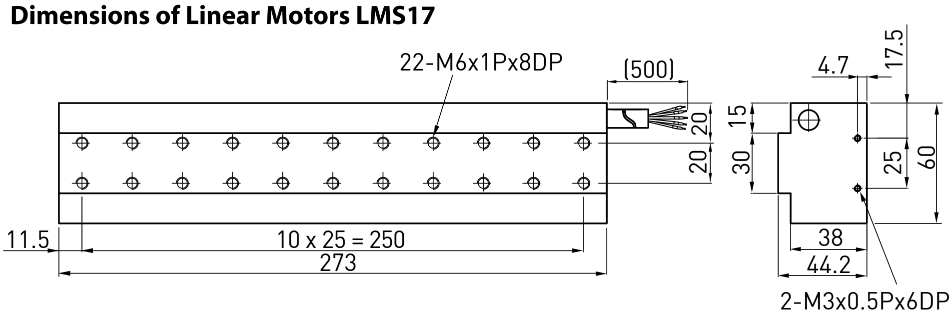
Dimensions of Linear Motors LMS13



Dimensions of Linear Motors LMS23



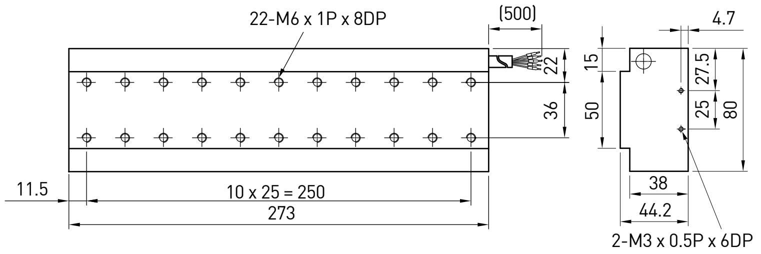
Dimensions of Linear Motors LMS17



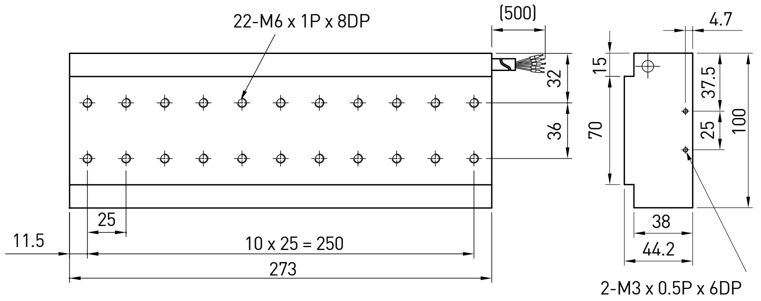
Positioning Systems

Linear Motor Components

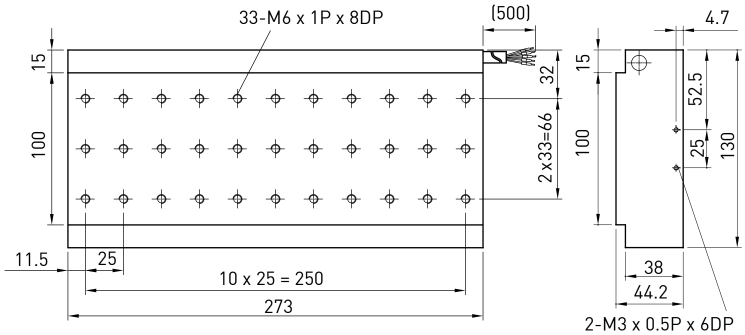
Dimensions of Linear Motors LMS27



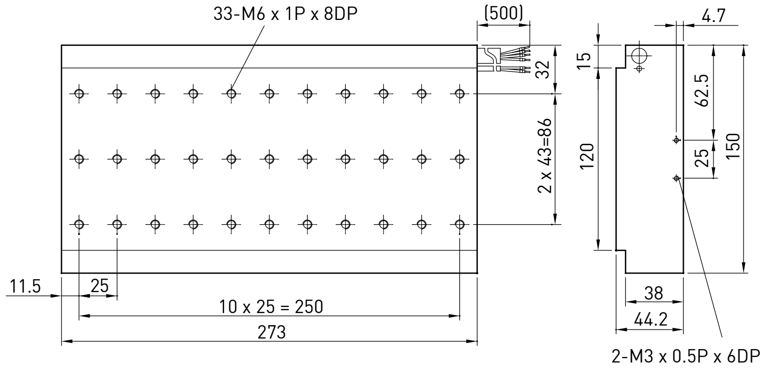
Dimensions of Linear Motors LMS37 (L)



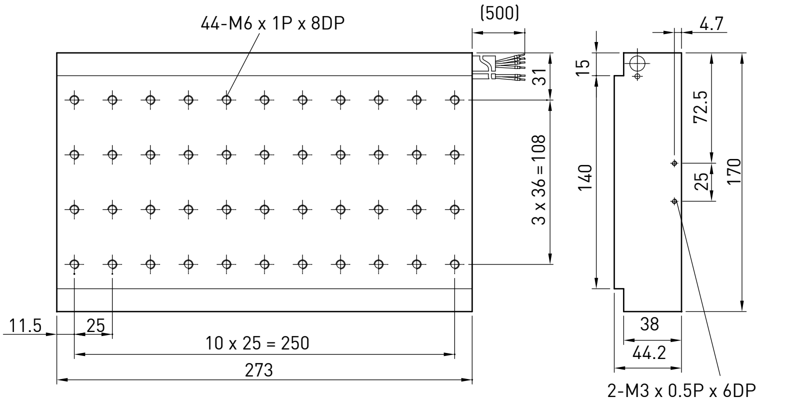
Dimensions of Linear Motors LMS47 (L)



Dimensions of Linear Motors LMS57 (L)

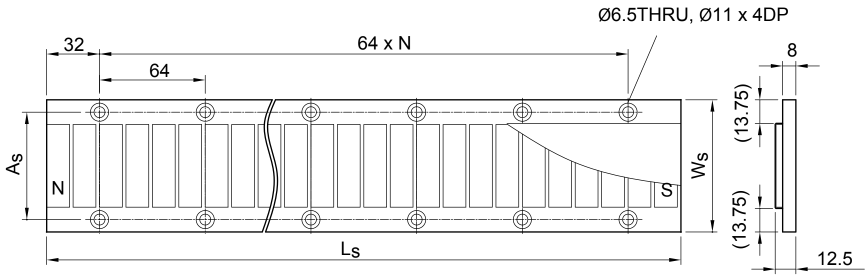


Dimensions of Linear Motors LMS67 (L)

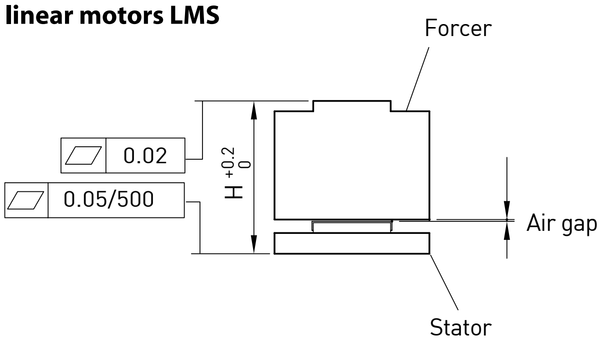


Dimensions of stators for linear motors LMS

(Values for L_S, A_S, W_S and H see Table 4.1)



Installing linear motors LMS



Structure of the order number of linear motors LMS, stators

LMS 1 S 3

Series	Width of stator	Stator model	Length of stator
	1: for linear motors, LMS13 and LMS17 series	S: Standard	0: 128 mm (N=1)
	2: for linear motors, LMS23 and LMS27 series	C: Customized	1: 192 mm (N=2)
	3: for linear motors, LMS37 (L) and LMSC7 (L) series		3: 320 mm (N=4)
	4: for linear motors, LMS47 (L) series		
	5: for linear motors, LMS57 (L) series		
	6: for linear motors, LMS67 (L) series		

Positioning Systems

Linear Motor Components

4.2 Linear Motors, LMSC Series

HIWIN synchronous linear motors LMSC are iron-core motors with similar properties to the motors of the LMS series. Due to the special arrangement of the forcer between two stators, the attraction force in the LMSC motors is canceled. As a result, the guide rails are relieved of loads and a high power density is achieved with relatively short sliders.

- Large force constant
- Water cooling possible
- Attraction force compensation
- No attraction force introduction into the guide elements
- Several forcers possible on one stator
- Any stroke length

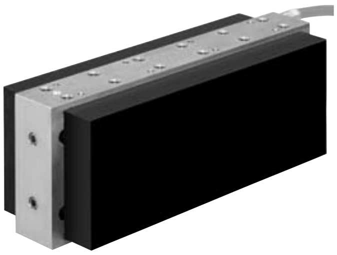


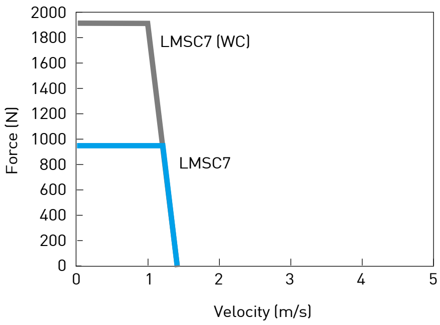
Table 4.2 **Specifications for Linear Motors, LMSC Series**

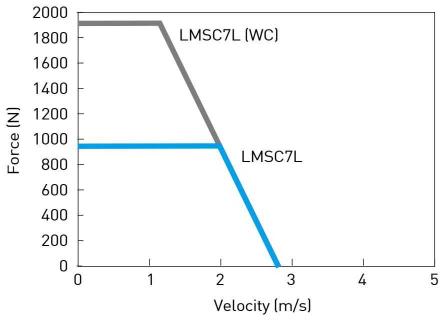
	Symbol	Unit	LMSC7	LMSC7(WC)[2)]	LMSC7L	LMSC7L (WC)[2)]
Continuous force	F_c	N	950	1900	950	1900
Continuous current	I_c	A(rms)	3.5	7.0	7.0	14.0
Peak force (for 1 s)	F_p	N	1900	2710	1900	2710
Peak current (for 1 s)	I_p	A(rms)	7.0	10.0	14.0	20.0
Force constant	K_f	N/A (rms)	271	271	136	136
Attraction force	F_a	N	0[1)]	0[1)]	0[1)]	0[1)]
Max. winding temp.	T_{max}	°C	100	100	100	100
Electrical time constant	K_e	ms	10.5	10.5	10.0	10.0
Resistance (line to line at 25 °C)	R_{25}	Ω	17.2	17.2	4.0	4.0
Inductance (line to line)	L	mH	180	180	40	40
Pole pair pitch	2τ	mm	32	32	32	32
Bend radius of motor cable	R_{bend}	mm	37.5	37.5	37.5	37.5
Back emf constant (line to line)	K_v	Vrms/(m/s)	141	141	71	71
Motor constant (at 25 °C)	K_m	$N/\sqrt{W}$	53.4	53.4	53.4	53.4
Thermal resistance	R_{th}	°C/W	0.24	0.24	0.24	0.24
Thermal switch		100°C, Bimetal (opener), DC 12V/6A, DC 24V/3A				
Max. DC bus voltage		V	750			
Mass of forcer	M_f	kg	14.0	14.0	14.0	14.0
Unit mass of stator	M_s	kg/m	16.4	16.4	16.4	16.4
Width of stator	W_s	mm	100	100	100	100
Length of stator/Dimension N	L_s	mm	128mm/N=1, 192mm/N=2, 320mm/N=4			
Stator mounting distance	A_s	mm	85	85	85	85
Total height	H	mm	131.5	131.5	131.5	131.5

Note: 1) 0: Counter balanced by equal attraction force
2) WC: with water cooling
Values in the table are according to no forced cooling except labelled with WC (Water Cooling).
Except dimensions, all the specifications in the table are in ± 10% of tolerance.

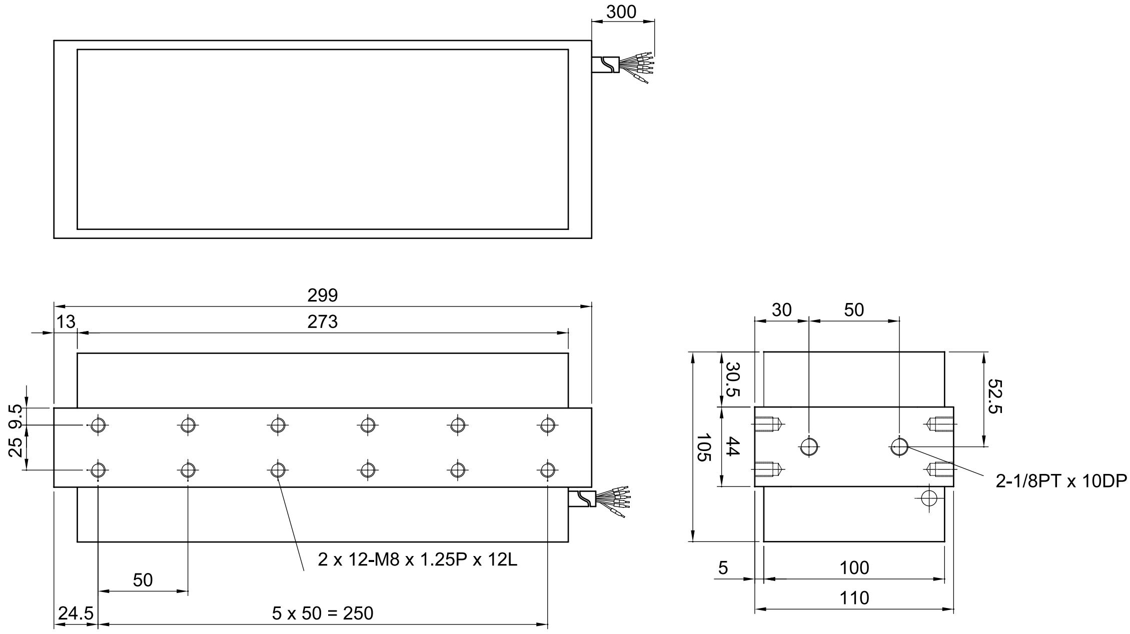
LMSC series F-V Curve

Force vs. Velocity curves are calculated with DC bus voltage=300 VDC

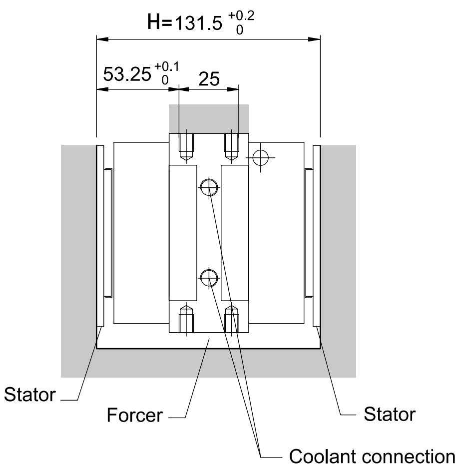




Dimensions for linear motor LMSC7 (L) forcer



Installing linear motors LMSC7 (L)



Positioning Systems

Linear Motor Components

4.3 Linear Motors, LMC Series

4.3.1 Linear Motors, LMCA, LMCB, LMCC Series

HIWIN synchronous linear motors LMC are the born sprinters. They are light, extremely dynamic. This is due to their coreless primary part (forcer) with epoxy cast coils, it needs to move very little of its own weight. The secondary part is composed of an U-shaped stator made of permanent magnets.

- 3-phase
- Extremely dynamic
- Good synchronization and high speed consistency
- Low inertia and high acceleration
- Low profile
- No cogging
- Several forcers possible on one stator

Force Chart for Linear Motors, LMC Series

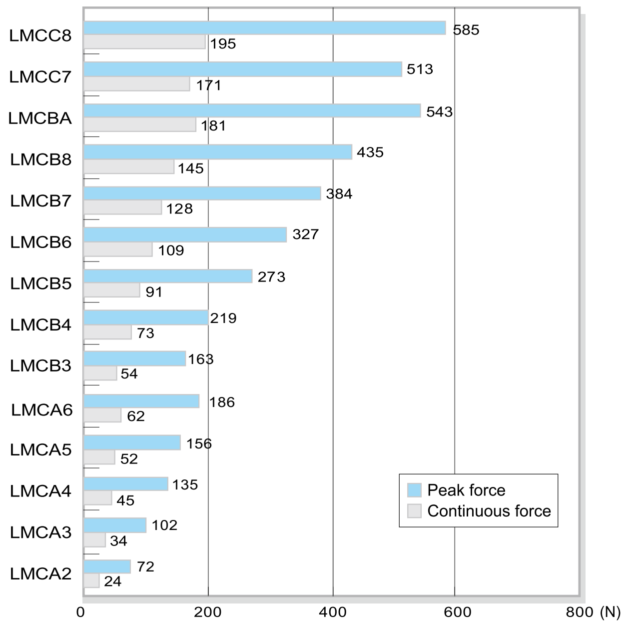


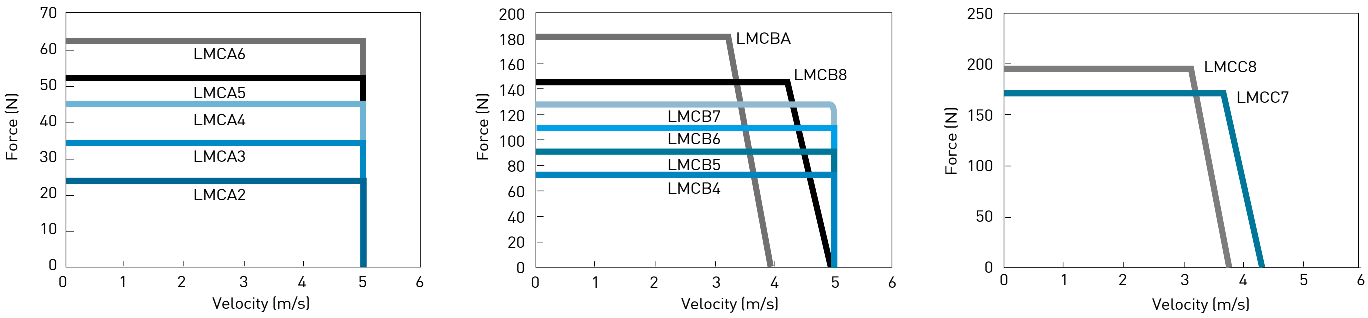
Table 4.3 Specifications for Linear Motors, LMCA, LMCB, LMCC Series

	Symbol	Unit	LMCA2	LMCA3	LMCA4	LMCA5	LMCA6	LMCB3	LMCB4	LMCB5	LMCB6	LMCB7	LMCB8	LMCBA	LMCC7	LMCC8
Continuous force	F_c	N	24	34	45	52	62	54	73	91	109	128	145	181	171	195
Continuous current	I_c	A (rms)	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
Peak force (for 1 s)	F_p	N	72	102	135	156	186	163	219	273	327	384	435	543	513	585
Peak current (for 1 s)	I_p	A (rms)	6.9	6.3	6.3	5.4	5.4	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Force constant	K_f	N/A (rms)	10.6	15.8	21.2	28.2	33.8	27.2	36.3	45.4	54.5	63.5	72.5	90.6	85.4	97.5
Max. winding temp.	T_{max}	°C	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Electrical time constant	K_e	ms	0.4	0.3	0.4	0.3	0.4	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.5	0.5
Resistance (line to line at 25 °C)	R_{25}	Ω	3.4	4.8	6.0	7.0	8.0	5.5	8.2	10.4	13.4	14.6	16.6	20.8	16.8	19.2
Inductance (line to line)	L	mH	1.2	1.6	2.2	2.4	2.8	1.8	2.6	3.8	4.4	5.4	6.2	7.8	8.4	9.6
Pole pair pitch	2 τ	mm	32	32	32	32	32	32	32	32	32	32	32	32	32	32
Bend radius of motor cable	R_{bend}	mm	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Back emf constant (line to line)	K_v	Vrms/(m/s)	5.9	8.8	11.9	14.5	17.4	15.2	20.0	24.8	29.3	34.7	40.0	50.0	45.4	51.9
Motor constant (at 25 °C)	K_m	$N/\sqrt{W}$	4.6	6.0	7.1	8.9	9.9	9.4	10.4	11.5	12.2	13.7	14.5	16.2	17.0	18.2
Thermal resistance	R_{th}	°C/W	2.78	2.36	1.89	2.20	1.93	2.27	1.52	1.20	0.93	0.86	0.75	0.60	0.74	0.65
Thermal switch			100°C, Bimetal (opener), DC 12V/6A, DC 24V/3A													
Max. DC bus voltage		V	250													
Mass of forcer	M_f	kg	0.15	0.23	0.31	0.38	0.45	0.29	0.38	0.48	0.58	0.68	0.72	0.88	0.74	0.76
Unit mass of stator	M_s	kg/m	7	7	7	7	7	12	12	12	12	12	12	12	21	21
Length of forcer/ Dimension n	L_f	mm	66/2	98/3	130/4	162/5	194/6	98/3	130/4	162/5	194/6	226/7	258/8	322/10	226/7	258/8
Height of forcer	h	mm	59	59	59	59	59	79	79	79	79	79	79	79	99	99
Height of stator	H_s	mm	60	60	60	60	60	80	80	80	80	80	80	80	103	103
Width of stator	W_s	mm	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	35.2	35.2
Length of stator / Dimension N	L_s	mm	128mm/N=1, 192mm/N=2, 320mm/N=4													
Total height	H	mm	74.5	74.5	74.5	74.5	74.5	94.5	94.5	94.5	94.5	94.5	94.5	94.5	117.5	117.5

Except dimensions, all the specifications in the table are in ± 10% of tolerance.

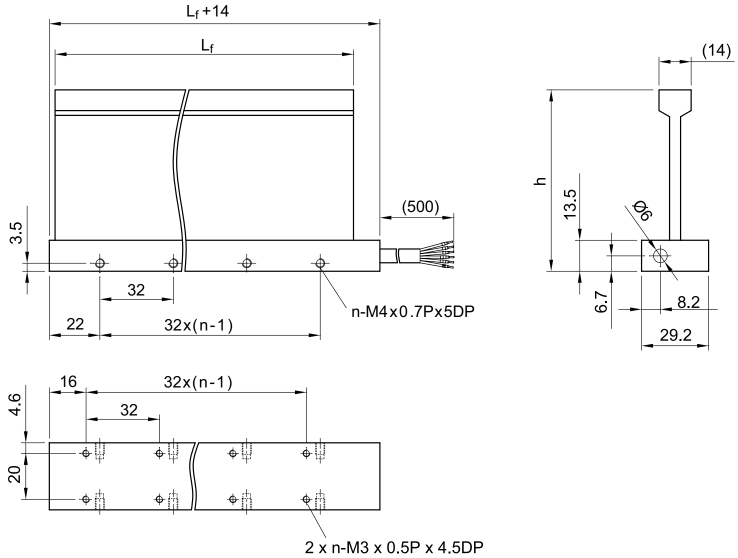
LMC series F-V Curve

Force vs. Velocity curves are calculated with DC bus voltage=300 VDC

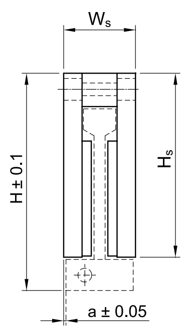


Dimensions for linear motor LMC forcer

(Values for L_f, h and n: see Table 4.3)



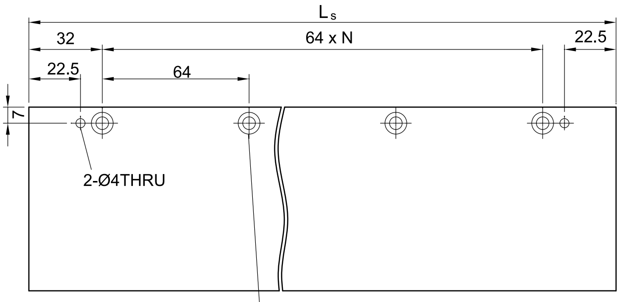
Installing linear motors LMC



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

Dimensions for linear motor LMC stator

(Values for L_S, H_S, W_S, N and H: see Table 4.3)



* LMCASX / LMCBSX
(N+1)-Ø5.5THRU, Ø9.5 x 8DP
* LMCCSX
(N+1)-Ø6.5THRU, Ø11 x 10DP

Structure of the order number of linear motor LMCA, LMCB, and LMCC stators

LMC A S 3

Series	Stator height	Stator model	Length of stator
	A: 60 mm	S: Standard	0: 128 mm (N=1)
	B: 80 mm	C: Customized	1: 192 mm (N=2)
	C: 103 mm		3: 320 mm (N=4)

Positioning Systems

Linear Motor Components

4.3.2 Linear Motors, LMCD, LMCE Series

HIWIN synchronous linear motors LMCD and LMCE are the born sprinters. They are light, extremely dynamic. This is due to their coreless primary part (forcer) with epoxy cast coils, it needs to move very little of its own weight. The secondary part is composed of an U-shaped stator made of permanent magnets.

- 3-pahse
- Extremely dynamic
- Good synchronization and high speed consistency
- Low inertia and high acceleration
- Low profile
- No cogging
- Several forcers possible on one stator

Force Chart for Linear Motors

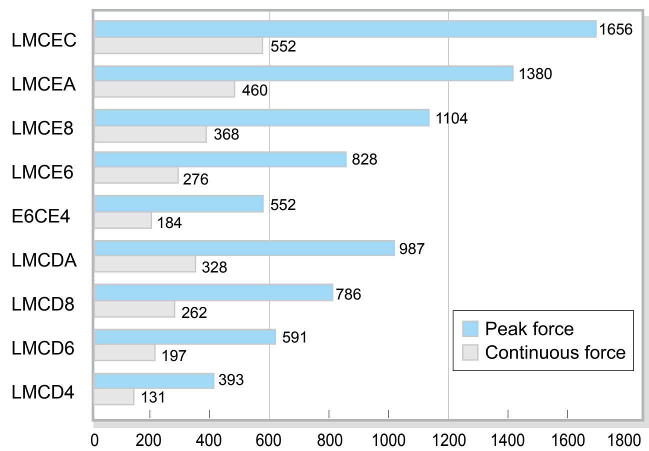


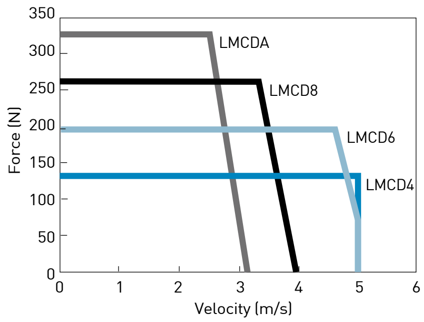
Table 4.4 Specifications for Linear Motors, LMCD and LMCE Series

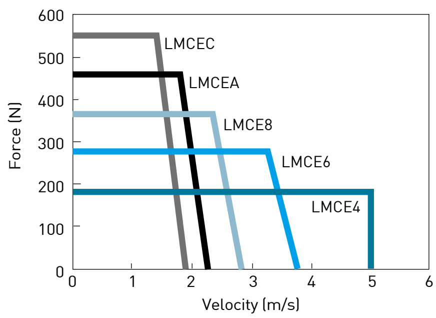
	Symbol	Unit	LMCD4	LMCD6	LMCD8	LMCDA	LMCE4	LMCE6	LMCE8	LMCEA	LMCEC
Continuous force	F_c	N	131	197	262	328	184	276	368	460	552
Continuous current	I_c	A (rms)	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Peak force (for 1 s)	F_p	N	393	591	786	987	552	828	1104	1380	1656
Peak current (for 1 s)	I_p	A (rms)	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75	9.75
Force constant	K_f	N/A (rms)	40.3	60.6	80.6	100.9	56.6	84.9	113.2	141.5	169.8
Max. winding temp.	T_{max}	°C	100	100	100	100	100	100	100	100	100
Electrical time constant	K_e	ms	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Resistance (line to line at 25 °C)	R_{25}	Ω	5.1	7.7	10.8	13.8	5.9	8.8	11.7	14.6	17.5
Inductance (line to line)	L	mH	2.1	3.2	4.5	5.7	2.5	3.7	4.9	6.1	7.3
Pole pair pitch	2τ	mm	60	60	60	60	60	60	60	60	60
Bend radius of motor cable	R_{bend}	mm	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Back emf constant (line to line)	K_v	Vrms/(m/s)	25	38	50	63	35	53	70	88	106
Motor constant (at 25 °C)	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	0.93	0.61	0.44	0.34	0.81	0.54	0.40	0.32	0.27
Thermal switch			100°C, Bimetal (opener), DC 12V/6A, DC 24V/3A								
Max. DC bus voltage		V	500								
Mass of forcer	M_f	kg	0.88	1.32	1.76	2.20	1.23	1.84	2.46	3.08	3.70
Unit mass of stator	M_s	kg/m	16	16	16	16	20	20	20	20	20
Length of forcer/ Dimension n	L_f	mm	260/7	380/10	500/13	620/16	260/7	380/10	500/13	620/16	740/19
Height of forcer	h	mm	87.5	87.5	87.5	87.5	107.5	107.5	107.5	107.5	107.5
Height of stator	H_s	mm	86.8	86.8	86.8	86.8	106.8	106.8	106.8	106.8	106.8
Width of stator	W_s	mm	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5
Length of stator/ Dimension N	L_s	mm	120mm/N=2, 180mm/N=3, 300mm/N=5								
Total height	H	mm	105	105	105	105	125	125	125	125	125

Note: Except dimensions, all the specifications in the table are in ±10% of tolerance.

LMCD and LMCE series F-V Curve

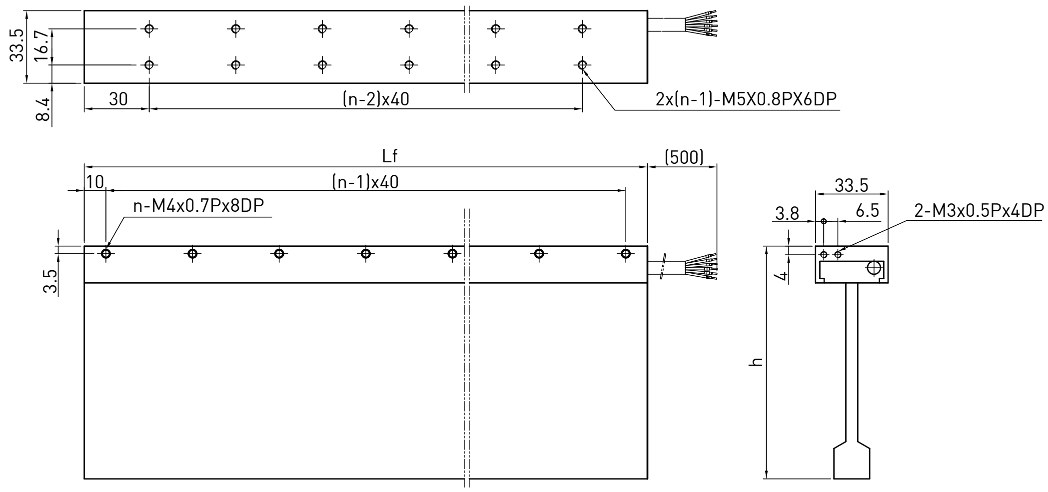
Force vs. Velocity curves are calculated with DC bus voltage=300 VDC





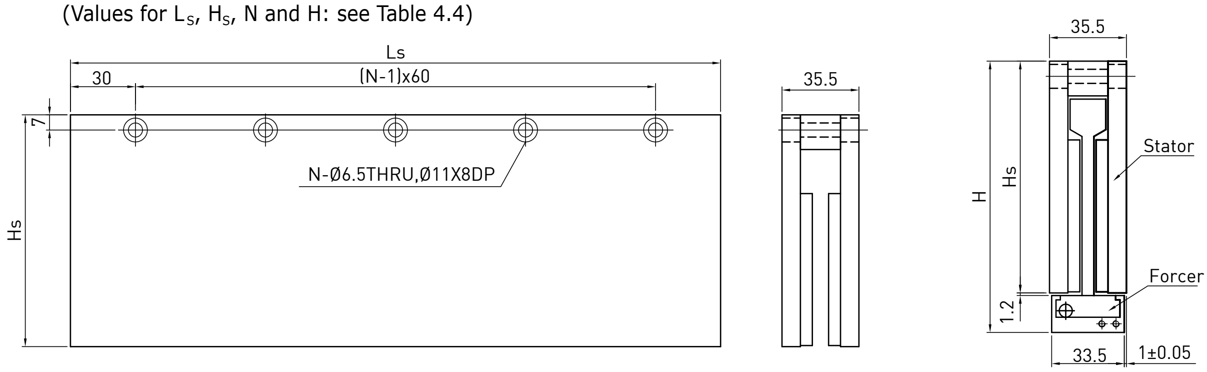
Dimensions for linear motor LMCD and LMCE forcer

(Values for L_f, h and n: see Table 4.4)

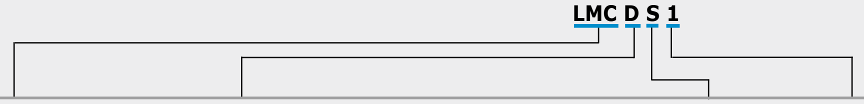


Dimensions for linear motor LMCD and LMCE stator

(Values for L_S, H_S, N and H: see Table 4.4)



Structure of the order number of linear motor LMCD and LMCE stators



Series	Stator height	Stator model	Length of stator
	D: 86.8 mm	**S: Standard**	**1: 120 mm (N=2)**
	E: 106.8 mm	**C: Customized**	**B: 180 mm (N=3)**
			2: 300 mm (N=5)

Positioning Systems

Linear Motor Components

4.4 Linear Motors, LMF Series

HIWIN synchronous linear motors LMF are coiled stack of sheets with water-cooling loop. They are especial distinguished by very high power density and minimum cogging force. This three-phase motor is composed of a primary part (forcer) with iron core and secondary part (stator) with permanent magnets. With the combination of several stators, many stroke combinations are possible.

- 3-phase
- Water-cooling
- UL certification
- Low cogging
- Unlimited stroke

Table 4.5 **Specifications for Linear Motors, LMF Series**

	Symbol	Unit	LMF01	LMF02	LMF03	LMF11	LMF12	LMF13	LMF14	LMF21	LMF22	LMF23	LMF24
Continuous force	F_c	N	94	187	281	170	340	510	680	255	510	764	1019
Continuous current	I_c	A(rms)	2.0	4.0	5.9	2.0	4.0	5.9	7.9	2.0	4.0	5.9	7.9
Continuous force (WC)	F_c	N	140	281	421	255	510	764	1019	382	764	1147	1529
Continuous current (WC)	I_c	A(rms)	3.0	5.9	8.9	3.0	5.9	8.9	11.9	3.0	5.9	8.9	11.9
Peak force (for 1 s)	F_p	N	254	508	762	462	924	1386	1848	694	1388	2082	2776
Peak current (for 1 s)	I_p	A(rms)	5.4	10.8	16.2	5.4	10.8	16.2	21.6	5.4	10.8	16.2	21.6
Force constant	K_f	N/A (rms)	47.3	47.3	47.3	85.8	85.8	85.8	85.8	128.7	128.7	128.7	128.7
Attraction force	F_a	N	570	1140	1710	954	1909	2863	3818	1431	2863	4294	5727
Max. winding temp.	T_{max}	°C	120	120	120	120	120	120	120	120	120	120	120
Electrical time constant	K_e	ms	4.5	4.5	4.4	5.2	5.2	5.3	5.2	5.1	5.1	5.1	5.1
Resistance (line to line at 25 °C)	R_{25}	Ω	8.7	4.3	3.0	12.8	6.4	4.1	3.2	18.4	9.2	6.1	4.6
Inductance (line to line)	L	mH	39.0	19.5	13.2	66.0	33.0	21.8	16.5	94.0	47.0	31.3	23.5
Pole pair pitch	2τ	mm	30	30	30	30	30	30	30	30	30	30	30
Back emf constant (line to line)	K_v	Vrms/(m/s)	27.0	27.0	27.0	49.0	49.0	49.0	49.0	73.5	73.5	73.5	73.5
Motor constant (at 25 °C)	K_m	$N/\sqrt{W}$	13.1	18.6	22.3	19.6	27.7	34.6	39.2	24.5	34.6	42.5	49.0
Thermal resistance	R_{th}	°C/W	1.95	0.99	0.63	1.33	0.66	0.46	0.33	0.92	0.46	0.31	0.23
Thermal resistance(WC)	R_{th}	°C/W	0.87	0.44	0.28	0.59	0.30	0.20	0.15	0.41	0.21	0.14	0.10
Thermal switch			1 x KTY84-130+ 1 x (3 PTC SNM120 In Series)										
Max. DC bus voltage		V	600										
Mass of forcer	M_f	kg	1.5	2.3	3.1	2.4	4.0	5.6	7.6	3.2	5.5	8.0	10.4
Unit mass of stator	M_s	kg/m	3.7	3.7	3.7	5.8	5.8	5.8	5.8	9.8	9.8	9.8	9.8
Width of stator	W_s	mm	58	58	58	88	88	88	88	118	118	118	118
Length of stator/Dimension N	L_s	mm	120mm/N=2, 180mm/N=3, 300mm/N=5										
Stator mounting distance	W_{s1}	mm	48	48	48	74	74	74	74	104	104	104	104
Total height	H	mm	48.5	48.5	48.5	48.5	48.5	48.5	48.5	50.5	50.5	50.5	50.5

Note: WC: with water cooling
Except dimensions, all the specifications in the table are in ±10% of tolerance.

Force Chart for Linear Motors, LMF Series

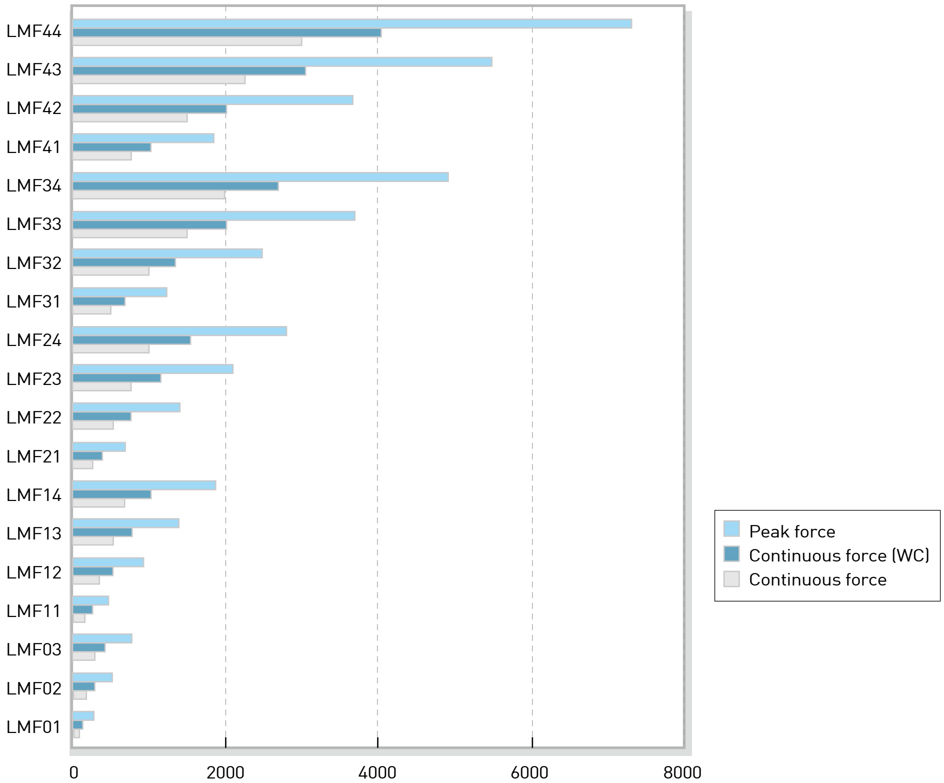


Table 4.6 Specifications for Linear Motors, LMF Series

	Symbol	Unit	LMF31	LMF32	LMF33	LMF34	LMF41	LMF42	LMF43	LMF44
Continuous force	F_c	N	501	1001	1502	2002	751	1502	2252	3003
Continuous current	I_c	A(rms)	3.9	7.7	11.6	15.4	3.9	7.7	11.6	15.4
Continuous force (WC)	F_c	N	672	1344	2016	2688	1008	2016	3024	4033
Continuous current (WC)	I_c	A(rms)	5.2	10.3	15.5	20.7	5.2	10.3	15.5	20.7
Peak force (for 1 s)	F_p	N	1234	2468	3702	4936	1832	3666	5496	7328
Peak current (for 1 s)	I_p	A(rms)	9.4	18.8	28.2	37.6	9.4	18.8	28.2	37.6
Force constant	K_f	N/A (rms)	130	130	130	130	195	195	195	195
Attraction force	F_a	N	3430	6860	10290	13720	5145	10290	15435	20580
Max. winding temp.	T_{max}	°C	120	120	120	120	120	120	120	120
Electrical time constant	K_e	ms	8.6	8.6	8.6	8.6	8.2	8.2	8.2	8.2
Resistance (line to line at 25 °C)	R_{25}	Ω	5.6	2.8	1.8	1.4	8.8	4.4	2.9	2.2
Inductance (line to line)	L	mH	48.0	24.0	16.0	12.0	72.0	36.0	24.0	18.0
Pole pair pitch	2τ	mm	46	46	46	46	46	46	46	46
Back emf constant (line to line)	K_v	Vrms/(m/s)	59.1	59.1	59.1	59.1	88.7	88.7	88.7	88.7
Motor constant (at 25 °C)	K_m	$N/\sqrt{W}$	44.9	63.4	79.1	89.7	53.7	75.9	93.5	107.3
Thermal resistance	R_{th}	°C/W	0.80	0.40	0.28	0.20	0.51	0.26	0.17	0.13
Thermal resistance(WC)	R_{th}	°C/W	0.45	0.22	0.15	0.11	0.28	0.14	0.10	0.07
Thermal switch			1 x KTY84-130+ 1 x (3 PTC SNM120 In Series)							
Max. DC bus voltage		V	600							
Mass of forcer	M_f	kg	6.4	11.7	17.3	22.5	9.5	16.2	23.0	29.0
Unit mass of stator	M_s	kg/m	16.2	16.2	16.2	16.2	22.3	22.3	22.3	22.3
Width of stator	W_s	mm	134	134	134	134	180	180	180	180
Length of stator/Dimension N	L_s	mm	184 mm/N=2, 276 mm/N=3, 460 mm/N=5							
Stator mounting distance	W_{s1}	mm	115	115	115	115	161	161	161	161
Total height	H	mm	64.1	64.1	64.1	64.1	66.1	66.1	66.1	66.1

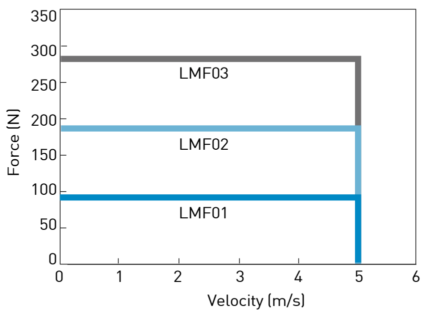
Note: WC: with water cooling
Except dimensions, all the specifications in the table are in ±10% of tolerance.

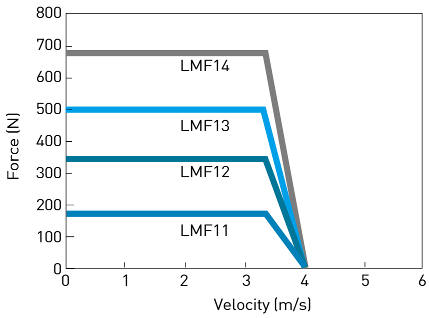
Positioning Systems

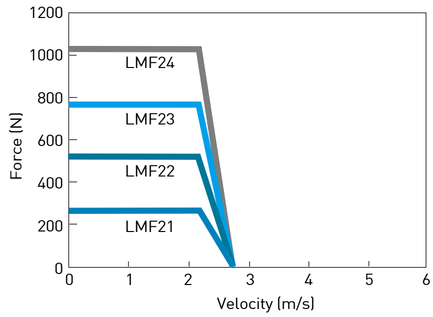
Linear Motor Components

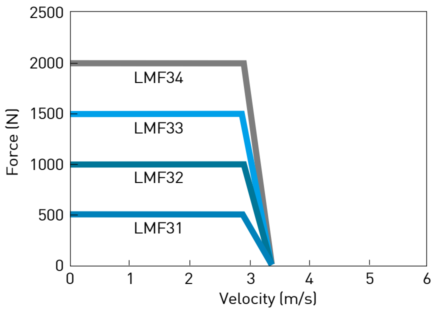
LMF series F-V Curve (no water cooling)

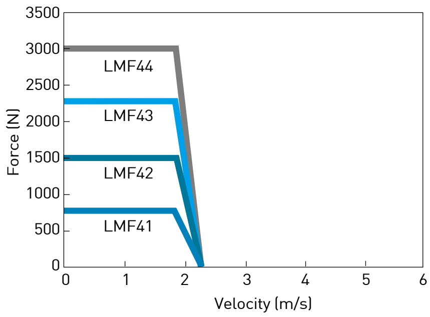
Force vs. Velocity curves are calculated with DC bus voltage=300 VDC





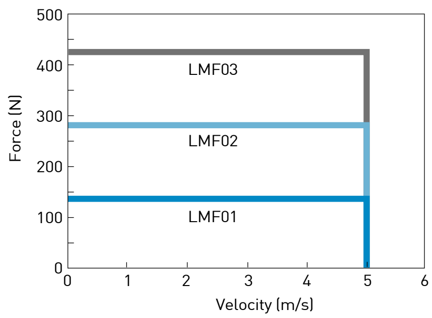


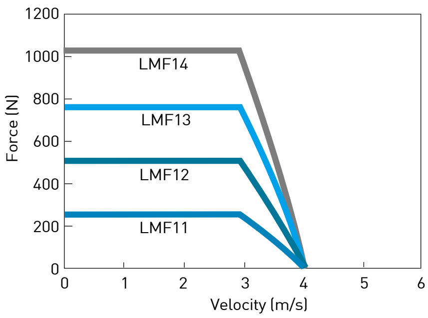


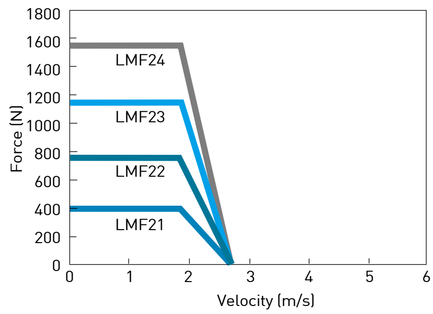


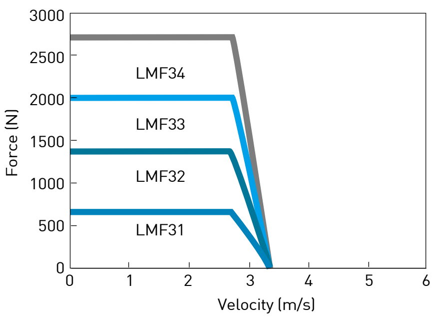
LMF series F-V Curve (water cooling)

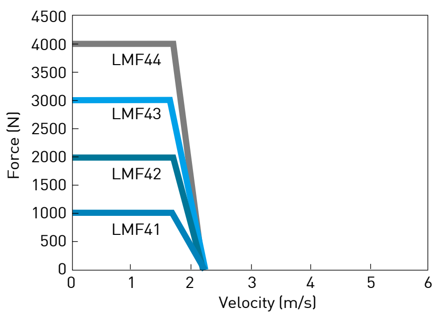
Force vs. Velocity curves are calculated with DC bus voltage=300 VDC



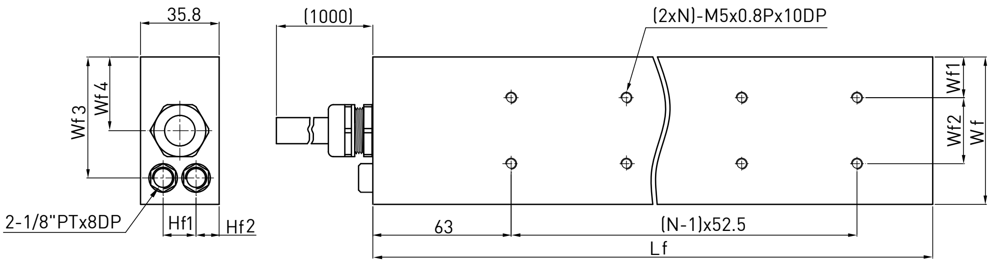






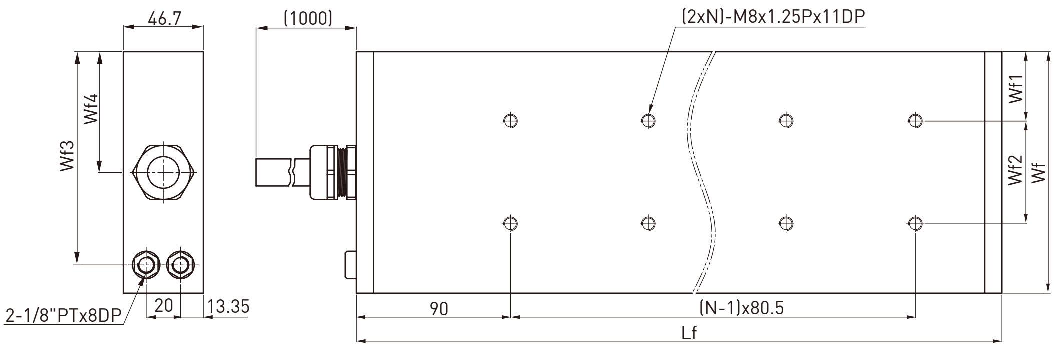


Dimensions for linear motor LMF 0 , 1 , 2 forcer



Type	Lf	Wf	Wf1	Wf2	Wf3	Wf4	N	Hf1	Hf2
LMF01	150	67	18.5	30	55	33.5	2	15	10.5
LMF02	255	67	18.5	30	55	33.5	4	15	10.5
LMF03	360	67	18.5	30	55	33.5	6	15	10.5
LMF11	150	96	33	30	81.5	48	2	18	8.9
LMF12	255	96	33	30	81.5	48	4	18	8.9
LMF13	360	96	33	30	81.5	48	6	18	8.9
LMF14	465	96	33	30	81.5	48	8	18	8.9
LMF21	150	126	40.5	45	111.5	63	2	18	8.9
LMF22	255	126	40.5	45	111.5	63	4	18	8.9
LMF23	360	126	40.5	45	111.5	63	6	18	8.9
LMF24	465	126	40.5	45	111.5	63	8	18	8.9

Dimensions for linear motor LMF 3, 4 forcer



Type	Lf	Wf	Wf1	Wf2	Wf3	Wf4	N
LMF31	221	141	40.5	60	126.5	70.5	2
LMF32	382	141	40.5	60	126.5	70.5	4
LMF33	543	141	40.5	60	126.5	70.5	6
LMF34	704	141	40.5	60	126.5	70.5	8
LMF41	221	188	54	80	173.5	94	2
LMF42	382	188	54	80	173.5	94	4
LMF43	543	188	54	80	173.5	94	6
LMF44	704	188	54	80	173.5	94	8

Positioning Systems

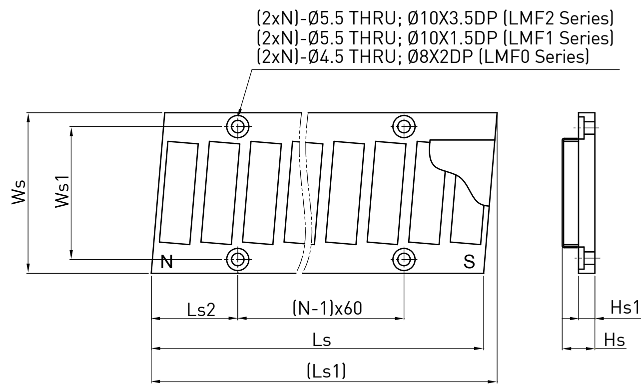
Linear Motor Components

Structure of the order number of linear motors LMF stator

LMF 0 S 1

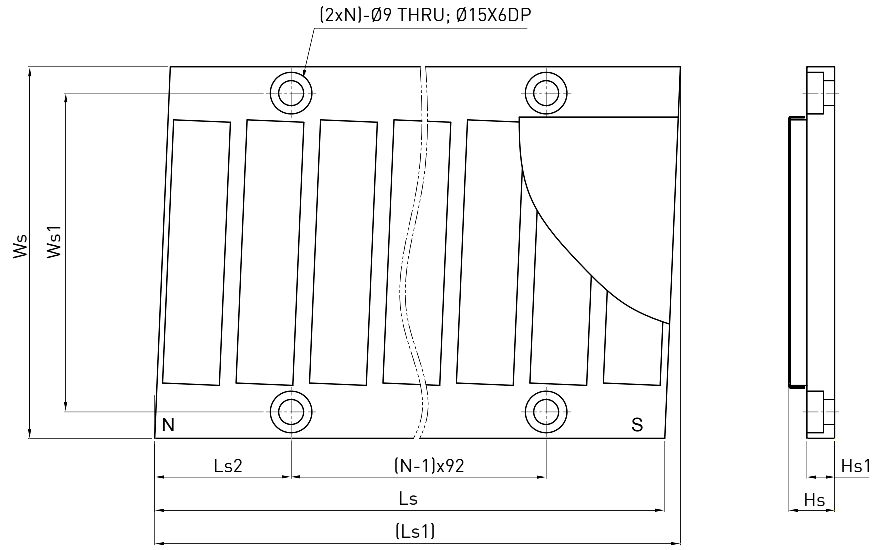
Series	Width of stator	Stator model	Length of stator
	0: 58 mm 1: 88 mm 2: 118 mm 3: 134 mm 4: 180 mm	S: Standard C: Customized	for 0~2 series 1: 120 mm 2: 180 mm 3: 300 mm for 3~4 series 1: 184 mm 2: 276 mm 3: 460 mm

Dimensions for linear motor LMF 0, 1, 2 Stator



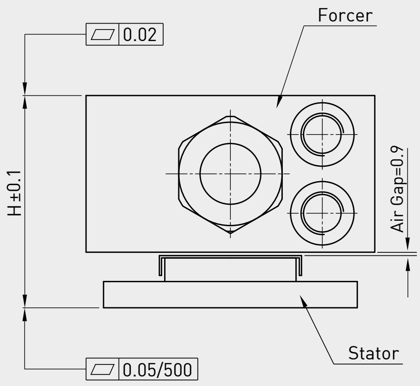
Type	Ls	(Ls1)	N	Ls2	Hs	Hs1	Ws	Ws1
LMF0S1	120	124.87	2	31.25	11.8	5.9	58	48
LMF0S2	180	184.87	3	31.25	11.8	5.9	58	48
LMF0S3	300	304.87	5	31.25	11.8	5.9	58	48
LMF1S1	120	122.77	2	30.6	11.8	5.9	88	74
LMF1S2	180	182.77	3	30.6	11.8	5.9	88	74
LMF1S3	300	302.77	5	30.6	11.8	5.9	88	74
LMF2S1	120	123.09	2	30.4	13.8	7.9	118	104
LMF2S2	180	183.09	3	30.4	13.8	7.9	118	104
LMF2S3	300	303.09	5	30.4	13.8	7.9	118	104

Dimensions for linear motor LMF 3, 4 Stator



Type	Ls	(Ls1)	N	Ls2	Hs	Hs1	Ws	Ws1
LMF3S1	184	189.6	2	49.2	16.5	10	134	115
LMF3S2	276	281.6	3	49.2	16.5	10	134	115
LMF3S3	460	465.6	5	49.2	16.5	10	134	115
LMF4S1	184	189.03	2	48.9	18.5	12	180	161
LMF4S2	276	281.03	3	48.9	18.5	12	180	161
LMF4S3	460	465.03	5	48.9	18.5	12	180	161

Linear Motor Assembly



Type	H
LMF01	48.5
LMF02	48.5
LMF03	48.5
LMF11	48.5
LMF12	48.5
LMF13	48.5
LMF14	48.5
LMF21	50.5
LMF22	50.5
LMF23	50.5
LMF24	50.5

Type	H
LMF31	64.1
LMF32	64.1
LMF33	64.1
LMF34	64.1
LMF41	66.1
LMF42	66.1
LMF43	66.1
LMF44	66.1

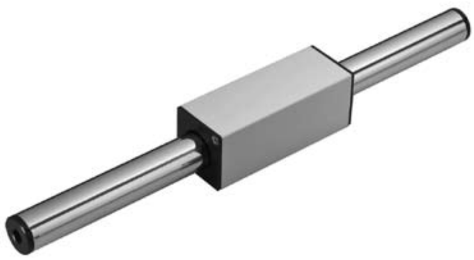
Positioning Systems

Linear Motor Components

4.5 Linear Motors, LMT Series

HIWIN Linear turbo LMT series are linear motors with the unique shape by arranging cylindrically permanent magnets. Due to the coreless forcer, the LMT Turbo motors are very light and extremely dynamic. They are also good substitutes for ballscrew applications, because of the same installation interface.

- 3-phase
- Low mass and high acceleration
- Extremely dynamic
- Wide air gap and easy assembly
- No cogging and no contact
- No wearing
- Multiple forcers



Force Chart for Linear Motors

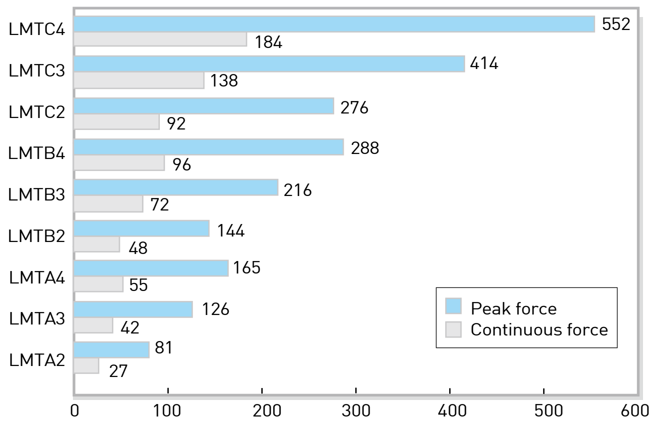


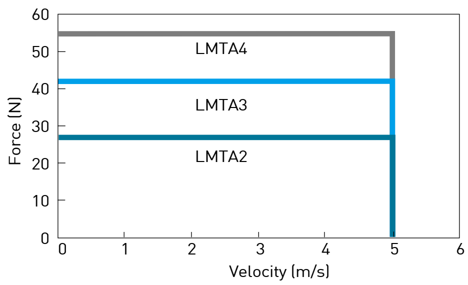
Table 4.7 Specifications for Linear Motors, LMT Series

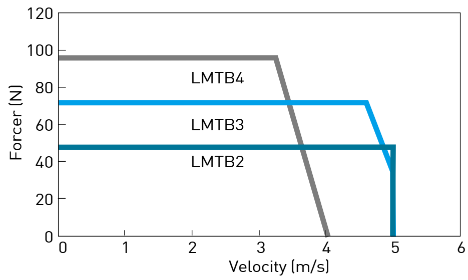
	Symbol	Unit	LMTA2	LMTA3	LMTA4	LMTB2	LMTB3	LMTB4	LMTC2	LMTC3	LMTC4
Continuous force	F_c	N	27	42	55	48	72	96	92	138	184
Continuous current	I_c	A (rms)	1.5	1.5	1.5	1.2	1.2	1.2	2.4	2.4	2.4
Peak force for 1 sec.	F_p	N	81	126	165	144	216	288	276	414	552
Peak current for 1 sec.	I_p	A (rms)	4.5	4.5	4.5	3.6	3.6	3.6	7.2	7.2	7.2
Force constant	K_f	N/A (rms)	18	28	37	40	60	80	38	57	77
Max. winding temp.	T_{max}	°C	100	100	100	100	100	100	100	100	100
Electrical time constant	K_e	ms	0.6	0.6	0.6	0.9	0.9	0.9	1.0	1.0	1.0
Resistance (line to line at 25 °C)	R_{25}	Ω	7.4	11.1	14.8	16.0	24.0	32.4	6.2	9.3	12.4
Inductance (line to line)	L	mH	4.5	6.7	8.9	14.2	21.3	28.4	6.1	9.2	12.2
Pole pair pitch	2τ	mm	72	72	72	90	90	90	120	120	120
Bend radius of motor cable	R_{bend}	mm	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5
Back emf constant (line to line)	K_v	Vrms/(m/s)	11.7	17.5	23.3	22.0	33.0	44.0	24.6	36.9	49.2
Motor constant (at 25 °C)	K_m	$N/\sqrt{W}$	5.4	6.9	7.9	8.2	10.0	11.6	12.6	15.4	17.8
Thermal resistance	R_{th}	°C/W	3.0	2.0	1.3	2.2	1.4	1.1	1.4	0.9	0.7
Thermal switch			100 °C, Thermistor								
Max. DC bus voltage		V	250								
Mass of forcer	M_f	kg	0.62	0.78	0.94	0.99	1.32	1.65	1.60	2.20	2.80
Unit mass of stator	M_s	kg/m	2.0	2.0	2.0	3.2	3.2	3.2	6.4	6.4	6.4
Length of forcer	L_f	mm	94	130	166	120	165	210	160	220	280
Height of forcer	H	mm	40	40	40	50	50	50	60	60	60
Wide of forcer	W	mm	40	40	40	50	50	50	60	60	60
Diameter of stator	D	mm	20	20	20	25	25	25	35	35	35
Fixing pitch	$A \times A_1$	mm	84×20	120×20	156×20	105×25	150×25	195×25	140×30	200×30	260×30
Fixing screw	M x L	mm	4 - M4 × 6			4 - M6 × 9			4 - M8 × 12		
Air gap	G	mm	0.75			0.75			1.00		

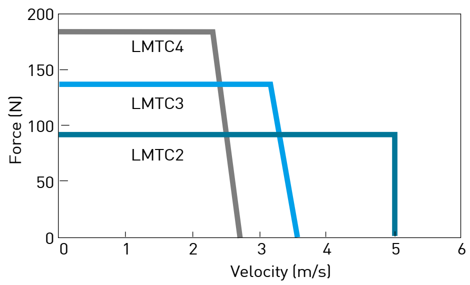
Note: Except dimensions, all the specifications in the table are in ± 10% of tolerance.

LMT series F-V curves

Force vs. Velocity curves are calculated with DC bus voltage=300 VDC







Structure of the order number of linear turbo LMT stators

LMT A S -xxxx

Series	Diameter of stator	Option	Length of stator(L_S) [mm]
Linear Turbo Motor	A: 20 mm B: 25 mm C: 35 mm	S: Standard C: Customized	See Table 4.8

Positioning Systems

Linear Motor Components

Dimensions for linear motor LMT

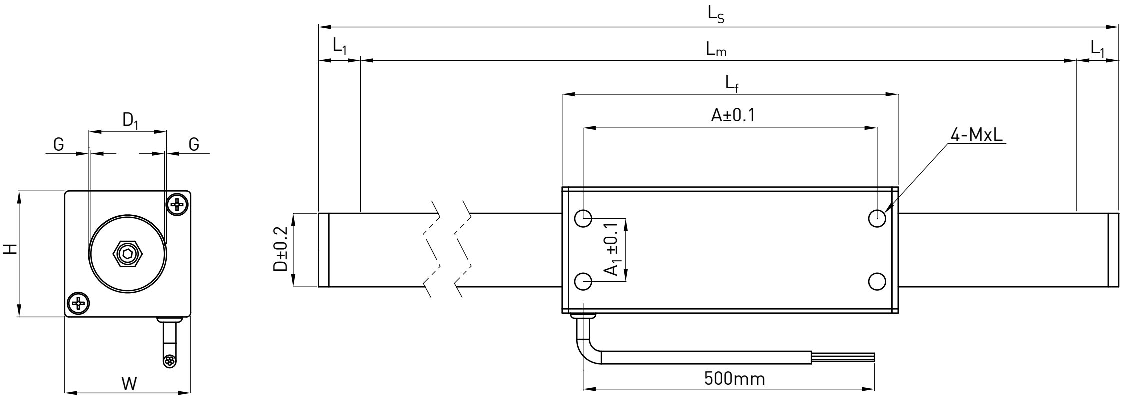
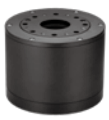


Table 4.8 Length of LMT Stator

Type	Length of stator Ls (Magnets length/support) (mm)					
LMTAS	204 (144/30)	240 (180/30)	276 (216/30)	312 (252/30)	348 (288/30)	384 (324/30)
	420 (360/30)	456 (396/30)	492 (432/30)	558 (468/45)	594 (504/45)	630 (540/45)
	666 (576/45)	702 (612/45)	738 (648/45)	774 (684/45)	810 (720/45)	846 (756/45)
	882 (792/45)	918 (828/45)	954 (864/45)	1030 (900/65)	1066 (936/65)	1102 (972/65)
	1138 (1008/65)	1174 (1044/65)	1210 (1108/65)	1246 (1116/65)	1282 (1152/65)	1318 (1188/65)
	1354 (1224/65)	1390 (1260/65)	1426 (1296/65)	1462 (1332/65)	1498 (1368/65)	1534 (1404/65)
	1570 (1440/65)	1606 (1476/65)				
LMTBS	295 (180/57.5)	340 (225/57.5)	385 (270/57.5)	430 (315/57.5)	475 (360/57.5)	520 (405/57.5)
	565 (450/57.5)	610 (495/57.5)	655 (540/57.5)	700 (585/57.5)	745 (630/57.5)	790 (675/57.5)
	835 (720/57.5)	880 (765/57.5)	925 (810/57.5)	970 (855/57.5)	1015 (900/57.5)	1100 (945/77.5)
	1145 (990/77.5)	1190 (1035/77.5)	1235 (1080/77.5)	1280 (1125/77.5)	1325 (1170/77.5)	1370 (1215/77.5)
	1415 (1260/77.5)	1460 (1305/77.5)	1505 (1350/77.5)	1550 (1395/77.5)	1595 (1440/77.5)	1640 (1485/77.5)
	1685 (1530/77.5)	1730 (1575/77.5)	1775 (1620/77.5)	1820 (1665/77.5)	1865 (1710/77.5)	1966 (1755/105.5)
	2011 (1800/105.5)					
LMTCS	360 (240/60)	420 (300/60)	480 (360/60)	540 (420/60)	600 (480/60)	660 (540/60)
	720 (600/60)	780 (660/60)	840 (720/60)	900 (780/60)	960 (840/60)	1020 (900/60)
	1080 (960/60)	1140 (1020/60)	1240 (1080/80)	1300 (1140/80)	1360 (1200/80)	1420 (1260/80)
	1480 (1320/80)	1540 (1380/80)	1600 (1440/80)	1660 (1500/80)	1720 (1560/80)	1780 (1620/80)
	1840 (1680/80)	1900 (1740/80)	2020 (1800/110)	2080 (1860/110)	2140 (1920/110)	2200 (1980/110)
	2260 (2040/110)	2320 (2100/110)	2380 (2160/110)	2440 (2220/110)	2500 (2280/110)	

Effective stroke (S) = Magnets length (L_m) – Length of forcer (L_f)
Length of stator (L_s) = Magnets length (L_m) + Length of support (L_1) × 2

5 Torque Motor Rotary Tables



Positioning Systems

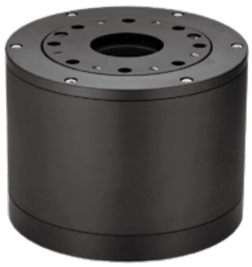
Torque Motor Rotary Tables

5.1 Product Overview and Application Areas

The extremely rigid connection between motor and load, and a servo-drive regulation ensures excellent acceleration capabilities and good uniformity of movement.
HIWIN rotary tables and torque motors are especially well suited for tasks in automation due to the hollow shaft design. Media, cable systems or mechanical parts can be fed through without problems.

HIWIN Rotary Tables:
TMS series utilize cross roller bearing.

- Drive free of clearance
- Hollow shaft
- No gear transmission losses
- Maintenance free and compact
- Driver can be selected freely
- Brush-free drive
- Extremely rigid support with cross-roller
- Meet IP65 enclosure standards as an option
- Integrated brake is available as an option



Short and compact:
HIWIN rotary tables are optimized for high torques and robust dynamics.

Table 5.1 **Application Areas of Rotary Tables**

Classification	Application	Features and main reasons for use					
		Accuracy	Speed	Rigidity	Compactness	Clearliness	Freedom from maintenance
Production equipment	CVD, wafer cleaning, ion implantation	o			o	o	o
	Semi-conductor transport, inspection/processing	o			o	o	o
Assembly machines	Assembly machines for electric components	o	o		o	o	o
	High-speed assembly machines for electronic components	o	o		o	o	o
	Various assembly machines	o	o		o		o
Machine tools	Tool changers		o		o		o
	C axes	o		o	o		o
Inspection/ testing equipment	Machine part inspection	o			o		o
	Inspection of electric components	o			o		o
	Inspection of optical components	o			o		o
	Chemical analysis of liquids		o			o	o
	Various Inspection/testing equipment	o			o		o
Robots	Various assembly robots	o	o	o	o		o
	Various transport robots	o	o		o		o
	Inspection/transport robots in clean rooms	o	o		o	o	o

5.2 TMS Rotary Tables

5.2.1 TMS0x Rotary Tables

Dimensions of TMS0x rotary tables
(Values see Table 5.2)

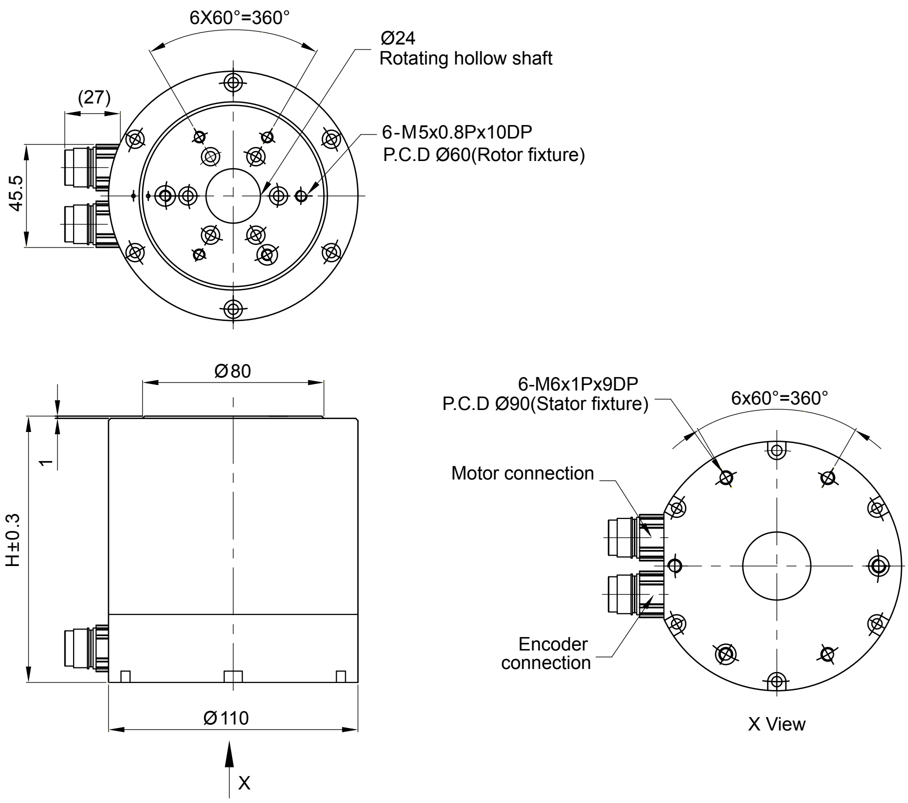


Table 5.2 **Specifications for TMS0x rotary table**

	Symbol	Unit	TMS03	TMS07
Continuous torque	T_c	Nm	3.1	6.2
Continuous current	I_c	A (rms)	2	2
Peak torque for 1 sec.	T_p	Nm	7.7	15.5
Peak current for 1 sec.	I_p	A (rms)	5	5
Torque constant	K_t	Nm/A (rms)	1.55	3.1
Electrical time constant	K_e	ms	2.1	2.5
Resistance (line to line, 25 °C)	R_{25}	Ω	7.1	12.4
Inductance (line to line)	L	mH	15.2	30.4
Number of poles	2p		10	10
Back emf constant (line to line)	K_v	Vrms/(rad/s)	0.82	1.7
Motor constant (25 °C)	K_m	$Nm/\sqrt{W}$	0.5	0.7
Thermal resistance	R_{th}	°C/W	1.8	1.0
Thermal switch			100°C, Bimetal(opener), DC12V/6A or DC24V/3A	
Max. DC bus voltage		V	500	
Inertia of rotating parts	J	kg m^2	0.003	0.006
Mass of motor	M_m	kg	4	7
Max. axial load	F_a	N	3700	3700
Max. radial load	F_r	N	820	820
Max. speed	n	rpm	700	700
Repeatability		Arc sec	± 3	
Accuracy*		Arc sec	± 10	
Height	H	mm	117.5	150

* With HIWIN Solution
Except dimensions, all the specifications in the table are in ±10% of tolerance.

Positioning Systems

Torque Motor Rotary Tables

5.2.2 TMS1x Rotary Tables

Dimensions of TMS1x rotary tables
(Values see Table 5.3)

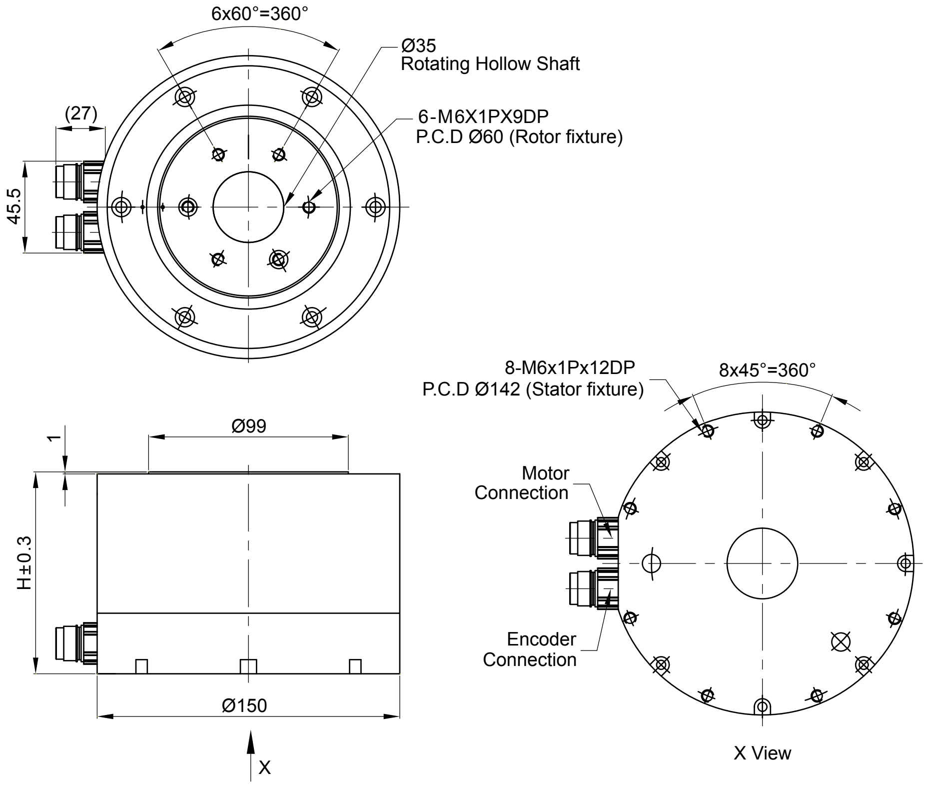


Table 5.3 **Specifications for TMS1x rotary table**

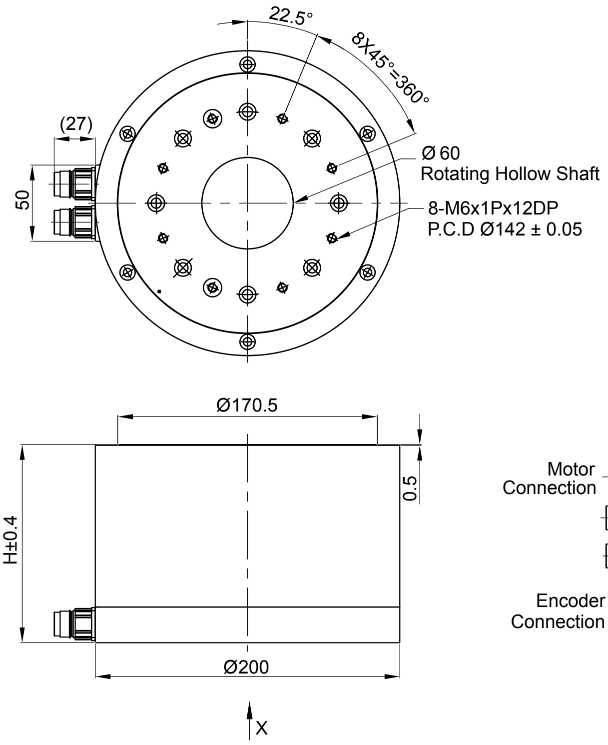
	Symbol	Unit	TMS12	TMS14	TMS16	TMS18
Continuous torque	T_c	Nm	5	10	15	20
Continuous current	I_c	A (rms)	4	4	4	4
Peak torque for 1 sec.	T_p	Nm	12.5	25	37.5	50
Peak current for 1 sec.	I_p	A (rms)	10	10	10	10
Torque constant	K_t	Nm/A (rms)	1.25	2.50	3.75	5.00
Electrical time constant	K_e	ms	3.2	3.6	3.8	4.0
Resistance (line to line, 25 °C)	R_{25}	Ω	2.6	3.9	5.2	6.5
Inductance (line to line)	L	mH	8.2	14	20	26
Number of poles	2p		22	22	22	22
Back emf constant (line to line)	K_v	Vrms/(rad/s)	0.6	1.2	1.8	2.4
Motor constant (25 °C)	K_m	$Nm/\sqrt{W}$	0.6	1.0	1.3	1.6
Thermal resistance	R_{th}	°C/W	1.2	0.8	0.6	0.5
Thermal switch			100°C, Bimetal(opener), DC12V/6A or DC24V/3A			
Max. DC bus voltage		V	500			
Inertia of rotating parts	J	$kg\ m^2$	0.006	0.0065	0.007	0.0075
Mass of motor	M_m	kg	5.7	7	8.3	9.5
Max. axial load	F_a	N	3700	3700	3700	3700
Max. radial load	F_r	N	1700	1700	1700	1700
Max. speed	n	rpm	700	700	700	700
Repeatability		Arc sec	± 3			
Accuracy*		Arc sec	± 10			
Height	H	mm	100	120	140	160

* With HIWIN Solution
Except dimensions, all the specifications in the table are in ±10% of tolerance.

5.2.3 TMS3x Rotary Tables

Dimensions of TMS3x rotary tables

(Values see Table 5.4)



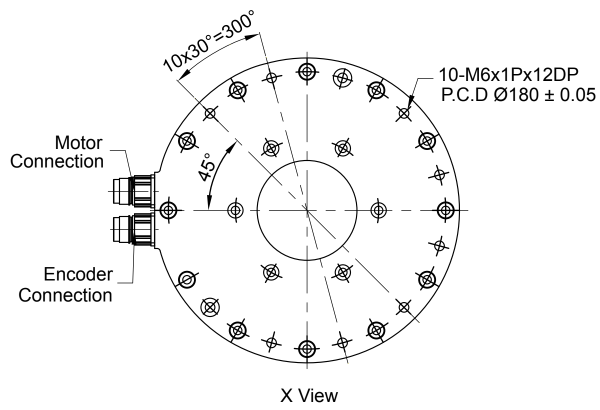


Table 5.4 **Specifications for TMS3x rotary table**

	Symbol	Unit	TMS32	TMS34	TMS38	TMS3C
Continuous torque	T_c	Nm	10	20	40	60
Continuous current	I_c	A (rms)	3	3	3	3
Peak torque for 1 sec.	T_p	Nm	25	50	100	150
Peak current for 1 sec.	I_p	A (rms)	7.5	7.5	7.5	7.5
Torque constant	K_t	Nm/A (rms)	3.3	6.6	13.3	20.0
Electrical time constant	K_e	ms	4.7	5.4	5.7	5.9
Resistance (line to line, 25 °C)	R_{25}	Ω	5.8	8.4	13.6	18.8
Inductance (line to line)	L	mH	27	45	78	111
Number of poles	2p		22	22	22	22
Back emf constant (line to line)	K_v	Vrms/(rad/s)	1.6	3.2	6.4	9.6
Motor constant (25 °C)	K_m	$Nm/\sqrt{W}$	1.1	1.9	3.0	3.8
Thermal resistance	R_{th}	°C/W	1.0	0.7	0.4	0.3
Thermal switch			100°C, Bimetal(opener), DC12V/6A or DC24V/3A			
Max. DC bus voltage		V	500			
Inertia of rotating parts	J	kg m^2	0.014	0.02	0.026	0.035
Mass of motor	M_m	kg	15	21	26	32
Max. axial load	F_a	N	8000	8000	8000	8000
Max. radial load	F_r	N	6500	6500	6500	6500
Max. speed	n	rpm	700	500	240	120
Repeatability		Arc sec	± 2.5			
Accuracy*		Arc sec	± 10			
Height	H	mm	130	150	190	230

* With HIWIN Solution
Except dimensions, all the specifications in the table are in ±10% of tolerance.

Positioning Systems

Torque Motor Rotary Tables

5.2.4 TMS7x Rotary Tables

Dimensions of TMS7x rotary tables
(Values see Table 5.5)

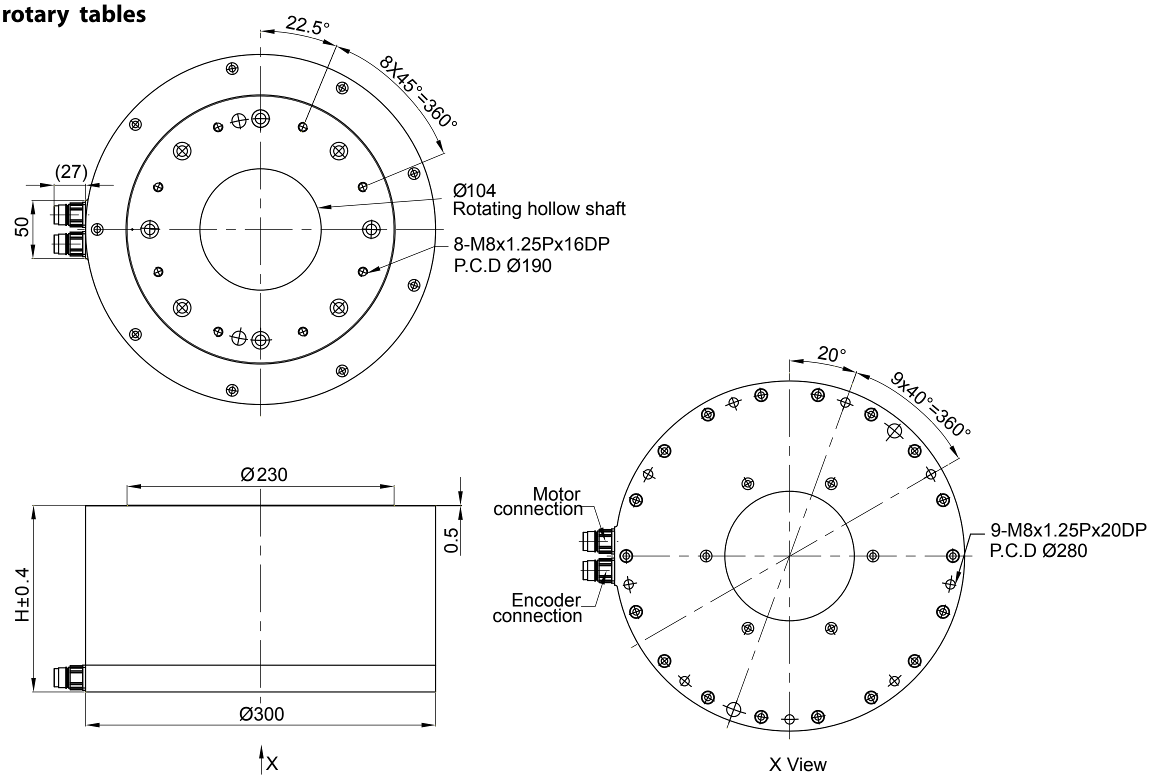


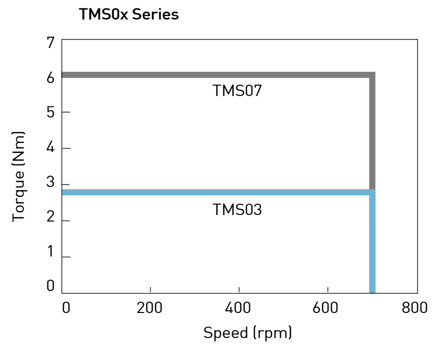
Table 5.5 **Specifications for TMS7x rotary table**

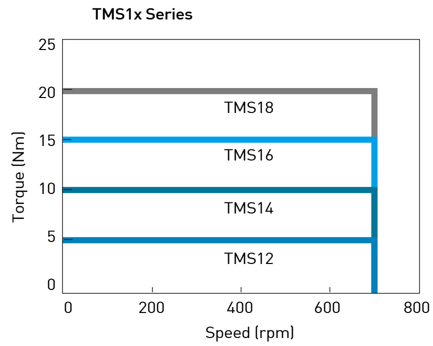
	Symbol	Unit	TMS74	TMS76	TMS7C
Continuous torque	T_c	Nm	50	75	150
Continuous current	I_c	A (rms)	3	3	3
Peak torque for 1 sec.	T_p	Nm	130	190	380
Peak current for 1 sec.	I_p	A (rms)	8	8	8
Torque constant	K_t	Nm/A (rms)	16.7	25.0	50.0
Electrical time constant	K_e	ms	5.0	5.1	5.4
Resistance (line to line, 25 °C)	R_{25}	Ω	14.0	19.0	32.5
Inductance (line to line)	L	mH	70.0	96.5	176.0
Number of poles	2p		44	44	44
Back emf constant (line to line)	K_v	Vrms/(rad/s)	10.8	16.2	32.4
Motor constant (25 °C)	K_m	$Nm/\sqrt{W}$	3.6	4.7	7.2
Thermal resistance	R_{th}	°C/W	0.4	0.3	0.2
Thermal switch			100°C, Bimetal(opener), DC12V/6A or DC24V/3A		
Max. DC bus voltage		V	500		
Inertia of rotating parts	J	kg m^2	0.152	0.174	0.241
Mass of motor	M_m	kg	39	44.5	61.5
Max. axial load	F_a	N	8000	8000	8000
Max. radial load	F_r	N	6500	6500	6500
Max. speed	n	rpm	180	120	48
Repeatability		Arc sec	± 2.5		
Accuracy*		Arc sec	± 10		
Height	H	mm	160	180	240

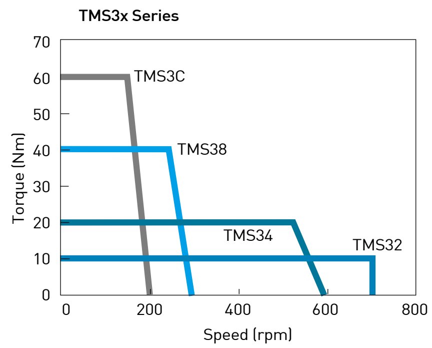
* With HIWIN Solution
Except dimensions, all the specifications in the table are in ±10% of tolerance.

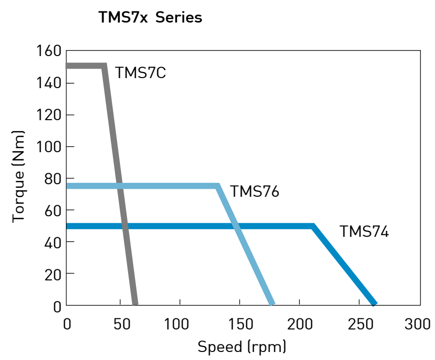
TMS series T-N curves

Torque vs. Velocity curves are calculated with DC bus voltage=300 VDC









Structure of the order number of TMS rotary tables

TM S 3 4

Series	Type	Size	Rotor height
	S: Complete rotary table	0: External diameter 110 mm 1: External diameter 150 mm 3: External diameter 200 mm 7: External diameter 300 mm	2: 20 mm 4: 40 mm 6: 60 mm 8: 80 mm C: 120 mm

Positioning Systems

Torque Motor Rotary Tables

5.3 TMX Rotary Tables

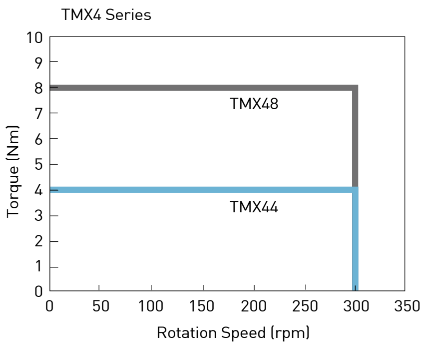
- High torque direct drive motor, no gear box and no backlash
- High resolution resolver integrated, full servo loop control
- Compact size and high stiffness
- Simple motor structure

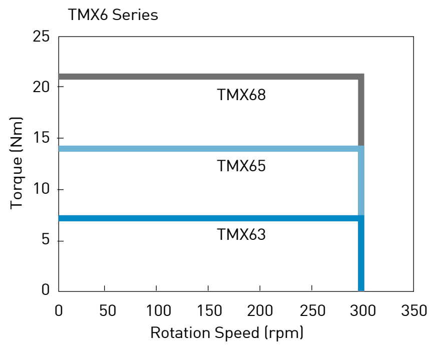
Table 5.6 **Specifications for TMX rotary tables**

	Symbol	Unit	TMX44	TMX48	TMX63	TMX65	TMX68
Continuous torque	T_c	Nm	4	8	7	14	21
Continuous current	I_c	A (rms)	2.7	2.7	7.3	7.3	7.3
Peak torque for 1 sec.	T_p	Nm	12	24	18	36	54
Peak current for 1 sec.	I_p	A (rms)	8.1	8.1	21.9	21.9	21.9
Torque constant	K_t	Nm/A (rms)	1.55	3.1	0.96	1.92	2.88
Electrical time constant	K_e	ms	2.9	2.9	4.4	4.4	4.4
Resistance (line to line, 25 °C)	R_{25}	Ω	2.4	4.8	0.5	1	1.5
Inductance (line to line)	L	mH	7	14	2.2	4.4	6.6
Number of poles	2p		14	14	16	16	16
Back emf constant (line to line)	K_v	Vrms/(rad/s)	0.9	1.8	0.6	1.2	1.8
Motor constant (25 °C)	K_m	$Nm/\sqrt{W}$	0.8	1.2	1.9	2.7	3.3
Thermal resistance	R_{th}	°C/W	2.8	3.4	2.0	2.4	2.9
Thermal switch			100°C, Bimetal(opener), DC12V/6A or DC24V/3A				
Max. DC bus voltage		V	500				
Inertia of rotating parts	J	kg m^2	0.005	0.01	0.02	0.03	0.04
Mass of motor	M_m	kg	4.5	7	8	11	15
Max. axial load	F_a	N	1000	1000	3700	3700	3700
Max. speed	n	rpm	300				
Repeatability		Arc sec	± 3				
Accuracy*		Arc sec	± 75				
Height	H	mm	120	160	109.5	134.5	159.5

* With HIWIN Solution
Except dimensions, all the specifications in the table are in ±10% of tolerance.

Torque to rotational speed curve



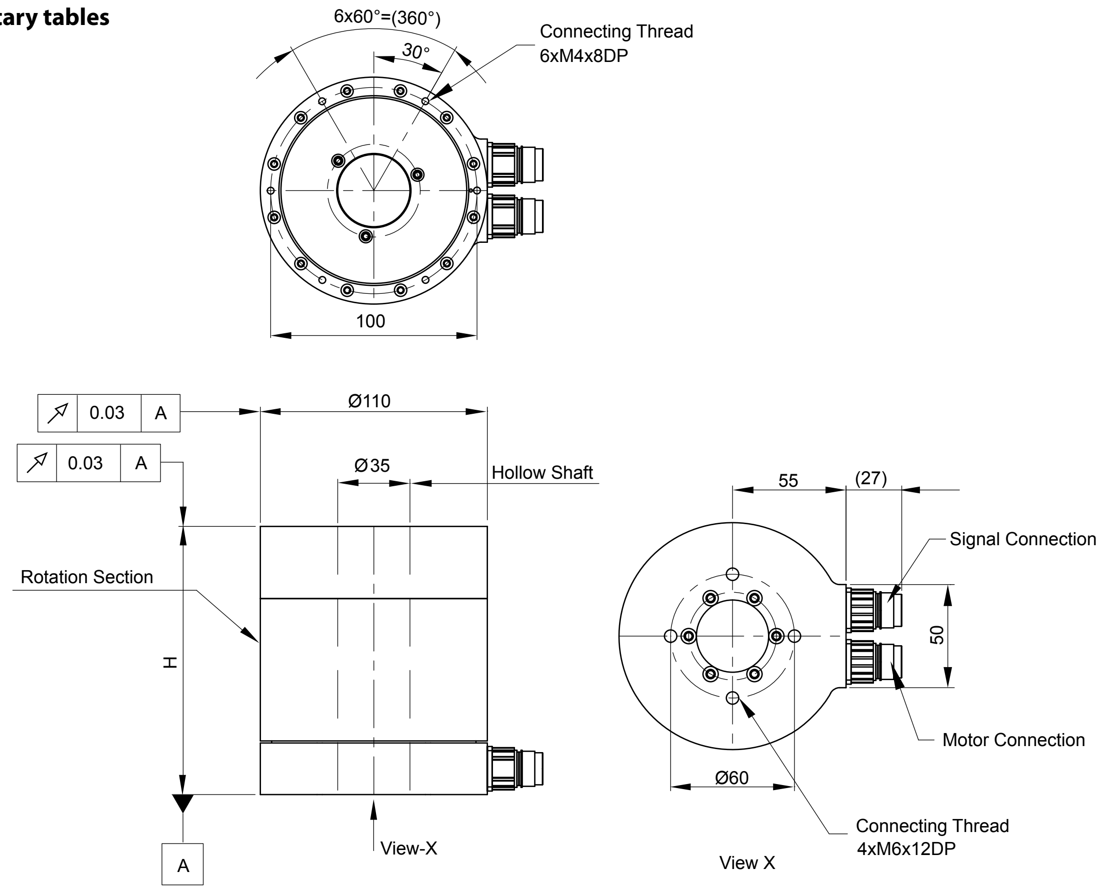


The torque to speed curve may vary from different types of driving systems. The curves showing below are base on Hiwin standard drivers (amplifiers).TMX4 series are driven by LMDR6 which is using 110V AC as input voltage. TMX6 is driven by Xenus driver which is using 220V AC as input voltage.

5.3.1 TMX4 Rotary Tables

Dimensions of TMX4 rotary tables

(Values see Table 5.6)



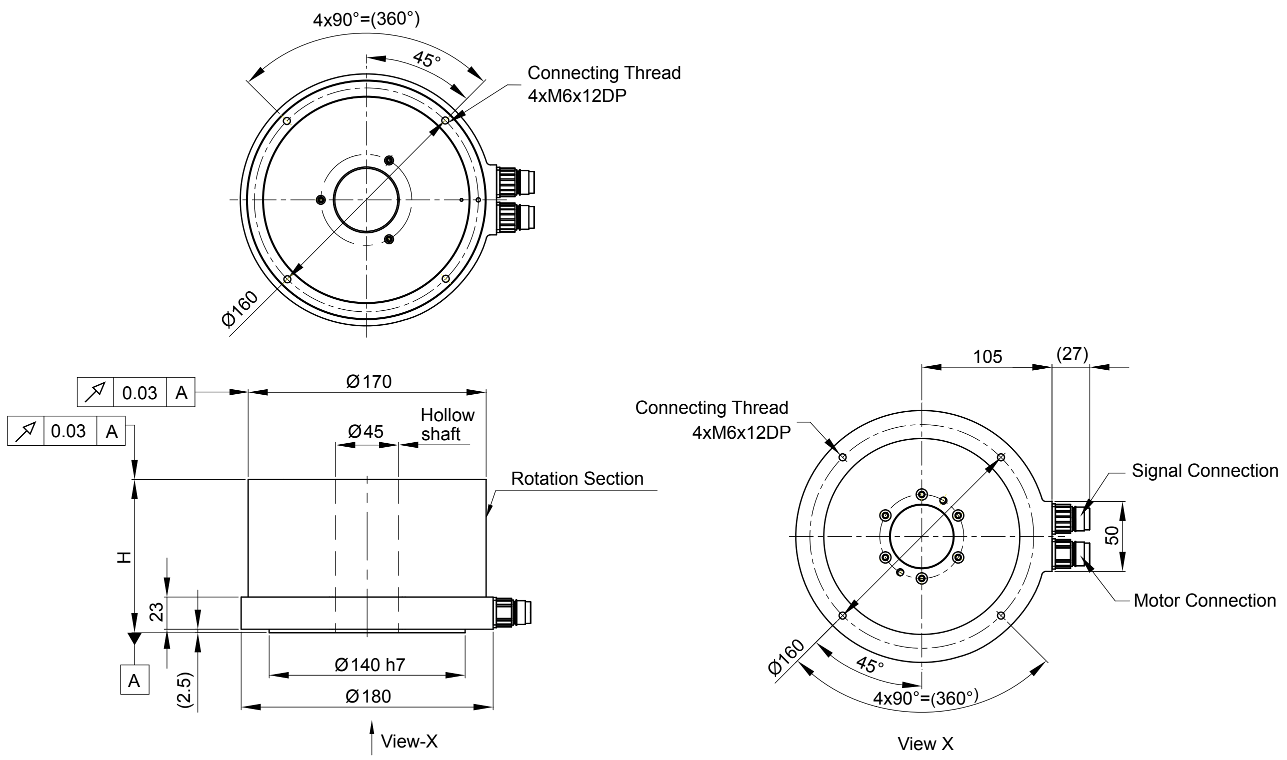
Positioning Systems

Torque Motor Rotary Tables

5.3.2 TMX6 Rotary Tables

Dimensions of TMX6 rotary tables

(Values see Table 5.6)

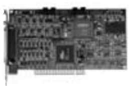


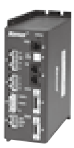
Structure of the order number of TMX rotary tables

TM X 4 4

Series	Type	Motor Outer Diameter	Length of stack
Torque Motor	X: Resolver type	4: 110 mm 6: 170 mm	3: 30 mm 4: 40 mm 5: 50 mm 8: 80 mm

6 Control and Drivers



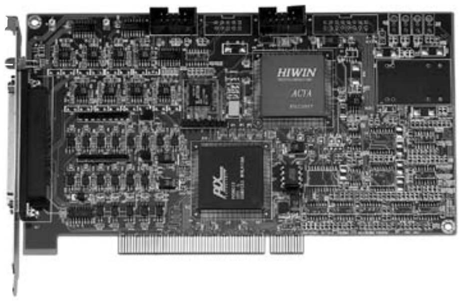


Positioning Systems
Control and Drivers

6.1 Control Card PCI4P

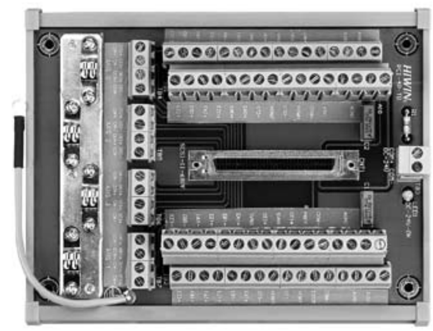
The HIWIN control card PCI4P controls a driver with up to four axes. It can be used for stepping motors and for pulse-controlled servo motors.

- 32 bit PCI card, Plug-and-Play
- Pulse train generation for 4 axes
- 13 digital inputs, 5 digital outputs
- Supports STEP/DIR, CW/CCW and A/B phase pulse format
- Differential pulse output reduces noise interference
- Linear interpolation for three axes
- Circular interpolation for two axes
- Supports speed profile T and S
- 4 x 32 bit counter for digital incremental encoder (Max. 1.76MHz after 4x evaluation)
- Encoder latch function
- DLL driver library for Windows, MCCL Motion Library for VC++/VB programming under Windows XP with 98 functions
- Referencing, limit switch, jog function
- Supports stepping motors, AC servo motors and linear motors
- MotionMaker™ user interface for convenient operation
- Power supply slot
  +5 V DC +/–5 %, max. 900 mA via PCI-Bus in PC
- External power supply (input)
  +24 V DC +/–5 %, max. 500 mA, prepared by user



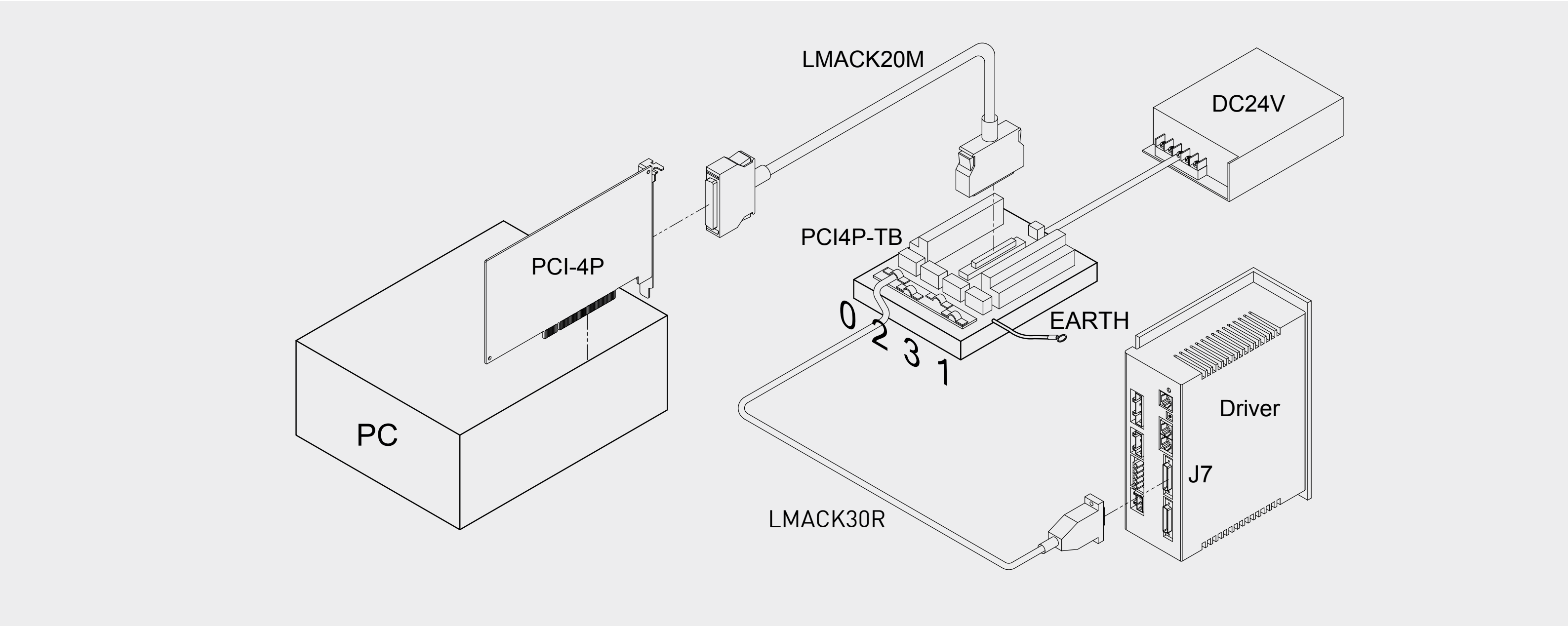
6.1.1 Terminal Block PCI4P-TB

The terminal block PCI4P-TB provides clear connection options for pulse generators and all inputs and outputs of the control card.



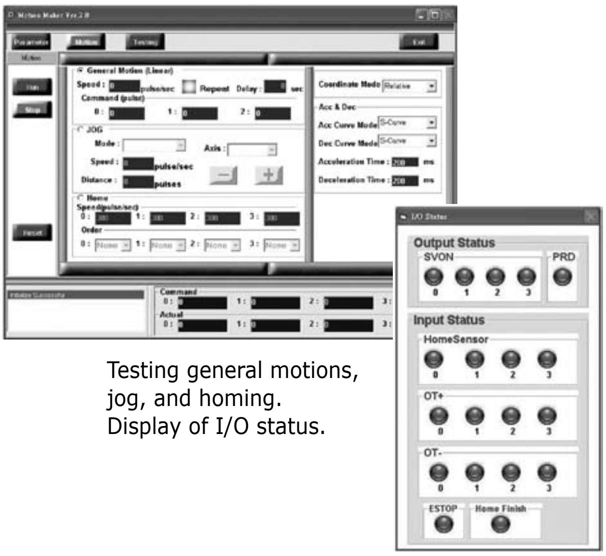
Applicable for stepping motor,
AC servo motors and linear servo motors etc.

Connection example

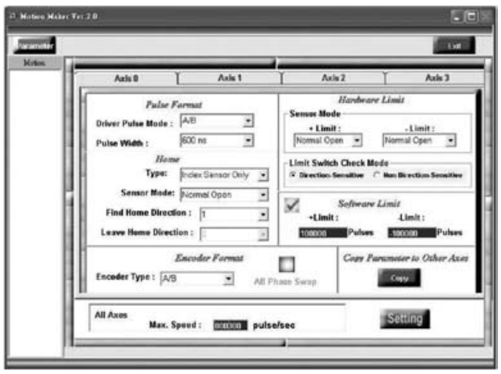


HIWIN Motion Maker

HIWIN Motion Maker tool software is easy to use for the first step of building a motion system with PCI-4P. With its help, a user can check if the wiring and logic of switches are satisfactory and make test runs.



Testing general motions,
jog, and homing.
Display of I/O status.



Pulse formats, Homing,
Hardware and software limits.

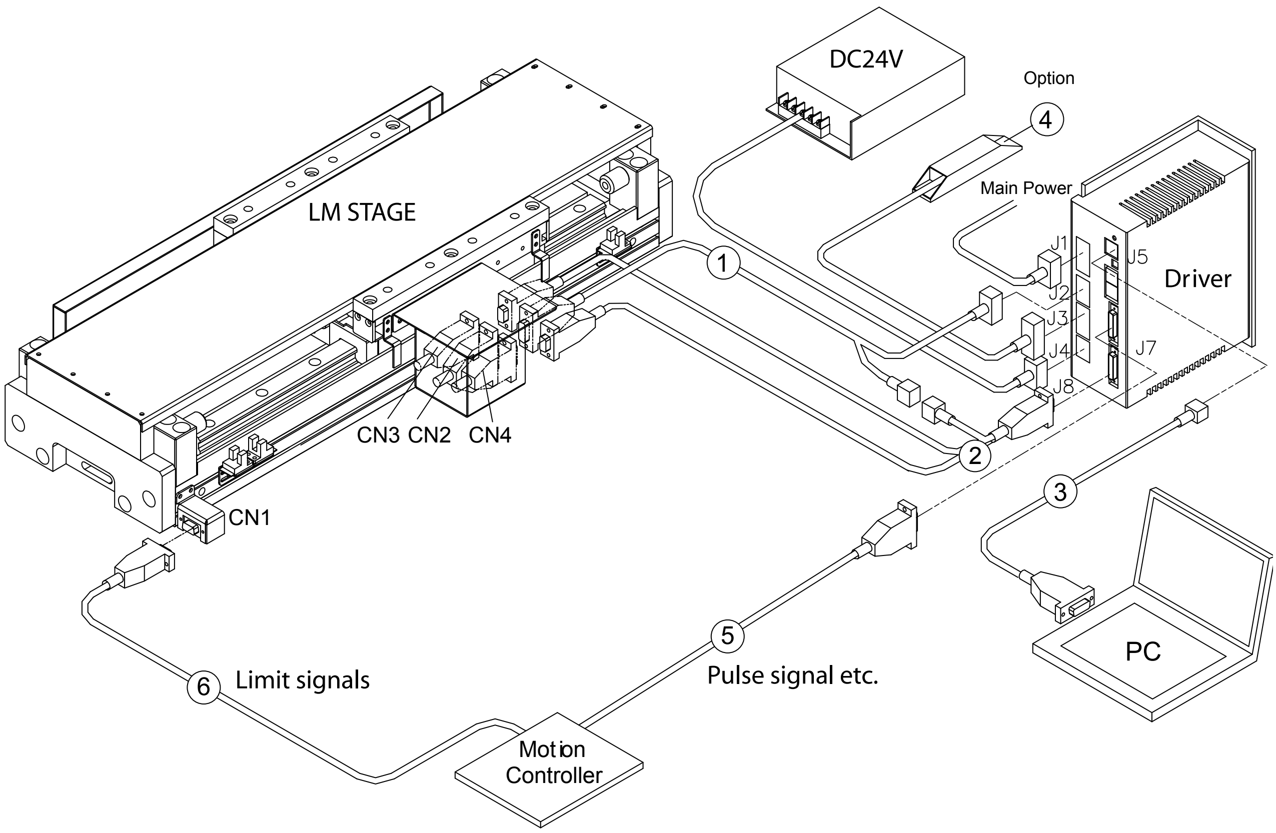
Positioning Systems
Control and Drivers

6.2 Drivers

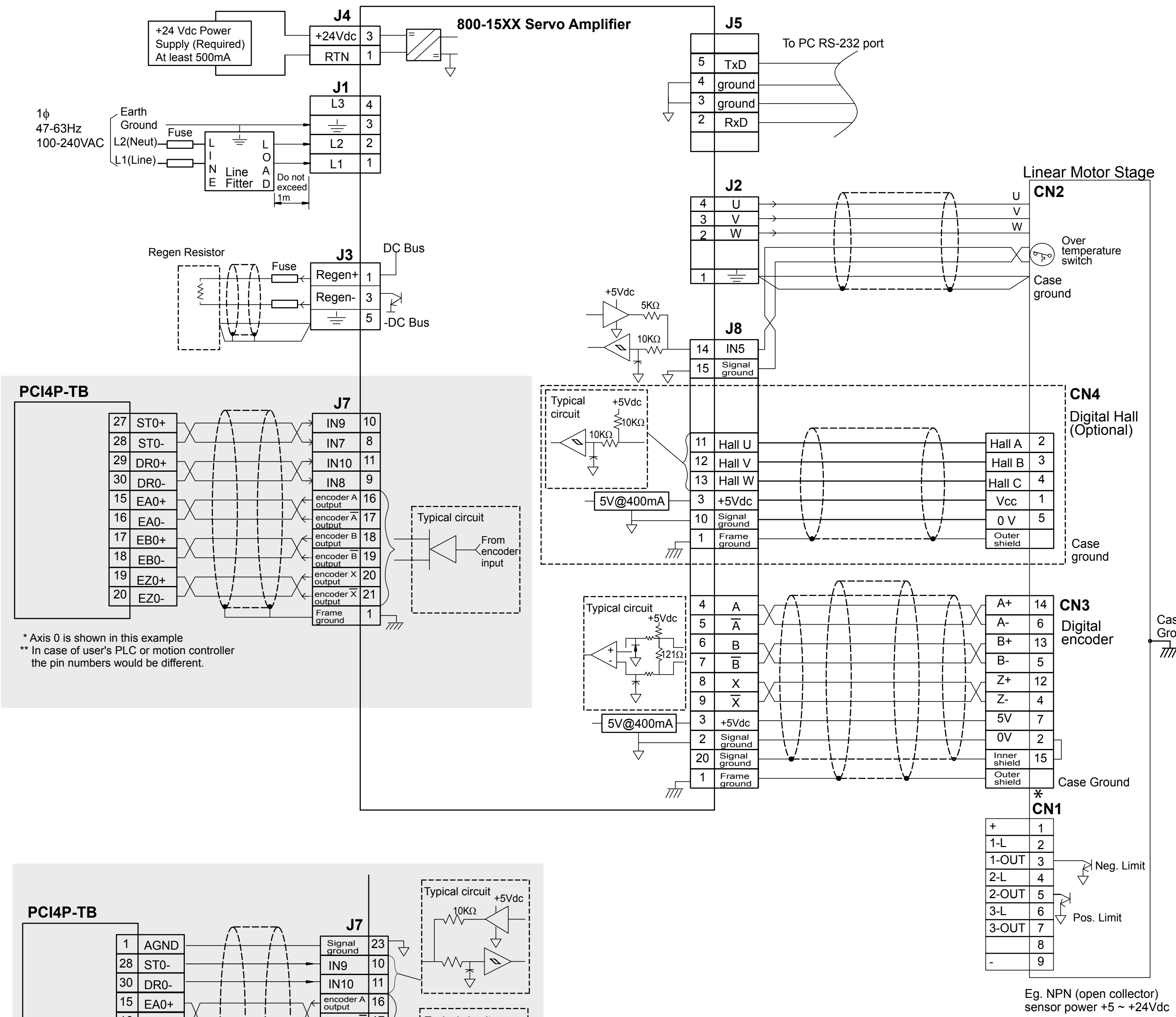
6.2.1 Drivers for Linear Motor Stages

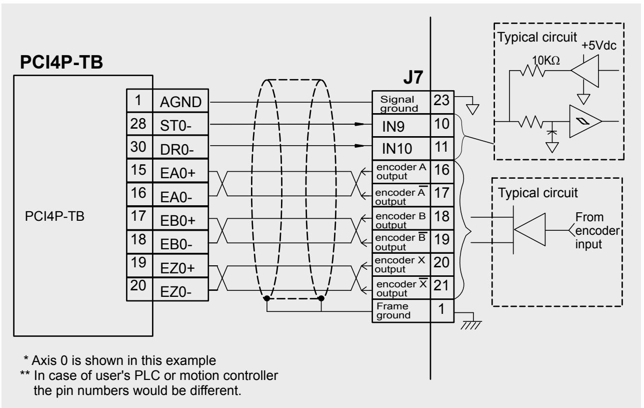
800-15XX Servo Driver

- Digital amplifier
- Field oriented control
- Intuitive CME2 interface
- 100-240VAC input power
- CANopen
- Step/Direction
- Indexer
- Support analog and digital encoder



Wiring examples





Note: For XSL-230. All other connections, same as 800-15XX.

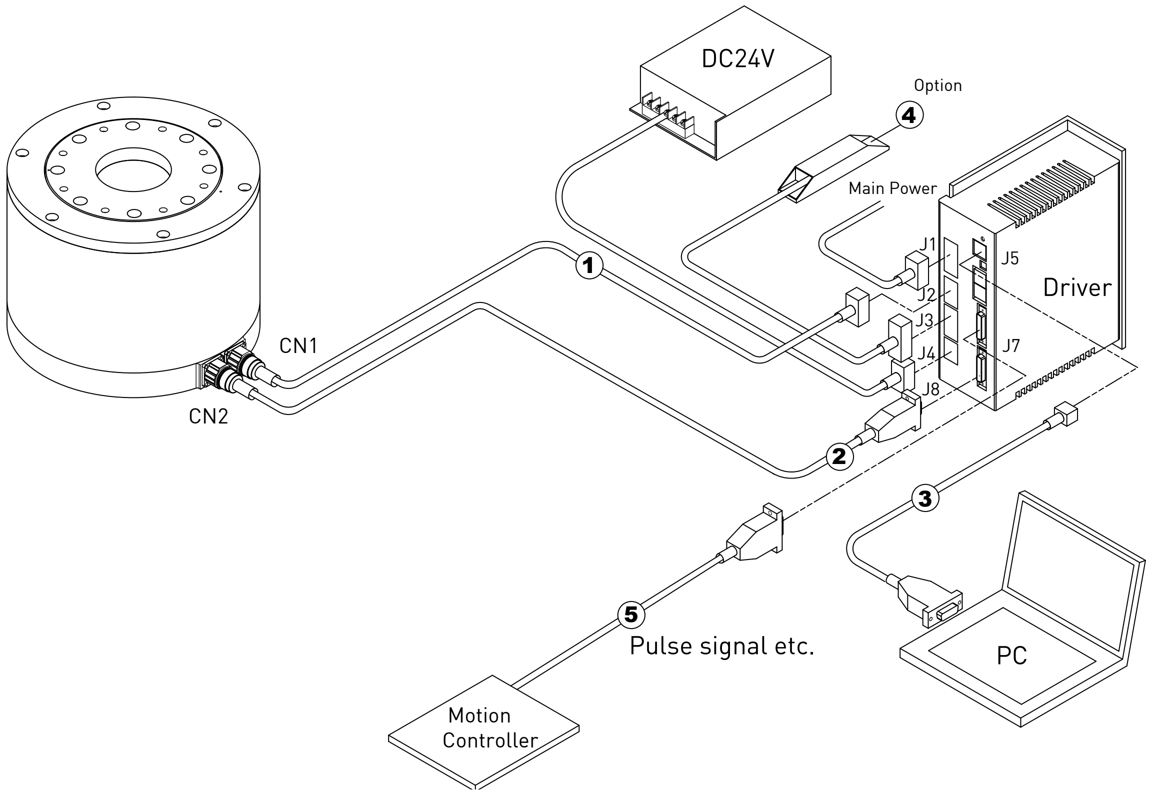
Positioning Systems

Control and Drivers

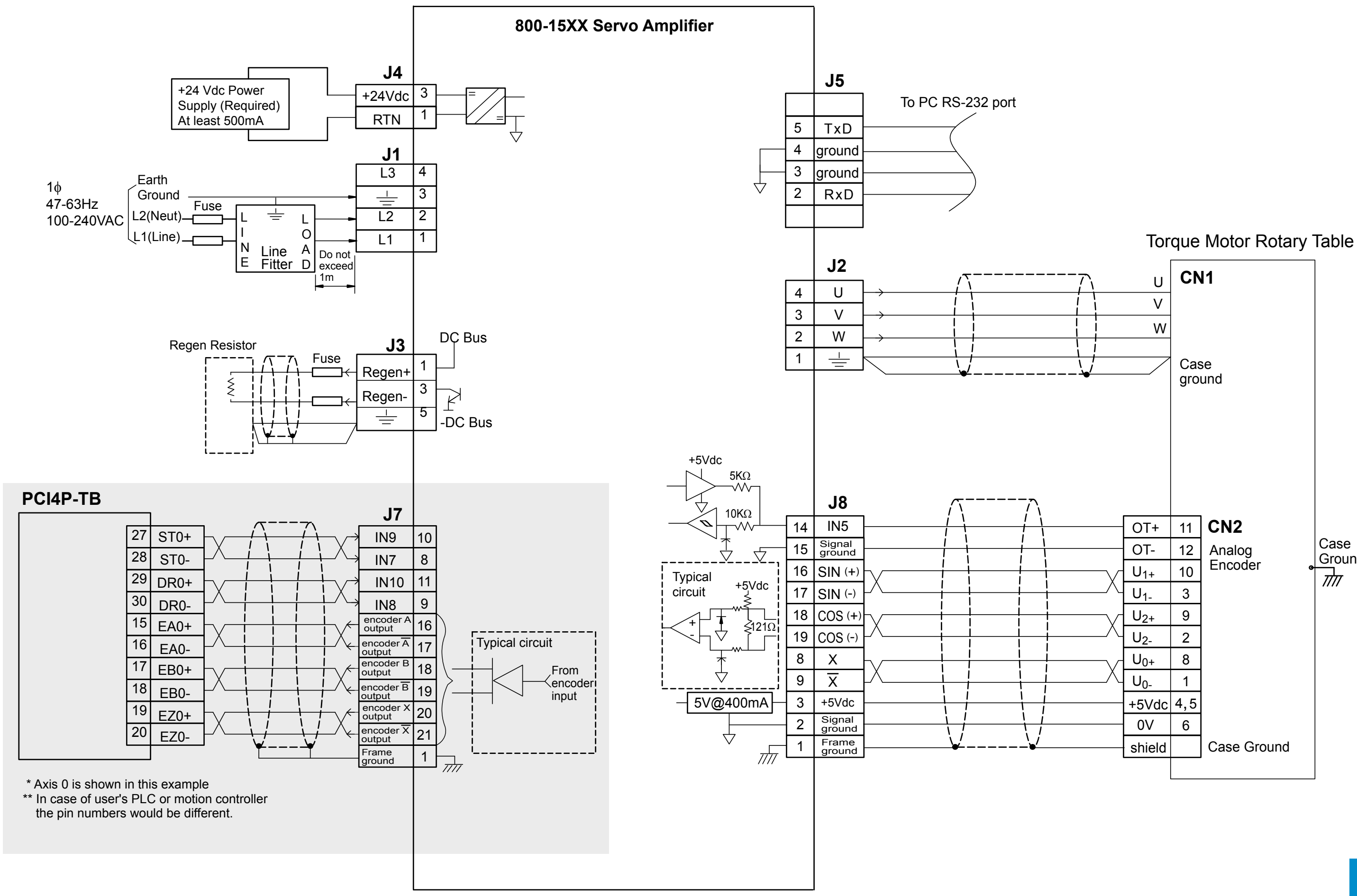
6.2.2 Drivers for Rotary Tables

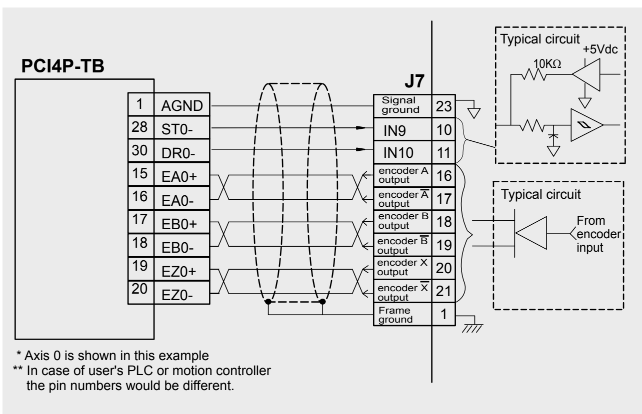
800-15XX Servo Driver

- Digital amplifier
- Field oriented control
- Intuitive CME2 interface
- 100-240VAC input power
- CANopen
- Step/Direction
- Indexer
- Support analog and digital encoder



Wiring examples



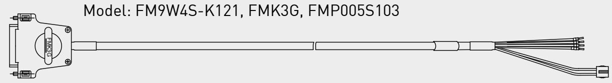
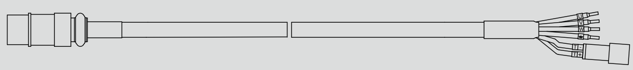
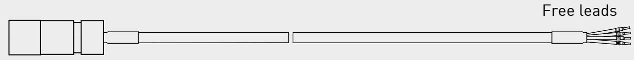
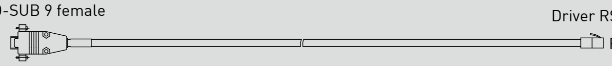
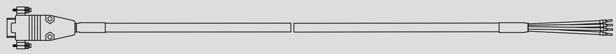


Note: For XSL-230. All other connections, same as 800-15XX.

Positioning Systems

Control and Drivers

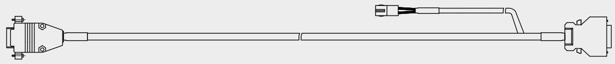
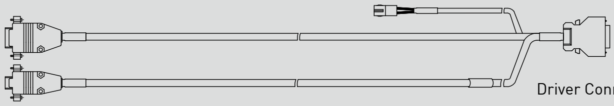
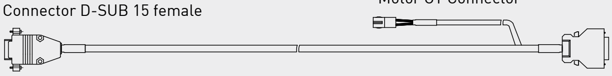
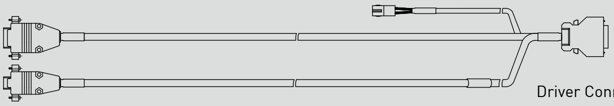
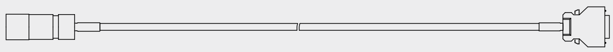
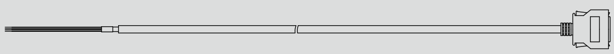
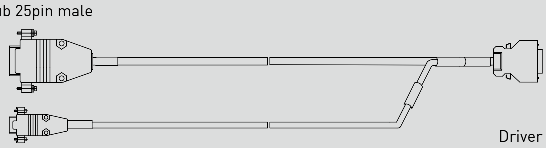
6.2.3 Driver Accessories

Part name	Model	Connector	Description
① Motor Power Cable UVW and Over Temp. Signal Cable	LMACS□□D	J2, J8	For LMS 
	LMACS□□E		For LMC 
	LMACS□□F		For TMS 
③ RS-232 Cable	LMACR21D	J5	To PC (about 2m long For 800-1513, 800-1519 and XTL.) 
④ Regen Resistor	050100700001	J3	68Ω, Rated 100W, Peak 500W
⑥ Limit Switch Cable	LMACK□□S		For Positioning Stage 
EMC Accessory	S6EMC		Line Filter (AC 1 phase), Ferrite cores for power cable, motor cable and encoder cable
Heat Sink	XSL-HL		Low profile
	XSL-HS		Standard
Digital Hall Sensor	LMAHS		For LMS series, single ended signal
	LMAHC		For LMCA, LMCB and LMCC series, single ended signal
	LMAHC2		For LMCD and LMCE series, single ended signal
Analog Hall Sensor	LMAHSA-D		For LMS series, differential signal
	LMAHCA-D		For LMCA, LMCB and LMCC series, differential signal

□□	03	04	05	06	07	08	09	10
Cable length (m)	3	4	5	6	7	8	9	10

Note: User must prepare one 24Vdc power supply for each driver.

6.2.4 For 800-1513 and 800-1519 Amplifiers

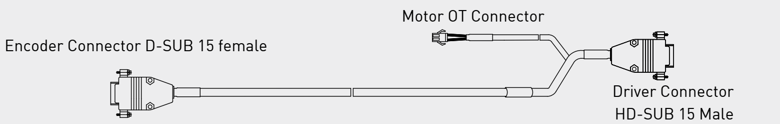
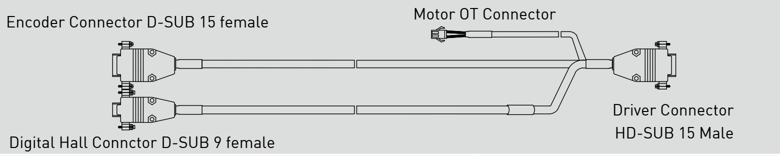
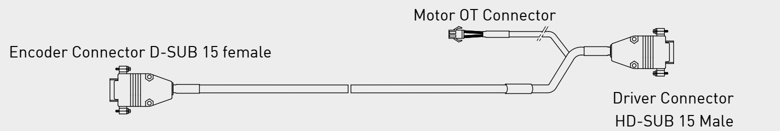
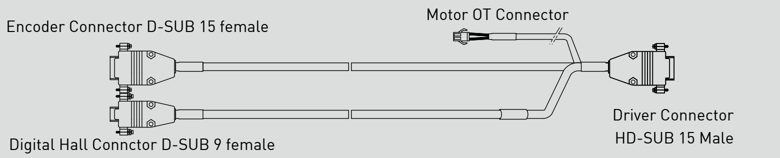
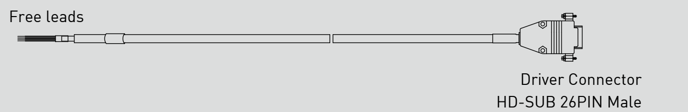
Part name	Model	Connector	Description
② Encoder Cable	LMACE□□D	J8	For Renishaw Digital Encoder, motor OT 
	LMACE□□E		For Renishaw Digital Encoder, motor OT, and digital hall sensors 
	LMACE□□F		For Renishaw Analog Encoder, motor OT 
	LMACE□□G		For Renishaw Analog Encoder, motor OT, and digital hall sensors. 
	LMACE□□H		For Jena analog encoder and motor OT. For TMS 
⑤ Controller Pulse Cable	LMACK30R	J7	To motion controller (about 3m long) 
	LMACK□□T		For ACS SPiiPlus SA 
Connectors kit	XSL-CK	J1-J8	
	800-CK	J1-J7	

□□	03	04	05	06	07	08	09	10
Cable length (m)	3	4	5	6	7	8	9	10

Positioning Systems

Control and Drivers

6.2.5 For XTL Amplifiers

<table>
<tr><th>Part name</th><th>Model</th><th>Connector</th><th>Description</th></tr>
<tr><td rowspan="5">② Encoder Cable</td><td>LMACE□□L</td><td rowspan="5">J8</td><td>For Renishaw Digital Encoder, motor OT (XTL)
</td></tr>
<tr><td>LMACE□□P</td><td>For Renishaw Digital Encoder, motor OT, and digital hall sensors (XTL)
</td></tr>
<tr><td>LMACE□□M</td><td>For Renishaw Analog Encoder, motor OT (XTL)
</td></tr>
<tr><td>LMACE□□N</td><td>For Renishaw Analog Encoder, motor OT, and digital hall sensors (XTL)
</td></tr>
<tr><td>LMACE□□R</td><td>For Jena analog encoder and motor OT. For TMS (XTL)
</td></tr>
<tr><td>⑤ Controller Pulse Cable</td><td>LMACK30U</td><td>J7</td><td>For motion controller(about 3m long) (XTL)
</td></tr>
</table>

□□	03	04	05	06	07	08	09	10
Cable length (m)	3	4	5	6	7	8	9	10

6.2.6 Pin Assignment

LMACE□□E
LMACE□□D (Without Hall Sensor)

Signal	D-Sub 15Pin Female	Color (051400300063)	SCSI 20Pin Male
5V	7	Brown	3
0V	2	White	2
A+	14	Green	4
A-	6	Yellow	5
B+	13	Blue	6
B-	5	Red	7
Z+	12	Purple	8
Z-	4	Grey	9
Inner Shield	15	Inner Shield	20
Case	-	Outer Shield	1
Signal	**2Pin Female**	**Color (051400100133)**	
T+	1	Brown	14
T-	2	Blue	15
Signal	**D-Sub 9Pin Female**	**Color (051400100075)**	
5V	1	Brown	3
Hall A	2	White	11
Hall B	3	Grey	12
Hall C	4	Yellow	13
0V	5	Green	10
Shield	Case	Shield	1

LMACE□□P
LMACE□□L (Without Hall Sensor)

Signal	D-Sub 15Pin Female	Color (051400300063)	HD-Sub 15Pin Male
5V	7	Brown	4
0V	2	White	5
A+	14	Green	14
A-	6	Yellow	13
B+	13	Blue	12
B-	5	Red	11
Z+	12	Purple	8
Z-	4	Grey	7
Inner Shield	15	Inner Shield	15
Case	-	Outer Shield	1
Signal	**2Pin Female**	**Color (051400100133)**	
T+	1	Brown	10
T-	2	Blue	15
Signal	**D-Sub 9Pin Female**	**Color (051400100075)**	
5V	1	Brown	2
Hall A	2	White	3
Hall B	3	Grey	6
Hall C	4	Yellow	9
0V	5	Green	15
Shield	Case	Shield	1

LMACE□□G
LMACE□□F (Without Hall Sensor)

Signal	D-Sub 15Pin Female	Color (051400300063)	SCSI 20Pin Male
5V	4	Brown	3
0V	12	White	2
Sin(+)	9	Red	16
Sin(-)	1	Blue	17
Cos(+)	10	Yellow	18
Cos(-)	2	Green	19
Z+	3	Purple	8
Z-	11	Grey	9
Inner Shield	15	Inner Shield	20
Case	-	Outer Shield	1
Signal	**2Pin Female**	**Color (051400100133)**	
T+	1	Brown	14
T-	2	Blue	15
Signal	**D-Sub 9Pin Female**	**Color (051400100075)**	
5V	1	Brown	3
Hall A	2	White	11
Hall B	3	Grey	12
Hall C	4	Yellow	13
0V	5	Green	10
Shield	Case	Shield	1

LMACE□□N
LMACE□□M (Without Hall Sensor)

Signal	D-Sub 15Pin Female	Color (051400300063)	HD-Sub 15Pin Male
5V	4	Brown	4
0V	12	White	5
Sin(+)	9	Red	14
Sin(-)	1	Blue	13
Cos(+)	10	Yellow	12
Cos(-)	2	Green	11
Z+	3	Purple	8
Z-	11	Grey	7
Inner Shield	15	Inner Shield	15
Case	-	Outer Shield	1
Signal	**2Pin Female**	**Color (051400100133)**	
T+	1	Brown	10
T-	2	Blue	15
Signal	**D-Sub 9Pin Female**	**Color (051400100075)**	
5V	1	Brown	2
Hall A	2	White	3
Hall B	3	Grey	6
Hall C	4	Yellow	9
0V	5	Green	15
Shield	Case	Shield	1

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Control and Drivers

LMACE□□H

Function	8-10-0090 (Female)	JENA Signal	Color (051400300069)	SCSI 20Pin (Male)	800-151x Signal
Power	4	5V	Brown	3	+5Vdc
	5	5V	Brown	-	-
	6	0V	White	2	Signal Gnd
Incremental signals	2	U_2-	Red	19	Cos(-)
	3	U_1-	Yellow	17	Sin(-)
	9	U_2+	Blue	18	Cos(+)
	10	U_1+	Green	16	Sin(+)
Reference mark	1	U_0-	Pink	9	/X
	8	U_0+	Grey	8	X
	6	0V	Inner Shield	20	Signal Gnd
	Case	Shield	Outer Shield	1	Frame Gnd
Temperature	11	T+	Purple	14	[IN5] Motemp
	12	T-	Brown/Yellow	15	Signal Gnd

LMACE□□R

Function	8-10-0090 (Female)	JENA Signal	Color (051400300069)	HD-Sub 15Pin(Male)	XTL Signal
Power	4	5V	Brown	4	+5Vdc
	5	5V	Brown	-	-
	6	0V	White	5	Signal Gnd
Incremental signals	2	U_2-	Red	11	Cos(-)
	3	U_1-	Yellow	13	Sin(-)
	9	U_2+	Blue	12	Cos(+)
	10	U_1+	Green	14	Sin(+)
Reference mark	1	U_0-	Pink	7	/X
	8	U_0+	Grey	8	X
	6	0V	Inner Shield	15	Signal Gnd
	Case	Shield	Outer Shield	1	Frame Gnd
Temperature	11	T+	Purple	10	[IN5] Motemp
	12	T-	Brown/Yellow	15	Signal Gnd

LMACK30R

Signal	Pin	Color	Pair		Color	Pin	Signal
Frame Ground	1	Brown	1a	8a	Blue	14	[Out2]
Signal Ground	2	Brown/Black	1b	8b	Blue/Black	15	[Out3]
Enable [IN1]	3	Red	2a	9a	Light Blue	16	Encoder A In/Out
GP Input [IN2]	4	Red/Black	2b	9b	Light Blue/Black	17	Encoder /A In/Out
GP Input [IN3]	5	Orange	3a	10a	Purple	18	Encoder B In/Out
GP Input [IN4]	6	Orange/Black	3b	10b	Purple/Black	19	Encoder /B In/Out
HS Input [IN6]	7	Green	6a	11a	Gray	20	Encoder X In/Out
HS Input [IN7]	8	Pink	4a	11b	Gray/Black	21	Encoder /X In/Out
HS Input [IN8]	9	Yellow	5a	12a	White/Red	22	+5 Vdc @ 400mA
HS Input [IN9]	10	Pink/Black	4b	12b	Black	23	Siganl Ground
HS Input [IN10]	11	Yellow/Black	5b	13a	White	24	Analog Ref In (+)
GP Input [IN11]	12	Green/Black	6b	13b	White/Black	25	Analog Ref In (-)
[Out1]	13	Light/Green	7a	7b	Light Green/Black	26	[IN12] GP Input
Shield	Case						

LMACK30U

Signal	Pin	Color	Pair		Color	Pin	Signal
Frame Ground	1	Brown	1a	5b	Yellow/Black	14	[In10] HS
Ref (-)	2	White/Black	13b	1b	Brown/Black	15	Signal Gnd
Ref (+)	3	White	13a	7a	Light Green	16	[Out1]
[IN1] Enable	4	Red	2a	8a	Blue	17	[Out2]
[IN2] GP	5	Red/Black	2b	8b	Blue/Black	18	[Out3]
[IN3] GP	6	Orange	3a	12b	Black	19	Signal Gnd
[IN4] GP	7	Orange/Black	3b	12a	White/Red	20	+5 Vdc
[IN11] GP	8	Green/Black	6b	11b	Gray/Black	21	Multi Encoder/X
[IN12] GP	9	Light Green/Black	7b	11a	Gray	22	Multi Encoder X
[IN6] HS	10	Green	6a	10b	Purple/Black	23	Multi Encoder/B
[IN7] HS	11	Pink	4a	10a	Purple	24	Multi Encoder B
[IN8] HS	12	Yellow	5a	9b	Light Blue/Black	25	Multi Encoder/A
[IN9] HS	13	Pink/Black	4b	9a	Light Blue	26	Multi Encoder A
Shield	Case						

Positioning Systems

Appendix A: Motor Sizing

Start Motor Sizing

The following contents describe how to choose proper motor according to speed, moving distance, and loading inertia. The basic process for sizing a motor is:

- Decide motion profile and required parameters
- Calculate peak and continuous force
- Select motor

Symbols

X : move distance (mm)
T : move time (sec)
a : acceleration (mm/s^2)
V : velocity (mm/s)
M_L : loading (kg)
g : gravitation acceleration (mm/s^2)
F_p : peak force (N)
F_c : continuous force (N)
F_a : attraction force between stator and forcer (applicable for LMS, LMF series) (N)
F_i : inertia force (N)
K_p : force constant (N/Arms)
I_p : peak current (Arms)
I_e : effective current (Arms)
I_c : continuous current (Arms)
V_0 : starting velocity (mm/s)

STEP 1 Decide motion velocity profile and required parameters

In order to determine the correct motor for a particular application it is necessary to be familiar with the motion equation.

Motion equation

Basic kinematics equations are described as follows:

$$V = V_0 + aT$$

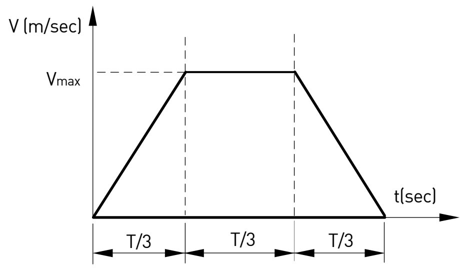
$$X = V_0T + \frac{1}{2}aT^2$$

Where V is velocity, a is acceleration, T is move time and X is move distance.
You can choose two of the four parameters (V, a, T and X) as your designed parameters, then the last two parameters can be calculated by above equations.

Motion velocity profile

1. 1/3-1/3-1/3 trapezoid profile

If the distance (X) and move time (T) have been given, the most common and efficient velocity profile for point-to-point motion is the "1/3-1/3-1/3" trapezoid curve because it provides the optimal move by minimizing the power required to complete the move. It breaks the time of the acceleration, traveling, and deceleration into three segments as shown below.



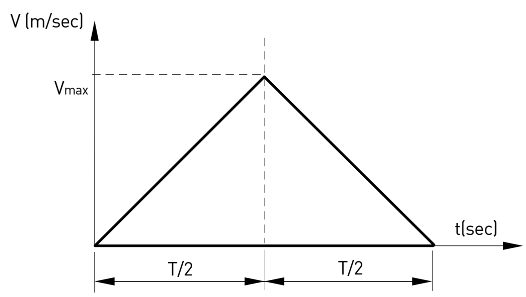
$$V_{max} = 1.5 \times \frac{X}{T} \quad (\text{Because } X = \frac{V}{2} \times \frac{T}{3} + V \times \frac{T}{3} + \frac{V}{2} \times \frac{T}{3})$$

$$a_{max} = \frac{V_{max}}{T/3} = \frac{4.5X}{T^2}$$

Herein the parameters are described as motion equation.

2. 1/2-1/2 triangle profile

If X and T are given, another common motion profile is the 1/2-1/2 triangle profile. The motion is divided into two parts, namely acceleration and deceleration. The second motion velocity profile is shown as follows.

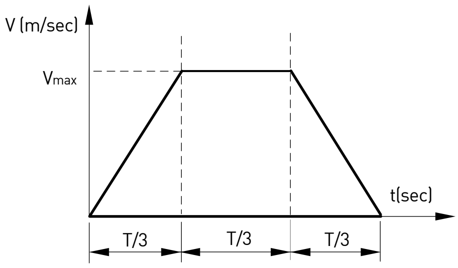
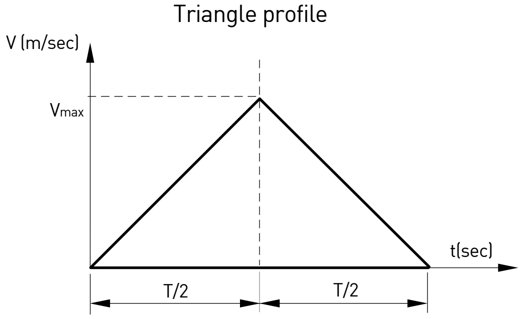


$$V_{max} = 2 \times \frac{X}{T}$$

$$a_{max} = \frac{4X}{T^2}$$

The acceleration required in the first motion velocity profile is bigger than that in the second motion velocity profile; therefore, the required motor size is bigger. When choosing second motion velocity profile, the chosen motor size is smaller, however, we need to verify the DC bus of driver is bigger enough, due to the higher velocity (V_{max}).

3. Some useful equations

	1/3 -1/3-1/3 Trapezoid profile	Triangle profile
		
V	$1.5 \times \frac{X}{T}$	$2 \times \frac{X}{T}$, or $\sqrt{a \times X}$
a	$\frac{4.5X}{T^2}$	$\frac{4X}{T^2}$
t	$\frac{X}{V_{max}} + \frac{V_{max}}{a}$ (if $\frac{X}{V_{max}} \geq \frac{V_{max}}{a}$)	

STEP 2 Determine peak force and effective force

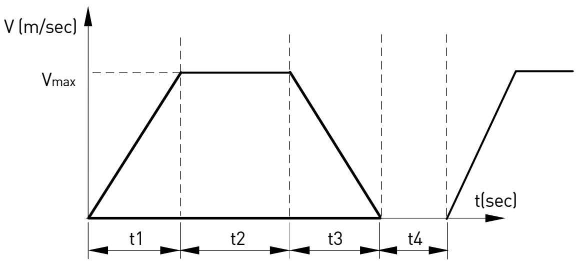
The peak force can be calculated by the follow equation

$$F_p = M_L \times a_{max} + (M_L \times g + F_a) \times \mu = F_i + F_f$$

Where F_i is inertia force while F_f is friction force, and μ is friction factor.

In most cases, motions are cyclic point-to-point movements. Assuming a cyclic motion shown in the following profile with a pause time of t_4 second, the effective force can be calculated as following formula:

$$F_e = \sqrt{\frac{(F_i + F_f)^2 t_1 + F_f^2 t_2 + (F_i - F_f)^2 t_3}{t_1 + t_2 + t_3 + t_4}}$$



The peak current I_p and effective current I_e can be calculated by using motor force constant K_f.

$$I_p = \frac{F_p}{K_f}$$

$$I_e = \frac{F_e}{K_f}$$

STEP 3 Select motor by peak force and verify the current supply of motor

From the catalog of HIWIN, you can check the specifications of motor and choose an applicable motor by peak force, and then you can verify the current supply if it is fitted the specification as follows.

$$I_p = \frac{F_p}{K_f} < I_p \text{ (from specification of chosen motor)}$$

$$I_e = \frac{F_e}{K_f} < I_c \text{ (from specification of chosen motor)}$$

Regarding effective and continuous current, the ratio of I_e/I_c had better be less than 0.7 to attain some margin.

Positioning Systems

Linear Motor Sizing Example

For example, if load is 5 kg (moving mass of mechanism is 1 kg and payload is 4 kg), friction factor μ is 0.01 ,distance is 500 mm, move time is 400 ms and dwell time is 350 ms.
At first, we can calculate the V_{max}, a_{max}, F_p and F_e by the formulas described above (choose the first motion velocity profile and LMC series)

$$V_{max} = 1.5\times\frac{X}{T} = 1.5\times\frac{0.5}{0.4} = 1.875\ (m/sec)$$

$$a_{max} = \frac{4.5\times X}{T^2} = \frac{4.5\times 0.5}{(0.4)^2} = 14.06\ (m/sec^2)$$

$$F_p = M_L \times a_{max} + (M_L \times g + F_a)\times \mu$$

$$= 5\times 14.06 + 5\times 9.81\times 0.01 = 70.3 + 0.49 = 70.79\,(N)$$

$$F_e = \sqrt{\frac{\left[(70.3+0.49)^2 + 0.49^2 + (70.3-0.49)^2\right]\times 0.1333}{0.4+0.35}}$$

$$= 41.92\,(N)$$

In this case, we can choose motor of type LMCA6 (p.48) which can provide up to 187(N)of peak force and continuous force 62(N), and the force constant is 33.8 N/A(rms). Then the current supply of motor can be determined as follows

$$I_p = \frac{F_p}{K_f} = \frac{70.79}{33.8} = 2.09\,(Arms) < 5.4(Arms)$$

$$I_p = \frac{F_e}{K_f} = \frac{41.92}{33.8} = 1.24\,(Arms) < 1.8(Arms)$$

$$I_e / I_c = \frac{1.24}{1.8}\times 100\% = 68.89\% < 70\%$$

Appendix B: Sizing a Regen Resistor

1. Gather required information

To calculate the power and resistance of the regen resistor requires information about the amplifier and the motor. For all applications, gather the following information:

- Detail of motion profile, including acceleration and velocity
- Amplifier model number
- Applied line voltage to amplifier
- Toque/force constant of the motor
- Resistance (line-to-line) of the motor windings

For rotary motor applications, gather additional information

- Load inertia seen by the motor
- Inertia of the motor

For linear motor applications, gather additional information

- Moving mass

2. Observe the properties of each deceleration during a complete cycle of operation

For each deceleration during the motion cycle, determine:

- Speed at the start of the deceleration
- Speed at the end of the deceleration
- Time over which the deceleration takes place

3. Calculate energy returned for each deceleration

The energy returned during each deceleration can be calculated by the following formulas.

Rotary motor:

$$E_{dec} = \frac{1}{2} J_t (\omega_1^2 - \omega_2^2)$$

E_{dec} (joules): Energy returned by the deceleration
J_t (kg m^2): Load inertia on the motor shaft plus the motor inertia
ω_1 (radians /sec): Shaft speed at the start of deceleration
ω_2 (radians /sec): Shaft speed at the end of deceleration
I_e : effective current (Arms)

Linear motor:

$$E_{dec} = \frac{1}{2} M_t (V_1^2 - V_2^2)$$

E_{dec} (joules): Energy returned by the deceleration
M_t (kg): Moving mass
V_1 (meters /sec): Velocity at the start of deceleration
V_2 (meters /sec): Velocity at the end of deceleration

4. Determine the amount of energy dissipated by the motor

Calculate the amount of energy dissipated by the motor due to current flow through the motor winding resistance using the following formula.

$$P_{motor} = \frac{3}{4} R_{winding} (\frac{F}{K_t})^2$$

P_{power} (watts): Power dissipated in the motor
$R_{winding}$ (ohm): Line to Line resistance of the motor coil
F : Force need to decelerate the motor
Nm for rotary applications
N for linear applications
K_t: Torque constant for the motor
Nm/Amp for rotary applications
N/Amp for linear applications
$E_{motor} = P_{motor} T_{decel}$
E_{motor} (joules): Energy dissipated in the motor
T_{decel} (seconds): Time of deceleration

5. Determine the amount of energy returned to the amplifier

Calculate the amount of energy that will be returned to the amplifier for each deceleration using the following formula

$E_{returned} = E_{dec} - E_{motor}$
$E_{returned}$ (joules): Energy returned to the amplifier
E_{dec} (joules): Energy returned by the deceleration
E_{motor} (joules): Energy dissipated by the motor

6. Determine if energy returned exceeds amplifier capacity

Compare the amount of energy returned to the amplifier in each deceleration with the amplifier's absorption capacity. The following formula is used to determine the energy that can be absorbed by the amplifier.

$$W_{capacity} = \frac{1}{2} C (V_{regen}^2 - (1.414 V_{mains})^2)$$

$W_{capacity}$ (joules): The energy that can be absorbed by the bus capacitor
C (farads): Bus capacitance
V_{regen}(volts): Voltage at which the regen circuit turns on
V_{mains}(volts): Mains voltage (AC) applied to the amplifier

7. Calculated energy to be dissipated for each deceleration

For each deceleration where the energy exceeds the amplifier's capacity, using the following formula to calculate the energy that must be dissipated by the regen resistor.

$E_{regen} = E_{returned} - E_{amp}$
E_{regen} (joules): Energy that must be dissipated in the regen resistor
$E_{returned}$ (joules): Energy delivered back to the amplifier from the motor
E_{amp} (joules): Energy that the amplifier will absorb

8. Calculate pulse power of each deceleration that exceeds amplifier capacity

For each deceleration where energy must be dissipated by the regen resistor, use the following formula to calculate the pulse power that will be dissipated by the regen resistor

$P_{pulse} = E_{regen} / T_{decel}$
P_{pulse} (watts): Pulse power
E_{regen} (joules): Energy that must be dissipated in the regen resistor
T_{decel} (seconds): Time of deceleration

9. Calculate resistance needed to dissipate the pulse power

Using the maximum pulse power from the previous calculation, calculate the resistance value of the regen resistor required to dissipate the maximum pulse power.

$R = V^2_{regen} / P_{pulse\ max}$
R(ohms):Resistance
$P_{pulse\ max}$:The maximum pulse power
V_{regen} :The voltage at which the regen circuit turns on

Positioning Systems

Choose a standard value of resistance less than the calculated value. The value must also be greater than the minimum regen resistor value specified by the amplifier supplier.

10. Regen resistor sizing example

Gather required information

LM ROBOTS type:LMXL1L-S37L-1200-G200

Amplifier: 800-1513A

DC bus capacitance: 1760μF

Regen circuit turn on voltage: 390V

Minimum resistance:15Ω

Moving mass: 86Kg (include payload 74 Kg)

V_{max}: 2 m/s

Acceleration, deceleration: 5 m/s^2

Power supply (AC) of driver: 220VAC

Motor type:LMS37L

Force constant (Kf): 68N/A(rms)

$R_{winding}$: 2 ohms(line-to-line)

Calculate regen resistor as following step:

$$F = ma = 86 \times 5 = 430\,(N)$$

$$E_{dec} = \frac{1}{2} m_t V^2 = \frac{1}{2} \times 86 \times 2^2 = 172(\text{joule})$$

$$P_{motor} = \frac{3}{4} \times R_{winding} \times \left(\frac{F}{K_f} \times \sqrt{2}\right)^2 = \frac{3}{4} \times 2 \times \left(\frac{430}{68} \times \sqrt{2}\right)^2$$
$$= 120\,(\text{Watt})$$

$$E_{motor} = P_{motor} \times T_{decel} = 120 \times \left(\frac{2}{5}\right) = 48\,(\text{joule})$$

$$E_{returned} = E_{dec} - E_{motor} = 172 - 48 = 124\,(\text{joule})$$

$$W_{capacity} = \frac{1}{2} \times C \times (V_{regen}^2 - (1.414 V_{mains})^2)$$
$$= \frac{1}{2} \times 1760 \times 10^{-6} \times (390^2 - (1.414 \times 220)^2)$$
$$= 48.7\,(\text{joule})$$

$$\because E_{returned} > W_{capacity}$$

$$E_{regen} = E_{returned} - E_{amp} = 124 - 48.7 = 75.3\,(\text{joule})$$

$$P_{pulse} = E_{regen} / T_{decel} = 75.3/0.4 = 188.25\,(\text{Watt})$$

$$R = \frac{V_{regen}^2}{P_{pulse}} = \frac{390^2}{188.25} = 807.97\,(\text{ohms})$$

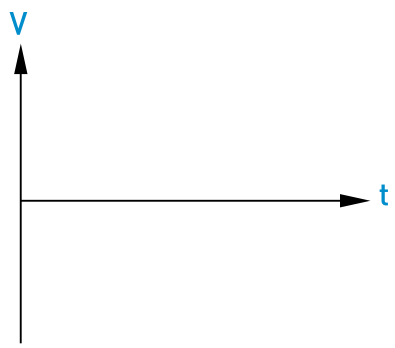
Because the total value of selected resistance must be less than 807.97 ohms and the power capacity must be more than 188.25 watts, we choose two resistors and connect them in series, in each resistor the resistance is 68 ohms and power capacity is 100W. The total resistance value is 136 ohms and power capacity is 200W. The resistance order number is 050100700001.

Appendix C: Linear Motor Inquiry Form

Date:

Company name: Email: Tel: Fax:	Contact person: Title:

Load(kg)/Moment of inertia(kg-m^2)		Notes:
Acceleration (m/s^2)/(rad/s^2)		
Max. speed (mm/s) (rad/s)		
Stroke (mm)		
Accuracy (mm)/(deg)		
Repeatability (mm)/(deg)		
Timing chart (bottom, right corner)	☐ Yes ☐ No	
Vertical movement	☐ Yes ☐ No	
Multiple forcer	☐ Yes ☐ No Number : ______	
Driver voltage		
Pulse format	☐ CW/CCW ☐ STEP/DIR	
Voltage command	☐ Yes ☐ No	
Need PC-based motion controller	☐ Yes ☐ No	
Application	☐ Point to point ☐ Scan	
Operational Environment		
Special measurement requirement		
Need regen resistor	☐ Yes ☐ No	
Budget		
Quantity		



The information below is to be filled out by our authorized agents.
Recommended specification:

Manager: Engineer: Salesperson:

FME001-07

MEMO

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Motion Control and System Technology

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ISO 9001 FM57748 ISO 14001 EMS61827 TAIWAN EXCELLENCE

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