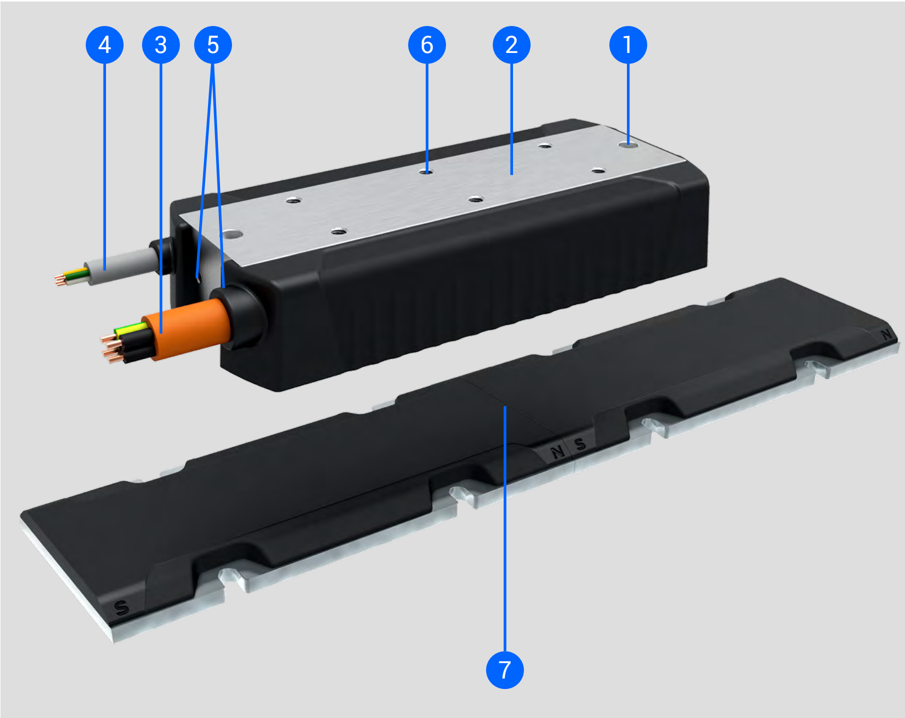
STRUCTURAL DESIGN



1 – Hole for the centering ring
2 – Forcer body
3 – Power cable
4 – Signal cable
5 – Hall sensor mounting holes
6 – Mounting holes
7 – Magnet plate

For more information regarding the Hall sensor, please refer to page 27–28.

TERMS EXPLANATION

Supply voltage V_{DC}:
A maximum allowed supply voltage, that can be applied to the motor windings.

Continuous force F_C:
Force produced by the continuous current (I_C) at an ambient temperature of 20 °C and continuous movement of the motor. The windings temperature depends on the attached plate (heatsink) heat dissipation and airflow around the motor.

Peak force F_P:
Force produced by the peak current (I_P) for a duration of 1 second. The force is used for acceleration or deceleration.

Ultimate force F_U:
Force produced by the ultimate current (I_U) for a duration of 0,5 seconds. The force is used for acceleration or deceleration.

Attraction force of magnets F_A:
Attraction force between the forcer and the magnet plate at the defined air gap.

Cogging (detent) force F_G:
Force generated due to the interaction between the permanent magnets of the magnet plate and the mover slots. The cogging force is permanently present and is position-dependent.

Force constant K_F:
Defines how much force is produced per unit of current. It is the ratio of the force to the motor phase current.

Motor constant K_M:
The ratio of the motor force and square root of the power loss at 20 °C. The constant determines the motor's efficiency.

Back EMF phase-phase constant K_{BEMF}:
Defines the phase-to-phase voltage generated when the motor is moving at 1 m/s at the magnet temperature of 20 °C.

Continuous current I_C:
It corresponds to the continuous force (F_C) and can be continuously applied to the motor at the ambient temperature of 20 °C and continuous movement of the motor. The windings temperature depends on the attached plate (heatsink) heat dissipation and airflow around the motor.

Peak current I_P:
Corresponds to the peak force (F_P) and can be applied to the motor for 1 second.

Ultimate current I_U:
Corresponds to the ultimate force (F_U) and can be applied to the motor for 0,5 seconds.

Resistance phase-phase R_{20}:
Motor windings resistance measured phase to phase (line to line) at 20 °C.

Resistance phase-phase R_{125}:
Motor windings resistance measured phase to phase (line to line) at 125 °C.

Induction phase-phase L_P:
Motor windings inductance measured phase-to-phase (line-to-line).

Electrical time constant t_C:
The electrical time constant is the amount of time it takes for the current in the motor windings to reach 63 % of its rated value. The time constant is found by dividing inductance by resistance.

Max. winding temperature T_{max}:
Defined as a maximum permissible temperature of the motor windings. During the normal operation, it is recommended that windings temperature does not exceed 80 % of T_{max}.

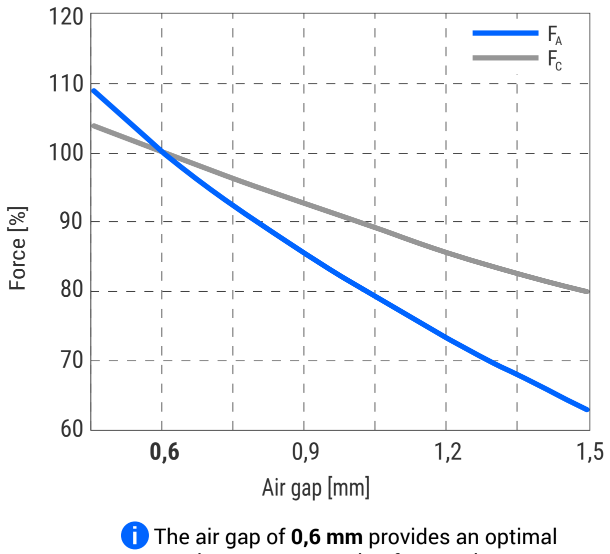
Thermal resistance R_{th}:
Defines the heat transfer resistance from the motor windings to the environment at the defined plate (heatsink) and air dissipation.

Thermal resistance to heatsink $R_{th\text{-}HS}$:
Defines the heat transfer resistance from the motor windings to the heatsink attached surface.

Magnet pitch τ:
Magnet pitch or pole pair length is the distance between two same polar magnets on the magnet plate.

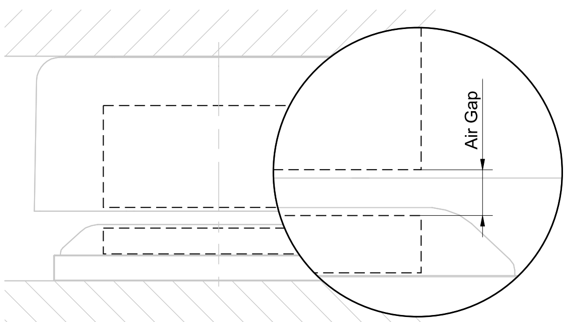
Thermal time constant τ_{th}:
Defined as a time required for the winding to reach 63 % of the max. temperature at continuous current. This value is only applicable when the mounting surface is at the constant temperature.

Continuous and attraction force as a function of an air gap



The air gap of **0,6 mm** provides an optimal continuous-to-attraction force ratio. Increasing the air gap will result in a lower attraction force, lower cogging and lower useful force.

Described parameters were measured with an air gap of **0,6 mm**.



An actual air gap between the magnet plate and coil unit is difficult to measure because of the casted finish. For an accurate measurement, the air gap can be calculated from the total mounting height.

HOW TO ORDER

Forcer order code:

LMCA - 60 - M - L

Series:
LMCA

Size:
– 30
– 60
– 90

Version:
– S
– M
– L
– XL

XL version is only available for sizes 60 and 90.

Type:
– L: Low speed
– H: High speed

Magnet plate order code:

MPA - 60 - 180 - H

Series:
MPA

Size:
– 30
– 60
– 90

Length:
– 120
– 180
– 300

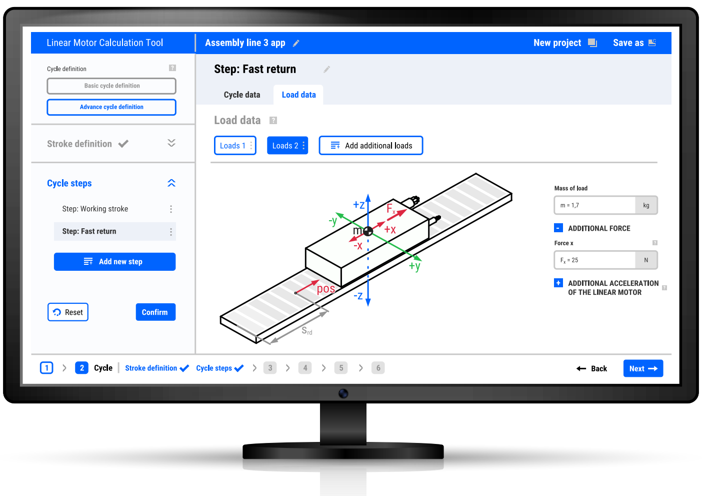
Type:
– C: Classic
– H: High performance

UNIMOTION

CALCULATE AND CONFIGURE YOUR OWN SOLUTION

The LINEAR MOTOR CALCULATION TOOL is an online application that enables quick and easy selection of a suitable product, with the possibility of achieving the optimal ratio between the given capacity and the price and the creation of the 3D models.

For more information please contact us or visit our website.



LMCA 60

General technical data

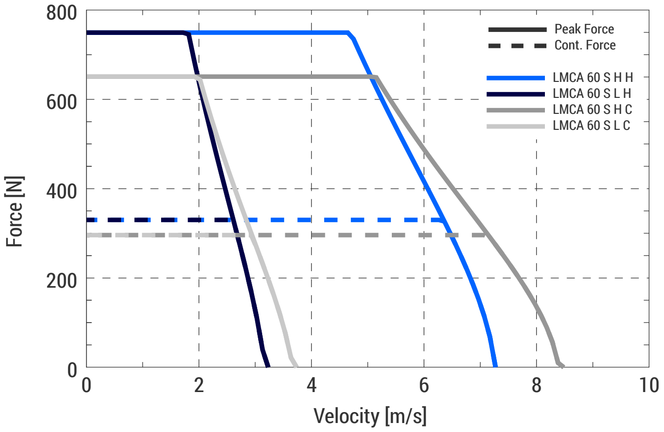
				LMCA 60															
				Version S				Version M				Version L				Version XL			
				Classic		High performance		Classic		High performance		Classic		High performance		Classic		High performance	
	PARAMETER	SYM	UNIT	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed	Low speed	High speed
PERFORMANCE	Max. supply voltage	V_{DC}	V (DC)	600															
	Continuous force[1]	F_C	N	282		315		558		622		834		930		1110		1237	
	Peak force (1s)[1]	F_P	N	621		715		1228		1414		1834		2112		2441		2810	
	Ultimate force (0,5s)[1]	F_U	N	783		920		1547		1818		2310		2715		3074		3613	
	Attraction force of magnets[2]	F_A	N	1356		1916		2490		3518		3624		5120		4758		6722	
	Force constant	K_F	$\frac{N}{A_{RMS}}$	94,0	41,0	105,0	45,9	93,0	40,6	103,7	45,3	92,7	40,5	103,3	45,1	92,5	40,4	103,1	45,0
	Motor constant	K_M	$\frac{N}{\sqrt{W}}$	27,0	26,9	30,1	30,1	37,7	37,8	42,0	42,1	46,0	45,8	51,3	51,1	53,0	52,8	59,1	58,8
	Back EMF phase-phase Constant	K_{BEMF}	$\frac{V}{(m/s)}$	54,4	23,7	62,8	27,4	53,7	23,5	62,0	27,1	53,5	23,4	61,8	27,0	53,4	23,3	61,7	26,9
ELECTRICAL	Continuous current	I_C	A_{RMS}	3,0	6,9	3,0	6,9	6,0	13,7	6,0	13,7	9,0	20,6	9,0	20,6	12,0	27,5	12,0	27,5
	Peak current	I_P	A_{RMS}	9,0	20,6	9,0	20,6	18,0	41,2	18,0	41,2	27,0	61,8	27,0	61,8	36,0	82,4	36,0	82,4
	Ultimate current	I_U	A_{RMS}	15,0	34,3	15,0	34,3	30,0	68,7	30,0	68,7	45,0	103,0	45,0	103,0	60,0	137,4	60,0	137,4
	Resistance at 20 °C phase-phase	R_{20}	Ω	8,11	1,55	8,11	1,55	4,06	0,77	4,06	0,77	2,7	0,52	2,7	0,52	2,03	0,39	2,03	0,39
	Resistance at 125 °C phase-phase	R_{125}	Ω	11,46	2,19	11,46	2,19	5,74	1,09	5,74	1,09	3,81	0,73	3,81	0,73	2,87	0,55	2,87	0,55
	Induction phase-phase	L_P	mH	49,5	9,4	49,5	9,4	24,8	4,7	24,8	4,7	16,5	3,1	16,5	3,1	12,4	2,4	12,4	2,4
	Electrical time constant[3]	t_C	mS	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,1	6,0	6,1	6,0	6,1	6,2	6,1	6,2
THERMAL	Max. winding temperature	T_{max}	°C	125															
	Max. allowed magnet plate temperature	T_{magnet}	°C	90															
	Thermal time constant	τ_{th}	s	88															
	Thermal resistance	R_{th}	$\frac{K}{W}$	0,68				0,34				0,23				0,17			
	Thermal resistance to heatsink	R_{th_HS}	$\frac{K}{W}$	0,180				0,090				0,060				0,045			
MECHANICAL	Forcer overall length	M_L	mm	128				233				338				443			
	Forcer overall width	M_W	mm	90															
	Forcer overall height	M_H	mm	23,5															
	Forcer mass	m_m	kg	1,4				2,6				3,8				4,9			
	Magnet plate weight	m_S	$\frac{kg}{m}$	4,4		4,8		4,4		4,8		4,4		4,8		4,4		4,8	
	Forcer wires cross-section	S_C	mm²	1,5								2,5							
	Sensor wires cross-section	S_{SC}	mm²	0,25															
	Forcer cable length	L_M	mm	1000															
	Sensor cable length	L_S	mm	1000															
	Magnet pitch	τ	mm	30															

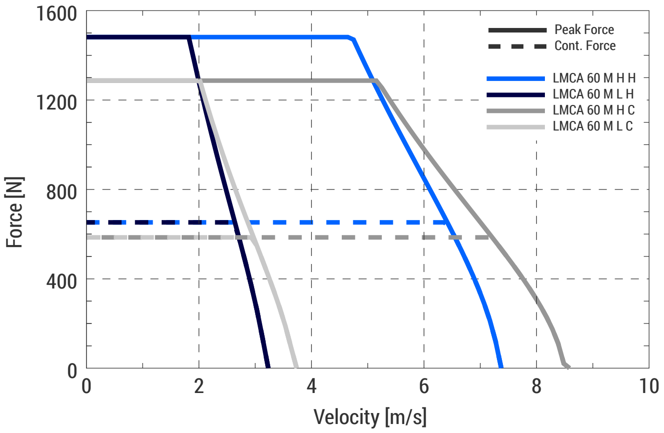
[1] Magnets at 20 °C
[2] RMS at 0 A and air gap of 0,6 mm
[3] Windings at 20 °C

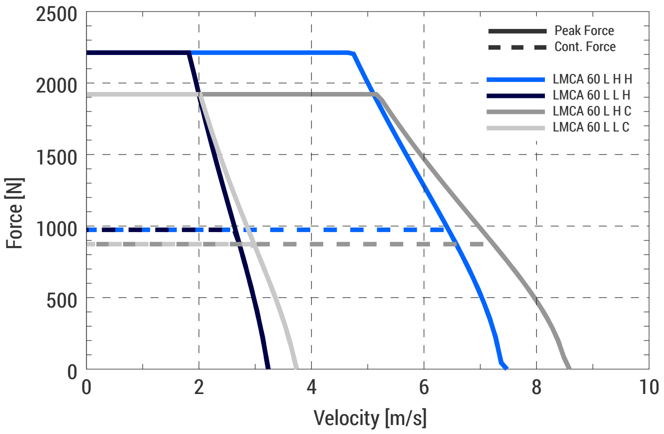
The specifications were measured without forced cooling. Electrical specifications tolerance is ± 10 %.

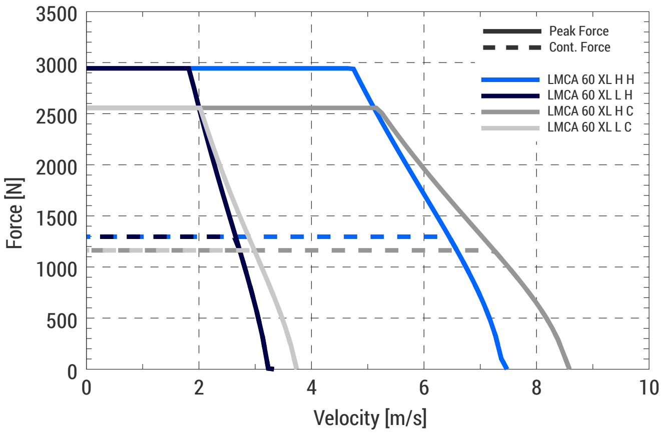
Force as a function of velocity diagrams

Bus voltage = 325 V DC

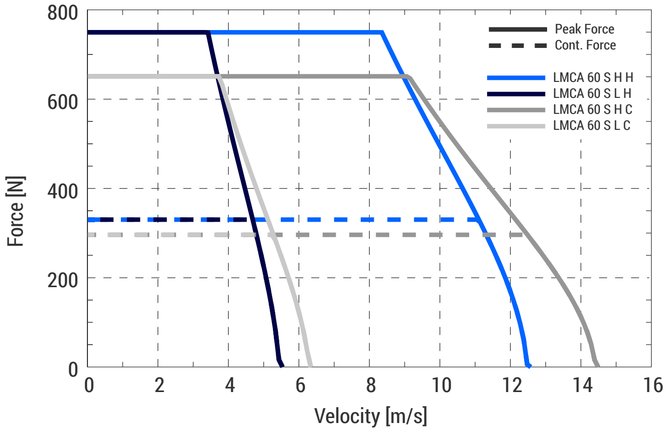


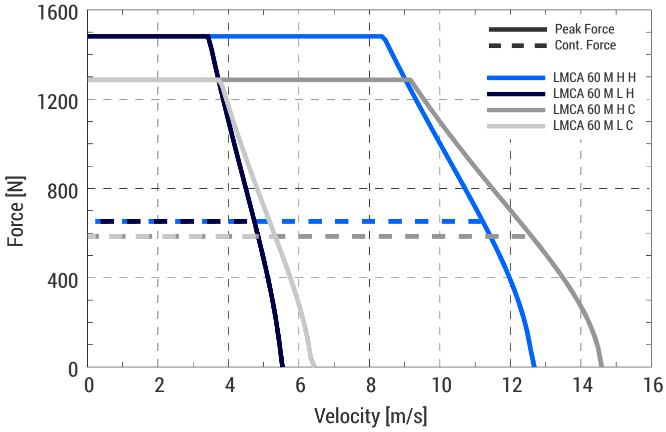


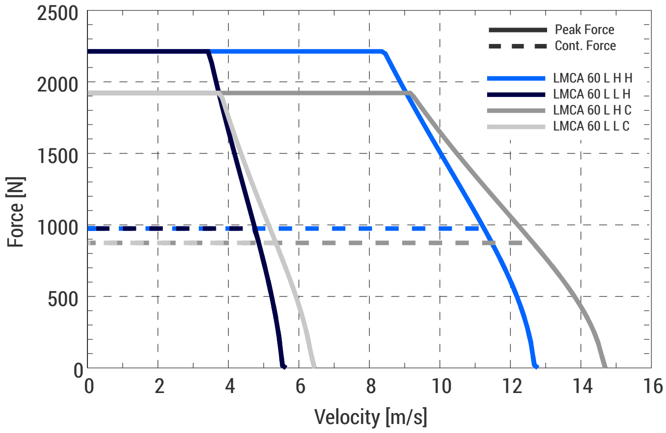


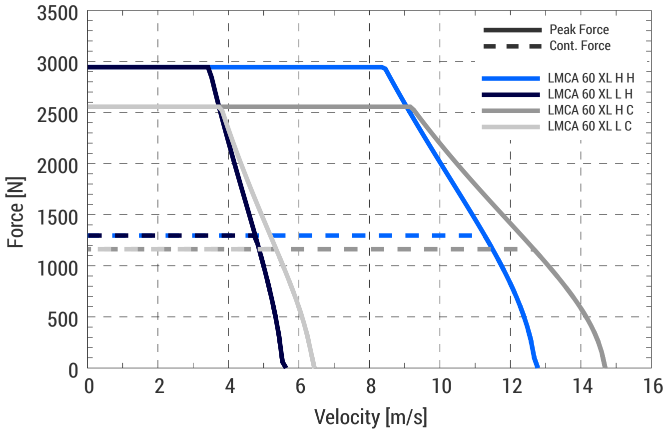


Bus voltage = 565 V DC

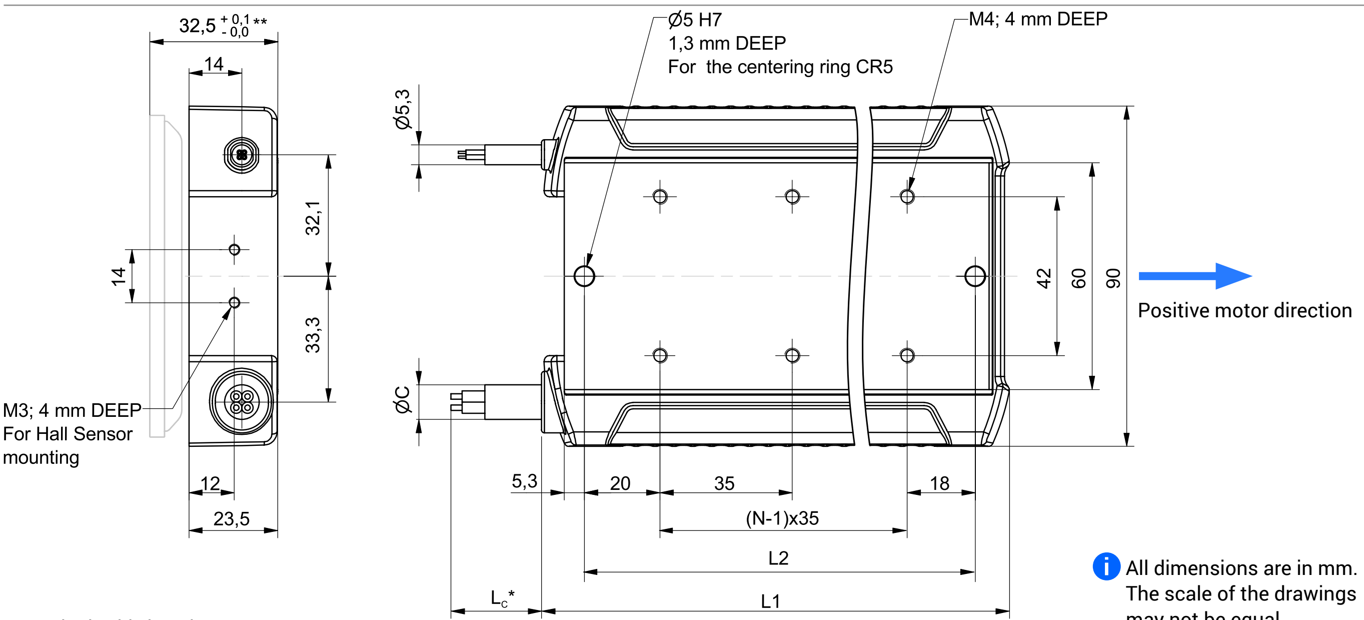








Forcer dimensions



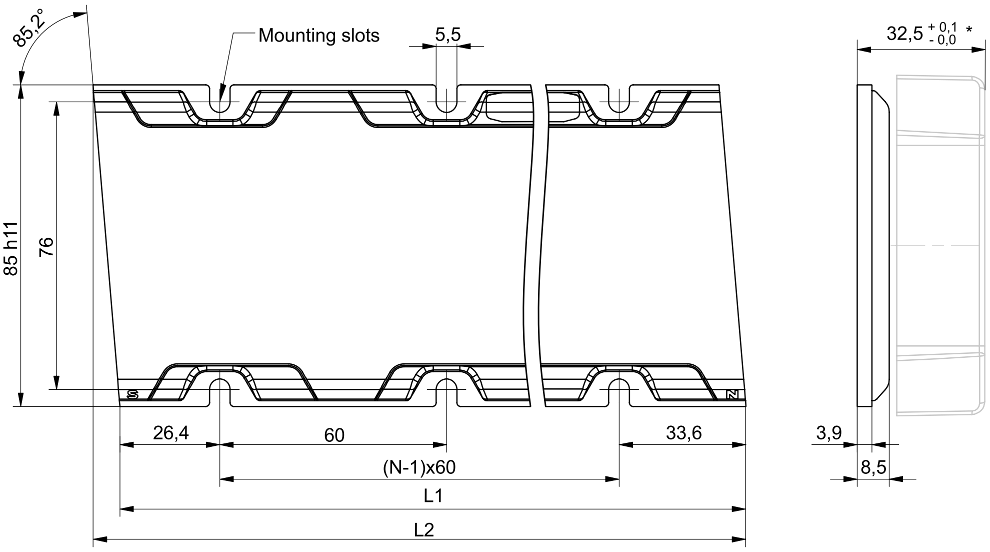
* Standard cable length
** The stated mounting height is set for the air gap of 0,6 mm. For more information, please refer to page 9.

All dimensions are in mm. The scale of the drawings may not be equal.

LMCA 60	L1 [mm]	L2 ± 0,02 [mm]	N	ØC	L_C [mm]
LMCA 60 S H/L	128	108	3	9,1	1000
LMCA 60 M H/L	233	213	6	9,1	1000
LMCA 60 L H/L	338	318	9	10,6	1000
LMCA 60 XL H/L	443	423	12	10,6	1000

'N' is the number of mounting holes in the x-direction.

Magnet plate dimensions



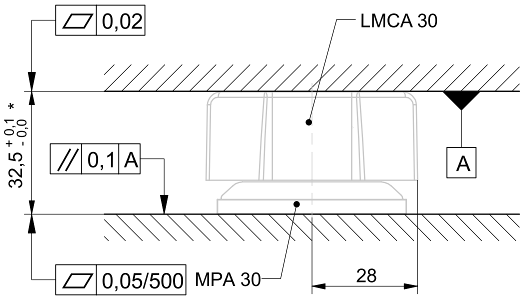
* The stated mounting height is set for the air gap of 0,6 mm.
For more information, please refer to page 9.

MPA 60	L1 [mm]	L2 [mm]	N
MPA 60 120 C/H	120	127,1	2
MPA 60 180 C/H	180	187,1	3
MPA 60 300 C/H	300	307,1	5

'N' is the number of mounting slots in x-direction.

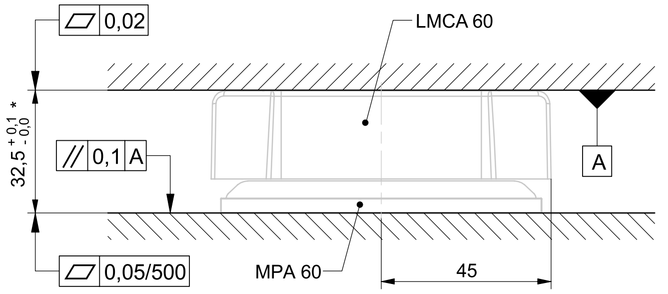
MOUNTING TOLERANCES

LMCA 30



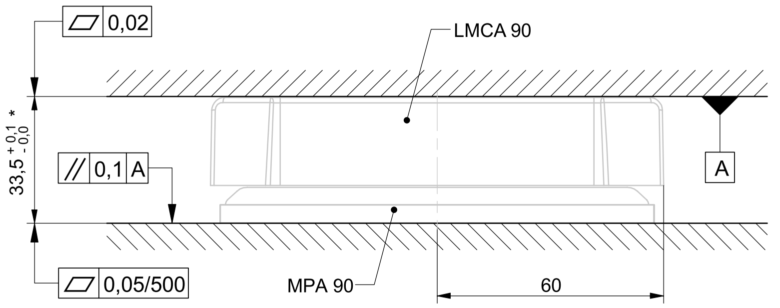
* The stated mounting height is set for the air gap of 0,6 mm.
For more information, please refer to page 9.
** We recommend using a thermally conductive paste between the forcer and heatsink to ensure a better heat transfer.

LMCA 60



* The stated mounting height is set for the air gap of 0,6 mm.
For more information, please refer to page 9.
** We recommend using a thermally conductive paste between the forcer and heatsink to ensure a better heat transfer.

LMCA 90



* The stated mounting height is set for the air gap of 0,6 mm.
For more information, please refer to page 9.
** We recommend using a thermally conductive paste between the forcer and heatsink to ensure a better heat transfer.

ELECTRICAL DATA

Temperature sensors description (KTY83 / PTC)

LMCA linear motors are equipped with two types of temperature sensors which are generally used for overheating protection. The first type is KTY83-122 which is thermally coupled with the U winding. The second one is the PTC, which consists of three PTCs connected in series. The PTC sensors are thermally coupled with U, V, and W windings, whereas the characteristic is harmonized by DIN 44082 standard.

The KTY83 sensor is commonly used for monitoring motor temperature, while the PTC sensor is used for cut-off protection when the motor temperature exceds the maximum allowed temperature.

For continuous operation, it is recommended that the motor temperature does not exceed 80 % (100 °C) of the maximum allowed motor temperature (125 °C).

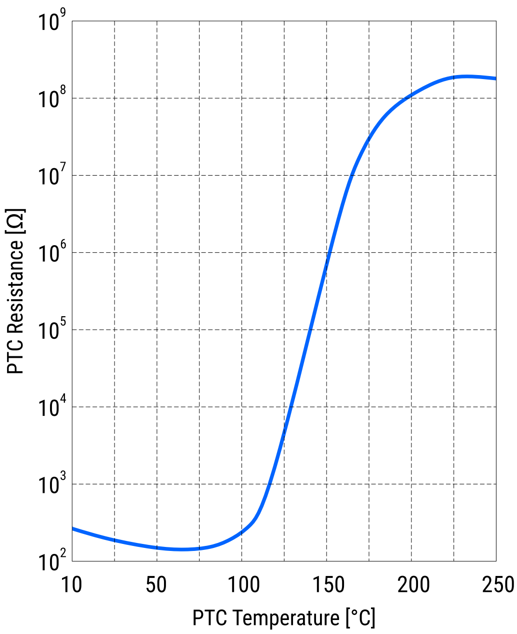
PTC Thermistor

As mentioned in the above description, windings are equipped with three PTC thermistors connected in series. This sensor's characteristic curve has an exponential rise when the temperature of the windings is approaching the maximum temperature of 125 °C. Therefore it can be used as an indicator of signaling critical temperature, which eliminates the need for sensing electronics. With this particular sensor, it is not possible to receive the exact temperature.

In the table below, resistances at specific temperatures are presented.

Resistance of PTCs at ambient temperature (25 °C)	< 300 Ω
Normal operating PTCs resistance (25 °C–120 °C)	< 3000 Ω
Cut-off resistance of PTCs	> 3990 Ω

The resistance is the sum of all three PTCs.



KTY83-122 Thermistor

As mentioned above, the forcer is equipped with one KTY83-122 thermistor. This sensor's characteristic curve is nearly linear through the whole operating range. The thermal time constant of this sensor is approximately 6 seconds.

With the below equation, you can calculate the temperature of the windings from the current resistance of this KTY83-122 sensor.

The temperature of the windings can be calculated from the current resistance of the KTY83 sensor with the use of the below equation.

$$T = 25 + \frac{\sqrt{\alpha^2 - 4 * \beta + 4 * \beta * \frac{R_T}{R_{25}}} - \alpha}{2 * \beta}$$

Values of specific elements are:

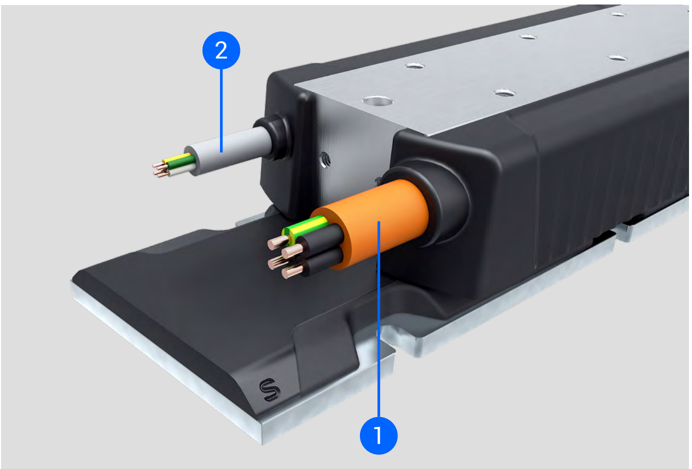
Parameter	Value	Unit
R_T	*Current sensor reading*	Ω
α	7,88E-03	K^{-1}
β	1,94E-05	K^{-2}
R_{25}	1010	Ω

In the table below, resistance values of KTY83 at specific temperatures are presented.

T [°C]	25	30	40	50	60	70	80	90	100	110	120	125	130
R [Ω]	1010	1049	1130	1214	1301	1392	1487	1585	1687	1792	1900	1956	2012

Resistance of KTY at ambient temperature (25 °C)	1010 Ω
Normal operating KTYs resistance (25 °C–120 °C)	< 1900 Ω
Cut-off resistance of KTY	> 1956 Ω

Pin layout



1 – Power cable
- Black: Phase cables (L1, L2, L3)
- Yellow: Neutral (N) + Ground (Protective Earth, PE)

2 – Temperature sensor cable
- Yellow & Green: PTC Thermistors
- White & Brown: KTY Thermistor