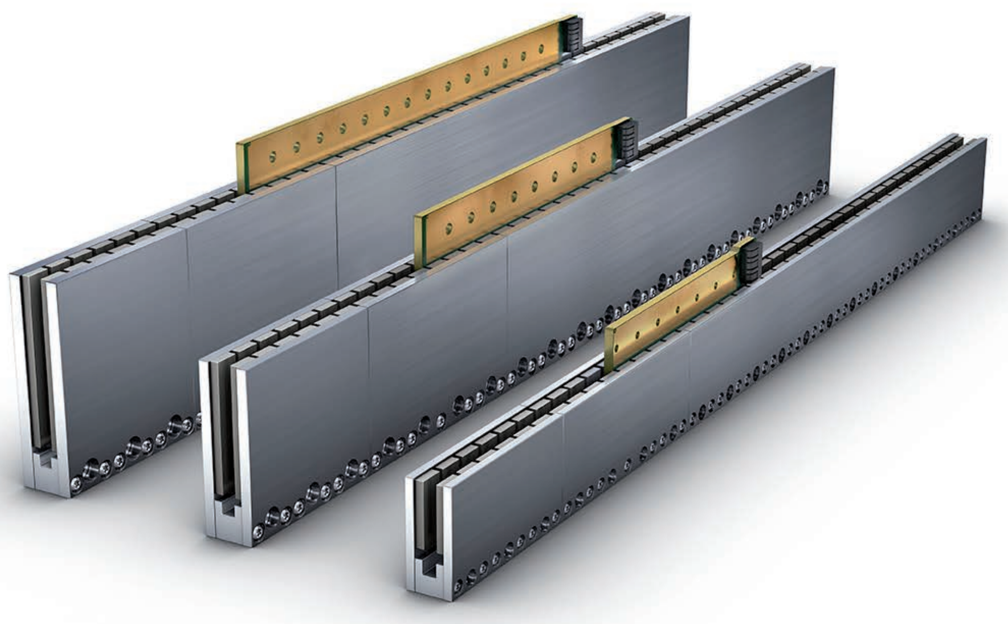
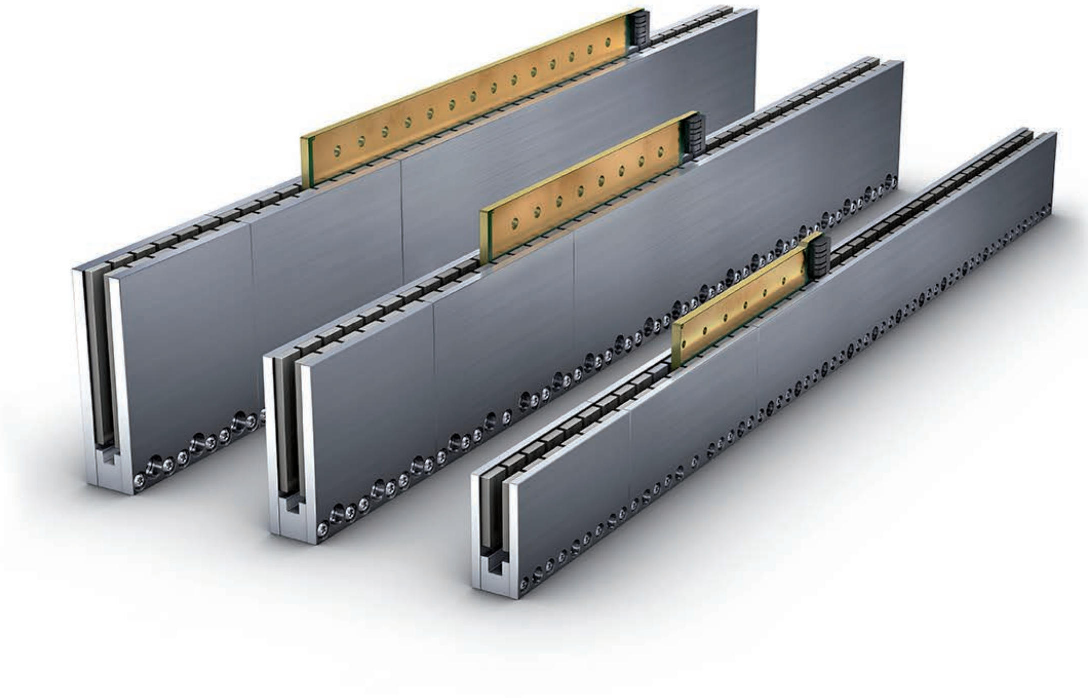
SCHAEFFLER



Ironless Linear Motors
UPLplus Series

Contents

UPLplus – the accelerator



The UPLplus linear motors are dynamic, lightweight and environmentally responsible.

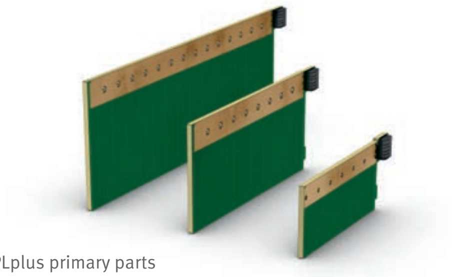
The ironless linear motors feature a force to mass ratio that is up to 42% better than similar competing products. With this product, Schaeffler Industrial Drives is following the trend for lightweight design, which is particularly relevant in medical technology and automation. Therefore the movement axes can be dimensioned smaller and lighter, resulting in higher acceleration speeds and increased output for the equipment.

Innovative manufacturing technology

The dead weight of the motor plays a key role, particularly in lightweight axis constructions that require maximum dynamic properties.

Thanks to innovative manufacturing technology, combined with the use of different materials, low masses can be achieved for the primary part along with excellent heat dissipation properties. By way of comparison, we generate up to 43% more nominal force using these measures than by using conventional technology with wound coils. This advantage enables the user to create smaller motor dimensions, which in turn allows for a more compact and lightweight construction.

Benefits and fields of application



UPLplus primary parts are extremely lightweight thanks to printed circuit technology.

The U-shaped UPLplus secondary parts can be easily adapted to the surrounding construction.

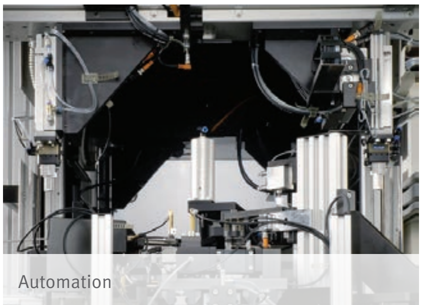
Benefits

- No cogging torque
- Optimum synchronisation
- Optimum positioning accuracy
- No attraction forces to the guidance system
- Increased output/productivity due to dynamic positioning
- Smaller motor dimensions possible due to innovation in manufacturing technology
- More compact/lightweight construction possible due to reduced motor mass

Fields of application

- Automation technology
- Measurement and inspection machines
- Medical engineering
- Air bearing axes
- Pick and place
- Semiconductor placement
- Z axis drives

The perfect drive for every application...



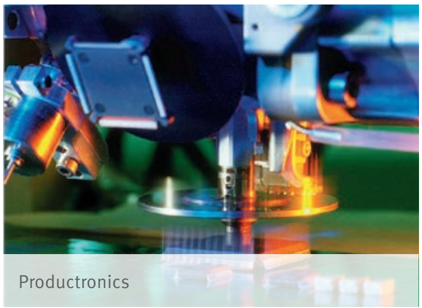
Automation

Handling

Printing machines

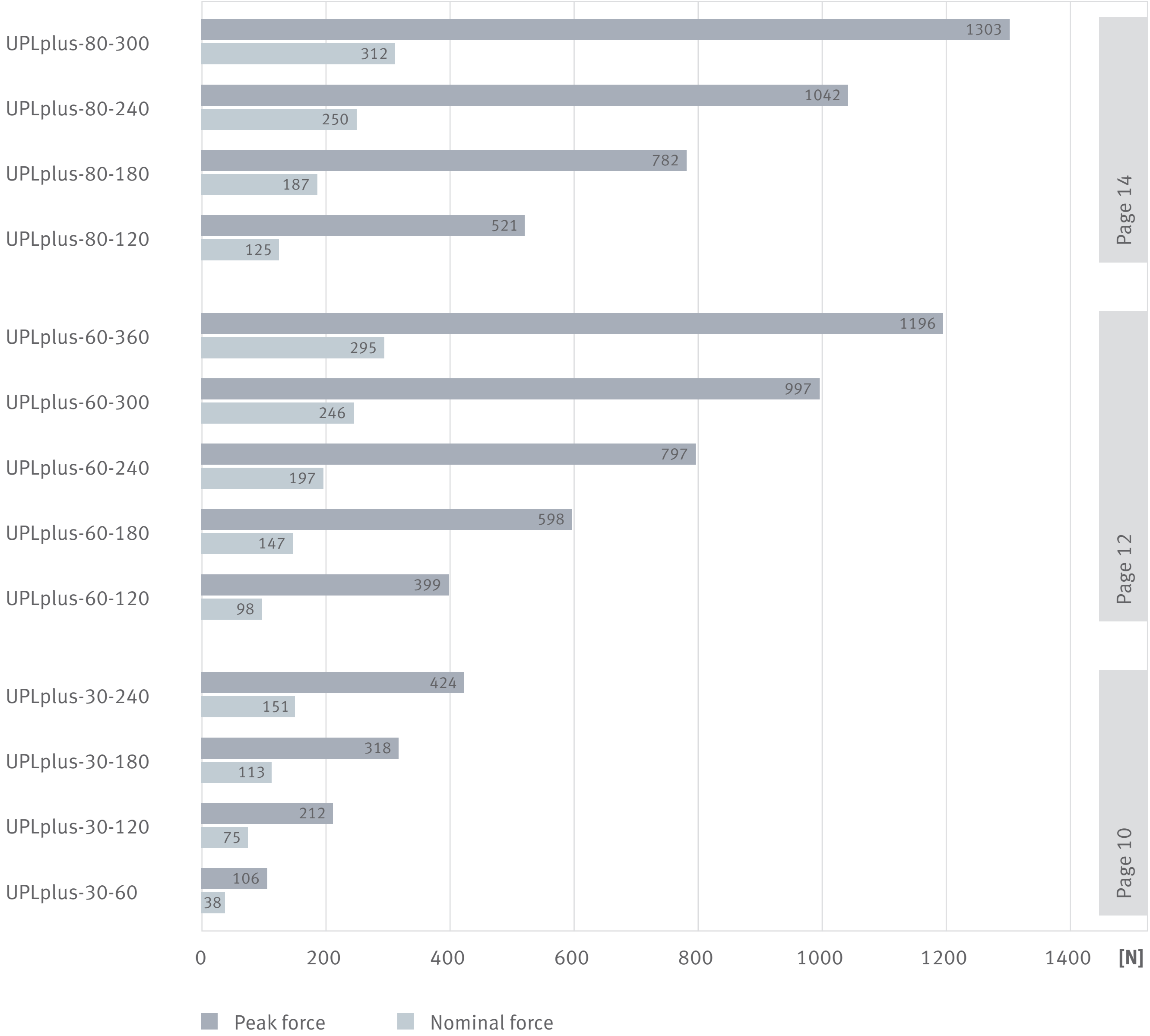
Medical engineering

Measuring technology



Productronics

Performance ranges

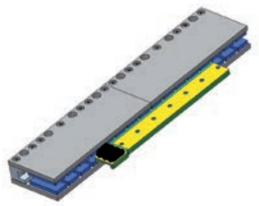


Modularity

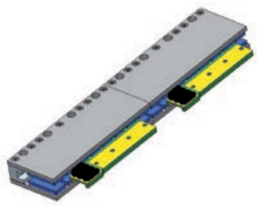
By arranging primary and secondary parts in different ways, various applications can be implemented, such as:

- Moving secondary part for short travel distances (the primary part is fixed in position; there are no moving cables)
- Several autonomous or parallel-operated primary parts in one secondary part track (the primary and secondary parts can be attached from either side)
- Gantry drives

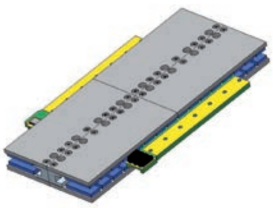
Example configurations of the UPLplus linear motors:



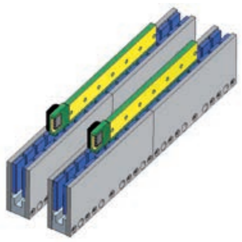
One primary part on one secondary part track.



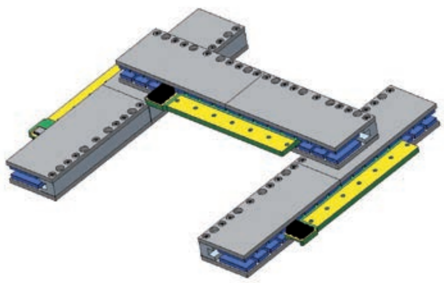
Several primary parts on one secondary part track.



Primary parts linked in parallel, version 1.



Primary parts linked in parallel, version 2.



Cross table or gantry arrangement.

Accessories

- Adapter strips
- Cable set
- Weight force compensation

Type designation

UPLplus series, primary part

UPLplus-3P-H-L-X-PRIM

Short designation, motor

UPLplus	UPLplus series, ironless linear motor (U-shaped, printed, linear)

Number of motor phases

3P	3-phase

Dimensions

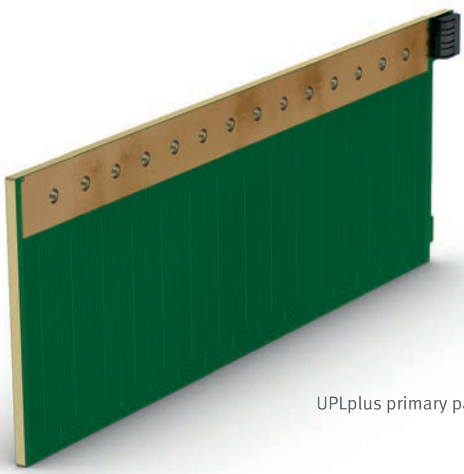
H	Effective active height [mm]
L	Length of coil system [mm]

Version

O	Standard
Sx	Special version (customer-specific)

Motor part

PRIM	Primary part



UPLplus primary part

Type designation

UPLplus series, secondary part

UPLplus-H-L(-X)-SEK

Short designation, motor

UPLplus	UPLplus series, ironless linear motor (U-shaped, printed, linear)

Dimensions

H	Effective active height [mm]
L	Length of secondary part [mm]

Version

Optional, only in special versions

Sx	Special version (customer-specific)

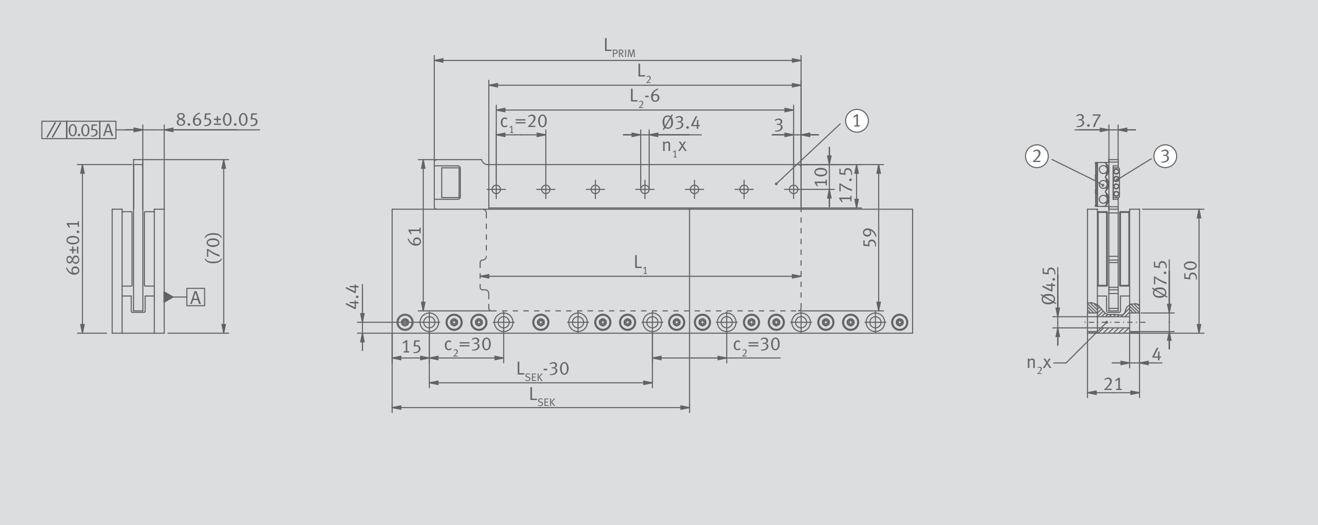
Motor part

SEK	Secondary part

UPLplus secondary part

UPLplus-30-L

Drawing and mechanical parameters



UPLplus-30-L drawing

① Mounting surface ② Motor connection ③ Sensor connection

Primary part	Symbol	Unit	UPLplus-3P-30-60-PRIM	UPLplus-3P-30-120-PRIM	UPLplus-3P-30-180-PRIM	UPLplus-3P-30-240-PRIM
Block length	L_{PRIM}	mm	88	148	208	268
Coil unit length	L_1	mm	69.5	129.5	189.5	249.5
Maximum mounting length	L_2	mm	66	126	186	246
Mounting holes	n_1	Number	4	7	10	13
Hole spacing	c_1	mm	20	20	20	20
Mass	m	g	64	122	182	242

Secondary part	Symbol	Unit	UPLplus-30-90-SEK	UPLplus-30-120-SEK	UPLplus-30-390-SEK
Length	L_{SEK}	mm	90	120	390
Mounting holes	n_2	Number	3	4	13
Hole spacing	c_2	mm	30	30	30
Mass	m	g	447	596	1938
Pole pair width	$2\tau_p$	mm	30	30	30

UPLplus-30-L

Performance data

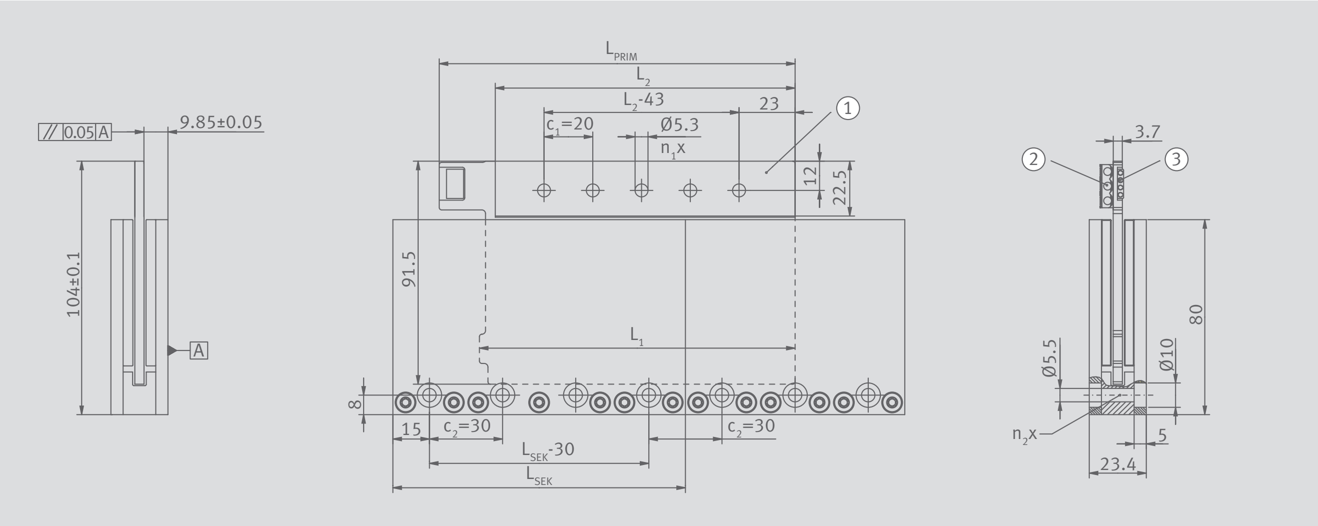
Parameter	Symbol	Unit	UPLplus-30-60	UPLplus-30-120	UPLplus-30-180	UPLplus-30-240
Maximum impulse force (1 s) at I_{mp} (25 °C)	F_{mp}	N	184	368	551	735
Peak force (3 s) at I_p (25 °C)	F_p	N	106	212	318	424
Nominal force, cooled at I_{cw} (140 °C)*	F_{cw}	N	38	75	113	151
Nominal force, not cooled at I_c (140 °C)	F_c	N	25	50	75	100
Maximum impulse current (1 s)	I_{mp}	A_{rms}	17.1	17.1	17.1	17.1
Peak current (3 s)	I_p	A_{rms}	9.9	9.9	9.9	9.9
Nominal current, cooled (140 °C)	I_{cw}	A_{rms}	3.5	3.5	3.5	3.5
Nominal current, not cooled (140 °C)	I_c	A_{rms}	2.3	2.3	2.3	2.3
Power loss at F_p (25 °C)	P_{lp}	W	624	1249	1872	2495
Power loss at F_{cw} (140 °C)	P_{lcw}	W	114	228	342	456
Power loss at F_c (140 °C)	P_{lc}	W	50	100	150	200
Motor constant (25 °C)	k_m	N/√W	4.2	6.0	7.4	8.5
Force constant	k_f	N/A_{rms}	10.7	21.5	32.2	42.9
Back EMF constant, phase to phase	k_u	V/(m/s)	8.8	17.5	26.3	35.1
Limit speed	v_p	m/s	30.4	12.5	6.5	3.5
Electrical resistance, phase to phase (25 °C)	R_{25}	Ω	4.3	8.5	12.8	17.0
Thermal resistance	R_{th}	K/W	1.01	0.50	0.34	0.25
Thermal time constant	τ_{th}	s	48	48	48	48
Temperature sensors			PTC, Pt1000			
Inductance, phase to phase	L	mH	1.1	2.3	3.4	4.5
Electrical time constant	τ_{el}	ms	0.27	0.27	0.27	0.27
Permissible winding temperature	ϑ	°C	140	140	140	140
DC link voltage (maximum)	U_{DCL}	V	330	330	330	330

* These values apply when the temperature is 25 °C at the mounting base of the primary part.

Subject to modifications without prior notification, where they serve technical progress. Tolerance range for values: ±10%
We would be glad to provide additional data and drawings on request.
We recommend a detailed application review by our engineering team for suitable motor selection.

UPLplus-60-L

Drawing and mechanical parameters



UPLplus-60-L drawing

① Mounting surface ② Motor connection ③ Sensor connection

Primary part	Symbol	Unit	UPLplus-3P-60-120-PRIM	UPLplus-3P-60-180-PRIM	UPLplus-3P-60-240-PRIM	UPLplus-3P-60-300-PRIM	UPLplus-3P-60-360-PRIM
Block length	L_{PRIM}	mm	146	206	266	326	386
Coil unit length	L_1	mm	129.5	189.5	249.5	309.5	369.5
Maximum mounting length	L_2	mm	123	183	243	303	363
Mounting holes	n_1	Number	5	8	11	14	17
Hole spacing	c_1	mm	20	20	20	20	20
Mass	m	g	189	283	377	471	564

Secondary part	Symbol	Unit	UPLplus-60-90-SEK	UPLplus-60-120-SEK	UPLplus-60-390-SEK
Length	L_{SEK}	mm	90	120	390
Mounting holes	n_2	Number	3	4	13
Hole spacing	c_2	mm	30	30	30
Mass	m	g	865	1154	3748
Pole pair width	$2\tau_p$	mm	30	30	30

UPLplus-60-L

Performance data

Parameter	Symbol	Unit	UPLplus-60-120	UPLplus-60-180	UPLplus-60-240	UPLplus-60-300	UPLplus-60-360
Maximum impulse force (1 s) at I_{mp} (25 °C)	F_{mp}	N	715	1073	1431	1788	2146
Peak force (3 s) at I_p (25 °C)	F_p	N	413	620	826	1033	1239
Nominal force, cooled at I_{cw} (140 °C)*	F_{cw}	N	106	159	212	265	318
Nominal force, not cooled at I_c (140 °C)	F_c	N	83	124	166	207	249
Maximum impulse current (1 s)	I_{mp}	A_{rms}	33.1	33.1	33.1	33.1	33.1
Peak current (3 s)	I_p	A_{rms}	19.1	19.1	19.1	19.1	19.1
Nominal current, cooled (140 °C)	I_{cw}	A_{rms}	4.9	4.9	4.9	4.9	4.9
Nominal current, not cooled (140 °C)	I_c	A_{rms}	3.8	3.8	3.8	3.8	3.8
Power loss at F_p (25 °C)	P_{lp}	W	1850	2775	3700	4625	5550
Power loss at F_{cw} (140 °C)	P_{lcw}	W	177	265	353	442	530
Power loss at F_c (140 °C)	P_{lc}	W	108	162	216	270	324
Motor constant (25 °C)	k_m	N/√W	9.6	11.8	13.6	15.2	16.6
Force constant	k_f	N/A_{rms}	21.6	32.4	43.2	54.0	64.8
Back EMF constant, phase to phase	k_u	V/(m/s)	17.6	26.5	35.3	44.1	52.9
Limit speed	v_p	m/s	28.6	17.7	12.2	8.9	6.7
Electrical resistance, phase to phase (25 °C)	R_{25}	Ω	3.4	5.1	6.7	8.4	10.1
Thermal resistance	R_{th}	K/W	0.65	0.43	0.33	0.26	0.22
Thermal time constant	τ_{th}	s	91	91	91	91	91
Temperature sensors					PTC, Pt1000		
Inductance, phase to phase	L	mH	1.0	1.5	2.0	2.5	3.0
Electrical time constant	τ_{el}	ms	0.30	0.30	0.30	0.30	0.30
Permissible winding temperature	ϑ	°C	140	140	140	140	140
DC link voltage (maximum)	U_{DCL}	V	600	600	600	600	600

* These values apply when the temperature is 25 °C at the mounting base of the primary part.

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We would be glad to provide additional data and drawings on request.
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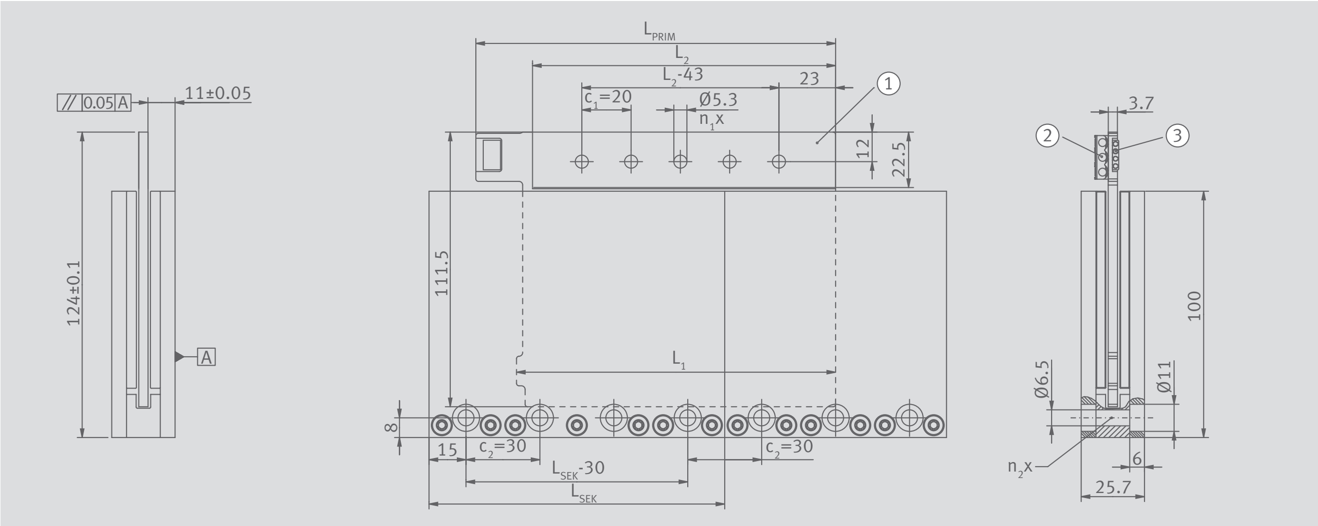
UPLplus-80-L

Drawing and mechanical parameters



UPLplus-80-L drawing

① Mounting surface ② Motor connection ③ Sensor connection

Primary part	Symbol	Unit	UPLplus-3P-80-120-PRIM	UPLplus-3P-80-180-PRIM	UPLplus-3P-80-240-PRIM	UPLplus-3P-80-300-PRIM
Block length	L_{PRIM}	mm	146	206	266	326
Coil unit length	L_1	mm	129.5	189.5	249.5	309.5
Maximum mounting length	L_2	mm	123	183	243	303
Mounting holes	n_1	Number	5	8	11	14
Hole spacing	c_1	mm	20	20	20	20
Mass	m	g	232	342	452	552

Secondary part	Symbol	Unit	UPLplus-80-90-SEK	UPLplus-80-120-SEK	UPLplus-80-390-SEK
Length	L_{SEK}	mm	90	120	390
Mounting holes	n_2	Number	3	4	13
Hole spacing	c_2	mm	30	30	30
Mass	m	g	1231	1641	5340
Pole pair width	$2\tau_p$	mm	30	30	30

UPLplus-80-L
Performance data

Parameter	Symbol	Unit	UPLplus-80-120	UPLplus-80-180	UPLplus-80-240	UPLplus-80-300
Maximum impulse force (1 s) at I_{mp} (25 °C)	F_{mp}	N	903	1354	1805	2257
Peak force (3 s) at I_p (25 °C)	F_p	N	521	782	1042	1303
Nominal force, cooled at I_{cw} (140 °C)*	F_{cw}	N	125	187	249	311
Nominal force, not cooled at I_c (140 °C)	F_c	N	89	133	177	221
Maximum impulse current (1 s)	I_{mp}	A_{rms}	33.0	33.0	33.0	33.0
Peak current (3 s)	I_p	A_{rms}	19.0	19.0	19.0	19.0
Nominal current, cooled (140 °C)	I_{cw}	A_{rms}	4.5	4.5	4.5	4.5
Nominal current, not cooled (140 °C)	I_c	A_{rms}	3.2	3.2	3.2	3.2
Power loss at F_p (25 °C)	P_{lp}	W	2427	3641	4855	6069
Power loss at F_{cw} (140 °C)	P_{lcw}	W	201	301	402	502
Power loss at F_c (140 °C)	P_{lc}	W	102	152	203	254
Motor constant (25 °C)	k_m	N/√W	10.6	13.0	15.0	16.7
Force constant	k_f	N/A_{rms}	27.4	41.1	54.8	68.5
Back EMF constant, phase to phase	k_u	V/(m/s)	22.4	33.5	44.7	55.9
Limit speed	v_p	m/s	21.4	12.8	8.5	5.9
Electrical resistance, phase to phase (25 °C)	R_{25}	Ω	4.5	6.7	8.9	11.2
Thermal resistance	R_{th}	K/W	0.57	0.38	0.29	0.23
Thermal time constant	τ_{th}	s	116	116	116	116
Temperature sensors			PTC, Pt1000			
Inductance, phase to phase	L	mH	1.4	2.1	2.8	3.5
Electrical time constant	τ_{el}	ms	0.31	0.31	0.31	0.31
Permissible winding temperature	ϑ	°C	140	140	140	140
DC link voltage (maximum)	U_{DCL}	V	600	600	600	600

* These values apply when the temperature is 25 °C at the mounting base of the primary part.

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We recommend a detailed application review by our engineering team for suitable motor selection.

Checklist for your inquiry

UPLplus linear motors

Please fill out the following checklist so we can answer your inquiry as quickly and precisely as possible.
Do not hesitate to contact the Schaeffler sales team if you have any questions.

Company	**Contact name**	**Sector · Project name**
______	______	______
______	______	______
Phone	**E-mail**	
______	______	

Application

______

______

______

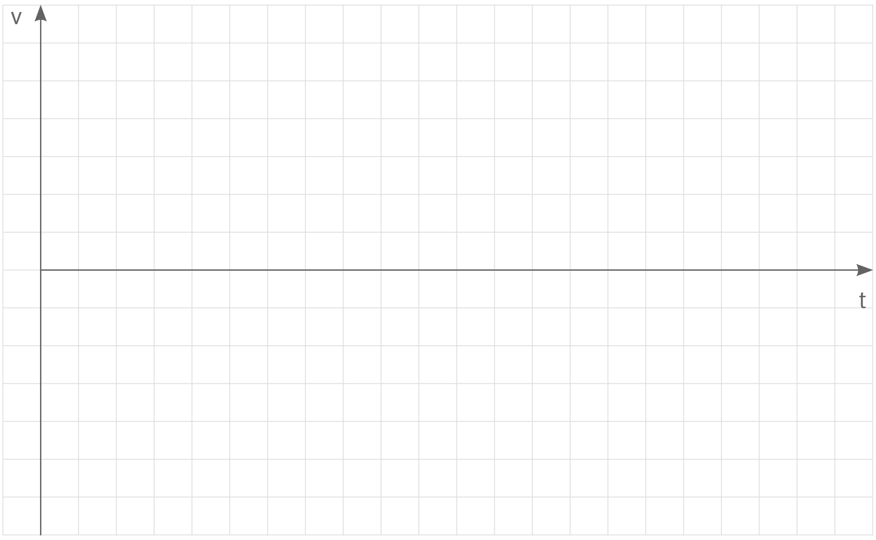
Environmental conditions	☐ Indoor area, 25 °C	☐ Other ______
Additional mass [kg]	______	
External forces, such as friction [N]	______	
Maximum speed [m/s]	______	
Maximum acceleration [m/s²]	______	
Available installation space [mm]	Axis length, total ______	Width x height ______
Stroke [mm]	Total stroke ______	Working stroke ______
Axis arrangement	☐ Horizontal	☐ Vertical
Weight force compensation	☐ Yes	☐ No
Clamping at standstill	☐ Yes	☐ No
DC link voltage [V_{DC}]	______	

Movement data

Positioning time [s] ______________________

Pause in movement [s] ______________________

Movement profile



Cooling

☐ Water
(25 °C at the mounting base)

☐ Air

☐ None

Requirement · quantity

☐ One-time requirement

☐ Prototype

☐ Series

Contact

Schaeffler Industrial Drives AG & Co. KG
Phone +49 3681 7574-0 · sales-sid@schaeffler.com

Glossary

Symbol	Meaning	Unit	Explanation
F_{mp}	Impulse force	N	Motor force which can be generated at maximum current density with impulse current I_{mp} in the millisecond range. This should not be used for motor sizing.
F_p	Peak force	N	Motor force which can be generated at peak current I_p. The permitted duration of peak force is heavily dependent on the current motor temperature and lasts only a few seconds (max. 3 s). When peak force is achieved, the coil temperature must not exceed 140 °C.
F_{cw}	Nominal force, cooled (25 °C at mounting base)	N	Motor force at I_{cw} which is available as a constant force at a cooled temperature during rated operation when an appropriate level of cooling is provided, and at which a temperature drop of approx. 115 K occurs between the winding and the cooling system.
F_c	Nominal force, not cooled	N	Motor force at nominal current I_c if all motor phases have the same loads, whereby it is assumed that the heat exchange surface is a mounting plate with approx. three times the surface area of the primary part surface.
I_{mp}	Impulse current	A_{rms}	Maximum effective impulse current in the millisecond range
I_p	Peak current	A_{rms}	Maximum effective peak current in the range of a few seconds (max. 3 s)
I_{cw}	Nominal current, cooled	A_{rms}	Effective nominal current which can be achieved in continuous operation when the mounting base temperature is 25 °C. The winding resistance value changes in accordance with the actual winding temperature.
I_c	Nominal current, not cooled	A_{rms}	Effective nominal current at which the related power loss at the defined size of the mounting base (see F_c) without compulsory cooling leads to a maximum motor temperature of approx. 140 °C.
P_l	Power loss	W	The thermal output resulting in the motor winding which leads to a time-dependent temperature increase subject to the operating mode (current) and the environmental conditions (cooling). In the upper dynamic range (at F_p), P_l is particularly high due to the squared dependence on current, whereas the warming in the nominal current range is relatively low. P_l is calculated with the aid of the motor constant k_m for a movement section with the required force F: $P_l = (F/km)^2$.
P_{lp}	Power loss	W	Peak power loss at I_p
P_{lcw}	Power loss (25 °C at mounting base)	W	Power loss at I_{cw}
P_{lc}	Power loss	W	Power loss at I_c
k_m	Motor constant	N/√W	Motor constant which expresses the relation between the generated force and the power loss (efficiency of the motor). It is dependent on the temperature. If the winding temperature is 140 °C, the motor constant reduces to 0.85 times its normal value.

Symbol	Meaning	Unit	Explanation
k_f	Force constant	N/A_{rms}	Winding parameter which, when multiplied by the current in the linear dynamic range, represents the motor force that is being produced: $F = I_c \cdot k_f$
k_u	Back EMF constant	V/(m/s)	Winding parameter which represents the armature countervoltage arising at the motor terminals in generator operation, subject to the speed. $U_g = k_u \cdot v$
v_p	Limit speed	m/s	Maximum speed at U_{DCL}. Speed that can be reached for a short period of time – it is reached when the force F_p at current I_p can be kept constant. The limit speed is higher when currents/forces are lower.
R_{25}	Electrical resistance	Ω	Winding resistance at 25 °C. At 140 °C, it increases to 1.45 times its normal value.
R_{th}	Thermal resistance	K/W	Resistance at which the temperature difference between the winding system and the cooling element surface or cooling base can be determined at a specific power loss value.
τ_{th}	Thermal time constant	s	Duration until 63% of the maximum coil temperature (140 °C) is reached when operating at the nominal current (nominal force).
L	Inductance	mH	Motor inductance – measured between two phases
τ_{el}	Electrical time constant	ms	Constant which describes the L/R ratio. The ratio is approximately constant, regardless of the winding system design. The controlled effective time constant decreases depending on the degree of voltage overshoot.
ϑ	Winding temperature (at the sensor)	°C	Permissible winding temperature which is recorded by sensors with a specific offset. The motor surface temperature that arises from this depends on: · the specific installation conditions (table size, dimensions of the machine construction) · the heat dissipation conditions (cooling) · the operating mode and therefore the mean power input and can only be determined if these factors are known.
U_{DCL}	DC link voltage	V	DC link voltage or supply voltage of the power actuators. The higher the speed and the countervoltage that rises with it and the greater the losses that depend on the frequency, the higher the voltage has to be.
$2\tau_p$	Pole pair width	mm	The pole pair width (also magnet periods) $2\tau_p$ denotes the travel distance of a pole pair on the linear motors. At the same time, τ with index p is the pole width (magnet width) in the displacement direction with a magnetic field alternating between N and S.

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