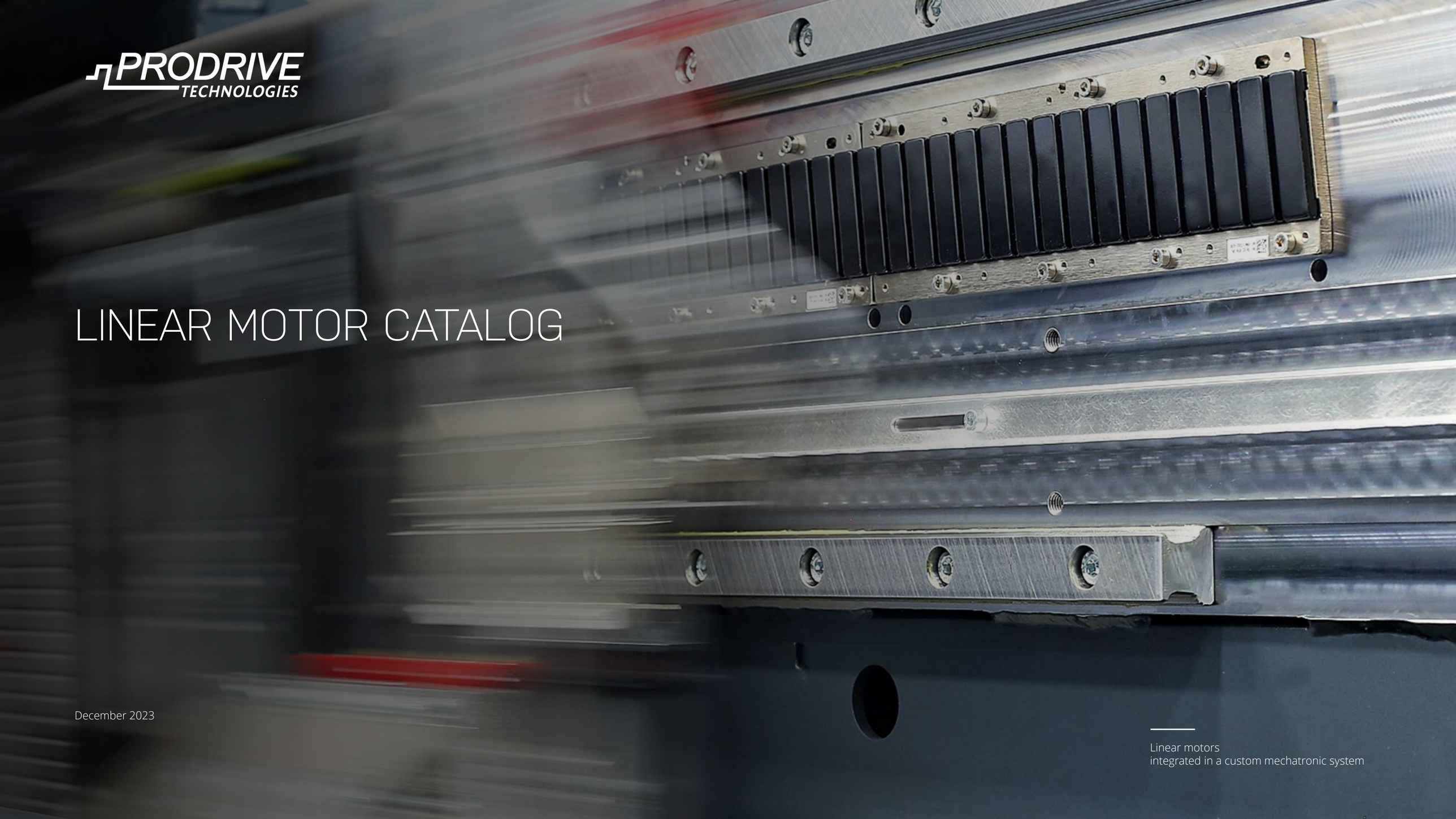
PRODRIVE TECHNOLOGIES

LINEAR MOTOR CATALOG

December 2023



Linear motors
integrated in a custom mechatronic system

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CREATING MEANINGFUL TECHNOLOGIES THAT MAKE THE WORLD WORK

Knowledge

Engineering excellence is the driving force behind linear motor innovation in both design and manufacturing. Prodrive has a highly skilled group of (electro-)mechanical engineers capable of customizing linear motor technology towards your needs.

Quality

Quality is in the DNA of Prodrive Technologies. With a long history in electronics manufacturing, Prodrive continues in the area of linear motor manufacturing with the same philosophy and processes, setting a new standard within the linear motor market.

Automation

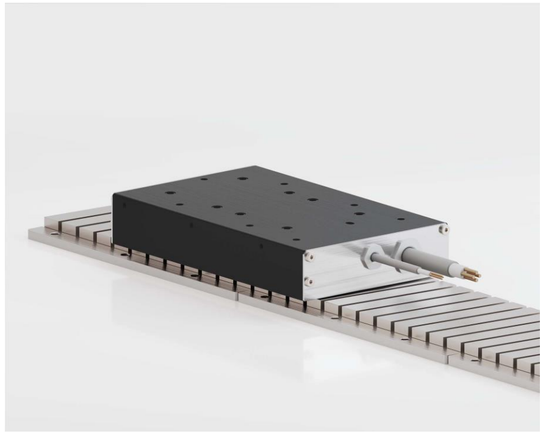
Design for manufacturing is key to reduce cost and guarantee quality. Winding, assembly, vacuum potting and magnet gluing are highly automated processes which guarantees a constant quality at minimum cost.

Time to market

Due to the agility of Prodrive Technologies' large development department, customization can be performed in a very short time, providing a short time to market for challenging mechatronic applications.

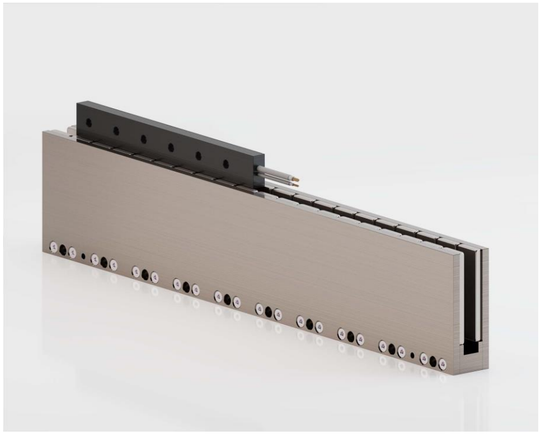
Prodrive Technologies HQ Campus, The Netherlands

OVERVIEW



Chiron

The Chiron line offers iron core linear motors which are optimized for high force and high efficiency. Find the optimal fit for your application due to the many different available form factors.

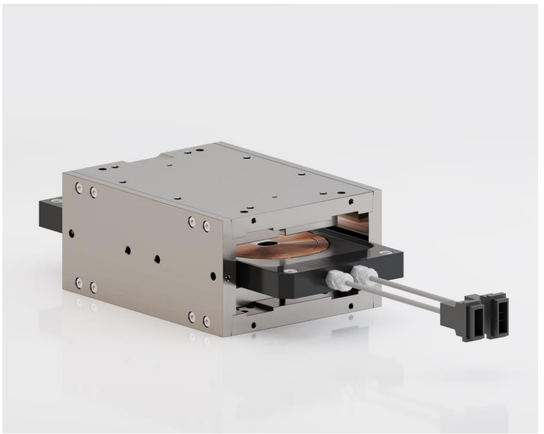


Phoenix

The Phoenix line offers ironless linear motors, for applications requiring an extremely low force ripple for excellent servo performance without attraction forces. Available in a large range of sizes.

Gryphon

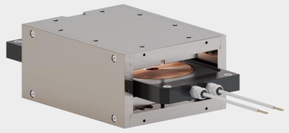
The Gryphon line offers a cost-effective solution for vacuum-compatible ironless linear motors. These motors also contain features providing magnetic shielding.

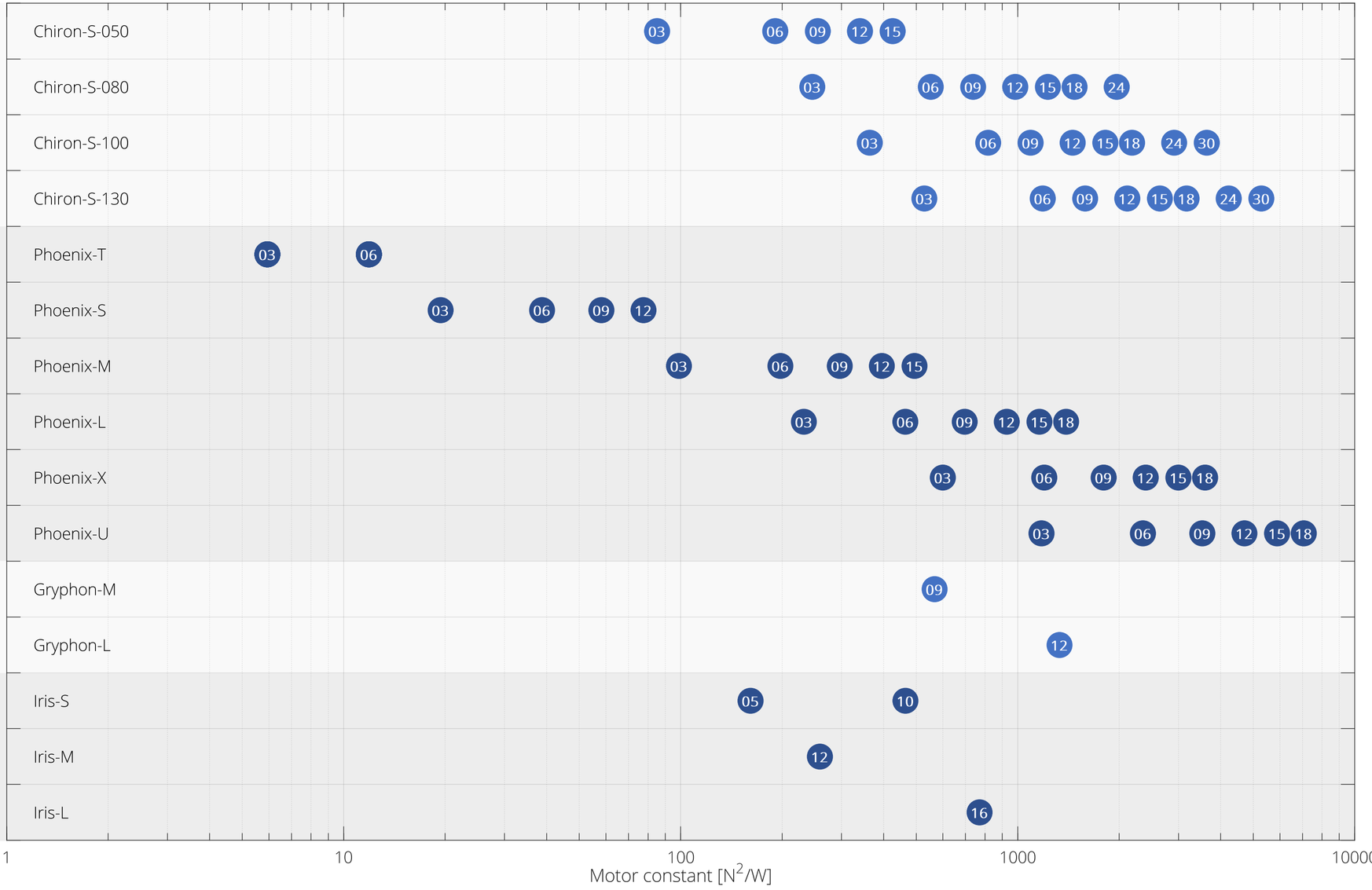


Iris

For short stroke applications requiring a relatively large displacement in three directions, the Iris line provides a high force density with zero attraction forces in a rectangular form factor.

OVERVIEW

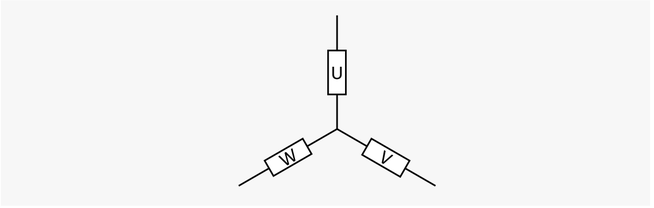



Chiron-S-050
03 06 09 12 15
Chiron-S-080
03 06 09 12 15 18 24
Chiron-S-100
03 06 09 12 15 18 24 30
Chiron-S-130
03 06 09 12 15 18 24 30
Phoenix-T
03 06
Phoenix-S
03 06 09 12
Phoenix-M
03 06 09 12 15
Phoenix-L
03 06 09 12 15 18
Phoenix-X
03 06 09 12 15 18
Phoenix-U
03 06 09 12 15 18
Gryphon-M
09
Gryphon-L
12
Iris-S
05 10
Iris-M
12
Iris-L
16
1
10
100
1000
10000
Motor constant [N2/W]

WINDING CONFIGURATIONS

The phases of all three-phase linear motors are star-connected.

The Chiron, Phoenix and Gryphon line can be selected with different winding configurations to create an optimal fit for your application.



Phase connection chart

Winding configuration A

The windings are configured such that independent of the number of coils, the force constant remains equal, and the maximum velocity remains unchanged. The maximum current increases with the number of coils.

Winding configuration B

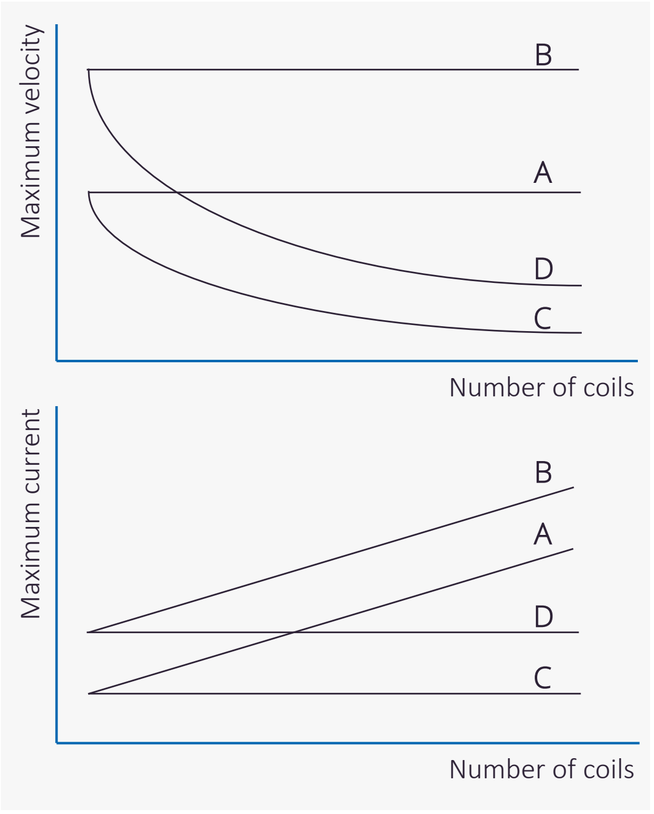
The windings are configured like winding configuration A, but this winding configuration can reach higher velocities at the expense of a lower force constant.

Winding configuration C

The windings are configured such that the current remains constant with increasing number of coils at the expense of reducing the maximum velocity. For the Chiron, Phoenix and Gryphon line, this configuration allows moving magnet applications with partial coil unit overlap.

Winding configuration D

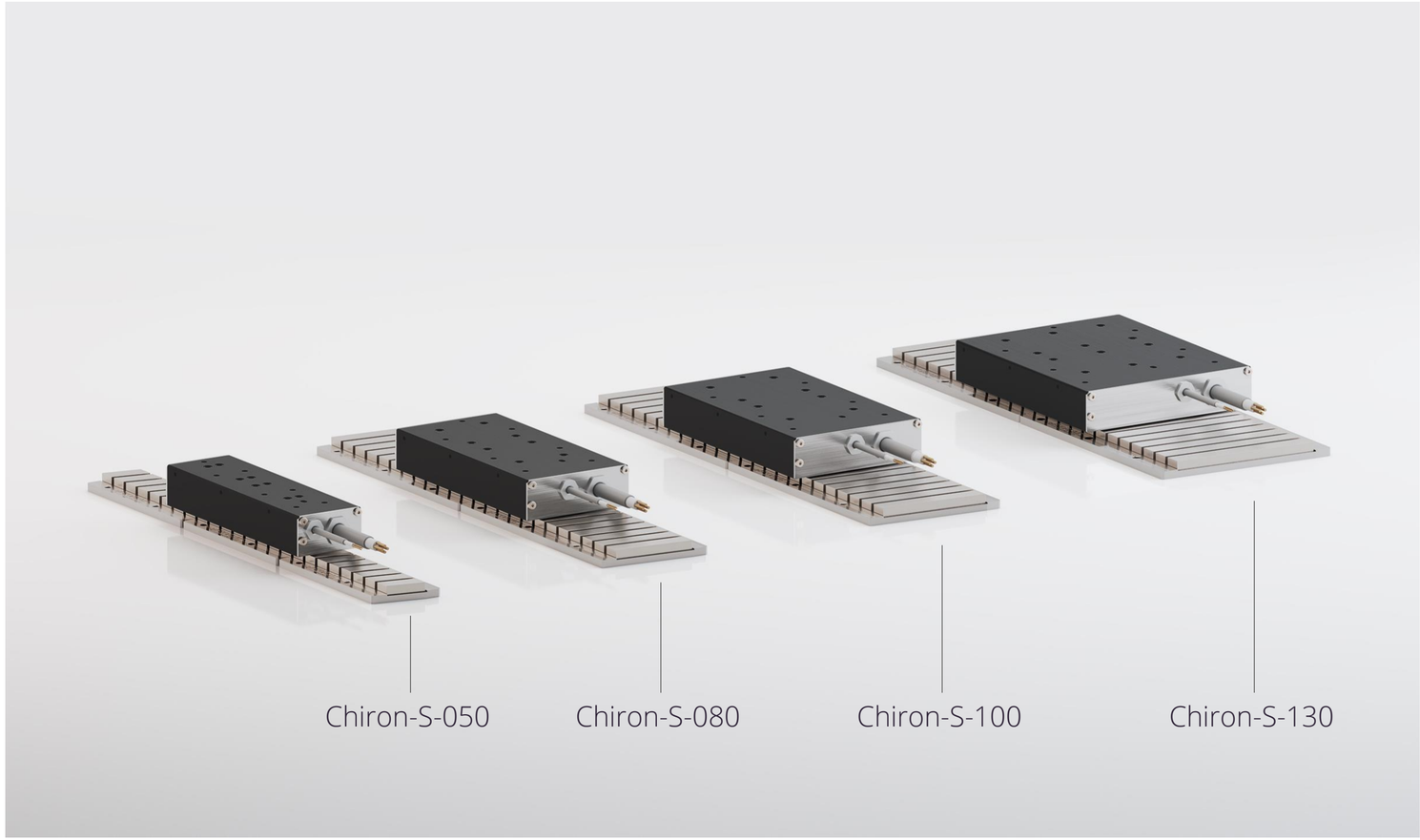
The windings are configured such that the current remains constant with increasing number of coils at the expense of reducing the maximum velocity. This configuration has a higher maximum velocity compared to winding configuration C. For the Phoenix line, this configuration allows moving magnet applications with partial coil unit overlap.



Winding configurations chart

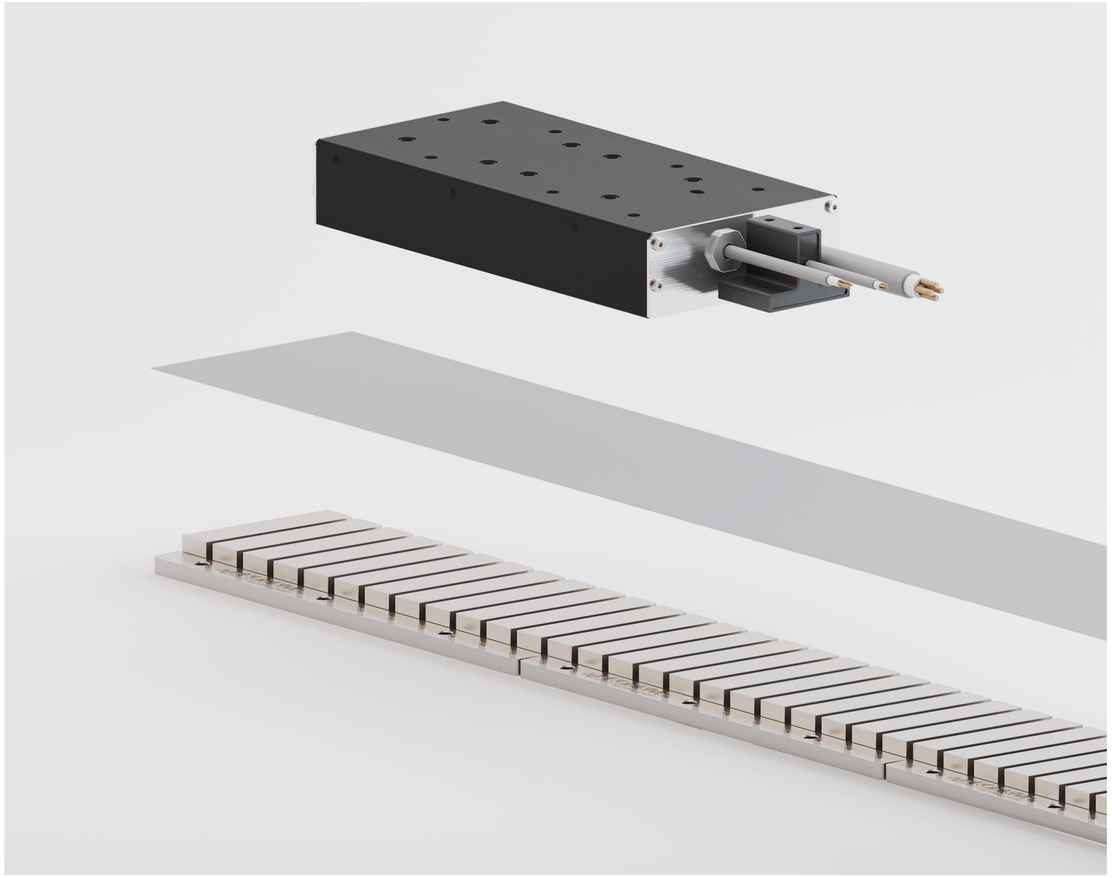
CHIRON LINE

The Chiron line offers iron core linear motors which are optimized for high force and high efficiency. Find the optimal fit for your application due to the many different available form factors.



Chiron line linear motors in different sizes

CHIRON FEATURES



Chiron magnet plates (Chiron-MP-080-12), coil unit (Chiron-CU-S-080-06-A-B), commutation sensor (Chiron-CS-A) and magnet plate cover

Chiron-CU-S-080-12-A-N

- Thermal interface (N = none / B = PTC+PT1000)
- Winding configuration (A / B / C / D)
- # of coils
- Depth (050 / 080 / 100 / 130)
- Type (S)
- Coil unit

Chiron-MP-080-16

- # of poles
- Depth (050 / 080 / 100 / 130)
- Magnet plate

Chiron-CS-A

- Type (A = analog / D = digital)
- Commutation sensor

- Modularity in width and depth for optimal mechanical integration
- Multiple winding configurations for optimal current/velocity matching
- Coil units have an optional temperature protection (PTC) and sensor (PT1000)
- Magnet plates can be butted together
- Magnets are skewed to minimize force ripples and detent forces
- IP rating of coil units is IP69K
- Optional stainless-steel cover plate for protection of the magnet plates
- Optional commutation sensor, analog Hall (sin/cos) or digital Hall

CHIRON-S-050 PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-S-050-03	CU-S-050-06		CU-S-050-09		CU-S-050-12			CU-S-050-15	
	Winding configuration	-	-	-	C	B	C	B	C	A	B	C	B	C
Electromechanical	Peak force (α_T = 5°C/s increase)	F_p	N	20	100	205		300		410			500	
	Continuous force, interface at 20°C	F_c	N	100	65	135		200		270			330	
	Attraction force (I = 0)	F_{att}	N	-	345	600		855		1110			1365	
	Motor constant	S	N^2/W	20	85	180		255		350			425	
	Force constant (I = I_c)	$K_{f,c}$	N/A_{rms}	-	26	26	55	26	79	54	26	105	26	132
	Force constant (I = I_p)	$K_{f,p}$	N/A_{rms}	-	23	23	49	23	69	48	23	92	23	116
	Maximum velocity (F = 0)	v_m	m/s	-	31	31	15	31	10	15	31	7.8	31	6.2
	Maximum velocity (F = F_p)	v_i	m/s	20	18	18	8.8	18	5.8	8.9	18	4.2	18	3.3
Electrical	Maximum dc bus voltage	V_{dc}	V	-	690	690		690		690			690	
	Phase resistance	$R_{ph,20}$	Ohm	20	2.9	1.5	5.8	1.0	8.7	2.9	0.7	12	0.6	15
	Phase inductance	L_{ph}	mH	20	14	7.0	28	4.7	42	14	3.5	56	2.8	70
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	22	22	47	22	67	46	22	89	22	111
	Maximum rms current	I_p	A_{rms}	20	4.3	8.7	4.3	13	4.3	8.7	17	4.3	22	4.3
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	2.5	5.0	2.5	7.6	2.5	5.0	10.1	2.5	13	2.5
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	73	145		218		291			364	
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	1.1	0.55		0.37		0.28			0.22	
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.9	0.43		0.29		0.22			0.17	
	Thermal time constant, interface at 20°C	τ_{th}	s	-	67	67		67		67			67	

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet plate
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications are based upon an airgap of 1 mm
- See ‘definitions’ section at the end of the catalog for more details

Product marking / approvals

CE

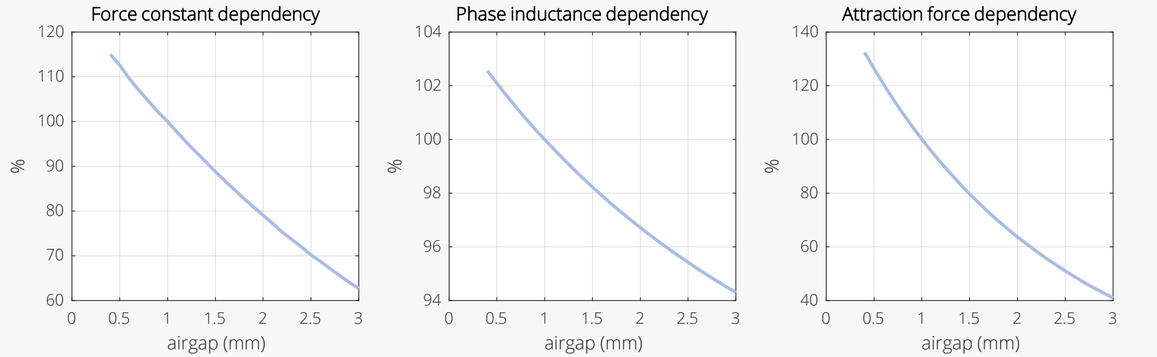
Power Interface:

- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

Thermal Interface:

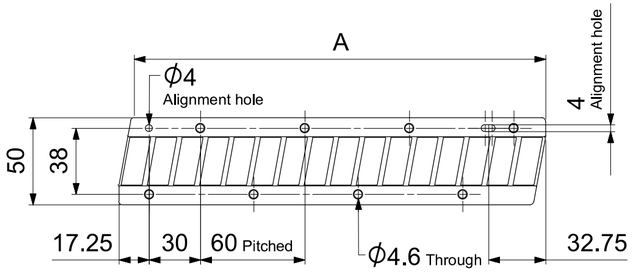
- PT1000 (White)
- PT1000 (Brown)
- PTC (Green)
- PTC (Yellow)

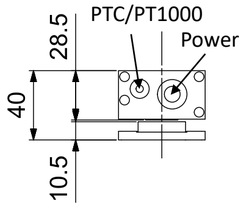
Electrical interfaces



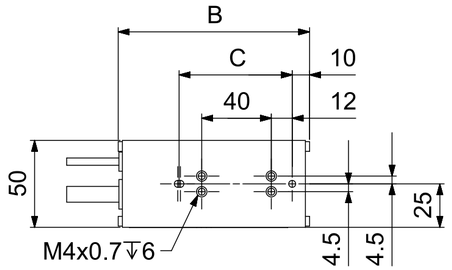
Airgap dependency

CHIRON-S-050 MECHANICAL SPECIFICATIONS



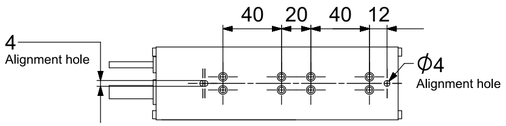


	Parameter	Symbol	Unit	MP-050-08	MP-050-16	MP-050-28
Magnet Plates	Number of poles	N_p	-	8	16	28
	Pole pitch (N-N)	$2\tau_p$	mm	30	30	30
	Width	A	mm	120	240	420
	Mass	M_{mp}	kg	0.4	0.7	1.2

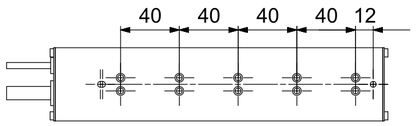


Chiron-CU-S-050-03

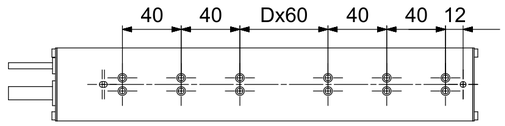
	Parameter	Symbol	Unit	CU-S-050-03	CU-S-050-06	CU-S-050-09	CU-S-050-12	CU-S-050-15
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15
	Coil pitch	τ_{coil}	mm	20	20	20	20	20
	Width	B	mm	110	170	230	290	350
	Center pin distance	C	mm	65	125	185	245	305
	Number of 60 mm pitches	D	mm	0	0	0	1	2
	Mass (ex. cable)	M_{cu}	kg	0.5	0.8	1.2	1.5	1.8
	Standard cable length	L_{cable}	m	1	1	1	1	1



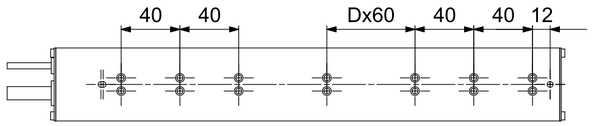
Chiron-CU-S-050-06



Chiron-CU-S-050-09



Chiron-CU-S-050-12



Chiron-CU-S-050-15

CHIRON-S-080 PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-S-080-03	CU-S-080-06		CU-S-080-09		CU-S-080-12			CU-S-080-15		CU-S-080-18				CU-S-080-24			
	Winding configuration	-	-	-	C	B	C	B	C	A	B	C	B	C	A	B	C	D	A	B	C	D
Electromechanical	Peak force (α_T = 5°C/s increase)	F_p	N	20	250	510		740		1000			1230		1480				1970			
	Continuous force, interface at 20°C	F_c	N	100	165	335		490		665			820		985				1310			
	Attraction force (I = 0)	F_{att}	N	-	830	1440		2050		2660			3270		3880				5100			
	Motor constant	S	N^2/W	20	250	520		740		1010			1230		1470				1960			
	Force constant (I = I_c)	$K_{f,c}$	N/A_{rms}	-	61	61	128	61	182	124	61	242	61	303	121	61	364	182	121	61	485	242
	Force constant (I = I_p)	$K_{f,p}$	N/A_{rms}	-	56	56	119	56	169	116	56	225	56	282	113	56	338	169	113	56	450	225
	Maximum velocity (F = 0)	v_m	m/s	-	14	14	6.4	14	4.6	6.7	14	3.4	14	2.7	6.8	14	2.3	4.6	6.8	14	1.7	3.4
	Maximum velocity (F = F_p)	v_i	m/s	20	8.2	8.2	3.8	8.2	2.4	3.8	8.2	1.7	8.2	1.2	3.9	8.2	0.9	2.4	3.9	8.2	0.5	1.7
Electrical	Maximum dc bus voltage	V_{dc}	V	-	690	690		690		690			690		690				690			
	Phase resistance	$R_{ph,20}$	Ohm	20	5.2	2.6	10	1.7	16	5.2	1.3	21	1.0	26	3.5	0.9	31	7.8	2.6	0.7	42	10
	Phase inductance	L_{ph}	mH	20	29	15	58	9.7	87	29	7.3	116	5.8	145	19	4.8	174	44	15	3.6	232	58
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	51	51	107	51	152	104	51	202	51	253	101	51	303	152	101	51	404	202
	Maximum rms current	I_p	A_{rms}	20	4.4	8.8	4.4	13	4.4	8.8	18	4.4	22	4.4	13	26	4.4	8.8	18	35	4.4	8.8
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	2.7	5.4	2.7	8.1	2.7	5.4	10.8	2.7	14	2.7	8.1	16	2.7	5.4	10.8	22	2.7	5.4
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	150	300		450		600			750		900				1200			
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.53	0.27		0.18		0.13			0.11		0.09				0.067			
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.43	0.22		0.14		0.11			0.09		0.07				0.054			
	Thermal time constant, interface at 20°C	τ_{th}	s	-	61	61		61		61			61		61				61			

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet plate
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications are based upon an airgap of 1 mm
- See ‘definitions’ section at the end of the catalog for more details

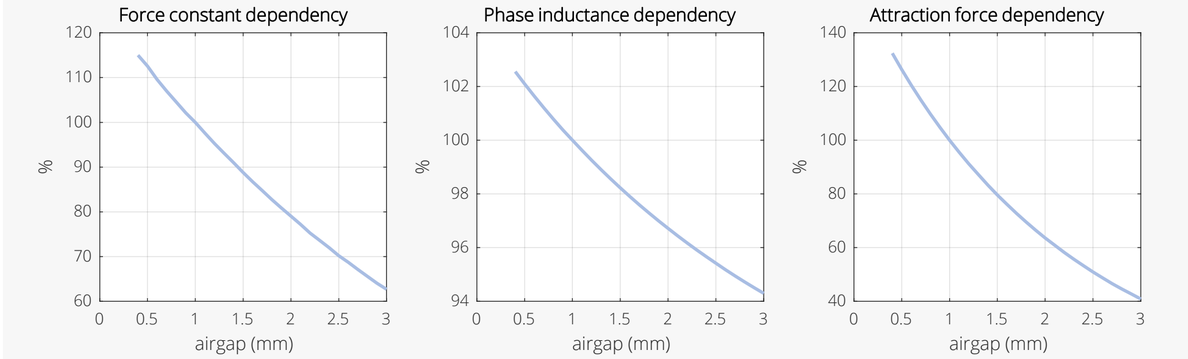
Product marking / approvals

CE

Power Interface:
- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

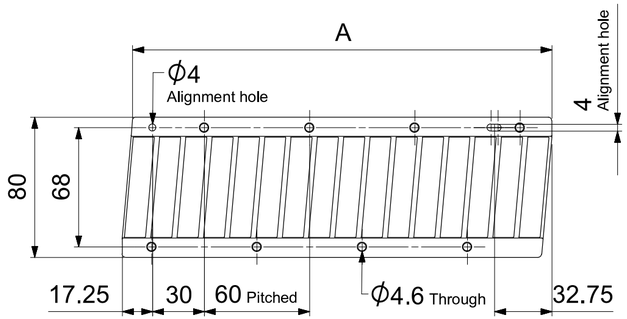
Thermal Interface:
- PT1000 (White)
- PT1000 (Brown)
- PTC (Green)
- PTC (Yellow)

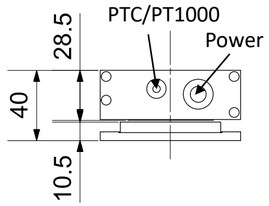
Electrical interfaces



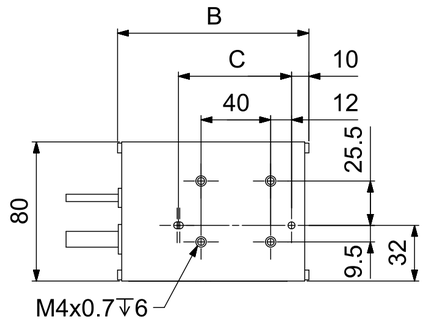
Airgap dependency

CHIRON-S-080 MECHANICAL SPECIFICATIONS



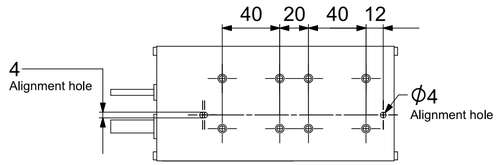


	Parameter	Symbol	Unit	MP-080-12	MP-080-16	MP-080-28	MP-080-36
Magnet Plates	Number of poles	N_p	-	12	16	28	36
	Pole pitch (N-N)	$2\tau_p$	mm	30	30	30	30
	Width	A	mm	180	240	420	540
	Mass	M_{mp}	kg	0.9	1.2	2.1	2.7

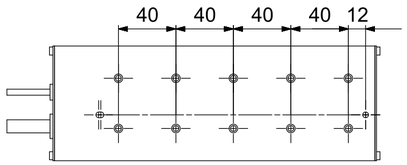


Chiron-CU-S-080-03

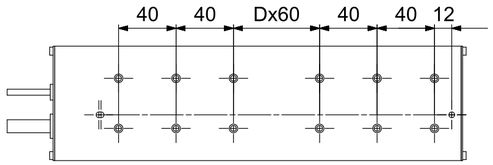
	Parameter	Symbol	Unit	CU-S-080-03	CU-S-080-06	CU-S-080-09	CU-S-080-12	CU-S-080-15	CU-S-080-18	CU-S-080-24
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15	18	24
	Coil pitch	τ_{coil}	mm	20	20	20	20	20	20	20
	Width	B	mm	110	170	230	290	350	410	530
	Center pin distance	C	mm	65	125	185	245	305	365	485
	Number of 60 mm pitches	D	mm	0	0	0	1	2	3	5
	Mass (ex. cable)	M_{cu}	kg	0.9	1.5	2.2	2.8	3.4	4.1	5.3
	Standard cable length	L_{cable}	m	1	1	1	1	1	1	1



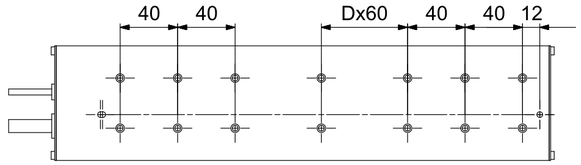
Chiron-CU-S-080-06



Chiron-CU-S-080-09



Chiron-CU-S-080-12



Chiron-CU-S-080-15/18/24

CHIRON-S-100 PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-S-100-03	CU-S-100-06		CU-S-100-09		CU-S-100-12			CU-S-100-15		CU-S-100-18				CU-S-100-24				CU-S-100-30			
	Winding configuration	-	-	-	C	B	C	B	C	A	B	C	B	C	A	B	C	D	A	B	C	D	A	B	C	D
Electromechanical	Peak force (α_T = 5°C/s increase)	F_p	N	20	340	710		1030		1400			1720		2070				2760				3450		3300	3450
	Continuous force, interface at 20°C	F_c	N	100	230	470		690		940			1160		1390				1850				2310			
	Attraction force (I = 0)	F_{att}	N	-	1160	2020		2890		3750			4620		5480				7210				8940			
	Motor constant	S	N^2/W	20	360	770		1090		1490			1820		2180				2910				3640			
	Force constant (I = I_c)	$K_{f,c}$	N/A_{rms}	-	84	84	177	84	252	172	84	336	84	420	168	84	503	252	168	84	671	336	168	84	839	420
	Force constant (I = I_p)	$K_{f,p}$	N/A_{rms}	-	78	78	165	78	235	161	78	314	78	392	157	78	470	235	157	78	627	314	157	78	784	392
	Maximum velocity (F = 0)	v_m	m/s	-	10	10	5	10	3	5	10	2.5	10	2.0	4.9	10	1.6	3.3	4.9	10	1.2	2.5	4.9	10	1.0	2.0
	Maximum velocity (F = F_p)	v_i	m/s	20	5.9	5.9	2.7	5.9	1.7	2.7	5.9	1.1	5.9	0.8	2.7	5.9	0.5	1.7	2.7	5.9	0.2	1.1	2.7	5.9	0.0	0.8
Electrical	Maximum dc bus voltage	V_{dc}	V	-	690	690		690		690			690		690				690				690			
	Phase resistance	$R_{ph,20}$	Ohm	20	6.7	3.4	13	2.2	20	6.7	1.7	27	1.3	34	4.5	1.1	40	10	3.4	0.8	54	13	2.7	0.7	67	17
	Phase inductance	L_{ph}	mH	20	39	20	78	13	117	39	9.8	156	7.8	195	26	6.5	234	59	20	4.9	312	78	16	3.9	390	98
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	70	70	148	70	209	143	70	279	70	349	140	70	419	209	140	70	558	279	140	70	698	349
	Maximum rms current	I_p	A_{rms}	20	4.4	8.8	4.4	13	4.4	8.8	18	4.4	22	4.4	13	26	4.4	8.8	18	35	4.4	8.8	22	44	4.2	8.8
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	2.8	5.5	2.8	8.3	2.8	5.5	11	2.8	14	2.8	8.3	17	2.8	5.5	11	22	2.8	5.5	14	28	2.8	5.5
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	200	400		600		800			1000		1200				1600				2000			
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.40	0.20		0.13		0.10			0.080		0.067				0.050				0.040			
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.33	0.17		0.11		0.08			0.067		0.056				0.042				0.033			
	Thermal time constant, interface at 20°C	τ_{th}	s	-	59	59		59		59			59		59				59				59			

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet plate
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications are based upon an airgap of 1 mm
- See ‘definitions’ section at the end of the catalog for more details

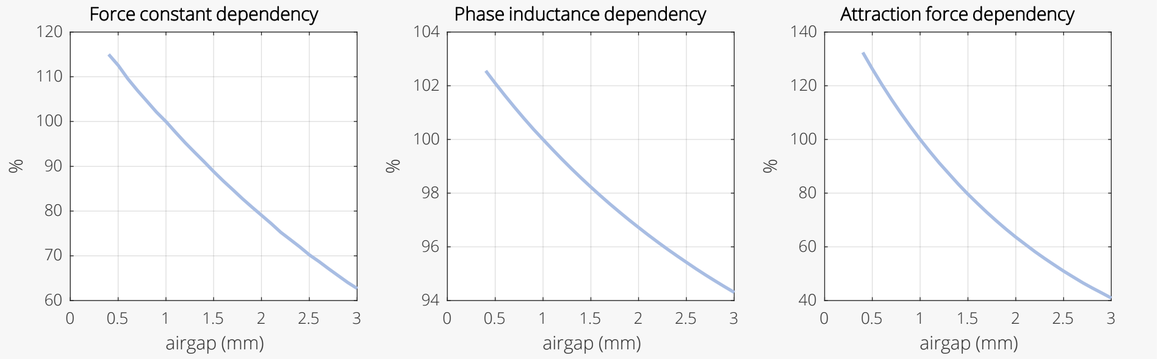
Product marking / approvals

CE

Power Interface:
- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

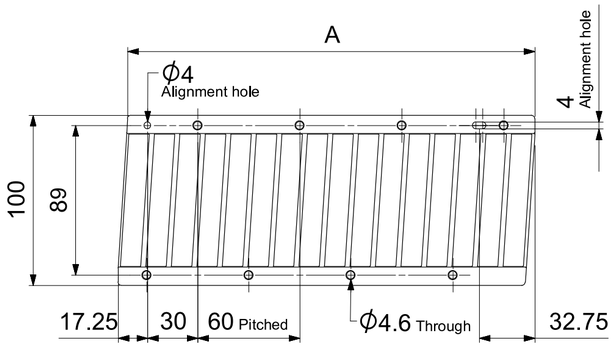
Thermal Interface:
- PT1000 (White)
- PT1000 (Brown)
- PTC (Green)
- PTC (Yellow)

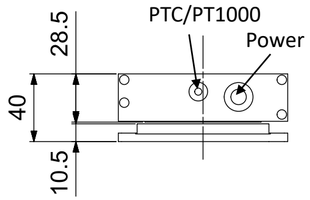
Electrical interfaces



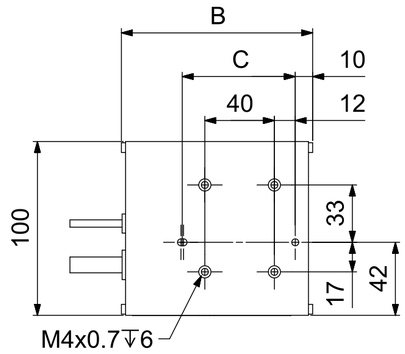
Airgap dependency

CHIRON-S-100 MECHANICAL SPECIFICATIONS



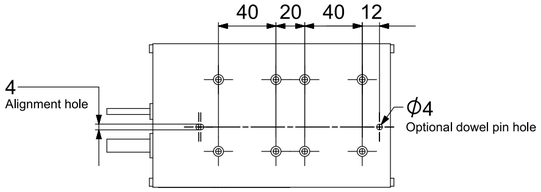


	Parameter	Symbol	Unit	MP-100-12	MP-100-16	MP-100-28	MP-100-36
Magnet Plates	Number of poles	N_p	-	12	16	28	36
	Pole pitch (N-N)	$2\tau_p$	mm	30	30	30	30
	Width	A	mm	180	240	420	540
	Mass	M_{mp}	kg	1.2	1.5	2.7	3.5

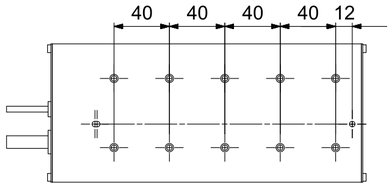


Chiron-CU-S-100-03

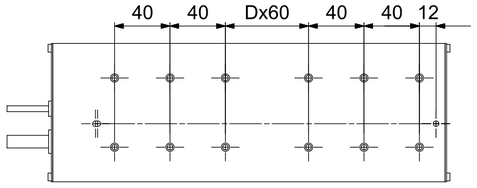
	Parameter	Symbol	Unit	CU-S-100-03	CU-S-100-06	CU-S-100-09	CU-S-100-12	CU-S-100-15	CU-S-100-18	CU-S-100-24	CU-S-100-30
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15	18	24	30
	Coil pitch	τ_{coil}	mm	20	20	20	20	20	20	20	20
	Width	B	mm	110	170	230	290	350	410	530	650
	Center pin distance	C	mm	65	125	185	245	305	365	485	605
	Number of 60 mm pitches	D	mm	0	0	0	1	2	3	5	7
	Mass (ex. cable)	M_{cu}	kg	1.2	2.0	2.8	3.7	4.5	5.4	7.0	8.7
	Standard cable length	L_{cable}	m	1	1	1	1	1	1	1	1



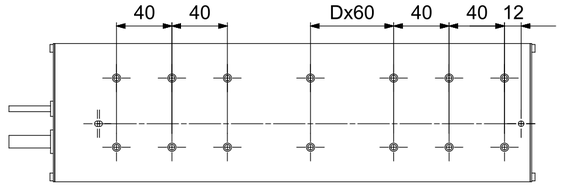
Chiron-CU-S-100-06



Chiron-CU-S-100-09



Chiron-CU-S-100-12



Chiron-CU-S-100-15/18/24/30

CHIRON-S-130 PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-S-130-03	CU-S-130-06		CU-S-130-09		CU-S-130-12			CU-S-130-15		CU-S-130-18				CU-S-130-24				CU-S-130-30			
	Winding configuration	-	-	-	C	B	C	B	C	A	B	C	B	C	A	B	C	D	A	B	C	D	A	B	C	D
Electromechanical	Peak force (α_T = 5°C/s increase)	F_p	N	20	500	1000		1450		2000			2450		2950				3900		3450	3900	4900		3450	4900
	Continuous force, interface at 20°C	F_c	N	100	320	660		970		1310			1610		1930				2580				3220		2800	3220
	Attraction force (I = 0)	F_{att}	N	-	1640	2860		4090		5310			6540		7760				10210				12660			
	Motor constant	S	N^2/W	20	550	1100		1600		2150			2650		3150				4200				5300			
	Force constant (I = I_c)	$K_{f,c}$	N/A_{rms}	-	118	118	247	118	353	241	118	470	118	588	235	118	705	353	235	118	940	470	235	118	1175	588
	Force constant (I = I_p)	$K_{f,p}$	N/A_{rms}	-	111	111	234	111	333	228	111	444	111	555	222	111	665	333	222	111	887	444	222	111	1109	555
	Maximum velocity (F = 0)	v_m	m/s	-	7.1	7.1	3.3	7.1	2.4	3.4	7.1	1.8	7.1	1.4	3.5	7.1	1.2	2.4	3.5	7.1	0.9	1.8	3.5	7.1	0.7	1.4
	Maximum velocity (F = F_p)	v_i	m/s	20	4.1	4.1	1.8	4.1	1.0	1.8	4.1	0.6	4.1	0.4	1.8	4.1	0.2	1.0	1.8	4.1	0.0	0.6	1.8	4.1	0.0	0.4
Electrical	Maximum dc bus voltage	V_{dc}	V	-	690	690		690		690			690		690				690				690			
	Phase resistance	$R_{ph,20}$	Ohm	20	9.0	4.5	18	3.0	27	9.0	2.3	36	1.8	45	6.0	1.5	54	14	4.5	1.1	72	18	3.6	0.9	90	23
	Phase inductance	L_{ph}	mH	20	55	28	110	18.3	165	55	13.8	220	11	275	37	9.2	330	83	28	6.9	440	110	22	5.5	550	138
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	97	97	207	97	292	200	97	390	97	487	195	97	585	292	195	97	780	390	195	97	975	487
	Maximum rms current	I_p	A_{rms}	20	4.4	8.8	4.4	13	4.4	8.8	18	4.4	22	4.4	13	26	4.4	8.8	18	35	3.9	8.8	22	44	3.1	8.8
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	2.7	5.5	2.7	8.2	2.7	5.5	11	2.7	14	2.7	8.2	16	2.7	5.5	11	22	2.7	5.5	14	27	2.4	5.5
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	267	533		800		1067			1333		1600				2133				2667			
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.30	0.15		0.10		0.08			0.060		0.050				0.038				0.030			
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.23	0.12		0.08		0.06			0.047		0.039				0.029				0.023			
	Thermal time constant, interface at 20°C	τ_{th}	s	-	58	58		58		58			58		58				58				58			

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet plate
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications are based upon an airgap of 1 mm
- See ‘definitions’ section at the end of the catalog for more details

Product marking / approvals

CE

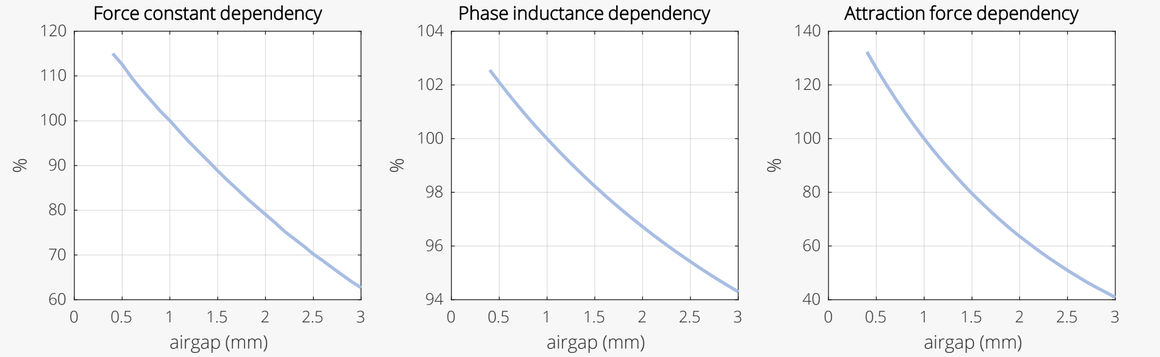
Power Interface:

- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

Thermal Interface:

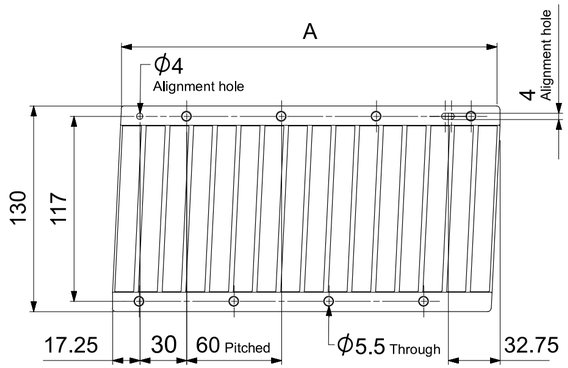
- PT1000 (White)
- PT1000 (Brown)
- PTC (Green)
- PTC (Yellow)

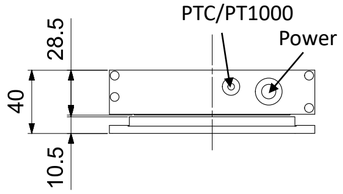
Electrical interfaces



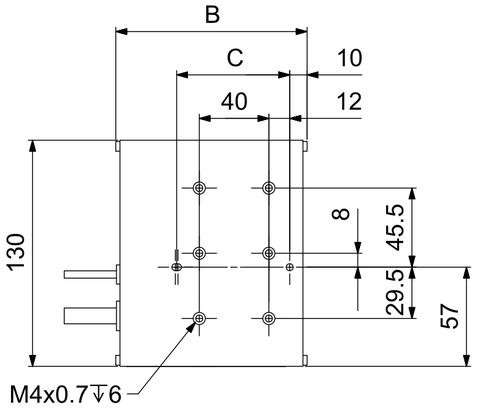
Airgap dependency

CHIRON-S-130 MECHANICAL SPECIFICATIONS



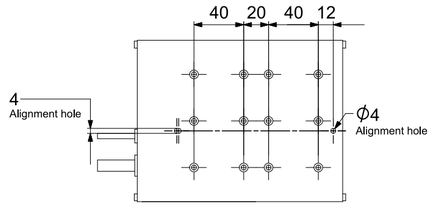


	Parameter	Symbol	Unit	MP-130-12	MP-130-16	MP-130-28	MP-130-36
Magnet Plates	Number of poles	N_p	-	12	16	28	36
	Pole pitch (N-N)	$2\tau_p$	mm	30	30	30	30
	Width	A	mm	180	240	420	540
	Mass	M_{mp}	kg	1.5	2.0	3.6	4.6

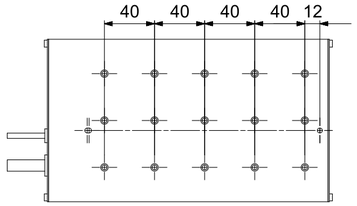


Chiron-CU-S-130-03

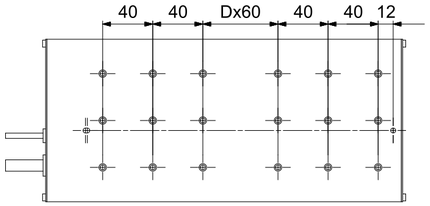
	Parameter	Symbol	Unit	CU-S-130-03	CU-S-130-06	CU-S-130-09	CU-S-130-12	CU-S-130-15	CU-S-130-18	CU-S-130-24	CU-S-130-30
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15	18	24	30
	Coil pitch	τ_{coil}	mm	20	20	20	20	20	20	20	20
	Width	B	mm	110	170	230	290	350	410	530	650
	Center pin distance	C	mm	65	125	185	245	305	365	485	605
	Number of 60 mm pitches	D	mm	0	0	0	1	2	3	5	7
	Mass (ex. cable)	M_{cu}	kg	1.5	2.7	3.8	5.0	6.1	7.3	9.6	11.9
	Standard cable length	L_{cable}	m	1	1	1	1	1	1	1	1



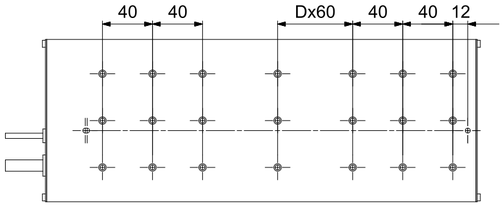
Chiron-CU-S-130-06



Chiron-CU-S-130-09

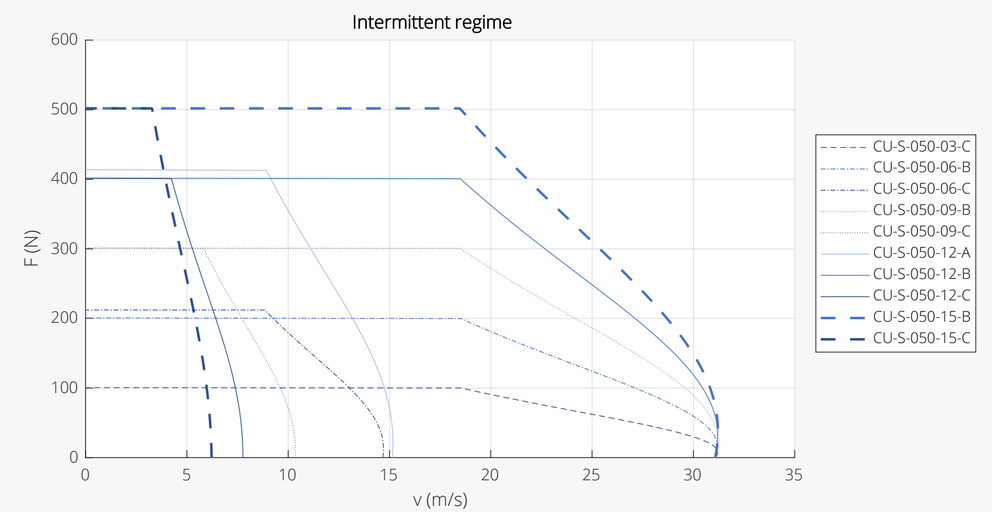


Chiron-CU-S-130-12

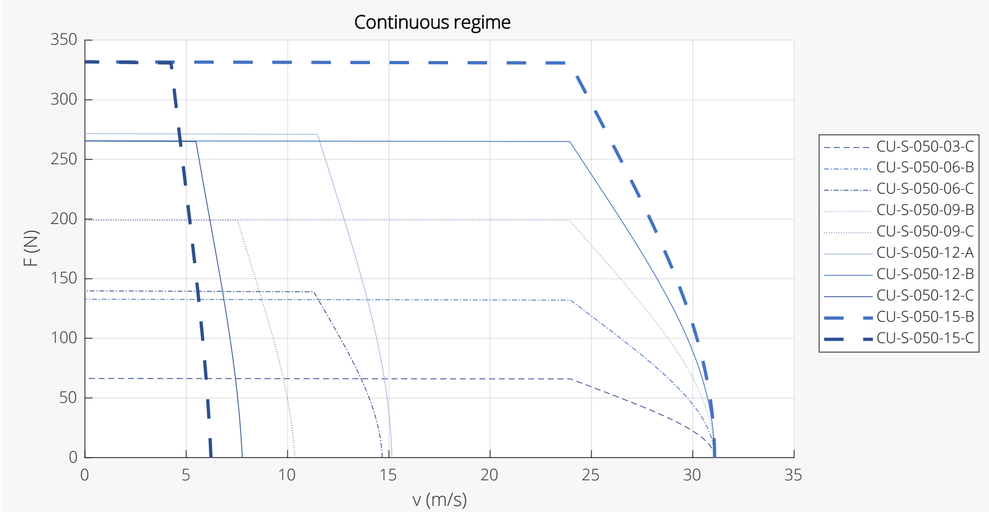


Chiron-CU-S-130-15/18/24/30

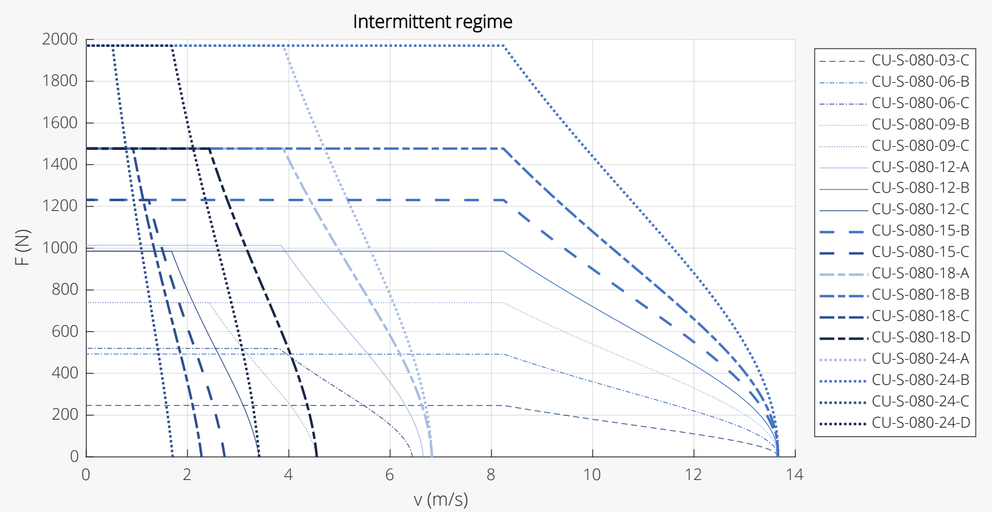
CHIRON-S-050/080 FORCE-VELOCITY DIAGRAMS



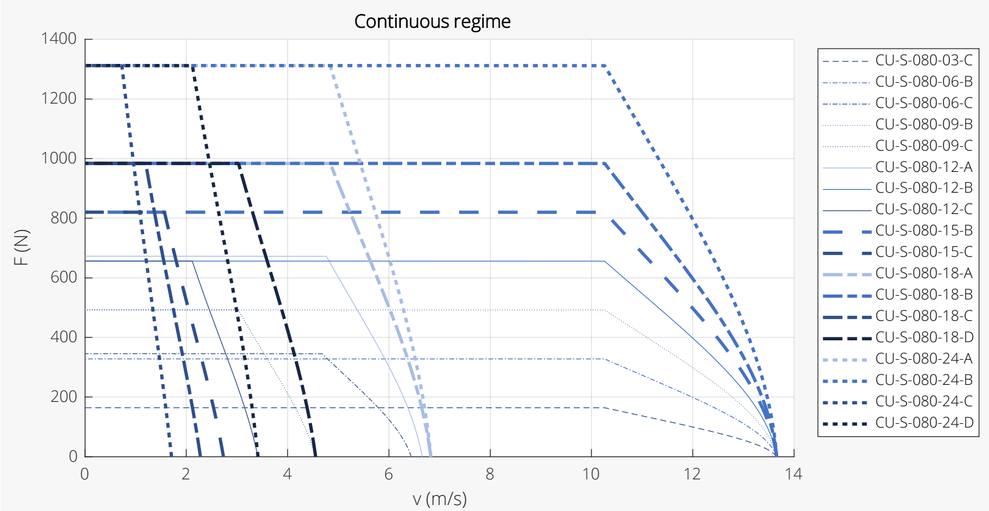
Force-Velocity Diagrams Size S-050 Intermittent Regime



Force-Velocity Diagrams Size S-050 Continuous Regime

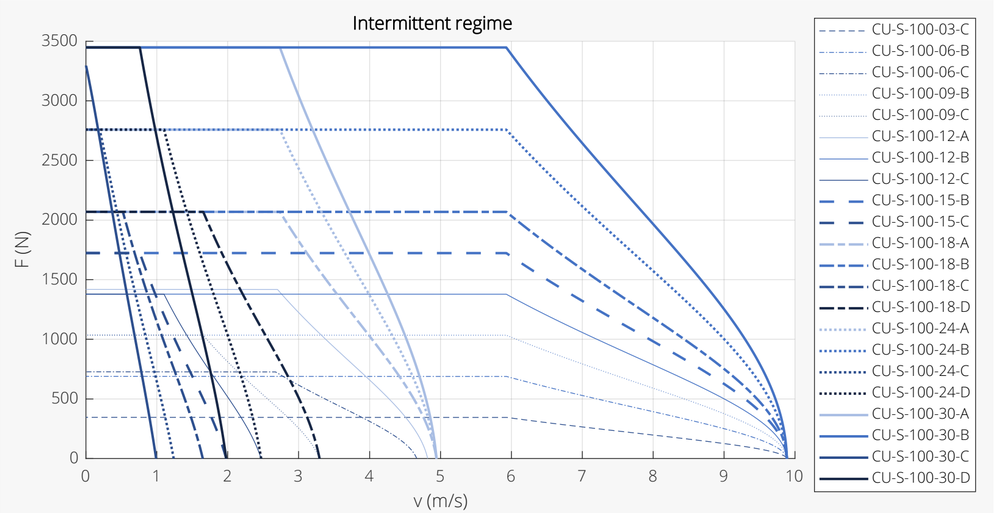


Force-Velocity Diagrams Size S-080 Intermittent Regime

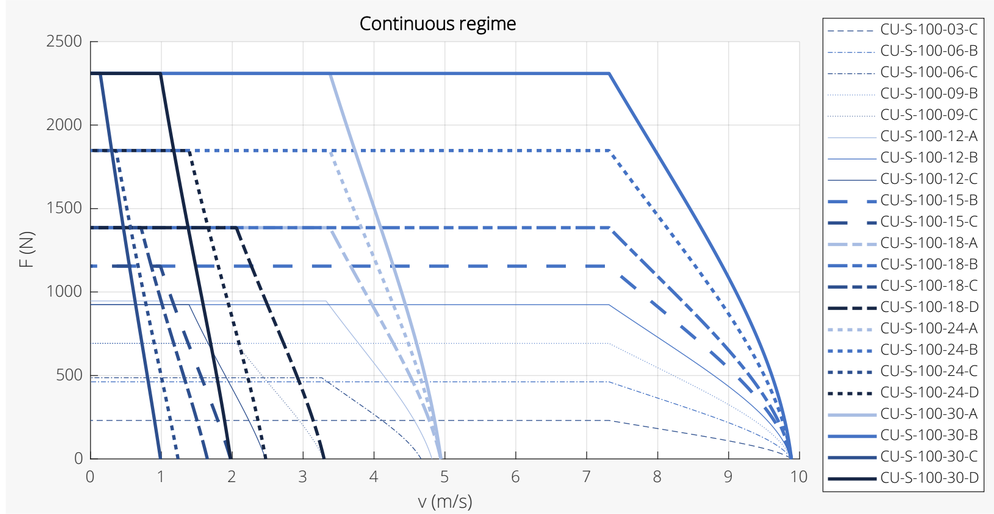


Force-Velocity Diagrams Size S-080 Continuous Regime

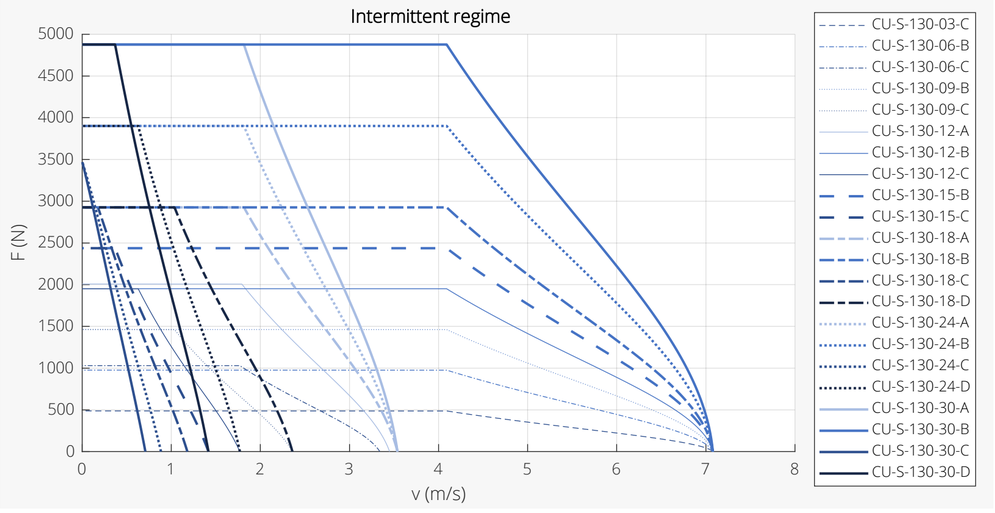
CHIRON-S-100/130 FORCE-VELOCITY DIAGRAMS



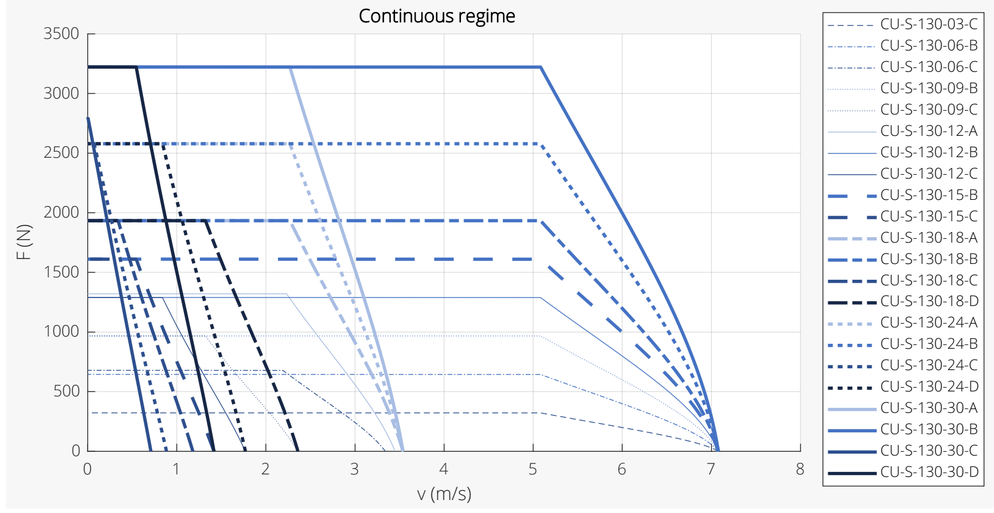
Force-Velocity Diagrams Size S-100 Intermittent Regime



Force-Velocity Diagrams Size S-100 Continuous Regime



Force-Velocity Diagrams Size S-130 Intermittent Regime



Force-Velocity Diagrams Size S-130 Continuous Regime

CHIRON COMMUTATION SENSORS

Chiron commutations sensor (Chiron-CS-D)

- For correct operation of a linear motor, the commutation angle (the electrical angle between the coil unit and the magnet yoke) should be known. This commutation angle is needed to determine the phase angle of the three phase currents.

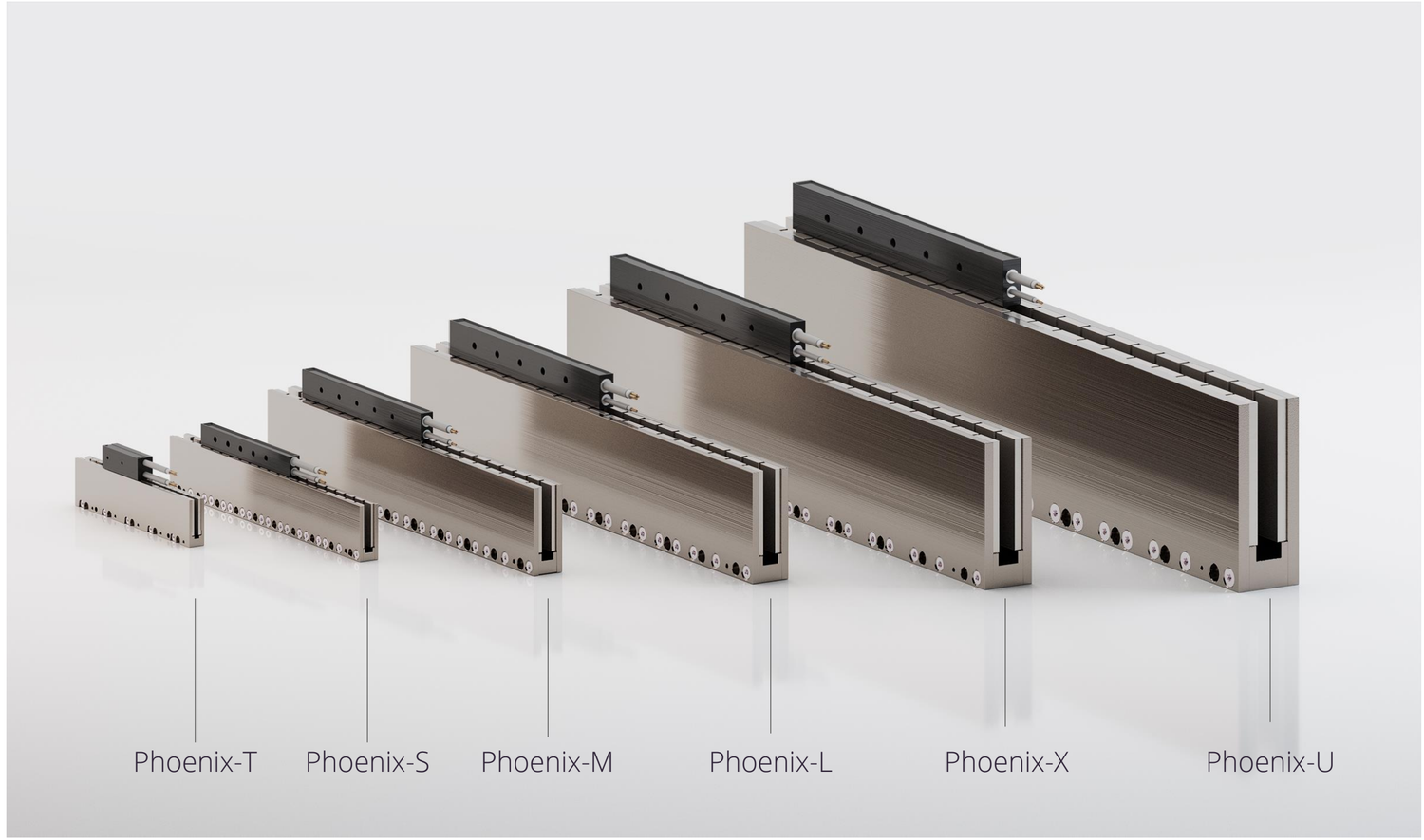
- The commutation angle can be derived from the relative displacement, for example using a position sensor. However, the Chiron commutation sensor can directly measure the commutation angle without the need of a position sensor. The Chiron commutation sensor can be added to your motion system which provides a cost-effective alternative to measure the commutation angle.

- The Chiron commutation sensor is available in two types. The digital type (Chiron-CS-D) contains three digital Hall sensors, each shifted by 120 electrical degrees, from which the commutation angle can be derived. The analog type (Chiron-CS-A) contains two analog Hall sensors, each shifted by 90 electrical degrees, providing sin/cos signals for a more accurate measurement of the commutation angle. Both commutation sensor types can be used for the complete range of sizes.

- The digital commutation sensor allows a supply voltage range between 4.5 Vdc and 28 Vdc. The supply voltage of the analog commutation sensor should be 5 Vdc.

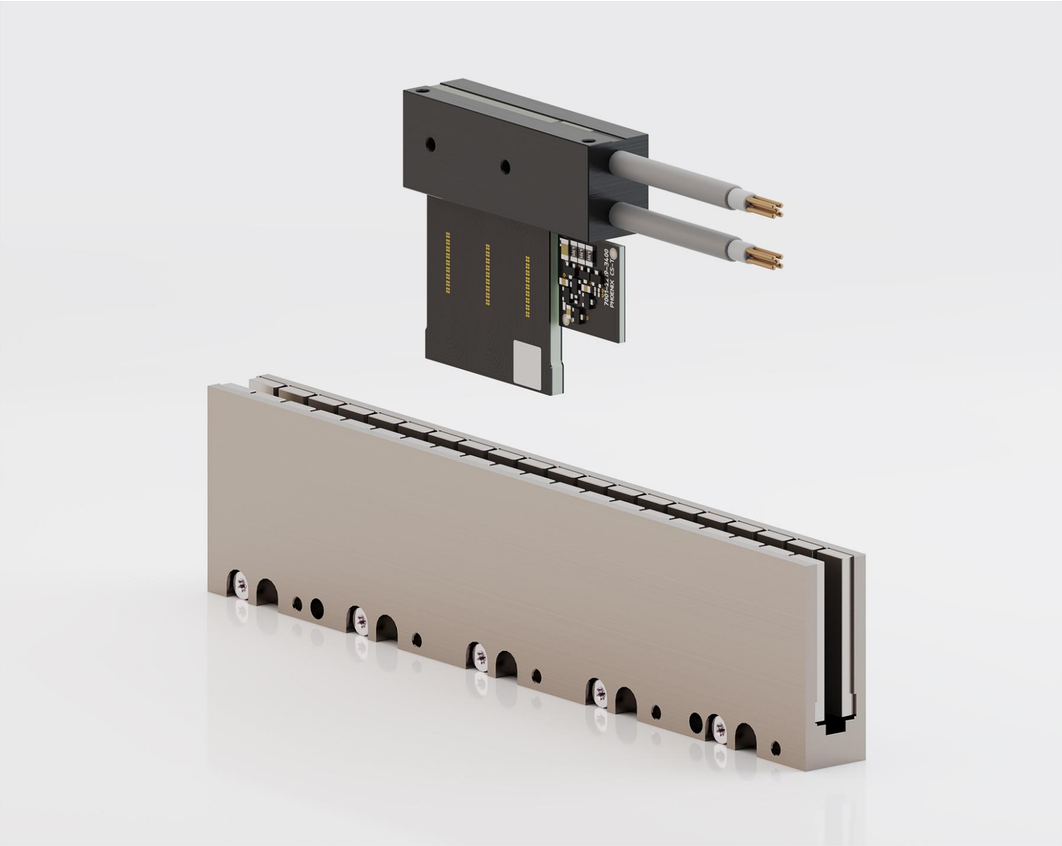
PHOENIX LINE

The Phoenix line offers ironless linear motors, for applications requiring an extremely low force ripple for excellent servo performance without attraction forces. Available in a large range of sizes.



Phoenix line linear motors in different sizes

PHOENIX-T FEATURES



Phoenix-T magnet yoke (Phoenix-MY-T-20-G00) and coil unit (Phoenix-CU-T-03-C-S-P-CS)

Phoenix-CU-T-06-A-S-P-CS

- Commutation sensor (NS = without sensor / CS with sensor)
- Cable output direction (P = parallel / O = orthogonal)
- Thermal interface (S = PT1000)
- Winding configuration (A / C)
- # of coils
- Size (T)
- Coil unit

Phoenix-MY-T-20-G00

- Additional airgap x 0.1 mm on each side
- # of poles
- Size (T)
- Magnet yoke

- Different cable output directions for optimal mechanical integration
- Coil units have a temperature sensor (PT1000)
- Motor phases and temperature sensor are integrated in a single cable
- Motor coils are made with PCB technology to improve quality and minimize cost
- Optional commutation sensor (CS), digital Hall, integrated in the coil unit
- Magnet yokes can be butted together
- Magnet yokes can be selected with larger airgaps to allow higher installation tolerances
- Extremely low force ripple due to ironless coil unit
- No attraction force
- Coil units are equipped with flex cables

PHOENIX-T PERFORMANCE SPECIFICATIONS

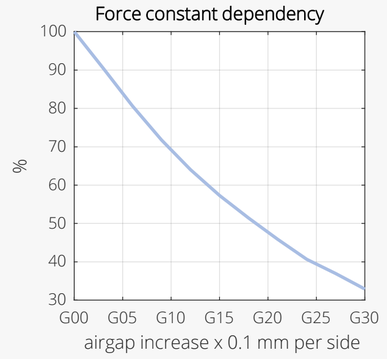
	Parameter	Symbol	Unit	T_{coil} (°C)	CU-T-03	CU-T-06
	Winding configuration	-	-	-	C	A
Electromechanical	Peak force (α_T = 20°C/s increase)	F_p	N	20	26	52
Electromechanical	Continuous force, interface at 20°C	F_c	N	100	9	17
Electromechanical	Attraction force (I = 0)	F_{att}	N	-	0	0
Electromechanical	Motor constant	S	N^2/W	20	6	12
Electromechanical	Force constant	K_f	N/A_{rms}	-	10.2	10.2
Electromechanical	Maximum velocity (F = 0)	v_m	m/s	-	7.2	7.2
Electromechanical	Maximum velocity (F = F_p)	v_i	m/s	20	2.8	2.8
Electrical	Maximum dc bus voltage	V_{dc}	V	-	60	60
Electrical	Phase resistance	$R_{ph,20}$	Ohm	20	5.8	2.9
Electrical	Phase inductance	L_{ph}	mH	20	0.50	0.25
Electrical	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	8	8
Electrical	Maximum rms current	I_p	A_{rms}	20	2.5	5.1
Electrical	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	0.8	1.7
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	16	33
Thermal	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	4.9	2.5
Thermal	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.58	0.29
Thermal	Thermal time constant, interface at 20°C	τ_{th}	s	-	45	45

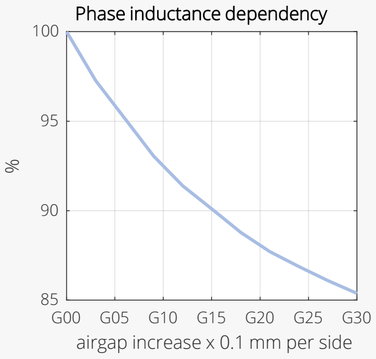
Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet yoke
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications consider a magnet yoke with nominal airgap (G00)
- See ‘definitions’ section at the end of the catalog for more details

Power/PT1000 Interface:
- Phase U (White)
- Phase V (Brown)
- Phase W (Green)
- PT1000 (Yellow)
- PT1000 (Grey)

Comm. Sensor Interface:
- GND (White)
- VCC (Brown)
- Hall A (Green)
- Hall B (Yellow)
- Hall C (Grey)

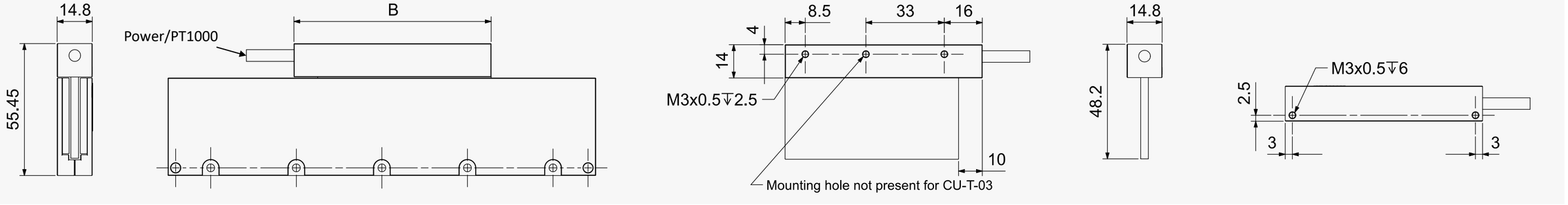




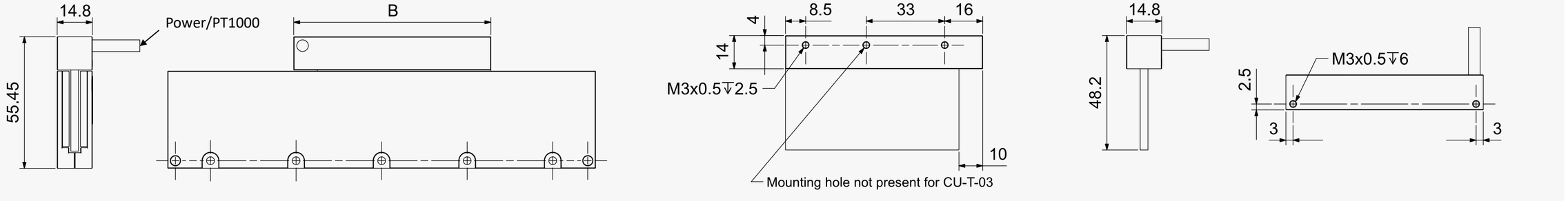
Electrical interfaces

Airgap dependency

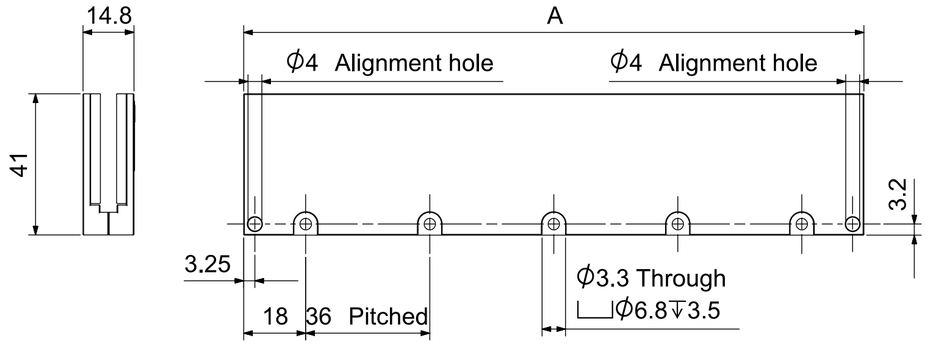
PHOENIX-T MECHANICAL SPECIFICATIONS WITHOUT CS



Parallel cable output



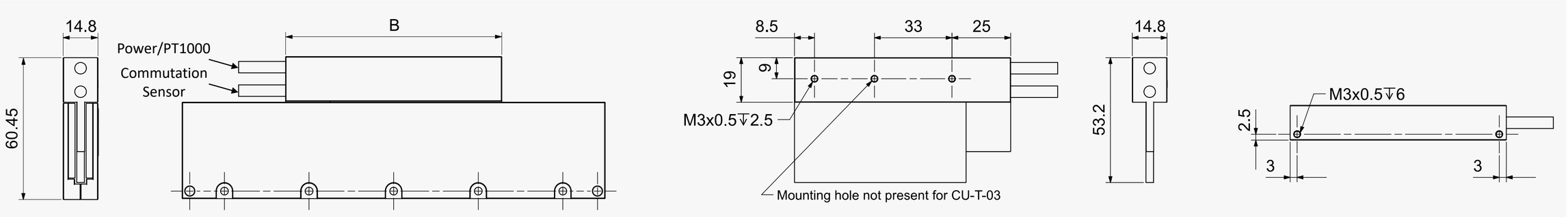
Orthogonal cable output



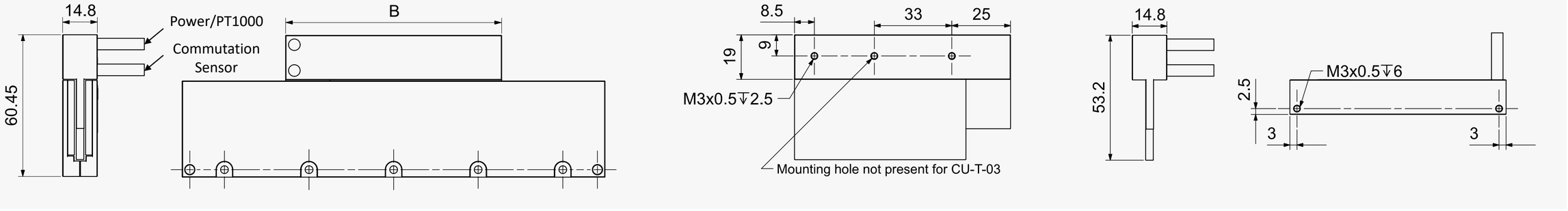
	Parameter	Symbol	Unit	MY-T-08	MY-T-12	MY-T-16	MY-T-20
Magnet Yokes	Number of poles	N_p	-	8	12	16	20
	Pole pitch (N-N)	$2\tau_p$	mm	18	18	18	18
	Width	A	mm	72	108	144	180
	Mass	M_{my}	kg	0.21	0.32	0.43	0.53

	Parameter	Symbol	Unit	CU-T-03	CU-T-06
Coil Units	Number of coils	N_{coil}	-	3	6
	Coil pitch	τ_{coil}	mm	12	12
	Width	B	mm	47	83
	Mass (ex. cable)	M_{cu}	kg	0.038	0.071
	Standard cable length	L_{cable}	m	1	1

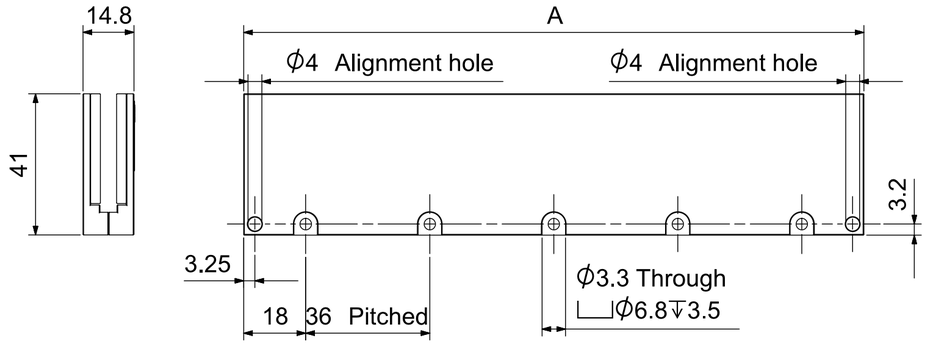
PHOENIX-T MECHANICAL SPECIFICATIONS WITH CS



Parallel cable output



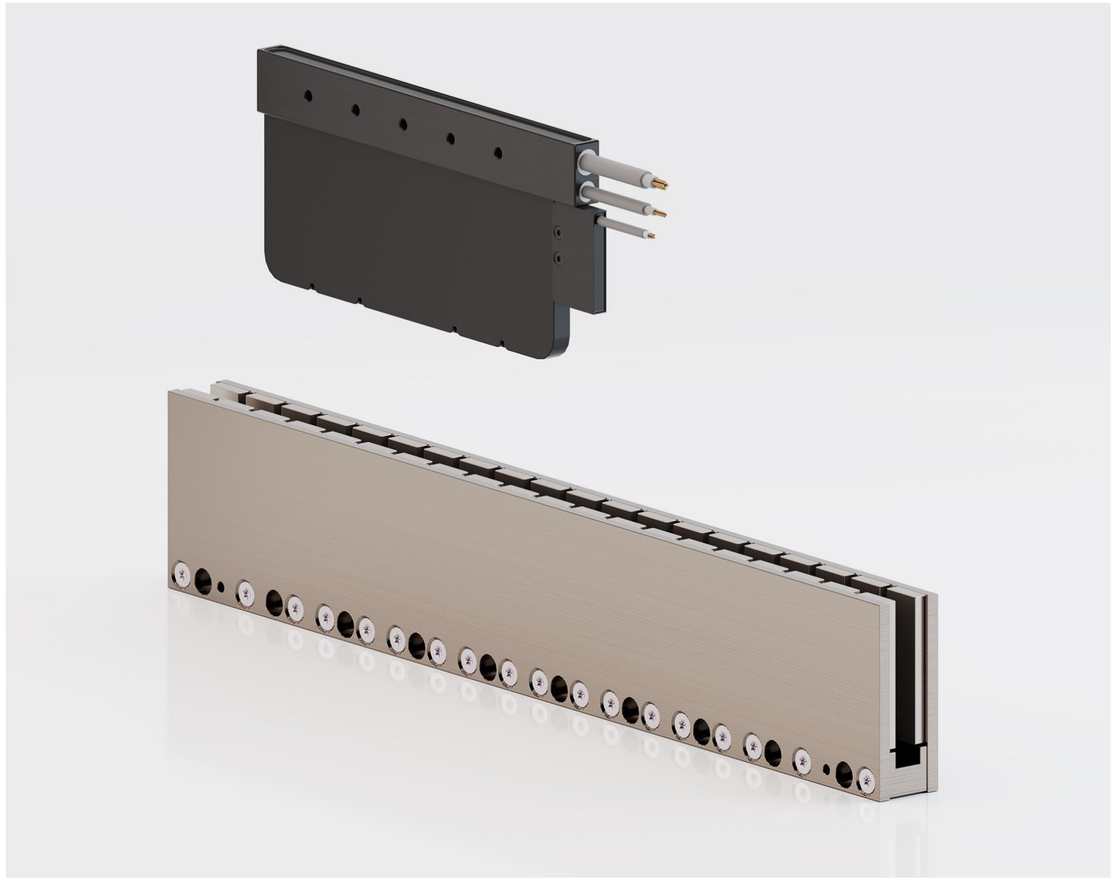
Orthogonal cable output



	Parameter	Symbol	Unit	MY-T-08	MY-T-12	MY-T-16	MY-T-20
Magnet Yokes	Number of poles	N_p	-	8	12	16	20
	Pole pitch (N-N)	$2\tau_p$	mm	18	18	18	18
	Width	A	mm	72	108	144	180
	Mass	M_{my}	kg	0.21	0.32	0.43	0.53

	Parameter	Symbol	Unit	CU-T-03	CU-T-06
Coil Units	Number of coils	N_{coil}	-	3	6
	Coil pitch	τ_{coil}	mm	12	12
	Width	B	mm	56	92
	Mass (ex. cable)	M_{cu}	kg	0.051	0.089
	Standard cable length	L_{cable}	m	1	1

PHOENIX-S/M/L/X/U FEATURES



Phoenix-S magnet yoke (Phoenix-MY-S-20-G00), coil unit (Phoenix-CU-S-06-A-B) and commutation sensor (Phoenix-CS-S)

Phoenix-CU-M-12-A-N

- Thermal interface (N = none / S = PT1000 / P = PTC / B = PTC+PT1000)
- Winding configuration (A / B / C / D)
- # of coils
- Size (S / M / L / X / U)
- Coil unit

Phoenix-MY-M-20-G00

- Additional airgap x 0.1 mm on each side
- # of poles
- Size (S / M / L / X / U)
- Magnet yoke

Phoenix-CS-M

- Size (S / M / L / X / U)
- Commutation sensor

- Multiple sizes for optimal mechanical integration
- Multiple winding configurations for optimal current/velocity matching
- Coil units have an optional temperature protection (PTC) and/or sensor (PT1000)
- Magnet yokes can be butted together
- Magnet yokes can be selected with larger airgaps to accommodate larger tolerances
- Extremely low force ripple due to ironless coil unit
- No attraction force
- IP rating of coil units is IP69K
- Optional commutation sensor (digital Hall A/B/C) can be connected to the coil unit

PHOENIX-S PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-S-03		CU-S-06			CU-S-09			CU-S-12	
	Winding configuration	-	-	-	C	D	A	B	C	A	C	D	C	D
Electromechanical	Peak force (α_T = 20°C/s increase)	F_p	N	20	80		160			230			310	
	Continuous force, interface at 20°C	F_c	N	100	25		50			75			95	
	Attraction force (I = 0)	F_{att}	N	-	0		0			0			0	
	Motor constant	S	N^2/W	20	20		40			60			80	
	Force constant	K_f	N/A_{rms}	-	17	8.6	17	8.6	34	17	51	26	68	34
	Maximum velocity (F = 0)	v_m	m/s	-	29	57	29	57	14	29	9.5	19	7.2	14
	Maximum velocity (F = F_p)	v_i	m/s	20	24	52	24	52	10	24	5.4	15	3.1	10
Electrical	Maximum dc bus voltage	V_{dc}	V	-	400		400			400			400	
	Phase resistance	$R_{ph,20}$	Ohm	20	5.0	1.3	2.5	0.6	10	1.7	15	3.8	20	5.0
	Phase inductance	L_{ph}	mH	20	1.5	0.4	0.7	0.2	3.0	0.5	4.4	1.1	5.9	1.5
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	14	7.0	14	7.0	28	14	42	21	56	28
	Maximum rms current	I_p	A_{rms}	20	4.5	9.1	9.1	18.2	4.5	13.6	4.5	9.1	4.5	9.1
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	1.4	2.8	2.8	5.7	1.4	4.2	1.4	2.8	1.4	2.8
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	40		79			119			159	
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	2.0		1.0			0.67			0.5	
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.19		0.093			0.062			0.047	
	Thermal time constant, interface at 20°C	τ_{th}	s	-	65		65			65			65	

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet yoke
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications consider a magnet yoke with nominal airgap (G00)
- See ‘definitions’ section at the end of the catalog for more details

Product marking / approvals

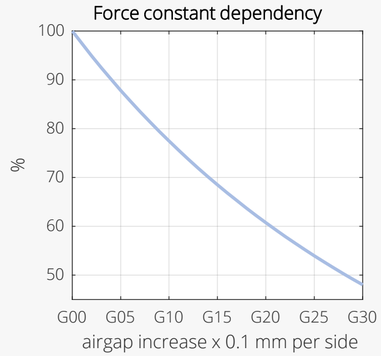
CE

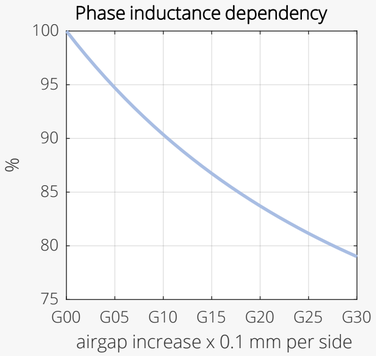
Power Interface:
- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

Thermal Interface (only N/S/P):
- PT1000 (White)
- PT1000 (Brown)

or
- PTC (Green)
- PTC (Yellow)

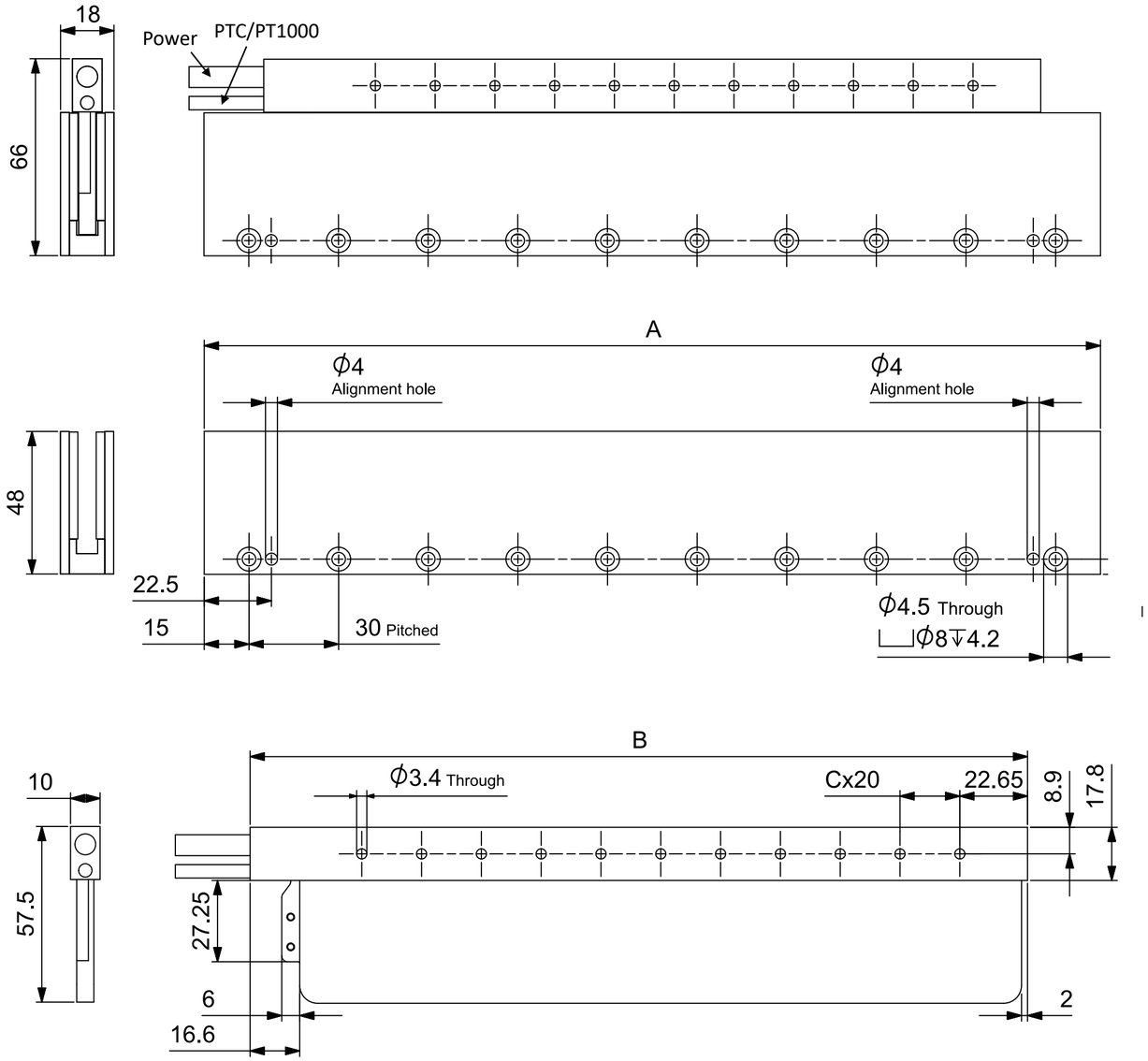
Electrical interfaces





Airgap dependency

PHOENIX-S MECHANICAL SPECIFICATIONS



	Parameter	Symbol	Unit	MY-S-08	MY-S-10	MY-S-12	MY-S-20	MY-S-28
Magnet Yokes	Number of poles	N_p	-	8	10	12	20	28
	Pole pitch (N-N)	$2\tau_p$	mm	30	30	30	30	30
	Width	A	mm	120	150	180	300	420
	Mass	M_{my}	kg	0.5	0.6	0.7	1.1	1.6

	Parameter	Symbol	Unit	CU-S-03	CU-S-06	CU-S-09	CU-S-12
Coil Units	Number of coils	N_{coil}	-	3	6	9	12
	Coil pitch	τ_{coil}	mm	20	20	20	20
	Width	B	mm	80	140	200	260
	Number of hole pitches	C	-	1	4	7	10
	Mass (ex. cable)	M_{cu}	kg	0.13	0.20	0.26	0.33
	Standard cable length	L_{cable}	m	1	1	1	1

PHOENIX-M PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-M-03		CU-M-06			CU-M-09				CU-M-12				CU-M-15			
	Winding configuration	-	-	-	C	D	A	B	C	A	B	C	D	A	B	C	D	A	B	C	D
Electromechanical	Peak force (α_T = 20°C/s increase)	F_p	N	20	300		650			950		750	950	1250		750	1250	1600		750	1550
	Continuous force, interface at 20°C	F_c	N	100	70		140			210				270				340			
	Attraction force (I = 0)	F_{att}	N	-	0		0			0				0				0			
	Motor constant	S	N^2/W	20	100		200			300				400				500			
	Force constant	K_f	N/A_{rms}	-	63	32	63	32	125	63	32	188	95	63	32	251	126	63	32	314	158
	Maximum velocity (F = 0)	v_m	m/s	-	7.8	16	7.8	16	3.9	7.8	16	2.6	5.2	7.8	16	2.0	3.9	7.8	16	1.6	3.1
	Maximum velocity (F = F_p)	v_i	m/s	20	4.5	12	4.5	12	0.7	4.5	12	0.0	2.0	4.5	12	0.0	0.7	4.5	12	0.0	0.0
Electrical	Maximum dc bus voltage	V_{dc}	V	-	400		400			400				400				400			
	Phase resistance	$R_{ph,20}$	Ohm	20	13	3.3	6.6	1.6	27	4.4	1.1	40	10	3.3	0.8	53	13	2.7	0.7	66	16
	Phase inductance	L_{ph}	mH	20	8.3	2.1	4.1	1.0	17	2.8	0.7	25	6.3	2.1	0.5	33	8.4	1.7	0.4	41	10
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	51	26	51	26	102	51	26	154	77	51	26	205	103	51	26	256	129
	Maximum rms current	I_p	A_{rms}	20	5.0	10	10	20	5.0	15	30	4.1	10	20	40	3.1	10	25	50	2.5	10
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	1.1	2.2	2.2	4.4	1.1	3.3	6.6	1.1	2.2	4.4	8.8	1.1	2.2	5.4	11	1.1	2.2
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	62		124			186				247				309			
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	1.3		0.65			0.43				0.32				0.26			
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.098		0.049			0.033				0.024				0.020			
	Thermal time constant, interface at 20°C	τ_{th}	s	-	160		160			160				160				160			

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet yoke
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications consider a magnet yoke with nominal airgap (G00)
- See ‘definitions’ section at the end of the catalog for more details

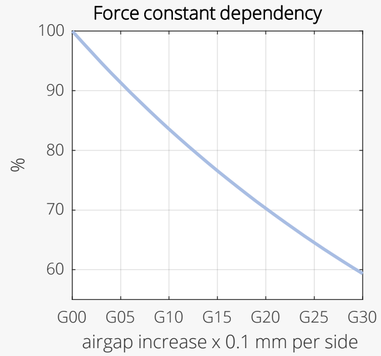
Product marking / approvals

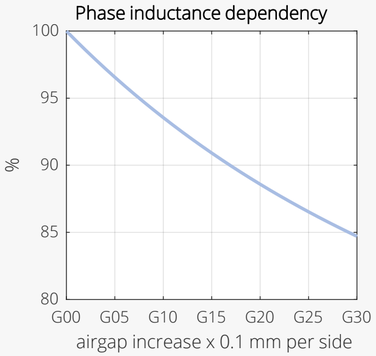
CE

Power Interface:
- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

Thermal Interface (only N/B):
- PT1000 (White)
- PT1000 (Brown)
- PTC (Green)
- PTC (Yellow)

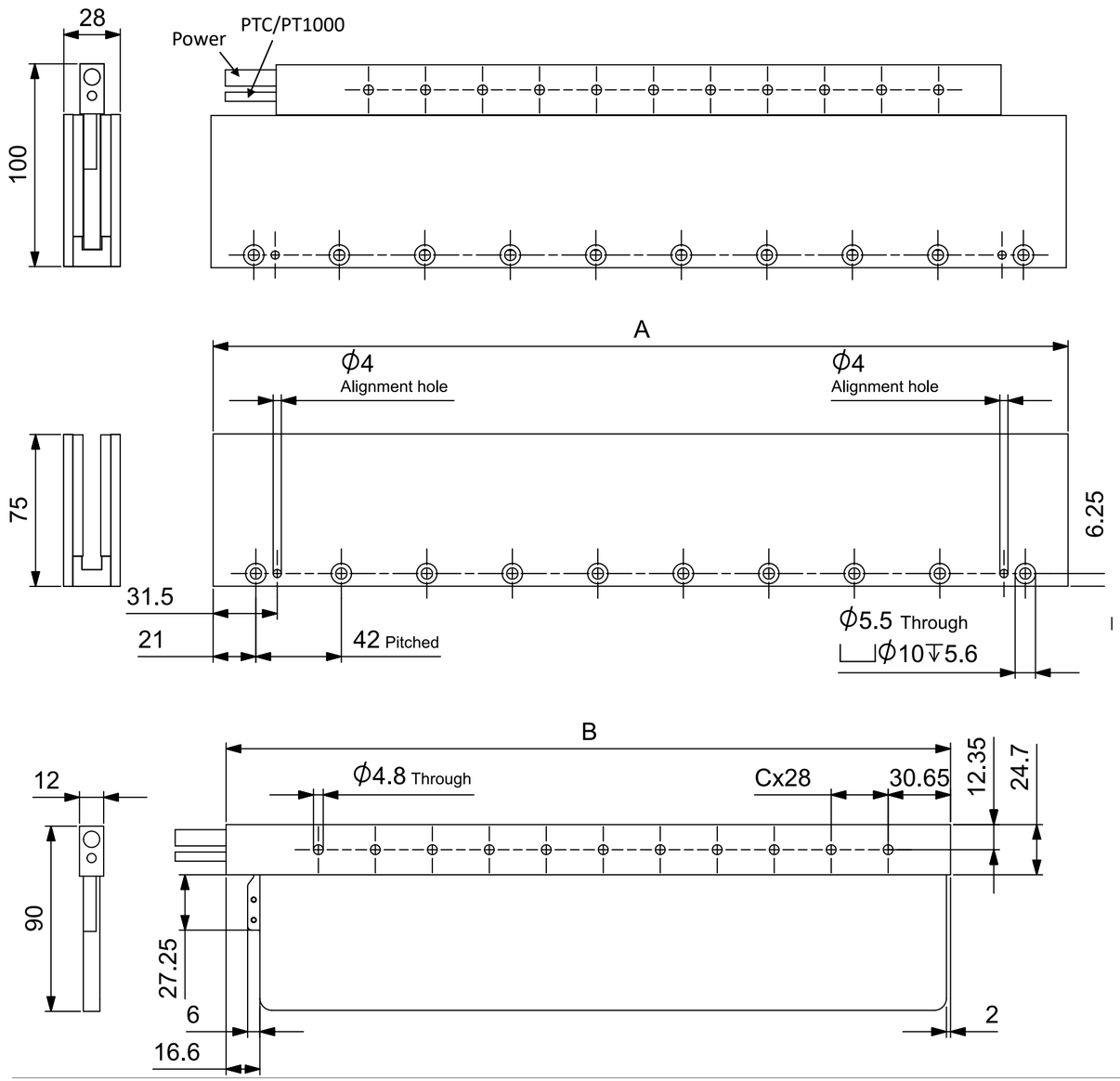
Electrical interfaces





Airgap dependency

PHOENIX-M MECHANICAL SPECIFICATIONS



	Parameter	Symbol	Unit	MY-M-08	MY-M-10	MY-M-12	MY-M-20	MY-M-48
Magnet Yokes	Number of poles	N_p	-	8	10	12	20	48
	Pole pitch (N-N)	$2\tau_p$	mm	42	42	42	42	42
	Width	A	mm	168	210	252	420	1008
	Mass	M_{my}	kg	1.7	2.1	2.5	4.2	10.0

	Parameter	Symbol	Unit	CU-M-03	CU-M-06	CU-M-09	CU-M-12	CU-M-15
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15
	Coil pitch	τ_{coil}	mm	28	28	28	28	28
	Width	B	mm	104	188	272	356	440
	Number of hole pitches	C	-	1	4	7	10	13
	Mass (ex. cable)	M_{cu}	kg	0.31	0.51	0.71	0.9	1.1
	Standard cable length	L_{cable}	m	1	1	1	1	1

PHOENIX-L PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-L-03		CU-L-06			CU-L-09				CU-L-12			CU-L-15			CU-L-18		
	Winding configuration	-	-	-	C	D	A	B	C	A	B	C	D	A	C	D	A	C	D	A	C	D
Electromechanical	Peak force (α_T = 20°C/s increase)	F_p	N	20	700		1350			2050		1850	2050	2700	1850	2700	3400	1850	3400	4050	1850	4050
	Continuous force, interface at 20°C	F_c	N	100	125		245			370				490			615			735		
	Attraction force (I = 0)	F_{att}	N	-	0		0			0				0			0			0		
	Motor constant	S	N^2/W	20	230		460			700				930			1160			1390		
	Force constant	K_f	N/A_{rms}	-	107	48	107	48	214	107	48	321	145	107	428	193	107	535	241	107	641	289
	Maximum velocity (F = 0)	v_m	m/s	-	7.9	18	7.9	18	4.0	7.9	18	2.6	5.8	7.9	2.0	4.4	7.9	1.6	3.5	7.9	1.3	2.9
	Maximum velocity (F = F_p)	v_i	m/s	20	4.8	13.9	4.8	14	1.0	4.8	14	0.0	2.8	4.8	0.0	1.4	4.8	0.0	0.6	4.8	0.0	0.0
Electrical	Maximum dc bus voltage	V_{dc}	V	-	690		690			690				690			690			690		
	Phase resistance	$R_{ph,20}$	Ohm	20	16	3.3	8.2	1.7	33	5.5	1.1	49	10	4.1	66	13	3.3	82	17	2.7	99	20
	Phase inductance	L_{ph}	mH	20	18	3.6	8.9	1.8	35	5.9	1.2	53	11	4.4	71	14	3.5	89	18	3.0	106	22
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	87	39	87	39	175	87	39	262	118	87	349	157	87	436	197	87	524	236
	Maximum rms current	I_p	A_{rms}	20	6.3	14	13	28	6.3	19	42	5.7	14	25	4.3	14	32	3.4	14	38	2.9	14
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	1.1	2.5	2.3	5.1	1.1	3.4	7.6	1.1	2.5	4.6	1.1	2.5	5.7	1.1	2.5	6.9	1.1	2.5
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	85		170			254				339			424			509		
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.94		0.47			0.31				0.24			0.19			0.16		
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.067		0.033			0.022				0.017			0.013			0.011		
	Thermal time constant, interface at 20°C	τ_{th}	s	-	180		180			180				180			180			180		

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet yoke
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications consider a magnet yoke with nominal airgap (G00)
- See ‘definitions’ section at the end of the catalog for more details

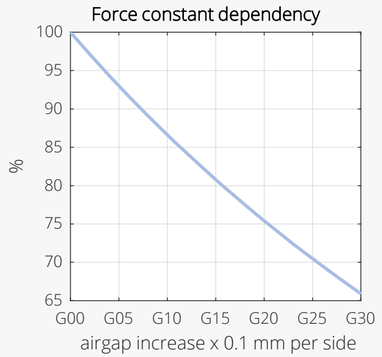
Product marking / approvals

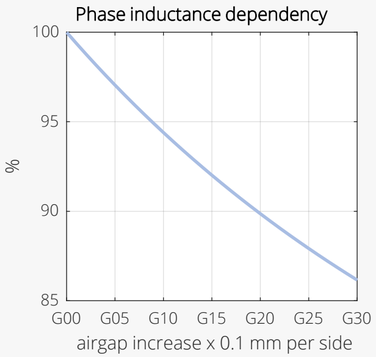
CE

Power Interface:
- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

Thermal Interface (only N/B):
- PT1000 (White)
- PT1000 (Brown)
- PTC (Green)
- PTC (Yellow)

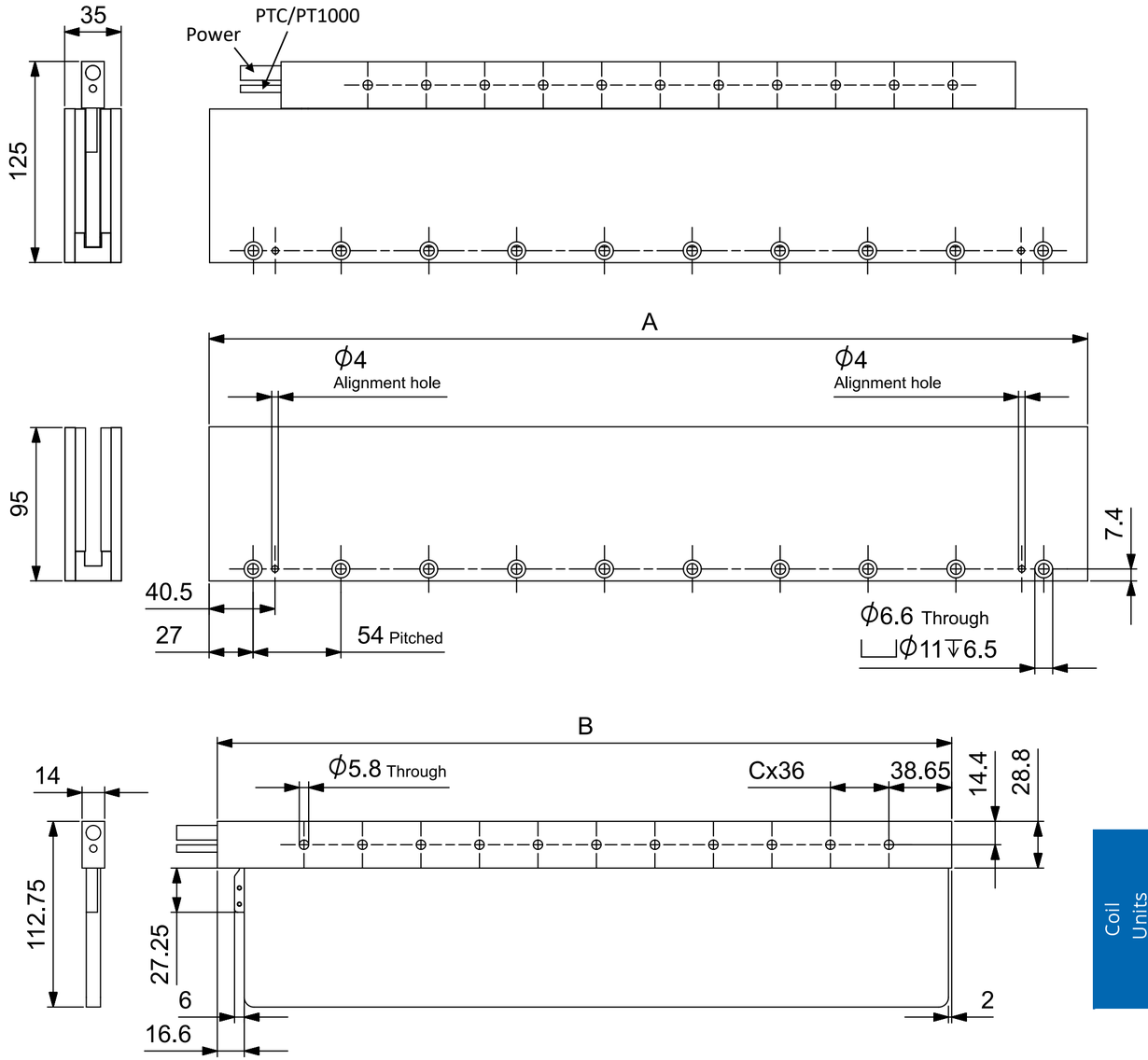
Electrical interfaces





Airgap dependency

PHOENIX-L MECHANICAL SPECIFICATIONS



	Parameter	Symbol	Unit	MY-L-08	MY-L-10	MY-L-12	MY-L-20	MY-L-36
Magnet Yokes	Number of poles	N_p	-	8	10	12	20	36
	Pole pitch (N-N)	$2\tau_p$	mm	54	54	54	54	54
	Width	A	mm	216	270	324	540	972
	Mass	M_{my}	kg	3.6	4.5	5.4	9.0	16.1

	Parameter	Symbol	Unit	CU-L-03	CU-L-06	CU-L-09	CU-L-12	CU-L-15	CU-L-18
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15	18
	Coil pitch	τ_{coil}	mm	36	36	36	36	36	36
	Width	B	mm	128	236	344	452	560	668
	Number of hole pitches	C	-	1	4	7	10	13	16
	Mass (ex. cable)	M_{cu}	kg	0.52	0.9	1.3	1.7	2.1	2.4
	Standard cable length	L_{cable}	m	1	1	1	1	1	1

PHOENIX-X PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-X-03		CU-X-06			CU-X-09				CU-X-12				CU-X-15				CU-X-18		
	Winding configuration	-	-	-	C	D	A	B	C	A	B	C	D	A	B	C	D	A	B	C	D	A	C	D
Electromechanical	Peak force (α_T = 20°C/s increase)	F_p	N	20	1600		3250			4850		3500	4800	6450		3500	6400	8050		3500	7850	6600	5700	5600
	Continuous force, interface at 20°C	F_c	N	100	215		430			645				860				1075				1295		
	Attraction force (I = 0)	F_{att}	N	-	0		0			0				0				0				0		
	Motor constant	S	N^2/W	20	590		1190			1780				2370				2960				3570		
	Force constant	K_f	N/A_{rms}	-	144	63	144	63	288	144	63	433	189	144	63	577	252	144	63	721	315	144	865	378
	Maximum velocity (F = 0)	v_m	m/s	-	5.9	13	5.9	13	2.9	5.9	13	2.0	4.5	5.9	13	1.5	3.4	5.9	13	1.2	2.7	5.9	1.0	2.2
	Maximum velocity (F = F_p)	v_i	m/s	20	3.0	10	3.0	10	0.2	3.0	10	0.0	1.7	3.0	10	0.0	0.6	3.0	10	0.0	0.0	3.0	0.0	0.0
Electrical	Maximum dc bus voltage	V_{dc}	V	-	690		690			690				690				690				690		
	Phase resistance	$R_{ph,20}$	Ohm	20	11.6	2.3	5.8	1.1	23	3.9	0.8	35	6.8	2.9	0.6	46	9.0	2.3	0.5	58	11	1.9	69	14
	Phase inductance	L_{ph}	mH	20	21	4.0	10.5	2.0	42	7.0	1.3	63	12	5.3	1.0	84	16	4.2	0.8	105	20	3.5	126	24
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	118	51	118	51	235	118	51	353	154	118	51	471	206	118	51	589	257	118	706	309
	Maximum rms current	I_p	A_{rms}	20	11	25	22	51	11	34	76	8	25	45	102	6.1	25	56	127	4.9	25	67	4.1	21
	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	1.5	3.4	3.0	6.8	1.5	4.5	10	1.5	3.4	6.0	14	1.5	3.4	7.5	17	1.5	3.4	9	1.5	3.4
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	103		205			308				410				513				615		
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.78		0.39			0.26				0.20				0.16				0.13		
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.046		0.023			0.015				0.012				0.0092				0.0077		
	Thermal time constant, interface at 20°C	τ_{th}	s	-	320		320			320				320				320				320		

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet yoke
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications consider a magnet yoke with nominal airgap (G00)
- See ‘definitions’ section at the end of the catalog for more details

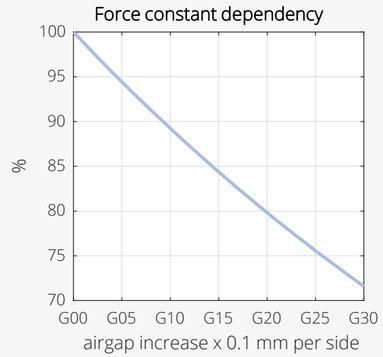
Product marking / approvals

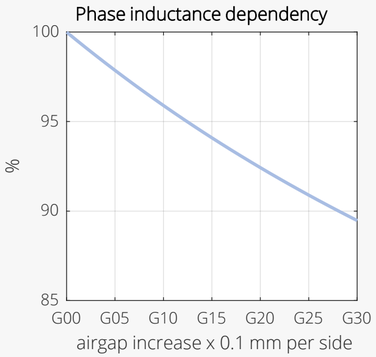
CE

Power Interface:
- Phase U (L1)
- Phase V (L2)
- Phase W (L3)
- PE (Green/Yellow)

Thermal Interface (only N/B):
- PT1000 (White)
- PT1000 (Brown)
- PTC (Green)
- PTC (Yellow)

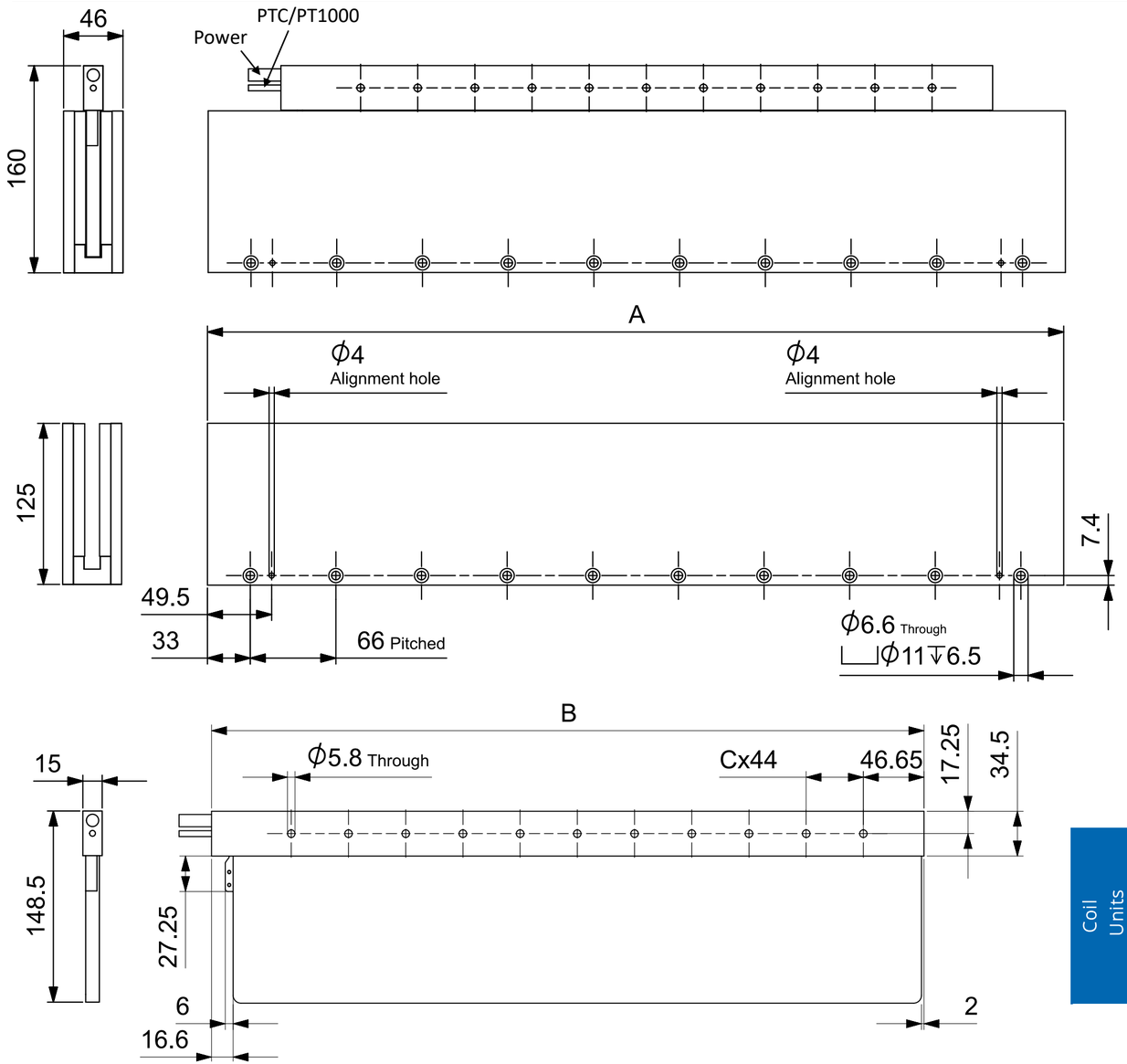
Electrical interfaces





Airgap dependency

PHOENIX-X MECHANICAL SPECIFICATIONS



	Parameter	Symbol	Unit	MY-X-08	MY-X-10	MY-X-12	MY-X-20
Magnet Yokes	Number of poles	N_p	-	8	10	12	20
	Pole pitch (N-N)	$2\tau_p$	mm	66	66	66	66
	Width	A	mm	264	330	396	660
	Mass	M_{my}	kg	7.7	9.6	11.5	19.2

	Parameter	Symbol	Unit	CU-X-03	CU-X-06	CU-X-09	CU-X-12	CU-X-15	CU-X-18
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15	18
	Coil pitch	τ_{coil}	mm	44	44	44	44	44	44
	Width	B	mm	152	284	416	548	680	812
	Number of hole pitches	C	-	1	4	7	10	13	16
	Mass (ex. cable)	M_{cu}	kg	0.9	1.7	2.5	3.2	4.0	4.8
	Standard cable length	L_{cable}	m	1	1	1	1	1	1

PHOENIX-U PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-U-03		CU-U-06			CU-U-09				CU-U-12			CU-U-15			CU-U-18		
	Winding configuration	-	-	-	C	D	A	B	C	A	B	C	D	A	C	D	A	C	D	A	C	D
Electromechanical	Peak force (α_T = 20°C/s increase)	F_p	N	20	3350		6650		5800	10000		5800	9950	13450	5800	10650	16800	5800	10650	20150	5800	10650
Electromechanical	Continuous force, interface at 20°C	F_c	N	100	330		670			1000				1340			1670			2010		
Electromechanical	Attraction force (I = 0)	F_{att}	N	-	0		0			0				0			0			0		
Electromechanical	Motor constant	S	N^2/W	20	1150		2350			3500				4950			6400			6850		
Electromechanical	Force constant	K_f	N/A_{rms}	-	171	91	171	91	342	171	91	513	272	171	684	363	171	856	454	171	1027	544
Electromechanical	Maximum velocity (F = 0)	v_m	m/s	-	4.9	9.3	4.9	9.3	2.5	4.9	9.3	1.6	3.1	4.9	1.2	2.3	4.9	1.0	1.9	4.9	0.8	1.6
Electromechanical	Maximum velocity (F = F_p)	v_i	m/s	20	1.9	5.6	1.9	5.6	0.0	1.9	5.6	0.0	0.2	1.9	0.0	0.0	1.9	0.0	0.0	1.9	0.0	0.0
Electrical	Maximum dc bus voltage	V_{dc}	V	-	690		690			690				690			690			690		
Electrical	Phase resistance	$R_{ph,20}$	Ohm	20	8.3	2.4	4.2	1.2	17	2.8	0.8	25	7.2	2.1	33	9.6	1.7	42	12	1.4	50	14
Electrical	Phase inductance	L_{ph}	mH	20	25	6.9	12	3.5	49	8.2	2.3	74	21	6.2	99	28	4.9	124	35	4.1	148	42
Electrical	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	140	74	140	74	279	140	74	419	222	140	559	296	140	699	370	140	838	444
Electrical	Maximum rms current	I_p	A_{rms}	20	20	36	39	73	17	59	109	11	36	78	8.5	29.3	98	6.8	23	118	5.7	20
Electrical	Continuous rms current, interface at 20°C	I_c	A_{rms}	100	2.0	3.7	3.9	7.3	2.0	5.9	11	2.0	3.7	7.9	2.0	3.7	10	2.0	3.7	12	2.0	3.7
Thermal	Continuous dissipation, interface at 20°C	$P_{d,c}$	W	100	126		253			379				537			695			758		
Thermal	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.63		0.32			0.21				0.15			0.12			0.11		
Thermal	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.036		0.018			0.012				0.0086			0.0066			0.0060		
Thermal	Thermal time constant, interface at 20°C	τ_{th}	s	-	550		550			550				550			550			550		

Notes

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Thermal Interface (only N/B):
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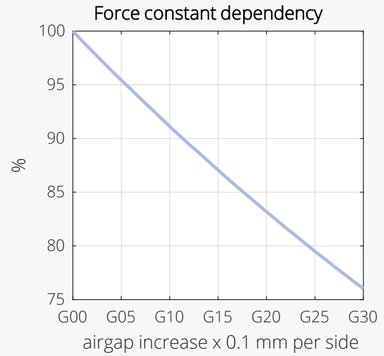
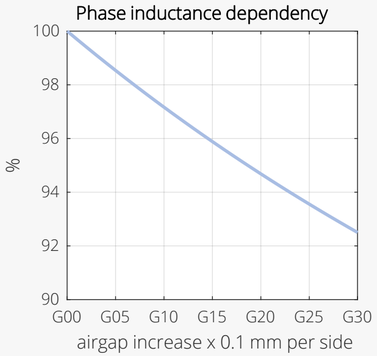
- PTC (Yellow)

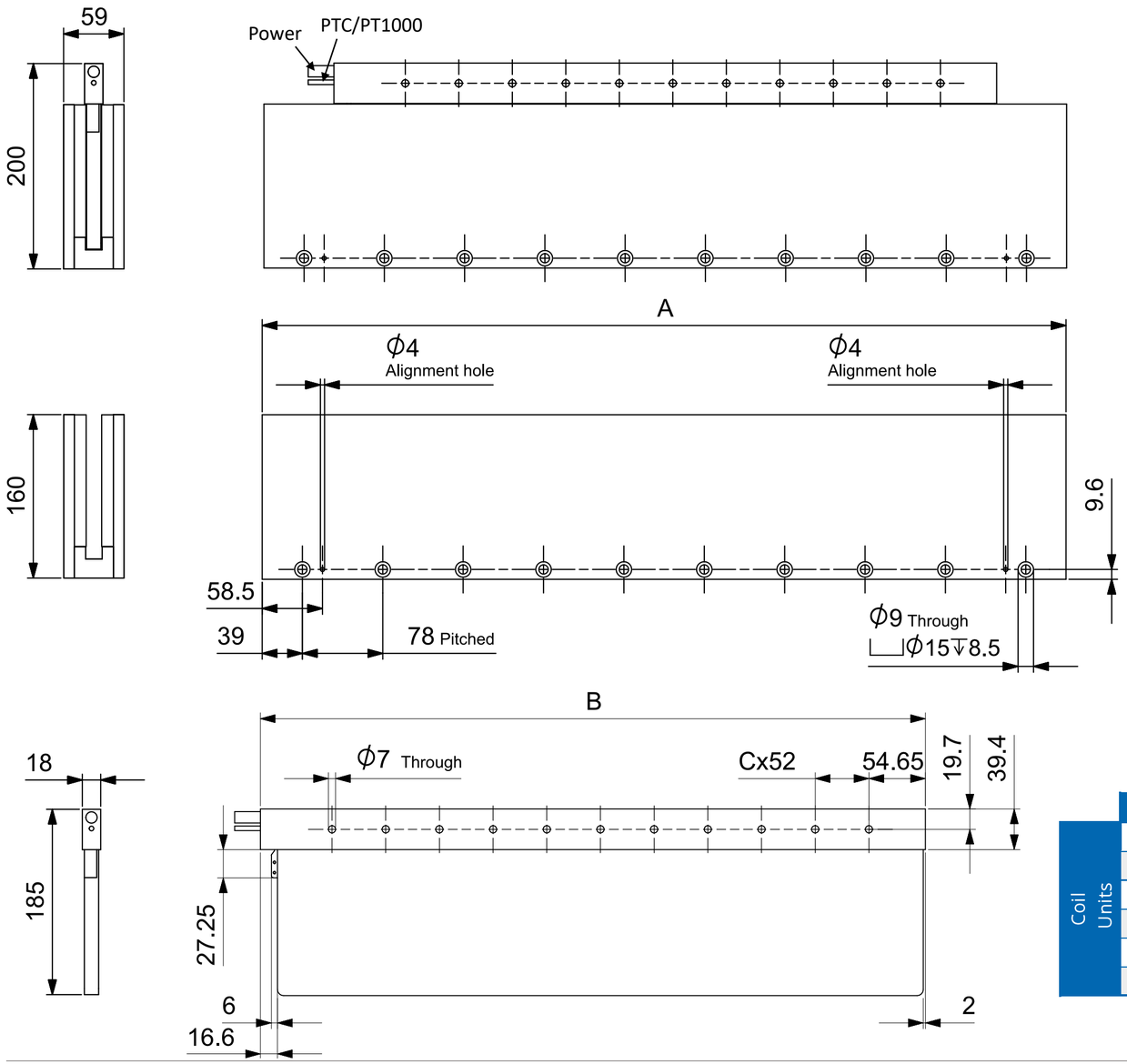
Electrical interfaces





Airgap dependency

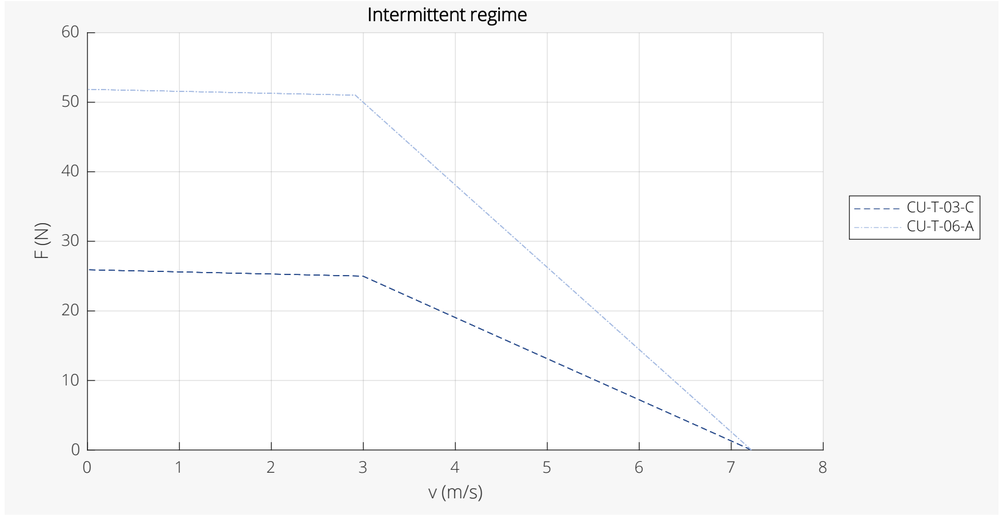
PHOENIX-U MECHANICAL SPECIFICATIONS



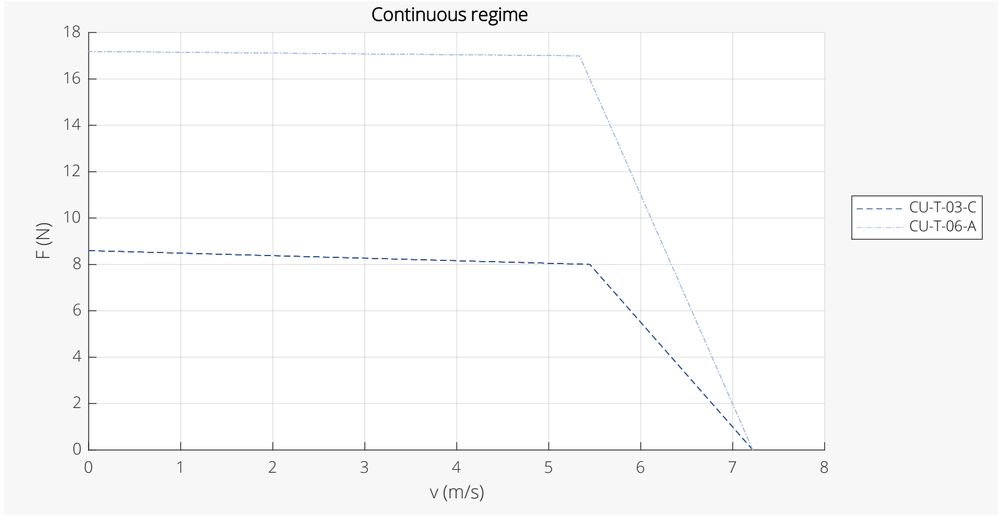
	Parameter	Symbol	Unit	MY-U-08	MY-U-10	MY-U-12	MY-U-18
Magnet Yokes	Number of poles	N_p	-	8	10	12	18
	Pole pitch (N-N)	$2\tau_p$	mm	78	78	78	78
	Width	A	mm	312	390	468	702
	Mass	M_{my}	kg	14.9	18.7	22.4	33.7

	Parameter	Symbol	Unit	CU-U-03	CU-U-06	CU-U-09	CU-U-12	CU-U-15	CU-U-18
Coil Units	Number of coils	N_{coil}	-	3	6	9	12	15	18
	Coil pitch	τ_{coil}	mm	52	52	52	52	52	52
	Width	B	mm	176	332	488	644	800	956
	Number of hole pitches	C	-	1	4	7	10	13	16
	Mass (ex. cable)	M_{cu}	kg	1.8	3.3	4.9	6.4	8.0	9.6
	Standard cable length	L_{cable}	m	1	1	1	1	1	1

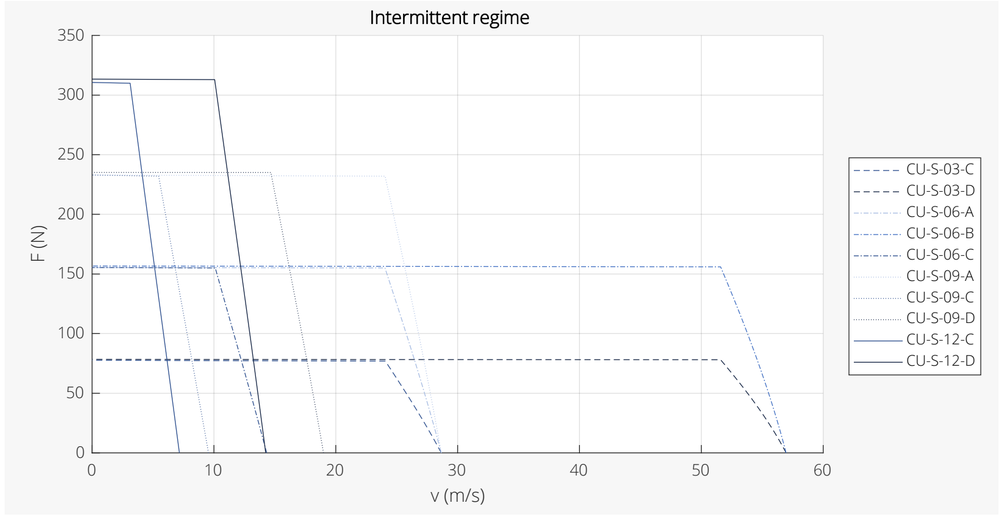
PHOENIX-T/S FORCE-VELOCITY DIAGRAMS



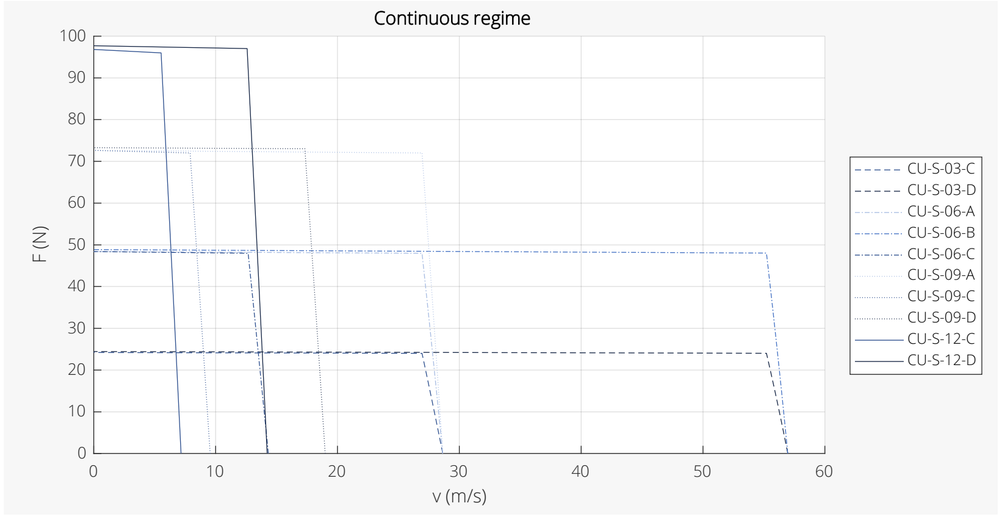
Force-Velocity Diagrams Size T Intermittent Regime



Force-Velocity Diagrams Size T Continuous Regime

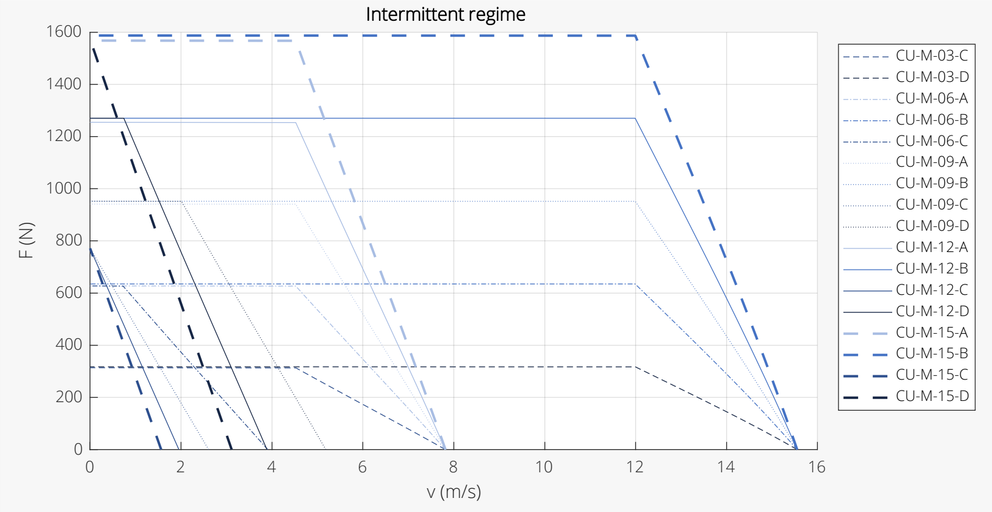


Force-Velocity Diagrams Size S Intermittent Regime

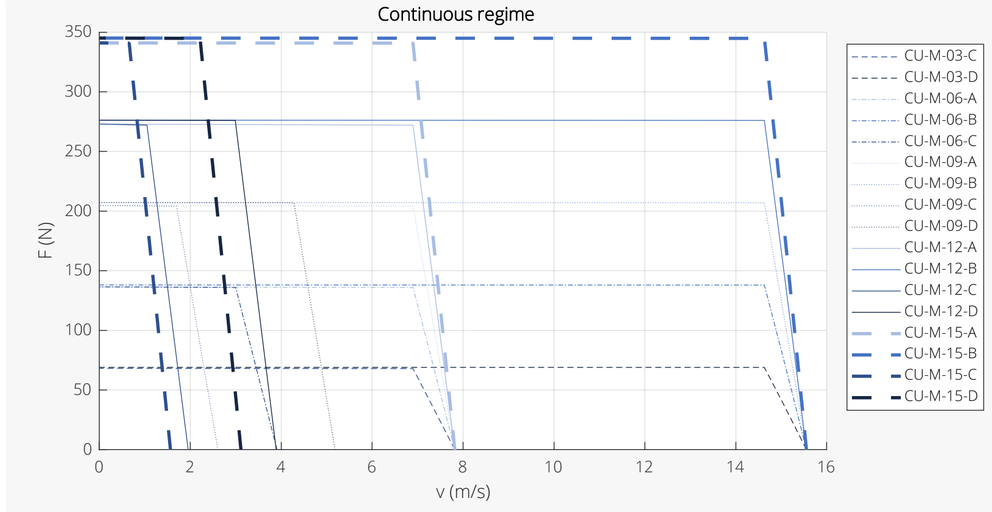


Force-Velocity Diagrams Size S Continuous Regime

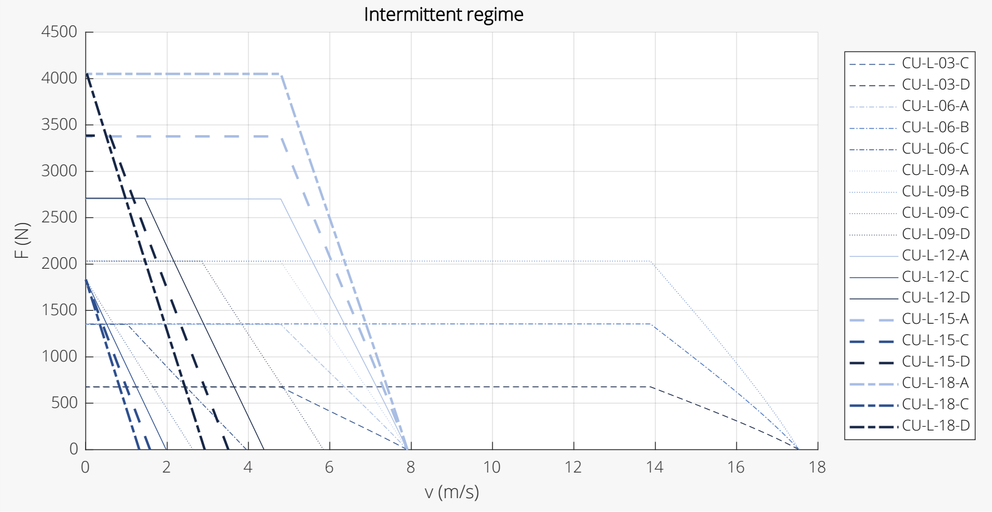
PHOENIX-M/L FORCE-VELOCITY DIAGRAMS



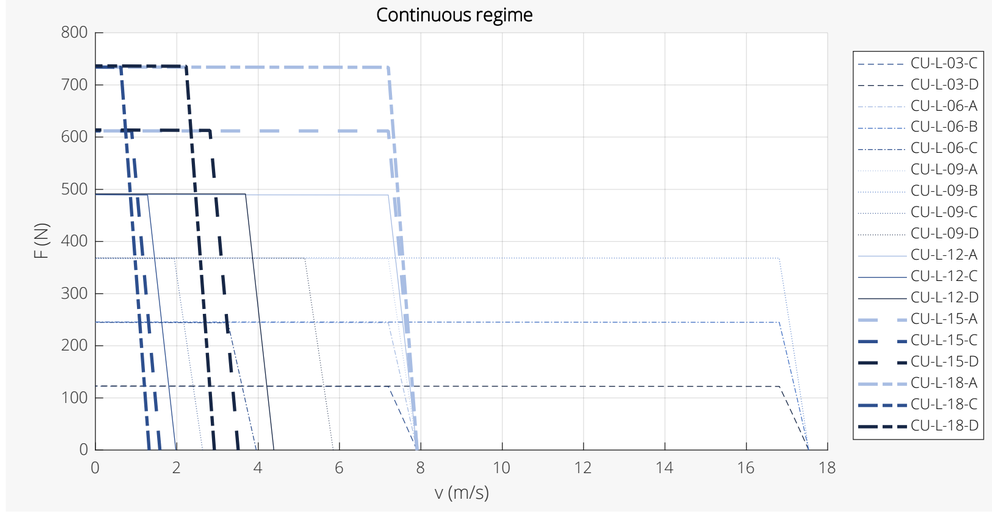
Force-Velocity Diagrams Size M Intermittent Regime



Force-Velocity Diagrams Size M Continuous Regime

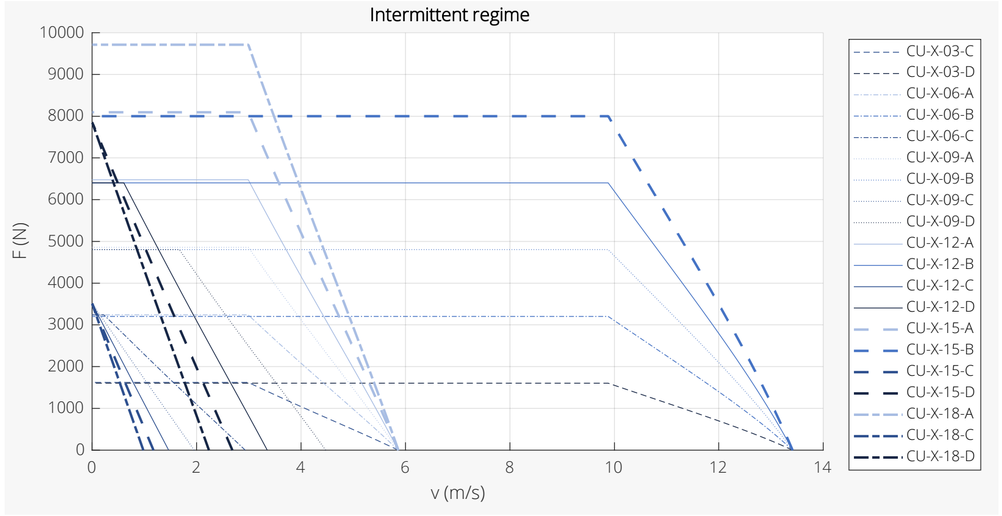


Force-Velocity Diagrams Size L Intermittent Regime

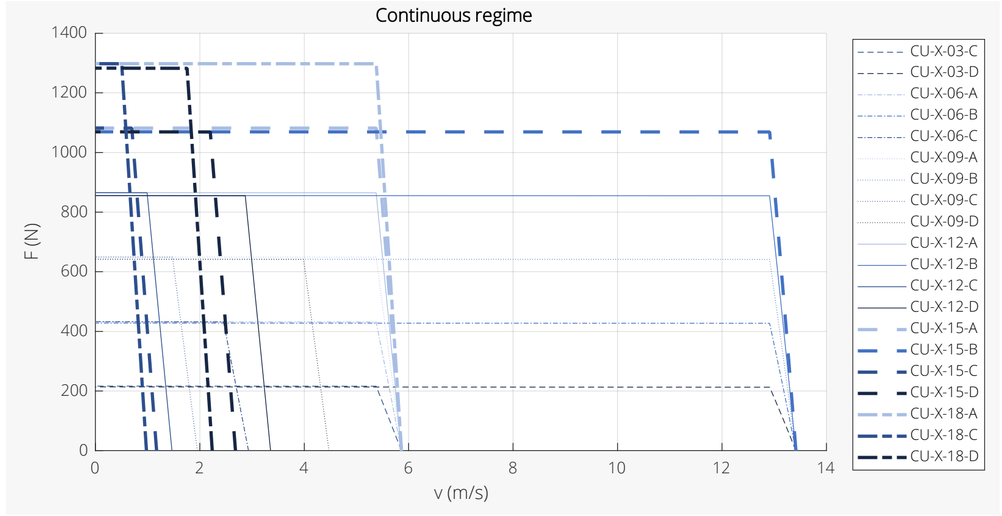


Force-Velocity Diagrams Size L Continuous Regime

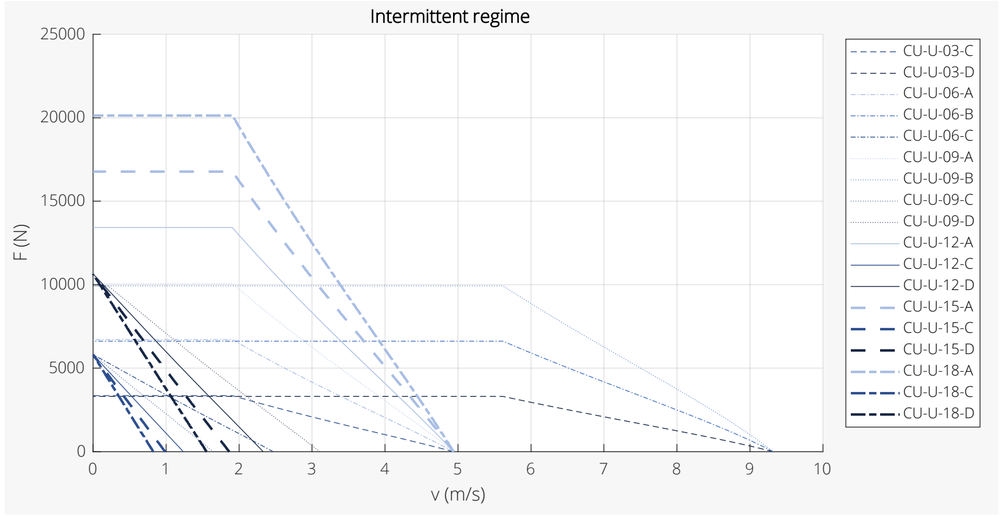
PHOENIX-X/U FORCE-VELOCITY DIAGRAMS



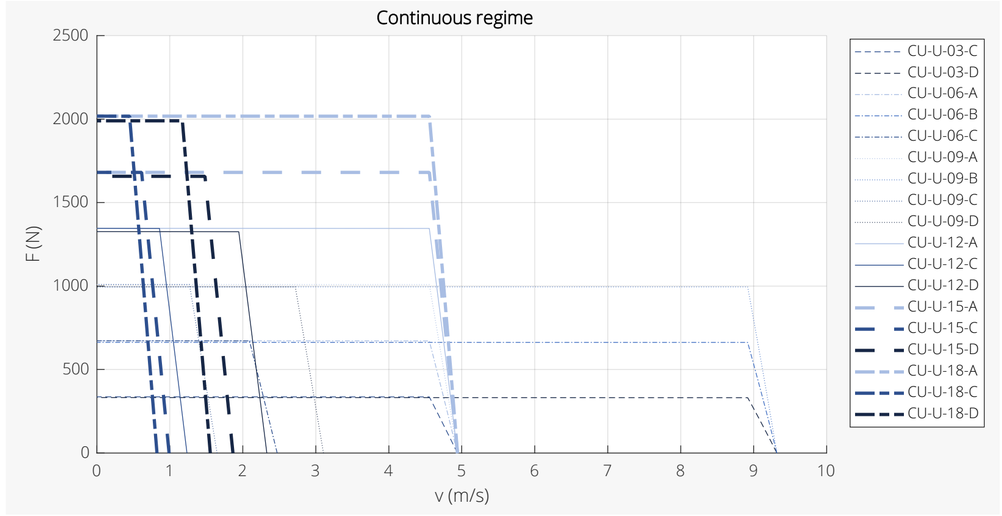
Force-Velocity Diagrams Size X Intermittent Regime



Force-Velocity Diagrams Size X Continuous Regime



Force-Velocity Diagrams Size U Intermittent Regime



Force-Velocity Diagrams Size U Continuous Regime

PHOENIX COMMUTATION SENSORS

Phoenix-S commutation sensor (Phoenix-CS-S)

- For correct operation of a linear motor, the commutation angle (the electrical angle between the coil unit and the magnet yoke) should be known. This commutation angle is needed to determine the phase angle of the three phase currents.

- The commutation angle can be derived from the relative displacement, for example using a position sensor. However, the Phoenix commutation sensor can directly measure the commutation angle without the need of a position sensor. The Phoenix commutation sensor can be directly attached to the coil unit which provides a cost-effective alternative to measure the commutation angle.

- The Phoenix commutation sensor contains three digital Hall sensors, each shifted by 120 electrical degrees, from which the commutation angle can be derived. Commutation sensors are available for each size of Phoenix (S/M/L/X/U).

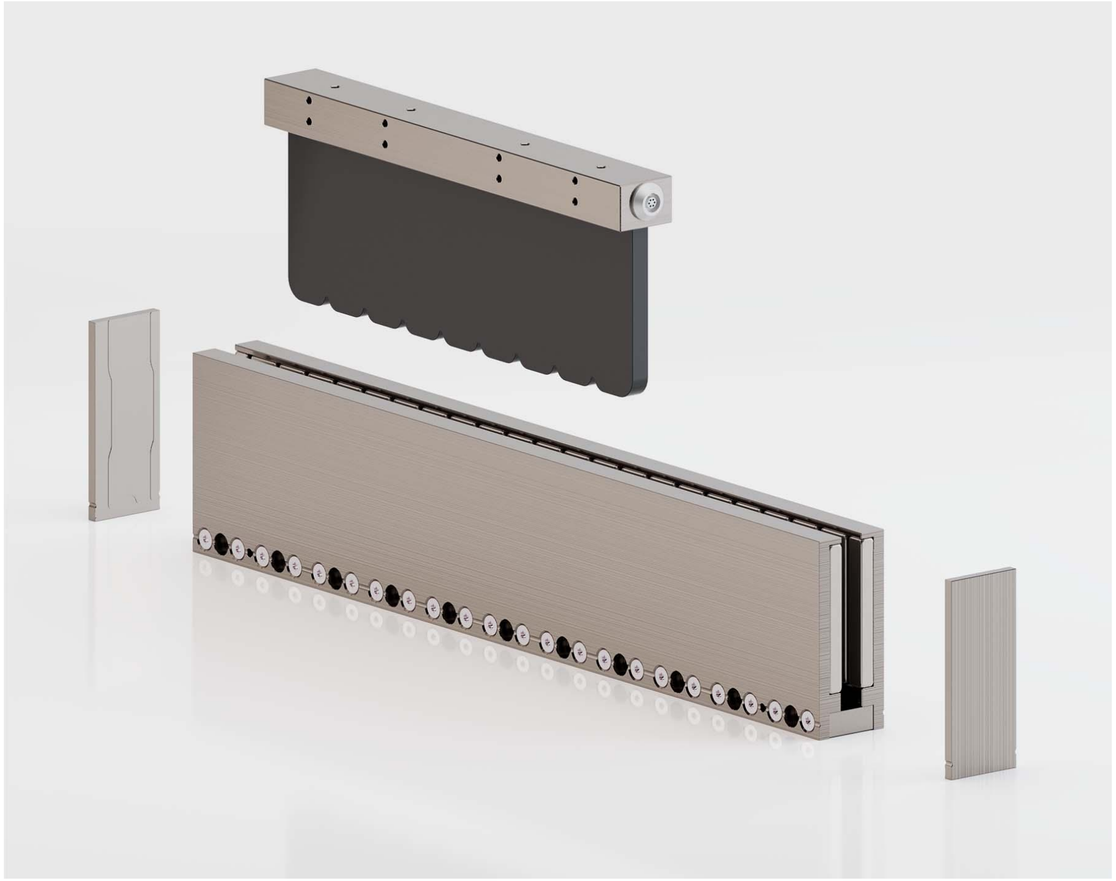
- The commutation sensor allows a supply voltage range between 4.5 Vdc and 28 Vdc.

GRYPHON LINE

The Gryphon line offers a cost-effective solution for vacuum-compatible ironless linear motors. These motors also contain features providing magnetic shielding.

Gryphon line in medium and large configuration

GRYPHON - FEATURES



Gryphon magnet yoke (Gryphon-MY-M-22-EB-G00) and coil unit (Gryphon-CU-M-09-C-C)

Gryphon-CU-M-09-C-C

- Connector
- Winding configuration (C)
- # of coils
- Size (M / L)
- Coil unit

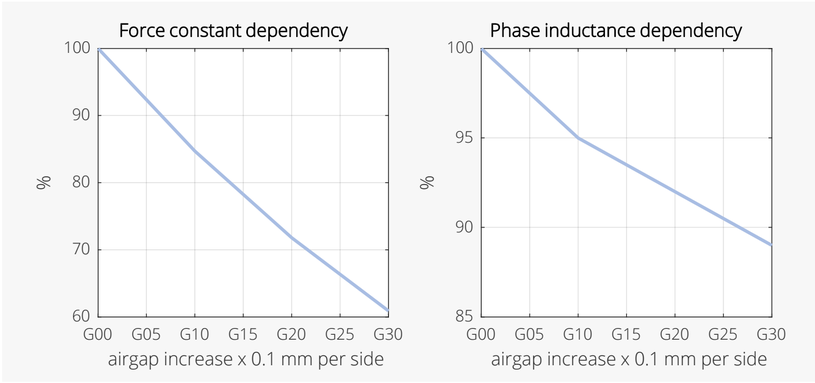
Gryphon-MY-M-12-FX-G00

- Additional airgap x 0.1 mm on each side
- End plates (X, L, R, B)
- Half pole location (C, D, E, F)
- # of poles
- Size (M / L)
- Magnet yoke

- Magnet yokes and coil units are made of low outgassing materials
- Coil units have a temperature sensor (PT1000)
- Coil units have a vacuum compatible connector
- Magnet yokes can be butted together
- Magnet yokes can be selected with larger airgaps to allow higher installation tolerances
- Magnet yokes have optional half poles at the end to improve magnetic shielding:
  - C: Half pole on the left side
  - D: Half pole on the right side
  - E: Half pole on both sides
  - F: Full pole on both sides
- Magnet yokes of size M have optional end plates to improve magnetic shielding:
  - X: no end plates
  - L: end plate on the left
  - R: end plate on the right
  - B: end plates on both sides
- IP rating of coil units is IP4X

GRYPHON-M/L PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-M-09	CU-L-12
	Winding configuration	-	-	-	C	C
Electromechanical	Peak force	F_p	N	20	269	414
	Continuous force, interface at 20°C	F_c	N	50	161	249
	Attraction force (I = 0)	F_{att}	N	-	0	0
	Motor constant	S	N^2/W	20	566	1330
	Force constant	K_f	N/A_{rms}	-	54	83
	Maximum velocity (F = 0)	v_m	m/s	-	2.3	1.5
	Maximum velocity (F = F_p)	v_i	m/s	20	1.8	1.2
Electrical	Maximum dc bus voltage	V_{dc}	V	-	100	100
	Phase resistance	$R_{ph,20}$	Ohm	20	1.7	1.7
	Phase inductance	L_{ph}	mH	20	2.3	2.6
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	44	68
	Maximum rms current	I_p	A_{rms}	20	5.0	5.0
	Continuous rms current	I_c	A_{rms}	50	3.0	3.0
Thermal	Continuous dissipation	$P_{d,c}$	W	50	51	52
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.37	0.19
	Thermal time constant, interface at 20°C	τ_{th}	s	-	627	541



Airgap dependency M-size

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet yoke
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications consider a magnet yoke with nominal airgap (G00)
- See ‘definitions’ section at the end of the catalog for more details

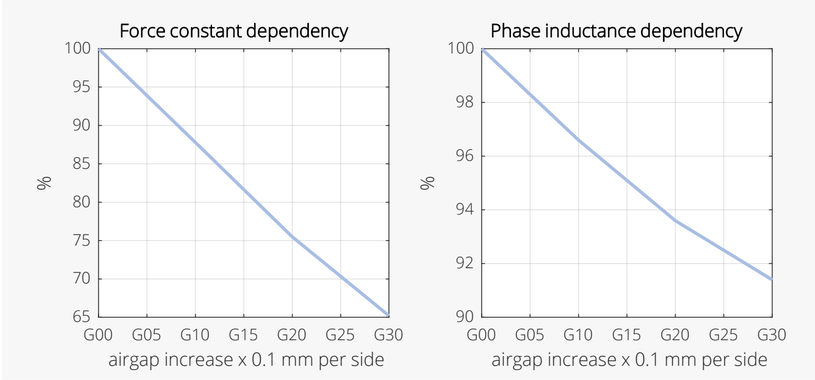
Product marking / approvals

Power/PTC Interface:

Connector: LEMO HGG.1B.306.CLLPV

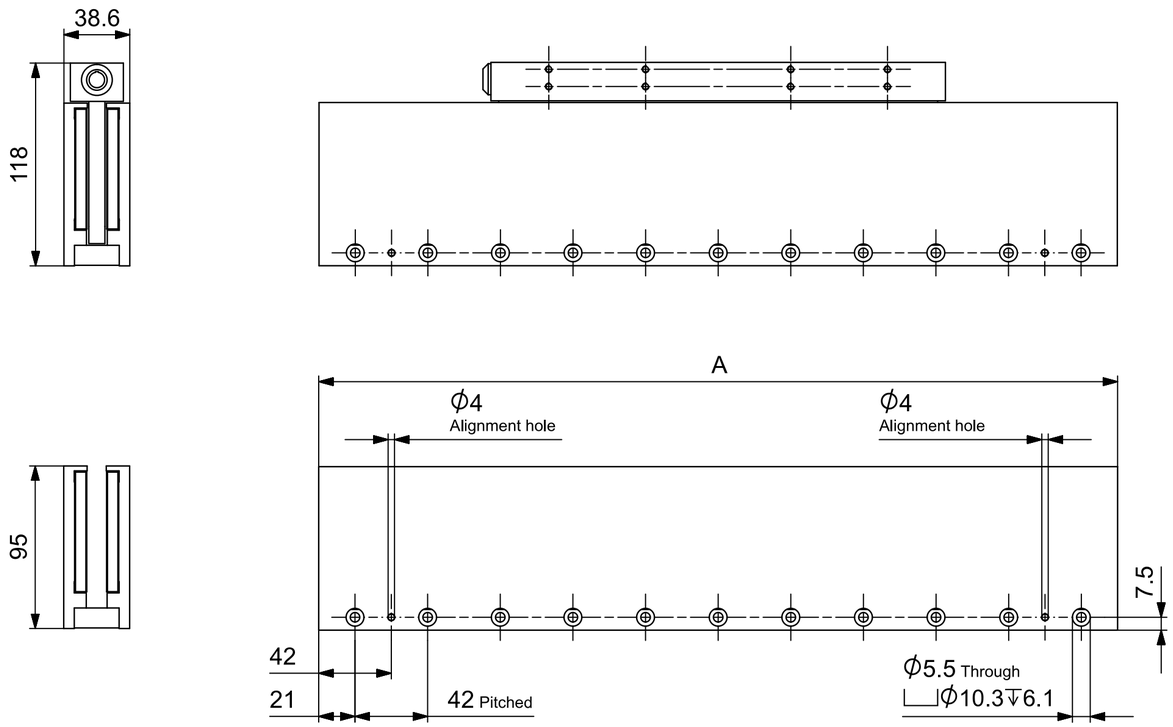
- Phase U (Pin 1)
- Phase V (Pin 2)
- Phase W (Pin 3)
- PE (Pin 4)
- PT1000 (Pin 5)
- PT1000 (Pin 6)

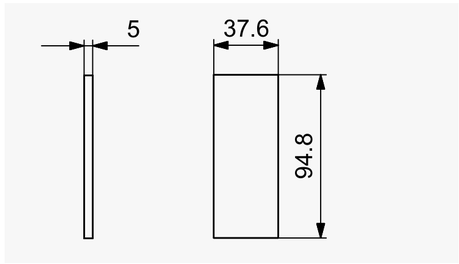
Electrical interfaces



Airgap dependency L-size

GRYPHON-M MECHANICAL SPECIFICATIONS



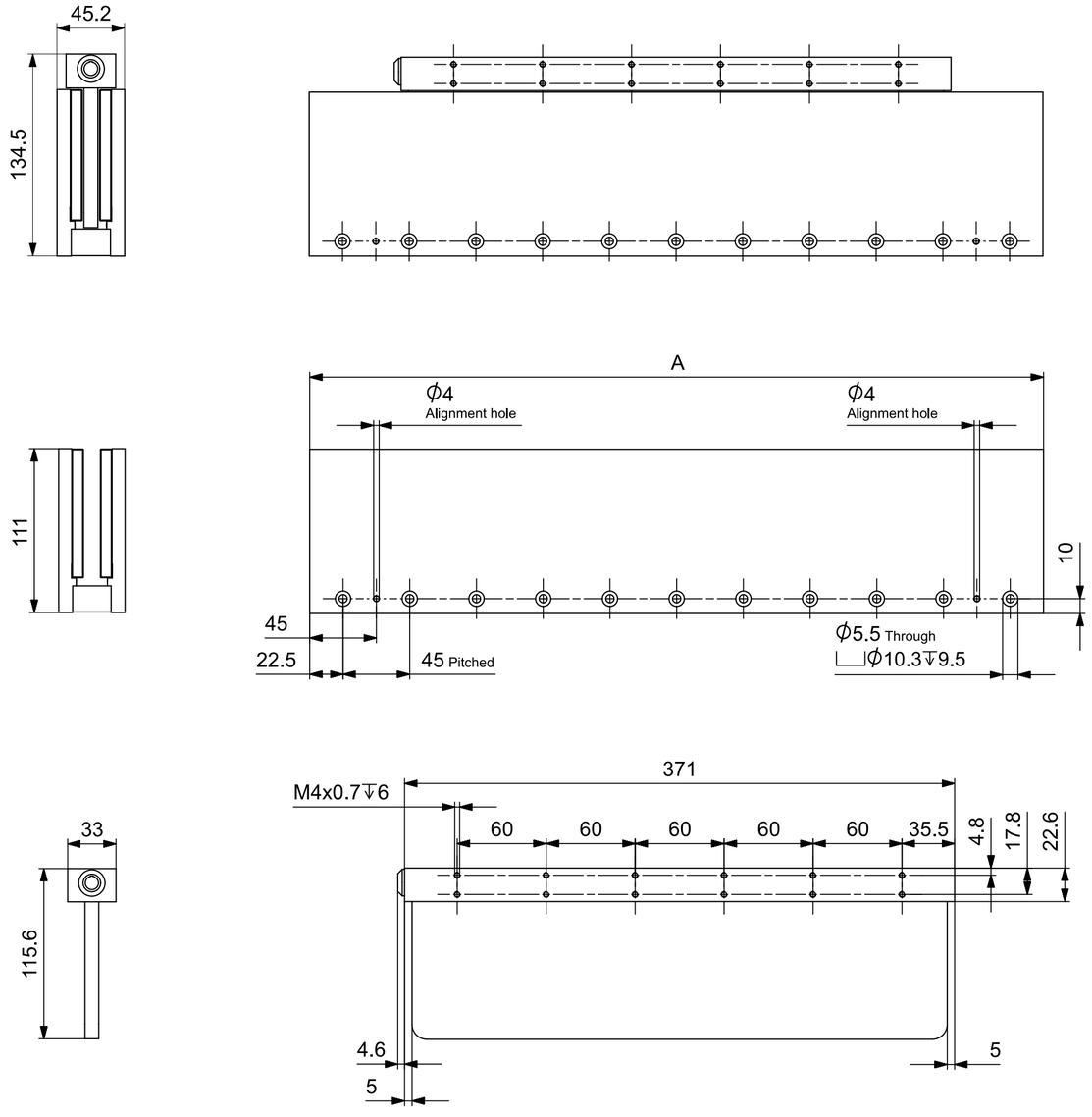


End plate

	Parameter	Symbol	Unit	MY-M-12	MY-M-22
Magnet Yokes	Number of poles	N_p	-	12	22
	Pole pitch (N-N)	$2\tau_p$	mm	42	42
	Width	A	mm	252	462
	Mass	M_{my}	kg	4.6	8.4

	Parameter	Symbol	Unit	CU-M-09
Coil Units	Number of coils	N_{coil}	-	9
	Coil pitch	τ_{coil}	mm	28
	Width	B	mm	263
	Mass	M_{cu}	kg	1.4

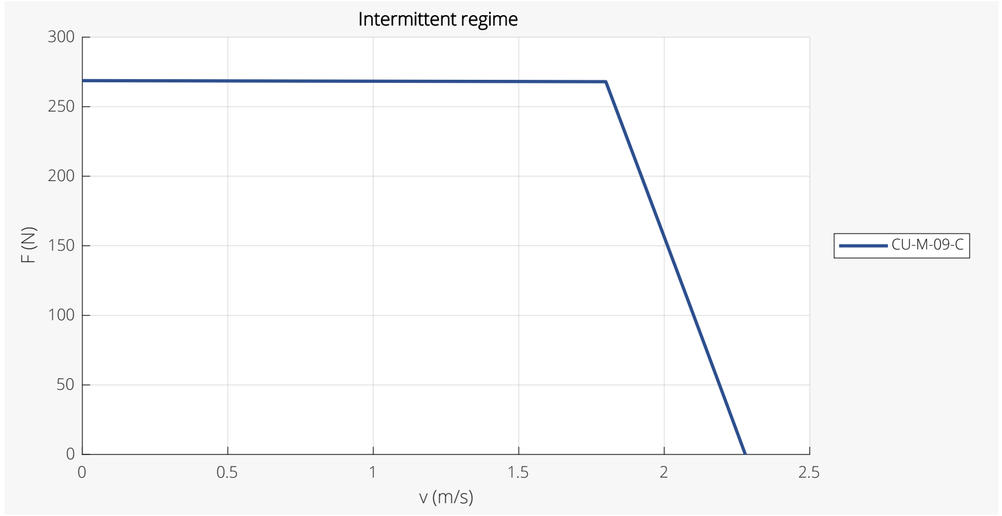
GRYPHON-L MECHANICAL SPECIFICATIONS



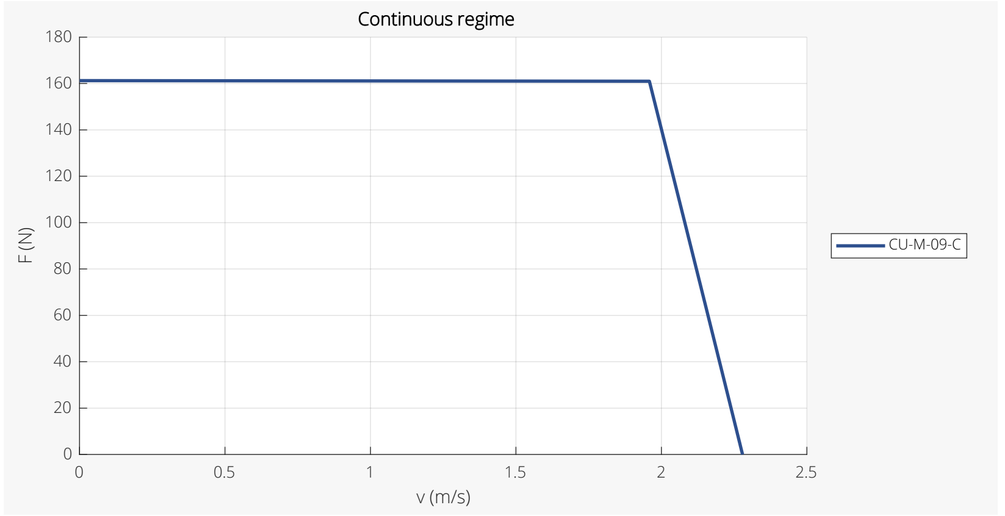
	Parameter	Symbol	Unit	MY-L-22	MY-L-24
Magnet Yokes	Number of poles	N_p	-	22	24
	Pole pitch (N-N)	$2\tau_p$	mm	45	45
	Width	A	mm	495	540
	Mass	M_{my}	kg	13.1	14.2

	Parameter	Symbol	Unit	CU-L-12
Coil Units	Number of coils	N_{coil}	-	12
	Coil pitch	τ_{coil}	mm	30
	Width	B	mm	371
	Mass	M_{cu}	kg	2.4

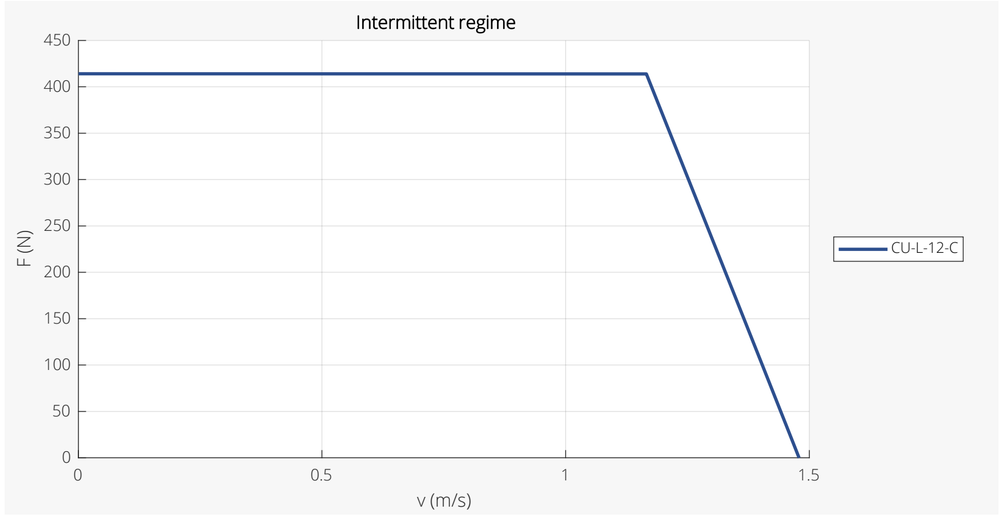
GRYPHON-M/L FORCE-VELOCITY DIAGRAMS



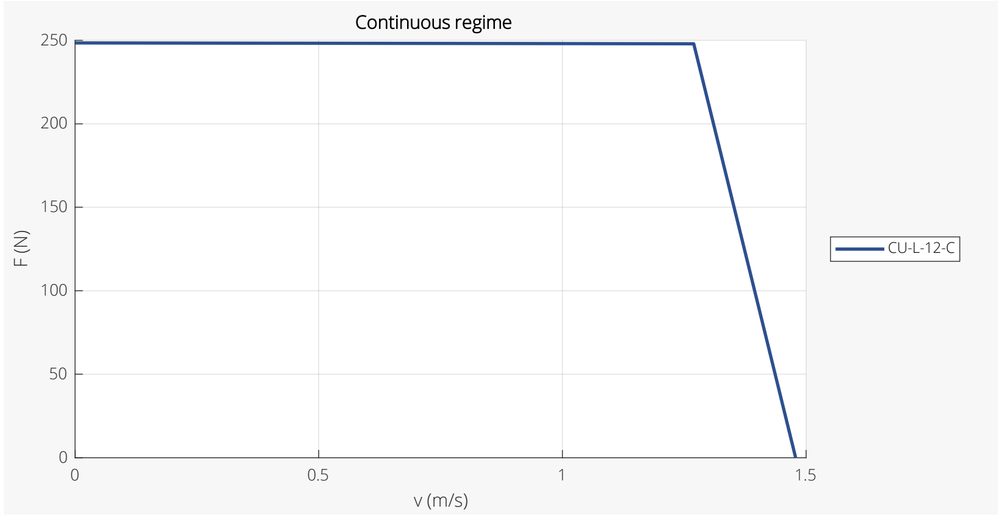
Force-Velocity Diagrams Size M Intermittent Regime



Force-Velocity Diagrams Size M Continuous Regime



Force-Velocity Diagrams Size L Intermittent Regime

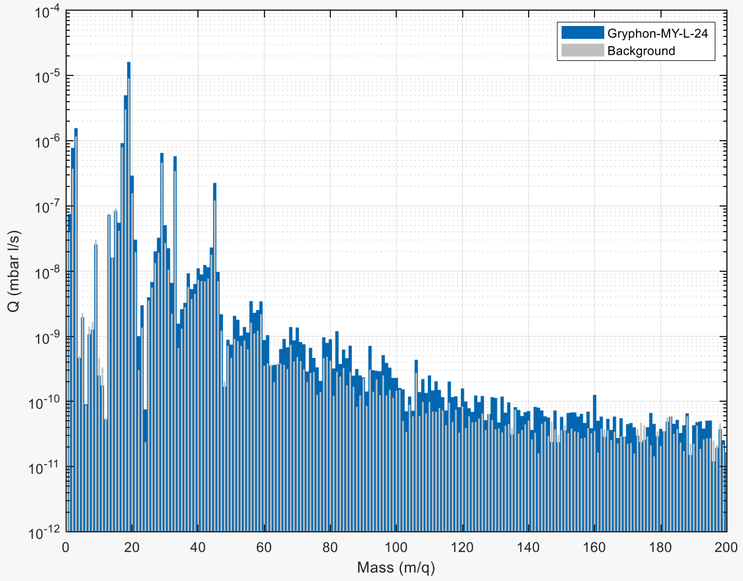


Force-Velocity Diagrams Size L Continuous Regime

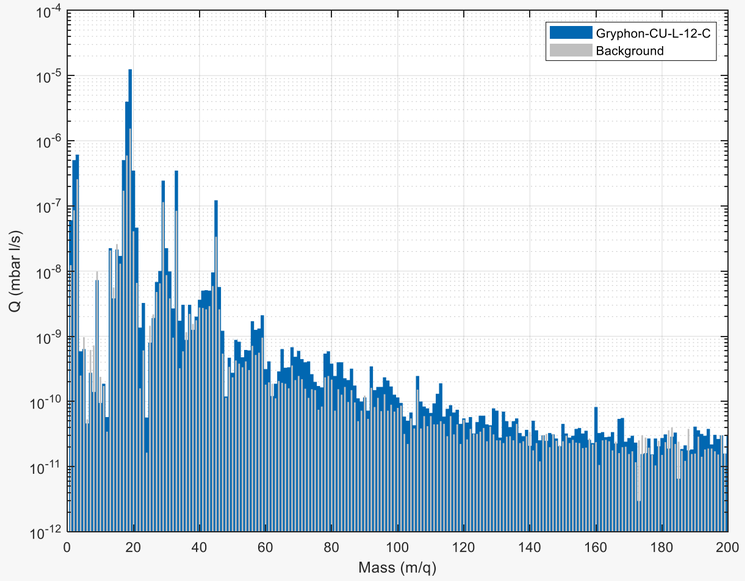
GRYPHON-L OUTGASSING MEASUREMENTS

The outgassing measurement results below are obtained after bakeout of the magnet yoke segments and coil units. Results are obtained at room temperature, 10 hours after TMP start. Vacuum level 1e-7 mbar (1e-5 Pa or 7.5e-8 Torr).

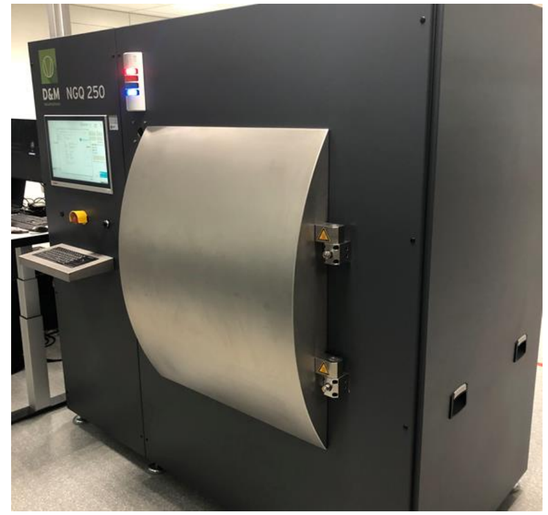
Gryphon-MY-L-24



Gryphon-CU-L-12-C



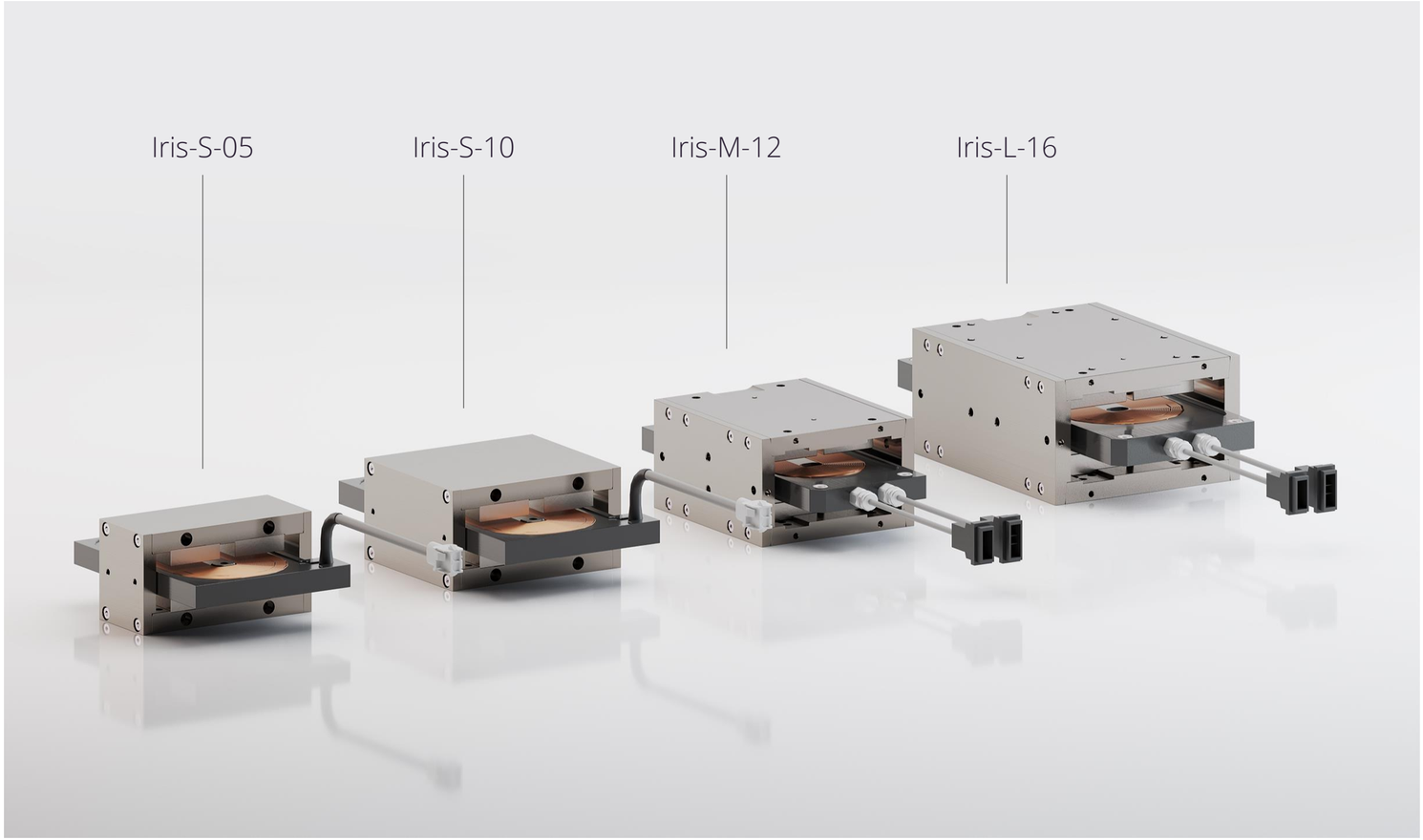
Outgassing measurements



Top picture: In-house RGA equipment
Bottom Picture: In-house bake out equipment

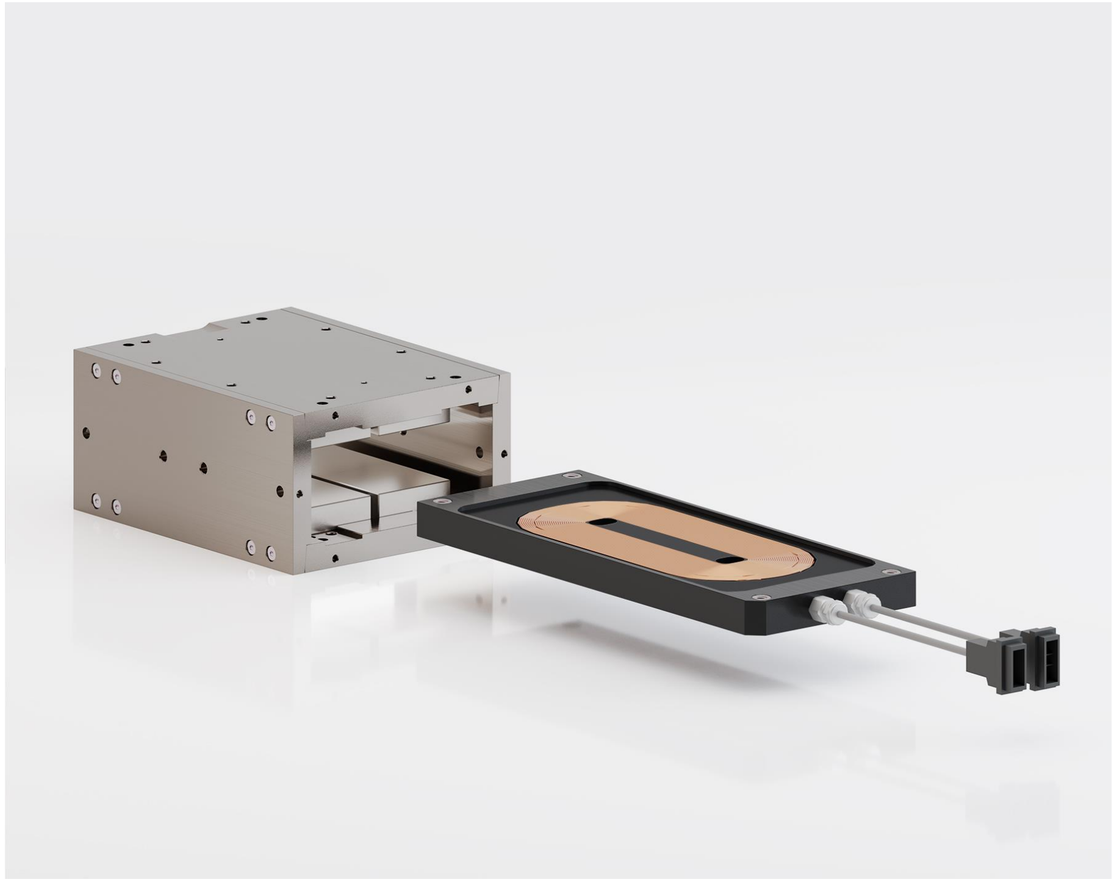
IRIS LINE

The Iris line offers short stroke linear motors with a rectangular form factor. The M and L size motors also contain magnetic shielding features.



Iris line short stroke motors in different sizes

IRIS LINE FEATURES



Iris-L-16

Iris-M-12

Depth (MY depth rounded to cm)
Size (S / M / L)

- Different sizes for optimal mechanical integration
- Coil unit housing optimized for heat transfer and force bandwidth
- Coil units are equipped with connectors
- IP rating of coil units is IP10
- The M/L size coil units have a temperature sensor (PT1000)
- The M/L size have magnets which are shorter than the back iron for improved magnetic shielding

IRIS PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	Iris-S-05	Iris-S-10	Iris-M-12	Iris-L-16
Electromech.	Peak force (α_T = 5°C/s increase)	F_p	N	20	400	600	450	1150
	Continuous force	F_c	N	100	100	180	150	250
	Continuous force (UL rated)	F_c	N	20	n.a.	n.a.	80	170
	Attraction force (I = 0)	F_{att}	N	-	0	0	0	0
	Motor constant	S	N^2/W	20	161	464	259	770
	Force constant	K_f	N/A	-	23	47	19	48
Electrical	Maximum dc bus voltage	V_{dc}	V	-	60	60	100	100
	Phase resistance	$R_{ph,20}$	Ohm	20	3.4	4.7	1.4	3.0
	Phase inductance	L_{ph}	mH	-	16.0	25.9	4.7	15.5
	EMF constant	K_e	Vs/m	-	23	47	19	48
	Maximum rms current	I_p	A	20	17.6	12.8	24.3	24.5
	Continuous rms current	I_c	A	100	4.4	3.9	8.0	5.3
	Continuous rms current (UL rated)	I_c	A	100	n.a.	n.a.	4.3	3.6
Thermal	Continuous dissipation	$P_{d,c}$	W	100	88	94	120	110
	Continuous dissipation (UL rated)	$P_{d,c}$	W	100	n.a.	n.a.	34	51
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.91	0.85	0.67	0.73
	Thermal resistance, coils to conv. surface	$R_{th,c}$	K/W	-	0.06	0.04	0.09	0.06
	Thermal time constant	τ_{th}	s	-	521	646	358	363

Notes

- Specifications are based upon a magnet temperature of 20°C
- See ‘definitions’ section at the end of the catalog for more details

Iris-S-05 / Iris-S-10

Power Interface:

Connector: TE Universal Mate-N-Lok

- Phase U+ (Pin 1)
- Phase U- (Pin 2)

Iris-M-12 / Iris-L-16

Power Interface:

Connector: JST F32MSF-03V-KX

- Phase U+ (Pin 1)
- Phase U- (Pin 3)

Thermal Interface:

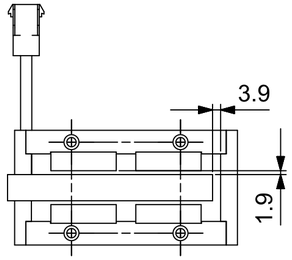
Connector: JST F31MSF-03V-KX

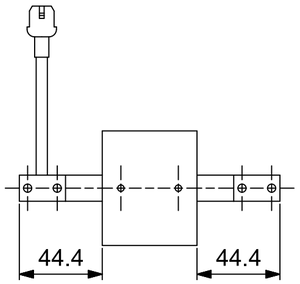
- PT1000 (Pin 1)
- PT1000 (Pin 3)

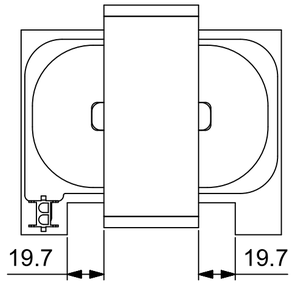
Product marking / approvals

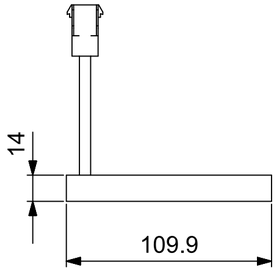
Electrical interfaces

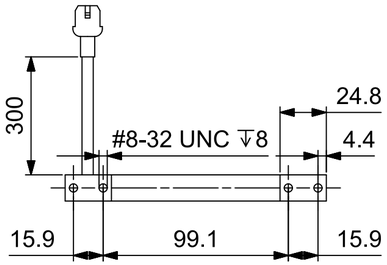
IRIS-S-05 MECHANICAL SPECIFICATIONS

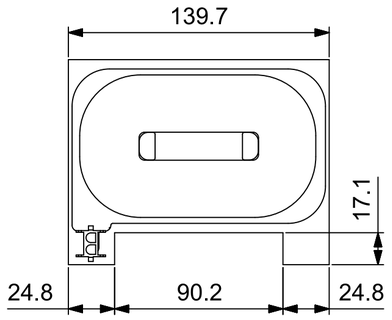


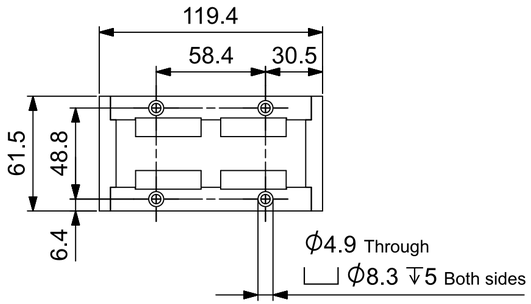


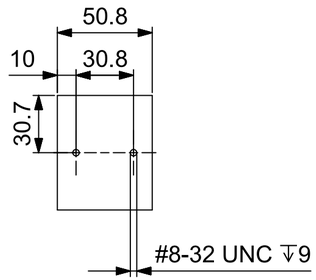


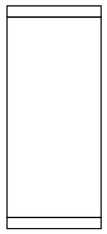






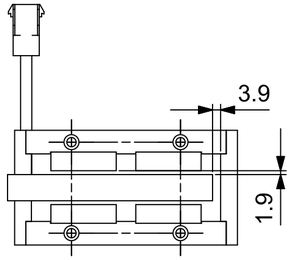


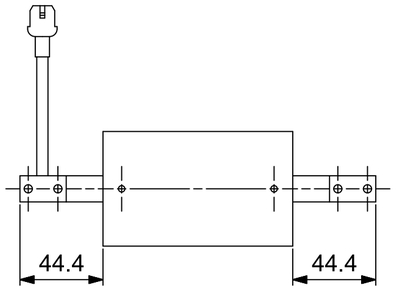


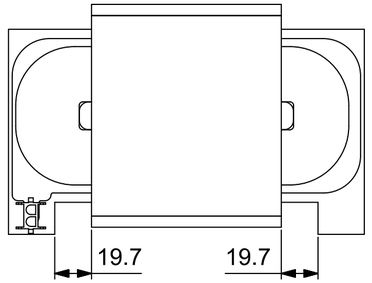


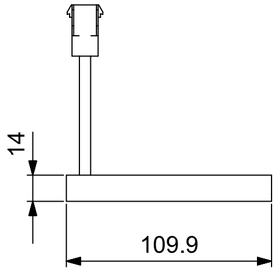
	Parameter	Symbol	Unit	S-05
Mass	Magnet yoke mass	M_{my}	kg	1.9
	Coil unit mass (incl. cable)	M_{cu}	kg	0.9
	Total mass (incl. cable)	M_{tot}	kg	2.8

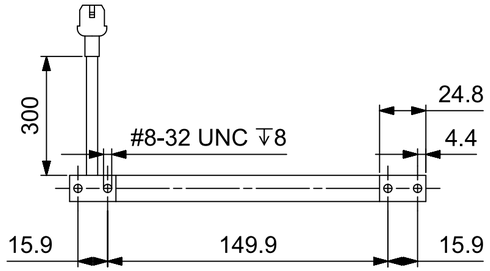
IRIS-S-10 MECHANICAL SPECIFICATIONS

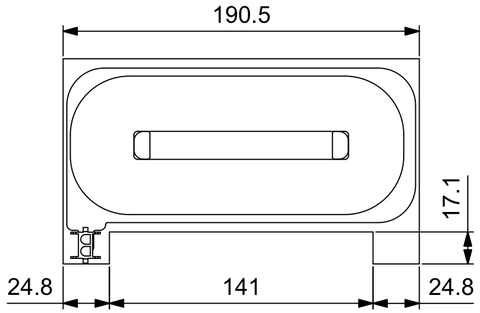


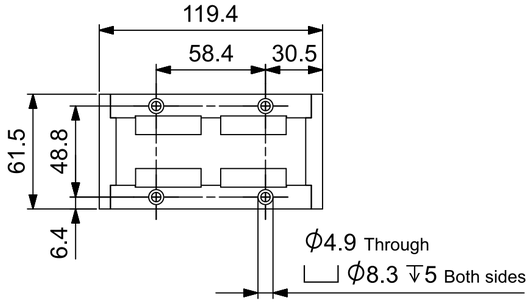


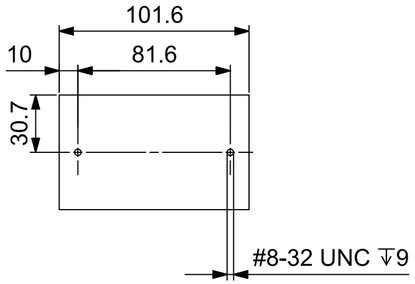


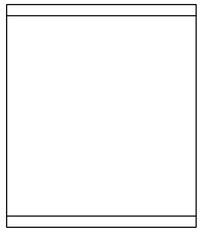






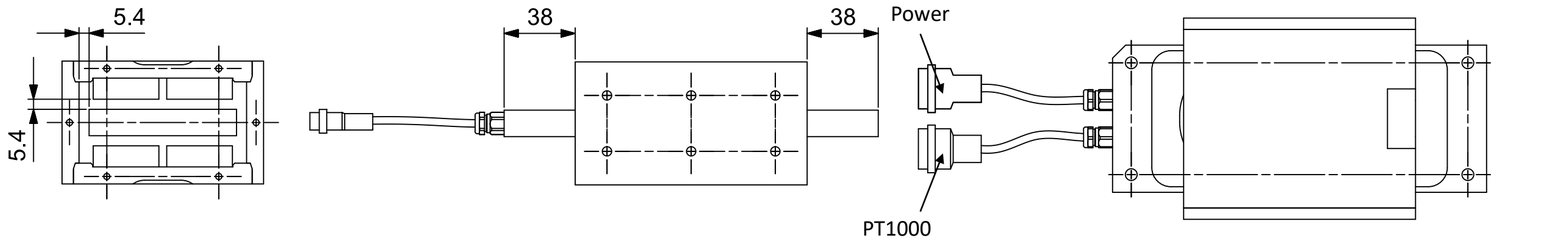


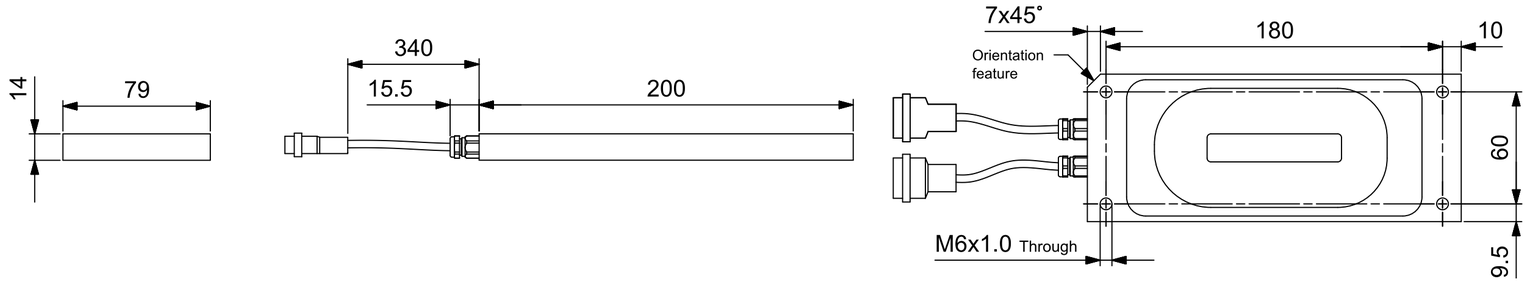


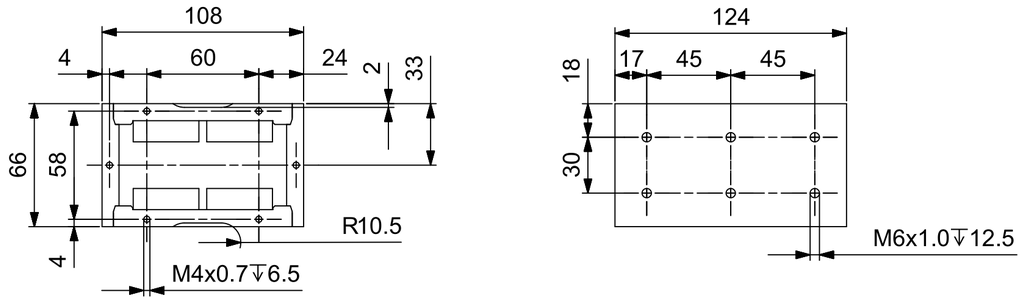


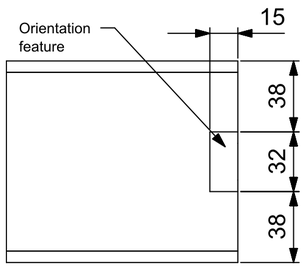
	Parameter	Symbol	Unit	S-10
Mass	Magnet yoke mass	M_{my}	kg	3.8
	Coil unit mass (incl. cable)	M_{cu}	kg	1.2
	Total mass (incl. cable)	M_{tot}	kg	5.0

IRIS-M-12 MECHANICAL SPECIFICATIONS



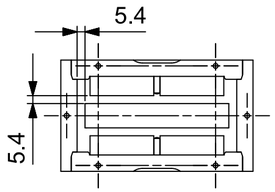


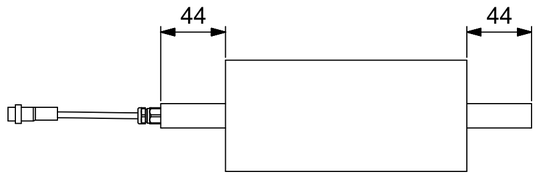


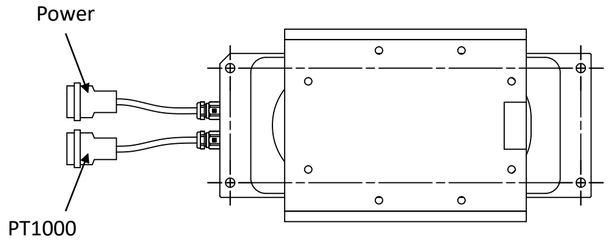


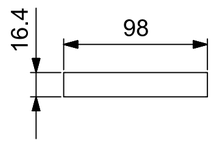
	Parameter	Symbol	Unit	M-12
Mass	Magnet yoke mass	M_{my}	kg	3.8
	Coil unit mass (incl. cable)	M_{cu}	kg	0.8
	Total mass (incl. cable)	M_{tot}	kg	4.6

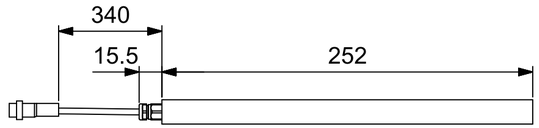
IRIS-L-16 MECHANICAL SPECIFICATIONS

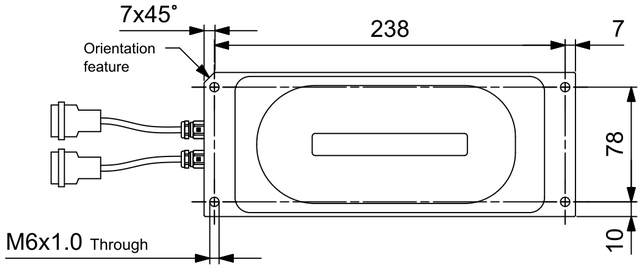


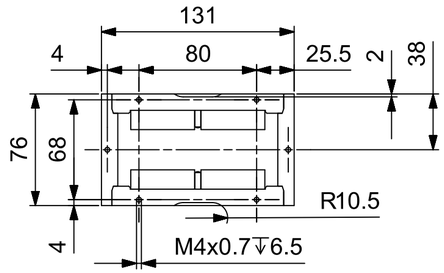


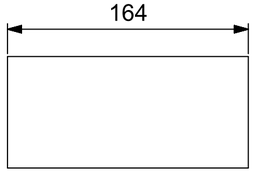


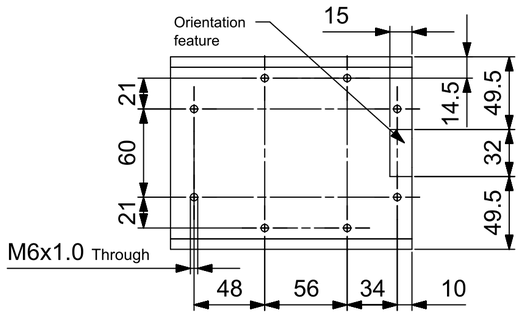












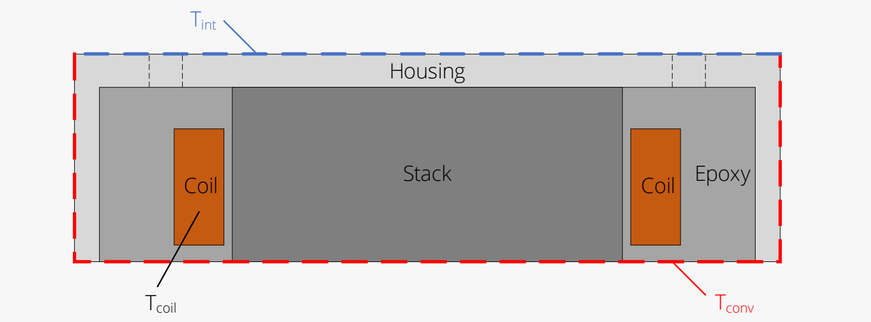
	Parameter	Symbol	Unit	L-16
Mass	Magnet yoke mass	M_{my}	kg	7.6
	Coil unit mass (incl. cable)	M_{cu}	kg	1.5
	Total mass (incl. cable)	M_{tot}	kg	9.1

DEFINITIONS

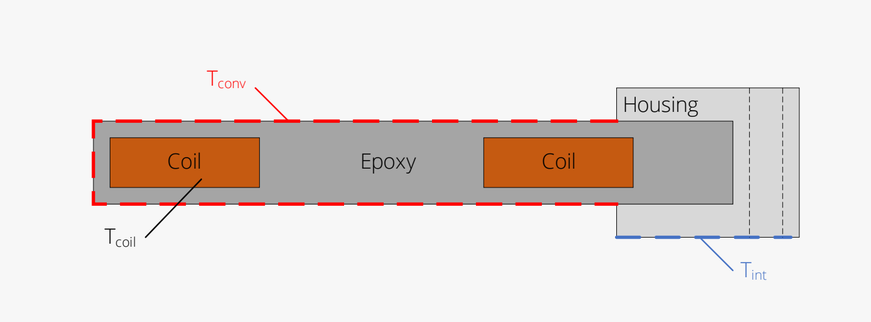
Parameter	Symbol / Equation	Unit	Remarks
Coil temperature	T_{coil}	°C	Average temperature over the complete coil volume
Interface temperature	T_{int}	°C	Average temperature over the complete interface surface
Convective surface temperature	T_{conv}	°C	Average temperature over the complete convective surface
Thermal resistance	$R_{th,i}$	K/W	From average coil temperature to average interface temperature
Thermal resistance	$R_{th,c}$	K/W	From average coil temperature to average convective surface temperature
Thermal time constant	τ_{th}	s	The time to reach 63.7% of the steady state temperature considering T_{int} = 20°C

The actual continuous force is strongly dependent on the cooling conditions available in the application. Depending on the situation (vacuum environment, natural convection, forced convection or other), the thermal resistances of the coil unit ($R_{th,i}$ and $R_{th,c}$) should be combined with the thermal resistances of the cooling interfaces to determine the overall thermal resistance (R_{th}). This overall thermal resistance provides the maximum dissipated power and continuous force.

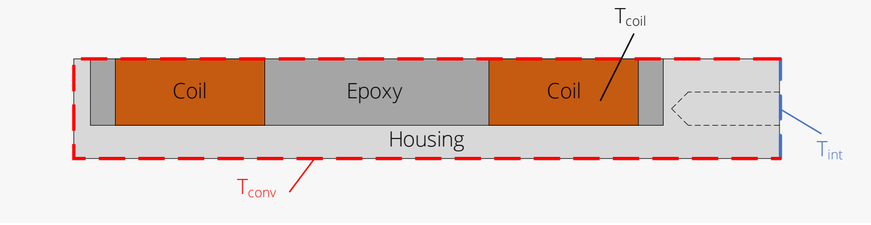
Please contact us for any support to calculate your specific application.



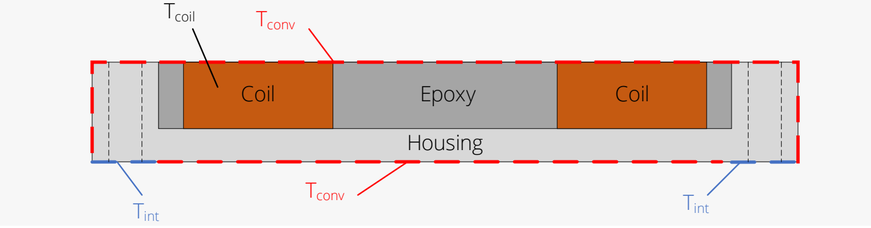
Chiron temperature definitions



Phoenix / Gryphon temperature definitions



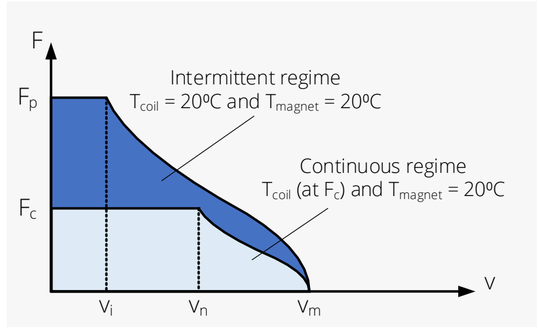
Iris-S temperature definitions



Iris-M/L temperature definitions

DEFINITIONS CHIRON/PHOENIX/GRYPHON

Description	Equation	Unit	Remarks
Phase resistance at T_{coil}	$R_{ph} = R_{ph,20}\left(1+0.0039(T_{coil}-20)\right)$	Ohm	
Force constant at no load	$K_{f,0} = \sqrt{3/2}\, K_{e,ll,p}$	N/A_{rms}	For Phoenix and Gryphon: $K_{f,0} = K_f$.
Continuous dissipation	$P_{d,c} = (T_{coil}-T_{int})/R_{th,i}$	W	Only copper losses are considered. This catalog considers T_{int} = 20ºC and only heat dissipation towards the interface.
Peak dissipation	$P_{d,p} = C_{th}\alpha_T$	W	α_T is mentioned at the peak force specification. C_{th} is the heat capacitance of the coils only and not specified seperately in the catalog.
Continuous rms current	$I_c = \min\left(\sqrt{\frac{P_{d,c}}{3R_{ph}}}, \frac{V_{dc}}{\sqrt{6}R_{ph}}\right)$	A_{rms}	Limited either by continuous dissipation or dc voltage and resistance or connector ratings (if applicable).
Peak rms current	$I_p = \min\left(\sqrt{\frac{P_{d,p}}{3R_{ph,20}}}, \frac{V_{dc}}{\sqrt{6}R_{ph,20}}\right)$	A_{rms}	Limited either by peak dissipation or dc voltage and resistance or connector ratings (if applicable).
Continuous force	$F_c = K_{f,c} I_c$	N	For Phoenix and Gryphon: $K_{f,c} = K_f$.
Peak force	$F_p = K_{f,p} I_p$	N	For Phoenix and Gryphon: $K_{f,p} = K_f$.
Steepness	$S = \frac{K_{f,0}^2}{3R_{ph,20}}$	N^2/W	For Phoenix and Gryphon: $K_{f,0} = K_f$.
Maximum velocity (F = 0)	$v_m = \frac{V_{dc}}{K_{e,ll,p}}$	m/s	Iron losses are not considered.
Maximum velocity ($F = F_p$)	$v_i = \left(\tau_p\sqrt{6\tau_p^2K_{f,p}^2V_{dc}^2+54\pi^2\left(L_{ph}^2I_p^2V_{dc}^2-6L_{ph}^2R_{ph,20}^2I_p^4\right)}-6\tau_p^2K_{f,p}R_{ph,20}I_p\right)\left(2\tau_p^2K_{f,p}^2+18\pi^2L_{ph}^2I_p^2\right)^{-1}$	m/s	For Phoenix and Gryphon: $K_{f,p} = K_f$. Iron losses are not considered.
Maximum velocity ($F = F_c$)	$v_n = \left(\tau_p\sqrt{6\tau_p^2K_{f,c}^2V_{dc}^2+54\pi^2\left(L_{ph}^2I_c^2V_{dc}^2-6L_{ph}^2R_{ph,100}^2I_p^4\right)}-6\tau_p^2K_{f,c}R_{ph,100}I_c\right)\left(2\tau_p^2K_{f,c}^2+18\pi^2L_{ph}^2I_c^2\right)^{-1}$	m/s	For Phoenix and Gryphon: $K_{f,c} = K_f$. Iron losses are not considered.



Force-velocity curves

DEFINITIONS IRIS

Description	Equation	Unit	Remarks
Phase resistance at T_{coil}	$R_{ph} = R_{ph,20}\left(1+0.0039(T_{coil}-20)\right)$	Ohm	
Force constant at no load	$K_f = K_e$	N/A	
Continuous dissipation	$P_{d,c} = (T_{coil}-T_{amb})/R_{th,i}$	W	Only copper losses are considered. This catalogue considers T_{amb} = 20ºC.
Peak dissipation	$P_{d,p} = C_{th}\alpha_T$	W	α_T is mentioned at the peak force specification.
Continuous rms current	$I_c = \min\left(\sqrt{\frac{P_{d,c}}{R_{ph}}}, \frac{V_{dc}}{R_{ph}}\right)$	A	Limited either by continuous dissipation or dc voltage and resistance or cable/connector ratings (if applicable).
Peak rms current	$I_p = \min\left(\sqrt{\frac{P_{d,p}}{R_{ph,20}}}, \frac{V_{dc}}{R_{ph,20}}\right)$	A	Limited either by peak dissipation or dc voltage and resistance or cable/connector ratings (if applicable).
Continuous force	$F_c = K_f I_c$	N	
Peak force	$F_p = K_f I_p$	N	
Motor constant	$S = \frac{K_f^2}{R_{ph,20}}$	N^2/W	

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December 2023