The correct motor selection: LSH or LST?

No matter which variant you have decided on: you have in any case chosen a high-quality synchronous servo motor.

Because both the LSH- and the LST-motors are equipped with high-quality bearings, the unchanged flange, the same insulation system and the same encoder system. In short: the mechanical part is absolutely identical and of qualitatively highest level!

The LST-motor differs from the LSH-motor in the design of the stator pack and the number of pole pairs of the rotor. While the LSH-motor is equipped with the new concentrated winding, the LST-motor trusts in the conventional 6-pole stator winding with the familiar properties of a dynamic synchronous servo motor with neodymium-iron-boron-magnet.

While the LST-motor has a relatively large winding overhang because of the conventional so-called “distributed winding”, this does not apply for the LSH-motor,

because of the so-called “compressed winding”.

Especially in motors with short laminated core the winding overhang usually found in the LST occupies half of the length of the stator. This stator length, that is not required for torque generation, does not exist in the LSH-motor.

This results in a shorter motor with higher torque and up to 100% higher dynamics. Moreover, due to this saving in material and manufacturing efforts we are able to offer the LSH-motor for an almost 20 % lower price. The different properties at a glance:

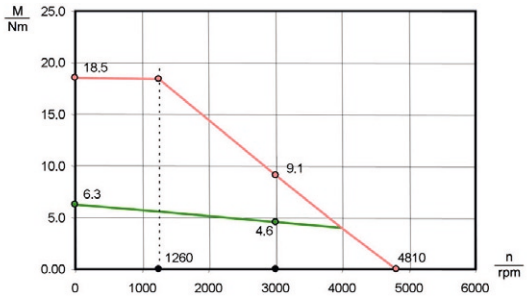
	Motor type LSH	Motor type LST
Winding technology	compressed winding technology	conventional “distributed winding”
Design	Rotor 10-pole (exception: LSH-050 = 6-pole)	6-pole design
Rated frequency	up to 250 Hz at 3000 rpm (exception: LSH-050 up to 225 Hz at 4500 rpm)	up to 150 Hz at 3000 rpm
Concentricity	very good	very good
Sizes	LSH-050 to LSH-127	LST-037 to LST-220
Moment of inertia	approx. 60 % of the LST-motor	100 %
Price-performance ratio	very good	good

Comparison of torque characteristics

The comparison of both characteristics clearly shows the higher torques of the LSH-motor in comparison to the LST-motor. The stall torque of the LSH is considerably higher than the torque of the LST.

The magnets of the LSH-motor also enable higher maximum torques than the magnets of the LST-motor.

LSH-97-2



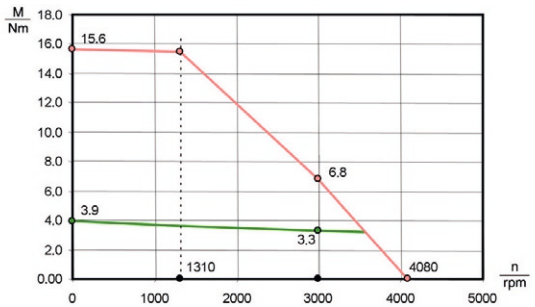
If high dynamics is an issue, the LSH-motor has its advantages. In standard applications the LSH-motor also convinces with its high power density. Furthermore, the LSH-motor is the winner in the price comparison and with its compact overall length.

Despite all these advantages, not all applications can be covered with the LSH-motor.

Due to the high number of pole pairs of the LSH-motor, it has a high rated frequency. This is why the core losses increase disproportionately with the speed. This is clearly apparent by the extremely descending torque characteristic of the LSH.

The comparison reveals that the application is decisive for choosing the appropriate motor type!

LST-97-2



Due to the 6-pole design the LST-motor is generally recommended for applications with rated speeds higher than 3000 rpm. Furthermore, the LST-motor is the right choice for extreme overloads under static conditions (e.g.: press applications). In case of a desired adaptation of moment of inertia the LST-motor is able to achieve better regulating properties than the more dynamic LSH-motor.

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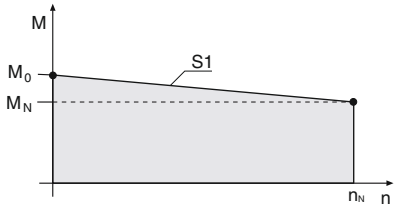
Basic equipment of the servo motors

Property	Synchronous servo motor LSx
Type of machine	Permanent-field synchronous servo motor
Magnetic material	Neodymium-iron-boron
Design (DIN 42948)	B5, V1, V3
Degree of protection (DIN 40050)	IP64, IP54 acc. to EN 60034-5 (rotating machines), IP65 optionally available
Insulating class	Insulating class F acc. to VDE0530, winding temperature rise Δt = 100 °C, Ambient temperature t_U = -20 °C to +40 °C, moisture condensation excluded!!!
Paint finish	RAL 9005 (matt black)
Shaft end on side A	smooth shaft (feather key and keyway DIN 6885, tolerance zone k6 optionally)
Rotational accuracy, concentricity and axial run-out deviation acc. to DIN 42955	Tolerance N (normal), tolerance R (reduced) on request
Thermal monitoring of motor	DIN-PTC in a stator winding
Torque load	In order to rule out thermal overloading of the motor, the effective moment of load at medium speed must not be above the S1-characteristic.  $M_{eff} = \sqrt{\frac{S\,(M^2_n \times t_n)}{t_{ges}}}$ $\bar{n} = \frac{S\,(n_n \times t_n)}{t_{ges}}$
Maximum pulse torque	Typically 2 to 4 times the rated torque for max. 0.2 s, depending on regulator assignment
Vibrational severity acc. to ISO 2373	Stage N, optionally R
Bearing life	the average life under nominal conditions (Mmax ≤ MN) is 20,000 h
Connecting type of motor, PTC-thermistor and holding brake	via push-lock terminals
Connecting type of encoder system	Signal plug (mating plug no included in scope of supply)

Cooling

The specified ratings refer to a max. ambient temperature of 40 °C and mounting of the motor to an aluminium plate with a max. temperature of 40 °C and an installation altitude of max. 1000 above seal level.

Minimum seating: 2.5 x the area of the motor flange

Thickness of seating: min. 10 mm

If the motor is to be mounted insulated (no heat discharge through the flange), the rated torque needs to be reduced.

From an installation altitude of 1000 m above sea level a power reduction of 1 % per 100 m is required. The max. installation altitude is 4000 m.

With ambient temperatures > 40 °C a power reduction of 1 % per 1 °C is required. The max. ambient temperature is 50 °C.

Order code LTi synchronous motors LSx

Example LSH-074-1-30-560

Article designation ➔	LSX	-	074	-	1	-	30	-	560	/	Options (if available)				
LTi synchronous motor series T or H	T H														
Edge measurement of motor in mm (not the flange measurement)			050 074 097 127 158 190 220												
Overall length					2 3 4 5										
Rated speed (x100)							30 45								
Controller d.c. link voltage (VDC)									24 48 320 560						
Ordering options (will be joined)											T0 B 1R G3 G6.1M G12.1S G12.2S	T1 P 3R G5 G6.1S G12.1M G12.2M	T4 X 5R G6.2M	K G6.2S	S4

Definition Standard	Motor shaft smooth (no feather key)	
	Resolver 1 pole pair	
	IP64 acc. to DIN 40050 except the flange	
	IP54 acc. to DIN VDE0530-5 or EN60034-5 (rotating machines)	
	Resolver plug straight outgoing	
	Power plug straight outgoing	
	Double basic insulation (winding and PTC)	
Options:	T0	(Thermal protection: thermostatic switch (e.g. Klixon)
	T1	(DIN-PTC double basic insulated) is specified as standard!
	T4	(Thermal protection: KTY84-130)
	B	Holding brake 24 VDC
	P	Feather key acc. to DIN 6885 sheet 1
	X	Customized design (e.g. special flange / shaft / housing, encoder, etc.)
	K	Cable 1 m open ends (standard LST-037)
	S4	angled / rotatable plugs
	1R	Resolver 1 pole pair
	V	Degree of protection IP65 without radial seal
	W	Degree of protection IP65 with radial seal (approx. 10mm longer)

Note:

Texts in pink represent motors or options, which are marked as preferred type (reduced delivery time).

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Encoder system options

Ordering options	Description	Interface	Oscillations analog	Single-turn info	Multi-turn info	Compatible with
1R	Resolver 1 pole pair	analog	1	14 bit	-	all LSx
3R	Resolver 3 pole pair	analog	3	3 x 14 bit	-	LSH-050 and LST-050 to LST-220
5R	Resolver 5 pole pair	analog	5	5 x 14 bit	-	LSH-074 to LSH-127
G3	Multi-turn absolute encoder EQN 1325	analog and SSI	2048	13 bit	12 bit	from LSx-074
G5	Single-turn absolute encoder ECN 1313	analog and SSI	2048	13 bit	-	from LSx-074
G6.1S	Single-turn absolute encoder SRS 50	analog and Hiperface	1024	15 bit	-	from LSx-074
G6.1M	Multi-turn absolute encoder SRM 50	analog and Hiperface	1024	15 bit	12 bit	from LSx-074
G6.2S	Single-turn absolute encoder SKS 36	analog and Hiperface	128	15 bit	-	from LSx-050
G6.2M	Multi-turn absolute encoder SKM 36	analog and Hiperface	128	15 bit	12 bit	from LSx-050
G12.1S	Single-turn absolute encoder ECN 1313	analog and Endat 2.1	2048	13 bit	-	from LSx-074
G12.1M	Multi-turn absolute encoder EQN 1325	analog and Endat 2.1	2048	13 bit	12 bit	from LSx-074
G12.2S	Single-turn absolute encoder ECN 1113	analog and Endat 2.1	512	13 bit	-	from LSx-050
G12.2M	Multi-turn absolute encoder EQN 1125	analog and Endat 2.1	512	13 bit	12 bit	from LSx-050

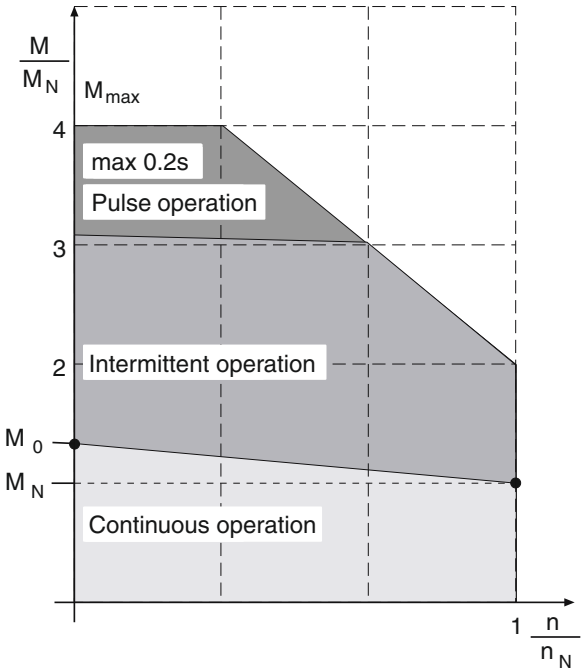
Ordering example:

Motor LSH-074-1-30-560 with (DIN-PTC, brake, feather key, angled / rotatable plugs and SRS50-encoder)
= LSH-074-1-30-560 / T1, B, P, S4, G6.1S

Note:

Texts in pink represent motors or options, which are marked as preferred type (reduced delivery time).

Typical M-n-characteristic of servo motors



M-n-characteristic for synchronous motors

Term	Explanation
M_0 stall torque	Thermal limiting torque of the motor at standstill. The motor is able to provide this torque over an unlimited period of time.
I_0 stall AC current	Effective value of the motor phase current, which is needed to generate the stall torque.
M_N rated torque	Thermal limiting torque of the motor at rated speed n_N.
I_N rated AC current	Effective value of the motor phase current, which is needed to generate the rated torque.
P_N rated power	Continuous output of the motor at the rated operating point (M_N, n_N) at rated AC current I_N and rated voltage U_N.
M_{MAX}, I_{MAX} cut-off characteristic	The motors may be loaded with max. four times the rated AC current.

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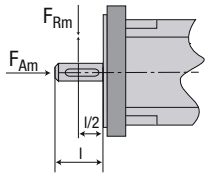
Permissible axial and transverse force

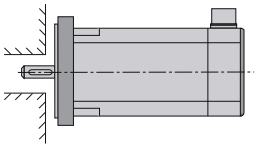
Sizes	Radial force F_{Rm} [N] at speed n [rpm]					Axial force F_{Am} [N] at speed n [rpm]					F_G
	1000	2000	3000	4500	6000	1000	2000	3000	4500	6000	[N]
LST-037	230	185	160	140	130	44	35	31	27	24	2
LST-037/B	130	100	90	77	70	24	19	17	15	13	2
LSH-050	310	250	220	190	170	60	50	42	36	32	2
LST-050	325	260	225	195	175	62	50	43	37	34	2
LSH-074	480	380	330	290	260	90	70	63	55	50	6
LST-074	535	425	370	325	295	100	80	70	60	55	6
LSH-097	850	680	600	520	470	160	130	115	100	90	15
LST-097	920	730	640	560	510	175	140	120	105	95	18
LSH-127	970	770	670	590	530	185	145	125	110	100	34
LST-127	1000	790	690	600	550	190	150	130	115	105	34
LST-158	1020	810	710	620	560	195	155	135	120	110	60
LST-190	1950	1550	1350	1170	1070	370	290	260	225	200	100
LST-220	2500	1950	1700	1490	1350	470	370	320	280	260	200

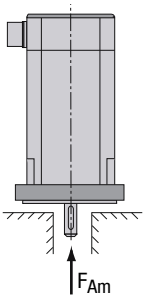


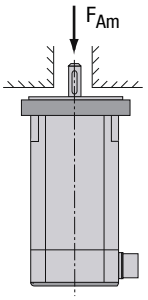
The table specifies the max. permissible transverse force (radial force FRm) at the point of application l/2 and the max. permissible axial force FAm for a life of 20,000 h. A transverse force not acting on the centre of the shaft end can be simply converted to the changed lever ratios.

Either the permissible radial force or the axial force may be applied to the motor shaft!

Technical data design







Design	B5	V1	V3
Shaft	free shaft end	free shaft end bottom	free shaft end top
Mounting	Flange mounting Access from housing side	Flange mounting bottom Access from housing side	Flange mounting top Access from housing side

Note: With vertical installation (V1) the permissible axial forces (FAm) do apply. With vertical installation pointing up (V3) the permissible axial forces are reduced by the force caused by the weight of the rotor (FG).

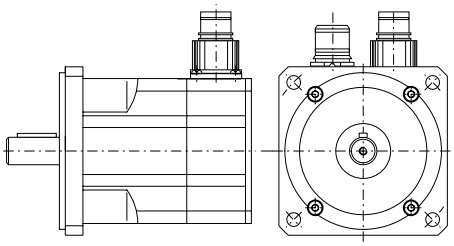
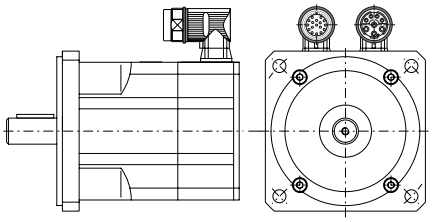
Connection system

LSH-074-1-30-560/S4*, G3*

Plug alignment

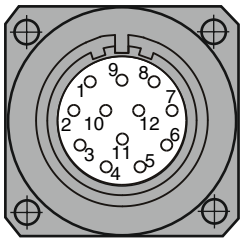
Connector pin assignment

*Example

Standard design	Design S4
	
Straight plug	Angled / rotatable plug

Encoder connections

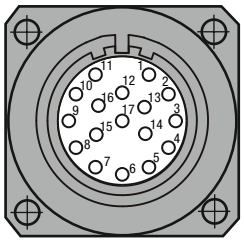
Encoder connection xR (resolver)



12-pole junction box
Contact pins ∅ 1 mm

Pin	Des.	Designation
1	Cos+	(S1)
2	COS-	(S3)
3	SIN+	(S2)
4	SIN-	(S4)
6	REF+	(R1)
7	REF-	(R2)
11	PTC+	Motor-PTC
12	PTC-	Motor-PTC
5, 8, 9, 10	n. c.	not assigned

Encoder connection Gx (optical encoder)



17-pole junction box
Contact pins ∅ 1 mm

Pin	Des. G3, G5, G12.x	Des. G6.x
1	A+	A+
2	A-	A-
3	B+	B+
4	B-	B-
7	GND / 0V	GND / 0V
8	VCC +5 V/150 mA	-
9	-	VCC 7-12V/100mA
10	DATA+	DATA+
11	DATA-	DATA-
12	CLK+	-
13	CLK-	-
16	VCC-Sense	-
17	GND-Sense	-
5, 6, 14, 15	n. c.	n. c.

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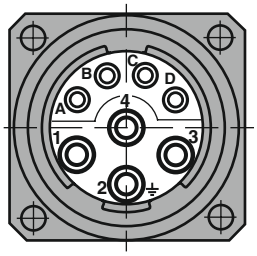
Power terminals

Power terminal

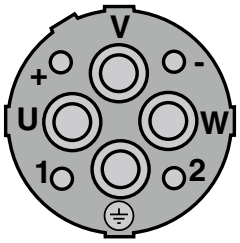


8-pole junction box contact pins
for contact 1 ... 4 ∅ 2 mm
for contact A ... D ∅ 1 mm

Pin	Des.	Designation
1	U	Motor phase U
2	PE	PE
3	W	Motor phase W
4	V	Motor phase V
A	Brake +	Brake +
B	Brake -	Brake -
C	PTC+	Motor PTC [1]
D	PTC-	Motor PTC [1]

[1] on motors with resolver, not used

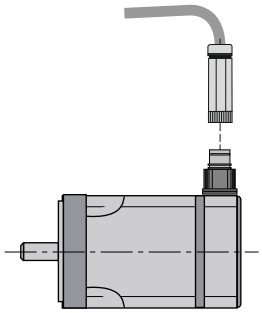
Power terminal 3220



Pin	Des.	Designation
U	-	Motor phase U
V	-	Motor phase V
W	-	Motor phase W
PE	-	PE
1	PTC+	Motor PTC [1]
2	PTC -	Motor PTC [1]
+	Brake +	Brake +
-	Brake -	Brake -

[1] on motors with resolver, not used

Overview LSH servo motors



Type	U_{DC}	Page
LSH-050	320 V	2 - 2
LSH-074	320 V	2 - 6
	560 V	2 - 10
LSH-097	320 V	2 - 14
	560 V	2 - 18
LSH-127	560 V	2 - 22

The LSH-motor - the power pack

With the new winding technology, the so-called concentrated winding, the new motor generation LSH achieves an increase in power density of 30 % to 70 % in comparison with conventional technology.

For the user this means an increase in dynamics of up to 100 % and a considerable reduction of installation space, together with good concentricity.

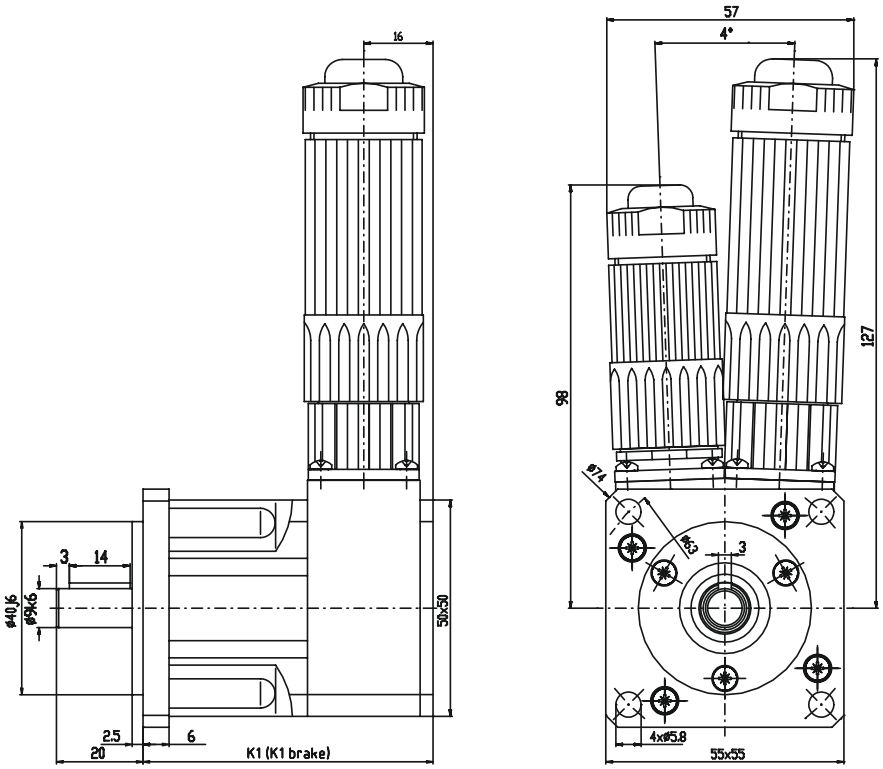
Technical data Motor	Stall torque M_0 [Nm]	Rated torque M_N [Nm]	Rated AC current at 560 V I_N [A]	Rated AC current at 320 V I_N [A]	Rated speed n_N [rpm]
LSH-050-1 1)	0.26	0.24	-	0.68	4500
LSH-050-2 1)	0.53	0.45	-	1.11	4500
LSH-050-3 1)	0.74	0.67	-	1.55	4500
LSH-050-4 1)	0.95	0.84	-	1.90	4500
LSH-074-1 2)	0.95	0.86	1.28	1.43	3000
LSH-074-2 2)	1.90	1.60	1.46	2.40	3000
LSH-074-3 2)	3.30	2.90	2.30	4.00	3000
LSH-074-4 2)	4.20	3.10	2.30	3.70	3000
LSH-097-1 2)	4.10	3.20	2.80	5.00	3000
LSH-097-2 2)	6.30	4.60	3.60	7.00	3000
LSH-097-3 2)	8.60	6.10	4.80	8.3	3000
LSH-127-1 3)	11.60	8.40	7.90	-	3000
LSH-127-2 3)	14.90	10.90	9.60	-	3000
LSH-127-3 3)	18.70	14.30	13.10	-	3000
LSH-127-4 3)	27.30	21.00	14.90	-	3000

1) DC link voltage 320 V
2) DC link voltage 320 V / 560 V
3) DC link voltage 560 V

Motor type LSH-050 (U_{ZK} = 320 V)

Motor length [mm]	K (with resolver)	K (with optical encoder G12.2x)	K (with optical encoder G6.2x)	Additional length with design LSX-xxx-...,B (brake)
LSH-050-1-45-320	67	130.5	98	38
LSH-050-2-45-320	82	145.5	113	38
LSH-050-3-45-320	97	160.5	128	38
LSH-050-4-45-320	112	175.5	143	38

Dimensional sketch



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Technical data	Symbol	LSH-050-1-45-320	LSH-050-2-45-320	LSH-050-3-45-320	LSH-050-4-45-320
Rated speed	n_n	4500 rpm	4500 rpm	4500 rpm	4500 rpm
Rated frequency	f_N	225 Hz	225 Hz	225 Hz	225 Hz
DC link voltage (controller)	U_{dc}	320 V	320 V	320 V	320 V
Nominal AC voltage	U_n	200 V	200 V	200 V	200 V
Rated torque	M_n	0.24 Nm	0.45 Nm	0.67 Nm	0.84 Nm
Rated AC current	I_n	0.68 A	1.11 A	1.55 A	1.90 A
Power	P	0.11 kW	0.21 kW	0.31 kW	0.40 kW
Stall torque	M_0	0.26 Nm	0.53 Nm	0.74 Nm	0.95 Nm
Stall AC current	I_0	0.70 A	1.26 A	1.66 A	2.1 A
Peak torque	M_{max}	1.0 Nm	2.0 Nm	2.8 Nm	3.6 Nm
Peak current	I_{max}	2.9 A	5.1 A	6.7 A	8.5 A
Maximum speed	n_{max}	12000 rpm	12000 rpm	12000 rpm	12000 rpm
EMF constant	K_E	22.5 V/1000	25.5 V/1000	27.0 V/1000	27.5 V/1000
Torque constant	K_T	0.37 Nm/A	0.42 Nm/A	0.45 Nm/	0.45 Nm/A
Winding resistance (two phases)	R_{2ph}	33.1 Ω	16.4 Ω	11.1 Ω	8.4 Ω
Winding inductance (two phases)	L_{2ph}	51 mH	32.7 mH	24.5 mH	19.4 mH
No load speed	n_0	8890 rpm	7840 rpm	7410 rpm	7250 rpm
Electric time constant	T_{el}	1.5 ms	2.0 ms	2.2 ms	2.3 ms
Thermal time constant	T_{th}	13 min.	15 min.	20 min.	22 min.
Moment of inertia of rotor	J	0.000006 kgm²	0.000008 kgm²	0.00001 kgm²	0.000012 kgm²
Mass	m	0.75 kg	0.92 kg	1.1 kg	1.26 kg
Brake (optional)					
Rated voltage ± 10 %	U_N	24 V ± 10 %			
Rated AC current at 20 °C to release	I_N	0.46 A			
permissible maximum speed	n_{max}	10,000 rpm			
permissible friction energy	W_R	0.41 x 10^6 Ws			
Moment of inertia	J_B	0.000007 kgm²			
Mass	m	0.15 kg			
Braking torque	M_H	2 Nm			

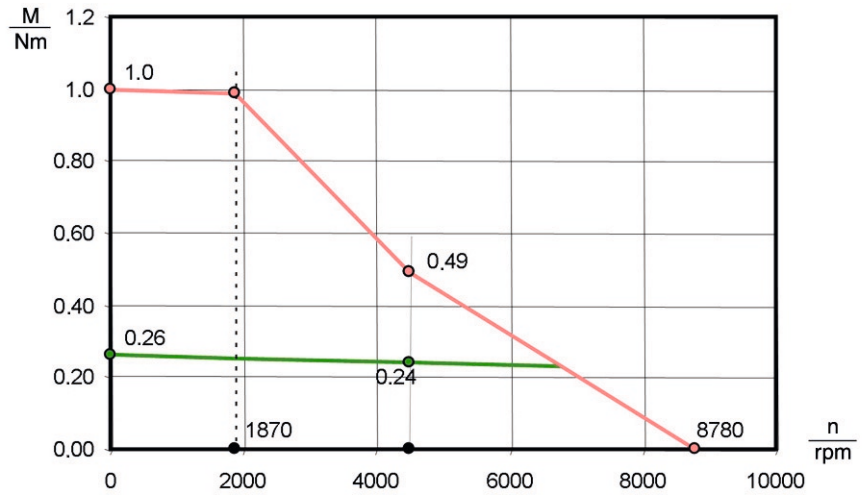
Motor type LSH-050 (U_{ZK} = 320 V)

Explanation on characteristics:

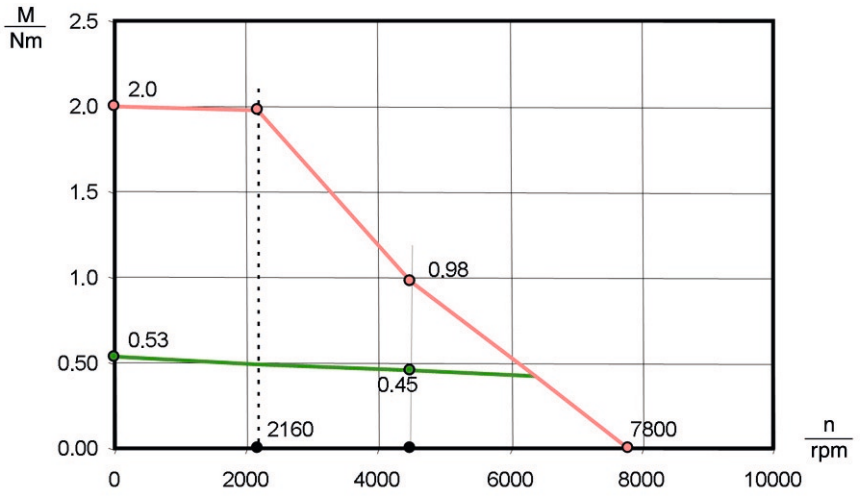
The upper characteristic (M_{max}) describes the short-term max. possible torque at the corresponding speed (important with dynamic processes).

The lower characteristic (M_{nenn}) shows the thermally permissible continuous torque.

LSH-050-1-45-320



LSH-050-2-45-320



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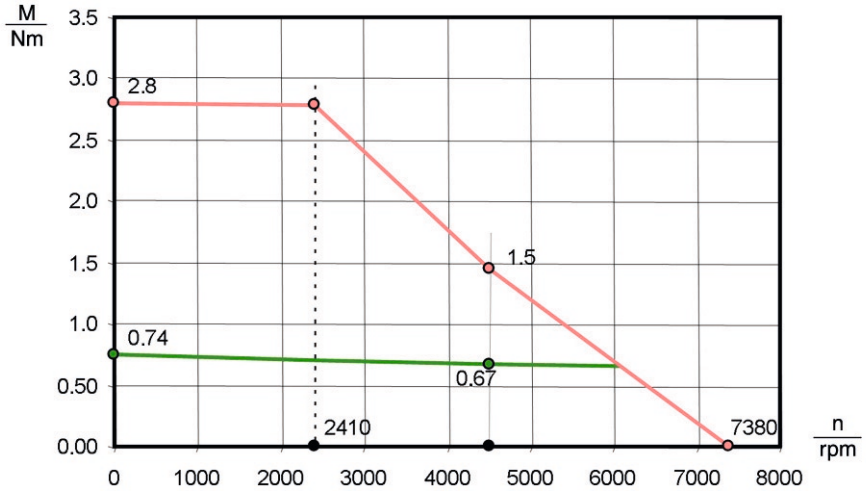
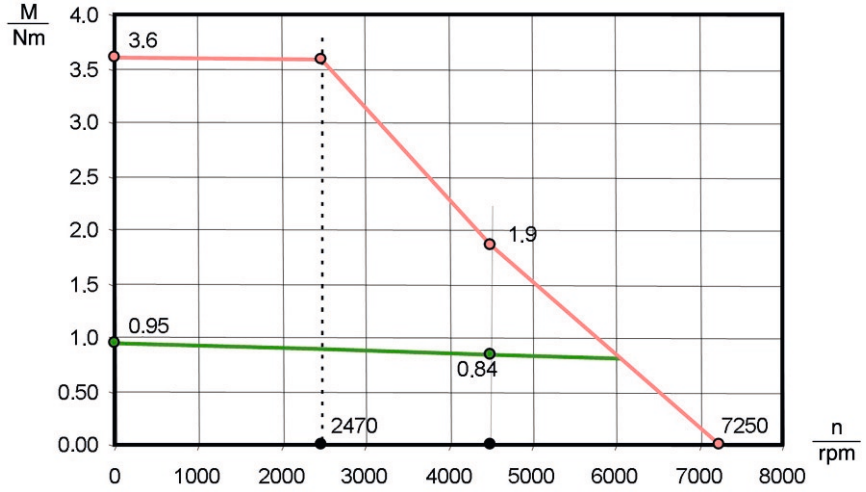
LSH-050-3-45-320



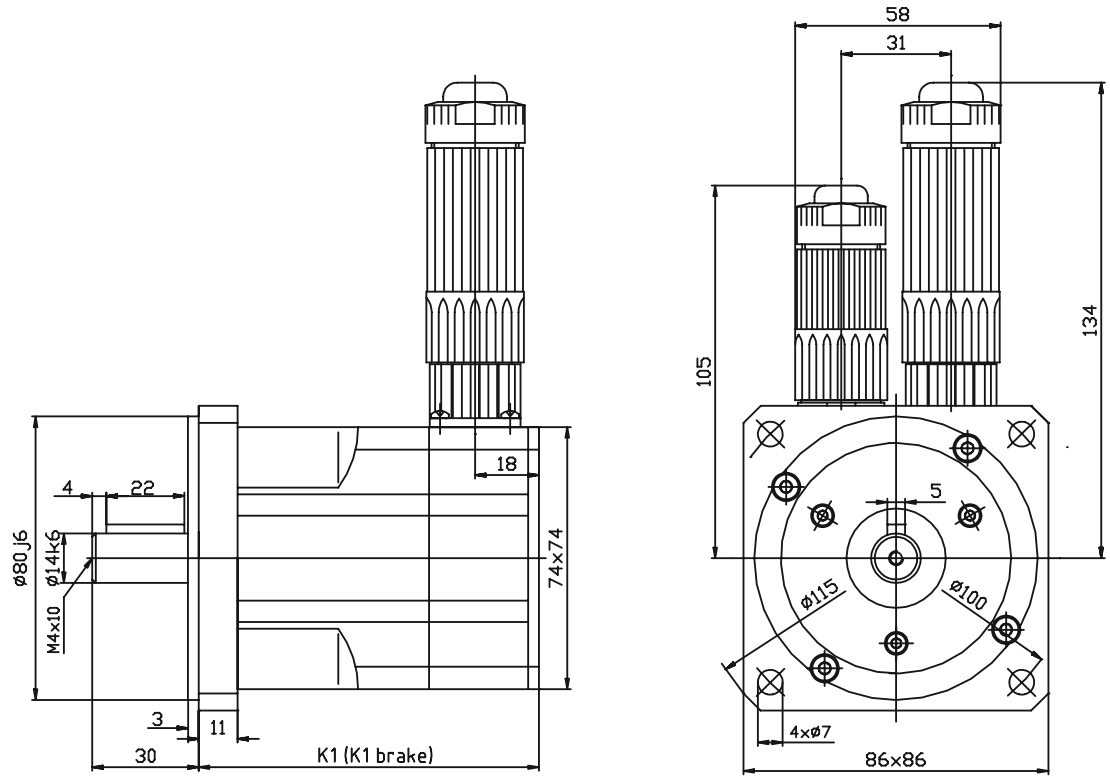
LSH-050-4-45-320



Motor type LSH-074 (U_{ZK} = 320 V)

Motor length [mm]	K (with resolver)	K (with optical encoder G3, G5, G12.x)	K (with optical encoder G6.x)	Additional length with design LSX-xxx-...,B (brake)
LSH-074-1-30-320	96	137	115.5	42
LSH-074-2-30-320	114	155	133.5	42
LSH-074-3-30-320	150	191	169.5	42
LSH-074-4-30-320	186	227	205.5	42

Dimensional sketch



Catalogue Servo Motors
Id.-No. 0814.258.5-00 Status: 08/2010

Technical data	Symbol	LSH-074-1-30-320	LSH-074-2-30-320	LSH-074-3-30-320	LSH-074-4-30-320
Rated speed	n_n	3000 rpm	3000 rpm	3000 rpm	3000 rpm
Rated frequency	f_N	250 Hz	250 Hz	250 Hz	250 Hz
DC link voltage (controller)	U_{dc}	320 V	320 V	320 V	320 V
Nominal AC voltage	U_n	200 V	200 V	200 V	200 V
Rated torque	M_n	0.86 Nm	1.6 Nm	2.9 Nm	3.1 Nm
Rated AC current	I_n	1.43 A	2.4 A	4.0 A	3.7 A
Power	P	0.27 kW	0.5 kW	0.91 kW	0.97 kW
Stall torque	M_0	0.95 Nm	1.9 Nm	3.3 Nm	4.2 Nm
Stall AC current	I_0	1.47 A	2.8 A	4.3 A	4.8 A
Peak torque	M_{max}	2.4 Nm	5.2 Nm	9.5 Nm	12.3 Nm
Peak current	I_{max}	5.4 A	11.1 A	18.6 A	21.0 A
Maximum speed	n_{max}	12000 rpm	12000 rpm	12000 rpm	12000 rpm
EMF constant	K_E	39.0 V/1000	41.5 V/1000	46.0 V/1000	53.0 V/1000
Torque constant	K_T	0.65 Nm/A	0.69 Nm/A	0.76 Nm/A	0.88 Nm/A
Winding resistance (two phases)	R_{2ph}	9.9 Ω	4.0 Ω	2.2 Ω	1.77 Ω
Winding inductance (two phases)	L_{2ph}	30.6 mH	15.4 mH	9.8 mH	10.0 mH
No load speed	n_0	5080 rpm	4800 rpm	4340 rpm	3760 rpm
Electric time constant	T_{el}	3.1 ms	3.9 ms	4.5 ms	5.6 ms
Thermal time constant	T_{th}	25 min.	30 min.	33 min.	36 min.
Moment of inertia of rotor	J	0.000050 kgm²	0.000070 kgm²	0.00011 kgm²	0.00015 kgm²
Mass	m	1.52 kg	2.09 kg	3.22 kg	4.35 kg
Brake (optional)					
Rated voltage ± 10 %	U_N	24 V ± 10 %			
Rated AC current at 20 °C to release	I_N	0.5 A			
permissible maximum speed	n_{max}	10,000 rpm			
permissible friction energy	W_R	0.58 x10⁶ Ws			
Moment of inertia	J_B	0.000018 kgm²			
Mass	m	0.3 kg			
Braking torque	M_H	4.5 Nm			

Motor type LSH-074 (U_{ZK} = 320 V)

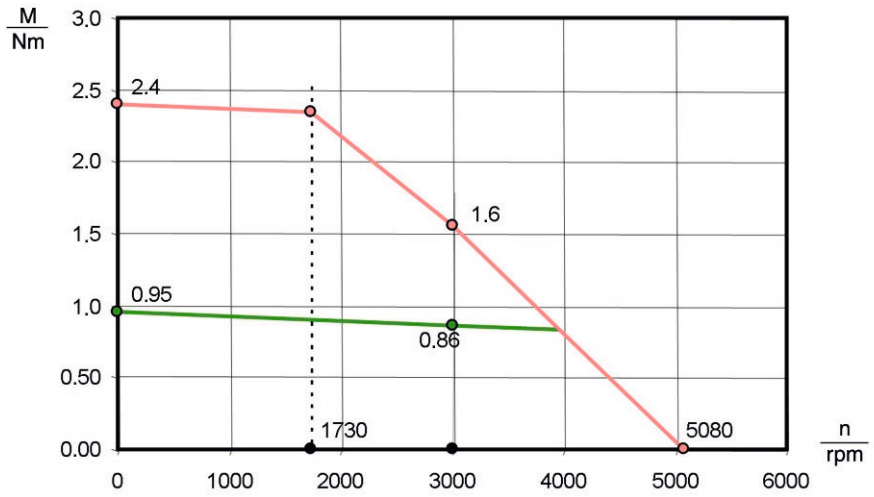
Explanation on characteristics:

The upper characteristic (M_{max}) describes the short-term max. possible torque at the corresponding speed (important with dynamic processes).

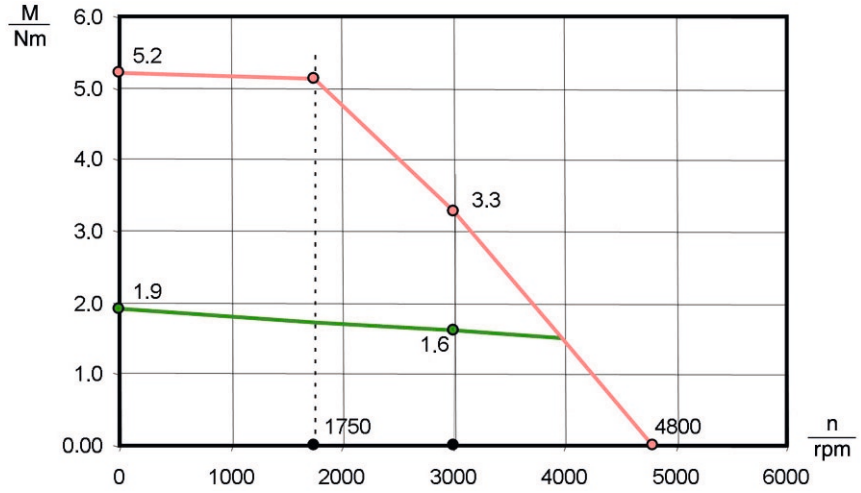
The lower characteristic (M_{nenn}) shows the thermally permissible continuous torque.

2

LSH-074-1-30-320

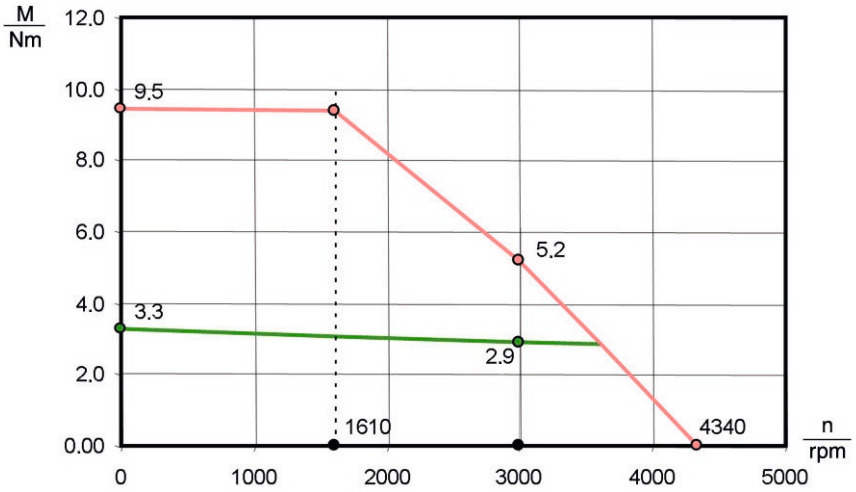


LSH-074-2-30-320

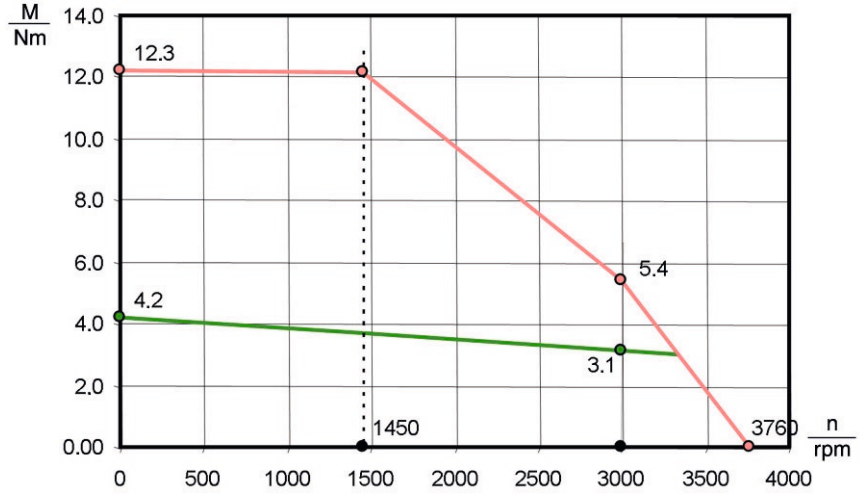


Catalogue Servo Motors
Id.-No.: 0814.258.5-00 Status: 08/2010

LSH-074-3-30-320



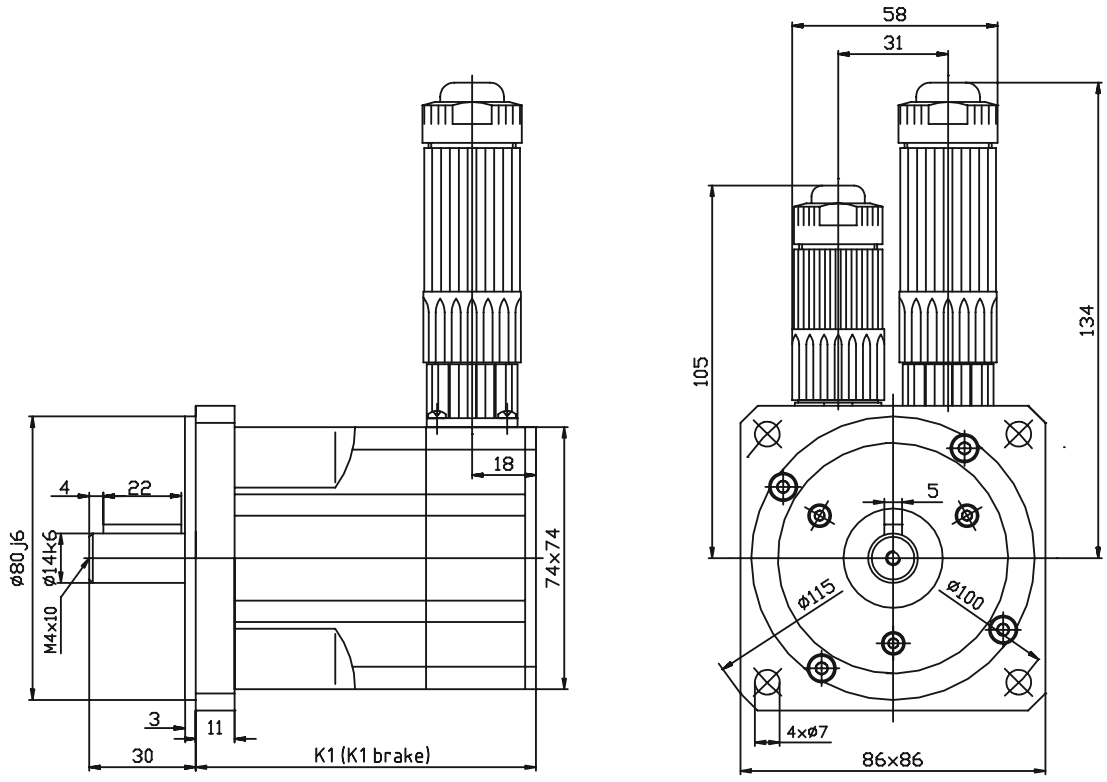
LSH-074-4-30-320



Motor type LSH-074 (U_{ZK} = 560 V)

Motor length [mm]	K (with resolver)	K (with optical encoder G3, G5, G12.x)	K (with optical encoder G6.x)	Additional length with design LSX-xxx-...,B (brake)
LSH-074-1-30-560	96	137	115.5	42
LSH-074-2-30-560	114	155	133.5	42
LSH-074-3-30-560	150	191	169.5	42
LSH-074-4-30-560	186	227	205.5	42

Dimensional sketch



Catalogue Servo Motors
Id.-No. 0814.258.5-00 Status: 08/2010

Technical data	Symbol	LSH-074-1-30-560	LSH-074-2-30-560	LSH-074-3-30-560	LSH-074-4-30-560
Rated speed	n_n	3000 rpm	3000 rpm	3000 rpm	3000 rpm
Rated frequency	f_N	250 Hz	250 Hz	250 Hz	250 Hz
DC link voltage (controller)	U_{dc}	560 V	560 V	560 V	560 V
Nominal AC voltage	U_n	330 V	330 V	330 V	330 V
Rated torque	M_n	0.86 Nm	1.6 Nm	2.9 Nm	3.1 Nm
Rated AC current	I_n	1.28 A	1.46 A	2.3 A	2.3 A
Power	P	0.27 kW	0.5 kW	0.91 kW	0.97 kW
Stall torque	M_0	0.95 Nm	1.9 Nm	3.3 Nm	4.2 Nm
Stall AC current	I_0	1.32 A	1.66 A	2.4 A	3.0 A
Peak torque	M_{max}	2.4 Nm	5.2 Nm	9.5 Nm	12.3 Nm
Peak current	I_{max}	4.9 A	6.7 A	10.6 A	12.9 A
Maximum speed	n_{max}	12000 rpm	12000 rpm	12000 rpm	12000 rpm
EMF constant	K_E	43.5V/1000	69.0 V/1000	81.0 V/1000	86.0 V/1000
Torque constant	K_T	0.72 Nm/A	1.14 Nm/A	1.34 Nm/A	1.42 Nm/A
Winding resistance (two phases)	R_{2ph}	12.6 Ω	11.6 Ω	6.5 Ω	4.6 Ω
Winding inductance (two phases)	L_{2ph}	38.0 mH	42.3 mH	30.6 mH	26.1 mH
No load speed	n_0	7520 rpm	4770 rpm	4060 rpm	3830 rpm
Electric time constant	T_{el}	3.0 ms	3.6 ms	4.7 ms	5.7 ms
Thermal time constant	T_{th}	25 min.	30 min.	33 min.	36 min.
Moment of inertia of rotor	J	0.000050 kgm²	0.000070 kgm²	0.00011 kgm²	0.00015 kgm²
Mass	m	1.52 kg	2.09 kg	3.22 kg	4.35 kg
Brake (optional)					
Rated voltage ± 10 %	U_N	24 V ± 10 %			
Rated AC current at 20 °C to release	I_N	0.5 A			
permissible maximum speed	n_{max}	10,000 rpm			
permissible friction energy	W_R	0.58 x 10^6 Ws			
Moment of inertia	J_B	0.000018 kgm²			
Mass	m	0.3 kg			
Braking torque	M_H	4.5 Nm			

Motor type LSH-074 (U_{ZK} = 560 V)

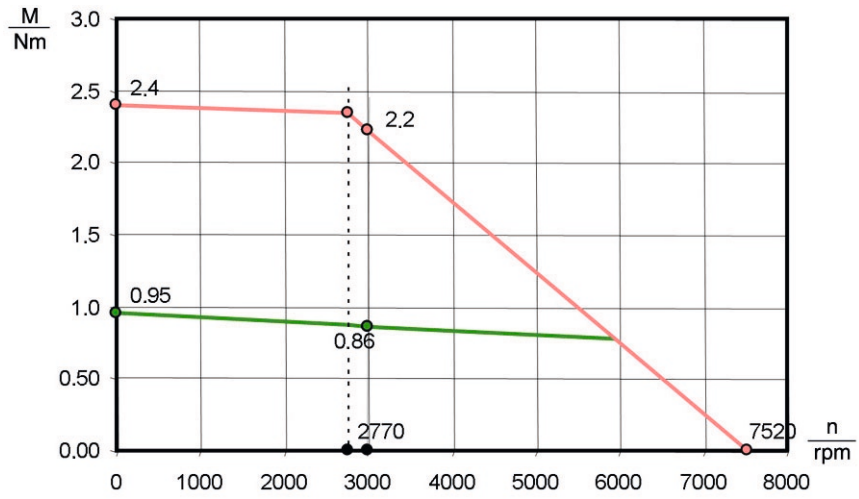
Explanation on characteristics:

The upper characteristic (M_{max}) describes the short-term max. possible torque at the corresponding speed (important with dynamic processes).

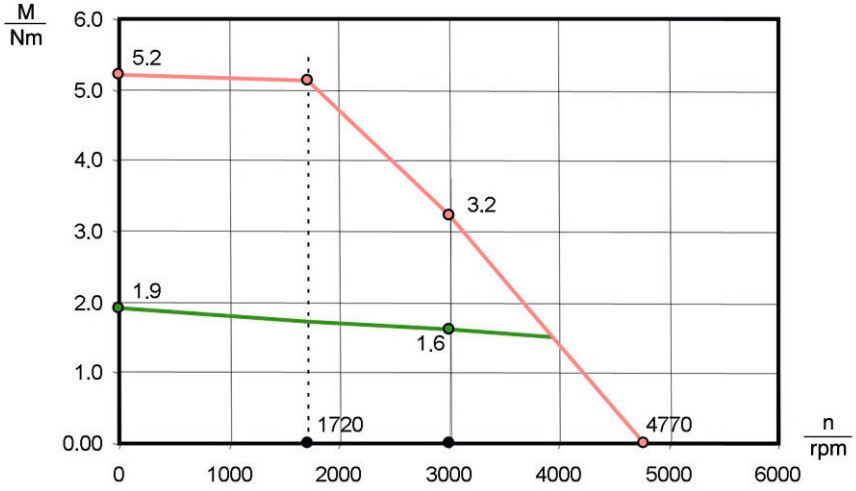
The lower characteristic (M_{nenn}) shows the thermally permissible continuous torque.

2

LSH-074-1-30-560

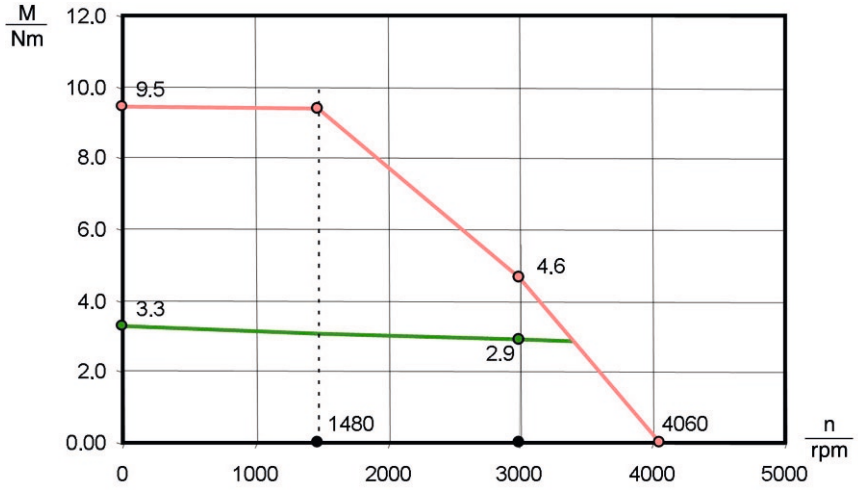


LSH-074-2-30-560

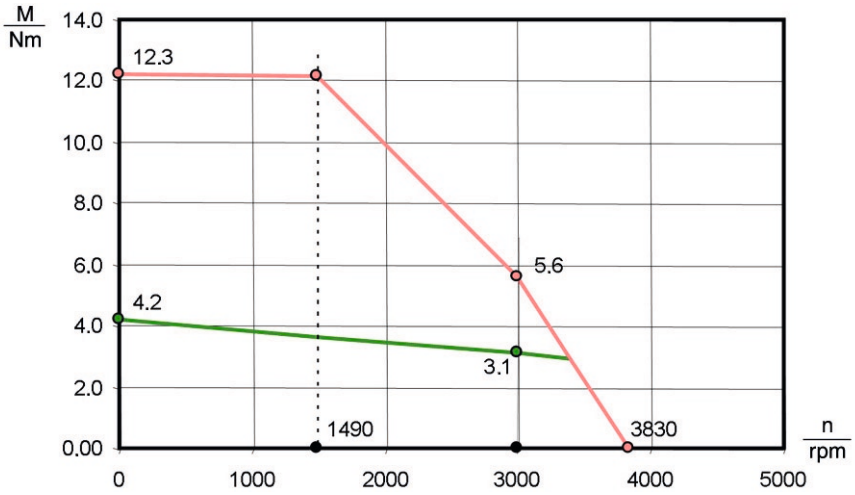


Catalogue Servo Motors
Id.-No.: 0814.258.5-00 Status: 08/2010

LSH-074-3-30-560



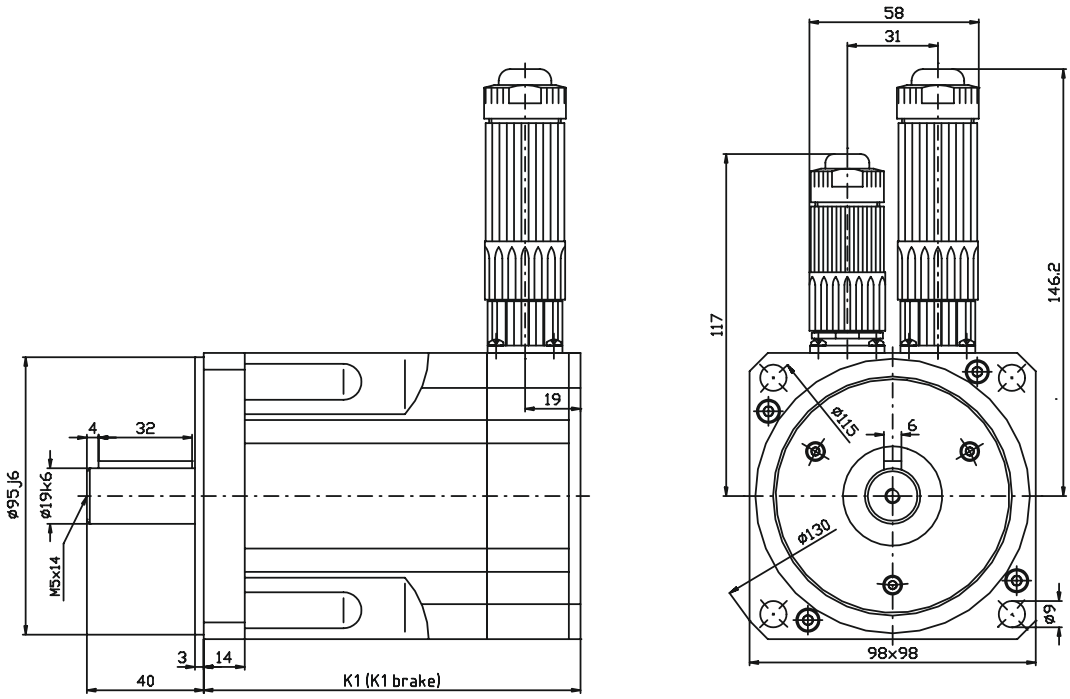
LSH-074-4-30-560



Motor type LSH-097 (U_{ZK} = 320 V)

Motor length [mm]	K (with resolver)	K (with optical encoder G3, G5, G12.x)	K (with optical encoder G6.x)	Additional length with design LSX-xxx-...,B (brake)
LSH-097-1-30-320	129	166	150	41
LSH-097-2-30-320	159	196	180	41
LSH-097-3-30-320	189	226	210	41

Dimensional sketch



Catalogue Servo Motors
Id.-No. 0814.258.5-00 Status: 08/2010

Technical data	Symbol	LSH-097-1-30-320	LSH-097-2-30-320	LSH-097-3-30-320
Rated speed	n_n	3000 rpm	3000 rpm	3000 rpm
Rated frequency	f_N	250 Hz	250 Hz	250 Hz
DC link voltage (controller)	U_{dc}	320 V	320 V	320 V
Nominal AC voltage	U_n	200 V	200 V	200 V
Rated torque	M_n	3.2 Nm	4.6 Nm	6.1 Nm
Rated AC current	I_n	5.0 A	7.0 A	8.3 A
Power	P	1.0 kW	1.44 kW	1.9 kW
Stall torque	M_0	4.1 Nm	6.3 Nm	8.6 Nm
Stall AC current	I_0	6.0 A	9.2 A	11.2 A
Peak torque	M_{max}	11.1 Nm	18.5 Nm	27.0 Nm
Peak current	I_{max}	24.0 A	40.0 A	53.0 A
Maximum speed	n_{max}	9000 rpm	9000 rpm	9000 rpm
EMF constant	K_E	40.5 V/1000	41.5 V/1000	46.5 V/1000
Torque constant	K_T	0.67 Nm/A	0.69 Nm/A	0.77 Nm/A
Winding resistance (two phases)	R_{2ph}	1.24 Ω	0.7 Ω	0.59 Ω
Winding inductance (two phases)	L_{2ph}	10.6 mH	6.9 mH	6.2 mH
No load speed	n_0	4920 rpm	4810 rpm	4290 rpm
Electric time constant	T_{el}	8.5 ms	9.9 ms	10.5 ms
Thermal time constant	T_{th}	29 min.	31 min.	33 min.
Moment of inertia of rotor	J	0.00017 kgm²	0.00026 kgm²	0.00035 kgm²
Mass	m	4.28 kg	5.34 kg	6.96 kg
Brake (optional)				
Rated voltage ± 10 %	U_N		24 V ± 10 %	
Rated AC current at 20 °C to release	I_N		0.75 A	
permissible maximum speed	n_{max}		10,000 rpm	
permissible friction energy	W_R		0.89 x 10^6 Ws	
Moment of inertia	J_B		0.000054 kgm²	
Mass	m		0.46 kg	
Braking torque	M_H		9.0 Nm	

Motor type LSH-097 (U_{ZK} = 320 V)

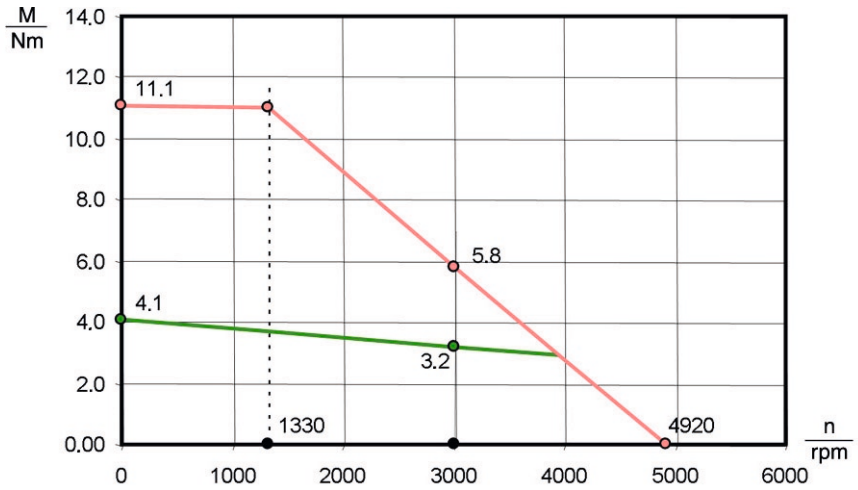
Explanation on characteristics:

The upper characteristic (M_{max}) describes the short-term max. possible torque at the corresponding speed (important with dynamic processes).

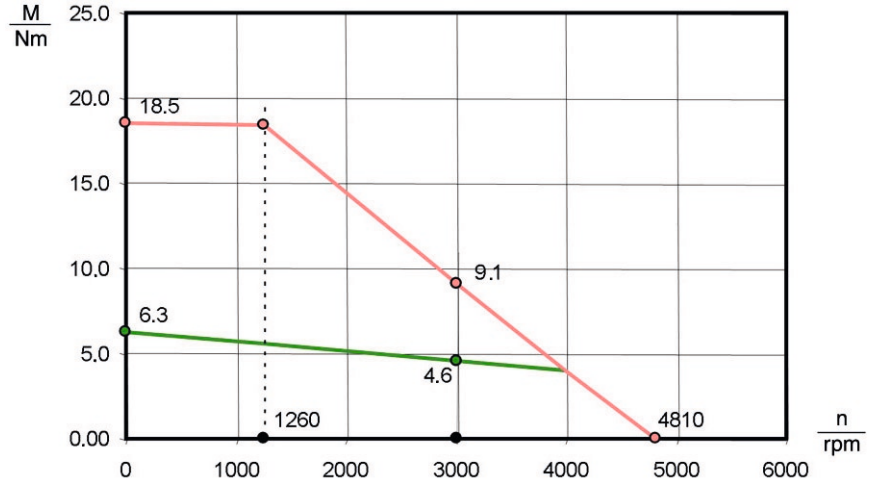
The lower characteristic (M_{nenn}) shows the thermally permissible continuous torque.

2

LSH-097-1-30-320



LSH-097-2-30-320



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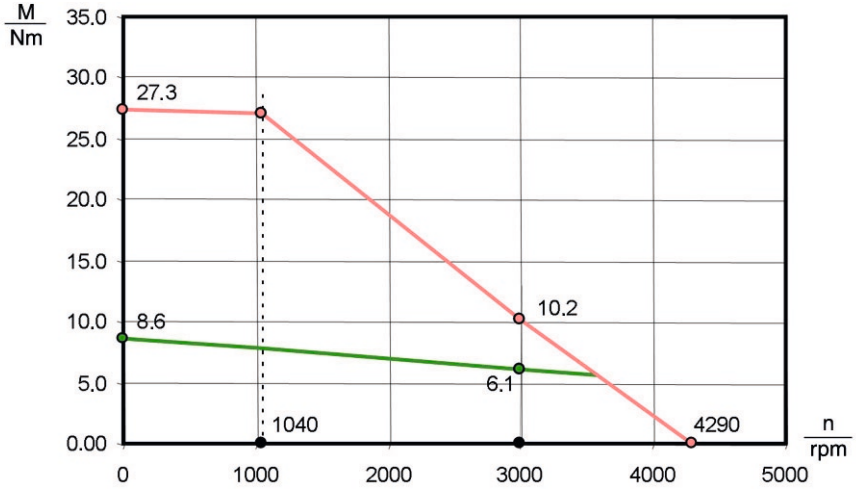
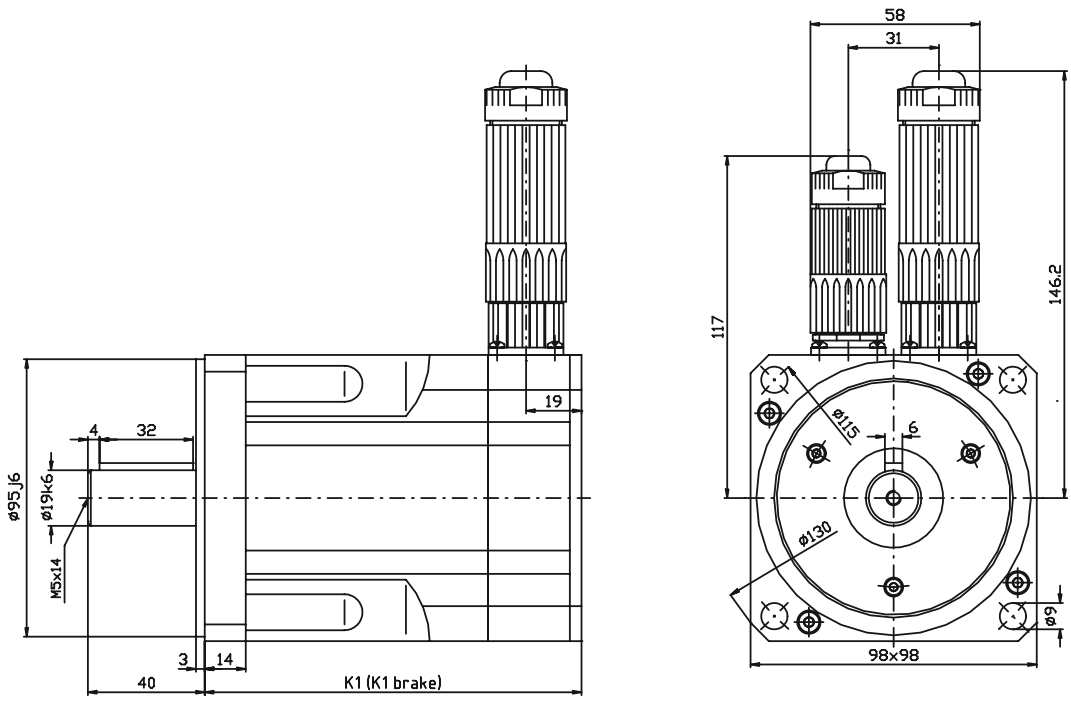
LSH-097-3-30-320



Motor type LSH-097 (U_{ZK} = 560 V)

Motor length [mm]	K (with resolver)	K (with optical encoder G3, G5, G12.x)	K (with optical encoder G6.x)	Additional length with design LSX-xxx-...,B (brake)
LSH-097-1-30-560	129	166	150	41
LSH-097-2-30-560	159	196	180	41
LSH-097-3-30-560	189	226	210	41

Dimensional sketch



Catalogue Servo Motors
Id.-No. 0814.258.5-00 Status: 08/2010

Technical data	Symbol	LSH-097-1-30-560	LSH-097-2-30-560	LSH-097-3-30-560
Rated speed	n_n	3000 rpm	3000 rpm	3000 rpm
Rated frequency	f_N	250 Hz	250 Hz	250 Hz
DC link voltage (controller)	U_{dc}	560 V	560 V	560 V
Nominal AC voltage	U_n	330 V	330 V	330 V
Rated torque	M_n	3.2 Nm	4.6 Nm	6.1 Nm
Rated AC current	I_n	2.8 A	3.6 A	4.8 A
Power	P	1.0 kW	1.44 kW	1.9 kW
Stall torque	M_0	4.1 Nm	6.3 Nm	8.6 Nm
Stall AC current	I_0	3.4 A	4.8 A	6.4 A
Peak torque	M_{max}	11.1 Nm	18.5 Nm	27.0 Nm
Peak current	I_{max}	13.6 A	21.0 A	31.0 A
Maximum speed	n_{max}	6000 rpm	6000 rpm	6000 rpm
EMF constant	K_E	72.0 V/1000	80.0 V/1000	81.0 V/1000
Torque constant	K_T	1.19 Nm/A	1.32 Nm/A	1.34 Nm/A
Winding resistance (two phases)	R_{2ph}	4.0 Ω	2.7 Ω	1.81 Ω
Winding inductance (two phases)	L_{2ph}	34.0 mH	25.5 mH	18.6 mH
No load speed	n_0	4570 rpm	4120 rpm	4070 rpm
Electric time constant	T_{el}	8.5 ms	9.5 ms	10.3 ms
Thermal time constant	T_{th}	29 min.	31 min.	33 min.
Moment of inertia of rotor	J	0.00017 kgm²	0.00026 kgm²	0.00035 kgm²
Mass	m	4.28 kg	5.34 kg	6.96 kg
Brake (optional)				
Rated voltage ± 10 %	U_N		24 V ± 10 %	
Rated AC current at 20 °C to release	I_N		0.75 A	
permissible maximum speed	n_{max}		10,000 rpm	
permissible friction energy	W_R		0.89 x 10^6 Ws	
Moment of inertia	J_B		0.000054 kgm²	
Mass	m		0.46 kg	
Braking torque	M_H		9.0 Nm	

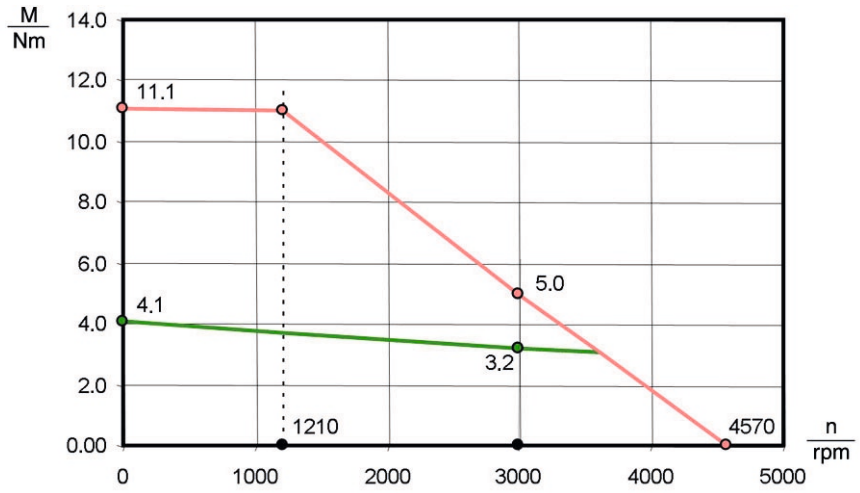
Motor type LSH-097 (U_{ZK} = 560 V)

Explanation on characteristics:

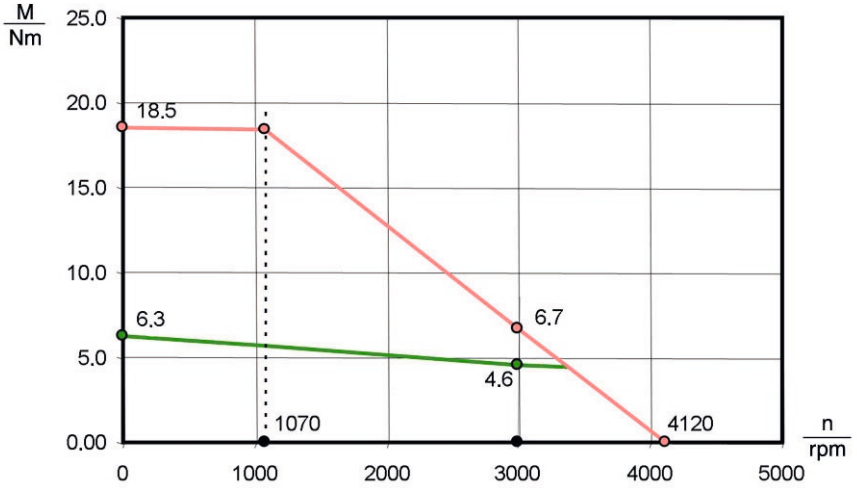
The upper characteristic (M_{max}) describes the short-term max. possible torque at the corresponding speed (important with dynamic processes).

The lower characteristic (M_{nenn}) shows the thermally permissible continuous torque.

LSH-097-1-30-560



LSH-097-2-30-560



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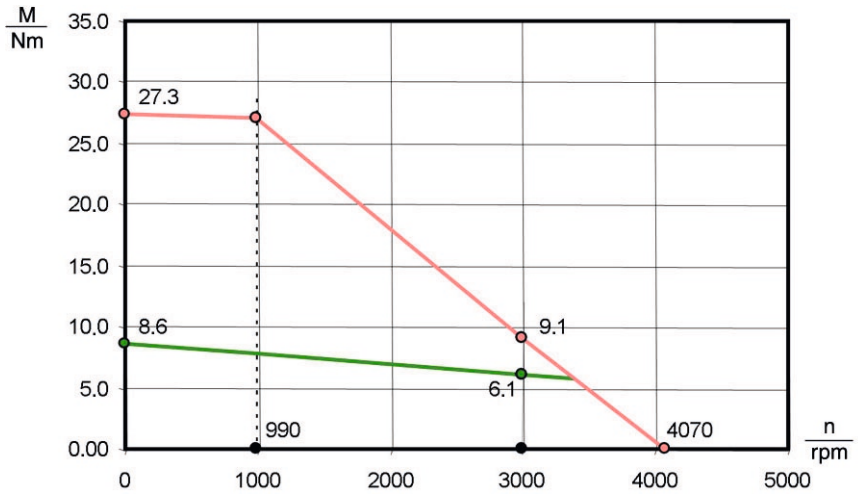
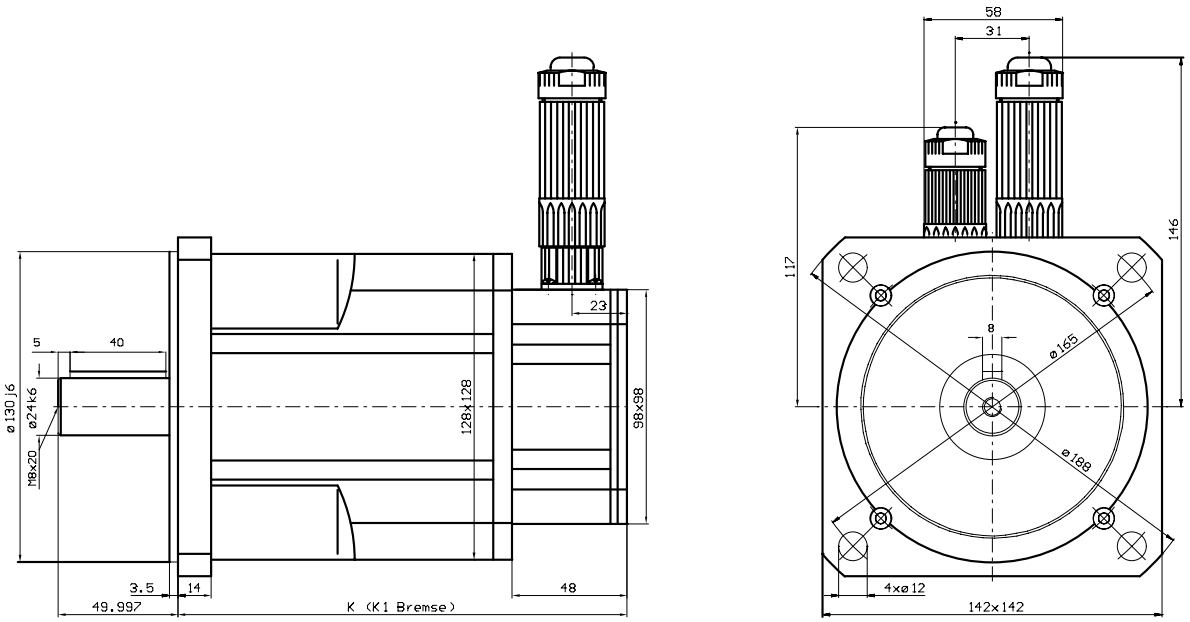
LSH-097-3-30-560



Motor type LSH-127 (U_{ZK} = 560 V)

Motor length [mm]	K (with resolver)	K (with optical encoder G3, G5, G12.x)	K (with optical encoder G6.x)	Additional length with design LSX-xxx-...,B (brake)
LSH-127-1-30-560	172	192	175	52
LSH-127-2-30-560	200	220	203	52
LSH-127-3-30-560	230	250	233	52
LSH-127-4-30-560	290	310	293	52

Dimensional sketch



Catalogue Servo Motors
Id.-No. 0814.258.5-00 Status: 08/2010

Technical data	Symbol	LSH-127-1-30-560	LSH-127-2-30-560	LSH-127-3-30-560	LSH-127-4-30-560
Rated speed	n_n	3000 rpm	3000 rpm	3000 rpm	3000 rpm
Rated frequency	f_N	250 Hz	250 Hz	250 Hz	250 Hz
DC link voltage (controller)	U_{dc}	560 V	560 V	560 V	560 V
Nominal AC voltage	U_n	330 V	330 V	330 V	330 V
Rated torque	M_n	8.4 Nm	10.9 Nm	14.3 Nm	21.0 Nm
Rated AC current	I_n	7.9 A	9.6 A	13.1 A	14.9 A
Power	P	2.63 kW	3.42 kW	4.11 kW	6.60 kW
Stall torque	M_0	11.6 Nm	14.9 Nm	18.7 Nm	27.3 Nm
Stall AC current	I_0	10.3 A	12.5 A	16.4 A	19.0 A
Peak torque	M_{max}	32 Nm	41.0 Nm	51.0 Nm	75.0 Nm
Peak current	I_{max}	49.0 A	49.0 A	61.0 A	68.0 A
Maximum speed	n_{max}	9000 rpm	9000 rpm	9000 rpm	9000 rpm
EMF constant	K_E	68.0 V/1000	72.0 V/1000	74.0 V/1000	87.0 V/1000
Torque constant	K_T	1.12 Nm/A	1.19 Nm/A	1.14 Nm/A	1.44 Nm/A
Winding resistance (two phases)	R_{2ph}	0.71 Ω	0.48 Ω	0.35 Ω	0.32 Ω
Winding inductance (two phases)	L_{2ph}	11.4 mH	8.5 mH	6.4 mH	6.8 mH
No load speed	n_0	4840 rpm	4580 rpm	4780 rpm	3790 rpm
Electric time constant	T_{el}	16.1 ms	17.7 ms	18.3ms	21 ms
Thermal time constant	T_{th}	50 min.	55 min.	60 min.	75 min.
Moment of inertia of rotor	J	0.00068 kgm²	0.00083 kgm²	0.00110 kgm²	0.00153 kgm²
Mass	m	8.1 kg	10.1 kg	12.1 kg	16.1 kg
Brake (optional)					
Rated voltage ± 10 %	U_N	24 V ± 10 %			
Rated AC current at 20 °C to release	I_N	1.0 A			
permissible maximum speed	n_{max}	10,000 rpm			
permissible friction energy	W_R	1.29×10^6 Ws			
Moment of inertia	J_B	0.000166 kgm²			
Mass	m	0.9 kg			
Braking torque	M_H	18 Nm			

Motor type LSH-127 (U_{ZK} = 560 V)

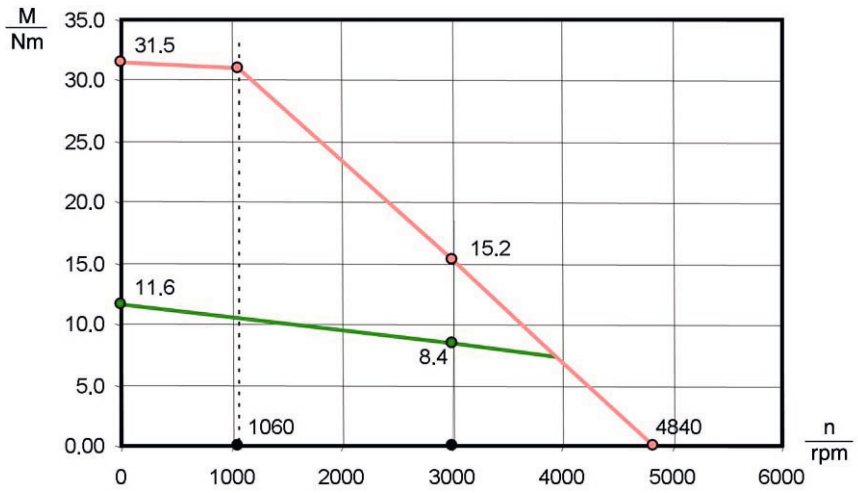
Explanation on characteristics:

The upper characteristic (M_{max}) describes the short-term max. possible torque at the corresponding speed (important with dynamic processes).

The lower characteristic (M_{nenn}) shows the thermally permissible continuous torque.

2

LSH-127-1-30-560



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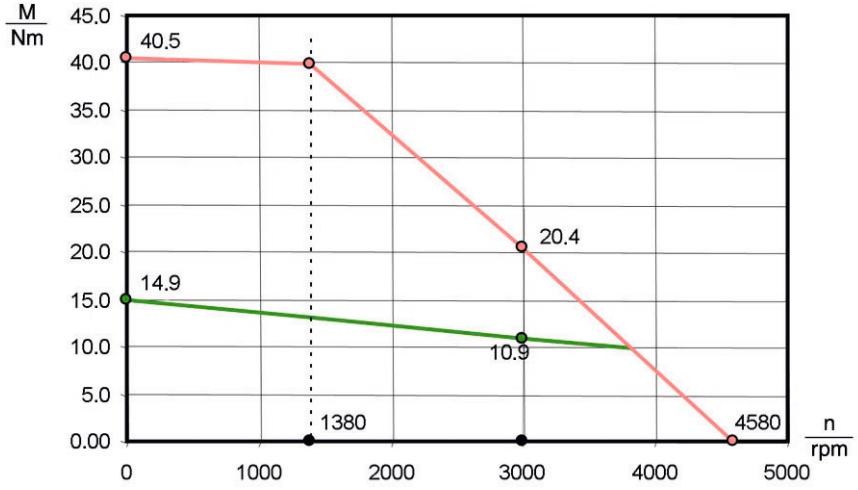

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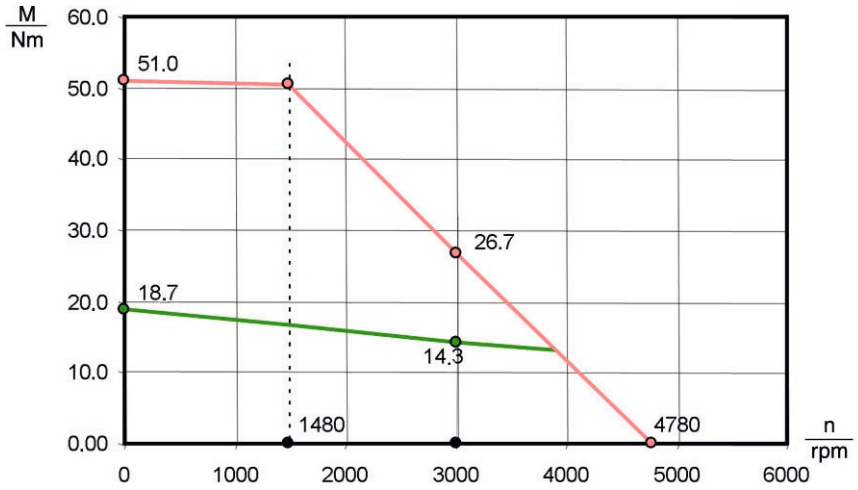

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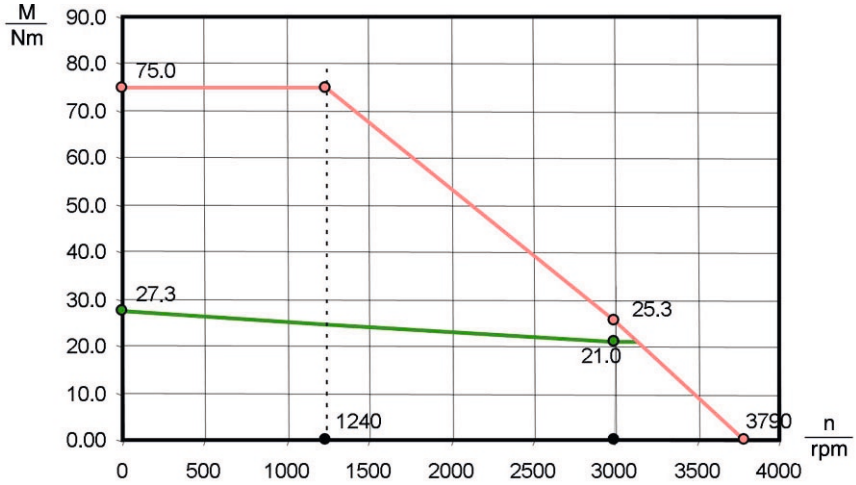


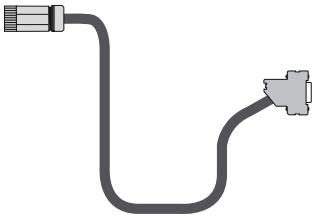
Encoders for servo motors

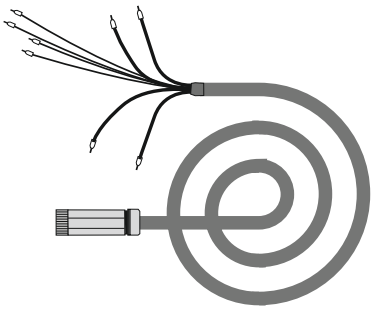
Overview of encoder types

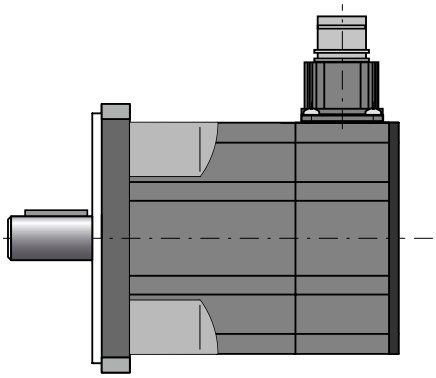
	Encoder designations		compatible with				Encoder properties		System properties		
Ordering option	Description	sin/cos periods/revolution	LST 037	LSx-050	LSH-074 to LSH-127	LST 074 to LST-220	typical absolute accuracy Encoder (data sheet of encoder manufacturer)	typical repeat accuracy of encoder (data sheet of encoder manufacturer)	ServoOne position resolution for positioning of speed control	c-line position resolution for positioning control	c-line position resolution for speed control
1R	Resolver 1 pole pair	1	X	X	X	X	+/-10‘	+/- 1‘	14 bit +/-1‘	14 bit +/-1‘	14 bit +/-1‘
3R	Resolver 3 pole pair	3	X	X		X	+/-5‘	+/- 1‘	3x14 bit +/- 0.3‘	3x14 bit +/- 0.3‘	3x14 bit +/- 0.3‘
5R	Resolver 5 pole pair	5			X		+/-5‘	+/- 1‘	5x14bit +/- 0,2‘	5x14bit +/- 0.2‘	5x14bit +/- 0.2‘
G3	Multi-turn absolute encoder EQN 1325 SSI	2048			X	X	+/- 20”	+/- 6”	25bit +/- 0.04”	16 bit (CDD)	25bit +/- 0.04”
G5	Single-turn absolute encoder ECN 1313 SSI	2048			X	X	+/- 20”	+/- 6”	25bit +/- 0.04”	16 bit (CDD)	25bit +/- 0.04”
G6.1S[1)]	Single-turn absolute encoder SRS 50	1024			X	X	+/-45”	+/- 7”	24bit +/- 0.08”	16 bit (CDD)	24bit +/- 0.08”
G6.1M[1)]	Multi-turn absolute encoder SRM 50	1024			X	X	+/-45”	+/- 7”	24bit +/- 0.08”	16 bit (CDD)	24bit +/- 0.08”
G6.2S[1)]	Single-turn absolute encoder SKS 36	128		X	X	X	+/- 80”	+/- 40”	21bit +/- 0.6”	16 bit (CDD)	21bit +/- 0.6”
G6.2M[1)]	Multi-turn absolute encoder SKM 36	128		X	X	X	+/- 80”	+/- 40”	21bit +/- 0.6”	16 bit (CDD)	21bit +/- 0.6”
G12.1S[1)]	Single-turn absolute encoder ECN 1313 Endat 2.1	2048			X	X	+/- 20”	+/- 6”	25bit +/- 0.04”	16 bit (CDD)	25bit +/- 0.04”
G12.1M[1)]	Multi-turn absolute encoder EQN 1325 Endat 2.1	2048			X	X	+/- 20”	+/- 6”	25bit +/- 0.04”	16 bit (CDD)	25bit +/- 0.04”
G12.2S[1)]	Single-turn absolute encoder ECN 1113 Endat 2.1	512			X	X	+/-60”	+/- 25”	23bit +/-0.16”	16 bit (CDD)	23bit +/-0.16”
G12.2M[1)]	Multi-turn absolute encoder EQN 1125 Endat 2.1	512			X	X	+/-60”	+/- 25”	23bit +/-0.16”	16 bit (CDD)	23bit +/-0.16”

[1)] not usable with CDE3000 and CDF3000

Accessories for servo motors







Prefabricated encoder cables

Ordering key

		K	RY2	-	KS	005
Prefabricated cable		K				
Encoder system	Resolver cable		RY2			
	Encoder cable SSI, G3, G5, EnDat 2.1, G12.x		GS2			
	Encoder cable Hiperface (G6.x) CDD3000		GH2			
	Encoder cable Hiperface (G6.x) ServoOne		GH3			
Chain trailing capability					KS	
Cable length	2 m					002
	3 m					003
	5 m					005
	8 m					008
	10 m					010
	15 m					015
	20 m					020

Technical data

		KRY2-KSxxx	KGS2-KSxxx
Controller type		CDD, CDE, ServoOne, ServoOne junior	CDD, CDE, ServoOne, ServoOne junior
Motors with encoder system		Resolver	G3, G5, G12.x (single- / multi-turn encoders with SSI-/Endat interface)
Assigment on controller side (Sub-D-plug)		1 = S2 2 = S4 3 = S1 4 = n.c. 5 = PTC+ 6 = R1 7 = R2 8 = S3 9 = PTC-	1 = A- 2 = A+ 3 = VCC (+5 V) 4 = DATA+ 5 = DATA- 6 = B- 8 = GND 11 = B+ 12 = VCC (Sense) 13 = GND (Sense) 14 = CLK+ 15 = CLK- 7, 9, 10 = n.c.
Minimum bending radius		90 mm	100 mm
Temperature range:	for stationary routing		-35 ... +80 °C
	for flexible applications	-40 ... +85 °C	-35 ... +80 °C
Cable diameter approx.		8.8 mm	
Chain trailing capability		yes	
Material of oversheath		PUR	
Resistance		against oil, hydrolysis and microbial activity (VDE0472)	
Certifications		UL-Style 20233, 80 °C - 300 V, CSA-C22.2N.210-M90, 75 °C - 300 V FT1	

	KGH2-KSxxx	KGH3-KSxxx	KGH4-KSxxx	KRY2-CDF-KSxxx
	CDD	ServoOne, ServoOne junior	ServoOne junior	CDF
	G6, G6.x (single-/ multi-turn encoders with Hiperface interface)			Resolver
	1 = REFCOS 2 = +COS 4 = DATA+ RS485 5 = DATA- RS485 6 = REFSIN 7 = U_S 7-12 V 8 = GND 11 = +SIN 3, 9, 10, 12, 13, 14, 15 = n.c.	1 = REFCOS 2 = +COS 3 = U_S 7-12 V 4 = DATA+ RS485 5 = DATA- RS485 6 = REFSIN 7 = Bridge to PIN 12 8 = GND 11 = +SIN 12 = Bridge to PIN 7 9, 10, 13, 14, 15 = n.c.	1 = REFCOS 2 = +COS 3 = U_S 7-12 V 4 = DATA+ RS485 5 = DATA- RS485 6 = REFSIN 7 = Bridge to PIN 12 8 = GND 9 = PTC- 10 = PTC+ 11 = +SIN 12 = Bridge to PIN 7 13, 14, 15 = n.c.	1 = SIN- (S4) 2 = SIN+ (S2) 6 = COS- (S3) 7 = REF- (R2) 9 = PTC- 10 = PTC+ 11 = COS+ (S1) 12 = REF+ (R1) 3, 4, 5, 8, 13, 14, 15 = n.c
	90 mm			
	-40 ... +85 °C			-40 ... +85 °C
	8.8 mm			
	yes			
	PUR			
	against oil, hydrolysis and microbial activity (VDE0472)			
	UL-Style 20233, 80 °C - 300 V, CSA-C22.2N.210-M90, 75 °C - 300 V FT1			

Prefabricated motor cables

Ordering key

		KMx	-	KS	005	-	
Prefabricated cable	C-Line	2					
	ServoOne	3					
	C-Line / ServoOne / ServoOne junior	4					
	ServoOne junior	5					
Chain trailing capability				KS			
Cable length	2 m				002		
	3 m				003		
	5 m				005		
	8 m				008		
	10 m				010		
	15 m				015		
	20 m				020		
Motor cable	up to Io = 16 A						-
	up to Io = 24 A						24 A
	up to Io = 63 A (only LSx-220)						63 A

Technical data

		KM2/3-KSxxx	KM3-KSxxx-24A
Motor type		Motors up to I_0 = 16 A with pluggable power terminal	Motors up to I_0 = 24 A with pluggable power terminal
Minimum bending radius:	for stationary routing	90 mm	115 mm
	for flexible applications	120 mm	150 mm
Temperature range		-30 ... +80 °C	
Cable diameter approx.		Ø 12 mm	Ø 15mm
Cable cross-section		4G1.5 + 2 x 2 x 0.75 mm²	4G2.5 + 2 x 2x 1 mm²
Material of oversheath		PUR	
Resistance		against oil, hydrolysis and microbial activity (VDE0472)	
Assigment of strands		U = 1 V = 2 W = 3 Ground = ye/gn PTC = 5 PTC = 6 Brake + = 7 Brake - = 8	
Certification		UL AWM 80 °C - 600 V/1000 V; CSA AWM 80 °C - 600 V/1000 V FT1	

Note. Strands 5 and 6 (PTC) are only required for motors with optical sensors (G3, G5, G6.x, G12.x). On the LSH-motors with resolver PTC-monitoring is accomplished through the resolver line.

	KM3-KSxxx-63A	KM4	KM5
	Motors up to I_0 = 63 A with pluggable power terminal	Motors up to I_0 = 16 A with pluggable power terminal	Motors up to I_0 = 16 A with pluggable power terminal
	165 mm 220 mm	65 mm 85 mm	90 mm 120 mm
	-30 ... +80 °C		
	Ø 22 mm	Ø 8.5 mm	Ø 12 mm
	4G10 + 2 x 1.5 mm² + 2 x 1 mm²	4G1.5	4G1.5 + 2 x 2 x 0.75 mm²
	PUR		
	against oil, hydrolysis and microbial activity (VDE0472)		
	U = 1 V = 2 W = 3 Ground = ye/gn PTC = 5 PTC = 6 Brake + = 7 Brake - = 8	U = 1 V = 2 W = 3 Ground = ye/gn	U = 1 V = 2 W = 3 Ground = ye/gn PTC = 5 PTC = 6 Brake + = 7 Brake - = 8
	UL AWM 80 °C - 600 V/1000 V; CSA AWM 80 °C - 600 V/1000 V FT1		

Appendix

Holding brake

LSH servo motors with holding brake are identified by their type plate.

Example: LSH-074-1-30-560/T1,B,1R

The backlash-free permanent-field single-area holding brake works in accordance with the stall AC current principle, i.e. the brake needs to energized for releasing.

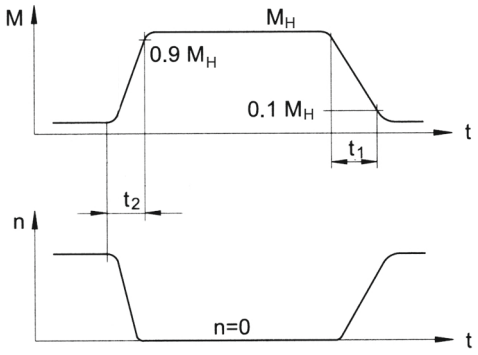
On all LSx-motors the holding brake is mounted directly behind the flange (side A) to provide an optimal holding torque.

The holding brake is generally switched on and off during standstill. When using the holding brake as an emergency stop brake you must pay attention to the maximum permissible friction energy (WR).

Note: When operating the brake as emergency stop brake the braking torque may be considerably lower than the holding torque.

Response times of holding brakes

Switching by DC-side:
Takes place between rectifier and coil, very short overtravel is thereby achieved. For all drives requiring exact braking, also for hoisting gear in particular, DC-side switching of the brake is strictly required (break time t2 =).



M	Braking torque	t	Time
M_H	Holding torque of spring operated brake	t_1	Make time
N	Rotary speed	t_2	Break time

Technical data holding brake

Size	t_1 [ms]	t_2 [ms]	M_H [Nm]	I_N [A] at 24 V	U_N [V]	n_{max} [min^{-1}]	m [kg]	W_R [10^6 Ws]	J_B [kgcm^2]
LST-037	6	10	0.4	0.33		10,000	0.075	0.20	0.013
LSx-050	6	25	2.0	0.46		10,000	0.15	0.41	0.07
LSx-074	7	35	4.5	0.5		10,000	0.3	0.58	0.18
LSx-097	7	40	9.0	0.75	24 V	10,000	0.82	0.89	0.54
LSx-127	10	50	18.0	1.0	± 10 %	10,000	1.8	1.29	1.66
LST-158	22	90	36	1.1		10,000	2.85	2.90	5.56
LST-190	22	90	36	1.1		8,000	3.25	2.9	6.2
LST-220	65	105	145	2.1		8,000	9.5	13	56

M_H Holding torque (break-away torque)
I_N Excitation current at 20 °C for releasing
U_N DC voltage for releasing
n_{max} Maximum speed (unbraked)
m Mass (weight)
WR Permissible friction energy up to 0.1 mm abrasion (for emergency stop)
J_B Moment of inertia of holding brake

Note: The above specified data m and J_B are pure brake data, without accounting for the required addition mass of the motor shaft.

Declaration of conformity for LSH- and LST-motors

EG-Konformitätserklärung

EC Declaration of Conformity

Der Hersteller *The manufacturer*	LTi DRiVES GmbH Gewerbestraße 5-9 35633 Lahnau

erklärt hiermit, dass die folgenden Produkte
declares that the following products

Produktbezeichnung: *Product designation:*	Synchron-Servomotor Synchronous Servomotor
Produkttypen: *Product types:*	LSH, LST *LSH, LST*

den Sicherheitsbestimmungen der nachstehenden EG-Richtlinie entsprechen:
comply with the essential requirements of the following EC Directive:

2006/95/EG *2006/95/EC*	[Niederspannungsrichtlinie] *[Low Voltage Directive]*

und dass folgende angeführte harmonisierte Norm angewandt wurde:
and that the following harmonised standard has been applied:

EN 60034-1:2004
Drehende elektrische Maschinen - Teil 1: Bemessung und Betriebsverhalten (IEC 60034-1:2004)
Rotating electrical machines - Part 1: Rating and performance (IEC 60034-1:2004)

EN 60034-5:2001+A1:2007
Drehende elektrische Maschinen - Teil 5: Schutzarten aufgrund der Gesamtkonstruktion von drehenden elektrischen Maschinen (IP-Code) - Einteilung (IEC 60034-5:2000)
Rotating electrical machines - Part 5: Degrees of protection provided by the integral design of rotating electrical machines (IP code); Classification (IEC 60034-5:2000)

EN 60034-6:1993
Drehende elektrische Maschinen - Teil 6: Einteilung der Kühlverfahren (IC-Code) (IEC 60034-6:1991)
Rotating electrical machines - Part 6: Methods of cooling (IC-Code) (IEC 60034-6:1991)

EN 60034-9:2005+A1:2007
Drehende elektrische Maschinen - Teil 9: Geräuschgrenzwerte (IEC 60034-9:2003)
Rotating electrical machines - Part 9: Noise limits (IEC 60034-9:2003)

Jahr der CE-Kennzeichnung / *Year of CE-marking:* 2005

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Name / *name*:	Dr. Josef Wiesing
Stellung / *position*:	Geschäftsführer / *Managing Director*
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LTi DRiVES GmbH
Gewerbestraße 5-9
35633 Lahnau
GERMANY
Fon +49 (0) 6441/ 96 6-0

Heinrich-Hertz-Straße 18
59423 Unna
GERMANY
Fon +49 (0) 2303/ 77 9-0

www.lt-i.com
info@lt-i.com

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