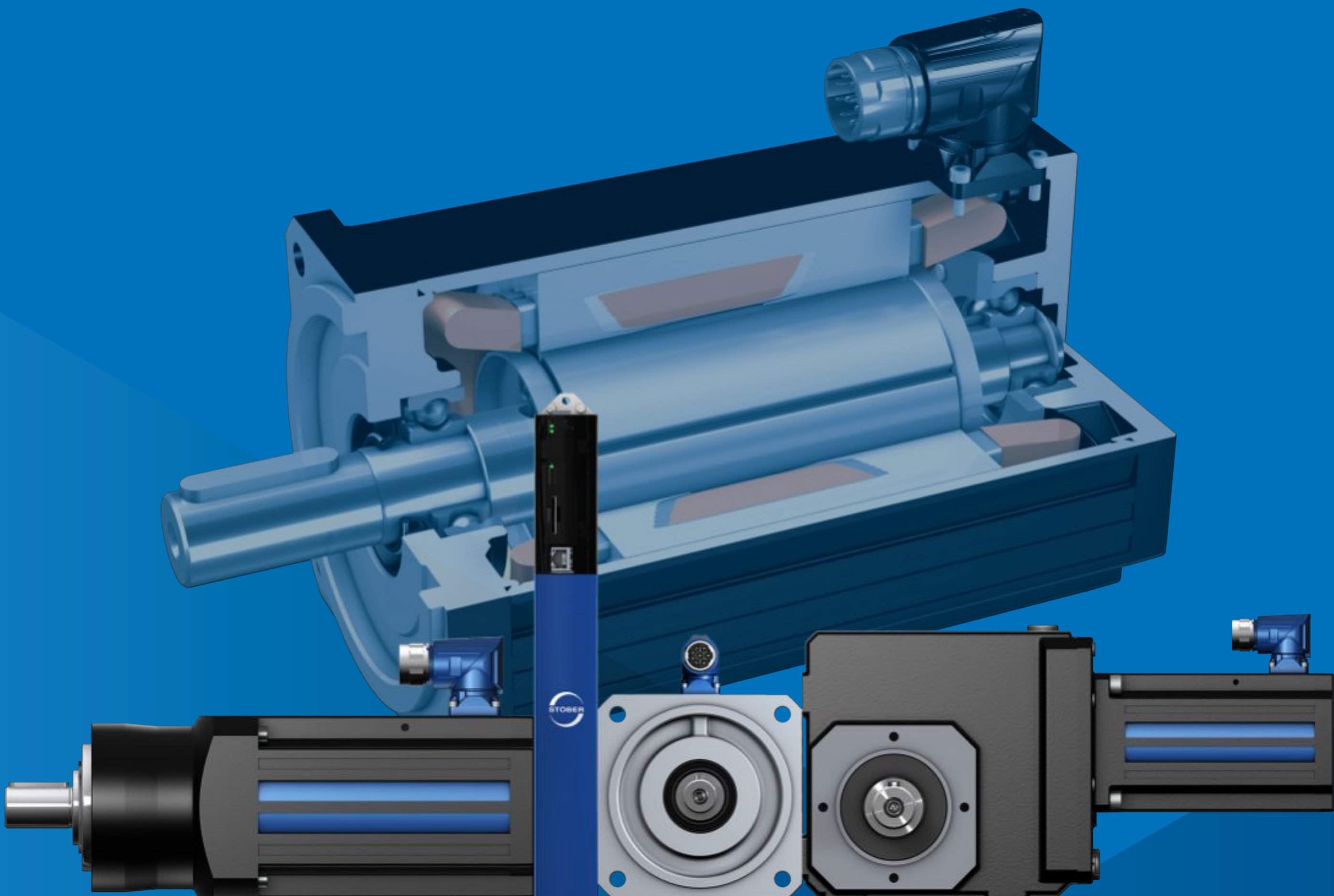


Lean motors

Sensorless drives

IE5 Ultra Premium Efficiency

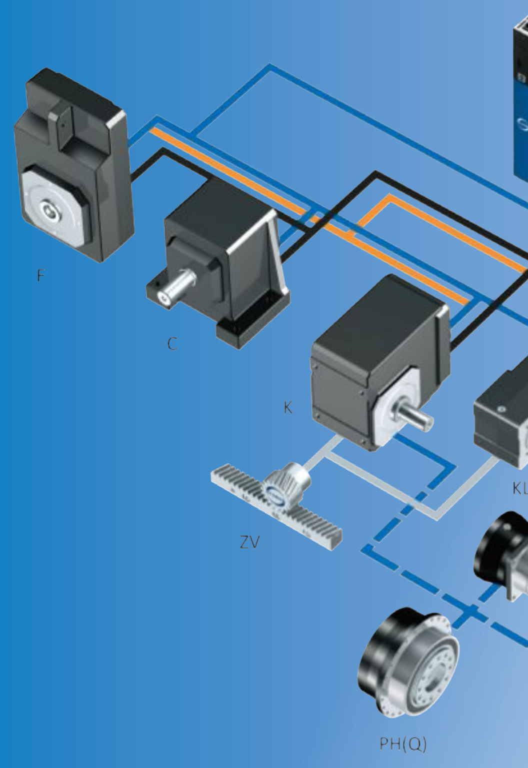
STÖBER

Lean motors

Sensorless drives

One partner. All the possibilities.

STOBER has developed and produced excellent drive technology since 1934 and is active internationally with around 1000 employees at 14 locations. STOBER impresses machine manufacturers in wide-ranging industries and markets around the world with tailor-made, highly efficient drive systems for demanding movements.



"Together with our customers, we achieve perfect motion in a wide variety of applications with our precisely coordinated system. Whenever precision, dynamics and quality are required, we are at your side as a reliable partner."

Rainer Wegener, Chief Executive Officer, STÖBER Antriebstechnik

Lean motors – what you can expect!

In this catalog, we introduce you to the rugged, compact and encoderless STOBER Lean motors. Featuring an IE5 classification and connected with corresponding STOBER SC6 and SI6 drive controllers using a single power cable. They are especially powerful and economical when combined with our precise STOBER servo gearboxes. It's impossible to be more efficient!

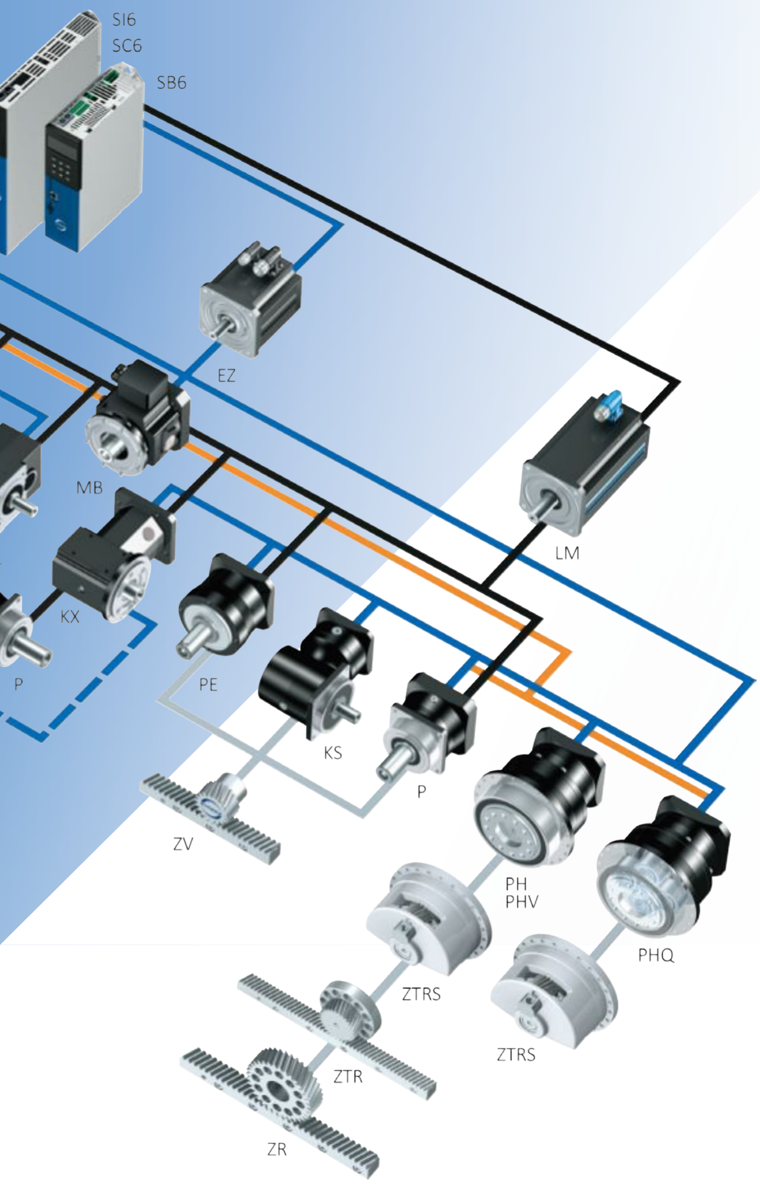
At home in the world of demanding motion

Gearboxes

Geared motors

Motors

Cables and drive controllers



Everything from a single source.

The STOBER drive system consisting of gearboxes, motors, cables and drive controllers has a modular design and is freely scalable—for tailor-made, compact and powerful machine concepts. It can be adapted to your individual requirements and combined as needed in nearly all industries and applications areas.

We check every single component and how it works together with others, taking on the responsibility for the complete drive train. For you, this means that one contact partner, certified operating safety and maximum availability are guaranteed.

Need special solutions?

Numerous one-of-a-kind product highlights and project-related adjustments make it possible. With a holistic approach to your specific task, we work together on individualized solutions that are optimally co-ordinated to your requirements. Dedicated and solution-oriented in the support of your visions and projects.

STOBER moves integrally and precisely.

"Versatile products, countless possibilities. Your perfect motion is what drives us!"

Markus Graf, Chief Sales Officer, STÖBER Antriebstechnik

STOBER moves as a team and with personality.

As a family-owned company, it is very important to us to maintain close relationships and treat each other with trust. We put people first.

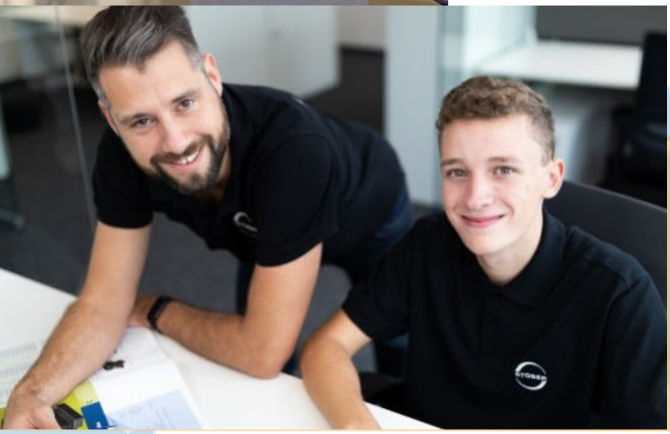
We are committed to the well-being of our employees, identify with the expectations of our customers, and show personal commitment to mutual success.

"We have installed gearboxes, motors and drive controllers from STOBER in nearly all our systems. STOBER supports us in new projects from the first stroke of a pencil in the design phase until commissioning. Our years of cooperation are shaped by openness and honesty and emanate a rather special spirit. The technical consulting, the support—that is real, experienced partnership"

Jürgen Leicht, Managing Partner of Leicht Stanzautomation

Working together. Worldwide. Successfully.

With an eye to the future, STOBER is facing the challenges of digitalization and investing in integrated solutions and a strong global presence in production, sales and service. STOBER China was founded at the end of 2019. As a result, we are present in more than 40 countries around in the world at 12 locations and with 80 service partners.



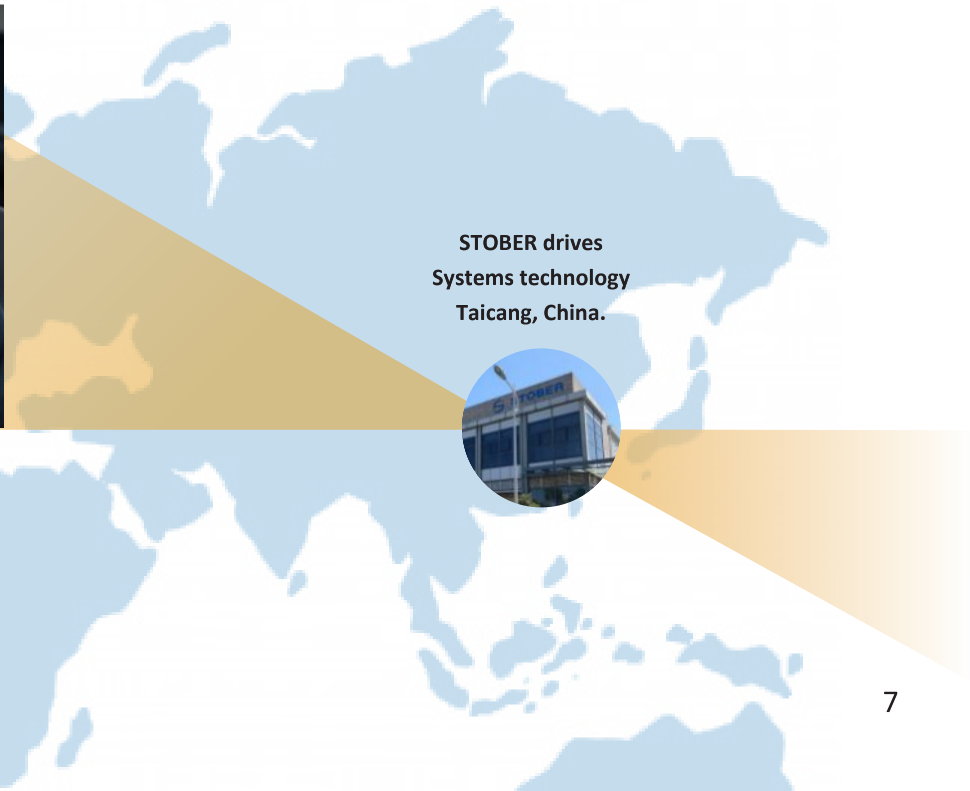


Table of contents

1 Selection tool

1.1 LM Lean motors

Product chapter	LM
Chapter number	[▷ 2]

Technical data

M_N	2.25 – 25.7 Nm
M_0	2.43 – 29.8 Nm

An explanation of the formula symbols can be found in the Chapter [▷ 15.1].

Features

Efficiency	★★★★★
Price category	€€€
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium

Shaft design	
Solid shaft with feather key	✓
Cooling	
Convection cooling	✓
Brake	
Spring-loaded holding brake	✓
Marks and test symbols	
CE	✓
UKCA	✓
cURus	✓

			
Product chapter	**SB6**	**SC6**	**SI6**
Chapter number	[3]	[4]	[5]

Technical data

$I_{2N,PU}$	4.5 – 32 A	5 – 50 A	4.5 – 19 A
$I_{2N,PU}$	3.8 – 20 A	4.5 – 40 A	4 – 15 A
I_{2maxPU}	8.1 – 57.6 A	10.5 – 105 A	9.5 – 39.9 A
I_{2maxPU}	9.5 – 50 A	11.3 – 100 A	10 – 37.5 A

An explanation of the formula symbols can be found in the Chapter [15.1].

Features

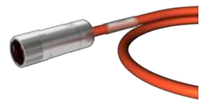
Optimal application area			
Number of axes	1 – 4	1 – 4	> 4
Application	Drive Based	Drive Based	CiA 402, PROFIdrive
Motor types			
Lean motors	✓	✓	✓
Asynchronous motors	✓	✓	✓
Synchronous Servo Motors	✓	✓	✓
Linear motors	✓	✓	✓
Torque motors	✓	✓	✓
Encoder interfaces			
EnDat 2.2 digital	✓	✓	✓
Incremental	✓	✓	✓
SSI	✓	✓	✓
Resolvers	(✓)	✓	✓
Pulse/direction signals	✓	✓	✓
EnDat 3 (OCS)	✓	✓	✓
Communication			
EtherCAT	✓	✓	✓
PROFINET	✓	✓	✓
Motor temperature sensor			
PTC thermistor	✓	✓	✓
Safety functions			
STO, SS1: SIL 3, PL e (cat. 4)	(✓)	(✓)	(✓)
SS2, SLS, SBC, SDI, SLI, ...: SIL 3, PL e (Cat. 4)	(✓)	(✓)	(✓)

(✓): Safety module required

	SB6		SC6	SI6
				
Product chapter	**SB6**		**SC6**	**SI6**
Chapter number	[3]		[4]	[5]

Features

Terminals	Base unit	XB6		
Digital inputs	4	(8)	8	8
Features				
Multi-axis drive system				✓
Stand-alone	✓		✓	
One Cable Solution (OCS)	✓		✓	✓
Live firmware update	✓		✓	✓
Removable data storage	✓		✓	✓
DC link connection	✓		✓	✓
Applications				
Torque/force mode	✓		✓	✓
Velocity mode	✓		✓	✓
Positioning mode	✓		✓	✓
Interpolating mode	✓		✓	✓
Conformity				
cULus	✓		✓	✓
CE	✓		✓	✓
UKCA			✓	✓



Product chapter	**Cables**
Chapter number	[▶ 6]

Power cables

Design	**Motor plug connector size**
	con.23
speedtec quick-lock	✓

Power cores (3 + PE)	**Brake cores**	**Temperature sensor cores**	**Cable ∅**	**Bending radius 1 (min.)**	**Bending radius 2 (min.)**
4 × 1.5 mm²	2 × 1.0 mm²	2 × 0.5 mm²	Max. 12.2 mm	122.0 mm	61.0 mm
4 × 2.5 mm²	2 × 1.0 mm²	2 × 1.0 mm²	Max. 15.1 mm	151.0 mm	75.5 mm

Bending radius: 1 = free to move, 2 = fixed installation

1.4 Inline and Offset Geared Motors

				
Product chapter	**P**	**PE**	**C**	**F**
Chapter number	[7]	[8]	[9]	[10]

Technical data

i	3 – 70	3 – 35	2 – 212	4.3 – 366
M_{2acc}	13 – 2000 Nm	13 – 250 Nm	8.7 – 4140 Nm	19 – 1100 Nm
$\Delta\phi_2$	1 – 5 arcmin	8 – 10 arcmin	10 – 20 arcmin	5 – 11 arcmin
η_{get}	95 – 97 %	95 – 97 %	96 – 97 %	96 – 97 %

An explanation of the formula symbols can be found in the Chapter [15.1].

Features

Power density	★★★★☆	★★★☆☆	★☆☆☆☆	★☆☆☆☆
Backlash	★★★★☆	★★★☆☆	★★☆☆☆	★★★☆☆
Price category	€€	€	€	€
Shaft load	★★★★☆	★★☆☆☆	★★☆☆☆	★★★☆☆
Smooth operation	★★★★☆	★★★☆☆	★★★☆☆	★★★☆☆
Torsional stiffness	★★★☆☆	★★★☆☆	★★☆☆☆	★★☆☆☆
Mass moment of inertia	★★★★★	★★★★★	★★★★★	★★★★★
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium			

Shaft design				
Solid shaft with feather key	✓	✓	✓	✓
Solid shaft without feather key	✓		C0 – C5: ✓ Starting at C6: Request	✓
Hollow shaft with keyway				✓
Hollow shaft with shrink ring				✓
Bearing design				
Standard	✓	✓	✓	✓
Axially reinforced	✓			
Radially reinforced	✓			
Maintenance-free	✓	✓	C0 – C5: ✓	✓

1.5 Right-angle geared motors



Product chapter	**PKX**	**KL**	**K**
Chapter number	[▷ 11]	[▷ 12]	[▷ 13]

Technical data

i	3 – 210	4 – 16	4 – 294
M_{2acc}	13 – 3300 Nm	35 – 60 Nm	17 – 6820 Nm
$\Delta\phi_2$	2 – 8.5 arcmin	16 – 20 arcmin	1.5 – 12 arcmin
η_{get}	94 – 96 %	97 %	94 – 97 %

An explanation of the formula symbols can be found in the Chapter [▷ 15.1].

Features

Power density	★★★★☆	★★☆☆☆	★★☆☆☆
Backlash	★★★★☆	★☆☆☆☆	★★★☆☆
Price category	€€€	€	€€
Shaft load	★★★★☆	★★☆☆☆	★★★☆☆
Smooth operation	★★☆☆☆	★★☆☆☆	★★★☆☆
Torsional stiffness	★★★☆☆	★★☆☆☆	★★☆☆☆
Mass moment of inertia	★★★☆☆	★★★★★	★★★★★
Key	★☆☆☆☆ good | ★★★★★ excellent € Economy | €€€€€ Premium		

Shaft design			
Solid shaft with feather key	✓	✓	✓
Solid shaft without feather key	✓	✓	K1 – K4: ✓ Starting at K5: Request
Solid shaft on both sides		✓	✓
Hollow shaft with keyway		✓	✓
Hollow shaft with shrink ring		✓	✓
Accessories			
Flange		✓	✓
Foot plates		✓	✓
Torque arm bracket			✓
Bearing design			
Standard	✓	✓	✓
Axially reinforced	✓		
Radially reinforced	✓		
Maintenance-free	✓	✓	K1 – K4: ✓

2 LM Lean motors

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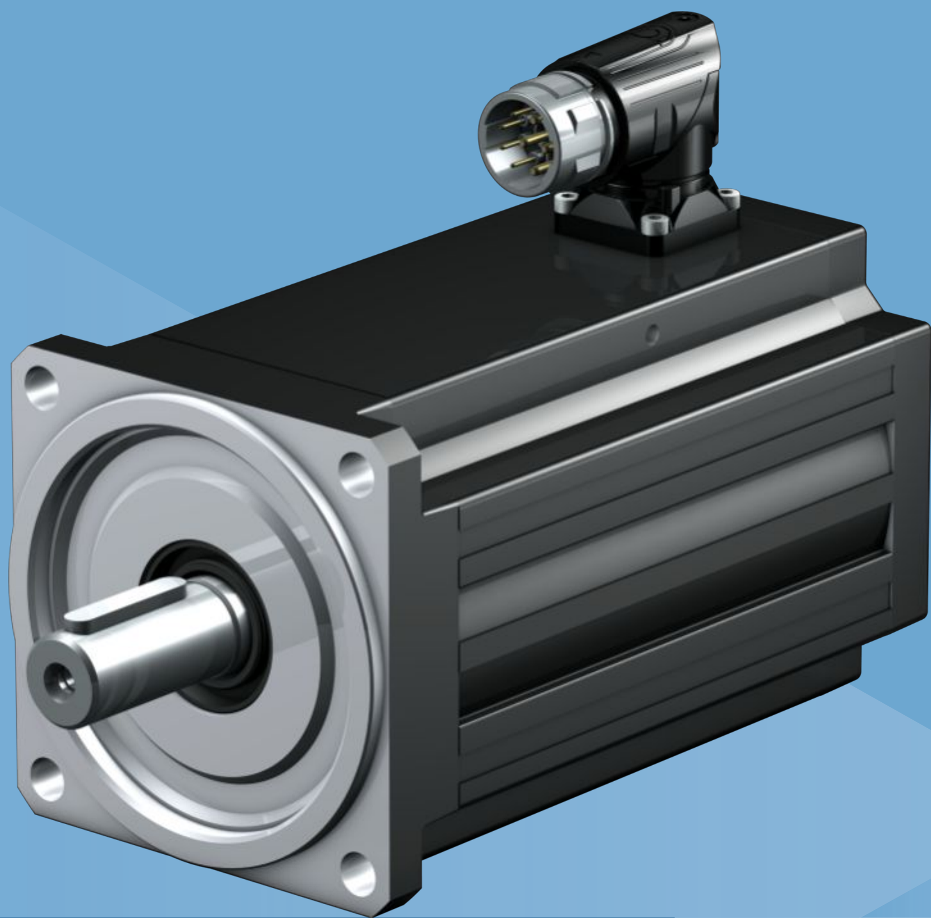


2 Lean motors

LM

2.1 Overview

High-efficiency synchronous motors

Features

Higher energy efficiency than comparable IE4 asynchronous motors	✓
Energy efficiency IE5 in accordance with IEC/TS 60034-30-2	✓
Higher acceleration performance than asynchronous motors	✓
Substantially lighter and more compact than comparable asynchronous motors	✓
Rugged thanks to absence of the encoder	✓
Wiring reduced to the power connection cable	✓
Rotatable plug connector[1] with quick-lock	✓

Technical data

M_N	2.25 – 25.7 Nm
M_0	2.43 – 29.8 Nm

[1] The plug connectors can be pivoted up to 10 times at a defined angle. They cannot be rotated repeatedly.

2.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from −15 °C to +40 °C
- Operation on a STOBER drive controller
- DC link voltage U_{ZK} = DC 540 V
- Coating: RAL 9005 Jet black, matte

In addition, the technical data applies to an uninsulated design with the following thermal mounting conditions:

Type	Dimensions of steel mounting flange (thickness x width x height)	Convection surface area Steel mounting flange
LM4, LM5	23 x 210 x 275 mm	0.16 m^2
LM7	28 x 300 x 400 mm	0.3 m^2

Note the differing ambient conditions in Chapter [2.7.3]

An explanation of the formula symbols can be found in the Chapter [15.1].

Type	K_{EM} [V/1000 min^{-1}]	n_N [rpm]	M_N [Nm]	I_N [A]	$K_{M,N}$ [Nm/A]	P_N [kW]	η_{mot} [%]	M_0 [Nm]	I_0 [A]	M_R [Nm]	M_{max} <1000 min^{-1} [Nm]	I_{max} <1000 min^{-1} [A]	M_{max} ≥1000 min^{-1} [Nm]	I_{max} ≥1000 min^{-1} [A]	J [kgcm²]	m [kg]
LM401U	110	3000	2.25	1.59	1.42	0.71	85	2.43	1.82	0.04	3.77	2.76	4.51	3.31	1.67	4.42
LM402U	120	3000	4.41	2.88	1.53	1.4	88	4.50	2.94	0.04	7.84	4.96	9.70	6.16	3.01	6.08
LM403U	120	3000	6.06	3.92	1.55	1.9	90	6.19	4.08	0.04	11.5	7.02	12.8	7.85	4.31	7.62
LM503U	135	3000	9.48	5.62	1.69	3.0	93	10.1	5.95	0.06	18.3	10.6	20.4	11.8	10.4	10.5
LM505U	135	3000	13.7	7.83	1.75	4.3	94	15.5	8.83	0.06	27.2	15.0	32.1	17.8	16.8	15.1
LM704U	145	3000	19.3	10.6	1.81	6.1	95	21.3	11.6	0.23	38.8	20.0	41.2	22.3	36.5	20.9
LM706U	140	3000	25.7	14.7	1.75	8.1	96	29.8	16.8	0.23	51.5	27.7	61.4	31.7	53.8	28.0

The efficiency η_{mot} was determined based on the standards IEC/TS 60034-30-2 and DIN IEC 60034-2-3.

2.3 Torque/speed curves

Torque/speed curves depend on the nominal speed and/or winding design of the motor and the DC link voltage of the drive controller that is used. The following torque/speed curves apply to the DC link voltage DC 540 V.

At 1000 rpm, the measurement process for detecting the rotor position switches depending on the system, so that the maximum torque of the Lean motor is available as of 1000 rpm.

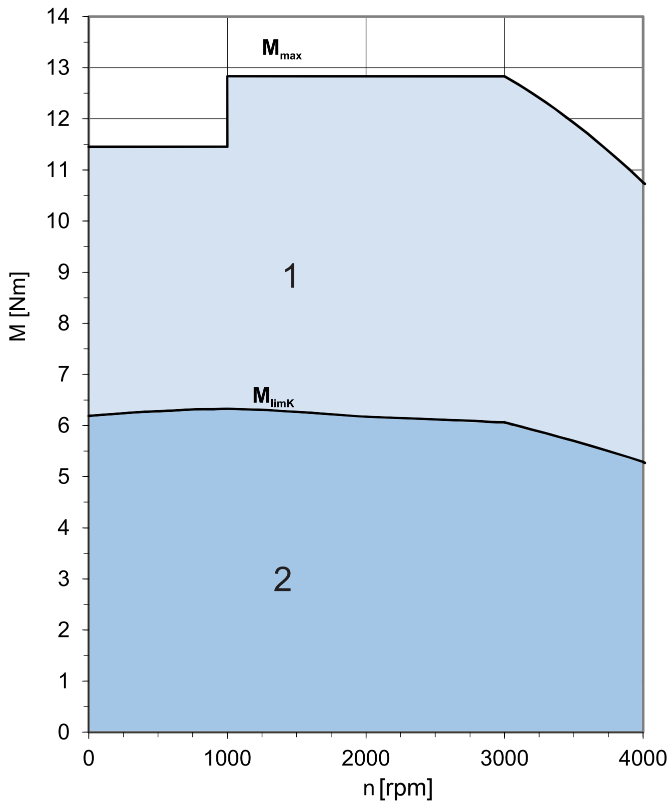
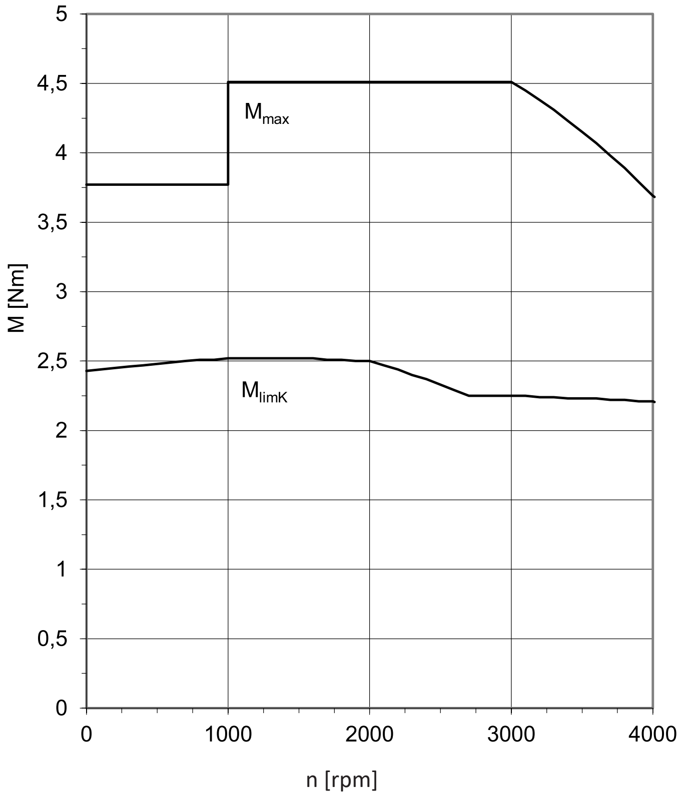


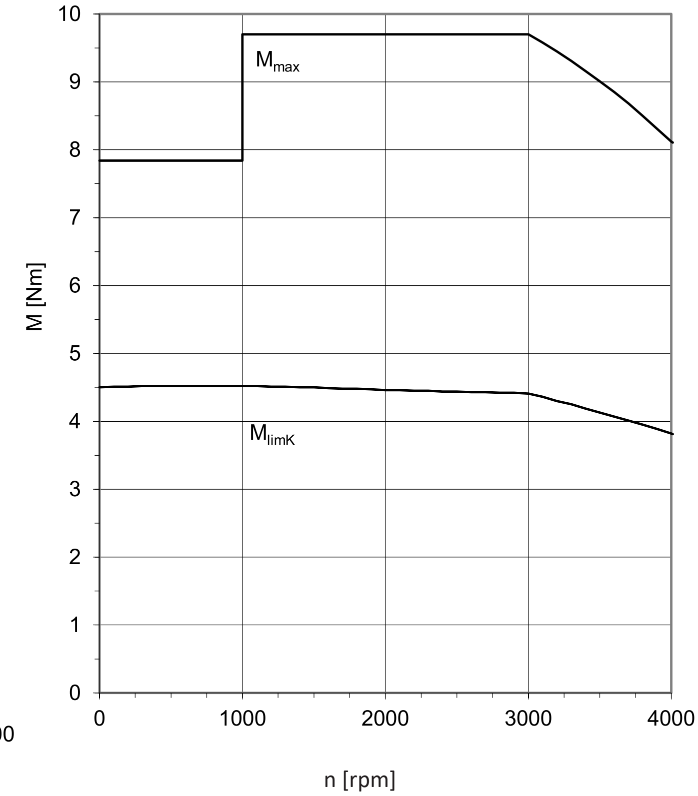
Fig. 1: Explanation of a torque/speed curve

1	Torque range for brief operation (ED_{10} < 100%) with Δϑ = 100 K	2	Torque range for continuous operation with constant load (S1 mode, ED_{10} = 100%) with Δϑ = 100 K

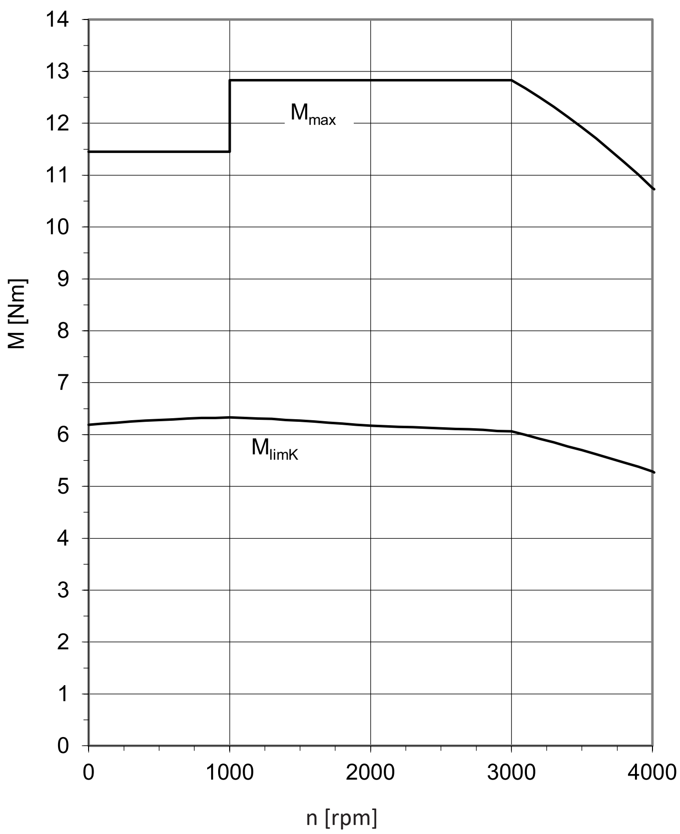
LM401U (n_N=3000 rpm)



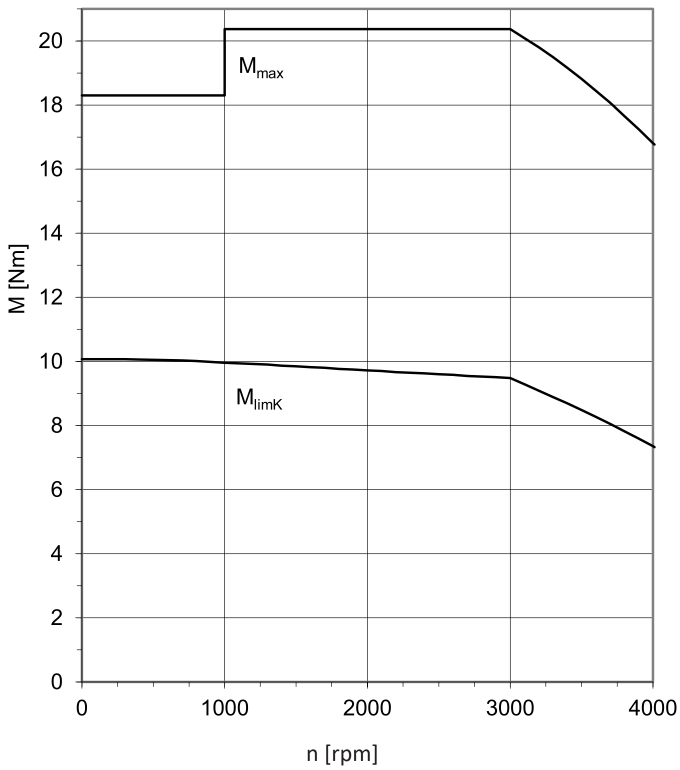
LM402U (n_N=3000 rpm)



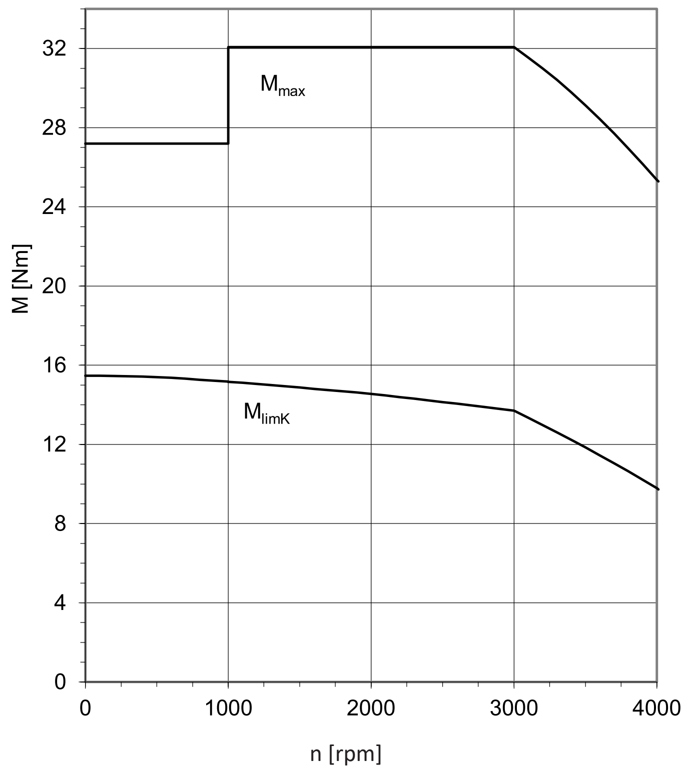
LM403U (n_N=3000 rpm)



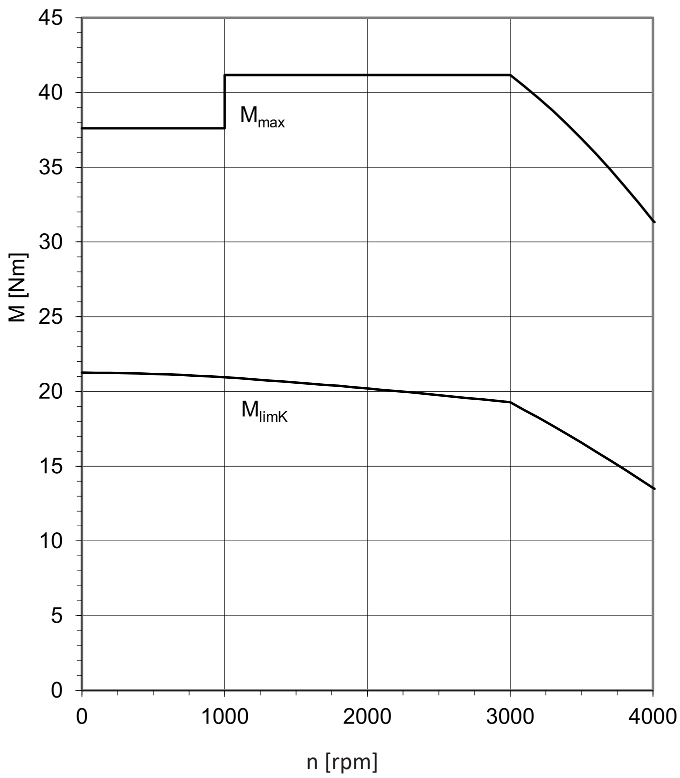
LM503U (n_N=3000 rpm)



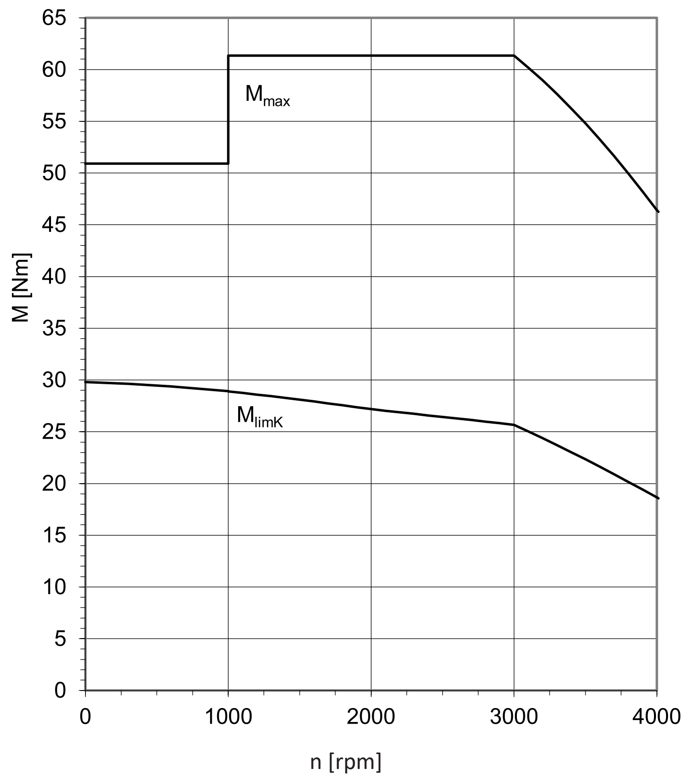
LM505U (n_N=3000 rpm)



LM704U (n_N=3000 rpm)



LM706U (n_N=3000 rpm)



2.4 Dimensional drawings

In this chapter, you can find the dimensions of the motors.

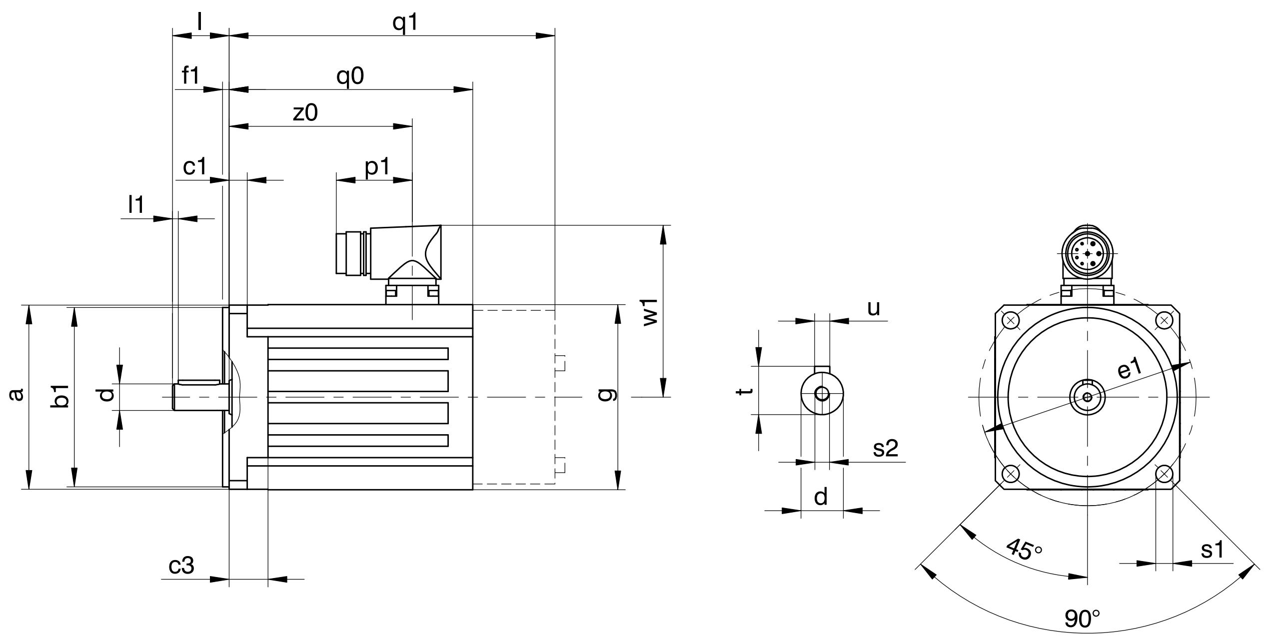
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50



q0 Applies to motors without brake.

q1 Applies to motors with brake.

Type	□a	∅b1	c1	c3	∅d	∅e1	f1	□g	l	l1	p1	q0	q1	∅s1	s2	t	u	w1	z0
LM401U	98	95_{j6}	9.5	20.5	14_{k6}	115	3.5	98	30	3	40	129.0	172.5	9	M5	16.0	A5×5×22	91	97
LM402U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	3	40	168.0	211.5	9	M6	21.5	A6×6×32	91	136
LM403U	98	95_{j6}	9.5	20.5	19_{k6}	115	3.5	98	40	3	40	199.0	242.5	9	M6	21.5	A6×6×32	91	167
LM503U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	3	40	202.5	250.5	9	M8	27.0	A8×7×40	100	172
LM505U	115	110_{j6}	10.0	16.0	24_{k6}	130	3.5	115	50	3	40	272.5	320.5	9	M8	27.0	A8×7×40	100	242
LM704U	145	130_{j6}	10.0	19.0	24_{k6}	165	3.5	145	50	3	40	255.5	314.5	11	M8	27.0	A8×7×40	115	223
LM706U	145	130_{j6}	10.0	19.0	32_{k6}	165	3.5	145	58	3	40	325.5	384.5	11	M12	35.0	A10×8×50	115	293

2.5 Type designation

Example code

LM	4	0	1	U	S	AR	O	110

Explanation

Code	Designation	Design
LM	Type	Lean motor
4	Size	4 (example)
0	Generation	0
1	Length	1 (example)
U	Cooling	Convection cooling

The following type code is not shown on the nameplate of geared motors.

S	Design	Standard
AR	Drive controllers	SC6
AT		SI6
BF		SB6
O	Brake	Without holding brake
F		Spring-loaded holding brake
110	Voltage constant K_{EM}	110 V/1000 rpm (example)

2.5.1 Nameplate

An example nameplate of an LM401 Lean motor is explained in the figure below.

Line	Value	Description
1	STOBER	Logo and address of the manufacturer
2	LM401USARF110	Type designation of the motor
3	3~ synchronous servo motor	Motor type: Three-phase synchronous servo motor
	S1 Operating	Operating mode
4	M0=10.1 Nm	Stall torque
	I0=5.95 A	Stall current
	KEM=135 V/1000 rpm	Voltage constant
5	nN=3,000 rpm	Nominal speed
	PN=2.97 kW	Nominal power
	IP56	Protection class of the motor
	TE	Protection class in accordance with UL1004
6	Brake	Holding brake (optional)
	13.00 Nm	Static braking torque at 100 °C
	24.00 V	Nominal voltage (DC) of the holding brake
	0.90 A	Nominal current of the holding brake at 20 °C
7	SN 10860496	Serial number of the motor
8	26/11	Date of manufacture (year/calendar week)
	PF	Place of manufacture (abbreviation)
9	CE	CE mark
	UKCA	UKCA mark
10	IE5	IEC energy efficiency
11	cURus	cURus test symbol, registered under UL number E488992
12	Therm. class 155 (F)	Thermal class
	Therm. prot. PTC 145 °C	Type of temperature sensor
13	QR code	Link to product information

2.6 Product description

2.6.1 General features

Feature	Description
Design	Sensorless synchronous motor with interior permanent magnets
Design	IM B5, IM V1, IM V3 in accordance with EN 60034-7
Protection class	IP56 / IP66 (option)
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating $\Delta\vartheta$ = 100 K)
Surface	Matte black as per RAL 9005
Cooling	IC 410 convection cooling
Bearing	Rolling bearing with lifetime lubrication and non-contact sealing
Sealing	Radial shaft seal rings made of FKM (A side)
Shaft	Shaft with feather key, diameter quality k6
Radial runout	Normal tolerance class in accordance with IEC 60072-1
Concentricity	Normal tolerance class in accordance with IEC 60072-1
Axial runout	Normal tolerance class in accordance with IEC 60072-1
Vibration intensity	A in accordance with EN 60034-14
Noise level	Limit values in accordance with EN 60034-9

Note

Repainting the motor changes its thermal properties. This lowers the performance limit of the motor.

2.6.2 Electrical features

General electrical features of the motor are described in this chapter. You can find more details in Chapter Selection tables.

Feature	Description
DC link voltage	DC 540 V (max. 750 V) on STOBER drive controllers
Winding	Three-phase
Circuit	Star, center not led through
Protection class	I (protective grounding) in accordance with EN 61140
Number of pole pairs	3

2.6.3 Ambient conditions

Standard ambient conditions for transport, storage and operation of the motor are described in this chapter. Information about differing ambient conditions can be found in the chapter [▸ 2.7.3].

Feature	Description
Surrounding temperature for transport/storage	−30 °C to +85 °C
Surrounding temperature for operation	−15 °C to +40 °C
Relative humidity	5% to 95%, no condensation
Installation altitude	≤ 1000 m above sea level
Shock load	≤ 50 m/s² (5 g), 6 ms in accordance with EN 60068-2-27

Notes

- STOBER Lean motors are not suitable for potentially explosive atmospheres in accordance with (ATEX) Directive 2014/34/EU.
- Secure the power cable close to the motor so that vibrations of the cable do not place impermissible loads on the motor plug connector.
- Note that the braking torques of the holding brake (optional) may be reduced by shock loading.
- Also take into consideration the shock load of the motor due to output units (such as gearboxes and pumps) which are coupled with the motor.

To prevent damage, protect the motor from the following influences:

- Environments with harmful oils, acids, gases, vapors, dust or radiation
- Extreme temperature fluctuations with high humidity
- Condensation or icing
- Strong UV radiation (e.g. direct sunlight)
- Presence of salt spray
- Shaking, impacts, vibrations and high acceleration
- Sparks or heat

2.6.4 Positioning behavior

Lean motors do not have an encoder installed. Instead, they exhibit anisotropic behavior where the winding inductance depends on the rotor position. The drive controller sends electric signals through the motor windings and calculates the rotor position of the motor based on the received signals. As a result, Lean motors can be used as servo drives in applications for which a positioning accuracy of ± 1° and speed ripple factor ≤ 1% is sufficient. The speed and torque of the Lean motors can be set to any point from a standstill to maximum speed with full torque control.

Because of this, Lean motors, with or without a holding brake, are not suitable for use in safety-related applications. To find an optimal solution for a safety-related application, contact STOBER System Support.

2.6.5 Possible combinations with drive controllers

The Lean motor can be operated with STOBER SB6, SC6 or SI6 drive controllers. For detailed information about the drive controllers, refer to the corresponding chapter in this catalog.

2.6.6 Temperature sensor

In this chapter, you can find technical data on the temperature sensor installed in STOBER Lean motors for implementing thermal winding protection. To prevent damage to the motor, always monitor the temperature sensor with appropriate devices that will turn off the motor if the maximum permitted winding temperature is exceeded.

You can find information about the electrical connection of the temperature sensor in the "Connection method" chapter.

2.6.6.1 PTC thermistor

The PTC thermistor is installed as a standard temperature sensor in STOBER Lean motors.

The PTC thermistor is a triple thermistor in accordance with DIN 44082 that can be used for monitoring the temperature of each winding phase. The resistance values in the following table and curve refer to a single thermistor in accordance with DIN 44081. These values must be multiplied by 3 for a triple thermistor in accordance with DIN 44082.

Feature	Description
Nominal response temperature ϑ_{NAT}	145 °C ± 5 K
Resistance R −20 °C up to ϑ_{NAT} − 20 K	≤ 250 Ω
Resistance R with ϑ_{NAT} − 5 K	≤ 550 Ω
Resistance R with ϑ_{NAT} + 5 K	≥ 1330 Ω
Resistance R with ϑ_{NAT} + 15 K	≥ 4000 Ω
Operating voltage	≤ DC 7.5 V
Thermal response time	< 5 s
Thermal class	155 (F) in accordance with EN 60034-1 (155 °C, heating Δϑ = 100 K)

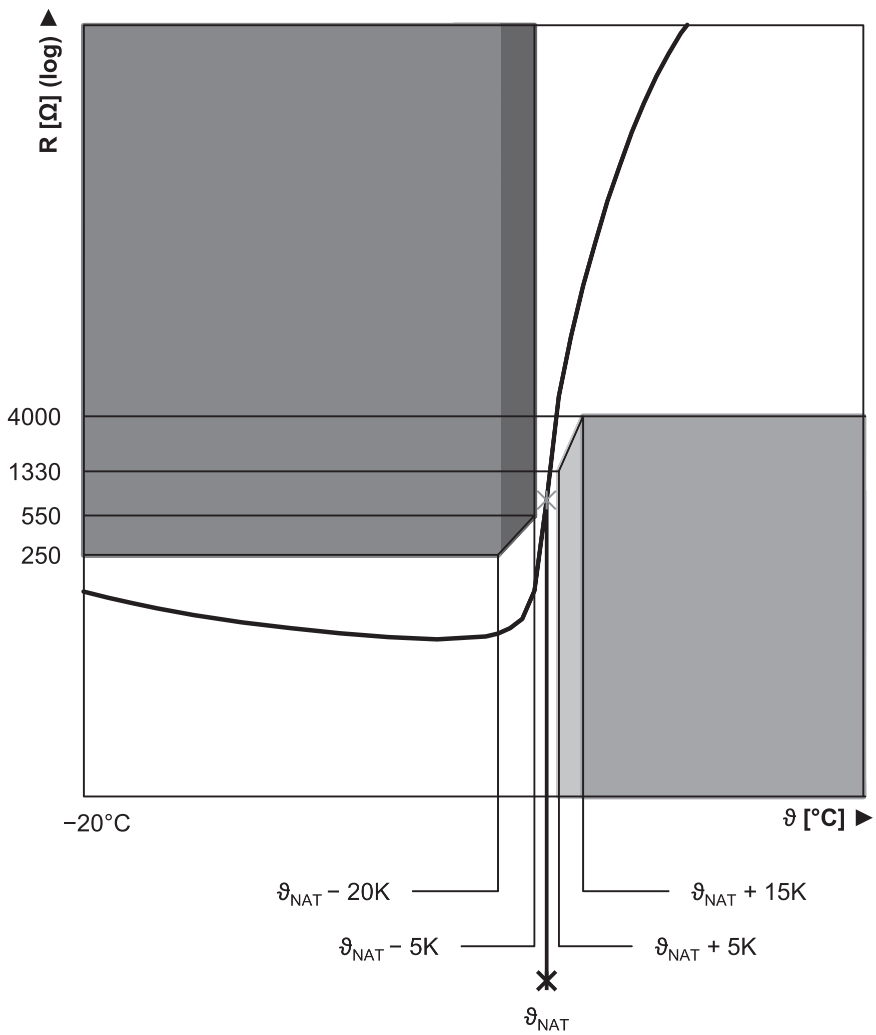


Fig. 2: PTC thermistor curve (single thermistor)

2.6.7 Cooling

A Lean motor is cooled by convection cooling (IC 410 in accordance with EN 60034-6). In this process, the motor heat is dissipated into the ambient air through natural convection and radiation. Here, unimpeded suctioning of the cooling air and escape of the hot air has to be ensured by maintaining sufficient distances to the machine environment.

2.6.8 Holding brake

STOBER Lean motors can be optionally equipped with a spring-loaded holding brake in order to secure the motor shaft when the motor is at a standstill. The holding brake engages automatically if the voltage drops.

Nominal voltage of the spring-loaded holding brake: DC 24 V ± 10%, any polarity.

Observe the following during project configuration:

- The holding brake is designed to keep the motor shaft from moving. Activate braking processes during operation using the corresponding electrical functions of the drive controller. In exceptional circumstances, the holding brake can be used for braking from full speed (following a power failure or when setting up the machine). The maximum permitted work done by friction $W_{B,Rmax/h}$ may not be exceeded.
- Note that the braking torque M_{Bdyn} may initially be up to 50% less when braking from full speed. As a result, the braking effect has a delayed action and braking distances become longer.
- Regularly perform a brake test to ensure the functional safety of the brakes. Details can be found in the documentation of the motor and the drive controller.
- The holding brake of the motor does not offer adequate safety for persons in the hazardous area of gravity-loaded vertical axes. Therefore take additional measures to minimize risk, e.g. by providing a mechanical substructure for maintenance work.
- Take into consideration voltage losses in the connection cables that connect the voltage source to the holding brake connections.
- The holding torque of the brake can be reduced by shock loading. Information about shock loading can be found in the chapter Ambient conditions.

Calculation of work done by friction per braking process

$$W_{B,R/B} = \frac{J_{tot} \cdot n^2}{182.4} \cdot \frac{M_{Bdyn}}{M_{Bdyn} \pm M_L}, \; M_{Bdyn} > M_L$$

The sign of M_L is positive if the movement runs vertically upwards or horizontally and it is negative if the movement runs vertically down.

Calculation of the stop time

$$t_{dec} = 2.66 \cdot t_{1B} + \frac{n \cdot J_{tot}}{9.55 \cdot M_{Bdyn}}$$

Switching behavior

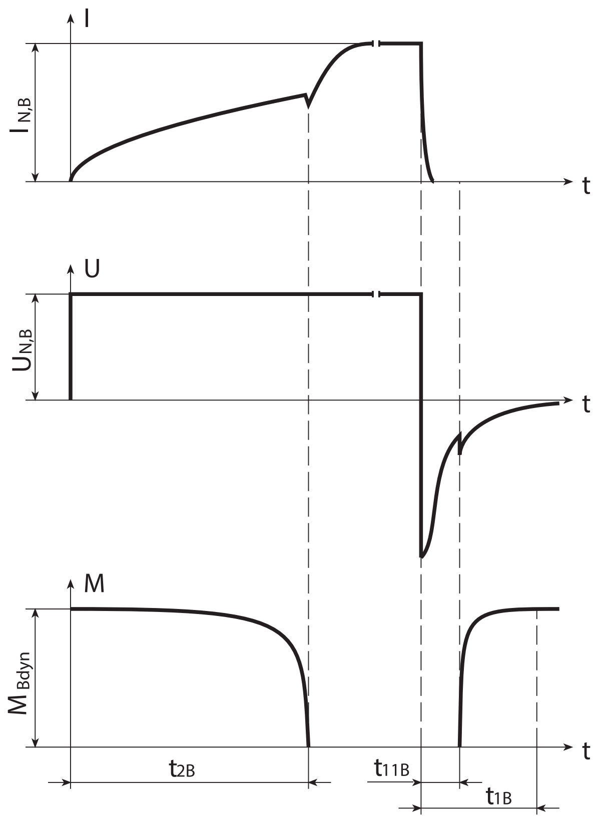


Fig. 3: Holding brake – Switching behavior

Technical data

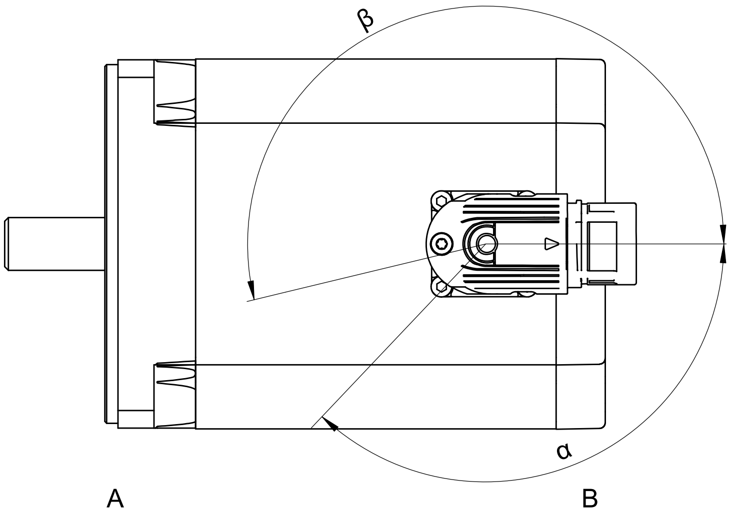
Type	M_{Bstat} [Nm]	M_{Bdyn} [Nm]	$I_{N,B}$ [A]	$W_{B,Rmax/h}$ [kJ/h]	N_{Bstop}	J_{Bstop} [kgcm²]	$W_{B,Rlim}$ [kJ]	t_{2B} [ms]	t_{11B} [ms]	t_{1B} [ms]	$x_{B,N}$ [mm]	ΔJ_B [kgcm²]	Δm_B [kg]
LM401	7.0	6.0	0.90	3.0	428000	3.78	8000	60	18	40	0.15	0.22	1.80
LM402	7.0	6.0	0.90	3.0	250000	6.47	8000	60	18	40	0.15	0.22	1.80
LM403	7.0	6.0	0.90	3.0	178000	9.06	8000	60	18	40	0.15	0.22	1.80
LM503	13	11	0.90	6.0	119000	22.1	13000	80	27	27	0.25	0.69	2.80
LM505	13	11	0.90	6.0	75000	34.9	13000	80	27	27	0.25	0.69	2.80
LM704	31	19	1.9	7.0	53000	76.4	20000	100	50	125	0.20	1.77	4.80
LM706	31	19	1.9	7.0	36000	111	20000	100	50	125	0.20	1.77	4.80

2.6.9 Connection method

2.6.9.1 Plug connectors

The standard version of Lean motors is equipped with a rotatable quick-lock plug connector[2]. Details can be found in this chapter.

The figures represent the position of the plug connectors upon delivery.



A	Attachment or output side of the motor	B	Not output side

Plug connector features

Motor type	Size	Connection	Turning range	
			α	β
LM4 – LM7	con.23	Quick-lock	130°	192°

The number in the designation of the plug connector size indicates approximately the external thread diameter of the plug connector in mm (for example con.23 designates a plug connector with an external thread diameter of about 23 mm).

2.6.9.2 Connection of the motor housing to the grounding conductor system

Connect the motor housing to the machine's grounding conductor system to protect persons.

All attachment parts required for the connection of the grounding conductor to the motor housing are delivered with the motor. The grounding screw of the motor is identified with the symbol ⏚ in accordance with IEC 60417-DB. The cross-section of the grounding conductor has to be at least as large as the cross-section of the lines in the power connection.

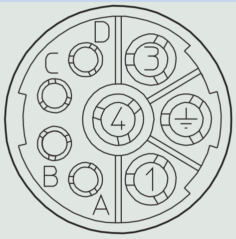
[2] The plug connectors can be pivoted up to 10 times at a defined angle. They cannot be rotated repeatedly.

2.6.9.3 Terminal assignment

The terminal assignment of Lean motors in the standard version is described in this chapter. For more information, refer to the connection plan included in the delivery of every motor.

Power connection

Plug connector size con.23

Connection diagram	Pin	Connection
	1	1U1 (U phase)
	3	1V1 (V phase)
	4	1W1 (W phase)
	A	1BD1 (brake +)
	B	1BD2 (brake −)
	C	1TP1 (temperature sensor +)
	D	1TP2 (temperature sensor -)
	⏚	PE (grounding conductor)

2.7 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

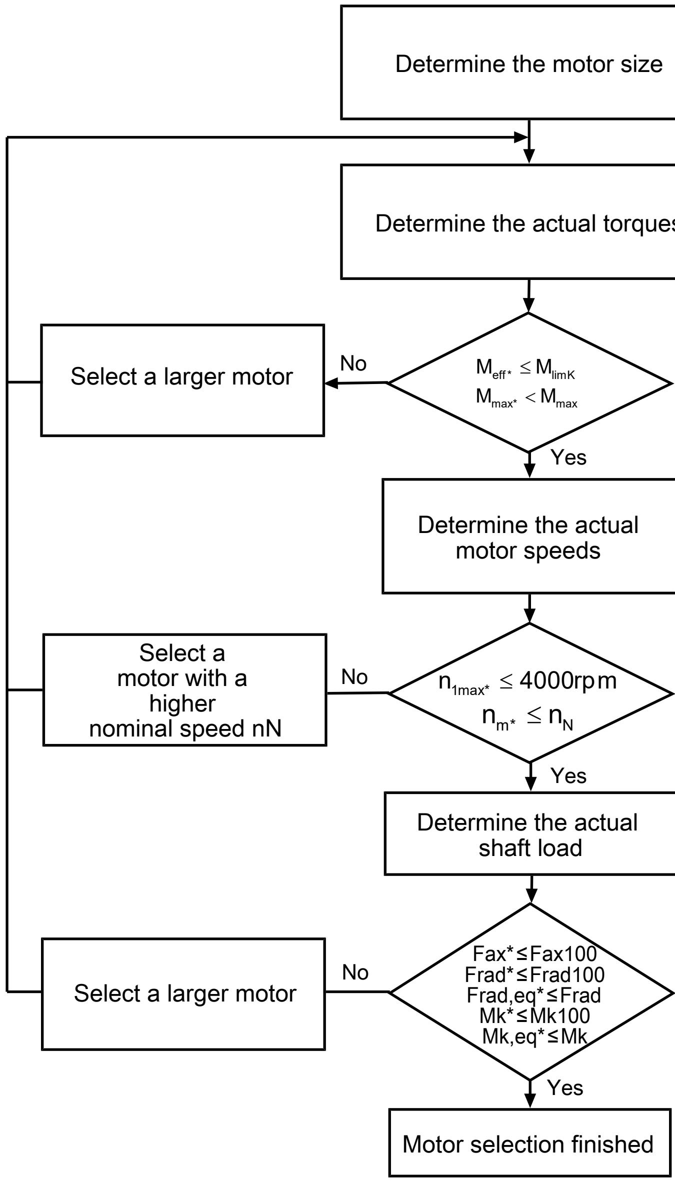
It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in the Chapter [▸ 15.1].

The formula symbols for values actually present in the application are marked with *.

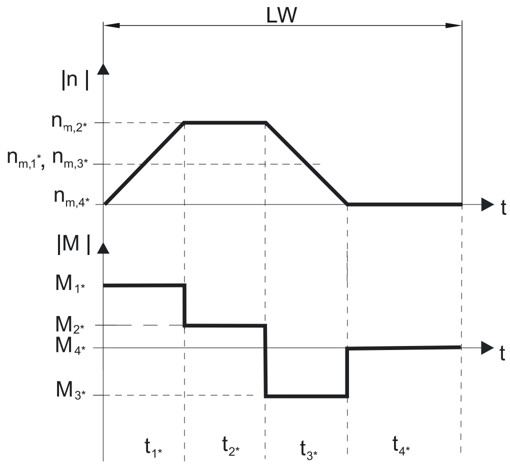
2.7.1 Drive selection



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [▸ 2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations refer to a representation of the power delivered at the motor shaft in accordance with the following example:



Calculation of the actual average input speed

$$n_{m*} = \frac{|n_{m,1*}| \cdot t_{1*} + \ldots + |n_{m,n*}| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

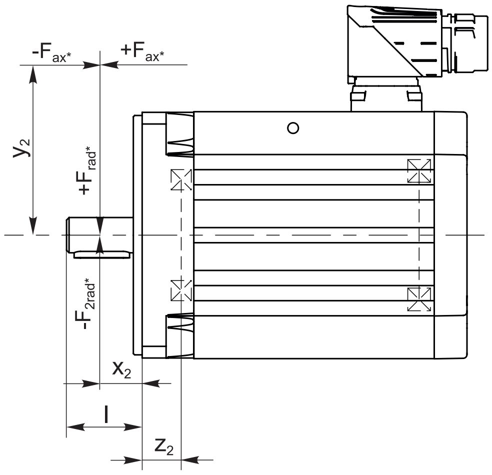
If t_{1*} + ... + t_{3*} ≥ 6 min, determine n_{m*} without the rest phase t_{4*}.

Calculation of the actual effective torque

$$M_{eff*} = \sqrt{\frac{t_{1*} \cdot M_{1*}^2 + \ldots + t_{n*} \cdot M_{n*}^2}{t_{1*} + \ldots + t_{n*}}}$$

2.7.2 Permitted shaft loads

The shaft loads permitted for the Lean motor are defined in this chapter.



Permitted shaft loads

Type	z_2 [mm]	F_{ax100} [N]	F_{rad100} [N]	M_{k100} [Nm]
LM401	19.5	550	1800	62
LM402	19.5	550	1800	71
LM403	19.5	550	1800	71
LM503	19.5	750	2400	107
LM505	19.5	750	2400	107
LM704	24.5	1300	4200	208
LM706	24.5	1300	4200	225

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- A force applied at the center of the output shaft: $x_2 = l / 2$ (shaft dimensions can be found in the chapter Dimensional drawings)
- Output speeds $n_{m*} \le 100$ rpm ($F_{ax} = F_{ax100}$; $F_{rad} = F_{rad100}$; $M_k = M_{k100}$)

The following applies to output speeds $n_{m*} > 100$ rpm:

$$F_{ax} = \frac{F_{ax100}}{\sqrt[3]{\frac{n_{m*}}{100\text{ rpm}}}} \qquad F_{rad} = \frac{F_{rad100}}{\sqrt[3]{\frac{n_{m*}}{100\text{ rpm}}}} \qquad M_k = \frac{M_{k100}}{\sqrt[3]{\frac{n_{m*}}{100\text{ rpm}}}}$$

The following applies to other force application points:

$$M_{k*} = \frac{2 \cdot F_{ax*} \cdot y_2 + F_{rad*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

2.7.3 Derating

If you use the motor under ambient conditions that differ from the standard ambient conditions, the nominal torque M_N of the motor is reduced. In this chapter, you can find information for calculating the reduced nominal torque.

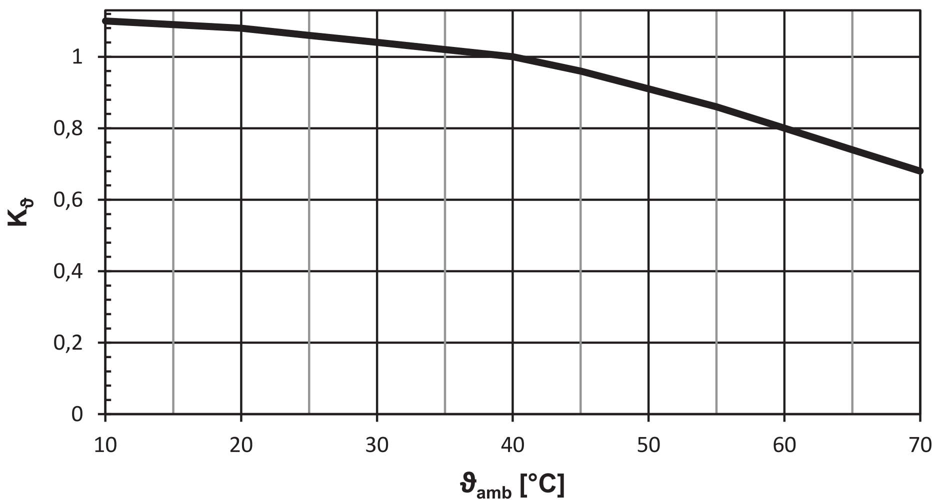


Fig. 4: Derating depending on the surrounding temperature

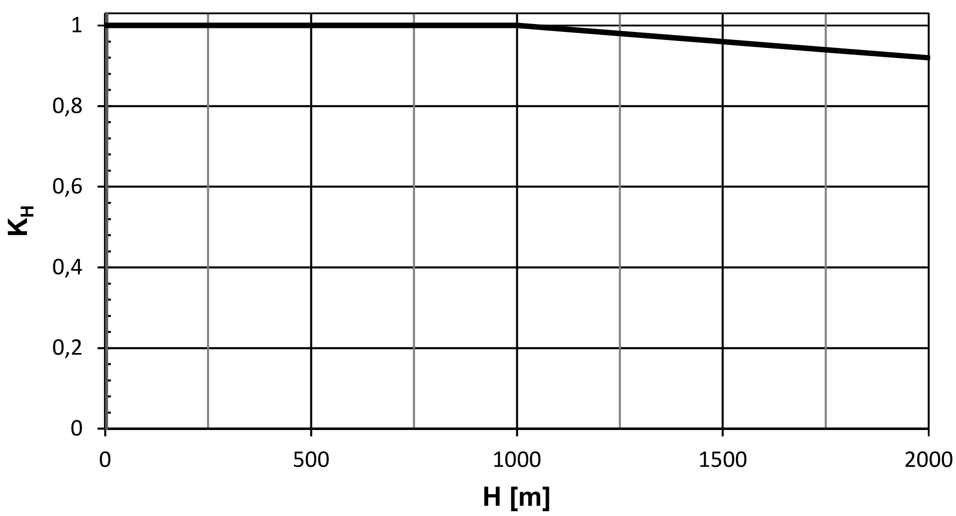


Fig. 5: Derating depending on the installation height

Calculation

If surrounding temperature ϑ_{amb} > 40 °C:

$M_{Nred} = M_N \cdot K_\vartheta$

If installation altitude H > 1000 m above sea level:

$M_{Nred} = M_N \cdot K_H$

If the surrounding temperature ϑ_{amb} > 40 °C and installation altitude H > 1000 m above sea level:

$M_{Nred} = M_N \cdot K_H \cdot K_\vartheta$

2.8 Further information

2.8.1 Directives and standards

STOBER Lean motors meet the requirements of the following directives and standards:

- (Low Voltage) Directive 2014/35/EU
- EN 60034-1:2010 + Cor.:2010
- EN 60034-5:2020
- EN 60034-6:1993

2.8.2 Identifiers and test symbols

Lean motors have the following marks and test symbols:

CE mark: The product meets the requirements of EU directives.

UKCA mark: The product meets the requirements of UK directives.

cURus test symbol "Servo and Stepper Motors – Component"; registered under UL number E488992 with Underwriters Laboratories USA.

2.8.3 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual for LM Lean motors	443048_en

3 SB6 drive controllers

Table of contents

3 Drive controllers

SB6

3.1 Overview

The universal solution for design freedom

Features

- Single-axis controller with a nominal output current of up to 32 A and 250% overload capacity
- Control of rotary synchronous servo motors and asynchronous motors
- Control of linear and torque motors
- Sensorless position control of STOBER Lean motors
- One Cable Solution EnDat 3
- Electronic motor nameplate via EnDat encoder interfaces
- Integrated EtherCAT or PROFINET communication
- STO safety technology using terminals or STO and SS1 using FSoE or PROFIsafe: SIL 3, PL e (Cat. 4)
- Extended safety technology (SS1, SS2, SLS, SBC, SBT...) using FSoE
- Optional operating unit consisting of text display and keys
- Modular interface concept
- Integrated brake control
- Energy supply through direct power feed-in
- Available EPLAN macros in the EPLAN Data Portal

3.1.1 Features

With its modular interface concept and compact design, the stand-alone SB6 drive controller enables extremely versatile system designs. SB6 is available as a single-axis controller in three sizes with a nominal output current of up to 32 A. If you are looking for a universal and flexible solution, the SB6 drive controller is the right choice.

SB6 drive controllers

Easy connection, quick and safe parameterization

The One Cable Solution (OCS) from STOBER combines power and encoder communication in a single hybrid cable – for minimal cabling and easy installation.

The electronic motor nameplate is automatically transmitted via the digital EnDat 3 interface. The drive controller detects all the motor data automatically – the parameterization process is fast, reliable and error-free.

The optimized hybrid cable offers maximum signal quality and system reliability.

Ready-to-connect power and encoder cables with an EnDat 2.2 interface and electronic nameplate function are available as alternatives. Both variants ensure optimal coordination of the interaction between the motor and drive controller – for efficient and reliable commissioning.

Play it safe with STOBER

Integrated safety

STOBER drive controllers have safety functions such as Safe Torque Off (STO) and Safe Stop 1 (SS1) that can be controlled either conventionally via terminals, or via the safe communication standards PROFIsafe (PROFINET) and Fail Safe over EtherCAT (FSoE). The fully electronic design works quickly and free of wear. Additional cyclical function tests are no longer necessary. This increases availability and reduces the amount of testing required during operation.

Extended safety

For stricter requirements, STOBER offers optional safety functions up to SIL 3, PL e (category 4). These include functions such as Safely Limited Speed (SLS) for safe speed monitoring and Safe Operating Stop (SOS) to safely keep stopped axes in place, as well as Safe Brake Control (SBC) and Safe Brake Test (SBT) for reliable brake control and testing. Optimized monitoring mechanisms ensure short reaction times, minimum safety distances and increased system availability – for productive safety at the highest level.

Robust and resilient

The drive controllers boast a stable, durable design. The housing is made from high-quality sheet steel for reliable shielding, mechanical strength and optimum heat dissipation – even under demanding operating conditions. Inside, powerful computing units, carefully selected components and precision manufacturing ensure reliable operation over the long term.

An SD card slot is available on the front panel for removable data storage. An SD card can be used for quick series commissioning by copying, or for easy device replacement in the event of servicing. The removable data storage can also be used as a medium for storing additional project data and documentation.

3.1.2 Software components

Project configuration and commissioning

The DriveControlSuite project configuration and commissioning software has all the functions for the efficient use of drive controllers in single-axis and multi-axis applications. The program guides you step by step through the complete project configuration and parameterization process using wizards.

Open communication

The Ethernet-based EtherCAT and PROFINET fieldbus systems are available in the drive controller.

Applications

A drive-based application is recommended for the decentralized motion control of sophisticated machines.

The drive-based application package from STOBER is the right choice wherever universal and flexible solutions are needed. The Drive Based application provides drive-based motion control for positioning, velocity and torque/force with the PLCopen Motion Control command set. These standard commands have been combined into operating modes for different applications and supplemented with additional functions such as motion block linking, cams and much more. For the command operating mode, all properties of the movements are specified directly by the controller. The properties of the movements in the drive are predefined in the motion block operating mode so that only a start signal is necessary to perform the movement. Linking can be used to define complete motion sequences. There is a separate operating mode available for applications controlled by velocity or torque/force such as pumps, fans or conveyor belts. This also allows for operation without a controller.

In addition, the CiA 402 and PROFIdrive applications are also available, which include both the controller-based and drive-based operating modes and application classes. For example, standard telegrams 1, 2 and 3 as well as telegrams 102 and 111 are available for standard drives according to PROFIdrive in application class 1 and for decentralized positioning control according to application class 3. Based on these telegrams, the drive controllers can be used with the SpeedAxis and BasicPos (EPos) technology objects.

Standard telegrams 3 and 5 as well as telegram 105 are available for controller-based motion control according to PROFIdrive in application class 4.

Furthermore, programming based on IEC 61131-3 with CFC can be used to create new applications or expand existing ones.

3.1.3 Operating motors, encoders and brakes

You can use the drive controller to operate Lean motors of the LM series, synchronous servo motors (such as those of the EZ series), asynchronous motors, linear motors or torque motors.

Evaluation options for feedback are available on the X4 connection for the following encoders:

- EnDat 2.1/2.2 digital encoders
- SSI encoders
- Differential TTL and differential HTL incremental encoders
- EnDat 3 or HIPERFACE DSL encoders (with One Cable Solution design)

In addition, evaluation options for the following encoders are available on the X1 connection:

- Single-ended HTL incremental encoders
- Single-ended HTL pulse/direction interface

The following additional encoder types can be connected via the optional available XB6 terminal module:

- Resolvers
- EnDat 2.1 sin/cos encoders
- Sin/cos encoders
- EnDat 2.1/2.2 digital encoders
- SSI encoders
- Differential TTL incremental encoders
- Differential TTL pulse/direction interface
- Differential TTL Hall sensor

All device types of the drive controller have connections for PTC thermistors and can activate a 24 V_{DC} brake as standard.

3.1.4 Application training

STOBER offers a multi-level training program that is essentially focused on the drive controller.

G6 Basic

Training content: System overview, installation and commissioning of the drive controller. Use of option modules. Parameterization, commissioning and diagnostics using the commissioning software. Remote maintenance. Basics of controller optimization. Configuration of the drive train. Integrated software functions. Software applications. Connection to a higher-level controller. Basics of safety technology. Practical exercises on training topics.

Software used: DriveControlSuite.

G6 Customized

Training content: Special knowledge for regulating, control and safety technology. Practical exercises on training topics.

3.2 Technical data

Technical data for the drive controller can be found in the following chapters.

3.2.1 Type designation

SB	6	A	0	6	Z	X	O

Tab. 1: Example code for type designation

Code	Designation	Design
SB	Series	
6	Generation	Generation 6
A	Version	
0 – 2	Size	
6	Power output stage	Power output stage within the size
Z	Safety technology	SZ6: Without safety technology
R		SR6: STO using terminals
U		SU6: STO and SS1 using PROFIsafe
Y		SY6: STO and SS1 using FSoE
X		SX6: Extended safety technology using FSoE
N	Terminal module	Without terminal module
X		XB6: With extended terminal option
N	Operating unit	Without operating unit
O		OP6: With operating unit

Tab. 2: Meaning of the example code

3.2.2 Sizes

Type	ID No.	Size	Axis controller
SB6A06	5050162	Size 0	Single-axis controller
SB6A16	5050164	Size 1	Single-axis controller
SB6A26	5050166	Size 2	Single-axis controller

Tab. 3: Available SB6 types and sizes

SB6 in sizes 2, 1 and 0

Note that the basic device is delivered without terminals. Suitable terminal sets can be ordered with the drive controllers or as separate accessories.

3.2.3 General technical data

The following information applies to all device types.

Device features	
Protection class of the device	IP20
Protection class of the installation space	At least IP54
Protection class	Protection class I in accordance with EN 61140
Radio interference suppression	Integrated line filter in accordance with EN 61800-3, interference emission class C3
Overvoltage category	III in accordance with EN 61800-5-1
Marks and test symbols	CE, cULus, RoHS

Tab. 4: Device features

Transport and storage conditions	
Storage/ transport temperature	−20 °C to +70 °C Maximum change: 20 K/h
Relative humidity	Maximum relative humidity 85%, non-condensing
Vibration (transport) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²
Fall height for free fall[1] Weight < 100 kg in accordance with EN 61800-2 (or IEC 60721-3-2, class 2M4)	0.25 m
Shock testing in accordance with EN 60068-2-27	Pulse shape: Half-sine Acceleration: 5 g Shock duration: 30 ms Number of shocks: 3 per axis

Tab. 5: Transport and storage conditions

Operating conditions	
Surrounding temperature during operation	0 °C to 45 °C with nominal data 45 °C to 55 °C with derating −2.5% / K
Relative humidity	Maximum relative humidity 85%, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above sea level with −1.5%/100 m derating
Pollution degree	Pollution degree 2 in accordance with EN 50178

[1] Only valid for components in their original packaging.

Operating conditions	
Ventilation	Installed fan
Vibration (operation) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 6: Operating conditions

Discharge times	
Self-discharge of DC link	15 min

Tab. 7: Discharge times of the DC link circuit

3.2.4 Electrical data

The electrical data of the available sizes as well as the properties of the brake chopper can be found in the following chapters.

An explanation of the symbols used for formulas can be found in Chapter [▷ 15.1].

3.2.4.1 Control unit

Electrical data	All types
U_{1CU}	24 V_{DC}, +20%/−15%
I_{1maxCU}	1.5 A

Tab. 8: Control unit electrical data

3.2.4.2 Power unit: Size 0

Electrical data	SB6A06
U_{1PU}	3 × 400 V_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz
f_{2PU}	0 – 700 Hz
U_{2PU}	0 – max. U_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	135 µF
$C_{N,PU}$	540 µF

Tab. 9: SB6 electrical data, size 0

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SB6A06
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	5.4 A
$I_{2N,PU}$	4.5 A
I_{2maxPU}	180% for 5 s; 150% for 30 s

Tab. 10: SB6 electrical data, size 0, for 4 kHz clock frequency

Electrical data	SB6A06
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	4 A
$I_{2N,PU}$	3.8 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 11: SB6 electrical data, size 0, for 8 kHz clock frequency

Electrical data	SB6A06
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	100 Ω
P_{maxRB}	6.4 kW
P_{effRB}	2.9 kW

Tab. 12: Brake chopper electrical data, size 0

3.2.4.3 Power unit: Size 1

Electrical data	SB6A16
U_{1PU}	3 × 400 V_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz
f_{2PU}	0 – 700 Hz
U_{2PU}	0 – max. U_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	560 µF
$C_{N,PU}$	1400 µF

Tab. 13: SB6 electrical data, size 1

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SB6A16
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	19.2 A
$I_{2N,PU}$	16 A
I_{2maxPU}	180% for 5 s; 150% for 30 s

Tab. 14: SB6 electrical data, size 1, for 4 kHz clock frequency

Electrical data	SB6A16
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	15.8 A
$I_{2N,PU}$	12 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 15: SB6 electrical data, size 1, for 8 kHz clock frequency

Electrical data	SB6A16
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	47 Ω
P_{maxRB}	13.6 kW
P_{effRB}	6.2 kW

Tab. 16: Brake chopper electrical data, size 1

3.2.4.4 Power unit: Size 2

Electrical data	SB6A26
U_{1PU}	3 × 400 V_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz
f_{2PU}	0 – 700 Hz
U_{2PU}	0 – max. U_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	1000 µF
$C_{N,PU}$	1400 µF

Tab. 17: SB6 electrical data, size 2

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SB6A26
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	38.4 A
$I_{2N,PU}$	32 A
I_{2maxPU}	180% for 5 s; 150% for 30 s

Tab. 18: SB6 electrical data, size 2, for 4 kHz clock frequency

Electrical data	SB6A26
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	32.6 A
$I_{2N,PU}$	20 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 19: SB6 electrical data, size 2, for 8 kHz clock frequency

Electrical data	SB6A26
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	22 Ω
P_{maxRB}	29.1 kW
P_{effRB}	13.2 kW

Tab. 20: Brake chopper electrical data, size 2

3.2.4.5 DC link connection

The charging capacity of the drive controllers can be increased by a DC link connection only if the power supply is connected to all drive controllers simultaneously.

3.2.4.6 Power loss data in accordance with EN 61800-9-2

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[2]	Operating points[3]								IE class[4]	Comparison[5]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)		
				Relative losses									
	[A]	[kVA]	[W]	[%]									
SB6A06	4.5	3.1	Max. 12	1.71	1.86	2.24	1.75	1.97	2.51	2.16	3.04	IE2	
SB6A16	16	11.1	Max. 12	0.95	1.12	1.66	0.99	1.23	1.98	1.41	2.52	IE2	
SB6A26	32	22.2	15	0.70	0.87	1.40	0.74	0.97	1.67	1.11	2.10	IE2	
				Absolute losses P_V									
	[A]	[kVA]	[W]	[W]									[%]
SB6A06	4.5	3.1	Max. 12	52.9	57.6	69.3	54.4	61.0	77.9	67.1	94.1	IE2	39.6
SB6A16	16	11.1	Max. 12	104.9	124.0	184.6	110.3	136.6	219.8	156.0	279.8	IE2	35.8
SB6A26	32	22.2	Max. 15	154.7	192.8	311.3	164.7	214.9	370.5	246.9	465.9	IE2	38.6

Tab. 21: Power loss data of the SB6 drive controller in accordance with EN 61800-9-2

General conditions

The power loss data applies to drive controllers without accessories.

The power loss calculation is based on a 3-phase supply voltage with 400 V_{AC}/50 Hz.

The calculated data includes a supplement of 10% in accordance with EN 61800-9-2.

The power loss specifications refer to a clock frequency of 4 kHz.

The absolute losses for a power unit that is switched off refer to the 24 V_{DC} power supply of the control electronics.

[2] Absolute losses for a power unit that is switched off

[3] Operating points for relative motor stator frequency in % and relative torque current in %

[4] IE class in accordance with EN 61800-9-2

[5] Comparison of the losses for the reference related to IE2 in the nominal point (90, 100)

3.2.4.7 Power loss data of accessories

If you intend to order the drive controller with accessory parts, losses increase as follows.

Type	Absolute losses P_V [W]
SR6 safety module	1
SY6 or SU6 safety module	2
SX6 safety module	< 4
XB6 terminal module	< 5
OP6 operating unit	1

Tab. 22: Absolute losses of the accessories

Information

Note the absolute power loss of the encoder (usually < 3 W) and of the brake when designing as well.

Loss specifications for other optional accessories can be found in the technical data of the respective accessory part.

3.2.5 Cycle times

Possible cycle times can be found in the following table.

Type	Cycle times	Relevant parameters
Application	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150
EtherCAT fieldbus, cyclical communication	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in TwinCAT 3 or CODESYS
PROFINET RT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms, 8 ms	Adjustable in the TIA Portal
PROFINET IRT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms	Adjustable in the TIA Portal
Motion core (movement calculation)	250 µs	—
Control cascade	62.5 µs	B24 ≥ 8 kHz and B20 = 48, 64 or 70
	125 µs	B24 = 4 kHz

Tab. 23: Cycle times

Information

For Lean motors (control mode B20 = 32: LM - sensorless vector control), only operation at 4 kHz is permitted.

3.2.6 Derating

When dimensioning the drive controller, observe the derating of the nominal output current as a function of the clock frequency, surrounding temperature and installation altitude. There is no restriction for a surrounding temperature from 0 °C to 45 °C and an installation altitude of 0 m to 1000 m. The details given below apply to values outside these ranges.

3.2.6.1 Effect of the clock frequency

Changing the clock frequency f_{PWM} affects the amount of noise produced by the drive, among other things. However, increasing the clock frequency results in increased losses. During project configuration, define the highest clock frequency and use it to determine the nominal output current $I_{2N,PU}$ for dimensioning the drive controller.

Type	$I_{2N,PU}$ 4 kHz [A]	$I_{2N,PU}$ 8 kHz [A]	$I_{2N,PU}$ 16 kHz [A]
SB6A06	4.5	3.8	2.3
SB6A16	16	12	5.7
SB6A26	32	20	12

Tab. 24: Nominal output current $I_{2N,PU}$ dependent on the clock frequency

3.2.6.2 Effect of the installation altitude

Derating as a function of the installation altitude is determined as follows:

- 0 m to 1000 m: No restriction (D_{IA} = 100%)
- 1000 m to 2000 m: Derating −1.5%/100 m

Example

The drive controller needs to be installed at an altitude of 1500 m above sea level.

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100% − 5 × 1.5% = 92.5%

3.2.6.3 Effect of the surrounding temperature

Derating as a function of the surrounding temperature is determined as follows:

- 0 °C to 45 °C: No restrictions (D_T = 100%)
- 45 °C to 55 °C: Derating −2.5%/K

Example

The drive controller needs to be operated at 50 °C.

The derating factor D_T is calculated as follows
D_T= 100% − 5 × 2.5% = 87.5%

3.2.6.4 Calculating the derating

Follow these steps for the calculation:

1. Determine the highest clock frequency (f_{PWM}) that will be used during operation and use it to determine the nominal current $I_{2N,PU}$.
2. Determine the derating factors for installation altitude and surrounding temperature.
3. Calculate the reduced nominal current $I_{2N,PU(red)}$ in accordance with the following formula:
   $I_{2N,PU(red)} = I_{2N,PU} \times D_T \times D_{IA}$

Example

A drive controller of type SB6A06 needs to be operated at a clock frequency of 8 kHz at an altitude of 1500 m above sea level and a surrounding temperature of 50 °C.

The nominal current of the SB6A06 at 8 kHz is 3.8 A. The derating factor D_T is calculated as follows:
D_T = 100% − 5 × 2.5% = 87.5%

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100% − 5 × 1.5% = 92.5%

The output current of importance for the project configuration is:
$I_{2N,PU(red)}$ = 3.8 A × 0.875 × 0.925 = 2.75 A

3.2.7 Dimensions

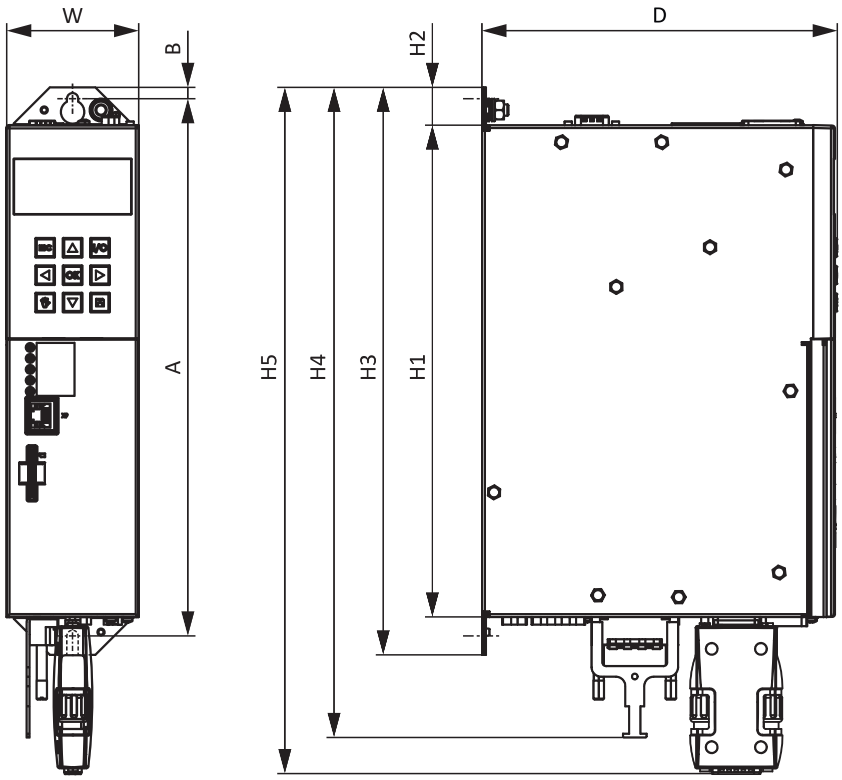


Fig. 1: SB6 dimensional drawing

Dimension			SB6A06	SB6A16	SB6A26
Drive controller	Width	W	70		105
	Depth	D	188	276	
	Body height	H1	260		
	Fastening clip height	H2	20		
	Height incl. fastening clips	H3	300		
	Total height incl. shield contact (terminal X20)	H4	344		362
	Height incl. AES	H5	360		
Fastening bores (M5)	Vertical distance	A	283+2		
	Vertical distance to the upper edge	B	6		

Tab. 25: SB6 dimensions [mm]

If you are using shield plate EM6 instead of a shield contact at terminal X20, please note the following deviating total height H4:

Dimension			SB6A06	SB6A16	SB6A26
Drive controller	Total height incl. shield plate EM6	H4	360		

Tab. 26: Total height including shield plate EM6 [mm]

Take the additional installation depth of the rear section modules into account when calculating the overall dimensions.

3.2.8 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
SB6A06	2500	3500
SB6A16	3700	5400
SB6A26	5000	6500

Tab. 27: SB6 weight [g]

3.2.9 Minimum clearances

Drive controller

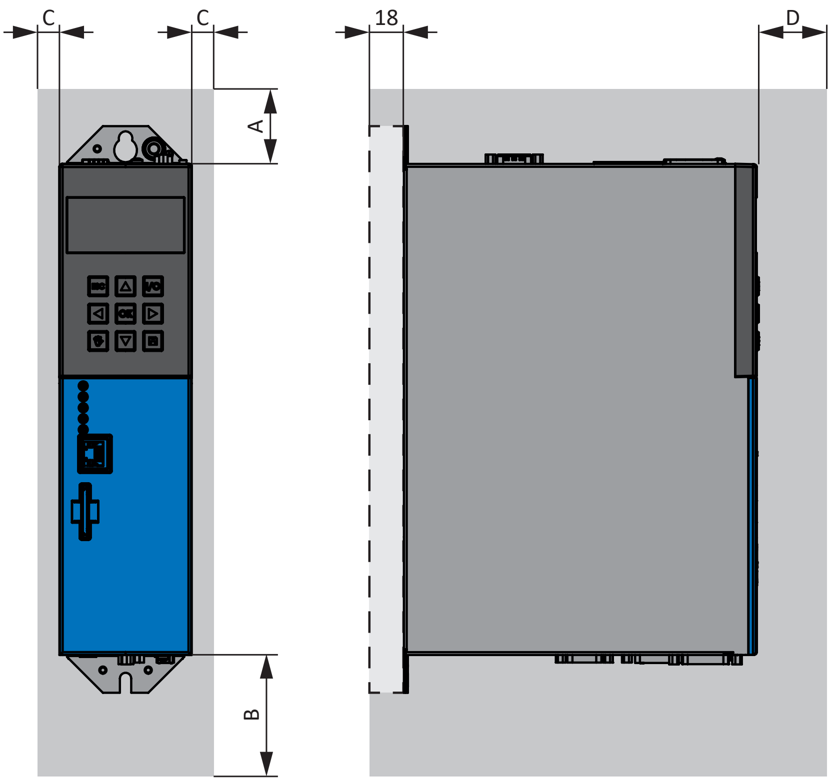


Fig. 2: Minimum clearances

Take into account the additional installation depth of 18 mm for the optional RB 5000 rear section braking resistor.

The dimensions specified in the table relate to the outer edges of the drive controller.

Minimum clearance	A (above)	B (below)	C (on the side)	D (in front)
All sizes	100	200	5	50[6]

Tab. 28: Minimum clearances [mm]

Chokes and filters

Avoid installation below drive controllers or supply modules. For installation in a control cabinet, a distance of approximately 100 mm to other neighboring components is recommended. This distance ensures proper heat dissipation for chokes and filters.

Braking resistors

Avoid installation below drive controllers or supply modules. In order for heated air to flow out unimpeded, a minimum clearance of approximately 200 mm must be maintained in relation to neighboring components or walls and approximately 300 mm must be maintained to components above or ceilings.

[6] Minimum clearance to be taken into account for permanent connection of the X9 service interface

3.3 Drive controller/motor combinations

An explanation of the symbols used for formulas can be found in Chapter [▸ 15.1].

IC 410 convection cooling

Type	K_{EM} [V/1000 min^{-1}]	n_N [rpm]	M_N [Nm]	I_N [A]	M_0 [Nm]	I_0 [A]	Type	$f_{PWM,PU}$ [kHz]	$I_{2N,PU}$ [A]	$I_{2N,PU}/I_0$
LM4										
LM401U	110	3000	2.25	1.59	2.43	1.82	SB6A06	4	4.5	2.5
LM402U	120	3000	4.41	2.88	4.50	2.94	SB6A06	4	4.5	1.5
LM403U	120	3000	6.06	3.92	6.19	4.08	SB6A06	4	4.5	1.1
LM5										
LM503U	135	3000	9.48	5.62	10.1	5.95	SB6A16	4	16	2.7
LM505U	135	3000	13.7	7.83	15.5	8.83	SB6A16	4	16	1.8
LM7										
LM704U	145	3000	19.3	10.6	21.3	11.6	SB6A16	4	16	1.4
LM704U	145	3000	19.3	10.6	21.3	11.6	SB6A26	4	32	2.8
LM706U	140	3000	25.7	14.7	29.8	16.8	SB6A26	4	32	1.9

3.4 Accessories

You can find information about the available accessories in the following chapters.

3.4.1 Safety technology

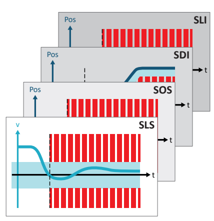
Information

The drive controller is delivered in the standard design without safety technology (option SZ6). If you want a drive controller with integrated safety technology, you must order it together with the drive controller. The safety modules are an integrated part of the drive controllers and must not be modified.

SZ6 option – Without safety technology

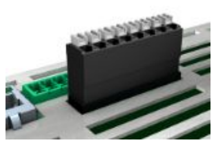
ID No. 56660
Design without safety technology.

SX6 safety module – Extended safety technology using FSoE



ID No. 5050185
Optional accessory for use in safety-related applications up to PL e, SIL 3 in accordance with EN ISO 13849-1 and EN 61800-5-2. In addition to the basic Safe Torque Off (STO) safety function, SX6 provides other safety functions specified in EN 61800-5-2. In addition to the safe stop functions Safe Stop 1 (SS1) and Safe Stop 2 (SS2), these also include Safely-Limited Speed (SLS), Safe Brake Control (SBC), Safe Brake Test (SBT), Safe Direction (SDI) and Safely-Limited Increment (SLI). Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

SR6 safety module – STO using terminals



ID No. 56661
Optional accessory for the use of the Safe Torque Off safety function (STO) in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via terminal X12.

SY6 safety module – STO and SS1 using FSoE

ID No. 56662
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

SU6 safety module – STO and SS1 using PROFIsafe

ID No. 56696
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via PROFINET (PROFIsafe).

3.4.2 Communication

The drive controller has two interfaces for the EtherCAT or PROFINET connection on the top of the device as well as an Ethernet service interface on the front of the device. Cables for the connection are available separately.

EtherCAT or PROFINET

Specify the desired fieldbus system when placing your order for the base device, since fieldbus communication is defined by the firmware.

EtherCAT cables

Ethernet patch cable, CAT5e, yellow.
The following designs are available:
ID no. 49313: length approx. 0.25 m.
ID no. 49314: length approx. 0.5 m.

PC connecting cable

ID No. 49857
Cable for connecting the X9 service interface to the PC, CAT5e, blue, length: 5 m.

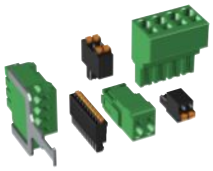
USB 2.0 Ethernet adapter

ID No. 49940
Adapter for connecting Ethernet to a USB port.

3.4.3 Terminal set

For connection, you need a fitting terminal set for each SB6 drive controller.

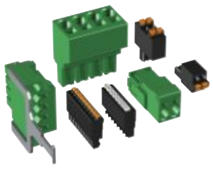
Terminal set for drive controllers (standard version)



(Fig. similar)

The following designs are available:
ID No. 138711
Terminal set for SB6A06Z/U/Y/X.
ID No. 138712
Terminal set for SB6A16Z/U/Y/X.
ID No. 138713
Terminal set for SB6A26Z/U/Y/X.
Contents: 10 terminals.

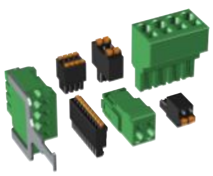
Terminal set for drive controllers with SR6 safety module (STO using terminals)



(Fig. similar)

The following designs are available:
ID No. 138717
Terminal set for SB6A06 with SR6.
ID No. 138718
Terminal set for SB6A16 with SR6.
ID No. 138719
Terminal set for SB6A26 with SR6.
Contents: 11 terminals.

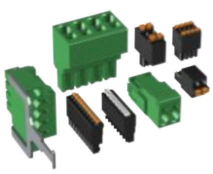
Terminal set for drive controllers with XB6 terminal module



(Fig. similar)

The following designs are available:
ID No. 138720
Terminal set for SB6A06Z/U/Y/X with XB6.
ID No. 138721
Terminal set for SB6A16Z/U/Y/X with XB6.
ID No. 138722
Terminal set for SB6A26Z/U/Y/X with XB6.
Contents: 12 terminals.

Terminal set for drive controllers with SR6 safety module (STO using terminals) and XB6 terminal module



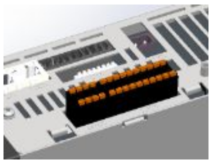
(Fig. similar)

The following designs are available:
ID No. 138723
Terminal set for SB6A06 with SR6 and XB6.
ID No. 138724
Terminal set for SB6A16 with SR6 and XB6.
ID No. 138725
Terminal set for SB6A26 with SR6 and XB6.
Contents: 13 terminals.

Note that the basic device is delivered without terminals. Suitable terminal sets can be ordered with the drive controllers or as separate accessories.

3.4.4 Terminal module

XB6 terminal module



ID No. 5050181

Optional terminal module for connecting analog and digital signals as well as encoders.

Inputs and outputs:

- 8 digital inputs (24 V_{DC})
- 8 digital outputs (24 V_{DC})
- 2 analog inputs (±10 V_{DC}, 1 × ±20 mA, 16 bits)
- 2 analog outputs (±10 V_{DC}, ±20 mA, 12 bits)

Supported encoders and interfaces:

- Resolver (evaluation)
- EnDat 2.1 sin/cos encoder (evaluation)
- Sin/cos encoder (evaluation)
- EnDat 2.1/2.2 digital encoder (evaluation)
- SSI encoder (SSI motion bus, evaluation, simulation and SSI passive)
- Differential TTL incremental encoder (evaluation and simulation)
- Differential TTL pulse/direction interface (evaluation and simulation)

X120 SSI/TTL connecting cable

ID No. 49482

Cable for connecting the X120 interface for TTL incremental signals and SSI signals. Can be used in conjunction with the RI6 and XI6 G5 terminal modules, the SB6 XB6 terminal module and the X301 interface of the LA6 adapter box, length: 0.3 m.

3.4.5 Braking resistor

In addition to drive controllers, STOBER offers the following braking resistors described below in various sizes and performance classes. For the selection, note the minimum permitted braking resistors specified in the technical data of the individual drive controller types.

3.4.5.1 Tubular fixed resistor FZMU, FZZMU

Type	FZMU 400×65		FZZMU 400×65	
ID No.	49010	55445	53895	55447
SB6A06	X	—	—	—
SB6A16	(X)	—	X	—
SB6A26	(—)	X	(X)	X

Tab. 29: Assignment of FZMU, FZZMU braking resistor – SB6 drive controller

X	Recommended
(X)	Possible
(—)	Useful under certain conditions
—	Not possible

Properties

Technical data	FZMU 400×65		FZZMU 400×65	
ID No.	49010	55445	53895	55447
Type	Tubular fixed resistor		Tubular fixed resistor	
Resistance [Ω]	100 ± 10 %	22 ± 10 %	47 ± 10 %	22 ± 10 %
Thermal drift	±10 %		±10 %	
Power [W]	600		1200	
Therm. time const. τ_{th} [s]	40		40	
Pulse power for < 1 s [kW]	18		36	
U_{max} [V]	848		848	
Weight without packaging [g]	2200		4170	
Protection class	IP20		IP20	
Marks and test symbols	cURus, CE, UKCA		cURus, CE, UKCA	

Tab. 30: FZMU, FZZMU technical data

Dimensions

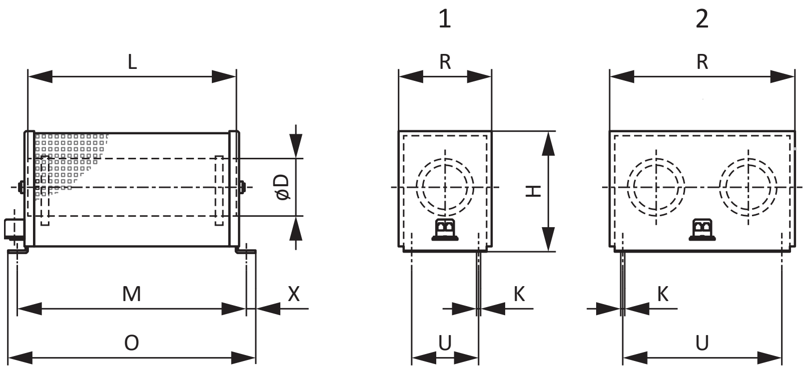


Fig. 3: FZMU (1), FZZMU (2) dimensional drawing

Dimension	FZMU 400×65		FZZMU 400×65	
ID No.	49010	55445	53895	55447
L x D	400 × 65		400 × 65	
H	120		120	
K	6.5 × 12		6.5 × 12	
M	430		426	
O	485		485	
R	92		185	
U	64		150	
X	10		10	

Tab. 31: FZMU, FZZMU dimensions [mm]

3.4.5.2 GVADU, GBADU flat resistor

Type	GVADU 210×20	GBADU 265×30	GBADU 335×30	GBADU 265×30
ID No.	55441	55442	55443	55444
SB6A06	X	X	—	—
SB6A16	(X)	(X)	X	—
SB6A26	(—)	(—)	(X)	X

Tab. 32: Assignment of GVADU, GBADU braking resistor – SB6 drive controller

X	Recommended
(X)	Possible
(—)	Useful under certain conditions
—	Not possible

Properties

Technical data	GVADU 210×20	GBADU 265×30	GBADU 335×30	GBADU 265×30
ID No.	55441	55442	55443	55444
Type	22 ± 10 %			
Resistance [Ω]	100 ± 10 %	100 ± 10 %	47 ± 10 %	22 ± 10 %
Thermal drift	±10 %	±10 %	±10 %	±10 %
Power [W]	150	300	400	300
Therm. time const. τ_{th} [s]	60	60	60	60
Pulse power for < 1 s [kW]	3.3	6.6	8.8	6.6
U_{max} [V]	848	848	848	848
Cable design	Radox	FEP	FEP	FEP
Cable length [mm]	500	1500	1500	1500
Conductor cross-section [AWG]	18/19 (0.82 mm²)	14/19 (1.9 mm²)	14/19 (1.9 mm²)	14/19 (1.9 mm²)
Weight without packaging [g]	300	930	1200	930
Protection class	IP54	IP54	IP54	IP54
Marks and test symbols	cURus, CE, UKCA			

Tab. 33: GVADU, GBADU technical data

Dimensions

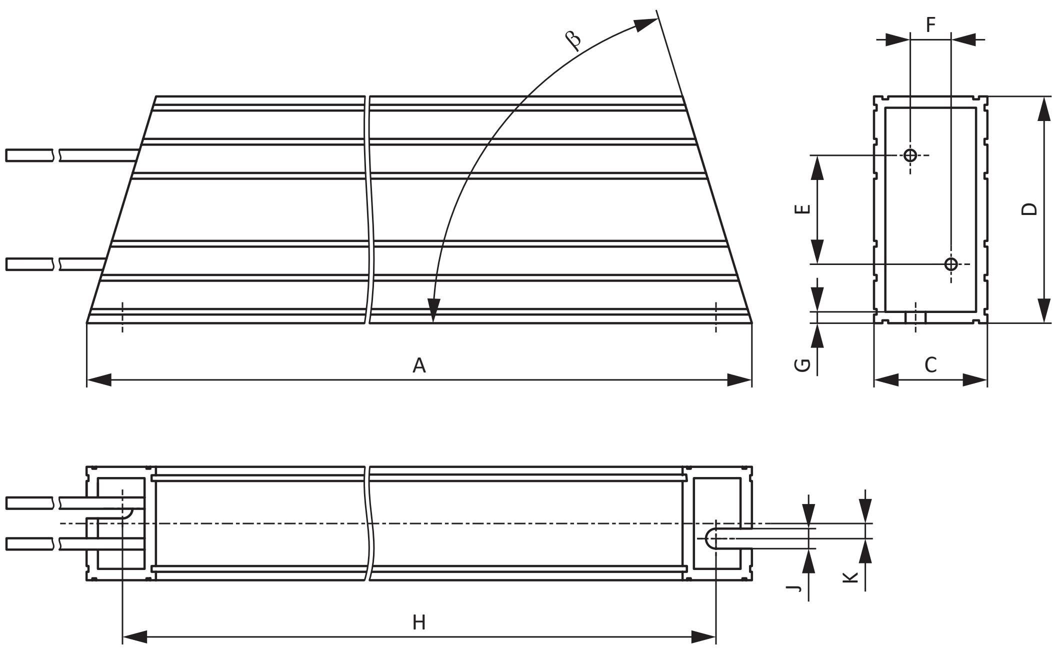


Fig. 4: GVADU, GBADU dimensional drawing

Dimension	GVADU 210×20	GBADU 265×30	GBADU 335×30	GBADU 265×30
ID No.	55441	55442	55443	55444
A	210	265	335	265
H	192	246	316	246
C	20	30	30	30
D	40	60	60	60
E	18.2	28.8	28.8	28.8
F	6.2	10.8	10.8	10.8
G	2	3	3	3
K	2.5	4	4	4
J	4.3	5.3	5.3	5.3
β	65°	73°	73°	73°

Tab. 34: GVADU, GBADU dimensions [mm]

3.4.5.3 RB 5000 rear section braking resistor

Type	RB 5022	RB 5047	RB 5100
ID No.	45618	44966	44965
SB6A06	—	—	X
SB6A16	—	X	(X)
SB6A26	X	—	—

Tab. 35: Assignment of RB 5000 braking resistor – SB6 drive controller

X	Recommended
(X)	Possible
—	Not possible

Properties

Technical data	RB 5022	RB 5047	RB 5100
ID No.	45618	44966	44965
Resistance [Ω]	22 ± 10 %	47 ± 10 %	100 ± 10 %
Thermal drift	±10 %	±10 %	±10 %
Power [W]	100	60	60
Therm. time const. τ_{th} [s]	8	8	8
Pulse power for < 1 s [kW]	1.5	1.0	1.0
U_{max} [V]	800	800	800
Weight without packaging [g]	640	460	440
Cable design	Radox	Radox	Radox
Cable length [mm]	250	250	250
Conductor cross-section [AWG]	18/19 (0.82 mm^2)	18/19 (0.82 mm^2)	18/19 (0.82 mm^2)
Maximum torque of M5 threaded bolts [Nm]	5	5	5
Protection class	IP40	IP40	IP40
Marks and test symbols	cURus, CE, UKCA	cURus, CE, UKCA	cURus, CE, UKCA

Tab. 36: RB 5000 technical data

Dimensions

Dimension	RB 5022	RB 5047	RB 5100
ID No.	45618	44966	44965
Height	300	300	300
Width	94	62	62
Depth	18	18	18
Drilling diagram corresponds to size	Size 2	Size 1	Size 0 and Size 1

Tab. 37: RB 5000 dimensions [mm]

3.4.6 Choke

Technical specifications for suitable chokes can be found in the following chapters.

3.4.6.1 TEP output choke

Output chokes are required for connecting size 0 to 2 drive controllers to synchronous servo motors or asynchronous motors from a cable length > 50 m in order to reduce interference pulses and protect the drive system. If Lean motors are connected, output chokes must not be used.

Information

The following technical data only applies to a rotating magnetic field frequency of 200 Hz. For example, this rotating magnetic field frequency is achieved with a motor with 4 pole pairs and a nominal speed of 3000 rpm. Always observe the specified derating for higher rotating magnetic field frequencies. Also observe the relationship with the clock frequency.

Properties

Technical data	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
ID No.	53188	53189	53190
Voltage range	3 × 0 to 480 V_{AC}		
Frequency range	0 – 200 Hz		
Nominal current $I_{N,MF}$ at 4 kHz	4 A	17.5 A	38 A
Nominal current $I_{N,MF}$ at 8 kHz	3.3 A	15.2 A	30.4 A
Max. permitted motor cable length with output choke	100 m		
Max. surrounding temperature $\vartheta_{amb,max}$	40 °C		
Protection class	IP00		
Winding losses	11 W	29 W	61 W
Iron losses	25 W	16 W	33 W
Connection	Screw terminal		
Max. conductor cross-section	10 mm²		
UL Recognized Component (CAN; USA)	Yes		
Marks and test symbols	cURus, CE		

Tab. 38: TEP technical data

Dimensions

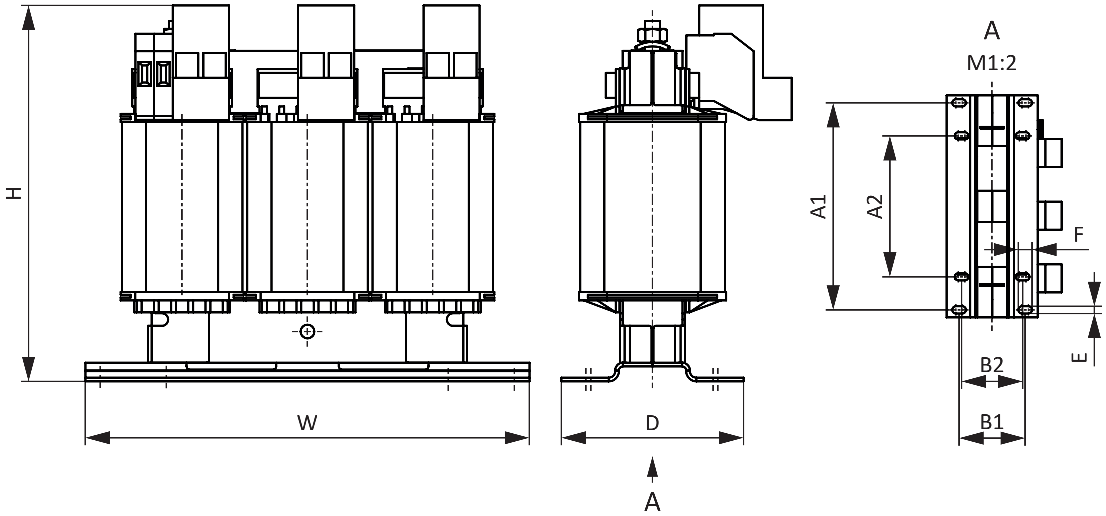


Fig. 5: TEP dimensional drawing

Dimension	TEP3720-0ES41	TEP3820-0CS41	TEP4020-0RS41
Height H [mm]	Max. 150	Max. 152	Max. 172
Width W [mm]	178	178	219
Depth D [mm]	73	88	119
Vertical distance – A1 fastening bores [mm]	166	166	201
Vertical distance – A2 fastening bores [mm]	113	113	136
Horizontal distance – B1 fastening bores [mm]	53	68	89
Horizontal distance – B2 fastening bores [mm]	49	64	76
Drill holes – Depth E [mm]	5.8	5.8	7
Drill holes – Width F [mm]	11	11	13
Screw connection – M	M5	M5	M6
Weight without packaging [g]	2900	5900	8800

Tab. 39: TEP dimensions and weight

3.4.7 EMC shield plate

As an alternative to shield contact at terminal X20 of the drive controller, you can use the following shield plate to connect the cable shield of the power cable.

EM6A0 EMC shield plate

ID No. 135115
EMC shield plate for SB6 and SD6 series drive controllers up to size 2.
Accessory part for shield connection of the power cable.
Can be attached to the drive controller housing.
Including shield connection terminal.

3.5 Further information

3.5.1 Directives and standards

The following European directives and standards are relevant to the drive controllers:

- Directive 2006/42/EC – Machinery Directive
- Directive 2014/30/EU – EMC Directive
- Directive 2011/65/EU – RoHS Directive
- Directive 2009/125/EC – Ecodesign Directive
- EN IEC 61800-3:2018
- EN 61800-5-1:2007 + A1:2017
- EN 61800-5-2:2017
- EN IEC 63000:2018
- EN ISO 13849-1:2015

3.5.2 Marks and test symbols

The following marks and test symbols are mentioned in the technical data.

RoHS lead-free mark
Marking in accordance with RoHS directive 2011-65-EU.

CE mark
Manufacturer's self declaration: The product meets the requirements of EU directives.

UL test symbol (cULus)
This product is listed by UL for the United States and Canada. Representative samples of this product have been evaluated by UL and meet the requirements of applicable standards.

UL recognized component mark (cURus)
This component or material is recognized by UL for the US and Canada. Representative samples of this product have been evaluated by UL and meet applicable requirements.

3.5.3 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
SB6 drive controller manual	443340

4 SC6 drive controllers

Table of contents

4 Drive controllers

SC6

4.1 Overview

The innovative one for economical application concepts

Features

- Single or double-axis controller with a nominal output current up to 19 A and 250% overload capacity
- Sensorless position control of Lean motors
- Control of rotary synchronous servo motors and asynchronous motors
- Control of linear and torque motors
- One Cable Solution EnDat 3
- Electronic motor nameplate via EnDat encoder interfaces
- Integrated EtherCAT or PROFINET communication
- STO safety technology using terminals or STO and SS1 using FSoE or PROFIsafe: SIL 3, PL e (Cat. 4)
- Extended safety technology (SS1, SS2, SLS, SBC, SBT...) using FSoE
- Integrated brake control
- Single-ended nominal power consumption on double-axis controllers for operation of motors with different power
- Energy supply through direct power feed-in
- Flexible DC link connection for multi-axis applications
- Available EPLAN macros in the EPLAN Data Portal

4.1.1 Features

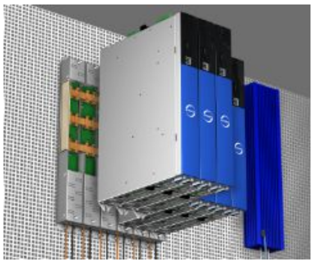
The stand-alone SC6 drive controller enables extremely economical system designs due to its integrated power supply and slim design. The SC6 series is ideal for combination with the innovative Lean motor – for example, for energy-efficient transport systems. Another benefit is that the Lean motor and SC6 run completely without an encoder! However, the SC6 can also be used in combination with asynchronous motors or synchronous servo motors with encoders (e.g. the EZ series). SC6 is available in three sizes with a nominal output current of up to 19 A: Sizes 0 and 1 as a double-axis controller, size 2 as a single-axis controller.

For use with STOBER Lean motors, the sensorless vector control, specially designed for controlling Lean motors, is available.

The compact SC6 for Lean motors of the LM series

Quick DC-Link

The drive controllers have the option of a DC link connection. This technology makes it possible for the regenerative production of energy from one drive to be used as motor energy by another drive, improving the energy efficiency of the application. The Quick DC-Link rear structure element has been developed for setting up a reliable and efficient rail connection to the DC link connection. This optionally available accessory connects the DC links of the individual drive controllers by means of copper rails that can carry a load of up to 200 A. The rails can be attached without any tools using quick fastening clamps.



Perfectly adapted combinations

SC6 drive controllers can be combined with the STOBER SI6 and SD6 series as needed. For the general energy supply, the drive controllers from the SC6, SI6 and SD6 series are connected to each other using Quick DC-Link modules.

Tailored energy usage

When using double-axis modules, the unused power reserves of one axis can be used for other axes.

Easy connection, quick and safe parameterization

The One Cable Solution (OCS) from STOBER combines power and encoder communication in a single hybrid cable – for minimal cabling and easy installation.

The electronic motor nameplate is automatically transmitted via the digital EnDat 3 interface. The drive controller detects all the motor data automatically – the parameterization process is fast, reliable and error-free.

The optimized hybrid cable offers maximum signal quality and system reliability.

Ready-to-connect power and encoder cables with an EnDat 2.2 interface and electronic nameplate function are available as alternatives. Both variants ensure optimal coordination of the interaction between the motor and drive controller – for efficient and reliable commissioning.

Play it safe with STOBER

Integrated safety

STOBER drive controllers have safety functions such as Safe Torque Off (STO) and Safe Stop 1 (SS1) – which can be controlled either conventionally via terminals, or via the safe communication standards PROFIsafe (PROFINET) and Fail Safe over EtherCAT (FSoE). The fully electronic design is fast and free of wear. Additional cyclical function tests are no longer necessary. This increases availability and reduces the amount of testing required during operation.

Extended safety

For stricter requirements, STOBER offers optional safety functions up to SIL 3, PL e (category 4). In addition to STO, which can be activated for each axis individually in multi-axis systems, extended functions such as Safely Limited Speed (SLS), Safe Operating Stop (SOS), Safe Brake Control (SBC) and Safe Brake Test (SBT) are also available. Optimized monitoring mechanisms ensure short reaction times, minimum safety distances and increased system availability – for productive safety at the highest level.

Robust and resilient

The drive controllers boast a stable, durable design. The housing is made from high-quality sheet steel for reliable shielding, mechanical strength and optimum heat dissipation – even under demanding operating conditions. Inside, powerful computing units, carefully selected components and precision manufacturing ensure reliable operation over the long term.

An SD card slot is available on the front panel for removable data storage. An SD card can be used for quick series commissioning by copying, or for easy device replacement in the event of servicing. The removable data storage can also be used as a medium for storing additional project data and documentation.

4.1.2 Software components

Project configuration and commissioning

The DriveControlSuite project configuration and commissioning software has all the functions for the efficient use of drive controllers in single-axis and multi-axis applications. The program guides you step by step through the complete project configuration and parameterization process using wizards.

Open communication

The Ethernet-based EtherCAT and PROFINET fieldbus systems are available in the drive controller.

Applications

A drive-based application is recommended for the decentralized motion control of sophisticated machines.

The drive-based application package from STOBER is the right choice wherever universal and flexible solutions are needed. The Drive Based application provides drive-based motion control for positioning, velocity and torque/force with the PLCopen Motion Control command set. These standard commands have been combined into operating modes for different applications and supplemented with additional functions such as motion block linking, cams and much more. For the command operating mode, all properties of the movements are specified directly by the controller. The properties of the movements in the drive are predefined in the motion block operating mode so that only a start signal is necessary to perform the movement. Linking can be used to define complete motion sequences. There is a separate operating mode available for applications controlled by velocity or torque/force such as pumps, fans or conveyor belts. This also allows for operation without a controller.

In addition, the CiA 402 and PROFIdrive applications are also available, which include both the controller-based and drive-based operating modes and application classes. For example, standard telegrams 1, 2 and 3 as well as telegrams 102 and 111 are available for standard drives according to PROFIdrive in application class 1 and for decentralized positioning control according to application class 3. Based on these telegrams, the drive controllers can be used with the SpeedAxis and BasicPos (EPos) technology objects.

Standard telegrams 3 and 5 as well as telegram 105 are available for controller-based motion control according to PROFIdrive in application class 4.

Furthermore, programming based on IEC 61131-3 with CFC can be used to create new applications or expand existing ones.

4.1.3 Application training

STOBER offers a multi-level training program that is essentially focused on the drive controller.

G6 Basic

Training content: System overview, installation and commissioning of the drive controller. Use of option modules. Parameterization, commissioning and diagnostics using the commissioning software. Remote maintenance. Basics of controller optimization. Configuration of the drive train. Integrated software functions. Software applications. Connection to a higher-level controller. Basics of safety technology. Practical exercises on training topics.

Software used: DriveControlSuite.

G6 Customized

Training content: Special knowledge for regulating, control and safety technology. Practical exercises on training topics.

4.2 Technical data

Technical data for the drive controller can be found in the following chapters.

4.2.1 Type designation

SC	**6**	**A**	**0**	**6**	**2**	**Z**

Tab. 1: Example code for type designation

Code	Designation	Design
SC	Series	
6	Generation	Generation 6
A	Version	
0 – 2	Size	
6	Power output stage	Power output stage within the size
2	Axis controller	Double-axis controller
1		Single-axis controller
Z	Safety technology	SZ6: Without safety technology
R		SR6: STO using terminals
U		SU6: STO and SS1 using PROFIsafe
Y		SY6: STO and SS1 using FSoE
X		SX6: Extended safety technology using FSoE

Tab. 2: Meaning of the example code

4.2.2 Sizes

Type	ID No.	Size	Axis controller
SC6A062	56690	Size 0	Double-axis controller
SC6A162	56691	Size 1	Double-axis controller
SC6A261	56692	Size 2	Single-axis controller

Tab. 3: Available SC6 types and sizes

SC6 in sizes 0 to 2

Note that the basic device is delivered without terminals. Suitable terminal sets are available separately for each size.

4.2.3 General technical data

The following information applies to all device types.

Device features	
Protection class of the device	IP20
Protection class of the installation space	At least IP54
Protection class	Protection class I in accordance with EN 61140
Radio interference suppression	Integrated line filter in accordance with EN 61800-3, interference emission class C3
Overvoltage category	III in accordance with EN 61800-5-1
Marks and test symbols	CE, cULus, RoHS

Tab. 4: Device features

Transport and storage conditions	
Storage/ transport temperature	−20 °C to +70 °C Maximum change: 20 K/h
Relative humidity	Maximum relative humidity 85%, non-condensing
Vibration (transport) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²
Fall height for free fall[1] Weight < 100 kg in accordance with EN 61800-2 (or IEC 60721-3-2, class 2M4)	0.25 m
Shock testing in accordance with EN 60068-2-27	Pulse shape: Half-sine Acceleration: 5 g Shock duration: 30 ms Number of shocks: 3 per axis

Tab. 5: Transport and storage conditions

Operating conditions	
Surrounding temperature during operation	0 °C to 45 °C with nominal data 45 °C to 55 °C with derating −2.5% / K
Relative humidity	Maximum relative humidity 85%, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above sea level with −1.5%/100 m derating
Pollution degree	Pollution degree 2 in accordance with EN 50178
Ventilation	Installed fan
Vibration (operation) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 6: Operating conditions

Discharge times	
Self-discharge of DC link	15 min

Tab. 7: Discharge times of the DC link circuit

[1] Only valid for components in their original packaging.

4.2.4 Electrical data

The electrical data of the available sizes as well as the properties of the brake chopper can be found in the following chapters.

An explanation of the symbols used for formulas can be found in Chapter [▷ 15.1].

4.2.4.1 Control unit

Electrical data	All types
U_{1CU}	24 V_{DC}, +20%/−15%
I_{1maxCU}	1.5 A

Tab. 8: Control unit electrical data

4.2.4.2 Power unit: Size 0

Electrical data	SC6A062
U_{1PU}	3 × 400 V_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz
f_{2PU}	0 – 700 Hz
U_{2PU}	0 – max. U_{1PU}
$U_{2PU,ZK}$	$\sqrt{2} \times U_{1PU}$
C_{PU}	270 µF
$C_{N,PU}$	1400 µF
C_{maxPU}	1880 µF

Tab. 9: SC6 electrical data, size 0

The charging capacity depends on the time between two energizing processes:

Information

For the maximum charging capacity C_{maxPU}, a time span of ≥ 15 min must be maintained between two energizing processes.

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SC6A062
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	10 A
$I_{2N,PU}$	2 × 4.5 A
I_{2maxPU}	210% for 2 s; 150% for 30 s

Tab. 10: SC6 electrical data, size 0, for 4 kHz clock frequency

Electrical data	SC6A062
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	8.9 A
$I_{2N,PU}$	2 × 4 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 11: SC6 electrical data, size 0, for 8 kHz clock frequency

Electrical data	SC6A062
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	100 Ω
P_{maxRB}	6.4 kW
P_{effRB}	2.9 kW

Tab. 12: Brake chopper electrical data, size 0

4.2.4.3 Power unit: Size 1

Electrical data	SC6A162
U_{1PU}	3 × 400 V_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz
f_{2PU}	0 – 700 Hz
U_{2PU}	0 – max. U_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	940 µF
$C_{N,PU}$	1400 µF
C_{maxPU}	1880 µF

Tab. 13: SC6 electrical data, size 1

The charging capacity depends on the time between two energizing processes:

Information

For the maximum charging capacity C_{maxPU}, a time span of ≥ 15 min must be maintained between two energizing processes.

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SC6A162
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	23.2 A
$I_{2N,PU}$	2 × 10 A
I_{2maxPU}	210% for 2 s; 150% for 30 s

Tab. 14: SC6 electrical data, size 1, for 4 kHz clock frequency

Electrical data	SC6A162
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	20.9 A
$I_{2N,PU}$	2 × 9 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 15: SC6 electrical data, size 1, for 8 kHz clock frequency

Electrical data	SC6A162
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	47 Ω
P_{maxRB}	13.6 kW
P_{effRB}	6.2 kW

Tab. 16: Brake chopper electrical data, size 1

4.2.4.4 Power unit: Size 2

Electrical data	SC6A261
U_{1PU}	3 × 400 V_{AC}, +32% / −50%, 50/60 Hz; 3 × 480 V_{AC}, +10% / −58%, 50/60 Hz
f_{2PU}	0 – 700 Hz
U_{2PU}	0 – max. U_{1PU}
$U_{2PU,ZK}$	√2 × U_{1PU}
C_{PU}	940 µF
$C_{N,PU}$	1400 µF
C_{maxPU}	1880 µF

Tab. 17: SC6 electrical data, size 2

The charging capacity depends on the time between two energizing processes:

Information

For the maximum charging capacity C_{maxPU}, a time span of ≥ 15 min must be maintained between two energizing processes.

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SC6A261
$f_{PWM,PU}$	4 kHz
$I_{1N,PU}$	22.6 A
$I_{2N,PU}$	19 A
I_{2maxPU}	210% for 2 s; 150% for 30 s

Tab. 18: SC6 electrical data, size 2, for 4 kHz clock frequency

Electrical data	SC6A261
$f_{PWM,PU}$	8 kHz
$I_{1N,PU}$	17.9 A
$I_{2N,PU}$	15 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 19: SC6 electrical data, size 2, for 8 kHz clock frequency

Electrical data	SC6A261
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	47 Ω
P_{maxRB}	13.6 kW
P_{effRB}	6.2 kW

Tab. 20: Brake chopper electrical data, size 2

4.2.4.5 DC link connection

The charging capacity of the drive controllers can be increased by a DC link connection only if the power supply is connected to all drive controllers simultaneously.

4.2.4.6 Single-ended nominal power consumption on double-axis controllers

Operating two motors on one double-axis controller makes it possible to operate one of the motors with a continuous current above the nominal current of the drive controller if the continuous current of the second connected motor is lower than the nominal current of the drive controller. This enables economical combinations of double-axis controllers and motors.

An explanation of the symbols used for formulas can be found in Chapter [▸ 15.1].

The nominal output current for axis B can be determined using the following formula if the output current for axis A is known:

Formula 1

$$I_{2PU(B)} = I_{2N,PU} - \left(I_{2PU(A)} - I_{2N,PU} \right) \times \frac{3}{5} \qquad \text{for} \qquad 0 \le I_{2PU(A)} \le I_{2N,PU}$$

Formula 2

$$I_{2PU(B)} = I_{2N,PU} - \left(I_{2PU(A)} - I_{2N,PU} \right) \times \frac{5}{3} \qquad \text{for} \qquad I_{2N,PU} \le I_{2PU(A)} \le 1{,}6 \times I_{2N,PU}$$

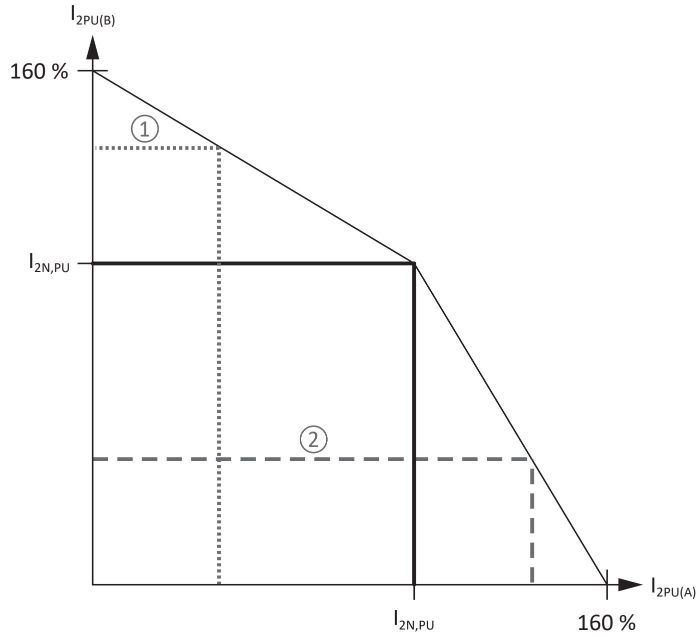


Fig. 1: Asymmetric load on double-axis controllers

Information

Note that the available maximum currents I_{2maxPU} of the axis controllers are also relative to the nominal output current $I_{2N,PU}$ for single-ended nominal power consumption.

4.2.4.7 Power loss data in accordance with EN 61800-9-2

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$[2]	Operating points[3]								IE class[4]	Comparison[5]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)		
				Relative losses									
	[A]	[kVA]	[W]	[%]									
SC6A062	4.5	6.2	Max. 10	1.34	1.49	1.86	1.40	1.63	2.19	1.84	2.77	IE2	
SC6A162	10	13.9	Max. 10	0.76	0.92	1.43	0.81	1.04	1.75	1.22	2.29	IE2	
SC6A261	19	13.2	10	0.77	0.95	1.56	0.82	1.08	1.89	1.25	2.43	IE2	
				Absolute losses P_V									
	[A]	[kVA]	[W]	[W]									[%]
SC6A062	4.5	6.2	Max. 10	83.2	92.5	115.2	86.7	100.8	135.8	113.9	171.7	IE2	36.0
SC6A162	10	13.9	Max. 10	105.5	128.3	198.8	113.1	145.1	243.5	170.1	318.7	IE2	40.8
SC6A261	19	13.2	Max. 10	101.2	125.8	206.1	108.5	142.0	249.5	165.6	320.4	IE2	41.0

Tab. 21: Power loss data of the SC6 drive controller in accordance with EN 61800-9-2

[2] Absolute losses for a power unit that is switched off

[3] Operating points for relative motor stator frequency in % and relative torque current in %

[4] IE class in accordance with EN 61800-9-2

[5] Comparison of the losses for the reference related to IE2 in the nominal point (90, 100)

General conditions

The specified losses apply to a drive controller. They apply to both axes together in the case of double-axis controllers.

The power loss data applies to drive controllers without accessories.

The power loss calculation is based on a 3-phase supply voltage with 400 V_{AC}/50 Hz.

The calculated data includes a supplement of 10% in accordance with EN 61800-9-2.

The power loss specifications refer to a clock frequency of 4 kHz.

The absolute losses for a power unit that is switched off refer to the 24 V_{DC} power supply of the control electronics.

4.2.4.8 Power loss data of accessories

If you intend to order the drive controller with accessory parts, losses increase as follows.

Type	Absolute losses P_V [W]
SR6 safety module	1
SY6 or SU6 safety module	2
SX6 safety module	< 4

Tab. 22: Absolute losses of the accessories

Information

Note the absolute power loss of the encoder (usually < 3 W) and of the brake when designing as well.

Loss specifications for other optional accessories can be found in the technical data of the respective accessory part.

4.2.5 Cycle times

Possible cycle times can be found in the following table.

Type	Cycle times	Relevant parameters
Application	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150
EtherCAT fieldbus, cyclical communication	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in TwinCAT 3 or CODESYS
PROFINET RT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms, 8 ms	Adjustable in the TIA Portal
PROFINET IRT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms	Adjustable in the TIA Portal
Motion core (movement calculation)	250 µs	—
Control cascade	62.5 µs	B24 ≥ 8 kHz and B20 = 48, 64 or 70
	125 µs	B24 = 4 kHz

Tab. 23: Cycle times

Information

For Lean motors (control mode B20 = 32: LM - sensorless vector control), only operation at 4 kHz is permitted.

4.2.6 Derating

When dimensioning the drive controller, observe the derating of the nominal output current as a function of the clock frequency, surrounding temperature and installation altitude. There is no restriction for a surrounding temperature from 0 °C to 45 °C and an installation altitude of 0 m to 1000 m. The details given below apply to values outside these ranges.

4.2.6.1 Effect of the clock frequency

Changing the clock frequency f_{PWM} affects the amount of noise produced by the drive, among other things. However, increasing the clock frequency results in increased losses. During project configuration, define the highest clock frequency and use it to determine the nominal output current $I_{2N,PU}$ for dimensioning the drive controller.

Type	$I_{2N,PU}$ 4 kHz [A]	$I_{2N,PU}$ 8 kHz [A]	$I_{2N,PU}$ 16 kHz [A]
SC6A062	2 × 4.5	2 × 4	2 × 3
SC6A162	2 × 10	2 × 9	2 × 5
SC6A261	19	15	8

Tab. 24: Nominal output current $I_{2N,PU}$ dependent on the clock frequency

4.2.6.2 Effect of the surrounding temperature

Derating as a function of the surrounding temperature is determined as follows:

- 0 °C to 45 °C: No restrictions (D_T = 100%)
- 45 °C to 55 °C: Derating −2.5%/K

Example

The drive controller needs to be operated at 50 °C.

The derating factor D_T is calculated as follows
D_T= 100% − 5 × 2.5% = 87.5%

4.2.6.3 Effect of the installation altitude

Derating as a function of the installation altitude is determined as follows:

- 0 m to 1000 m: No restriction (D_{IA} = 100%)
- 1000 m to 2000 m: Derating −1.5%/100 m

Example

The drive controller needs to be installed at an altitude of 1500 m above sea level.

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100% − 5 × 1.5% = 92.5%

4.2.6.4 Calculating the derating

Follow these steps for the calculation:

1. Determine the highest clock frequency (f_{PWM}) that will be used during operation and use it to determine the nominal current $I_{2N,PU}$.
2. Determine the derating factors for installation altitude and surrounding temperature.
3. Calculate the reduced nominal current $I_{2N,PU(red)}$ in accordance with the following formula:
   $I_{2N,PU(red)} = I_{2N,PU} \times D_T \times D_{IA}$

Example

A drive controller of type SC6A062 needs to be operated at a clock frequency of 8 kHz at an altitude of 1500 m above sea level and a surrounding temperature of 50 °C.

The nominal current of the SC6A062 at 8 kHz is 4 A per axis. The derating factor D_T is calculated as follows:
D_T = 100% − 5 × 2.5% = 87.5%

The derating factor D_{IA} is calculated as follows:
D_{IA} = 100% − 5 × 1.5% = 92.5%

The output current of importance for the project configuration is:

$I_{2N,PU(red)}$ = 4 A × 0.875 × 0.925 = 3.24 A

4.2.7 Dimensions

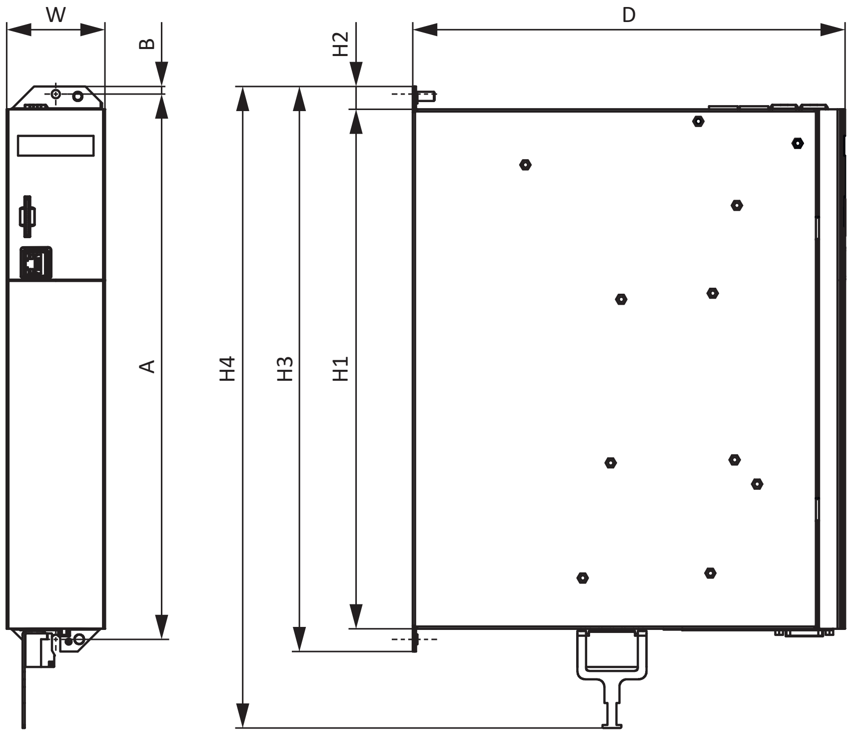


Fig. 2: SC6 dimensional drawing

Dimension			SC6A062	SC6A162	SC6A261
Drive controller	Width	W	45	65	
	Depth	D	265	286	
	Body height	H1	343		
	Fastening clip height	H2	15		
	Height incl. fastening clips	H3	373		
	Total height incl. shield connection	H4	423		
Fastening bores (M5)	Vertical distance	A	360+2		
	Vertical distance to the upper edge	B	5		

Tab. 25: SC6 dimensions [mm]

Take the additional installation depth of the rear section modules into account when calculating the overall dimensions.

4.2.8 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
SC6A062	3600	5200
SC6A162	5300	6700
SC6A261	5200	6400

Tab. 26: SC6 weight [g]

4.2.9 Minimum clearances

Drive controller

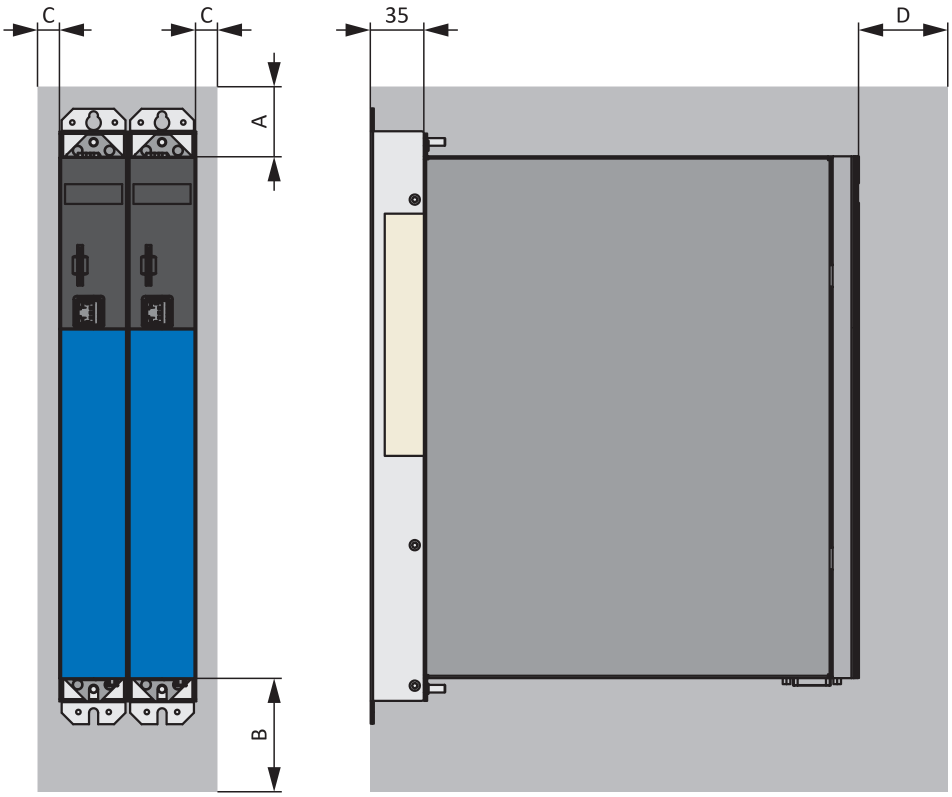


Fig. 3: Minimum clearances

Take into account the additional installation depth of 35 mm for the optional Quick DC-Link DL6B rear section modules.

The dimensions specified in the table relate to the outer edges of the drive controller.

Minimum clearance	A (above)	B (below)	C (on the side)	D (in front)
All sizes	100	200	5	50[6]

Tab. 27: Minimum clearances [mm]

Chokes and filters

Avoid installation below drive controllers or supply modules. For installation in a control cabinet, a distance of approximately 100 mm to other neighboring components is recommended. This distance ensures proper heat dissipation for chokes and filters.

Braking resistors

Avoid installation below drive controllers or supply modules. In order for heated air to flow out unimpeded, a minimum clearance of approximately 200 mm must be maintained in relation to neighboring components or walls and approximately 300 mm must be maintained to components above or ceilings.

[6] Minimum clearance to be taken into account for permanent connection of the X9 service interface

4.3 Drive controller/motor combinations

An explanation of the symbols used for formulas can be found in Chapter [▶ 15.1].

IC 410 convection cooling

Type	K_{EM} [V/1000 min^{-1}]	n_N [rpm]	M_N [Nm]	I_N [A]	M_0 [Nm]	I_0 [A]	Type	$f_{PWM,PU}$ [kHz]	$I_{2N,PU}$ [A]	$I_{2N,PU}/I_0$
LM4										
LM401U	110	3000	2.25	1.59	2.43	1.82	SC6A062	4	4.5	2.5
LM402U	120	3000	4.41	2.88	4.50	2.94	SC6A062	4	4.5	1.5
LM403U	120	3000	6.06	3.92	6.19	4.08	SC6A062	4	4.5	1.1
LM403U	120	3000	6.06	3.92	6.19	4.08	SC6A162	4	10	2.5
LM5										
LM503U	135	3000	9.48	5.62	10.1	5.95	SC6A162	4	10	1.7
LM505U	135	3000	13.7	7.83	15.5	8.83	SC6A162	4	10	1.1
LM505U	135	3000	13.7	7.83	15.5	8.83	SC6A261	4	19	2.2
LM7										
LM704U	145	3000	19.3	10.6	21.3	11.6	SC6A261	4	19	1.6
LM706U	140	3000	25.7	14.7	29.8	16.8	SC6A261	4	19	1.1

4.4 Accessories

You can find information about the available accessories in the following chapters.

4.4.1 Safety technology

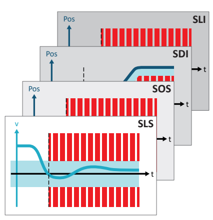
Information

The drive controller is delivered in the standard design without safety technology (option SZ6). If you want a drive controller with integrated safety technology, you must order it together with the drive controller. The safety modules are an integrated part of the drive controllers and must not be modified.

SZ6 option – Without safety technology

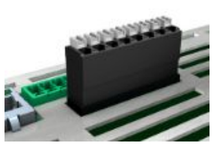
ID No. 56660
Design without safety technology.

SX6 safety module – Extended safety technology using FSoE



ID No. 5050185
Optional accessory for use in safety-related applications up to PL e, SIL 3 in accordance with EN ISO 13849-1 and EN 61800-5-2. In addition to the basic Safe Torque Off (STO) safety function, SX6 provides other safety functions specified in EN 61800-5-2. In addition to the safe stop functions Safe Stop 1 (SS1) and Safe Stop 2 (SS2), these also include Safely-Limited Speed (SLS), Safe Brake Control (SBC), Safe Brake Test (SBT), Safe Direction (SDI) and Safely-Limited Increment (SLI). Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

SR6 safety module – STO using terminals



ID No. 56661
Optional accessory for the use of the Safe Torque Off safety function (STO) in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via terminal X12.

SY6 safety module – STO and SS1 using FSoE

ID No. 56662
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

SU6 safety module – STO and SS1 using PROFIsafe

ID No. 56696
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via PROFINET (PROFIsafe).

4.4.2 Communication

The drive controller has two interfaces for the EtherCAT or PROFINET connection on the top of the device as well as an Ethernet service interface on the front of the device. Cables for the connection are available separately.

EtherCAT or PROFINET

Specify the desired fieldbus system when placing your order for the base device, since fieldbus communication is defined by the firmware.

EtherCAT cables

Ethernet patch cable, CAT5e, yellow.
The following designs are available:
ID no. 49313: length approx. 0.25 m.
ID no. 49314: length approx. 0.5 m.

PC connecting cable

ID No. 49857
Cable for connecting the X9 service interface to the PC, CAT5e, blue, length: 5 m.

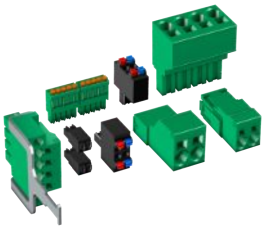
USB 2.0 Ethernet adapter

ID No. 49940
Adapter for connecting Ethernet to a USB port.

4.4.3 Terminal set

For connection, you need the fitting terminal set for each SC6 drive controller.

Terminal set for drive controllers without SR6 safety module (STO using terminals)



(Fig. similar)

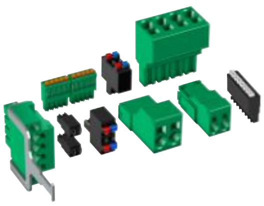
The following designs are available:

ID No. 138652
Terminal set for SC6A062Z/U/Y/X. Contents: 13 terminals.

ID No. 138653
Terminal set for SC6A162Z/U/Y/X. Contents: 13 terminals.

ID No. 138654
Terminal set for SC6A261Z/U/Y/X. Contents: 11 terminals.

Terminal set for drive controllers with SR6 safety module (STO using terminals)



(Fig. similar)

The following designs are available:

ID No. 138680
Terminal set for SC6A062R. Contents: 14 terminals.

ID No. 138681
Terminal set for SC6A162R. Contents: 14 terminals.

ID No. 138682
Terminal set for SC6A261R. Contents: 12 terminals.

4.4.4 DC link connection

If you want to connect SC6 drive controllers in the DC link group, you will need Quick DC-Link modules of type DL6B.

You receive the DL6B rear section modules in different designs for a horizontal connection, suitable for the size of the drive controller.

The quick fastening clamps for attaching the copper rails and an insulation connection piece are contained in the scope of delivery. The copper rails are not included in the scope of delivery. These must have a cross-section of 5 x 12 mm. Insulation end sections for the left and right termination of the device group as well as covers for the rear section modules are available separately. The covers protect rear section modules installed in the control cabinet that are only later built over with drive controllers, for example as part of a retrofit.

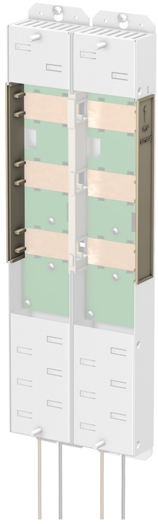
Quick DC-Link DL6B – rear section module for drive controller

The following designs are available:

DL6B10
ID No. 56655
Rear section module for size 0 drive controller:
SC6A062

DL6B11
ID No. 56656
Rear section module for size 1 or 2 drive controller:
SC6A162 and SC6A261

Quick DC-Link DL6B – insulation end section



ID No. 56659
Insulation end sections for the left and right termination of the group, 2 pcs.

Quick DC-Link DL6B – cover

The following designs are available:

QDL6C10
Id. No. 5050128
Cover for rear section module DL6B10,
Dimensions: 373 × 45 × 1 mm

QDL6C11
Id. No. 5050129
Cover for rear section module DL6B11,
Dimensions: 373 × 64 × 1 mm

4.4.5 Braking resistor

In addition to drive controllers, STOBER offers the following braking resistors described below in various sizes and performance classes. For the selection, note the minimum permitted braking resistors specified in the technical data of the individual drive controller types.

4.4.5.1 Tubular fixed resistor FZMU, FZZMU

Type	FZMU 400×65	FZZMU 400×65
ID No.	49010	53895
SC6A062	X	—
SC6A162	(X)	X
SC6A261	(X)	X

Tab. 28: Assignment of FZMU, FZZMU braking resistor – SC6 drive controller

X Recommended

(X) Possible

— Not possible

Properties

Technical data	FZMU 400×65	FZZMU 400×65
ID No.	49010	53895
Type	Tubular fixed resistor	Tubular fixed resistor
Resistance [Ω]	100 ±10%	47 ±10%
Thermal drift	±10%	±10%
Power [W]	600	1200
Therm. time const. τ_{th} [s]	40	40
Pulse power for < 1 s [kW]	18	36
U_{max} [V]	848	848
Weight without packaging [g]	2200	4170
Protection class	IP20	IP20
Marks and test symbols	cURus, CE, UKCA	cURus, CE, UKCA

Tab. 29: FZMU, FZZMU technical data

Dimensions

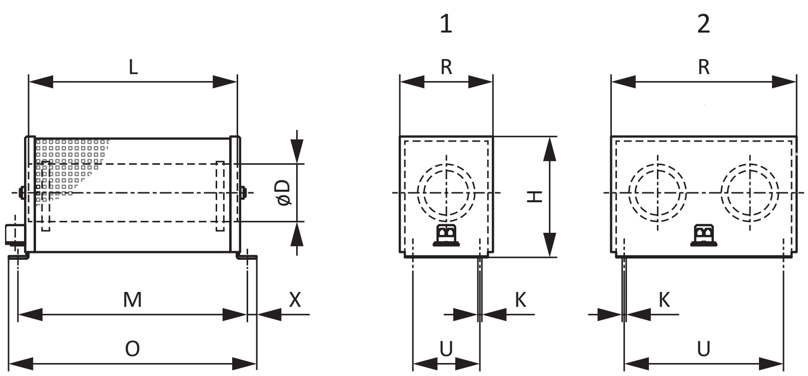


Fig. 4: FZMU (1), FZZMU (2) dimensional drawing

Dimension	FZMU 400×65	FZZMU 400×65
ID No.	49010	53895
L x D	400 × 65	400 × 65
H	120	120
K	6.5 × 12	6.5 × 12
M	430	426
O	485	485
R	92	185
U	64	150
X	10	10

Tab. 30: FZMU, FZZMU dimensions [mm]

4.4.5.2 GVADU, GBADU flat resistor

Type	GVADU 210×20	GBADU 265×30	GBADU 335×30
ID No.	55441	55442	55443
SC6A062	X	X	—
SC6A162	(X)	(X)	X
SC6A261	(X)	(X)	X

Tab. 31: Assignment of GVADU, GBADU braking resistor – SC6 drive controller

X	Recommended
(X)	Possible
—	Not possible

Properties

Technical data	GVADU 210×20	GBADU 265×30	GBADU 335×30
ID No.	55441	55442	55443
Type	Flat resistor		
Resistance [Ω]	100 ±10%	100 ±10%	47 ±10%
Thermal drift	±10%	±10%	±10%
Power [W]	150	300	400
Therm. time const. τ_{th} [s]	60	60	60
Pulse power for < 1 s [kW]	3.3	6.6	8.8
U_{max} [V]	848	848	848
Cable design	Radox	FEP	FEP
Cable length [mm]	500	1500	1500
Conductor cross-section [AWG]	18/19 (0.82 mm²)	14/19 (1.9 mm²)	14/19 (1.9 mm²)
Weight without packaging [g]	300	930	1200
Protection class	IP54	IP54	IP54
Marks and test symbols	cURus, CE, UKCA		

Tab. 32: GVADU, GBADU technical data

Dimensions

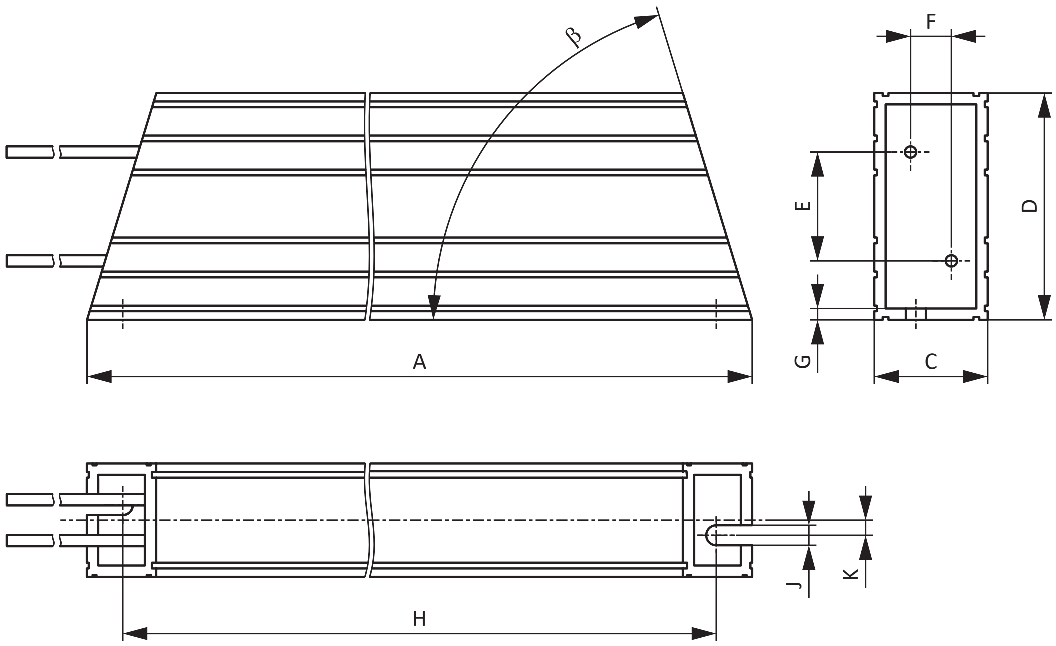


Fig. 5: GVADU, GBADU dimensional drawing

Dimension	GVADU 210×20	GBADU 265×30	GBADU 335×30
ID No.	55441	55442	55443
A	210	265	335
H	192	246	316
C	20	30	30
D	40	60	60
E	18.2	28.8	28.8
F	6.2	10.8	10.8
G	2	3	3
K	2.5	4	4
J	4.3	5.3	5.3
β	65°	73°	73°

Tab. 33: GVADU, GBADU dimensions [mm]

4.5 Further information

4.5.1 Directives and standards

The following European directives and standards are relevant to the drive controllers:

- Directive 2006/42/EC – Machinery Directive
- Directive 2014/30/EU – EMC Directive
- Directive 2011/65/EU – RoHS Directive
- Directive 2009/125/EC – Ecodesign Directive
- EN IEC 61800-3:2018
- EN 61800-5-1:2007 + A1:2017
- EN 61800-5-2:2017
- EN IEC 63000:2018
- EN ISO 13849-1:2015

4.5.2 Marks and test symbols

The following marks and test symbols are mentioned in the technical data.

RoHS lead-free mark
Marking in accordance with RoHS directive 2011-65-EU.

CE mark
Manufacturer's self declaration: The product meets the requirements of EU directives.

UKCA test symbol
Manufacturer's self declaration: The product meets the requirements of UK directives.

UL test symbol (cULus)
This product is listed by UL for the United States and Canada. Representative samples of this product have been evaluated by UL and meet the requirements of applicable standards.

UL recognized component mark (cURus)
This component or material is recognized by UL for the US and Canada. Representative samples of this product have been evaluated by UL and meet applicable requirements.

4.5.3 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Manual for SC6 drive controllers	442790

5 SI6 drive controllers

Table of contents

5 Drive controllers

SI6

5.1 Overview

The slim one for multi-axis drive systems

Features

- Single or double-axis controller with a nominal output current up to 50 A and 250% overload capacity
- Supply modules up to 50 kW nominal power
- Control of rotary synchronous servo motors and asynchronous motors
- Sensorless position control of Lean motors
- Control of linear and torque motors
- One Cable Solution EnDat 3
- Electronic motor nameplate via EnDat encoder interfaces
- Integrated EtherCAT or PROFINET communication
- STO safety technology using terminals or STO and SS1 using FSoE or PROFIsafe: SIL 3, PL e (Cat. 4)
- Extended safety technology (SS1, SS2, SLS, SBC, SBT...) using FSoE
- Integrated brake control
- Energy supply over DC link connection
- Single-ended nominal power consumption on double-axis controllers for operation of motors with different power
- Variable feed-in power using supply modules that can be connected in parallel
- Available EPLAN macros in the EPLAN Data Portal

5.1.1 Features

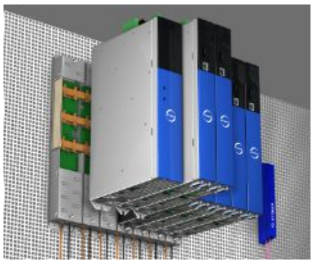
The multi-axis drive system is designed for multi-axis applications and consists of the SI6 drive controller and PS6 supply module in combination. The most striking feature is its extremely compact design! Each SI6 is connected to the central PS6 supply module. Additional fuses and cabling for each individual axis are not required. They thus reduce material and operating costs. Matching Quick DC-Link modules handle the energy supply for the drive controllers in the group. The SI6 drive controller is available in four sizes as a single or double-axis controller with a nominal output current of up to 50 A. The PS6 supply module is available in three sizes with a nominal output power of 10 kW to 50 kW.

For use with STOBER Lean motors, the sensorless vector control, specially designed for controlling Lean motors, is available.

Drive control in multi-axis drive systems with SI6 and PS6

Dimension capacities precisely

4 axes? 16? Or even 97? A single SI6 drive controller can control up to two axes. Thanks to the multi-axis drive system, the number of motors or axes to be controlled can be scaled without limit. If required, SI6 drive controllers can be combined with stand-alone units from the STOBER SC6 or SD6 series. For the general energy supply, the drive controllers from the SI6, SC6 and SD6 series can be connected to each other using Quick DC-Link modules.



Tailored energy usage

The SI6 drive controllers are connected to a central supply module. There is no need for decentralized supply modules or fuses and cabling for each axis. When using double-axis modules, the unused power reserves of one axis can be used for the second axis. A significant reduction in space and cost!

Easy connection, quick and safe parameterization

The One Cable Solution (OCS) from STOBER combines power and encoder communication in a single hybrid cable – for minimal cabling and easy installation.

The electronic motor nameplate is automatically transmitted via the digital EnDat 3 interface. The drive controller detects all the motor data automatically – the parameterization process is fast, reliable and error-free.

The optimized hybrid cable offers maximum signal quality and system reliability.

Ready-to-connect power and encoder cables with an EnDat 2.2 interface and electronic nameplate function are available as alternatives. Both variants ensure optimal coordination of the interaction between the motor and drive controller – for efficient and reliable commissioning.

Play it safe with STOBER

Integrated safety

STOBER drive controllers have safety functions such as Safe Torque Off (STO) and Safe Stop 1 (SS1) – which can be controlled either conventionally via terminals, or via the safe communication standards PROFIsafe (PROFINET) and Fail Safe over EtherCAT (FSoE). The fully electronic design is fast and free of wear. Additional cyclical function tests are no longer necessary. This increases availability and reduces the amount of testing required during operation.

Extended safety

For stricter requirements, STOBER offers optional safety functions up to SIL 3, PL e (category 4). In addition to STO, which can be activated for each axis individually in multi-axis systems, extended functions such as Safely Limited Speed (SLS), Safe Operating Stop (SOS), Safe Brake Control (SBC) and Safe Brake Test (SBT) are also available. Optimized monitoring mechanisms ensure short reaction times, minimum safety distances and increased system availability – for productive safety at the highest level.

Robust and resilient

The drive controllers boast a stable, durable design. The housing is made from high-quality sheet steel for reliable shielding, mechanical strength and optimum heat dissipation – even under demanding operating conditions. Inside, powerful computing units, carefully selected components and precision manufacturing ensure reliable operation over the long term.

An SD card slot is available on the front panel for removable data storage. An SD card can be used for quick series commissioning by copying, or for easy device replacement in the event of servicing. The removable data storage can also be used as a medium for storing additional project data and documentation.

5.1.2 Software components

Project configuration and commissioning

The DriveControlSuite project configuration and commissioning software has all the functions for the efficient use of drive controllers in single-axis and multi-axis applications. The program guides you step by step through the complete project configuration and parameterization process using wizards.

Open communication

The Ethernet-based EtherCAT and PROFINET fieldbus systems are available in the drive controller.

Applications

A controller-based application is recommended for the central motion control of complex machines.

With the controller-based operating modes of the CiA 402 application (csp, csv, cst, ip) or controller-based application class 4 of the PROFIdrive application, you can implement applications with synchronized, cyclic set value specification by a motion controller. In addition, the drive controllers can also independently handle motion tasks, such as referencing and jogging during commissioning. Standard telegrams 3 and 5 as well as telegram 105 are available for controller-based motion control according to PROFIdrive in application class 4. Based on these telegrams, the drive controllers can be used with the PositioningAxis, SynchronousAxis, OutputCam and Kinematics technology objects from TIA Portal.

The Drive Based drive-based applications, the drive-based operating modes of the CiA 402 application (pp, vl, pv, pt) and drive-based application classes 1 and 3 of the PROFIdrive application are also available.

Furthermore, programming based on IEC 61131-3 with CFC can be used to create new applications or expand existing ones.

5.1.3 Application training

STOBER offers a multi-level training program that is essentially focused on the drive controller.

G6 Basic

Training content: System overview, installation and commissioning of the drive controller. Use of option modules. Parameterization, commissioning and diagnostics using the commissioning software. Remote maintenance. Basics of controller optimization. Configuration of the drive train. Integrated software functions. Software applications. Connection to a higher-level controller. Basics of safety technology. Practical exercises on training topics.

Software used: DriveControlSuite.

G6 Customized

Training content: Special knowledge for regulating, control and safety technology. Practical exercises on training topics.

5.2 Technical data

Technical data for the drive controllers, supply modules and accessories can be found in the following chapters.

5.2.1 General technical data

The following specifications apply equally to the SI6 drive controller and the PS6 supply module.

Device features	
Protection class of the device	IP20
Protection class of the installation space	At least IP54
Protection class	Protection class I in accordance with EN 61140
Radio interference suppression	Integrated line filter in accordance with EN 61800-3, interference emission class C3
Overvoltage category	III in accordance with EN 61800-5-1
Marks and test symbols	CE, cULus, RoHS

Tab. 1: Device features

Transport and storage conditions	
Storage/ transport temperature	−20 °C to +70 °C Maximum change: 20 K/h
Relative humidity	Maximum relative humidity 85%, non-condensing
Vibration (transport) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²
Fall height for free fall[1] Weight < 100 kg in accordance with EN 61800-2 (or IEC 60721-3-2, class 2M4)	0.25 m
Shock testing in accordance with EN 60068-2-27	Pulse shape: Half-sine Acceleration: 5 g Shock duration: 30 ms Number of shocks: 3 per axis

Tab. 2: Transport and storage conditions

[1] Only valid for components in their original packaging.

Operating conditions	
Surrounding temperature during operation	0 °C to 45 °C with nominal data 45 °C to 55 °C with derating −2.5% / K
Relative humidity	Maximum relative humidity 85%, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above sea level with −1.5%/100 m derating
Pollution degree	Pollution degree 2 in accordance with EN 50178
Ventilation	Installed fan
Vibration (operation) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 3: Operating conditions

Discharge times	
Self-discharge of DC link	15 min
Fast discharge of DC link	Thanks to PS6 supply module in combination with a braking resistor: < 1 min

Tab. 4: Discharge times of the DC link circuit

5.2.2 Supply module

The following section contains specifications for the electrical data, dimensions and weight of the PS6 supply module.

5.2.2.1 Type designation

PS	**6**	**A**	**2**	**4**

Tab. 5: Example code for supply module type designation

Code	Designation	Design
PS	Series	
6	Generation	Generation 6
A	Version	
2 – 4	Size	
4	Power output stage	

Tab. 6: Meaning of the example code

5.2.2.2 Sizes

Type	ID No.	Size
PS6A24	56650	Size 2
PS6A34	56651	Size 3
PS6A44	5050113	Size 4

Tab. 7: Available PS6 types and sizes

PS6 in sizes 3, 2 and 4

Note that the basic device is delivered without terminals. Suitable terminal sets are available separately for each size.

5.2.2.3 Electrical data

The electrical data of the available PS6 sizes as well as the properties of the brake chopper can be found in the following sections.

An explanation of the symbols used for formulas can be found in Chapter [▶ 15.1].

5.2.2.3.1 Control unit

Electrical data	All types
U_{1CU}	24 V_{DC}, +20%/−15%
I_{1maxCU}	1.5 A

Tab. 8: Control unit electrical data

5.2.2.3.2 Power unit: Size 2

Electrical data	PS6A24
U_{1PU}	3 × 400 V_{AC}, +32%/−50%, 50/60 Hz; 3 × 480 V_{AC}, +10%/−58%, 50/60 Hz
$U_{2PU,ZK}$	$\sqrt{2} \times U_{1PU}$
$P_{2N,PU}$	10 kW
$I_{1N,PU}$	25 A
I_{1maxPU}	$I_{1N,PU}$ × 180% for 5 s; $I_{1N,PU}$ × 150% for 30 s
$C_{N,PU}$	5000 µF

Tab. 9: PS6 electrical data, size 2

5.2.2.3.3 Power unit: Size 3

Electrical data	PS6A34
U_{1PU}	3 × 400 V_{AC}, +32%/−50%, 50/60 Hz; 3 × 480 V_{AC}, +10%/−58%, 50/60 Hz
$U_{2PU,ZK}$	$\sqrt{2} \times U_{1PU}$
$P_{2N,PU}$	20 kW
$I_{1N,PU}$	50 A
I_{1maxPU}	$I_{1N,PU}$ × 180% for 5 s; $I_{1N,PU}$ × 150% for 30 s
$C_{N,PU}$	10000 µF

Tab. 10: PS6 electrical data, size 3

5.2.2.3.4 Power unit: Size 4

Electrical data	PS6A44
U_{1PU}	3 × 400 V_{AC}, +32%/−50%, 50/60 Hz; 3 × 480 V_{AC}, +10%/−58%, 50/60 Hz
$U_{2PU,ZK}$	$\sqrt{2} \times U_{1PU}$
$P_{2N,PU}$	50 kW
$I_{1N,PU}$	92 A
I_{1maxPU}	$I_{1N,PU}$ × 180% for 5 s; $I_{1N,PU}$ × 150% for 30 s
$C_{N,PU}$	20000 µF

Tab. 11: PS6 electrical data, size 4

5.2.2.3.5 Parallel connection

Only supply modules of either size 2 or 3 may be connected in parallel.

The power and current increase if supply modules are connected in parallel. Take into account that the total is derated by a factor of 0.8 in doing so.

The charging capacity of the supply modules can be increased by a parallel connection only if the power supply is connected to all supply modules simultaneously. Increasing the charging capacity also requires derating the total by a factor of 0.8.

The following table shows example combinations for parallel connection.

Electrical data	2 x PS6A24	3 x PS6A24	2 x PS6A34	3 x PS6A34
$P_{2N,PU}$	16 kW	24 kW	32 kW	48 kW
$I_{1N,PU}$	40 A	60 A	80 A	120 A
C_{maxPU}	8000 µF	12000 µF	16000 µF	24000 µF

Tab. 12: Electrical data for parallel connection: Example combinations

The following general conditions apply to the parallel connection of several PS6 supply modules:

- Only supply modules of size 2 or 3 may be connected in parallel.
- Only the same sizes may be connected in parallel.
- You can connect a maximum of 3 PS6A24 or 3 PS6A34 in parallel.

5.2.2.3.6 Brake chopper

Electrical data	PS6A24	PS6A34
U_{onCH}	780 – 800 V_{DC}	
U_{offCH}	740 – 760 V_{DC}	
R_{2minRB}	22 Ω	
P_{maxRB}	29.1 kW	
P_{effRB}	27.2 kW	

Tab. 13: Brake chopper electrical data, sizes 2 and 3

Electrical data	PS6A44
U_{onCH}	780 – 800 V_{DC}
U_{offCH}	740 – 760 V_{DC}
R_{2minRB}	9.5 Ω
P_{maxRB}	67.3 kW
P_{effRB}	62.9 kW

Tab. 14: Brake chopper electrical data, size 4

5.2.2.3.7 Fast discharge

Fast discharge is activated when no supply voltage is present for 20 s and the DC link voltage has reduced over this time. For active fast discharge, the DC link is discharged via the brake chopper and the braking resistor. Fast discharge does not take place for constant or increasing DC link voltage as this behavior indicates a second supply module in the DC link group. If the temperature sensor of the braking resistor is active, the fast discharge also remains off.

5.2.2.4 Dimensions

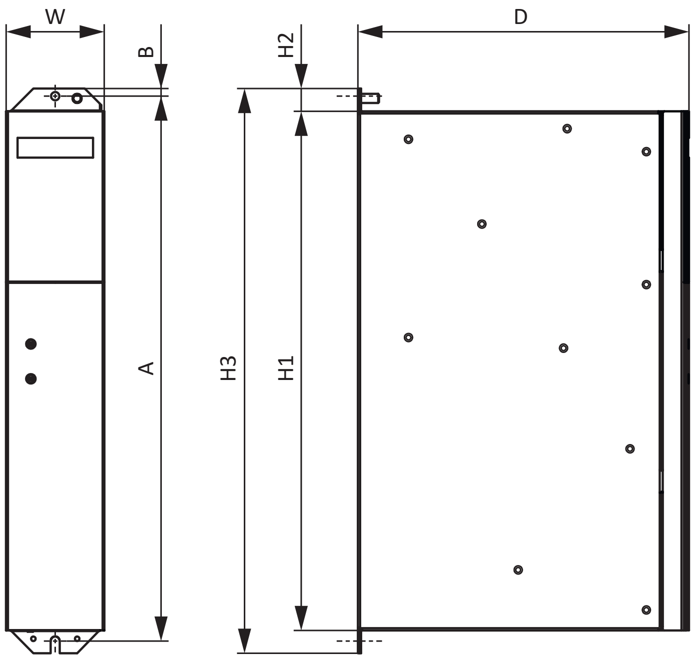


Fig. 1: PS6A24, PS6A34 dimensional drawing

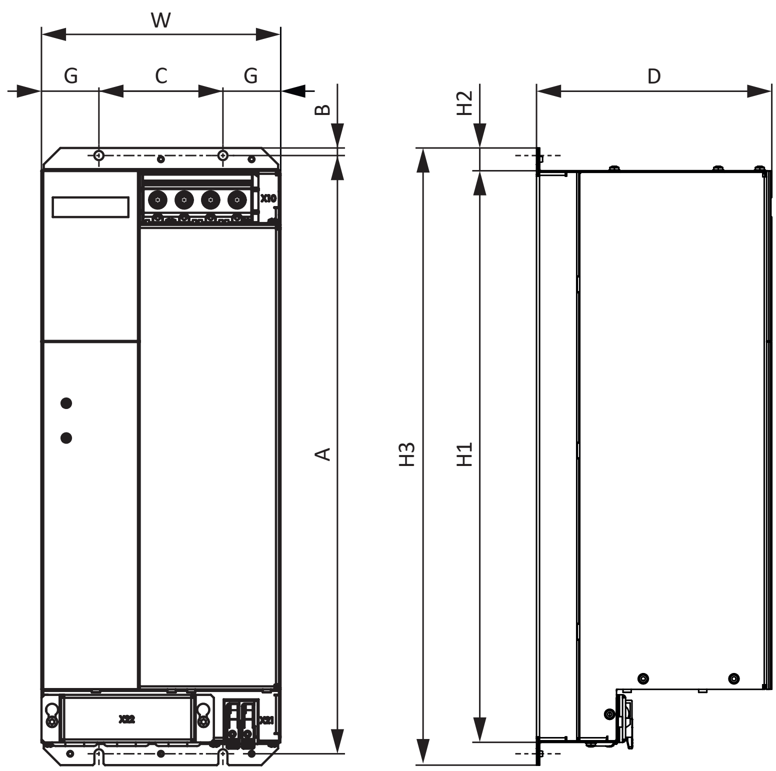


Fig. 2: PS6A44 dimensional drawing

Dimension			PS6A24	PS6A34	PS6A44
Supply module	Width	W	45	65	158
	Depth	D	204	219	156.5
	Body height	H1	343		378
	Fastening clip height	H2	15		
	Height incl. fastening clips	H3	373		408
Fastening bores (M5)	Vertical distance	A	360+2		396+2
	Vertical distance to the upper edge	B	5		
	Horizontal distance of the fastening bores	C	—		82
	Horizontal distance to the side edge	G	—		38

Tab. 15: PS6 dimensions [mm]

Take the additional installation depth of the rear section modules into account when calculating the overall dimensions.

5.2.2.5 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
PS6A24	2680	4180
PS6A34	3820	4920
PS6A44	6640	7640

Tab. 16: PS6 weight [g]

5.2.3 Drive controllers

The following chapters contain specifications for the electrical data, dimensions and weight of the drive controller.

5.2.3.1 Type designation

SI	**6**	**A**	**0**	**6**	**1**	**Z**

Tab. 17: Example code for drive controller type designation

Code	Designation	Design
SI	Series	
6	Generation	Generation 6
A	Version	
0 – 3	Size	
6	Power output stage	Power output stage within the size
1	Axis controller	Single-axis controller
2		Double-axis controller
Z	Safety technology	SZ6: Without safety technology
R		SR6: STO using terminals
U		SU6: STO and SS1 using PROFIsafe
Y		SY6: STO and SS1 using FSoE
X		SX6: Extended safety technology using FSoE

Tab. 18: Meaning of the example code

5.2.3.2 Sizes

Type	ID No.	Size	Axis controller
SI6A061	56645	Size 0	Single-axis controller
SI6A062	56646	Size 0	Double-axis controller
SI6A161	56647	Size 1	Single-axis controller
SI6A162	56648	Size 1	Double-axis controller
SI6A261	56649	Size 2	Single-axis controller
SI6A262	56653	Size 2	Double-axis controller
SI6A361	56654	Size 3	Single-axis controller

Tab. 19: Available SI6 types and sizes

SI6 in sizes 0 to 3

Note that the basic device is delivered without terminals. Suitable terminal sets are available separately for each size.

5.2.3.3 Electrical data

The electrical data of the available SI6 sizes can be found in the following sections.

An explanation of the symbols used for formulas can be found in Chapter [15.1].

5.2.3.3.1 Control unit

Electrical data	All types
U_{1CU}	24 V_{DC}, +20%/−15%
I_{1maxCU}	1.5 A

Tab. 20: Control unit electrical data

5.2.3.3.2 Power unit: Size 0

Electrical data	SI6A061	SI6A062
U_{1PU}	280 – 800 V_{DC}	
f_{2PU}	0 – 700 Hz	
U_{2PU}	0 – max. $\frac{U_{1PU}}{\sqrt{2}}$	
C_{PU}	180 µF	270 µF

Tab. 21: SI6 electrical data, size 0

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SI6A061	SI6A062
$f_{PWM,PU}$	4 kHz	
$I_{2N,PU}$	5 A	2 × 5 A
I_{2maxPU}	210% for 2 s; 150% for 30 s	

Tab. 22: SI6 electrical data, size 0, for 4 kHz clock frequency

Electrical data	SI6A061	SI6A062
$f_{PWM,PU}$	8 kHz	
$I_{2N,PU}$	4.5 A	2 × 4.5 A
I_{2maxPU}	250% for 2 s; 200% for 5 s	

Tab. 23: SI6 electrical data, size 0, for 8 kHz clock frequency

5.2.3.3.3 Power unit: Size 1

Electrical data	SI6A161	SI6A162
U_{1PU}	$280 - 800\ V_{DC}$	
f_{2PU}	0 – 700 Hz	
U_{2PU}	$0 - \max. \frac{U_{1PU}}{\sqrt{2}}$	
C_{PU}	470 µF	940 µF

Tab. 24: SI6 electrical data, size 1

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SI6A161	SI6A162
$f_{PWM,PU}$	4 kHz	
$I_{2N,PU}$	12 A	2 × 12 A
I_{2maxPU}	210% for 2 s; 150% for 30 s	

Tab. 25: SI6 electrical data, size 1, for 4 kHz clock frequency

Electrical data	SI6A161	SI6A162
$f_{PWM,PU}$	8 kHz	
$I_{2N,PU}$	10 A	2 × 10 A
I_{2maxPU}	250% for 2 s; 200% for 5 s	

Tab. 26: SI6 electrical data, size 1, for 8 kHz clock frequency

5.2.3.3.4 Power unit: Size 2

Electrical data	SI6A261	SI6A262
U_{1PU}	$280 - 800\ V_{DC}$	
f_{2PU}	0 – 700 Hz	
U_{2PU}	$0 - \max. \frac{U_{1PU}}{\sqrt{2}}$	
C_{PU}	940 µF	2250 µF

Tab. 27: SI6 electrical data, size 2

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SI6A261	SI6A262
$f_{PWM,PU}$	4 kHz	
$I_{2N,PU}$	22 A	2 × 25 A
I_{2maxPU}	210% for 2 s; 150% for 30 s	

Tab. 28: SI6 electrical data, size 2, for 4 kHz clock frequency

Electrical data	SI6A261	SI6A262
$f_{PWM,PU}$	8 kHz	
$I_{2N,PU}$	20 A	2 × 20 A
I_{2maxPU}	250% for 2 s; 200% for 5 s	

Tab. 29: SI6 electrical data, size 2, for 8 kHz clock frequency

5.2.3.3.5 Power unit: Size 3

Electrical data	SI6A361
U_{1PU}	280 – 800 V_{DC}
f_{2PU}	0 – 700 Hz
U_{2PU}	$0 - \text{max.} \frac{U_{1PU}}{\sqrt{2}}$
C_{PU}	2250 µF

Tab. 30: SI6 electrical data, size 3

Nominal currents up to +45 °C (in the control cabinet)

Electrical data	SI6A361
$f_{PWM,PU}$	4 kHz
$I_{2N,PU}$	50 A
I_{2maxPU}	210% for 2 s; 150% for 30 s

Tab. 31: SI6 electrical data, size 3, for 4 kHz clock frequency

Electrical data	SI6A361
$f_{PWM,PU}$	8 kHz
$I_{2N,PU}$	40 A
I_{2maxPU}	250% for 2 s; 200% for 5 s

Tab. 32: SI6 electrical data, size 3, for 8 kHz clock frequency

5.2.3.3.6 Single-ended nominal power consumption on double-axis controllers

Operating two motors on one double-axis controller makes it possible to operate one of the motors with a continuous current above the nominal current of the drive controller if the continuous current of the second connected motor is lower than the nominal current of the drive controller. This enables economical combinations of double-axis controllers and motors.

An explanation of the symbols used for formulas can be found in Chapter [▶ 15.1].

The nominal output current for axis B can be determined using the following formula if the output current for axis A is known:

Formula 1

$$I_{2PU(B)} = I_{2N,PU} - \left(I_{2PU(A)} - I_{2N,PU}\right) \times \frac{3}{5} \qquad \text{for} \qquad 0 \leq I_{2PU(A)} \leq I_{2N,PU}$$

Formula 2

$$I_{2PU(B)} = I_{2N,PU} - \left(I_{2PU(A)} - I_{2N,PU}\right) \times \frac{5}{3} \qquad \text{for} \qquad I_{2N,PU} \leq I_{2PU(A)} \leq 1{,}6 \times I_{2N,PU}$$

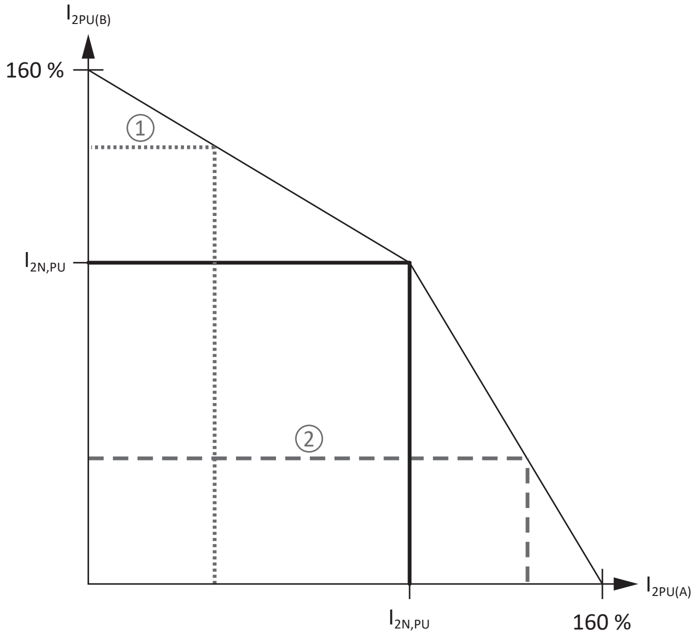


Fig. 3: Asymmetric load on double-axis controllers

Information

Note that the available maximum currents I_{2maxPU} of the axis controllers are also relative to the nominal output current $I_{2N,PU}$ for single-ended nominal power consumption.

5.2.3.3.7 Power loss data in accordance with EN 61800-9-2

Type	Nominal current $I_{2N,PU}$	Apparent power	Absolute losses $P_{V,CU}$ [2]	Operating points[3]								IE class[4]	Comparison[5]
				(0/25)	(0/50)	(0/100)	(50/25)	(50/50)	(50/100)	(90/50)	(90/100)		
				Relative losses									
	[A]	[kVA]	[W]	[%]									
SI6A06x	5	3.5	Max. 10	0.71	0.86	1.33	0.76	0.97	1.61	1.13	2.13	IE2	
SI6A16x	12	8.3	Max. 10	0.55	0.71	1.19	0.59	0.80	1.44	0.94	1.87	IE2	
SI6A261	22	16.6	Max. 10	0.55	0.71	1.19	0.59	0.80	1.44	0.94	1.87	IE2	
SI6A262	25	17.3	Max. 10	0.45	0.62	1.12	0.50	0.74	1.47	0.95	2.12	IE2	
SI6A361	50	34.6	Max. 10	0.45	0.62	1.12	0.50	0.74	1.47	0.95	2.12	IE2	
				Absolute losses P_V									
	[A]	[kVA]	[W]	[W]									[%]
SI6A06x	5	3.5	Max. 10	25	30.2	46.5	26.5	33.8	56.5	39.5	74.4	IE2	24.9
SI6A16x	12	8.3	Max. 10	45.7	58.7	98.7	49.1	66.3	119.6	78.1	155.4	IE2	26.7
SI6A261	22	16.6	Max. 10	91.5	117.4	197.3	98.2	132.6	239.2	156.2	310.8	IE2	30.8
SI6A262	25	17.3	Max. 10	77.9	106.5	193.0	87.1	127.9	254.3	163.8	367.6	IE2	36.4
SI6A361	50	34.6	Max. 10	155.8	213.1	386.0	174.3	255.8	508.6	327.6	735.2	IE2	39.5

Tab. 33: Power loss data in accordance with EN 61800-9-2 for one axis of a SI6 drive controller

General conditions

The specified losses apply to an axis of a drive controller and take into account the proportionate losses of the PS6 supply module for that axis.

For a group with a total of x axes, multiply the values by the number of axis controllers (x), e.g., x = 4 for 1 × PS6 and 2 × SI6A062.

The power loss data applies to drive controllers without accessories.

The power loss calculation is based on a three-phase supply voltage with 400 V_{AC}/50 Hz.

The calculated data includes a supplement of 10% in accordance with EN 61800-9-2.

The power loss specifications refer to a clock frequency of 4 kHz.

The absolute losses for a power unit that is switched off refer to the 24 V_{DC} power supply of the control electronics.

5.2.3.3.8 Power loss data of accessories

If you intend to order the drive controller with accessory parts, losses increase as follows.

Type	Absolute losses P_V [W]
SR6 safety module	1
SY6 or SU6 safety module	2
SX6 safety module	< 4

Tab. 34: Absolute losses of the accessories

Information

Note the absolute power loss of the encoder (usually < 3 W) and of the brake when designing as well.

Loss specifications for other optional accessories can be found in the technical data of the respective accessory part.

[2] Absolute losses for a power unit that is switched off
[3] Operating points for relative motor stator frequency in % and relative torque current in %
[4] IE class in accordance with EN 61800-9-2
[5] Comparison of the losses for the reference related to IE2 in the nominal point (90, 100)

5.2.3.4 Cycle times

Possible cycle times can be found in the following table.

Type	Cycle times	Relevant parameters
Application	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in A150
EtherCAT fieldbus, cyclical communication	250 µs, 500 µs, 1 ms, 2 ms, 4 ms, 8 ms	Adjustable in TwinCAT 3 or CODESYS
PROFINET RT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms, 8 ms	Adjustable in the TIA Portal
PROFINET IRT fieldbus, cyclical communication	1 ms, 2 ms, 4 ms	Adjustable in the TIA Portal
Motion core (movement calculation)	250 µs	—
Control cascade	62.5 µs	B24 ≥ 8 kHz and B20 = 48, 64 or 70
	125 µs	B24 = 4 kHz

Tab. 35: Cycle times

Information

For Lean motors (control mode B20 = 32: LM - sensorless vector control), only operation at 4 kHz is permitted.

5.2.3.5 Derating

When dimensioning the drive controller, observe the derating of the nominal output current as a function of the clock frequency, surrounding temperature and installation altitude. There is no restriction for a surrounding temperature from 0 °C to 45 °C and an installation altitude of 0 m to 1000 m. The details given below apply to values outside these ranges.

5.2.3.5.1 Effect of the clock frequency

Changing the clock frequency f_{PWM} affects the amount of noise produced by the drive, among other things. However, increasing the clock frequency results in increased losses. During project configuration, define the highest clock frequency and use it to determine the nominal output current $I_{2N,PU}$ for dimensioning the drive controller.

Type	$I_{2N,PU}$ 4 kHz [A]	$I_{2N,PU}$ 8 kHz [A]	$I_{2N,PU}$ 16 kHz [A]
SI6A061	5	4.5	3.5
SI6A062	2 × 5	2 × 4.5	2 × 3.5
SI6A161	12	10	6
SI6A162	2 × 12	2 × 10	2 × 6
SI6A261	22	20	10
SI6A262	2 × 25	2 × 20	2 × 10
SI6A361	50	40	—

Tab. 36: Nominal output current $I_{2N,PU}$ dependent on the clock frequency

5.2.3.5.2 Effect of the surrounding temperature

Derating as a function of the surrounding temperature is determined as follows:

- 0 °C to 45 °C: No restrictions (D_T = 100%)
- 45 °C to 55 °C: Derating −2.5%/K

Example

The drive controller needs to be operated at 50 °C.

The derating factor D_T is calculated as follows
D_T= 100% − 5 × 2.5% = 87.5%

5.2.3.5.3 Effect of the installation altitude

Derating as a function of the installation altitude is determined as follows:

- 0 m to 1000 m: No restriction (D_{IA} = 100%)
- 1000 m to 2000 m: Derating −1.5%/100 m

Example

The drive controller needs to be installed at an altitude of 1500 m above sea level.

The derating factor D_{IA} is calculated as follows:
$D_{IA} = 100\% - 5 \times 1.5\% = 92.5\%$

5.2.3.5.4 Calculating the derating

Follow these steps for the calculation:

1. Determine the highest clock frequency (f_{PWM}) that will be used during operation and use it to determine the nominal current $I_{2N,PU}$.
2. Determine the derating factors for installation altitude and surrounding temperature.
3. Calculate the reduced nominal current $I_{2N,PU(red)}$ in accordance with the following formula:
   $I_{2N,PU(red)} = I_{2N,PU} \times D_T \times D_{IA}$

Example

A drive controller of type SI6A061 needs to be operated at a clock frequency of 8 kHz at an altitude of 1500 m above sea level and a surrounding temperature of 50 °C.

The nominal current of the SI6A061 at 8 kHz is 4.5 A. The derating factor D_T is calculated as follows:
$D_T = 100\% - 5 \times 2.5\% = 87.5\%$

The derating factor D_{IA} is calculated as follows:
$D_{IA} = 100\% - 5 \times 1.5\% = 92.5\%$

The output current of importance for the project configuration is:
$I_{2N,PU(red)} = 4.5\ A \times 0.875 \times 0.925 = 3.64\ A$

5.2.3.6 Dimensions

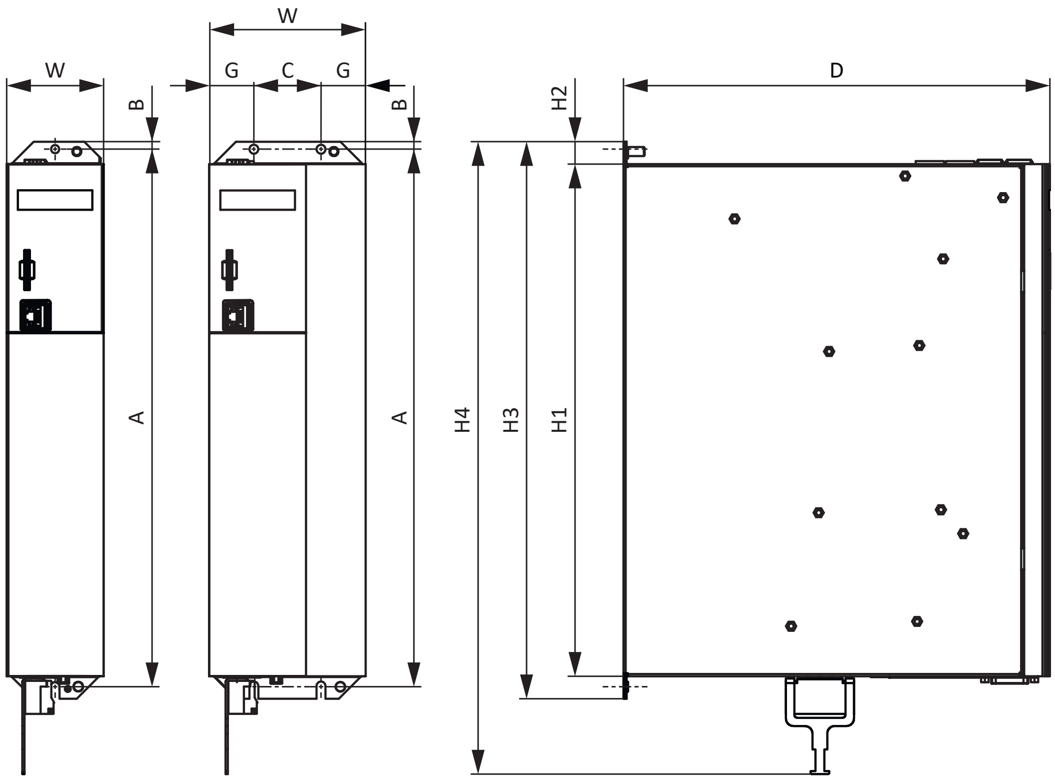


Fig. 4: SI6 dimensional drawing

Dimension			SI6A061 SI6A062	SI6A161 SI6A162	SI6A261	SI6A262	SI6A361
Drive controller	Width	W	45	65		105	
	Depth	D	265	286			
	Body height	H1	343				
	Fastening clip height	H2	15				
	Height incl. fastening clips	H3	373				
	Total height incl. shield connection	H4	423				
Fastening bores (M5)	Vertical distance	A	360+2				
	Vertical distance to the upper edge	B	5				
	Horizontal distance of the fastening bores	C	—			45	
	Horizontal distance to the side edge	G	—			30	

Tab. 37: SI6 dimensions [mm]

Take the additional installation depth of the rear section modules into account when calculating the overall dimensions.

5.2.3.7 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
SI6A061	2980	4600
SI6A062	3460	5060
SI6A161	3880	5260
SI6A162	4820	6240
SI6A261	4760	6200
SI6A262	6240	7420
SI6A361	6180	7360

Tab. 38: SI6 weight [g]

5.2.4 DC link connection

The following chapters contain the technical data of the DL6B Quick DC-Link modules.

5.2.4.1 General technical data

The following information applies to all Quick DC-Link modules and corresponds to the general technical data for the base device.

Device features	
Protection class of the device	IP20 (if built over with drive controller or supply module)
Protection class	Protection class I in accordance with EN 61140 (if built over with drive controller or supply module)
Protection class of the installation space	At least IP54

Tab. 39: Device features

Transport and storage conditions	
Storage/ transport temperature	−20 °C to +70 °C Maximum change: 20 K/h
Relative humidity	Maximum relative humidity 85%, non-condensing
Vibration (transport) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 3.5 mm 9 Hz ≤ f ≤ 200 Hz: 10 m/s² 200 Hz ≤ f ≤ 500 Hz: 15 m/s²
Fall height for free fall[6] Weight < 100 kg in accordance with EN 61800-2 (or IEC 60721-3-2, class 2M4)	0.25 m
Shock testing in accordance with EN 60068-2-27	Pulse shape: Half-sine Acceleration: 5 g Shock duration: 30 ms Number of shocks: 3 per axis

Tab. 40: Transport and storage conditions

Operating conditions	
Surrounding temperature during operation	0 °C to 45 °C with nominal data 45 °C to 55 °C with derating −2.5% / K
Relative humidity	Maximum relative humidity 85%, non-condensing
Installation altitude	0 m to 1000 m above sea level without restrictions 1000 m to 2000 m above sea level with −1.5%/100 m derating
Pollution degree	Pollution degree 2 in accordance with EN 50178
Vibration (operation) in accordance with EN 60068-2-6	5 Hz ≤ f ≤ 9 Hz: 0.35 mm 9 Hz ≤ f ≤ 200 Hz: 1 m/s²

Tab. 41: Operating conditions

[6] Only valid for components in their original packaging.

5.2.4.2 Assignment to DL6B – SI6 and PS6

DL6B is available in the following designs suitable for the individual drive controller types and supply module types:

Type	DL6B10	DL6B11	DL6B12	DL6B20	DL6B21	DL6B22
ID No.	56655	56656	56663	56657	56658	5050114
SI6A061	X	—	—	—	—	—
SI6A062	X	—	—	—	—	—
SI6A161	—	X	—	—	—	—
SI6A162	—	X	—	—	—	—
SI6A261	—	X	—	—	—	—
SI6A262	—	—	X	—	—	—
SI6A361	—	—	X	—	—	—
PS6A24	—	—	—	X	—	—
PS6A34	—	—	—	—	X	—
PS6A44	—	—	—	—	—	X

Tab. 42: DL6B assignment to SI6 and PS6

5.2.4.3 Dimensions

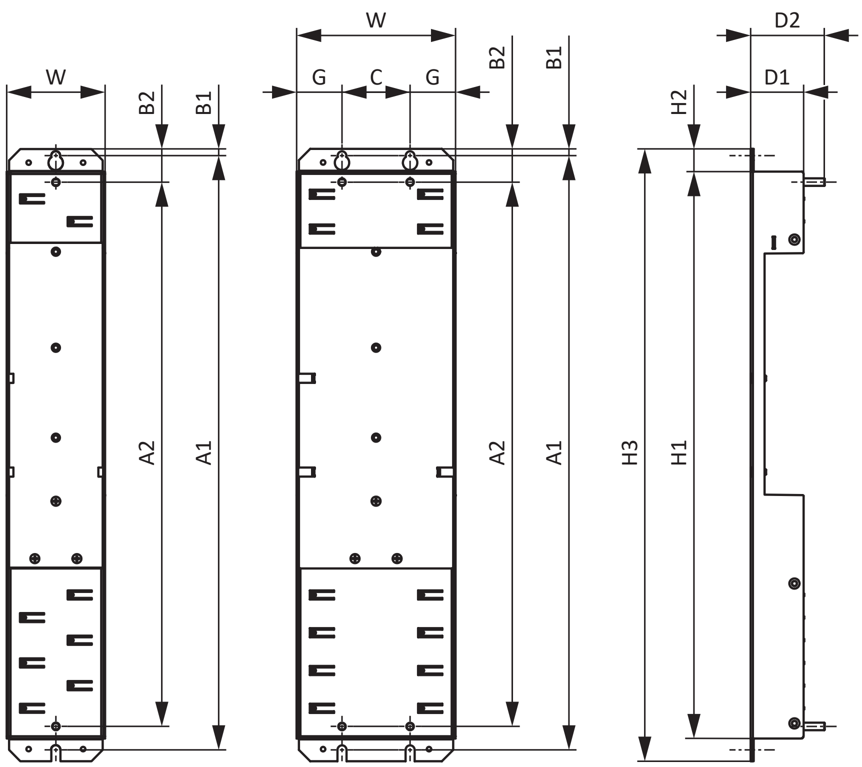


Fig. 5: Dimensional drawing of DL6B10 to DL6B21

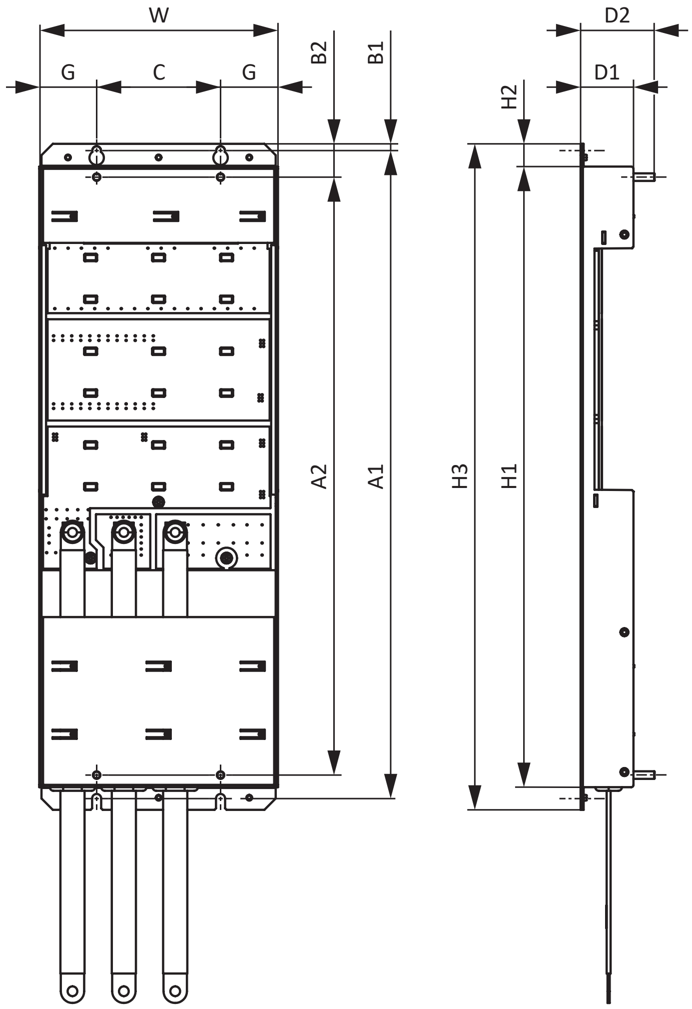


Fig. 6: DL6B22 dimensional drawing

<table>
<tr><th colspan="3">Dimension</th><th>DL6B10
DL6B20</th><th>DL6B11
DL6B21</th><th>DL6B12</th><th>DL6B22</th></tr>
<tr><td rowspan="6">Quick DC-Link</td><td>Width</td><td>W</td><td>45</td><td>65</td><td>105</td><td>158</td></tr>
<tr><td>Depth</td><td>D1</td><td colspan="4">35</td></tr>
<tr><td>Depth incl. attachment bolts</td><td>D2</td><td colspan="4">49</td></tr>
<tr><td>Height</td><td>H1</td><td colspan="3">375</td><td>410.5</td></tr>
<tr><td>Fastening clip height</td><td>H2</td><td colspan="4">15</td></tr>
<tr><td>Height incl. fastening clips</td><td>H3</td><td colspan="3">405</td><td>440.5</td></tr>
<tr><td rowspan="6">Fastening bores</td><td>Vertical distance (wall mounting)</td><td>A1</td><td colspan="3">393+2</td><td>429+2</td></tr>
<tr><td>Vertical distance (module mounting)</td><td>A2</td><td colspan="3">360</td><td>396</td></tr>
<tr><td>Vertical distance to the upper edge</td><td>B1</td><td colspan="4">4.5</td></tr>
<tr><td>Vertical distance to the upper edge</td><td>B2</td><td colspan="4">22</td></tr>
<tr><td>Horizontal distance of the fastening bores</td><td>C</td><td colspan="2">—</td><td>45</td><td>82</td></tr>
<tr><td>Horizontal distance to the side edge</td><td>G</td><td colspan="2">—</td><td>30</td><td>38</td></tr>
</table>

Tab. 43: DL6B dimensions [mm]

5.2.4.4 Weight

Type	Weight without packaging [g]	Weight with packaging [g]
DL6B10	440	480
DL6B11	560	600
DL6B12	880	920
DL6B20	480	520
DL6B21	740	780
DL6B22	1400	1440

Tab. 44: DL6B weight [g]

5.2.5 Minimum clearances

Drive controllers and supply modules

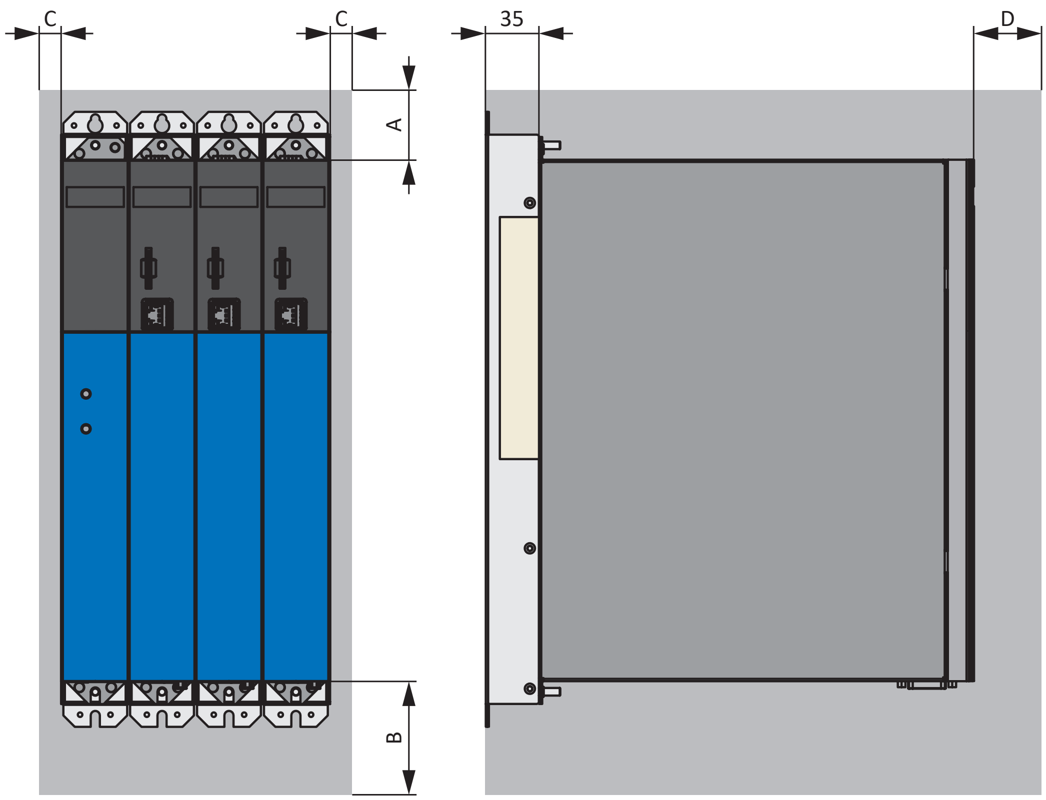


Fig. 7: Minimum clearances for drive controllers in combination with a PS6A24 or PS6A34 supply module

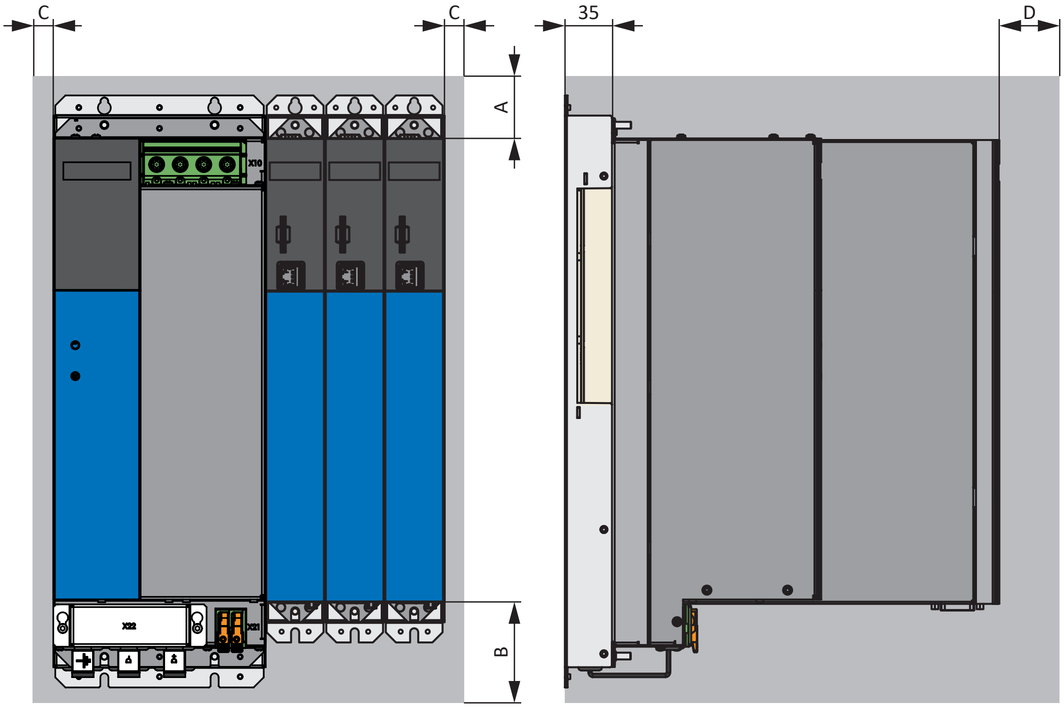


Fig. 8: Minimum clearances for drive controllers in combination with a PS6A44 supply module

Take into account the additional installation depth of 35 mm for the Quick DC-Link DL6B rear section modules.

The dimensions specified in the table relate to the outer edges of the drive controller or supply module.

Minimum clearance	A (above)	B (below)	C (on the side)	D (in front)
All sizes	100	200	5	50[7]

Tab. 45: Minimum clearances [mm]

Chokes and filters

Avoid installation below drive controllers or supply modules. For installation in a control cabinet, a distance of approximately 100 mm to other neighboring components is recommended. This distance ensures proper heat dissipation for chokes and filters.

Braking resistors

Avoid installation below drive controllers or supply modules. In order for heated air to flow out unimpeded, a minimum clearance of approximately 200 mm must be maintained in relation to neighboring components or walls and approximately 300 mm must be maintained to components above or ceilings.

[7] Minimum clearance to be taken into account for permanent connection of the X9 service interface

5.3 Drive controller/motor combinations

An explanation of the symbols used for formulas can be found in Chapter [▷ 15.1].

IC 410 convection cooling

Type	K_{EM} [V/1000 min^{-1}]	n_N [rpm]	M_N [Nm]	I_N [A]	M_0 [Nm]	I_0 [A]	Type	$f_{PWM,PU}$ [kHz]	$I_{2N,PU}$ [A]	$I_{2N,PU}/I_0$
LM4										
LM401U	110	3000	2.25	1.59	2.43	1.82	SI6A061	4	5	2.8
LM401U	110	3000	2.25	1.59	2.43	1.82	SI6A062	4	5	2.8
LM402U	120	3000	4.41	2.88	4.50	2.94	SI6A061	4	5	1.7
LM402U	120	3000	4.41	2.88	4.50	2.94	SI6A062	4	5	1.7
LM403U	120	3000	6.06	3.92	6.19	4.08	SI6A061	4	5	1.2
LM403U	120	3000	6.06	3.92	6.19	4.08	SI6A062	4	5	1.2
LM403U	120	3000	6.06	3.92	6.19	4.08	SI6A161	4	12	2.9
LM403U	120	3000	6.06	3.92	6.19	4.08	SI6A162	4	12	2.9
LM5										
LM503U	135	3000	9.48	5.62	10.1	5.95	SI6A161	4	12	2.0
LM503U	135	3000	9.48	5.62	10.1	5.95	SI6A162	4	12	2.0
LM505U	135	3000	13.7	7.83	15.5	8.83	SI6A161	4	12	1.4
LM505U	135	3000	13.7	7.83	15.5	8.83	SI6A162	4	12	1.4
LM505U	135	3000	13.7	7.83	15.5	8.83	SI6A261	4	22	2.5
LM505U	135	3000	13.7	7.83	15.5	8.83	SI6A262	4	25	2.8
LM7										
LM704U	145	3000	19.3	10.6	21.3	11.6	SI6A161	4	12	1.0
LM704U	145	3000	19.3	10.6	21.3	11.6	SI6A162	4	12	1.0
LM704U	145	3000	19.3	10.6	21.3	11.6	SI6A261	4	22	1.9
LM704U	145	3000	19.3	10.6	21.3	11.6	SI6A262	4	25	2.2
LM706U	140	3000	25.7	14.7	29.8	16.8	SI6A261	4	22	1.3
LM706U	140	3000	25.7	14.7	29.8	16.8	SI6A262	4	25	1.5
LM706U	140	3000	25.7	14.7	29.8	16.8	SI6A361	4	50	3.0

5.4 Accessories

You can find information about the available accessories in the following chapters.

5.4.1 Safety technology

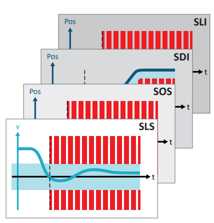
Information

The drive controller is delivered in the standard design without safety technology (option SZ6). If you want a drive controller with integrated safety technology, you must order it together with the drive controller. The safety modules are an integrated part of the drive controllers and must not be modified.

SZ6 option – Without safety technology

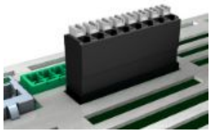
ID No. 56660
Design without safety technology.

SX6 safety module – Extended safety technology using FSoE



ID No. 5050185
Optional accessory for use in safety-related applications up to PL e, SIL 3 in accordance with EN ISO 13849-1 and EN 61800-5-2. In addition to the basic Safe Torque Off (STO) safety function, SX6 provides other safety functions specified in EN 61800-5-2. In addition to the safe stop functions Safe Stop 1 (SS1) and Safe Stop 2 (SS2), these also include Safely-Limited Speed (SLS), Safe Brake Control (SBC), Safe Brake Test (SBT), Safe Direction (SDI) and Safely-Limited Increment (SLI). Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

SR6 safety module – STO using terminals



ID No. 56661
Optional accessory for the use of the Safe Torque Off safety function (STO) in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via terminal X12.

SY6 safety module – STO and SS1 using FSoE

ID No. 56662
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

SU6 safety module – STO and SS1 using PROFIsafe

ID No. 56696
Optional accessory for the use of the Safe Torque Off (STO) and Safe Stop 1 (SS1) safety functions in safety-relevant applications (PL e, SIL 3) in accordance with EN ISO 13849-1 and EN 61800-5-2. Connection to a higher-level safety circuit via PROFINET (PROFIsafe).

5.4.2 Communication

The drive controller has two interfaces for the EtherCAT or PROFINET connection on the top of the device as well as an Ethernet service interface on the front of the device. Cables for the connection are available separately.

EtherCAT or PROFINET

Specify the desired fieldbus system when placing your order for the base device, since fieldbus communication is defined by the firmware.

EtherCAT cables

Ethernet patch cable, CAT5e, yellow.
The following designs are available:
ID no. 49313: length approx. 0.25 m.
ID no. 49314: length approx. 0.5 m.

PC connecting cable

ID No. 49857
Cable for connecting the X9 service interface to the PC, CAT5e, blue, length: 5 m.

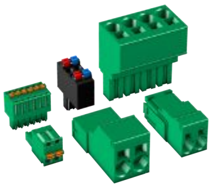
USB 2.0 Ethernet adapter

ID No. 49940
Adapter for connecting Ethernet to a USB port.

5.4.3 Terminal set

For the connection, you need suitable terminal sets for each PS6 supply module and each SI6 drive controller.

Terminal set for supply module



(Fig. similar)

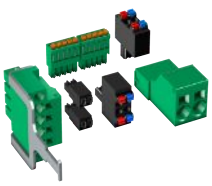
The following designs are available:

ID No. 138660
Terminal set for PS6A24. Contents: 6 terminals.

ID No. 138661
Terminal set for PS6A34. Contents: 6 terminals.

ID No. 138679
Terminal set for PS6A44. Contents: 3 terminals.

Terminal set for drive controllers without SR6 safety module (STO using terminals)



(Fig. similar)

The following designs are available:

ID No. 138655
Terminal set for SI6A061Z/U/Y/X. Contents: 9 terminals.

ID No. 138656
Terminal set for SI6A062Z/U/Y/X. Contents: 11 terminals.

ID No. 138657
Terminal set for SI6A161Z/U/Y/X. Contents: 9 terminals.

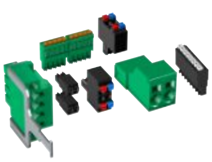
ID No. 138658
Terminal set for SI6A162Z/U/Y/X. Contents: 11 terminals.

ID No. 138659
Terminal set for SI6A261Z/U/Y/X. Contents: 9 terminals.

ID No. 138662
Terminal set for SI6A262Z/U/Y/X. Contents: 11 terminals.

ID No. 138663
Terminal set for SI6A361Z/U/Y/X. Contents: 9 terminals.

Terminal set for drive controllers with SR6 safety module (STO using terminals)



(Fig. similar)

The following designs are available:

ID No. 138683
Terminal set for SI6A061R. Contents: 10 terminals.

ID No. 138684
Terminal set for SI6A062R. Contents: 12 terminals.

ID No. 138685
Terminal set for SI6A161R. Contents: 10 terminals.

ID No. 138686
Terminal set for SI6A162R. Contents: 12 terminals.

ID No. 138687
Terminal set for SI6A261R. Contents: 10 terminals.

ID No. 138688
Terminal set for SI6A262R. Contents: 12 terminals.

ID No. 138689
Terminal set for SI6A361R. Contents: 10 terminals.

5.4.4 DC link connection

For the energy supply of the existing drive controllers in the group, you need suitable Quick DC-Link modules of type DL6B for each PS6 supply module and each SI6 drive controller.

For the horizontal connection, you receive DL6B rear section modules in various designs, matched to the size of the drive controller or supply module.

The quick fastening clamps for attaching the copper rails and an insulation connection piece are contained in the scope of delivery. The copper rails are not included in the scope of delivery. These must have a cross-section of 5 x 12 mm. Insulation end sections for the left and right termination of the device group as well as covers for the rear section modules are available separately. The covers protect rear section modules installed in the control cabinet that are only later built over with drive controllers or supply modules, for example as part of a retrofit.

Quick DC-Link DL6B – rear section module for drive controller

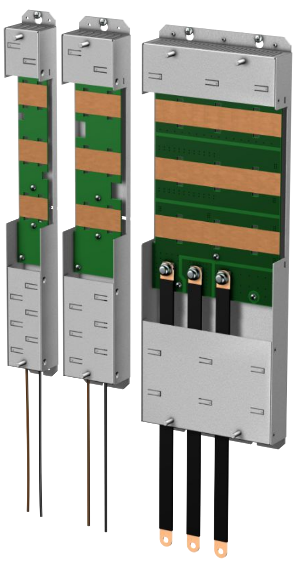
The following designs are available:

DL6B10
ID No. 56655
Rear section module for size 0 drive controller:
SI6A061 and SI6A062

DL6B11
ID No. 56656
Rear section module for size 1 or 2 (single-axis controller) drive controller:
SI6A161, SI6A162 and SI6A261

DL6B12
ID No. 56663
Rear section module for size 2 (double-axis controller) or 3 drive controller:
SI6A262 and SI6A361

Quick DC-Link DL6B – rear section module for supply module



The following designs are available:

DL6B20
ID No. 56657
Rear section module for size 2 supply module:
PS6A24

DL6B21
ID No. 56658
Rear section module for size 3 supply module:
PS6A34

DL6B22
ID No. 5050114
Rear section module for size 4 supply module:
PS6A44

Quick DC-Link DL6B – insulation end section

ID No. 56659

Insulation end sections for the left and right termination of the group, 2 pcs.

Quick DC-Link DL6B – cover

The following designs are available:

QDL6C10
ID No. 5050128
Cover for DL6B10 or DL6B20 rear section module,
Dimensions: 373 × 45 × 1 mm

QDL6C11
ID No. 5050129
Cover for DL6B11 or DL6B21 rear section module,
Dimensions: 373 × 64 × 1 mm

QDL6C12
ID No. 5050130
Cover for DL6B12 rear section module,
Dimensions: 373 × 105 × 1 mm

5.4.5 Braking resistor

In addition to the supply modules, STOBER offers braking resistors in the various sizes and performance classes described below. For the selection, note the minimum permitted braking resistors specified in the technical data of the supply modules. In the event of a fault, such as a defective brake chopper, the supply module must be disconnected from the power supply.

5.4.5.1 Assignment of braking resistor – PS6

Type	KWADQU 420×91 with MWS306L	KWADQU 420×91 with MWS310L	FZZMQU 400×65	FGFKQU 31005	FGFKQU 31009	FGFKQU 31114
ID No.	138675	138676	56635	56636	5050115	5050116
PS6A24	(X)	X	X	X	—	—
PS6A34	(X)	X	X	X	—	—
PS6A44	(—)	(—)	(—)	(X)	X	X

Tab. 46: Braking resistor assignment to PS6 supply module

X	Recommended
(X)	Possible
(—)	Useful under certain conditions
—	Not possible

5.4.5.2 KWADQU flat resistor

The braking resistor is available with two different mounting bracket sets (MWS).

Properties

Technical data	KWADQU 420×91 with MWS306L	KWADQU 420×91 with MWS310L
ID No.	138675	138676
Type	Flat resistor with temperature switch (incl. mounting bracket)	
Resistance [Ω]	100 ±10%	
Thermal drift	±10%	
Power [W]	600	
Thermal time constant τ_{th} [s]	60	
Pulse power for < 1 s [kW]	13	
U_{max} [V]	848	
Cable design	FEP	
Cable length [mm]	500	
Conductor cross-section [AWG]	14/19 (1.9 mm²)	
Weight without packaging [g]	2620	2770
Protection class	IP54	
Marks and test symbols	cURus, CE, UKCA	

Tab. 47: KWADQU technical data

Technical data	Temperature switch
Switching capacity	2 A / 24 V_{DC} (DC11)
Nominal response temperature ϑ_{NAT}	180 °C ± 5 K
Type	NC
Cable design	FEP
Cable length [mm]	500
Conductor cross-section [AWG]	22

Tab. 48: Temperature switch technical data

Dimensions

Braking resistor with MWS306L

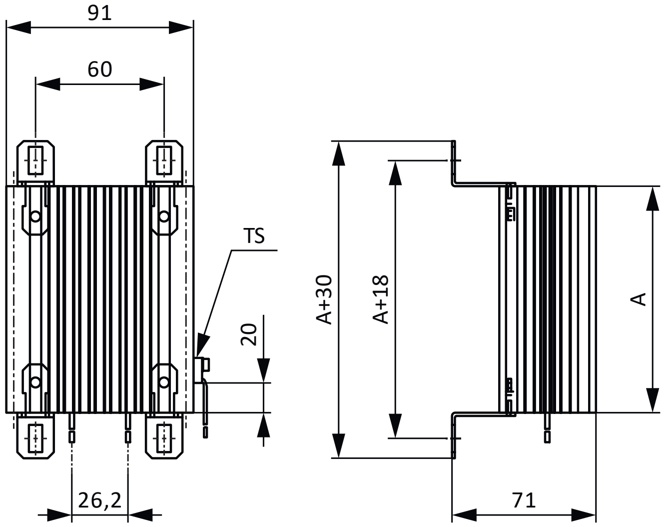


Fig. 9: KWADQU dimensional drawing with MWS306L

Braking resistor with MWS310L

The mounting brackets are freely positionable in the vertical direction over the entire length of the braking resistor.

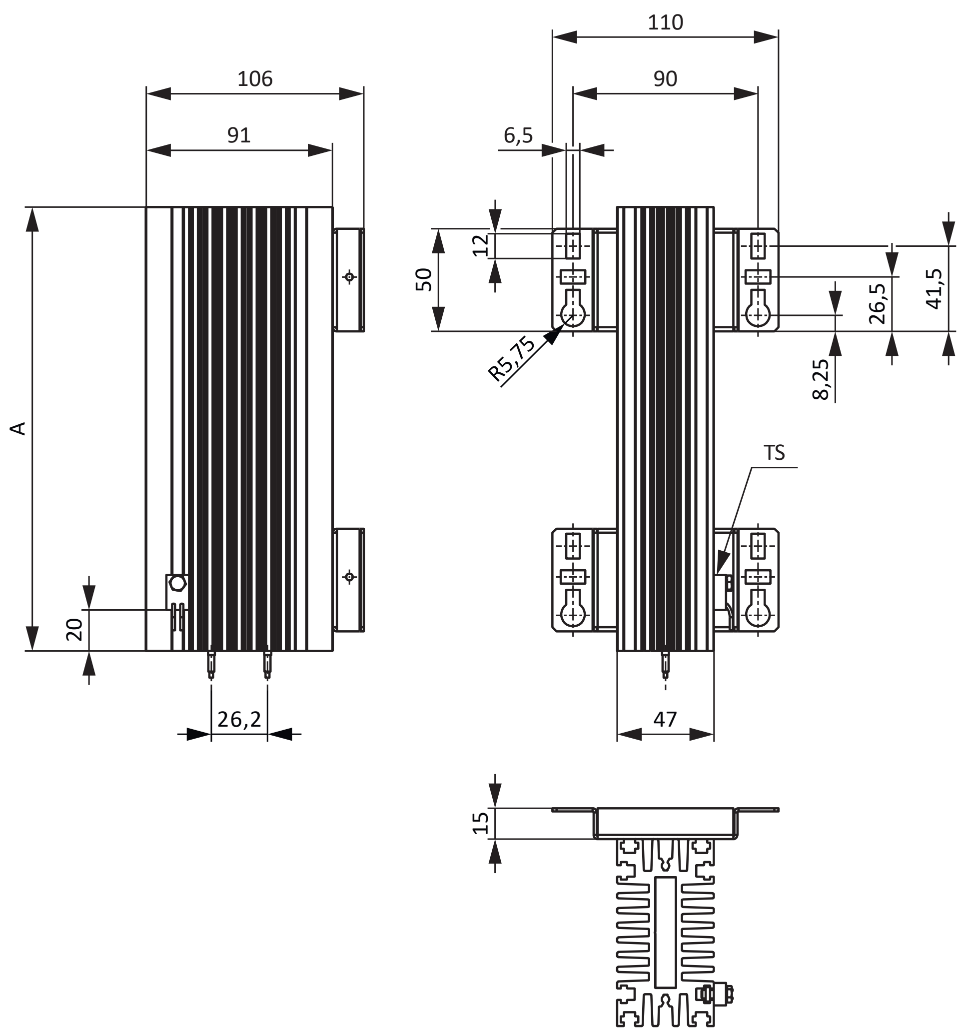


Fig. 10: KWADQU dimensional drawing with MWS310L

Dimension	KWADQU 420×91
A	420

Tab. 49: KWADQU dimensions [mm]

5.4.5.3 FZZMQU tubular fixed resistor

Properties

Technical data	FZZMQU 400×65
ID No.	56635
Type	Tubular fixed resistor with temperature switch
Resistance [Ω]	47 ±10%
Thermal drift	±10%
Power [W]	1200
Thermal time constant τ_{th} [s]	40
Pulse power for < 1 s [kW]	36
U_{max} [V]	848
Weight without packaging [g]	4200
Protection class	IP20
Marks and test symbols	cURus, CE, UKCA

Tab. 50: FZZMQU technical data

Technical data	Temperature switch
Switching capacity	2 A / 24 V_{DC} (DC11)
Nominal response temperature ϑ_{NAT}	180 °C ± 5 K
Type	NC
Cable design	FEP
Cable length [mm]	500
Conductor cross-section [AWG]	22

Tab. 51: Temperature switch technical data

Dimensions

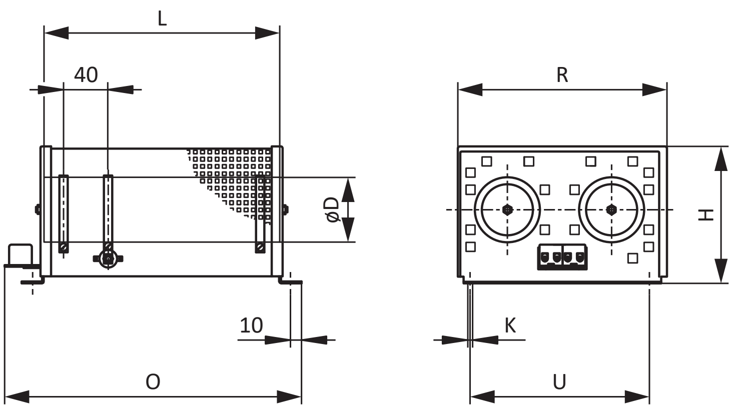


Fig. 11: FZZMQU dimensional drawing

Dimension	FZZMQU 400×65
L × D	400 × 65
H	120
K	6.5 × 12
O	485
R	185
U	150

Tab. 52: FZZMQU dimensions [mm]

5.4.5.4 FGFKQU steel-grid fixed resistor

Properties

Technical data	FGFKQU 31005	FGFKQU 31009	FGFKQU 31114
ID No.	56636	5050115	5050116
Type	Steel-grid fixed resistor with temperature switch		
Resistance [Ω]	22 ±10%	14.4 ±10%	9.5 ±10%
Thermal drift	±10%	±10%	±10%
Power [W]	2500	4500	7000
Thermal time constant τ_{th} [s]	30	30	20
Pulse power for < 1 s [kW]	50	90	140
U_{max} [V]	848		
Weight without packaging [g]	7500	9500	13000
Protection class	IP20		
Marks and test symbols	cURus, CE, UKCA		

Tab. 53: FGFKQU technical data

Technical data	Temperature switch
Switching capacity	2 A / 24 V_{DC} (DC11)
Nominal response temperature ϑ_{NAT}	100 °C ± 5 K
Type	NC
Cable design	FEP
Cable length [mm]	500
Conductor cross-section [AWG]	22

Tab. 54: Temperature switch technical data

Dimensions

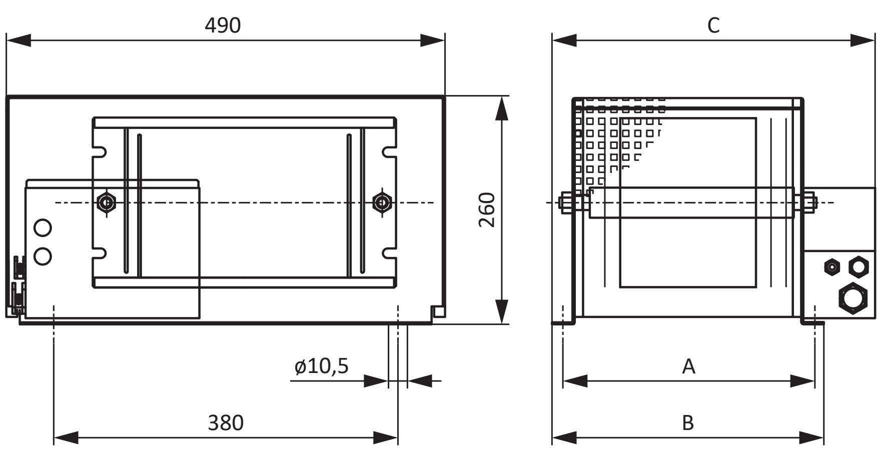


Fig. 12: FGFKQU dimensional drawing

Dimension	FGFKQU 31005	FGFKQU 31009	FGFKQU 31114
A	270		370
B	295		395
C	355		455

Tab. 55: FGFKQU dimensions [mm]

5.4.6 Choke

Technical specifications for suitable chokes can be found in the following chapters.

5.4.6.1 TEP power choke

Power chokes are used to dampen voltage and current peaks and reduce the load of the power feed-in of the supply modules.

Properties

Technical data	TEP4010-2US00
ID No.	56528
Phases	3
Thermally allowed continuous current	100 A
Nominal current $I_{N,MF}$	90 A
Absolute loss P_V	103 W
Inductance	0.14 mH
Voltage range	3 × 400 V_{AC}, +32%/−50% 3 × 480 V_{AC}, +10%/−58%
Voltage drop U_k	2%
Frequency range	50/60 Hz
Protection class	IP00
Max. surrounding temperature $\vartheta_{amb,max}$	40 °C
Insulation class	B
Connection	Screw terminal
Connection type	Flexible with and without end sleeve
Max. conductor cross-section	6 – 35 mm²
Tightening torque	2.5 Nm
Insulation stripping length	17 mm
Installation	Screws
Directive	EN 61558-2-20
UL Recognized Component (CAN; USA)	Yes
Marks and test symbols	cURus, CE

Tab. 56: TEP technical data

Dimensions

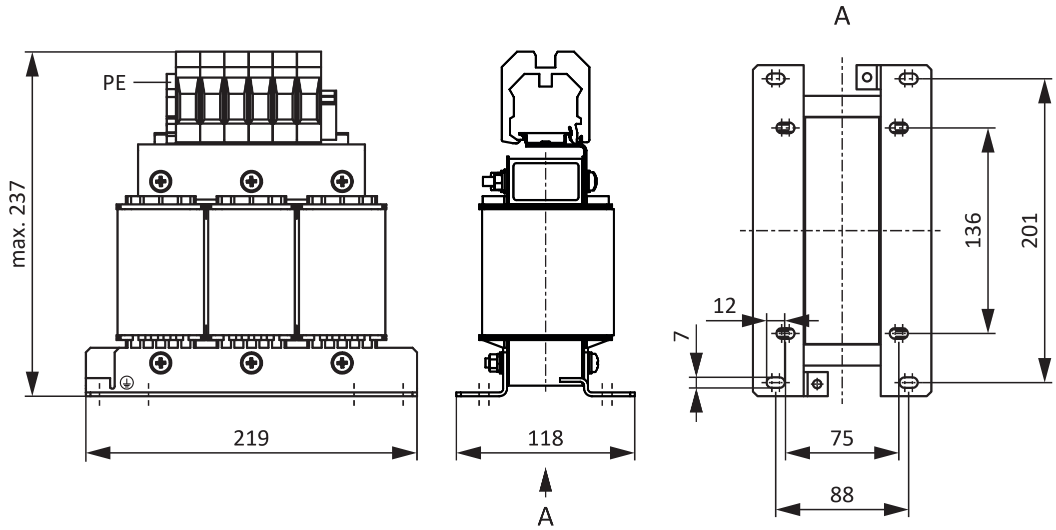


Fig. 13: Power choke dimensional drawing

Dimensions	TEP4010-2US00
Height [mm]	Max. 237
Width [mm]	219
Depth [mm]	118
Vertical distance 1 – Fastening bores [mm]	201
Vertical distance 2 – Fastening bores [mm]	136
Horizontal distance 1 – Fastening bores [mm]	88
Horizontal distance 2 – Fastening bores [mm]	75
Drill holes – Depth [mm]	7
Drill holes – Width [mm]	12
Screw connection – M	M6
Weight without packaging [g]	9900

Tab. 57: TEP dimensions and weight

5.5 Further information

5.5.1 Directives and standards

The following European directives and standards are relevant to the drive controllers:

- Directive 2006/42/EC – Machinery Directive
- Directive 2014/30/EU – EMC Directive
- Directive 2011/65/EU – RoHS Directive
- Directive 2009/125/EC – Ecodesign Directive
- EN IEC 61800-3:2018
- EN 61800-5-1:2007 + A1:2017
- EN 61800-5-2:2017
- EN IEC 63000:2018
- EN ISO 13849-1:2015

5.5.2 Marks and test symbols

The following marks and test symbols are mentioned in the technical data.

RoHS lead-free mark
Marking in accordance with RoHS directive 2011-65-EU.

CE mark
Manufacturer's self declaration: The product meets the requirements of EU directives.

UKCA test symbol
Manufacturer's self declaration: The product meets the requirements of UK directives.

UL test symbol (cULus)
This product is listed by UL for the United States and Canada. Representative samples of this product have been evaluated by UL and meet the requirements of applicable standards.

UL recognized component mark (cURus)
This component or material is recognized by UL for the US and Canada. Representative samples of this product have been evaluated by UL and meet applicable requirements.

5.5.3 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Manual for SI6 drive controllers	442728

6 Connection method

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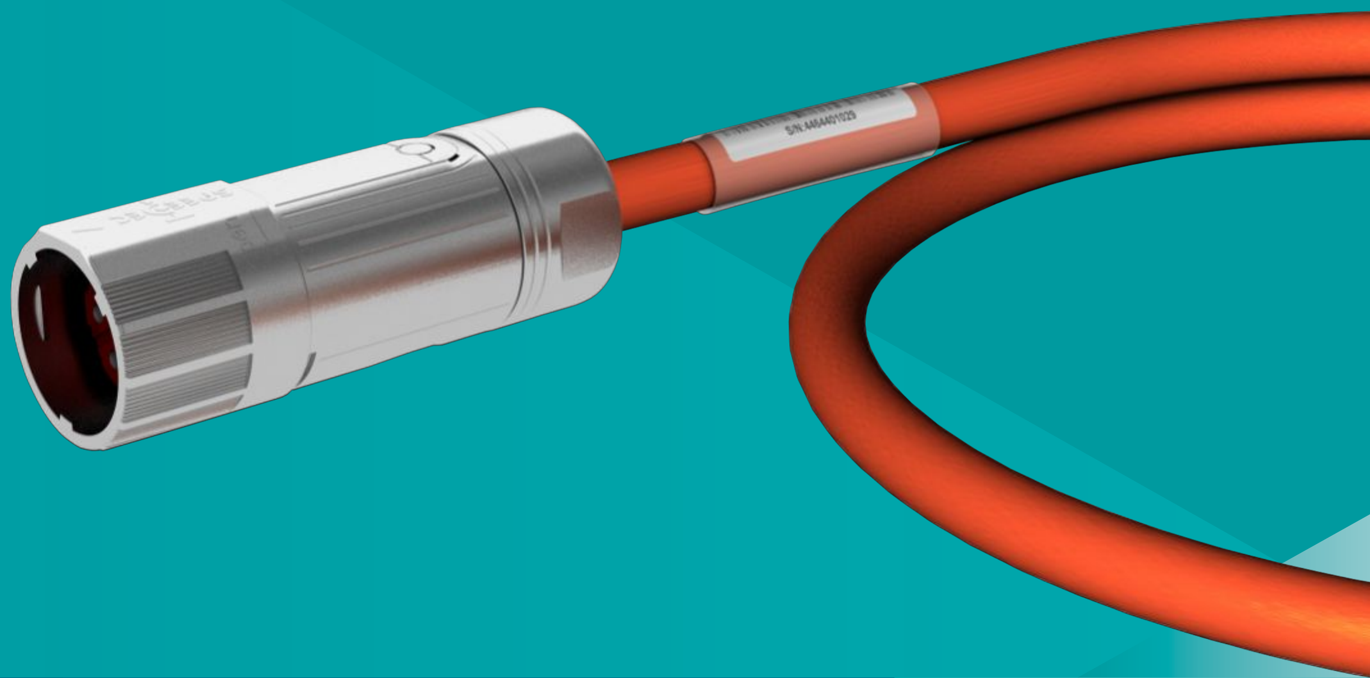


6 Connection method

6.1 Overview

Coordinated connection technology

Features

- Torsional stress ±30°/m
- Bending resistance
- Oil resistance
- Chemical resistance

A drive controller, cable and motor that are not coordinated with one another can lead to impermissibly high voltage peaks in the drive system, which may cause damage to the motor. The legal requirements of (EMC) Directive 2014/30/EU must also be observed.

The combination of STOBER motors with STOBER cables and STOBER drive controllers enables compliance with legal requirements.

STOBER offers a range of cables to match. Cables are available in different lengths and are ready-made on both ends.

6.2 Conventions for cables

In the cable connection descriptions, core colors are shortened and used as follows.

Cable colors

BK:	BLACK	PK:	PINK
BN:	BROWN	RD:	RED
BU:	BLUE	VT:	VIOLET
GN:	GREEN	WH:	WHITE
GY:	GRAY	YE:	YELLOW
OG:	ORANGE		

Formatting conventions

Two-colored core:	WHYE	WHITEYELLOW (white-yellow core)
Single-colored core:	BK/BN	BLACK/BROWN (black or brown core)
Core pair:	BU-BK	BLUE-BLACK (blue and black core)

6.3 Length definition for ready-made cables

The following length definitions apply to ready-made cables from STOBER.

Power cables

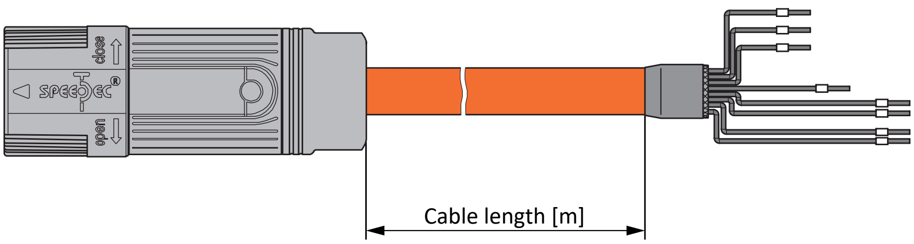


Fig. 1: Length definition for ready-made power cables

6.4 Power cables

The Lean motors of the LM series are equipped with plug connectors as standard.

The cables are available ready-made in the lengths 2.5 m, 5 m, 7.5 m, 10 m, 12.5 m, 15 m, 18 m, 20 m, 25 m, 30 m, 35 m, 40 m and 50 m.
Other lengths on request.

6.4.1 Motor assignment

STOBER offers cables with a minimum cross-section for the motors as standard. Depending on the application, however, larger conductor cross-sections may be required. For this reason, take into account the following points in addition for dimensioning the cable:

- Stall current I_0 of the motor
- Permitted current carrying capacity of the conductors
- Cable length
- Terminal specifications of the drive controller
- Connector size of the motor

Assignment of LM Lean motors (nN = 3000 rpm)

	K_{EM} [V/1000 rpm]	I_0 [A]	Plug connector size	Minimum cross-section [mm²]
LM401	110	1.82	con.23	1.5
LM402	120	2.94	con.23	1.5
LM403	120	4.08	con.23	1.5
LM503	135	5.95	con.23	1.5
LM505	135	8.83	con.23	1.5
LM704	145	11.6	con.23	2.5
LM706	140	16.8	con.23	2.5

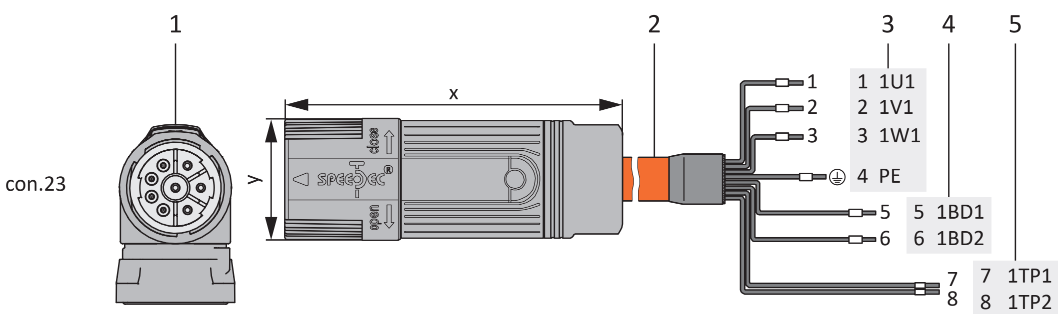
Tab. 1: Plug connector size and minimum cross-section, Lean motors

6.4.2 Connection description

Suitable power cables for the Lean motors in the LM series are available in plug connector size con.23 with a speedtec quick-lock.

Information

Observe the designations on the identification clips for the correct connection of the cores.



1 Plug connectors

2 Power cable, cable shield

3 Connection to terminal X20, motor

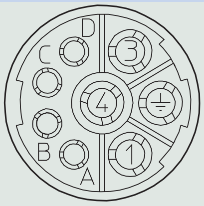
4 Connection of terminal X2/X5, brake

5 Connection to terminal X2, temperature sensor

Maximum cable length

The maximum cable length of the shielded power cable is 50 m. The use of cables with a length greater than 50 m and up to maximum 100 m must be checked by STOBER for the application.

Power cables – con.23 plug connector

Motor (1)			Cable (2)	Drive controller (3) – (5)		
Motor connection diagram	**Pin**	**Designation**	**Identification/ Core color**	**Pin X20**	**Pin X2**	**Pin X2**
	1	1U1	1	1	—	—
	3	1V1	2	2	—	—
	4	1W1	3	3	—	—
	A	1BD1	5	—	5	—
	B	1BD2	6	—	6	—
	C	1TP1	7	—	—	7
	D	1TP2	8	—	—	8
	⏚	PE	GNYE	4	—	—
	Housing	Shield	—	Shield con-tact	—	—

Tab. 2: con.23 power cable pin assignment

Length x [mm]	Diameter y [mm]
78	26

Tab. 3: con.23 connector dimensions

6.5 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Connection method manual	443102

7 P planetary geared motors

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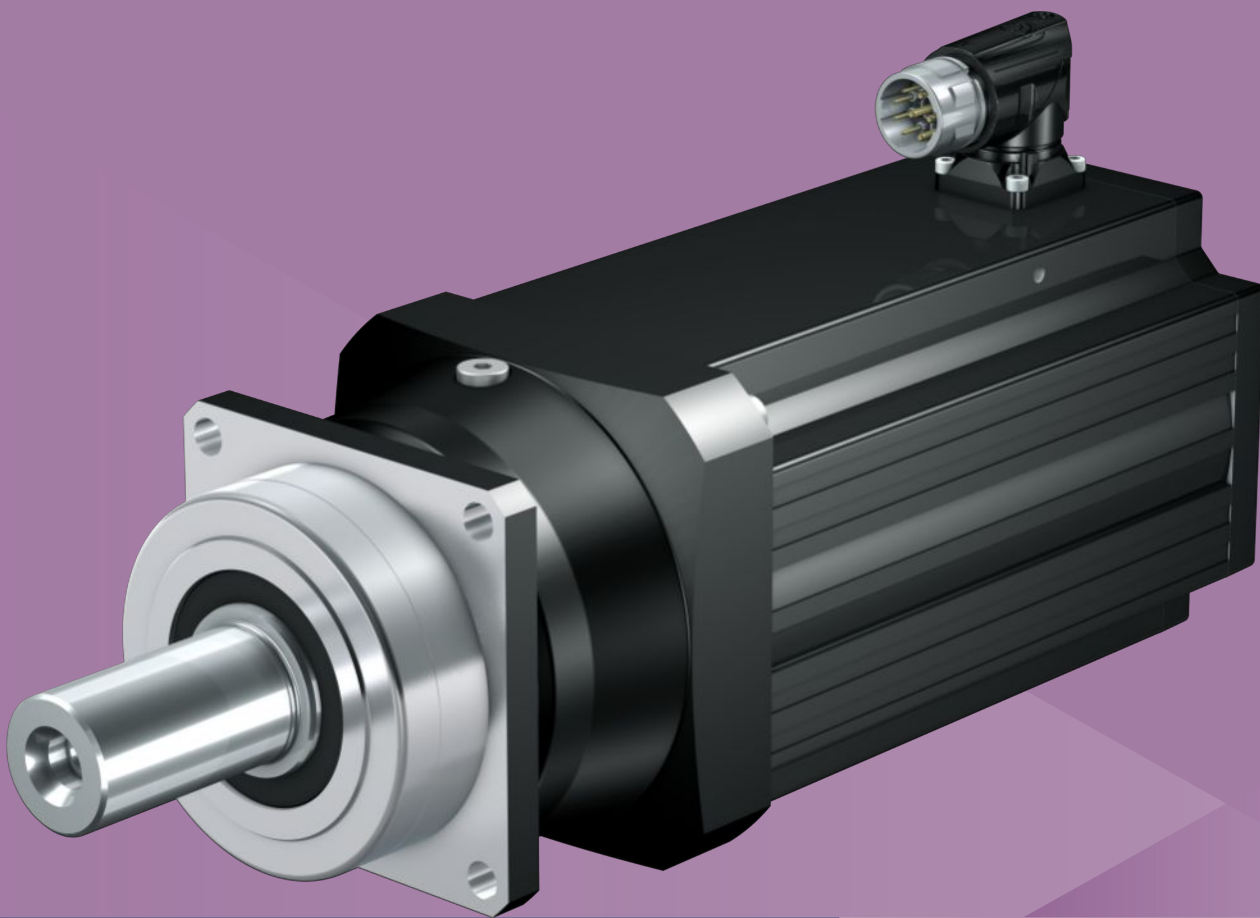


7 Planetary geared motors

P

7.1 Overview

Helical-geared precision planetary geared motors

Features

Power density	★★★★☆
Backlash	★★★★☆
Price category	€€
Shaft load	★★★★☆
Smooth operation	★★★★☆
Torsional stiffness	★★★☆☆
Mass moment of inertia	★★★★★
Helical gearing	✓
Maintenance-free	✓
Any mounting position	✓
Continuous operation without cooling	✓
Reinforced output bearing	✓ (optional)
Compact and dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

i	3 – 70
M_{2acc}	13 – 2000 Nm
$\Delta\phi_2$	1 – 5 arcmin
η_{get}	95 – 97 %

7.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Drives with convection-cooled motors
- M_{2acc}, M_{2accHT}: Solid shaft design without feather key (we generally recommend this shaft design for cyclic operation)

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the Chapter [▸ 15.1].

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2accHT} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2red}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
P3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 66 Nm)																	
300	22	24	1.2	1.3	P331_0100 LM401U	44	44	120	10.00	10/1	5500	8000	1.7	4.0	2.0	4.4	5.9
375	17	19	1.3	2.0	P331_0080 LM401U	35	35	126	8.000	8/1	5000	8000	1.7	4.0	2.0	4.7	5.9
375	34	35	2.6	1.0	P331_0080 LM402U	63	65	126	8.000	8/1	5000	8000	3.0	4.0	2.0	4.7	7.6
429	15	17	1.4	2.6	P331_0070 LM401U	31	31	138	7.000	7/1	5000	8000	1.7	4.0	2.0	5.1	5.9
429	30	31	2.7	1.3	P331_0070 LM402U	66	66	138	7.000	7/1	5000	8000	3.1	4.0	2.0	5.1	7.6
600	11	12	2.1	3.6	P331_0050 LM401U	22	22	150	5.000	5/1	4500	8000	1.7	4.0	2.0	5.5	5.9
600	21	22	4.0	1.8	P331_0050 LM402U	47	47	150	5.000	5/1	4500	8000	3.1	4.0	2.0	5.5	7.6
750	8.7	9.4	2.7	4.5	P331_0040 LM401U	17	17	130	4.000	4/1	4000	8000	1.8	4.0	2.0	5.5	5.9
750	17	17	5.3	2.3	P331_0040 LM402U	38	38	130	4.000	4/1	4000	8000	3.1	4.0	2.0	5.5	7.6
1000	6.5	7.1	5.7	4.0	P331_0030 LM401U	13	13	100	3.000	3/1	3500	7000	2.0	4.0	2.0	5.3	5.9
1000	13	13	11	2.0	P331_0030 LM402U	28	28	100	3.000	3/1	3500	7000	3.3	4.0	2.0	5.3	7.6
P4 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 140 Nm)																	
60	107	115	1.6	0.95	P432_0500 LM401U	132	138	264	50.00	50/1	5000	8000	1.7	5.0	3.0	12	8.3
75	86	92	2.1	1.0	P432_0400 LM401U	130	130	260	40.00	40/1	5000	8000	1.7	5.0	3.0	12	8.3
86	75	81	1.9	1.4	P432_0350 LM401U	133	138	266	35.00	35/1	4500	8000	1.7	5.0	3.0	12	8.3
94	68	74	2.3	1.3	P432_0320 LM401U	126	131	253	32.00	32/1	4000	8000	1.8	5.0	3.0	9.6	8.3
107	60	65	2.3	1.6	P432_0280 LM401U	120	120	260	28.00	28/1	4500	8000	1.7	5.0	3.0	12	8.3
107	117	120	4.5	0.81	P432_0280 LM402U	130	130	260	28.00	28/1	4500	8000	3.0	5.0	3.0	12	9.9
120	53	58	2.3	1.9	P432_0250 LM401U	107	107	268	25.00	25/1	4500	8000	1.7	5.0	3.0	13	8.3
120	105	107	4.5	0.96	P432_0250 LM402U	134	139	268	25.00	25/1	4500	8000	3.1	5.0	3.0	13	9.9
150	43	46	2.7	2.2	P432_0200 LM401U	86	86	268	20.00	20/1	4000	8000	1.8	5.0	3.0	12	8.3
150	84	86	5.3	1.1	P432_0200 LM402U	134	139	268	20.00	20/1	4000	8000	3.1	5.0	3.0	12	9.9
188	34	37	3.2	2.6	P432_0160 LM401U	69	69	260	16.00	16/1	4000	8000	1.8	5.0	3.0	12	8.3
188	67	68	6.4	1.3	P432_0160 LM402U	130	130	260	16.00	16/1	4000	8000	3.1	5.0	3.0	12	9.9
250	26	28	5.6	2.3	P432_0120 LM401U	51	51	200	12.00	12/1	3500	7000	1.8	5.0	3.0	11	8.3
250	50	51	11	1.2	P432_0120 LM402U	100	100	200	12.00	12/1	3500	7000	3.1	5.0	3.0	11	9.9
300	43	44	1.4	1.4	P431_0100 LM402U	94	94	230	10.00	10/1	4000	8000	3.1	4.0	2.0	9.1	8.6
300	59	60	1.9	1.0	P431_0100 LM403U	115	115	230	10.00	10/1	4000	8000	4.4	4.0	2.0	9.1	10
375	34	35	1.6	2.0	P431_0080 LM402U	75	75	239	8.000	8/1	4000	8000	3.1	4.0	2.0	9.8	8.6
375	47	48	2.2	1.5	P431_0080 LM403U	100	100	239	8.000	8/1	4000	8000	4.4	4.0	2.0	9.8	10
375	74	78	3.4	0.95	P431_0080 LM503U	120	125	239	8.000	8/1	4000	8000	10	4.0	2.0	9.8	13
429	30	31	1.7	2.5	P431_0070 LM402U	66	66	271	7.000	7/1	4000	8000	3.1	4.0	2.0	11	8.6
429	41	42	2.4	1.8	P431_0070 LM403U	87	87	271	7.000	7/1	4000	8000	4.4	4.0	2.0	11	10
429	64	68	3.7	1.2	P431_0070 LM503U	135	138	271	7.000	7/1	4000	8000	10	4.0	2.0	11	13
600	21	22	2.6	3.5	P431_0050 LM402U	47	47	277	5.000	5/1	3700	7000	3.2	4.0	2.0	13	8.6
600	29	30	3.6	2.5	P431_0050 LM403U	62	62	277	5.000	5/1	3700	7000	4.5	4.0	2.0	13	10
600	46	49	5.6	1.6	P431_0050 LM503U	99	99	277	5.000	5/1	3700	7000	11	4.0	2.0	13	13
600	66	75	8.1	1.1	P431_0050 LM505U	139	145	277	5.000	5/1	3700	7000	17	4.0	2.0	13	18
750	17	17	3.4	4.3	P431_0040 LM402U	38	38	240	4.000	4/1	3300	6500	3.4	4.0	2.0	13	8.6
750	24	24	4.7	3.2	P431_0040 LM403U	50	50	240	4.000	4/1	3300	6500	4.7	4.0	2.0	13	10
750	37	39	7.3	2.0	P431_0040 LM503U	79	79	240	4.000	4/1	3300	6500	11	4.0	2.0	13	13
750	53	60	11	1.4	P431_0040 LM505U	120	124	240	4.000	4/1	3300	6500	17	4.0	2.0	13	18
1000	13	13	8.2	3.4	P431_0030 LM402U	28	28	200	3.000	3/1	3000	6000	3.8	4.0	2.0	13	8.6
1000	18	18	11	2.5	P431_0030 LM403U	37	37	200	3.000	3/1	3000	6000	5.1	4.0	2.0	13	10
1000	28	29	18	1.6	P431_0030 LM503U	59	59	200	3.000	3/1	3000	6000	11	4.0	2.0	13	13
1000	40	45	25	1.1	P431_0030 LM505U	93	93	200	3.000	3/1	3000	6000	18	4.0	2.0	13	18
P5 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 360 Nm)																	
43	293	299	1.1	0.90	P532_0700 LM402U	345	357	690	70.00	70/1	4200	8000	3.1	4.0	2.0	30	13
54	235	239	1.5	0.94	P532_0560 LM402U	288	288	575	56.00	56/1	4000	8000	3.1	4.0	2.0	25	13
60	209	214	1.4	1.2	P532_0500 LM402U	352	352	704	50.00	50/1	4000	8000	3.1	4.0	2.0	32	13
60	288	294	1.9	0.88	P532_0500 LM403U	352	352	704	50.00	50/1	4000	8000	4.4	4.0	2.0	32	14
75	168	171	2.0	1.2	P532_0400 LM402U	300	300	600	40.00	40/1	4000	8000	3.1	4.0	2.0	31	13

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2accHT} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2red}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
P5 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 360 Nm)																	
75	230	235	2.7	0.88	P532_0400 LM403U	300	300	600	40.00	40/1	4000	8000	4.4	4.0	2.0	31	14
86	147	150	1.6	1.8	P532_0350 LM402U	323	323	704	35.00	35/1	4000	8000	3.1	4.0	2.0	33	13
86	201	206	2.2	1.3	P532_0350 LM403U	352	352	704	35.00	35/1	4000	8000	4.4	4.0	2.0	33	14
86	315	335	3.5	0.84	P532_0350 LM503U	352	352	704	35.00	35/1	4000	8000	10	4.0	2.0	33	17
94	134	137	1.9	1.8	P532_0320 LM402U	295	295	624	32.00	32/1	3500	7000	3.2	4.0	2.0	25	13
94	184	188	2.5	1.3	P532_0320 LM403U	312	363	624	32.00	32/1	3500	7000	4.5	4.0	2.0	25	14
94	288	306	4.0	0.83	P532_0320 LM503U	312	363	624	32.00	32/1	3500	7000	11	4.0	2.0	25	17
107	117	120	2.1	2.0	P532_0280 LM402U	258	258	600	28.00	28/1	4000	8000	3.1	4.0	2.0	32	13
107	161	165	2.8	1.4	P532_0280 LM403U	300	300	600	28.00	28/1	4000	8000	4.4	4.0	2.0	32	14
107	252	268	4.4	0.92	P532_0280 LM503U	300	300	600	28.00	28/1	4000	8000	10	4.0	2.0	32	17
120	105	107	1.9	2.5	P532_0250 LM402U	230	230	710	25.00	25/1	3700	7000	3.2	4.0	2.0	33	13
120	144	147	2.7	1.8	P532_0250 LM403U	305	305	710	25.00	25/1	3700	7000	4.5	4.0	2.0	33	14
120	225	239	4.2	1.2	P532_0250 LM503U	355	357	710	25.00	25/1	3700	7000	11	4.0	2.0	33	17
150	84	86	2.2	3.0	P532_0200 LM402U	184	184	710	20.00	20/1	3500	7000	3.3	4.0	2.0	33	13
150	115	118	3.1	2.2	P532_0200 LM403U	244	244	710	20.00	20/1	3500	7000	4.6	4.0	2.0	33	14
150	180	191	4.8	1.4	P532_0200 LM503U	355	364	710	20.00	20/1	3500	7000	11	4.0	2.0	33	17
150	260	294	7.0	0.96	P532_0200 LM505U	355	364	710	20.00	20/1	3500	7000	17	4.0	2.0	33	22
188	67	68	2.9	3.3	P532_0160 LM402U	147	147	600	16.00	16/1	3500	7000	3.3	4.0	2.0	33	13
188	92	94	3.9	2.4	P532_0160 LM403U	195	195	600	16.00	16/1	3500	7000	4.6	4.0	2.0	33	14
188	144	153	6.1	1.5	P532_0160 LM503U	300	300	600	16.00	16/1	3500	7000	11	4.0	2.0	33	17
188	208	235	8.9	1.1	P532_0160 LM505U	300	300	600	16.00	16/1	3500	7000	17	4.0	2.0	33	22
250	50	51	6.0	2.4	P532_0120 LM402U	111	111	400	12.00	12/1	3000	6000	3.4	4.0	2.0	31	13
250	69	71	8.3	1.7	P532_0120 LM403U	146	146	400	12.00	12/1	3000	6000	4.7	4.0	2.0	31	14
250	108	115	13	1.1	P532_0120 LM503U	200	200	400	12.00	12/1	3000	6000	11	4.0	2.0	31	17
300	92	98	3.5	1.6	P531_0100 LM503U	198	198	575	10.00	10/1	3700	7000	11	3.0	1.0	26	15
300	133	150	5.0	1.1	P531_0100 LM505U	288	288	575	10.00	10/1	3700	7000	17	3.0	1.0	26	19
375	74	78	3.7	2.4	P531_0080 LM503U	158	158	592	8.000	8/1	3700	7000	11	3.0	1.0	25	15
375	106	120	5.3	1.6	P531_0080 LM505U	249	249	592	8.000	8/1	3700	7000	17	3.0	1.0	25	19
375	150	165	7.5	1.2	P531_0080 LM704U	296	300	592	8.000	8/1	3700	7000	37	3.0	1.0	25	25
375	199	231	10	0.88	P531_0080 LM706U	296	300	592	8.000	8/1	3700	7000	54	3.0	1.0	25	32
429	64	68	4.1	2.9	P531_0070 LM503U	138	138	667	7.000	7/1	3700	7000	11	3.0	1.0	31	15
429	93	105	6.0	2.0	P531_0070 LM505U	218	218	667	7.000	7/1	3700	7000	17	3.0	1.0	31	19
429	131	144	8.4	1.4	P531_0070 LM704U	280	280	667	7.000	7/1	3700	7000	37	3.0	1.0	31	25
429	174	202	11	1.1	P531_0070 LM706U	333	380	667	7.000	7/1	3700	7000	54	3.0	1.0	31	32
600	46	49	6.2	4.0	P531_0050 LM503U	99	99	568	5.000	5/1	3500	7000	11	3.0	1.0	35	15
600	66	75	8.9	2.8	P531_0050 LM505U	156	156	568	5.000	5/1	3500	7000	17	3.0	1.0	35	19
600	93	103	13	2.0	P531_0050 LM704U	200	200	700	5.000	5/1	3500	7000	37	3.0	1.0	35	25
600	125	145	17	1.5	P531_0050 LM706U	298	298	700	5.000	5/1	3500	7000	55	3.0	1.0	35	32
750	37	39	8.1	5.0	P531_0040 LM503U	79	79	457	4.000	4/1	3000	6000	12	3.0	1.0	35	15
750	53	60	12	3.5	P531_0040 LM505U	124	124	457	4.000	4/1	3000	6000	18	3.0	1.0	35	19
750	75	82	16	2.5	P531_0040 LM704U	160	160	600	4.000	4/1	3000	6000	38	3.0	1.0	35	25
750	100	116	22	1.8	P531_0040 LM706U	238	238	600	4.000	4/1	3000	6000	55	3.0	1.0	35	32
1000	28	29	20	3.8	P531_0030 LM503U	59	59	343	3.000	3/1	2500	5000	13	3.0	1.0	35	15
1000	40	45	29	2.6	P531_0030 LM505U	93	93	343	3.000	3/1	2500	5000	20	3.0	1.0	35	19
1000	56	62	41	1.9	P531_0030 LM704U	120	120	400	3.000	3/1	2500	5000	39	3.0	1.0	35	25
1000	75	87	54	1.4	P531_0030 LM706U	179	179	400	3.000	3/1	2500	5000	57	3.0	1.0	35	32
P7 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 810 Nm)																	
43	630	670	1.4	0.88	P732_0700 LM503U	762	799	1525	70.00	70/1	3700	7000	11	4.0	2.0	60	24
54	504	536	1.7	0.99	P732_0560 LM503U	650	650	1300	56.00	56/1	3700	7000	11	4.0	2.0	57	24
60	450	478	1.7	1.2	P732_0500 LM503U	770	805	1540	50.00	50/1	3700	7000	11	4.0	2.0	63	24
60	651	735	2.4	0.85	P732_0500 LM505U	770	805	1540	50.00	50/1	3700	7000	17	4.0	2.0	63	29
75	360	383	2.3	1.3	P732_0400 LM503U	700	700	1400	40.00	40/1	3700	7000	11	4.0	2.0	63	24
75	521	588	3.3	0.87	P732_0400 LM505U	700	700	1400	40.00	40/1	3700	7000	17	4.0	2.0	63	29
86	315	335	2.0	1.7	P732_0350 LM503U	677	677	1540	35.00	35/1	3700	7000	11	4.0	2.0	64	24
86	456	514	2.9	1.2	P732_0350 LM505U	770	805	1540	35.00	35/1	3700	7000	17	4.0	2.0	64	29
86	641	707	4.1	0.84	P732_0350 LM704U	770	805	1540	35.00	35/1	3700	7000	37	4.0	2.0	64	35
94	288	306	2.4	1.6	P732_0320 LM503U	619	619	1460	32.00	32/1	3000	6000	11	4.0	2.0	57	24
94	416	470	3.5	1.1	P732_0320 LM505U	730	730	1460	32.00	32/1	3000	6000	18	4.0	2.0	57	29
94	586	646	5.0	0.80	P732_0320 LM704U	730	730	1460	32.00	32/1	3000	6000	37	4.0	2.0	57	35
107	252	268	2.3	2.1	P732_0280 LM503U	542	542	1400	28.00	28/1	3700	7000	11	4.0	2.0	64	24
107	364	412	3.3	1.5	P732_0280 LM505U	700	700	1400	28.00	28/1	3700	7000	17	4.0	2.0	64	29
107	513	566	4.6	1.1	P732_0280 LM704U	700	700	1400	28.00	28/1	3700	7000	37	4.0	2.0	64	35
120	225	239	2.6	2.2	P732_0250 LM503U	484	484	1610	25.00	25/1	3500	7000	11	4.0	2.0	64	24
120	325	367	3.7	1.5	P732_0250 LM505U	762	762	1610	25.00	25/1	3500	7000	17	4.0	2.0	64	29
120	458	505	5.3	1.1	P732_0250 LM704U	805	805	1610	25.00	25/1	3500	7000	37	4.0	2.0	64	35

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2accHT} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2red}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
P7 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 810 Nm)																	
120	610	708	7.0	0.82	P732_0250 LM706U	805	805	1610	25.00	25/1	3500	7000	54	4.0	2.0	64	42
150	180	191	3.2	2.6	P732_0200 LM503U	387	387	1610	20.00	20/1	3000	6000	11	4.0	2.0	64	24
150	260	294	4.6	1.8	P732_0200 LM505U	609	609	1610	20.00	20/1	3000	6000	18	4.0	2.0	64	29
150	366	404	6.4	1.3	P732_0200 LM704U	782	782	1610	20.00	20/1	3000	6000	37	4.0	2.0	64	35
150	488	566	8.5	0.94	P732_0200 LM706U	805	805	1610	20.00	20/1	3000	6000	55	4.0	2.0	64	42
188	144	153	3.6	3.1	P732_0160 LM503U	310	310	1400	16.00	16/1	3000	6000	11	4.0	2.0	65	24
188	208	235	5.2	2.2	P732_0160 LM505U	487	487	1400	16.00	16/1	3000	6000	18	4.0	2.0	65	29
188	293	323	7.3	1.5	P732_0160 LM704U	626	626	1400	16.00	16/1	3000	6000	38	4.0	2.0	65	35
188	390	453	9.8	1.2	P732_0160 LM706U	700	700	1400	16.00	16/1	3000	6000	55	4.0	2.0	65	42
250	108	115	6.3	2.7	P732_0120 LM503U	232	232	1000	12.00	12/1	2500	5000	12	4.0	2.0	62	24
250	156	176	9.2	1.9	P732_0120 LM505U	366	366	1000	12.00	12/1	2500	5000	18	4.0	2.0	62	29
250	220	242	13	1.3	P732_0120 LM704U	469	469	1000	12.00	12/1	2500	5000	38	4.0	2.0	62	35
250	293	340	17	1.0	P732_0120 LM706U	500	500	1000	12.00	12/1	2500	5000	55	4.0	2.0	62	42
300	187	206	4.3	1.5	P731_0100 LM704U	399	399	1150	10.00	10/1	3000	6000	37	3.0	1.0	55	31
300	249	289	5.8	1.1	P731_0100 LM706U	575	575	1150	10.00	10/1	3000	6000	54	3.0	1.0	55	38
375	150	165	4.5	2.3	P731_0080 LM704U	319	319	1336	8.000	8/1	3000	6000	37	3.0	1.0	58	31
375	199	231	6.0	1.8	P731_0080 LM706U	476	476	1336	8.000	8/1	3000	6000	55	3.0	1.0	58	38
429	131	144	4.8	2.9	P731_0070 LM704U	280	280	1561	7.000	7/1	3000	6000	38	3.0	1.0	61	31
429	174	202	6.4	2.2	P731_0070 LM706U	417	417	1561	7.000	7/1	3000	6000	55	3.0	1.0	61	38
600	93	103	7.2	4.1	P731_0050 LM704U	200	200	1119	5.000	5/1	2700	5500	39	3.0	1.0	67	31
600	125	145	9.6	3.1	P731_0050 LM706U	298	298	1119	5.000	5/1	2700	5500	56	3.0	1.0	67	38
750	100	116	13	3.9	P731_0040 LM706U	238	238	899	4.000	4/1	2500	5000	58	3.0	1.0	69	38
1000	56	62	21	4.4	P731_0030 LM704U	120	120	676	3.000	3/1	2200	4000	46	3.0	1.0	68	31
1000	75	87	28	3.3	P731_0030 LM706U	179	179	676	3.000	3/1	2200	4000	63	3.0	1.0	68	38
P8 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1840 Nm)																	
43	1281	1414	1.4	0.97	P832_0700 LM704U	1610	1610	3220	70.00	70/1	3000	6000	37	4.0	2.0	164	52
54	1025	1131	1.9	0.98	P832_0560 LM704U	1380	1380	2760	56.00	56/1	3000	6000	38	4.0	2.0	159	52
60	915	1010	1.6	1.4	P832_0500 LM704U	1840	1956	3230	50.00	50/1	3000	6000	37	4.0	2.0	173	52
60	1219	1416	2.1	1.0	P832_0500 LM706U	1840	2000	3230	50.00	50/1	3000	6000	54	4.0	2.0	173	59
75	732	808	2.2	1.4	P832_0400 LM704U	1564	1564	3200	40.00	40/1	3000	6000	37	4.0	2.0	168	52
75	975	1132	3.0	1.0	P832_0400 LM706U	1600	1600	3200	40.00	40/1	3000	6000	55	4.0	2.0	168	59
86	641	707	1.9	2.0	P832_0350 LM704U	1369	1369	3230	35.00	35/1	3000	6000	38	4.0	2.0	176	52
86	854	991	2.6	1.5	P832_0350 LM706U	1840	2000	3230	35.00	35/1	3000	6000	55	4.0	2.0	176	59
94	586	646	2.5	1.7	P832_0320 LM704U	1252	1252	3049	32.00	32/1	2700	5000	40	4.0	2.0	159	52
94	780	906	3.3	1.3	P832_0320 LM706U	1525	1595	3049	32.00	32/1	2700	5000	57	4.0	2.0	159	59
107	513	566	2.7	2.0	P832_0280 LM704U	1095	1095	3200	28.00	28/1	3000	5000	38	4.0	2.0	172	52
107	683	793	3.6	1.5	P832_0280 LM706U	1600	1600	3200	28.00	28/1	3000	5000	55	4.0	2.0	172	59
120	458	505	2.3	2.8	P832_0250 LM704U	978	978	3230	25.00	25/1	2900	5000	39	4.0	2.0	177	52
120	610	708	3.0	2.1	P832_0250 LM706U	1457	1457	3230	25.00	25/1	2900	5000	56	4.0	2.0	177	59
150	366	404	2.6	3.4	P832_0200 LM704U	782	782	3230	20.00	20/1	2700	5000	40	4.0	2.0	177	52
150	488	566	3.4	2.6	P832_0200 LM706U	1166	1166	3230	20.00	20/1	2700	5000	58	4.0	2.0	177	59
188	293	323	3.5	3.4	P832_0160 LM704U	626	626	3200	16.00	16/1	2700	5000	41	4.0	2.0	174	52
188	390	453	4.7	2.6	P832_0160 LM706U	933	933	3200	16.00	16/1	2700	5000	58	4.0	2.0	174	59
250	220	242	5.2	3.6	P832_0120 LM704U	469	469	2400	12.00	12/1	2200	4500	42	4.0	2.0	168	52
250	293	340	6.9	2.7	P832_0120 LM706U	699	699	2400	12.00	12/1	2200	4500	60	4.0	2.0	168	59

7.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gearbox dimensions, motor dimensions and geared motor dimensions.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

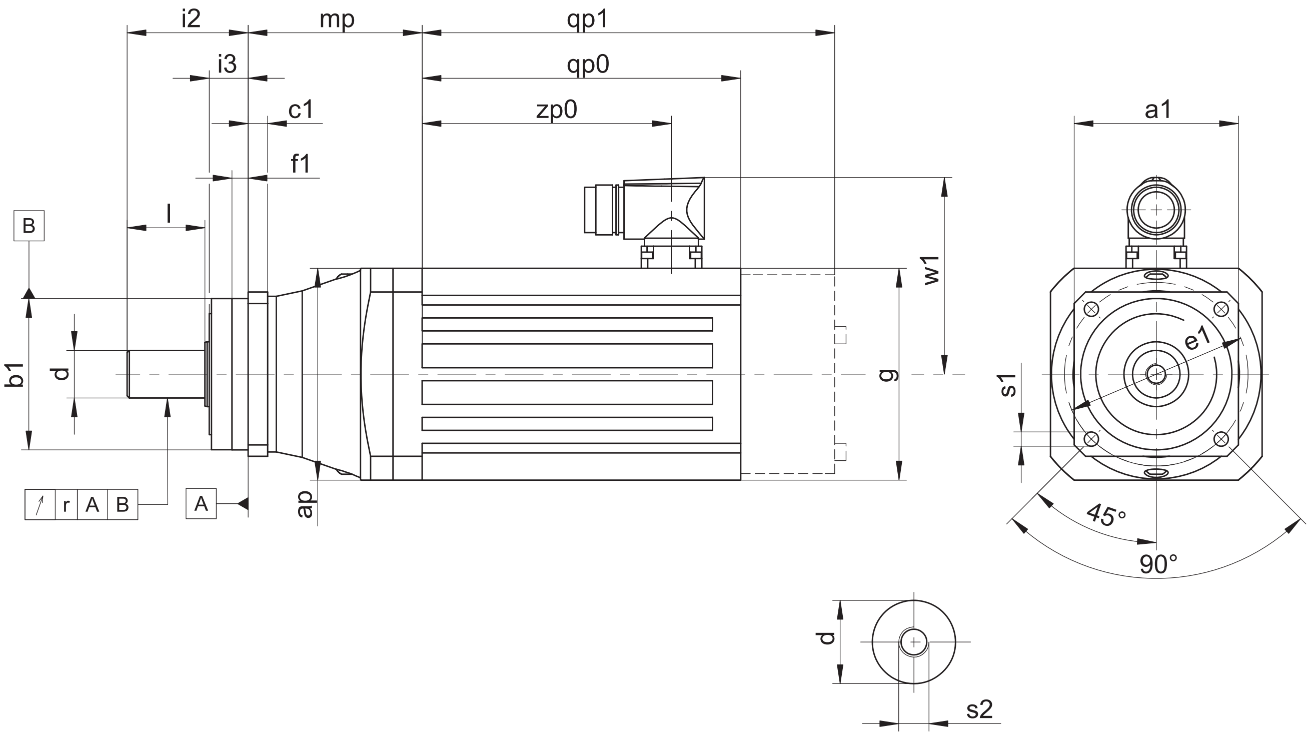
Tolerances

Solid shaft	Tolerance
Fit	ISO k6
Feather keys	DIN 6885-1, high form A
Balancing	With half feather key

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

7.3.1 G shaft design (solid shaft without feather key)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
–	The radial runout specification applies only to the reinforced bearing D.		

Dimensions of gearboxes

Type	□a1	⌀b1	c1	⌀d	⌀e1	f1	i2	i3	l	r	⌀s1	s2
P331	72	60_{h6}	7	16_{k6}	75	7.5	48	18	28	0.025	5.5	M5
P431	76	70_{h6}	9	22_{k6}	85	7.5	56	18	36	0.025	6.6	M8
P432	76	70_{h6}	9	22_{k6}	85	7.5	56	18	36	0.025	6.6	M8
P531	101	90_{h6}	10	32_{k6}	120	15.0	88	28	58	0.030	9.0	M12
P532	101	90_{h6}	10	32_{k6}	120	15.0	88	28	58	0.030	9.0	M12
P731	144	130_{h6}	15	40_{k6}	165	3.5	112	27	82	0.035	11.0	M16
P732	144	130_{h6}	15	40_{k6}	165	3.5	112	27	82	0.035	11.0	M16
P832	190	160_{h6}	15	55_{k6}	215	10.0	112	27	82	0.035	13.5	M20

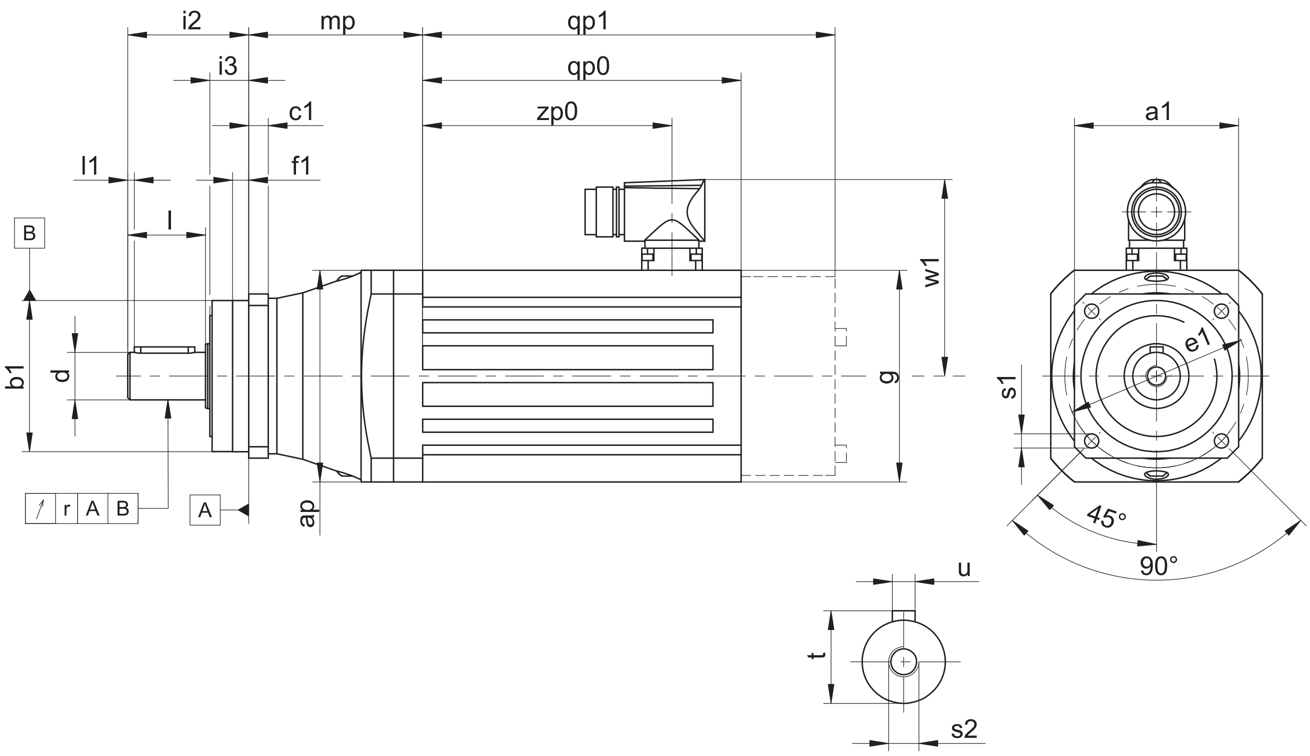
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152.0	91.0	76.5
LM402U	98	147.5	191.0	91.0	115.5
LM403U	98	178.5	222.0	91.0	146.5
LM503U	115	186.5	234.5	100.0	156.0
LM505U	115	256.5	304.5	100.0	226.0
LM704U	145	236.5	295.5	115.0	204.0
LM706U	145	306.5	365.5	115.0	274.0

Dimensions of geared motors

Type	LM4		LM5		LM7	
	ap	mp	ap	mp	ap	mp
P331	□98	65.0	–	–	–	–
P431	□98	80.5	□115	80.0	–	–
P432	⌀100	114.0	–	–	–	–
P531	–	–	□115	80.5	□145	83.5
P532	⌀120	122.5	⌀120	122.0	–	–
P731	–	–	–	–	□158	100.5
P732	–	–	⌀150	148.5	⌀150	151.5
P832	–	–	–	–	⌀204	192.5

7.3.2 P shaft design (solid shaft with feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

– The radial runout specification applies only to the reinforced bearing D.

Dimensions of gearboxes

Type	□a1	∅b1	c1	∅d	∅e1	f1	i2	i3	l	l1	r	∅s1	s2	t	u
P331	72	60_{h6}	7	16_{k6}	75	7.5	48	18	28	2	0.025	5.5	M5	18.0	A5×5×22
P431	76	70_{h6}	9	22_{k6}	85	7.5	56	18	36	3	0.025	6.6	M8	24.5	A6×6×28
P432	76	70_{h6}	9	22_{k6}	85	7.5	56	18	36	3	0.025	6.6	M8	24.5	A6×6×28
P531	101	90_{h6}	10	32_{k6}	120	15.0	88	28	58	3	0.030	9.0	M12	35.0	A10×8×50
P532	101	90_{h6}	10	32_{k6}	120	15.0	88	28	58	3	0.030	9.0	M12	35.0	A10×8×50
P731	144	130_{h6}	15	40_{k6}	165	3.5	112	27	82	4	0.035	11.0	M16	43.0	A12×8×70
P732	144	130_{h6}	15	40_{k6}	165	3.5	112	27	82	4	0.035	11.0	M16	43.0	A12×8×70
P832	190	160_{h6}	15	55_{k6}	215	10.0	112	27	82	6	0.035	13.5	M20	59.0	A16×10×70

Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152.0	91.0	76.5
LM402U	98	147.5	191.0	91.0	115.5
LM403U	98	178.5	222.0	91.0	146.5
LM503U	115	186.5	234.5	100.0	156.0
LM505U	115	256.5	304.5	100.0	226.0
LM704U	145	236.5	295.5	115.0	204.0
LM706U	145	306.5	365.5	115.0	274.0

Dimensions of geared motors

Type	LM4		LM5		LM7	
	ap	mp	ap	mp	ap	mp
P331	□98	65.0	–	–	–	–
P431	□98	80.5	□115	80.0	–	–
P432	∅100	114.0	–	–	–	–
P531	–	–	□115	80.5	□145	83.5
P532	∅120	122.5	∅120	122.0	–	–
P731	–	–	–	–	□158	100.5
P732	–	–	∅150	148.5	∅150	151.5
P832	–	–	–	–	∅204	192.5

7.4 Type designation

In this chapter, you can find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

P	4	3	1	S	G	S	S	0100	LM403U

Explanation

Code	Designation	Design
P	Type	Planetary gearbox
4	Size	4 (example)
3	Generation	Generation 3
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
G	Shaft	Solid shaft without feather key
P		Solid shaft with feather key
S	Bearing	Standard bearing
D		Axially reinforced bearing (P3 – P9)
Z		Radially reinforced bearing (P3 – P9)[1]
S	Backlash	Standard
R		Reduced
0100	Transmission ratio (i x 10)	i = 10 (example)
LM403U	Motor	LM Lean motor

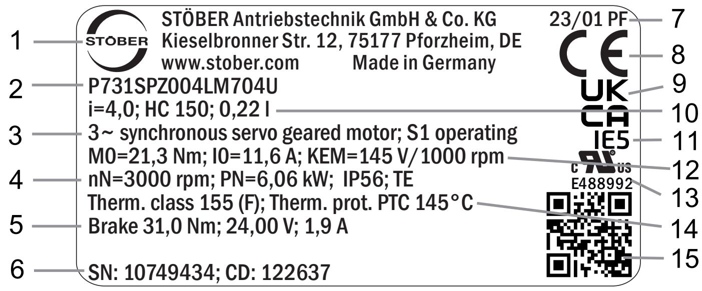
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [2]
- Radial shaft seal rings at the output made of NBR or FKM, see the chapter [7.6.3]
- The position of the plug connector, see the chapter [7.5.4]
- For reverse operation of the output shaft from ± 20° to ± 90° and horizontal installation, see the chapter [7.6.4]

[1] Not for reduced-backlash option.

7.4.1 Nameplate

In the following figure, the nameplate of a P731_LM704 Lean geared motor is explained as an example.

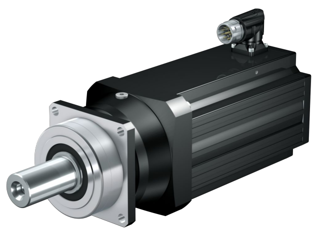


Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004LM704U	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=3000 rpm PN=6.06 kW IP56 TE	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004
5	Brake 31.0 Nm 24.00 V 1.9 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749434 CD: 122637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	IE5	IEC energy efficiency
12	M0=21.3 Nm I0=11.6 A KEM=145 V/1000 rpm	Stall torque Stall current Voltage constant
13	cURus E488992	cURus test symbol, registered under UL number E488992
14	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
15	QR code	Link to product information

7.5 Product description

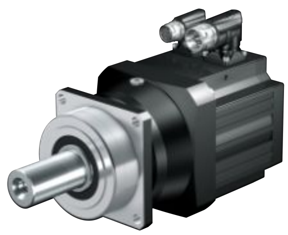
7.5.1 Input options

LM Lean motor



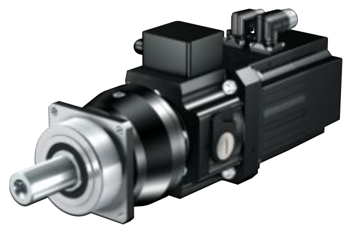
Catalog ID 443016_en

EZ synchronous servo motor



Catalog ID 442437_en

MB motor adapter +
EZ synchronous servo motor



Catalog ID 443311_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

7.5.2 Installation conditions

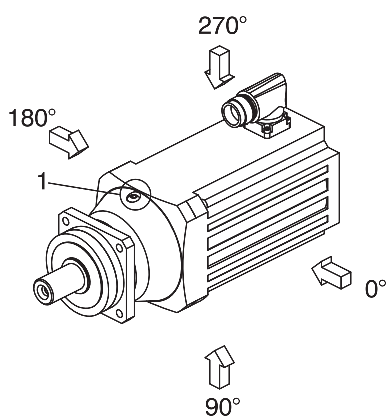
The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 12.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

7.5.3 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

7.5.4 Position of the plug connector



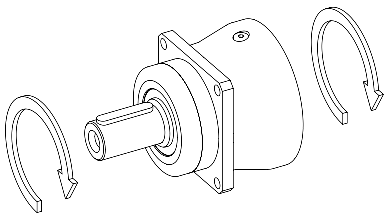
In the standard version, the plug connector is attached in the 270° position (relative to the oil drain plug (1) of the planetary gearbox). Indicate variations for your geared motor in the order.

7.5.5 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} single-stage	97%
η_{get} two-stage	95%
Protection class:[2]	
Gearbox	IP65
Motor	IP56, optionally IP66

7.5.6 Direction of rotation

The input and output rotate in the same direction.



7.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

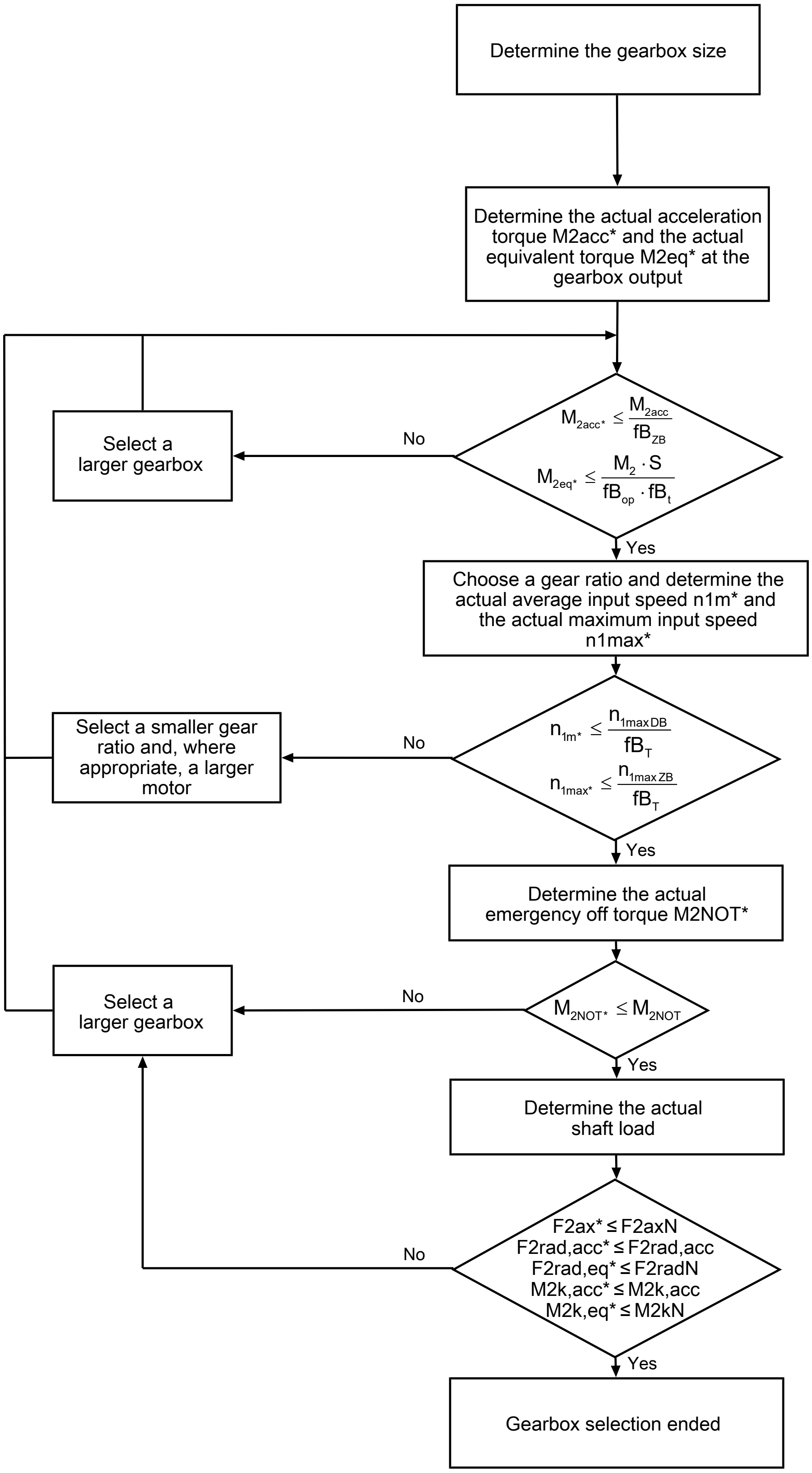
An explanation of the formula symbols can be found in the Chapter [▸ 15.1].

The formula symbols for values actually present in the application are marked with *.

[2] Observe the protection class of all the components.

7.6.1 Drive selection

Drive selection for gearboxes

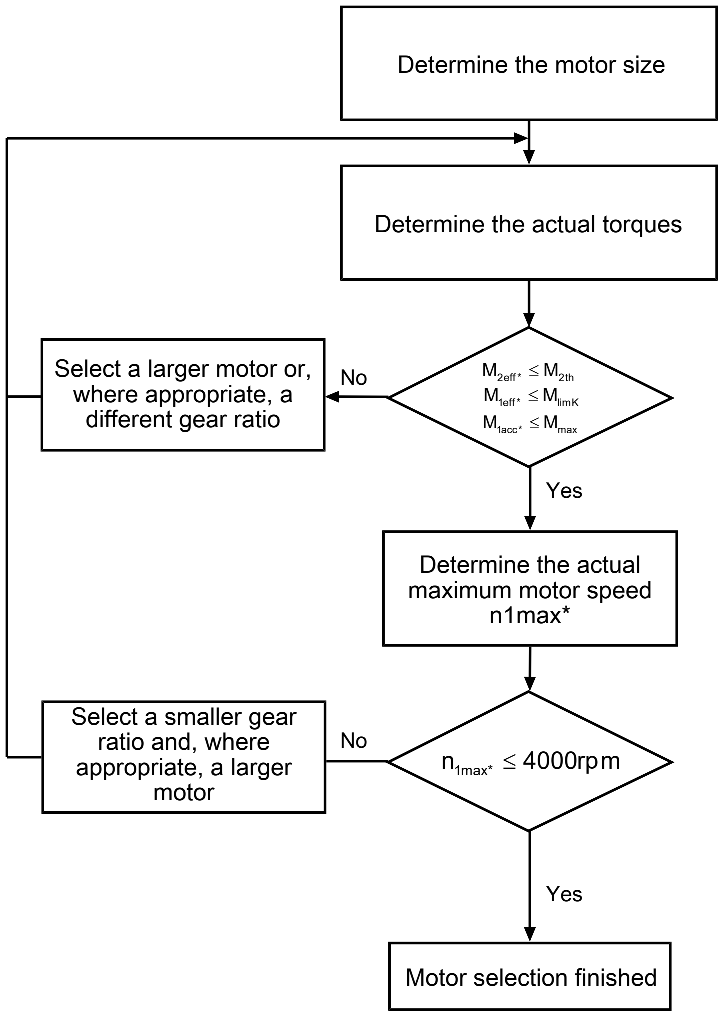


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc} (M_{2accHT} for reduced backlash), M_{2NOT}, M_2 and S.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

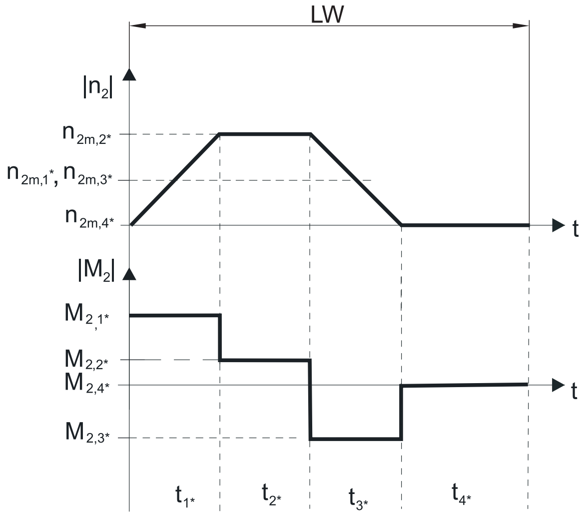
Drive selection for motors



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [▶ 2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc*} = J_{tot} \cdot \frac{\Delta n_2}{9{,}55 \cdot \Delta t} + M_{L*}$$

$$M_{1acc*} = \frac{M_{2acc*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9{,}55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m*} = n_{2m*} \cdot i$$

$$n_{2m*} = \frac{|n_{2m,1*}| \cdot t_{1*} + \ldots + |n_{2m,n*}| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If $t_{1*} + \ldots + t_{3*} \geq 6$ min, calculate n_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}{}^2 + \ldots + t_{n*} \cdot M_{2,n*}{}^2}{t_{1*} + \ldots + t_{n*}}}$$

Calculation of the actual emergency off torque

$$M_{2NOT*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L*}$$

Calculation of the actual equivalent torque

$$M_{2eq*} = \sqrt[3]{\frac{|n_{2m,1*}| \cdot t_{1*} \cdot |M_{2,1*}{}^3| + \ldots + |n_{2m,n*}| \cdot t_{n*} \cdot |M_{2,n*}{}^3|}{|n_{2m,1*}| \cdot t_{1*} + \ldots + |n_{2m,n*}| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle $ED_{10} > 50\%$ and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

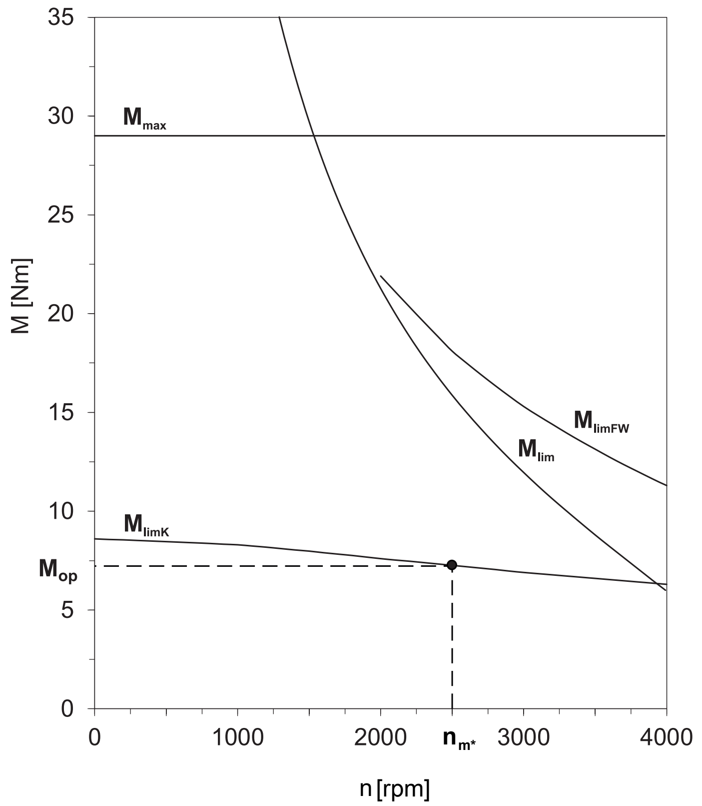
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter [▸ 2.3]. Note the size of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gearbox torques (M_{2acc}, M_{2NOT}) in the selection tables.

7.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m*} \leq 100$ rpm ($F^{2axN} = F_{2ax100}$; $F_{2radN} = F_{2rad100}$; $M_{2kN} = M_{2k100}$)
- Only if radial forces on the gearbox are stabilized by its pilots (housing, flange shaft)

Permitted shaft loads for standard bearing S

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
P2	17.0	500	1200	1300	34	36
P3	17.5	1000	2500	2500	79	79
P4	18.5	1500	4000	4500	146	164
P5	19.5	2300	6500	7000	315	340
P7	23.0	2900	8500	9000	544	576
P8	24.5	4700	13000	18000	852	1179
P9	33.0	6000	18000	27000	1539	2309

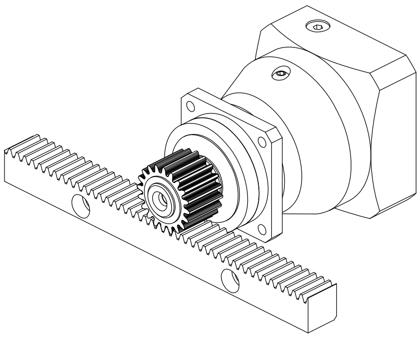


Fig. 1: Recommendation for bearing assignment S (e.g. for straight-cut gearing)

Permitted shaft loads for axially reinforced bearing D

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
P3	20.0	2500	2750	2750	94	94
P4	22.5	4000	4500	5000	182	203
P5	25.5	6000	7000	8000	382	436
P7	29.0	10000	9500	10000	665	700
P8	32.0	15500	15000	18000	1095	1314
P9	44.0	25000	20000	30000	1930	2895

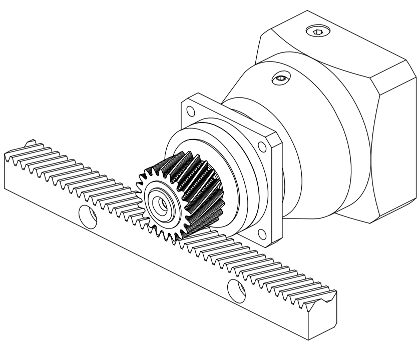


Fig. 2: Recommendation for bearing assignment D (e.g. for helical gearing)

Permitted shaft loads for radially reinforced bearing Z

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
P3	17.5	600	3000	3000	95	95
P4	18.5	1000	5000	5000	183	183
P5	19.5	1600	8000	8000	388	388
P7	23.0	2000	10000	10000	640	640
P8	24.5	3600	18000	18000	1179	1179
P9	33.0	5000	27000	35000	2309	2993

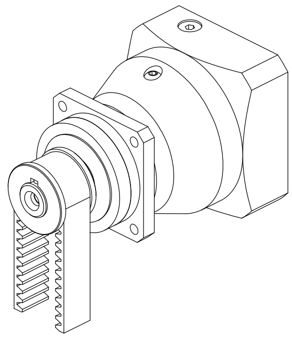


Fig. 3: Recommendation for bearing assignment Z (e.g. for belt drives)

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m^*} > 100 rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table "Permitted shaft loads" in this chapter.

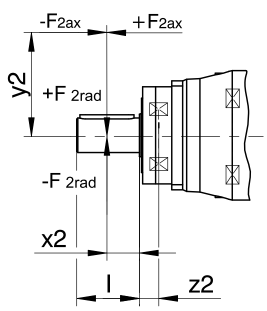


Fig. 4: Force application points

The specified values for $F_{2rad100}$ and $F_{2rad,acc}$ refer to an application of force at the center of the output shaft: $x_2 = l/2$.

Shaft dimensions can be found in the "Dimensional drawings" chapter.

The following applies to other force application points:

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax100}, $F_{2rad100}$ and M_{2k100} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{2k,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{2k,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{2rad,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{2rad,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

The following apply to the bearing service life L_{10h} ($ED_{10} \leq 40\%$):

L_{10h} > 10000 h with 1 < M_{2kN}/M_{2k^*} < 1.25

L_{10h} > 20000 h with 1.25 < M_{2kN}/M_{2k^*} < 1.5

L_{10h} > 30000 h with 1.5 < M_{2kN}/M_{2k^*}

For different duty cycles:

$$L_{10h} > L_{10h(ED_{10}=40\%)} \cdot \frac{40\%}{ED_{10}}$$

7.6.3 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

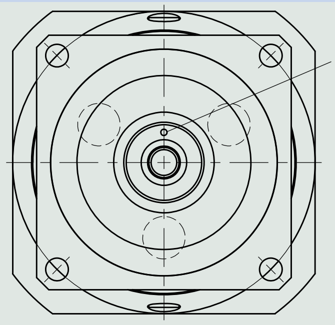
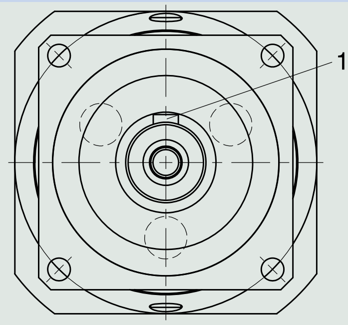
- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

7.6.4 Reverse operation

To ensure lubrication for circulating gearing parts during cyclic reverse operation from ± 20° to ± 90° at the output, pay careful attention to the position of the output shaft for the horizontal mounting of the gearbox, as shown in the diagrams below. The images show the center position of reverse operation. Cyclic reverse operation ≤ ± 20° on request.

Solid shaft without feather key	Solid shaft with feather key
	
1 Position of the mark: top	1 Position of the feather key: top

Notes

- If you use the solid shaft without a feather key (G), you must note the position of the mark during assembly.
- As an alternative, you can use the solid shaft with a feather key (P). In that case, the feather key functions for position orientation. For a backlash-free connection, also use a clamp.

7.7 Additional documentation

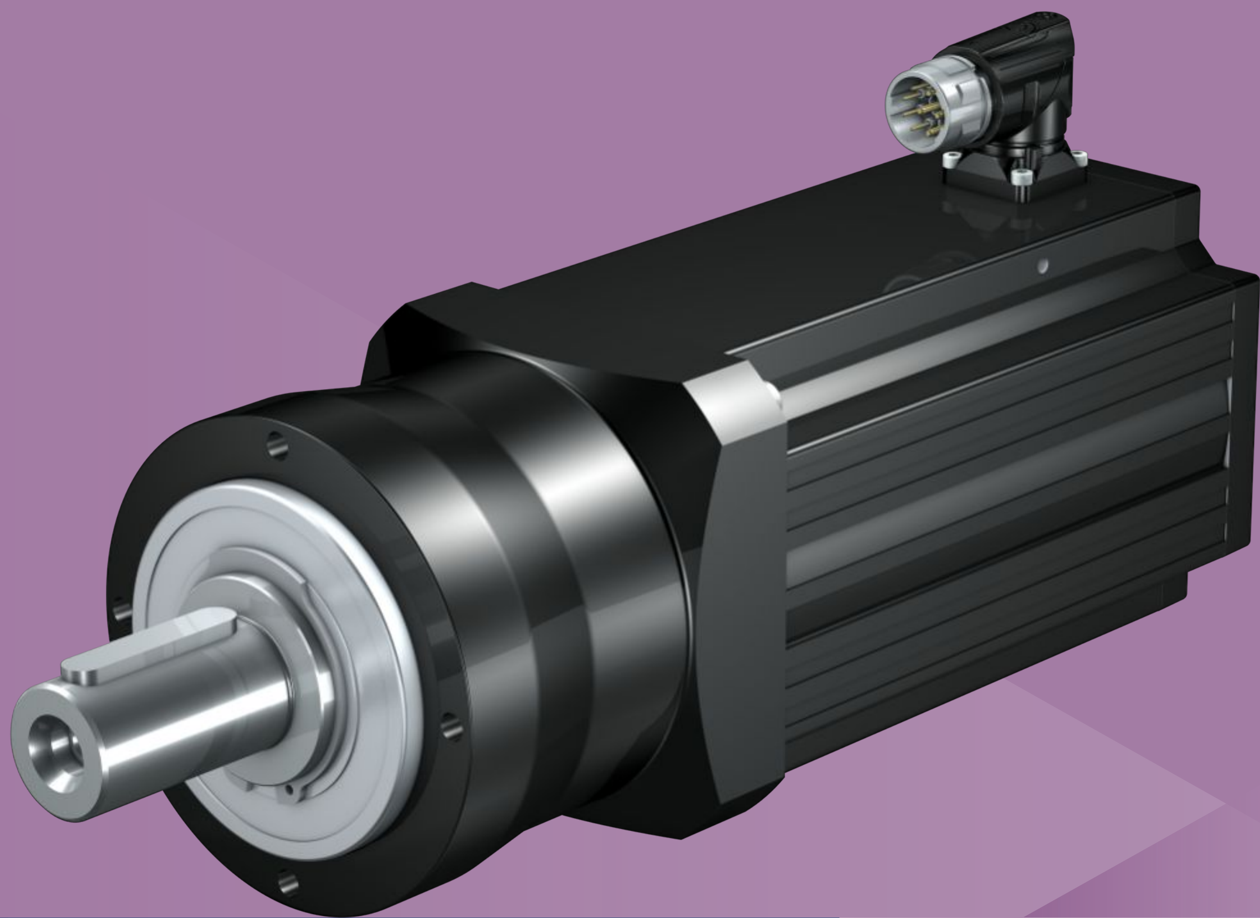
Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual gearboxes, geared motors P23 – P93	443356_en

8 PE planetary geared motors

Table of contents



8 Planetary geared motors

PE

8.1 Overview

Cost-efficient helical-geared planetary geared motors

Features

Power density	★★★☆☆
Backlash	★★★☆☆
Price category	€
Shaft load	★★☆☆☆
Smooth operation	★★★☆☆
Torsional stiffness	★★★☆☆
Mass moment of inertia	★★★★★
Helical gearing	✓
Maintenance-free	✓
Any mounting position	✓
Non-contact sealing at the input	✓
Compact and dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

i	3 – 35
M_{2acc}	13 – 250 Nm
$\Delta\phi_2$	8 – 10 arcmin
η_{get}	95 – 97 %

8.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Drives with convection-cooled motors

An explanation of the formula symbols can be found in the Chapter [▹ 15.1].

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
PE3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 47 Nm)															
300	22	24	1.7	0.95	PE321_0100 LM401U	44	90	10.00	10/1	4000	7000	1.7	8.0	3.7	5.9
429	15	17	2.6	1.4	PE321_0070 LM401U	31	90	7.000	7/1	4000	7000	1.7	8.0	4.1	5.9
600	11	12	4.1	1.8	PE321_0050 LM401U	22	90	5.000	5/1	3700	7000	1.7	8.0	4.5	5.9
600	21	22	8.0	0.93	PE321_0050 LM402U	47	90	5.000	5/1	3700	7000	3.1	8.0	4.5	7.5
750	8.7	9.4	5.5	2.2	PE321_0040 LM401U	17	85	4.000	4/1	3700	7000	1.8	8.0	4.4	5.9
750	17	17	11	1.1	PE321_0040 LM402U	38	85	4.000	4/1	3700	7000	3.1	8.0	4.4	7.5
1000	6.5	7.1	9.0	2.5	PE321_0030 LM401U	13	64	3.000	3/1	3500	6000	1.9	8.0	3.5	5.9
1000	13	13	18	1.3	PE321_0030 LM402U	28	64	3.000	3/1	3500	6000	3.2	8.0	3.5	7.5
PE4 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 100 Nm)															
107	60	65	4.2	0.86	PE422_0280 LM401U	95	190	28.00	28/1	4000	7000	1.7	10.0	13	8.5
120	53	58	4.5	0.97	PE422_0250 LM401U	103	200	25.00	25/1	3700	7000	1.8	10.0	13	8.5
150	43	46	5.0	1.2	PE422_0200 LM401U	86	200	20.00	20/1	3700	7000	1.8	10.0	13	8.5
188	34	37	5.6	1.5	PE422_0160 LM401U	69	190	16.00	16/1	3700	7000	1.8	10.0	13	8.5
300	43	44	1.8	1.1	PE421_0100 LM402U	92	184	10.00	10/1	3600	6000	3.1	8.0	10	8.9
300	59	60	2.4	0.81	PE421_0100 LM403U	92	184	10.00	10/1	3600	6000	4.4	8.0	10	10
429	30	31	2.7	1.6	PE421_0070 LM402U	66	200	7.000	7/1	3600	6000	3.1	8.0	13	8.9
429	41	42	3.7	1.2	PE421_0070 LM403U	87	200	7.000	7/1	3600	6000	4.4	8.0	13	10
600	21	22	4.3	2.1	PE421_0050 LM402U	47	200	5.000	5/1	3400	6000	3.2	8.0	14	8.9
600	29	30	6.0	1.5	PE421_0050 LM403U	62	200	5.000	5/1	3400	6000	4.5	8.0	14	10
600	46	49	9.3	0.97	PE421_0050 LM503U	99	200	5.000	5/1	3400	6000	11	8.0	14	13
750	17	17	5.8	2.6	PE421_0040 LM402U	38	200	4.000	4/1	3400	6000	3.3	8.0	14	8.9
750	24	24	7.9	1.9	PE421_0040 LM403U	50	200	4.000	4/1	3400	6000	4.6	8.0	14	10
750	37	39	12	1.2	PE421_0040 LM503U	79	200	4.000	4/1	3400	6000	11	8.0	14	13
750	53	60	18	0.82	PE421_0040 LM505U	100	200	4.000	4/1	3400	6000	17	8.0	14	18
1000	13	13	10	2.8	PE421_0030 LM402U	28	180	3.000	3/1	3000	5500	3.6	8.0	12	8.9
1000	18	18	14	2.0	PE421_0030 LM403U	37	180	3.000	3/1	3000	5500	4.9	8.0	12	10
1000	28	29	21	1.3	PE421_0030 LM503U	59	180	3.000	3/1	3000	5500	11	8.0	12	13
1000	40	45	31	0.90	PE421_0030 LM505U	90	180	3.000	3/1	3000	5500	17	8.0	12	18
PE5 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 250 Nm)															
86	147	150	3.3	0.87	PE522_0350 LM402U	250	500	35.00	35/1	3600	6000	3.1	10.0	33	14
107	117	120	3.7	1.1	PE522_0280 LM402U	240	480	28.00	28/1	3600	6000	3.1	10.0	33	14
120	105	107	4.0	1.2	PE522_0250 LM402U	230	500	25.00	25/1	3400	6000	3.2	10.0	33	14
120	144	147	5.4	0.88	PE522_0250 LM403U	250	500	25.00	25/1	3400	6000	4.5	10.0	33	16
150	84	86	4.4	1.5	PE522_0200 LM402U	184	500	20.00	20/1	3400	6000	3.3	10.0	33	14
150	115	118	6.1	1.1	PE522_0200 LM403U	244	500	20.00	20/1	3400	6000	4.6	10.0	33	16
188	67	68	5.0	1.9	PE522_0160 LM402U	147	480	16.00	16/1	3400	6000	3.4	10.0	33	14
188	92	94	6.8	1.4	PE522_0160 LM403U	195	480	16.00	16/1	3400	6000	4.7	10.0	33	16
188	144	153	11	0.88	PE522_0160 LM503U	240	480	16.00	16/1	3400	6000	11	10.0	33	19
300	92	98	4.8	1.1	PE521_0100 LM503U	198	440	10.00	10/1	3000	5000	11	8.0	27	16
429	64	68	7.3	1.6	PE521_0070 LM503U	138	500	7.000	7/1	2800	5000	11	8.0	32	16
429	93	105	11	1.1	PE521_0070 LM505U	218	500	7.000	7/1	2800	5000	17	8.0	32	21
600	46	49	11	2.2	PE521_0050 LM503U	99	432	5.000	5/1	2600	5000	11	8.0	36	16
600	66	75	16	1.6	PE521_0050 LM505U	156	432	5.000	5/1	2600	5000	17	8.0	36	21
600	93	103	22	1.1	PE521_0050 LM704U	200	500	5.000	5/1	2600	5000	37	8.0	36	27
600	125	145	30	0.83	PE521_0050 LM706U	250	500	5.000	5/1	2600	5000	54	8.0	36	34
750	37	39	14	2.8	PE521_0040 LM503U	79	345	4.000	4/1	2600	5000	11	8.0	37	16
750	53	60	21	1.9	PE521_0040 LM505U	124	345	4.000	4/1	2600	5000	18	8.0	37	21
750	75	82	29	1.4	PE521_0040 LM704U	160	500	4.000	4/1	2600	5000	37	8.0	37	27
750	100	116	39	1.0	PE521_0040 LM706U	238	500	4.000	4/1	2600	5000	55	8.0	37	34
1000	28	29	29	2.6	PE521_0030 LM503U	59	259	3.000	3/1	2500	4500	12	8.0	33	16
1000	40	45	42	1.8	PE521_0030 LM505U	93	259	3.000	3/1	2500	4500	19	8.0	33	21
1000	56	62	60	1.3	PE521_0030 LM704U	120	360	3.000	3/1	2500	4500	38	8.0	33	27
1000	75	87	79	0.96	PE521_0030 LM706U	179	360	3.000	3/1	2500	4500	56	8.0	33	34

8.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gearbox dimensions, motor dimensions and geared motor dimensions.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

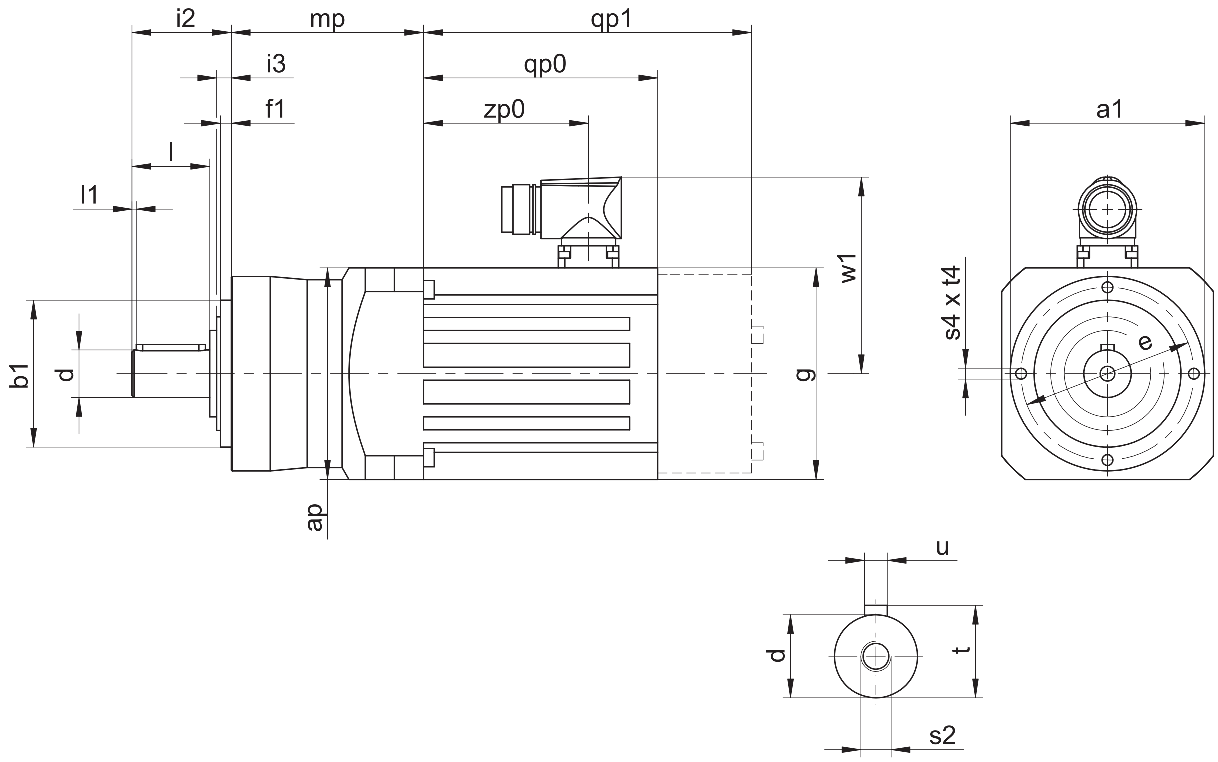
Tolerances

Solid shaft	Tolerance
Fit	ISO k6
Feather keys	DIN 6885-1, high form A
Balancing	With half feather key

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

8.3.1 P shaft design (solid shaft with feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

Dimensions of gearboxes

Type	∅a1	∅b1	∅d	∅e	f1	i2	i3	l	l1	s2	s4	t	t4	u
PE321	70	52_{h6}	16_{k6}	62	5	36	6.0	28	2	M5	M5	18.0	10	A5×5×22
PE421	90	68_{h6}	22_{k6}	80	5	46	6.5	36	2	M8	M6	24.5	12	A6×6×32
PE422	90	68_{h6}	22_{k6}	80	5	46	6.5	36	2	M8	M6	24.5	12	A6×6×32
PE521	120	90_{h6}	32_{k6}	108	6	70	8.0	58	4	M12	M8	35.0	16	A10×8×50
PE522	120	90_{h6}	32_{k6}	108	6	70	8.0	58	4	M12	M8	35.0	16	A10×8×50

Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152.0	91	76.5
LM402U	98	147.5	191.0	91	115.5
LM403U	98	178.5	222.0	91	146.5
LM503U	115	186.5	234.5	100	156.0
LM505U	115	256.5	304.5	100	226.0
LM704U	145	236.5	295.5	115	204.0
LM706U	145	306.5	365.5	115	274.0

Dimensions of geared motors

Type	LM4		LM5		LM7	
	ap	mp	ap	mp	ap	mp
PE321	□98	83.0	–	–	–	–
PE421	□98	89.0	□115	91.5	–	–
PE422	∅100	125.5	–	–	–	–
PE521	–	–	∅120	110.0	□145	113.0
PE522	∅120	152.0	∅120	151.5	–	–

8.4 Type designation

In this chapter, you can find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

PE	4	2	2	S	P	S	S	0120	LM403U

Explanation

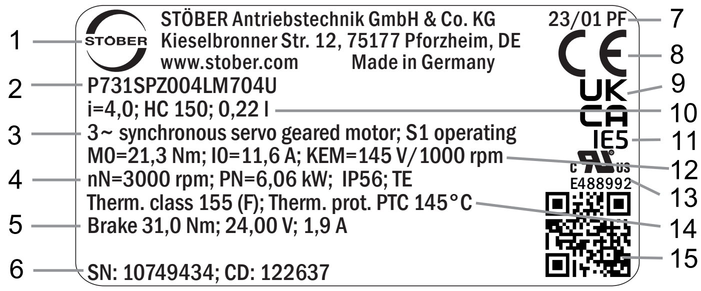
Code	Designation	Design
PE	Type	Planetary gearbox
4	Size	4 (example)
2	Generation	Generation 2
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
P	Shaft	Solid shaft with feather key
S	Bearing	Standard bearing
S	Backlash	Standard
0120	Transmission ratio (i x 10)	i = 12 (example)
LM403U	Motor	LM Lean motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▷ 2]

8.4.1 Nameplate

In the following figure, the nameplate of a P731_LM704 Lean geared motor is explained as an example.



Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004LM704U	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=3000 rpm PN=6.06 kW IP56 TE	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004
5	Brake 31.0 Nm 24.00 V 1.9 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749434 CD: 122637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	IE5	IEC energy efficiency
12	M0=21.3 Nm I0=11.6 A KEM=145 V/1000 rpm	Stall torque Stall current Voltage constant
13	cURus E488992	cURus test symbol, registered under UL number E488992
14	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
15	QR code	Link to product information

8.5 Product description

8.5.1 Input options

LM Lean motor

Catalog ID 443016_en

EZ synchronous servo motor

Catalog ID 442437_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

8.5.2 Installation conditions

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

8.5.3 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

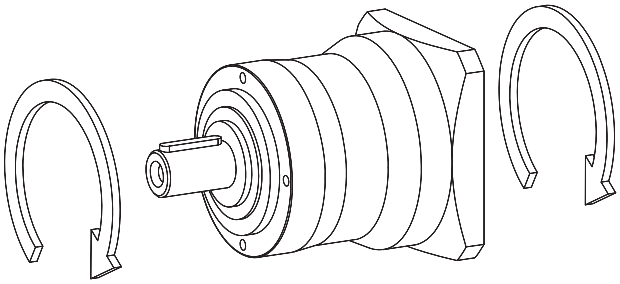
8.5.4 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} single-stage	97%
η_{get} two-stage	95%
Protection class:[1]	
Gearbox	IP64
Motor	IP56, optionally IP66

[1] Observe the protection class of all the components.

8.5.5 Direction of rotation

The input and output rotate in the same direction.



8.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

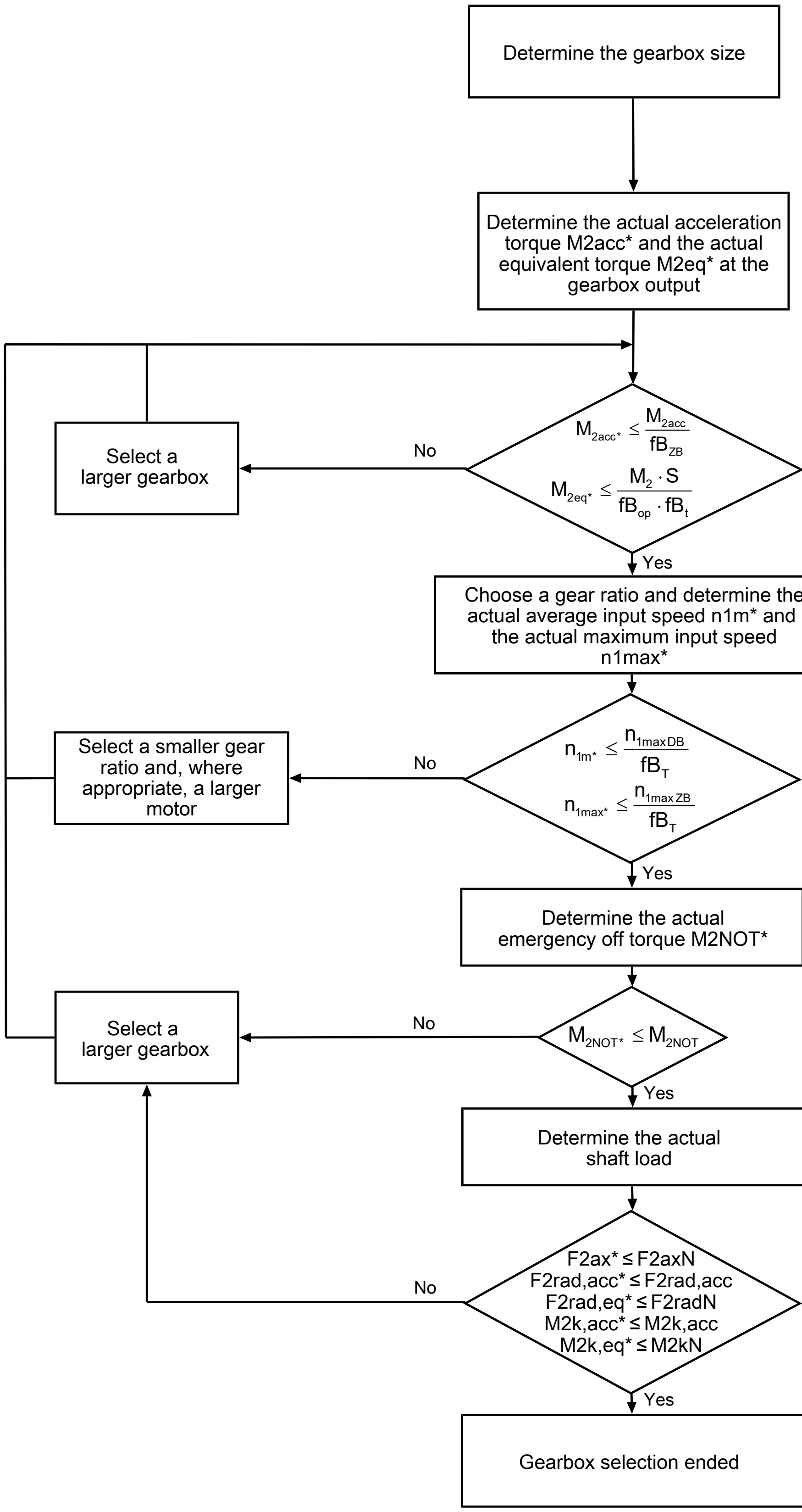
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in the Chapter [15.1].

The formula symbols for values actually present in the application are marked with *.

8.6.1 Drive selection

Drive selection for gearboxes

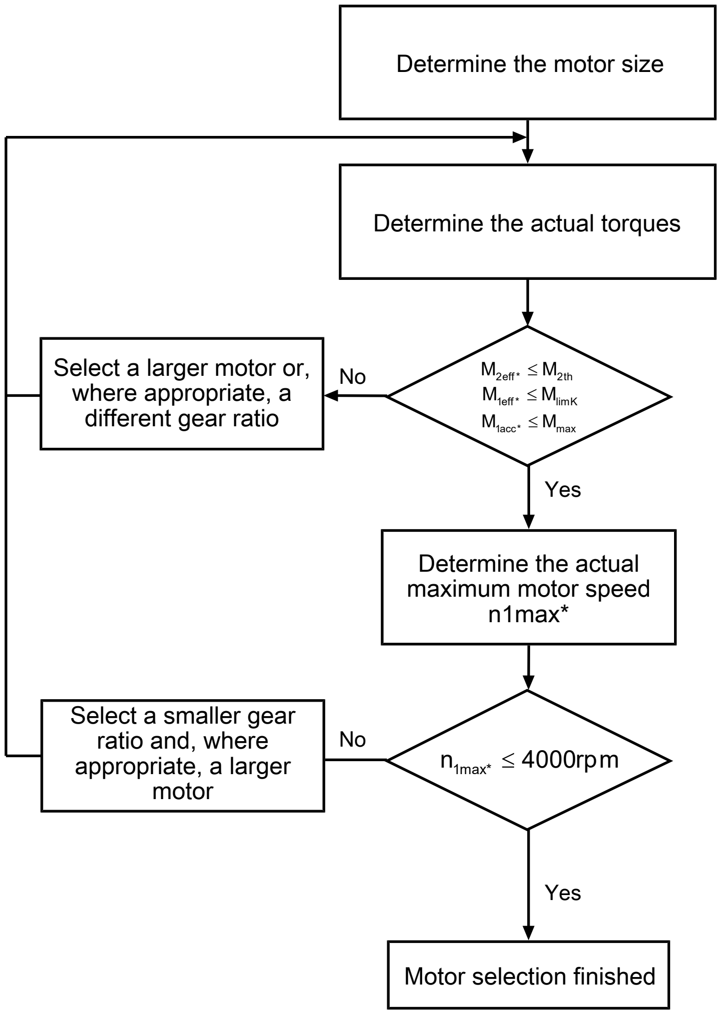


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_2 and S.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

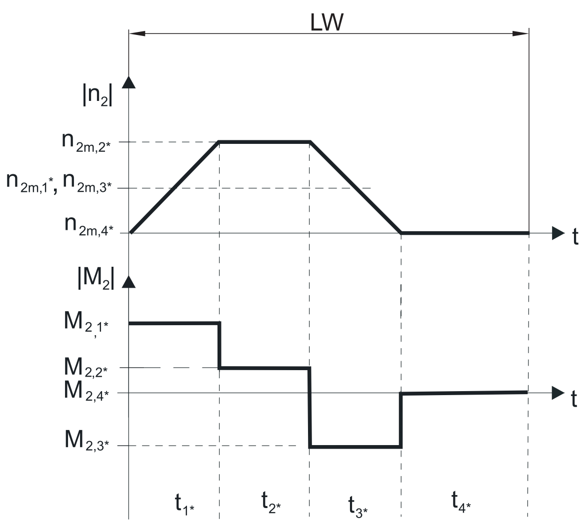
Drive selection for motors



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [▷ 2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc^*} = J_{tot} \cdot \frac{\Delta n_2}{9{,}55 \cdot \Delta t} + M_{L^*}$$

$$M_{1acc^*} = \frac{M_{2acc^*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9{,}55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If t_{1^*} + ... + $t_{3^*} \geq 6$ min, calculate n_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}^{\;2} + \ldots + t_{n^*} \cdot M_{2,n^*}^{\;2}}{t_{1^*} + \ldots + t_{n^*}}}$$

Calculation of the actual emergency off torque

$$M_{2NOT^*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L^*}$$

Calculation of the actual equivalent torque

$$M_{2eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{2,1^*}^{\;3}\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{2,n^*}^{\;3}\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

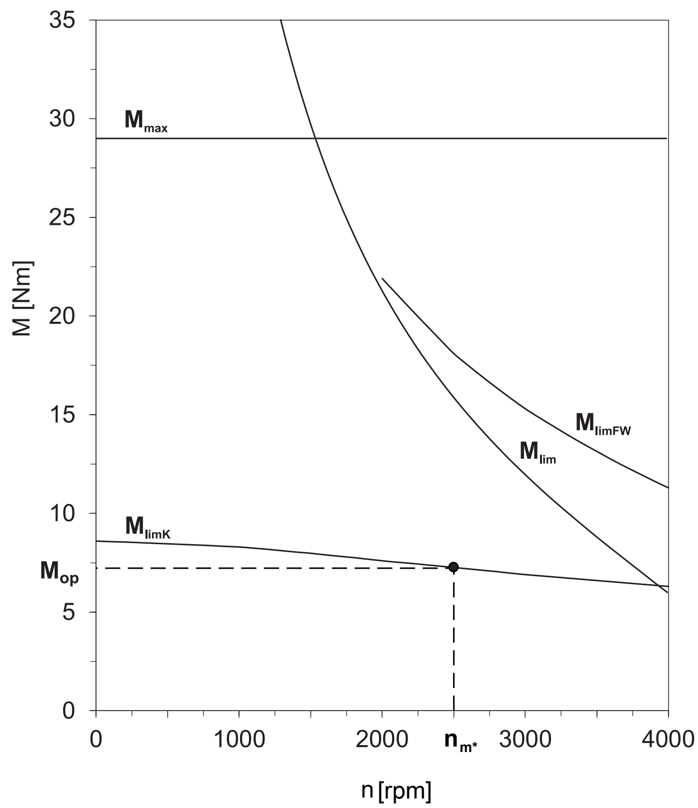
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m^*} can be found in the motor characteristic curve in the chapter [▶ 2.3]. Note the size of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.00
Reversing load cyclic operation	1.00

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gearbox torques (M_{2acc}, M_{2NOT}) in the selection tables.

8.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m*} \leq 100$ rpm ($F^{2axN} = F_{2ax100}$; $F_{2radN} = F_{2rad100}$; $M_{2kN} = M_{2k100}$)
- Only if radial forces on the gearbox are stabilized by its pilots (housing, flange shaft)

Permitted shaft loads for standard bearing S

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
PE2	8.0	400	800	800	13	13
PE3	11.0	800	1600	1600	40	40
PE4	13.0	1900	2400	2400	73	73
PE5	16.0	4000	4600	4600	206	206

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds $n_{2m*} > 100$ rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m*}}{100\text{ rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m*}}{100\text{ rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m*}}{100\text{ rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table "Permitted shaft loads" in this chapter.

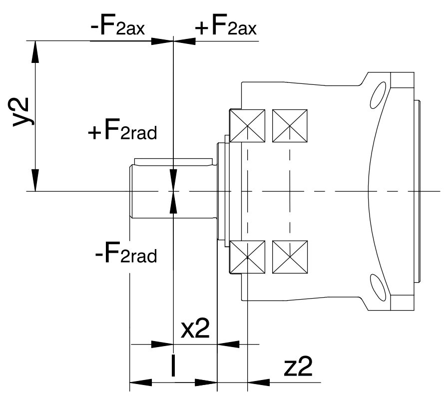


Fig. 1: Force application points

The specified values for $F_{2rad100}$ and $F_{2rad,acc}$ refer to an application of force at the center of the output shaft: $x_2 = l/2$.

Shaft dimensions can be found in the "Dimensional drawings" chapter.

The following applies to other force application points:

$$M_{2k,acc*} = \frac{2 \cdot F_{2ax*} \cdot y_2 + F_{2rad,acc*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax100}, $F_{2rad100}$ and M_{2k100} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{2k,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{2k,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{2rad,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{2rad,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

The following apply to the bearing service life L_{10h} (ED_{10} ≤ 40%):

L_{10h} > 10000 h with 1 < M_{2kN}/M_{2k^*} < 1.25

L_{10h} > 20000 h with 1.25 < M_{2kN}/M_{2k^*} < 1.5

L_{10h} > 30000 h with 1.5 < M_{2kN}/M_{2k^*}

For different duty cycles:

$$L_{10h} > L_{10h(ED_{10}=40\%)} \cdot \frac{40\%}{ED_{10}}$$

8.6.3 Radial shaft seal rings

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

8.7 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual for PE22 – PE52 planetary gearboxes and planetary geared motors	443252_en

9 C helical geared motors

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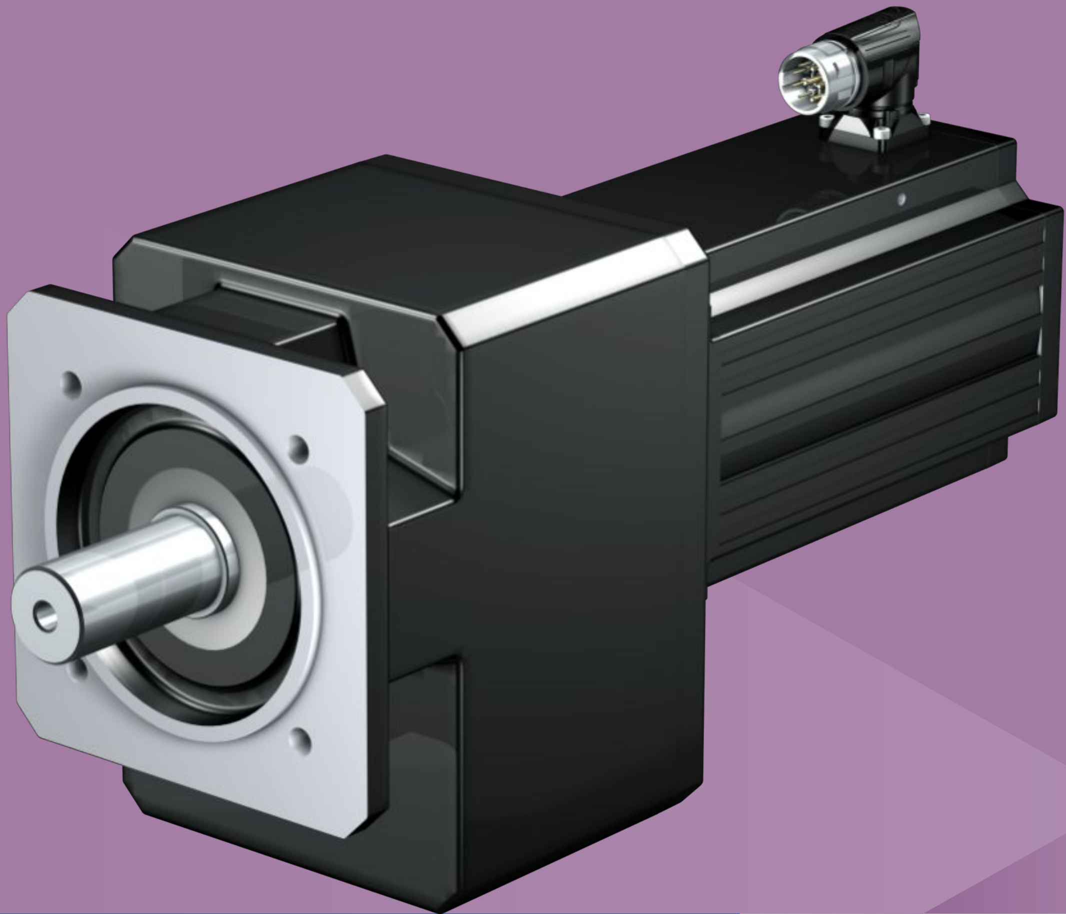


9 **Helical geared motors** C

9.1 Overview

Compact helical geared motors

Features

Power density	★☆☆☆☆
Backlash	★★☆☆☆
Price category	€
Shaft load	★★☆☆☆
Smooth operation	★★★☆☆
Torsional stiffness	★★☆☆☆
Mass moment of inertia	★★★★★
Helical gearing	✓
Maintenance-free (C0 – C5)	✓
FKM seal ring at the input	✓
Reinforced output bearing	✓ (on request)
Compact and dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

i	2 – 212
M_{2acc}	8.7 – 4140 Nm
$\Delta\phi_2$	10 – 20 arcmin
η_{get}	96 – 97 %

9.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Drives with convection-cooled motors
- Weight specification for mounting position EL1, housing design N

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the Chapter [▷ 15.1].

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,3,4	n_{1maxDB} EL5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[Nm/ arcmin]	[kg]
C0 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 72 Nm)																
96	68	74	3.7	0.88	C002_0310 LM401U	72	120	31.26	2813/90	4000	4000	7000	1.7	16.0	1.6	10
107	61	66	3.5	0.98	C002_0280 LM401U	65	120	27.99	2015/72	4000	4000	7000	1.7	16.0	1.6	10
120	55	59	3.3	1.1	C002_0250 LM401U	72	120	24.97	899/36	4000	4000	7000	1.7	16.0	1.6	10
129	51	55	3.2	1.2	C002_0230 LM401U	65	120	23.21	325/14	4000	4000	7000	1.7	16.0	1.6	10
145	45	49	3.0	1.3	C002_0210 LM401U	72	120	20.71	145/7	4000	4000	7000	1.7	16.0	1.6	10
171	38	41	2.7	1.6	C002_0175 LM401U	65	120	17.53	3575/204	4000	4000	6500	1.8	16.0	1.6	10
171	75	76	5.4	0.80	C002_0175 LM402U	65	120	17.53	3575/204	4000	4000	6500	3.1	16.0	1.6	12
192	34	37	2.6	1.8	C002_0155 LM401U	68	114	15.64	1595/102	4000	4000	6500	1.8	16.0	1.6	10
192	67	68	5.1	0.90	C002_0155 LM402U	72	120	15.64	1595/102	4000	4000	6500	3.1	16.0	1.6	12
213	31	33	2.5	2.0	C002_0140 LM401U	62	102	14.08	169/12	4000	4000	6500	1.8	16.0	1.6	10
213	60	61	4.8	1.0	C002_0140 LM402U	65	120	14.08	169/12	4000	4000	6500	3.2	16.0	1.6	12
239	27	30	2.3	2.2	C002_0125 LM401U	55	91	12.57	377/30	4000	4000	6500	1.8	16.0	1.6	10
239	54	55	4.6	1.1	C002_0125 LM402U	72	120	12.57	377/30	4000	4000	6500	3.2	16.0	1.6	12
239	74	75	6.3	0.81	C002_0125 LM403U	72	120	12.57	377/30	4000	4000	6500	4.5	16.0	1.6	14
260	25	27	2.3	2.3	C002_0115 LM401U	50	84	11.54	3185/276	3700	3600	6000	1.9	16.0	1.6	10
260	49	50	4.5	1.2	C002_0115 LM402U	65	120	11.54	3185/276	3700	3600	6000	3.2	16.0	1.6	12
260	68	69	6.2	0.86	C002_0115 LM403U	65	120	11.54	3185/276	3700	3600	6000	4.5	16.0	1.6	14
291	22	24	2.2	2.5	C002_0105 LM401U	45	75	10.30	1421/138	3700	3600	6000	1.9	16.0	1.6	10
291	44	45	4.4	1.3	C002_0105 LM402U	72	120	10.30	1421/138	3700	3600	6000	3.2	16.0	1.6	12
291	61	62	6.1	0.93	C002_0105 LM403U	72	120	10.30	1421/138	3700	3600	6000	4.5	16.0	1.6	14
325	20	22	2.2	2.7	C002_0092 LM401U	40	67	9.228	1495/162	3700	3600	6000	1.9	16.0	1.6	10
325	39	40	4.3	1.4	C002_0092 LM402U	65	120	9.228	1495/162	3700	3600	6000	3.3	16.0	1.6	12
325	54	55	5.9	1.0	C002_0092 LM403U	65	120	9.228	1495/162	3700	3600	6000	4.6	16.0	1.6	14
364	18	19	2.4	2.7	C002_0082 LM401U	36	60	8.235	667/81	3700	3600	6000	1.9	16.0	1.6	10
364	35	36	4.2	1.5	C002_0082 LM402U	72	120	8.235	667/81	3700	3600	6000	3.3	16.0	1.6	12
364	48	49	5.8	1.1	C002_0082 LM403U	72	120	8.235	667/81	3700	3600	6000	4.6	16.0	1.6	14
389	17	18	2.6	2.5	C002_0077 LM401U	34	53	7.714	54/7	4000	4000	7000	1.8	20.0	1.3	10
389	33	34	5.0	1.3	C002_0077 LM402U	65	110	7.714	54/7	4000	4000	7000	3.1	20.0	1.3	12
389	45	46	6.8	0.95	C002_0077 LM403U	65	110	7.714	54/7	4000	4000	7000	4.4	20.0	1.3	14
476	14	15	2.7	2.7	C002_0063 LM401U	28	46	6.300	2035/323	4000	4000	6500	1.8	20.0	1.3	10
476	27	28	4.8	1.5	C002_0063 LM402U	59	110	6.300	2035/323	4000	4000	6500	3.2	20.0	1.3	12
476	37	38	6.6	1.1	C002_0063 LM403U	65	110	6.300	2035/323	4000	4000	6500	4.5	20.0	1.3	14
515	13	14	2.8	2.7	C002_0058 LM401U	25	42	5.824	99/17	4000	4000	6500	1.8	20.0	1.3	10
515	25	25	4.7	1.6	C002_0058 LM402U	55	110	5.824	99/17	4000	4000	6500	3.2	20.0	1.3	12
515	34	35	6.5	1.1	C002_0058 LM403U	65	110	5.824	99/17	4000	4000	6500	4.5	20.0	1.3	14
593	11	12	3.0	2.7	C002_0051 LM401U	22	37	5.063	481/95	4000	4000	6500	1.9	20.0	1.3	10
593	22	22	4.6	1.7	C002_0051 LM402U	48	110	5.063	481/95	4000	4000	6500	3.2	20.0	1.3	12
593	30	30	6.4	1.3	C002_0051 LM403U	63	110	5.063	481/95	4000	4000	6500	4.5	20.0	1.3	14
593	47	49	9.9	0.81	C002_0051 LM503U	65	110	5.063	481/95	4000	4000	6500	11	20.0	1.3	17
641	10	11	3.1	2.7	C002_0047 LM401U	20	34	4.680	117/25	4000	4000	6500	1.9	20.0	1.3	10
641	20	20	4.6	1.8	C002_0047 LM402U	44	110	4.680	117/25	4000	4000	6500	3.2	20.0	1.3	12
641	28	28	6.3	1.3	C002_0047 LM403U	58	110	4.680	117/25	4000	4000	6500	4.5	20.0	1.3	14
641	43	46	9.8	0.85	C002_0047 LM503U	65	110	4.680	117/25	4000	4000	6500	11	20.0	1.3	17
723	9.1	9.8	3.3	2.7	C002_0041 LM401U	18	30	4.149	1813/437	3700	3600	6000	1.9	20.0	1.3	10
723	18	18	4.5	2.0	C002_0041 LM402U	39	110	4.149	1813/437	3700	3600	6000	3.3	20.0	1.3	12
723	24	25	6.1	1.4	C002_0041 LM403U	52	110	4.149	1813/437	3700	3600	6000	4.6	20.0	1.3	14
723	38	41	9.6	0.92	C002_0041 LM503U	65	110	4.149	1813/437	3700	3600	6000	11	20.0	1.3	17
782	8.4	9.0	3.4	2.7	C002_0038 LM401U	17	28	3.835	441/115	3700	3600	6000	1.9	20.0	1.3	10
782	16	17	4.4	2.1	C002_0038 LM402U	36	110	3.835	441/115	3700	3600	6000	3.3	20.0	1.3	12
782	23	23	6.1	1.5	C002_0038 LM403U	48	110	3.835	441/115	3700	3600	6000	4.6	20.0	1.3	14
782	35	37	9.5	0.97	C002_0038 LM503U	65	110	3.835	441/115	3700	3600	6000	11	20.0	1.3	17
904	7.2	7.8	3.7	2.7	C002_0033 LM401U	15	24	3.318	1702/513	3700	3600	6000	2.0	20.0	1.3	10

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2,3,4 [rpm]	n_{1maxDB} EL5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
C0 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 72 Nm)																
904	14	14	4.3	2.3	C002_0033 LM402U	31	97	3.318	1702/513	3700	3600	6000	3.4	20.0	1.3	12
904	20	20	5.9	1.7	C002_0033 LM403U	41	97	3.318	1702/513	3700	3600	6000	4.7	20.0	1.3	14
904	31	32	9.3	1.1	C002_0033 LM503U	62	97	3.318	1702/513	3700	3600	6000	11	20.0	1.3	17
978	6.7	7.2	3.9	2.7	C002_0031 LM401U	13	22	3.067	46/15	3700	3600	6000	2.0	20.0	1.3	10
978	13	13	4.3	2.4	C002_0031 LM402U	29	89	3.067	46/15	3700	3600	6000	3.4	20.0	1.3	12
978	18	18	5.8	1.8	C002_0031 LM403U	38	89	3.067	46/15	3700	3600	6000	4.7	20.0	1.3	14
978	28	30	9.1	1.1	C002_0031 LM503U	60	89	3.067	46/15	3700	3600	6000	11	20.0	1.3	17
1083	12	12	4.2	2.6	C002_0028 LM402U	26	81	2.769	36/13	3500	3000	6000	3.4	20.0	1.3	12
1083	16	17	5.7	1.9	C002_0028 LM403U	34	81	2.769	36/13	3500	3000	6000	4.7	20.0	1.3	14
1083	25	27	9.0	1.2	C002_0028 LM503U	55	81	2.769	36/13	3500	3000	6000	11	20.0	1.3	17
1083	37	42	13	0.83	C002_0028 LM505U	58	81	2.769	36/13	3500	3000	6000	17	20.0	1.3	21
1502	4.4	4.7	4.8	2.7	C002_0020 LM401U	8.7	15	1.997	1480/741	3500	3000	6000	2.4	20.0	1.3	10
1502	8.5	8.7	4.0	3.2	C002_0020 LM402U	19	58	1.997	1480/741	3500	3000	6000	3.8	20.0	1.3	12
1502	12	12	5.4	2.3	C002_0020 LM403U	25	58	1.997	1480/741	3500	3000	6000	5.1	20.0	1.3	14
1502	18	20	8.5	1.5	C002_0020 LM503U	39	58	1.997	1480/741	3500	3000	6000	11	20.0	1.3	17
1502	27	30	12	1.0	C002_0020 LM505U	47	58	1.997	1480/741	3500	3000	6000	17	20.0	1.3	21
C1 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 140 Nm)																
48	136	147	2.9	0.87	C102_0620 LM401U	138	228	62.43	4495/72	4000	3900	6500	1.7	15.0	3.9	15
53	123	133	2.7	0.98	C102_0560 LM401U	138	240	56.36	620/11	4000	3900	6500	1.7	15.0	3.9	15
60	109	118	2.6	1.1	C102_0500 LM401U	138	240	49.94	899/18	4000	3900	6500	1.7	15.0	3.9	15
64	102	111	2.5	1.2	C102_0470 LM401U	138	240	46.91	516/11	4000	3900	6500	1.7	15.0	3.9	15
72	91	98	2.3	1.3	C102_0420 LM401U	138	232	41.57	1247/30	4000	3900	6500	1.7	15.0	3.9	15
86	77	83	2.2	1.6	C102_0350 LM401U	138	217	35.07	2700/77	4000	3900	6500	1.8	15.0	3.9	15
86	150	153	4.2	0.80	C102_0350 LM402U	138	240	35.07	2700/77	4000	3900	6500	3.1	15.0	3.9	17
97	68	73	2.0	1.8	C102_0310 LM401U	136	193	31.07	435/14	4000	3900	6500	1.8	15.0	3.9	15
97	133	136	4.0	0.90	C102_0310 LM402U	138	240	31.07	435/14	4000	3900	6500	3.1	15.0	3.9	17
106	121	124	3.8	0.99	C102_0280 LM402U	138	240	28.36	312/11	4000	3900	6500	3.2	15.0	3.9	17
119	108	110	3.6	1.1	C102_0250 LM402U	138	240	25.13	377/15	4000	3900	6500	3.2	15.0	3.9	17
119	148	151	4.9	0.81	C102_0250 LM403U	138	240	25.13	377/15	4000	3900	6500	4.5	15.0	3.9	19
128	51	55	1.8	2.3	C102_0240 LM401U	103	171	23.52	1035/44	4000	3900	6500	1.9	15.0	3.9	15
128	101	103	3.5	1.2	C102_0240 LM402U	138	240	23.52	1035/44	4000	3900	6500	3.2	15.0	3.9	17
128	138	141	4.8	0.87	C102_0240 LM403U	138	240	23.52	1035/44	4000	3900	6500	4.5	15.0	3.9	19
144	45	49	1.7	2.6	C102_0210 LM401U	91	152	20.84	667/32	4000	3900	6500	1.9	15.0	3.9	15
144	89	91	3.3	1.3	C102_0210 LM402U	138	240	20.84	667/32	4000	3900	6500	3.2	15.0	3.9	17
144	123	125	4.5	0.98	C102_0210 LM403U	138	240	20.84	667/32	4000	3900	6500	4.5	15.0	3.9	19
169	39	42	1.8	2.7	C102_0175 LM401U	78	129	17.73	195/11	3800	3500	6000	2.0	15.0	3.9	15
169	76	77	3.0	1.6	C102_0175 LM402U	138	240	17.73	195/11	3800	3500	6000	3.3	15.0	3.9	17
169	104	106	4.1	1.2	C102_0175 LM403U	138	240	17.73	195/11	3800	3500	6000	4.6	15.0	3.9	19
191	34	37	1.9	2.7	C102_0155 LM401U	69	114	15.71	377/24	3800	3500	6000	2.0	15.0	3.9	15
191	67	69	2.8	1.8	C102_0155 LM402U	138	240	15.71	377/24	3800	3500	6000	3.3	15.0	3.9	17
191	92	94	3.9	1.3	C102_0155 LM403U	138	240	15.71	377/24	3800	3500	6000	4.6	15.0	3.9	19
191	144	153	6.1	0.83	C102_0155 LM503U	138	240	15.71	377/24	3800	3500	6000	11	15.0	3.9	21
213	60	61	2.7	2.0	C102_0140 LM402U	132	240	14.06	2010/143	3800	3500	6000	3.4	15.0	3.9	17
213	83	84	3.7	1.5	C102_0140 LM403U	138	240	14.06	2010/143	3800	3500	6000	4.7	15.0	3.9	19
213	129	137	5.7	0.93	C102_0140 LM503U	138	240	14.06	2010/143	3800	3500	6000	11	15.0	3.9	21
241	53	54	2.5	2.2	C102_0125 LM402U	117	240	12.46	1943/156	3800	3500	6000	3.4	15.0	3.9	17
241	73	75	3.5	1.6	C102_0125 LM403U	138	240	12.46	1943/156	3800	3500	6000	4.7	15.0	3.9	19
241	115	122	5.4	1.0	C102_0125 LM503U	138	240	12.46	1943/156	3800	3500	6000	11	15.0	3.9	21
256	26	28	2.2	2.7	C102_0115 LM401U	51	85	11.72	1160/99	3600	3100	6000	2.2	15.0	3.9	15
256	50	51	2.5	2.3	C102_0115 LM402U	110	240	11.72	1160/99	3600	3100	6000	3.5	15.0	3.9	17
256	69	70	3.4	1.7	C102_0115 LM403U	138	240	11.72	1160/99	3600	3100	6000	4.8	15.0	3.9	19
256	108	114	5.4	1.1	C102_0115 LM503U	138	240	11.72	1160/99	3600	3100	6000	11	15.0	3.9	21
289	23	24	2.3	2.7	C102_0105 LM401U	45	76	10.38	841/81	3600	3100	6000	2.2	15.0	3.9	15
289	44	45	2.5	2.5	C102_0105 LM402U	98	240	10.38	841/81	3600	3100	6000	3.6	15.0	3.9	17
289	61	62	3.4	1.8	C102_0105 LM403U	129	240	10.38	841/81	3600	3100	6000	4.9	15.0	3.9	19
289	95	101	5.3	1.2	C102_0105 LM503U	138	240	10.38	841/81	3600	3100	6000	11	15.0	3.9	21
289	138	156	7.6	0.82	C102_0105 LM505U	138	240	10.38	841/81	3600	3100	6000	17	15.0	3.9	26
322	40	41	2.4	2.7	C102_0093 LM402U	88	240	9.326	3180/341	3600	3100	6000	3.7	15.0	3.9	17
322	55	56	3.3	2.0	C102_0093 LM403U	116	240	9.326	3180/341	3600	3100	6000	5.0	15.0	3.9	19
322	86	91	5.2	1.3	C102_0093 LM503U	138	240	9.326	3180/341	3600	3100	6000	11	15.0	3.9	21
322	124	140	7.5	0.88	C102_0093 LM505U	138	240	9.326	3180/341	3600	3100	6000	17	15.0	3.9	26
363	35	36	2.4	3.0	C102_0083 LM402U	78	240	8.263	1537/186	3600	3100	6000	3.7	15.0	3.9	17
363	49	50	3.2	2.1	C102_0083 LM403U	103	240	8.263	1537/186	3600	3100	6000	5.0	15.0	3.9	19
363	76	81	5.1	1.4	C102_0083 LM503U	138	240	8.263	1537/186	3600	3100	6000	11	15.0	3.9	21

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} [rpm]	[rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
										EL1,2,3,4	EL5,6					
C1 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 140 Nm)																
363	110	124	7.3	0.95	C102_0083 LM505U	138	240	8.263	1537/186	3600	3100	6000	17	15.0	3.9	26
385	17	18	2.7	2.7	C102_0078 LM401U	34	57	7.796	3243/416	4000	3900	6500	1.9	18.0	3.1	15
385	33	34	2.8	2.6	C102_0078 LM402U	73	209	7.796	3243/416	4000	3900	6500	3.3	18.0	3.1	17
385	46	47	3.8	1.9	C102_0078 LM403U	97	209	7.796	3243/416	4000	3900	6500	4.6	18.0	3.1	19
385	72	76	5.9	1.2	C102_0078 LM503U	130	209	7.796	3243/416	4000	3900	6500	11	18.0	3.1	21
385	104	117	8.6	0.84	C102_0078 LM505U	130	209	7.796	3243/416	4000	3900	6500	17	18.0	3.1	26
473	14	15	3.0	2.7	C102_0063 LM401U	28	46	6.338	507/80	3800	3500	6000	2.1	18.0	3.1	15
473	27	28	2.7	3.0	C102_0063 LM402U	60	184	6.338	507/80	3800	3500	6000	3.4	18.0	3.1	17
473	37	38	3.7	2.2	C102_0063 LM403U	79	184	6.338	507/80	3800	3500	6000	4.7	18.0	3.1	19
473	58	62	5.7	1.4	C102_0063 LM503U	125	184	6.338	507/80	3800	3500	6000	11	18.0	3.1	21
473	84	95	8.3	0.96	C102_0063 LM505U	130	184	6.338	507/80	3800	3500	6000	17	18.0	3.1	26
511	13	14	3.1	2.7	C102_0059 LM401U	26	43	5.875	47/8	3800	3500	6000	2.1	18.0	3.1	15
511	25	26	2.6	3.1	C102_0059 LM402U	55	171	5.875	47/8	3800	3500	6000	3.4	18.0	3.1	17
511	35	35	3.6	2.3	C102_0059 LM403U	73	171	5.875	47/8	3800	3500	6000	4.7	18.0	3.1	19
511	54	57	5.7	1.5	C102_0059 LM503U	116	171	5.875	47/8	3800	3500	6000	11	18.0	3.1	21
511	78	88	8.2	1.0	C102_0059 LM505U	130	171	5.875	47/8	3800	3500	6000	17	18.0	3.1	26
597	21	22	2.6	3.5	C102_0050 LM402U	47	146	5.025	201/40	3800	3500	6000	3.5	18.0	3.1	17
597	30	30	3.5	2.5	C102_0050 LM403U	63	146	5.025	201/40	3800	3500	6000	4.8	18.0	3.1	19
597	46	49	5.5	1.6	C102_0050 LM503U	99	146	5.025	201/40	3800	3500	6000	11	18.0	3.1	21
597	67	75	8.0	1.1	C102_0050 LM505U	117	146	5.025	201/40	3800	3500	6000	17	18.0	3.1	26
644	20	20	2.5	3.7	C102_0047 LM402U	44	136	4.658	3149/676	3800	3500	6000	3.6	18.0	3.1	17
644	27	28	3.5	2.7	C102_0047 LM403U	58	136	4.658	3149/676	3800	3500	6000	4.9	18.0	3.1	19
644	43	45	5.4	1.7	C102_0047 LM503U	92	136	4.658	3149/676	3800	3500	6000	11	18.0	3.1	21
644	62	70	7.9	1.2	C102_0047 LM505U	108	136	4.658	3149/676	3800	3500	6000	17	18.0	3.1	26
644	87	96	11	0.84	C102_0047 LM704U	130	220	4.658	3149/676	3800	3500	6000	37	18.0	3.1	32
716	9.1	9.9	3.7	2.7	C102_0042 LM401U	18	30	4.189	377/90	3600	3100	6000	2.4	18.0	3.1	15
716	18	18	2.5	3.9	C102_0042 LM402U	39	122	4.189	377/90	3600	3100	6000	3.7	18.0	3.1	17
716	25	25	3.4	2.9	C102_0042 LM403U	52	122	4.189	377/90	3600	3100	6000	5.0	18.0	3.1	19
716	39	41	5.3	1.8	C102_0042 LM503U	83	122	4.189	377/90	3600	3100	6000	11	18.0	3.1	21
716	56	63	7.7	1.3	C102_0042 LM505U	98	122	4.189	377/90	3600	3100	6000	17	18.0	3.1	26
716	78	86	11	0.90	C102_0042 LM704U	130	220	4.189	377/90	3600	3100	6000	37	18.0	3.1	32
773	8.5	9.2	3.8	2.7	C102_0039 LM401U	17	28	3.883	1363/351	3600	3100	6000	2.4	18.0	3.1	15
773	17	17	2.5	4.1	C102_0039 LM402U	37	113	3.883	1363/351	3600	3100	6000	3.7	18.0	3.1	17
773	23	23	3.4	3.0	C102_0039 LM403U	48	113	3.883	1363/351	3600	3100	6000	5.0	18.0	3.1	19
773	36	38	5.3	1.9	C102_0039 LM503U	77	113	3.883	1363/351	3600	3100	6000	11	18.0	3.1	21
773	52	58	7.6	1.3	C102_0039 LM505U	90	113	3.883	1363/351	3600	3100	6000	17	18.0	3.1	26
773	73	80	11	0.95	C102_0039 LM704U	130	220	3.883	1363/351	3600	3100	6000	37	18.0	3.1	32
900	14	15	2.4	4.6	C102_0033 LM402U	31	97	3.334	2067/620	3600	3100	6000	4.0	18.0	3.1	17
900	20	20	3.3	3.3	C102_0033 LM403U	41	97	3.334	2067/620	3600	3100	6000	5.3	18.0	3.1	19
900	31	33	5.2	2.1	C102_0033 LM503U	66	97	3.334	2067/620	3600	3100	6000	11	18.0	3.1	21
900	44	50	7.4	1.5	C102_0033 LM505U	78	97	3.334	2067/620	3600	3100	6000	18	18.0	3.1	26
900	62	69	10	1.0	C102_0033 LM704U	123	220	3.334	2067/620	3600	3100	6000	37	18.0	3.1	32
971	13	13	2.4	4.8	C102_0031 LM402U	29	90	3.091	2491/806	3600	3100	6000	4.0	18.0	3.1	17
971	18	19	3.3	3.5	C102_0031 LM403U	38	90	3.091	2491/806	3600	3100	6000	5.3	18.0	3.1	19
971	28	30	5.1	2.2	C102_0031 LM503U	61	90	3.091	2491/806	3600	3100	6000	11	18.0	3.1	21
971	41	46	7.3	1.5	C102_0031 LM505U	72	90	3.091	2491/806	3600	3100	6000	18	18.0	3.1	26
971	58	64	10	1.1	C102_0031 LM704U	120	220	3.091	2491/806	3600	3100	6000	37	18.0	3.1	32
971	77	89	14	0.83	C102_0031 LM706U	120	220	3.091	2491/806	3600	3100	6000	55	18.0	3.1	39
1162	48	53	10	1.2	C102_0026 LM704U	103	188	2.582	1911/740	3100	2600	5000	38	18.0	3.1	32
1162	64	75	13	0.93	C102_0026 LM706U	113	188	2.582	1911/740	3100	2600	5000	55	18.0	3.1	39
1253	45	49	9.9	1.3	C102_0024 LM704U	96	174	2.394	2303/962	3100	2600	5000	38	18.0	3.1	32
1253	60	69	13	0.98	C102_0024 LM706U	110	174	2.394	2303/962	3100	2600	5000	55	18.0	3.1	39
1378	13	13	3.4	4.0	C102_0022 LM403U	27	63	2.177	468/215	3100	2600	5000	6.1	18.0	3.1	19
1378	20	21	5.4	2.5	C102_0022 LM503U	43	63	2.177	468/215	3100	2600	5000	12	18.0	3.1	21
1378	29	33	7.7	1.8	C102_0022 LM505U	51	63	2.177	468/215	3100	2600	5000	19	18.0	3.1	26
1378	41	45	9.8	1.4	C102_0022 LM704U	87	158	2.177	468/215	3100	2600	5000	38	18.0	3.1	32
1378	54	63	13	1.0	C102_0022 LM706U	107	158	2.177	468/215	3100	2600	5000	56	18.0	3.1	39
1487	12	12	3.6	4.0	C102_0020 LM403U	25	59	2.018	1128/559	3100	2600	5000	6.2	18.0	3.1	19
1487	19	20	5.6	2.5	C102_0020 LM503U	40	59	2.018	1128/559	3100	2600	5000	12	18.0	3.1	21
1487	27	30	8.0	1.8	C102_0020 LM505U	47	59	2.018	1128/559	3100	2600	5000	19	18.0	3.1	26
1487	38	42	9.6	1.5	C102_0020 LM704U	81	147	2.018	1128/559	3100	2600	5000	38	18.0	3.1	32
1487	50	58	13	1.1	C102_0020 LM706U	104	147	2.018	1128/559	3100	2600	5000	56	18.0	3.1	39

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,3,4	n_{1maxDB} EL5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[Nm/ arcmin]	[kg]
C2 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 230 Nm)																
27	238	257	2.5	0.84	C203_1110 LM401U	230	400	110.6	191149/1728	4000	3900	6500	1.7	14.0	8.3	24
32	199	215	2.3	1.0	C203_0920 LM401U	230	400	92.40	29939/324	4000	3900	6500	1.7	14.0	8.3	24
37	173	187	2.1	1.2	C203_0810 LM401U	230	400	80.62	11609/144	4000	3900	6500	1.7	14.0	8.3	24
43	153	166	2.0	1.3	C202_0700 LM401U	230	302	70.32	7595/108	4000	3900	6500	1.7	14.0	8.3	19
49	134	145	2.0	1.4	C202_0610 LM401U	211	263	61.35	2945/48	4000	3900	6500	1.7	14.0	8.3	19
53	241	246	3.5	0.83	C202_0560 LM402U	230	400	56.42	1862/33	4000	3900	6500	3.1	14.0	8.3	21
61	211	215	3.3	0.95	C202_0490 LM402U	230	400	49.23	1083/22	4000	3900	6500	3.1	14.0	8.3	21
64	200	204	3.2	1.0	C202_0470 LM402U	230	400	46.82	2107/45	4000	3900	6500	3.2	14.0	8.3	21
73	175	178	3.0	1.1	C202_0410 LM402U	230	400	40.85	817/20	4000	3900	6500	3.2	14.0	8.3	21
73	240	245	4.1	0.83	C202_0410 LM403U	230	400	40.85	817/20	4000	3900	6500	4.5	14.0	8.3	23
85	150	154	2.8	1.3	C202_0350 LM402U	230	400	35.18	1372/39	4000	3900	6500	3.2	14.0	8.3	21
85	207	211	3.8	0.97	C202_0350 LM403U	230	400	35.18	1372/39	4000	3900	6500	4.5	14.0	8.3	23
98	131	134	2.6	1.5	C202_0310 LM402U	230	400	30.69	399/13	4000	3900	6500	3.2	14.0	8.3	21
98	180	184	3.6	1.1	C202_0310 LM403U	230	400	30.69	399/13	4000	3900	6500	4.5	14.0	8.3	23
106	121	123	2.5	1.7	C202_0280 LM402U	230	400	28.24	4067/144	4000	3900	6500	3.3	14.0	8.3	21
106	166	170	3.4	1.2	C202_0280 LM403U	230	400	28.24	4067/144	4000	3900	6500	4.6	14.0	8.3	23
122	105	108	2.3	1.9	C202_0250 LM402U	230	400	24.64	1577/64	4000	3900	6500	3.3	14.0	8.3	21
122	145	148	3.2	1.4	C202_0250 LM403U	230	400	24.64	1577/64	4000	3900	6500	4.6	14.0	8.3	23
122	227	241	5.0	0.88	C202_0250 LM503U	230	400	24.64	1577/64	4000	3900	6500	11	14.0	8.3	25
127	101	103	2.3	2.0	C202_0240 LM402U	222	400	23.59	637/27	4000	3900	6500	3.4	14.0	8.3	21
127	139	142	3.1	1.4	C202_0240 LM403U	230	400	23.59	637/27	4000	3900	6500	4.7	14.0	8.3	23
127	217	230	4.9	0.92	C202_0240 LM503U	230	400	23.59	637/27	4000	3900	6500	11	14.0	8.3	25
146	88	90	2.1	2.3	C202_0210 LM402U	194	400	20.58	247/12	4000	3900	6500	3.4	14.0	8.3	21
146	121	124	2.9	1.7	C202_0210 LM403U	230	400	20.58	247/12	4000	3900	6500	4.7	14.0	8.3	23
146	189	201	4.6	1.1	C202_0210 LM503U	230	400	20.58	247/12	4000	3900	6500	11	14.0	8.3	25
171	75	76	2.0	2.7	C202_0175 LM402U	165	400	17.52	3626/207	3700	3500	5500	3.6	14.0	8.3	21
171	103	105	2.7	1.9	C202_0175 LM403U	218	400	17.52	3626/207	3700	3500	5500	4.9	14.0	8.3	23
171	161	171	4.2	1.2	C202_0175 LM503U	230	400	17.52	3626/207	3700	3500	5500	11	14.0	8.3	25
171	233	263	6.1	0.86	C202_0175 LM505U	230	400	17.52	3626/207	3700	3500	5500	17	14.0	8.3	30
196	65	67	1.8	3.1	C202_0155 LM402U	144	400	15.28	703/46	3700	3500	5500	3.7	14.0	8.3	21
196	90	92	2.5	2.2	C202_0155 LM403U	190	400	15.28	703/46	3700	3500	5500	5.0	14.0	8.3	23
196	141	149	4.0	1.4	C202_0155 LM503U	230	400	15.28	703/46	3700	3500	5500	11	14.0	8.3	25
196	203	229	5.7	0.99	C202_0155 LM505U	230	400	15.28	703/46	3700	3500	5500	17	14.0	8.3	30
213	60	62	1.8	3.3	C202_0140 LM402U	133	400	14.12	3430/243	3700	3500	5500	3.9	14.0	8.3	21
213	83	85	2.4	2.4	C202_0140 LM403U	176	400	14.12	3430/243	3700	3500	5500	5.2	14.0	8.3	23
213	130	138	3.8	1.5	C202_0140 LM503U	230	400	14.12	3430/243	3700	3500	5500	11	14.0	8.3	25
213	188	212	5.5	1.1	C202_0140 LM505U	230	400	14.12	3430/243	3700	3500	5500	18	14.0	8.3	30
244	53	54	1.7	3.7	C202_0125 LM402U	116	359	12.32	665/54	3700	3500	5500	3.9	14.0	8.3	21
244	72	74	2.3	2.7	C202_0125 LM403U	153	359	12.32	665/54	3700	3500	5500	5.2	14.0	8.3	23
244	113	120	3.6	1.7	C202_0125 LM503U	230	359	12.32	665/54	3700	3500	5500	11	14.0	8.3	25
244	164	185	5.2	1.2	C202_0125 LM505U	230	359	12.32	665/54	3700	3500	5500	18	14.0	8.3	30
244	230	254	7.4	0.85	C202_0125 LM704U	230	400	12.32	665/54	3700	3500	5500	37	14.0	8.3	36
255	50	51	1.7	3.8	C202_0120 LM402U	111	342	11.76	294/25	3500	3100	5000	4.1	14.0	8.3	21
255	69	71	2.3	2.8	C202_0120 LM403U	146	342	11.76	294/25	3500	3100	5000	5.4	14.0	8.3	23
255	108	115	3.6	1.8	C202_0120 LM503U	230	342	11.76	294/25	3500	3100	5000	11	14.0	8.3	25
255	156	176	5.2	1.2	C202_0120 LM505U	230	342	11.76	294/25	3500	3100	5000	18	14.0	8.3	30
255	220	243	7.3	0.88	C202_0120 LM704U	230	400	11.76	294/25	3500	3100	5000	38	14.0	8.3	36
292	44	45	1.6	4.2	C202_0105 LM402U	97	299	10.26	513/50	3500	3100	5000	4.2	14.0	8.3	21
292	60	62	2.3	3.1	C202_0105 LM403U	128	299	10.26	513/50	3500	3100	5000	5.5	14.0	8.3	23
292	94	100	3.5	2.0	C202_0105 LM503U	203	299	10.26	513/50	3500	3100	5000	12	14.0	8.3	25
292	136	154	5.1	1.4	C202_0105 LM505U	230	299	10.26	513/50	3500	3100	5000	18	14.0	8.3	30
292	192	212	7.2	0.96	C202_0105 LM704U	230	400	10.26	513/50	3500	3100	5000	38	14.0	8.3	36
320	175	194	7.0	1.0	C202_0094 LM704U	230	400	9.387	2450/261	3500	3100	5000	38	14.0	8.3	36
366	153	169	6.9	1.1	C202_0082 LM704U	230	400	8.190	475/58	3500	3100	5000	38	14.0	8.3	36
366	204	237	9.2	0.84	C202_0082 LM706U	230	400	8.190	475/58	3500	3100	5000	55	14.0	8.3	43
385	33	34	2.0	4.0	C202_0078 LM402U	73	216	7.800	39/5	4000	3900	6500	3.5	17.0	6.0	21
385	46	47	2.7	2.9	C202_0078 LM403U	97	216	7.800	39/5	4000	3900	6500	4.8	17.0	6.0	23
385	72	76	4.3	1.8	C202_0078 LM503U	154	216	7.800	39/5	4000	3900	6500	11	17.0	6.0	25
385	104	117	6.2	1.3	C202_0078 LM505U	173	216	7.800	39/5	4000	3900	6500	17	17.0	6.0	30
385	146	161	8.7	0.91	C202_0078 LM704U	200	350	7.800	39/5	4000	3900	6500	37	17.0	6.0	36
477	27	27	1.9	4.6	C202_0063 LM402U	59	183	6.295	3330/529	3700	3500	5500	3.8	17.0	6.0	21
477	37	38	2.6	3.3	C202_0063 LM403U	78	183	6.295	3330/529	3700	3500	5500	5.1	17.0	6.0	23
477	58	61	4.1	2.1	C202_0063 LM503U	124	183	6.295	3330/529	3700	3500	5500	11	17.0	6.0	25
477	84	94	6.0	1.5	C202_0063 LM505U	147	183	6.295	3330/529	3700	3500	5500	18	17.0	6.0	30

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2,3,4 [rpm]	n_{1maxDB} EL5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
C2 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 230 Nm)																
477	118	130	8.4	1.0	C202_0063 LM704U	200	350	6.295	3330/529	3700	3500	5500	37	17.0	6.0	36
518	25	25	1.9	4.8	C202_0058 LM402U	54	169	5.791	666/115	3700	3500	5500	3.8	17.0	6.0	21
518	34	35	2.6	3.5	C202_0058 LM403U	72	169	5.791	666/115	3700	3500	5500	5.1	17.0	6.0	23
518	53	57	4.1	2.2	C202_0058 LM503U	114	169	5.791	666/115	3700	3500	5500	11	17.0	6.0	25
518	77	87	5.9	1.6	C202_0058 LM505U	135	169	5.791	666/115	3700	3500	5500	18	17.0	6.0	30
518	108	119	8.3	1.1	C202_0058 LM704U	200	350	5.791	666/115	3700	3500	5500	37	17.0	6.0	36
518	144	167	11	0.83	C202_0058 LM706U	200	350	5.791	666/115	3700	3500	5500	55	17.0	6.0	43
591	30	30	2.5	3.8	C202_0051 LM403U	63	148	5.072	350/69	3700	3500	5500	5.4	17.0	6.0	23
591	47	50	4.0	2.5	C202_0051 LM503U	100	148	5.072	350/69	3700	3500	5500	11	17.0	6.0	25
591	67	76	5.7	1.7	C202_0051 LM505U	118	148	5.072	350/69	3700	3500	5500	18	17.0	6.0	30
591	95	105	8.1	1.2	C202_0051 LM704U	200	350	5.072	350/69	3700	3500	5500	38	17.0	6.0	36
591	126	147	11	0.91	C202_0051 LM706U	200	350	5.072	350/69	3700	3500	5500	55	17.0	6.0	43
643	27	28	2.6	4.0	C202_0047 LM403U	58	136	4.667	14/3	3700	3500	5500	5.4	17.0	6.0	23
643	43	46	4.0	2.5	C202_0047 LM503U	92	136	4.667	14/3	3700	3500	5500	11	17.0	6.0	25
643	62	70	5.8	1.8	C202_0047 LM505U	109	136	4.667	14/3	3700	3500	5500	18	17.0	6.0	30
643	87	96	8.0	1.3	C202_0047 LM704U	186	339	4.667	14/3	3700	3500	5500	38	17.0	6.0	36
643	116	135	11	0.96	C202_0047 LM706U	200	339	4.667	14/3	3700	3500	5500	55	17.0	6.0	43
710	25	25	2.7	4.0	C202_0042 LM403U	53	123	4.226	486/115	3500	3100	5000	5.8	17.0	6.0	23
710	39	41	4.2	2.5	C202_0042 LM503U	84	123	4.226	486/115	3500	3100	5000	12	17.0	6.0	25
710	56	63	6.1	1.8	C202_0042 LM505U	98	123	4.226	486/115	3500	3100	5000	18	17.0	6.0	30
710	79	87	7.8	1.4	C202_0042 LM704U	169	308	4.226	486/115	3500	3100	5000	38	17.0	6.0	36
710	105	122	10	1.0	C202_0042 LM706U	200	308	4.226	486/115	3500	3100	5000	55	17.0	6.0	43
772	23	23	2.8	4.0	C202_0039 LM403U	48	113	3.888	486/125	3500	3100	5000	5.8	17.0	6.0	23
772	36	38	4.4	2.5	C202_0039 LM503U	77	113	3.888	486/125	3500	3100	5000	12	17.0	6.0	25
772	52	58	6.4	1.8	C202_0039 LM505U	91	113	3.888	486/125	3500	3100	5000	18	17.0	6.0	30
772	73	80	7.7	1.4	C202_0039 LM704U	155	283	3.888	486/125	3500	3100	5000	38	17.0	6.0	36
772	97	112	10	1.1	C202_0039 LM706U	198	283	3.888	486/125	3500	3100	5000	55	17.0	6.0	43
889	63	70	7.6	1.6	C202_0034 LM704U	135	246	3.373	2250/667	3500	3100	5000	38	17.0	6.0	36
889	84	98	10	1.2	C202_0034 LM706U	189	246	3.373	2250/667	3500	3100	5000	56	17.0	6.0	43
967	58	64	7.4	1.7	C202_0031 LM704U	124	226	3.103	90/29	3500	3100	5000	39	17.0	6.0	36
967	77	90	9.9	1.3	C202_0031 LM706U	181	226	3.103	90/29	3500	3100	5000	56	17.0	6.0	43
1115	50	55	7.3	1.8	C202_0027 LM704U	107	196	2.690	495/184	3000	2600	4500	39	17.0	6.0	36
1115	67	78	9.7	1.4	C202_0027 LM706U	157	196	2.690	495/184	3000	2600	4500	57	17.0	6.0	43
1212	46	51	7.2	1.9	C202_0025 LM704U	99	180	2.475	99/40	3000	2600	4500	39	17.0	6.0	36
1212	62	72	9.6	1.5	C202_0025 LM706U	144	180	2.475	99/40	3000	2600	4500	57	17.0	6.0	43
1374	41	45	7.0	2.1	C202_0022 LM704U	87	159	2.184	2160/989	3000	2600	4500	40	17.0	6.0	36
1374	54	63	9.4	1.6	C202_0022 LM706U	127	159	2.184	2160/989	3000	2600	4500	58	17.0	6.0	43
1493	38	41	6.9	2.2	C202_0020 LM704U	80	146	2.009	432/215	3000	2600	4500	40	17.0	6.0	36
1493	50	58	9.2	1.7	C202_0020 LM706U	117	146	2.009	432/215	3000	2600	4500	58	17.0	6.0	43
C3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 400 Nm)																
16	393	425	2.0	0.89	C303_1830 LM401U	350	700	182.8	1645/9	3800	3500	6000	1.7	13.0	8.7	29
22	295	319	1.7	1.2	C303_1370 LM401U	350	700	137.2	59267/432	3800	3500	6000	1.7	13.0	8.7	29
27	236	255	1.5	1.5	C303_1100 LM401U	350	700	109.6	94705/864	3800	3500	6000	1.8	13.0	8.7	29
33	198	214	1.4	1.8	C303_0920 LM401U	350	590	91.93	39715/432	3800	3500	6000	1.8	13.0	8.7	29
33	388	395	2.8	0.90	C303_0920 LM402U	350	590	91.93	39715/432	3800	3500	6000	3.1	13.0	8.7	30
37	175	189	1.3	2.0	C303_0810 LM401U	351	522	81.47	1222/15	3800	3500	6000	1.8	13.0	8.7	29
37	343	350	2.6	1.0	C303_0810 LM402U	400	522	81.47	1222/15	3800	3500	6000	3.1	13.0	8.7	30
64	429	456	4.3	0.82	C302_0470 LM503U	350	700	46.67	140/3	3800	3500	6000	11	13.0	8.7	31
73	380	404	4.1	0.92	C302_0410 LM503U	400	700	41.35	2688/65	3800	3500	6000	11	13.0	8.7	31
86	322	342	3.7	1.1	C302_0350 LM503U	350	700	35.03	1261/36	3800	3500	6000	11	13.0	8.7	31
97	285	303	3.5	1.2	C302_0310 LM503U	400	700	31.04	776/25	3800	3500	6000	11	13.0	8.7	31
97	412	466	5.1	0.85	C302_0310 LM505U	400	700	31.04	776/25	3800	3500	6000	17	13.0	8.7	35
107	257	273	3.3	1.4	C302_0280 LM503U	350	700	27.99	2015/72	3800	3500	6000	11	13.0	8.7	31
107	372	420	4.8	0.94	C302_0280 LM505U	350	700	27.99	2015/72	3800	3500	6000	17	13.0	8.7	35
121	228	242	3.1	1.5	C302_0250 LM503U	400	666	24.80	124/5	3800	3500	6000	11	13.0	8.7	31
121	330	372	4.5	1.1	C302_0250 LM505U	400	666	24.80	124/5	3800	3500	6000	17	13.0	8.7	35
128	216	229	3.1	1.6	C302_0230 LM503U	350	683	23.47	845/36	3800	3500	6000	11	13.0	8.7	31
128	312	352	4.4	1.1	C302_0230 LM505U	350	683	23.47	845/36	3800	3500	6000	17	13.0	8.7	35
144	191	203	2.9	1.8	C302_0210 LM503U	400	605	20.80	104/5	3800	3500	6000	11	13.0	8.7	31
144	276	312	4.2	1.3	C302_0210 LM505U	400	605	20.80	104/5	3800	3500	6000	17	13.0	8.7	35
144	389	429	5.8	0.90	C302_0210 LM704U	400	700	20.80	104/5	3800	3500	6000	37	13.0	8.7	41
171	328	362	5.5	1.0	C302_0175 LM704U	350	700	17.54	1105/63	3500	3100	5500	38	13.0	8.7	41
193	291	321	5.4	1.1	C302_0155 LM704U	400	700	15.54	544/35	3500	3100	5500	38	13.0	8.7	41
193	387	449	7.2	0.85	C302_0155 LM706U	400	700	15.54	544/35	3500	3100	5500	55	13.0	8.7	48

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2,3,4 [rpm]	n_{1maxDB} EL5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
C3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 400 Nm)																
214	262	289	5.3	1.2	C302_0140 LM704U	350	700	13.99	2015/144	3500	3100	5500	38	13.0	8.7	41
214	348	404	7.0	0.91	C302_0140 LM706U	350	700	13.99	2015/144	3500	3100	5500	55	13.0	8.7	48
242	232	256	5.2	1.3	C302_0125 LM704U	400	700	12.40	62/5	3500	3100	5500	38	13.0	8.7	41
242	309	358	6.9	0.99	C302_0125 LM706U	400	700	12.40	62/5	3500	3100	5500	55	13.0	8.7	48
258	217	239	5.1	1.4	C302_0115 LM704U	350	700	11.61	325/28	3200	2800	4800	38	13.0	8.7	41
258	289	336	6.8	1.0	C302_0115 LM706U	350	700	11.61	325/28	3200	2800	4800	56	13.0	8.7	48
292	192	212	5.0	1.5	C302_0105 LM704U	400	700	10.29	72/7	3200	2800	4800	38	13.0	8.7	41
292	256	297	6.7	1.1	C302_0105 LM706U	400	700	10.29	72/7	3200	2800	4800	56	13.0	8.7	48
322	174	192	4.9	1.6	C302_0093 LM704U	350	678	9.310	3575/384	3200	2800	4800	39	13.0	8.7	41
322	232	269	6.6	1.2	C302_0093 LM706U	350	678	9.310	3575/384	3200	2800	4800	56	13.0	8.7	48
364	154	170	4.8	1.7	C302_0083 LM704U	329	600	8.250	33/4	3200	2800	4800	39	13.0	8.7	41
364	205	238	6.4	1.3	C302_0083 LM706U	400	600	8.250	33/4	3200	2800	4800	56	13.0	8.7	48
383	72	77	3.4	2.5	C302_0078 LM503U	155	228	7.841	494/63	3800	3500	6000	11	16.0	7.1	31
383	104	118	4.9	1.8	C302_0078 LM505U	183	228	7.841	494/63	3800	3500	6000	18	16.0	7.1	35
383	147	162	5.8	1.5	C302_0078 LM704U	313	469	7.841	494/63	3800	3500	6000	37	16.0	7.1	41
383	195	227	7.7	1.1	C302_0078 LM706U	330	469	7.841	494/63	3800	3500	6000	55	16.0	7.1	48
475	118	130	5.6	1.7	C302_0063 LM704U	252	434	6.314	221/35	3500	3100	5500	38	16.0	7.1	41
475	157	183	7.4	1.3	C302_0063 LM706U	330	434	6.314	221/35	3500	3100	5500	55	16.0	7.1	48
512	110	121	5.5	1.8	C302_0059 LM704U	234	403	5.859	2584/441	3500	3100	5500	38	16.0	7.1	41
512	146	169	7.4	1.3	C302_0059 LM706U	322	403	5.859	2584/441	3500	3100	5500	55	16.0	7.1	48
595	94	104	5.4	2.0	C302_0050 LM704U	201	367	5.038	403/80	3500	3100	5500	38	16.0	7.1	41
595	125	146	7.2	1.5	C302_0050 LM706U	293	367	5.038	403/80	3500	3100	5500	56	16.0	7.1	48
642	87	96	5.3	2.1	C302_0047 LM704U	187	340	4.675	589/126	3500	3100	5500	38	16.0	7.1	41
642	116	135	7.1	1.6	C302_0047 LM706U	272	340	4.675	589/126	3500	3100	5500	56	16.0	7.1	48
718	78	86	5.2	2.3	C302_0042 LM704U	167	304	4.179	117/28	3200	2800	4800	39	16.0	7.1	41
718	104	121	7.0	1.7	C302_0042 LM706U	243	304	4.179	117/28	3200	2800	4800	56	16.0	7.1	48
774	72	80	5.2	2.4	C302_0039 LM704U	155	282	3.878	190/49	3200	2800	4800	39	16.0	7.1	41
774	97	112	6.9	1.8	C302_0039 LM706U	226	282	3.878	190/49	3200	2800	4800	56	16.0	7.1	48
895	63	69	5.0	2.6	C302_0034 LM704U	134	244	3.352	429/128	3200	2800	4800	40	16.0	7.1	41
895	83	97	6.7	2.0	C302_0034 LM706U	195	244	3.352	429/128	3200	2800	4800	57	16.0	7.1	48
965	58	64	5.0	2.7	C302_0031 LM704U	124	226	3.110	1045/336	3200	2800	4800	40	16.0	7.1	41
965	77	90	6.6	2.1	C302_0031 LM706U	181	226	3.110	1045/336	3200	2800	4800	57	16.0	7.1	48
C4 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 600 Nm)																
43	643	683	3.6	0.86	C402_0700 LM503U	550	1022	69.88	559/8	3500	3200	5500	11	12.0	22	41
48	575	611	3.8	0.87	C402_0630 LM503U	600	914	62.52	8127/130	3500	3200	5500	11	12.0	22	41
53	516	548	3.3	1.1	C402_0560 LM503U	550	1025	56.10	9425/168	3500	3200	5500	11	12.0	22	41
60	462	490	3.1	1.2	C402_0500 LM503U	600	917	50.19	1305/26	3500	3200	5500	11	12.0	22	41
60	667	753	4.4	0.83	C402_0500 LM505U	600	917	50.19	1305/26	3500	3200	5500	17	12.0	22	45
64	429	456	3.0	1.3	C402_0470 LM503U	550	934	46.67	140/3	3500	3200	5500	11	12.0	22	41
64	620	700	4.3	0.89	C402_0470 LM505U	550	934	46.67	140/3	3500	3200	5500	17	12.0	22	45
72	384	408	2.8	1.4	C402_0420 LM503U	600	835	41.75	7056/169	3500	3200	5500	11	12.0	22	41
72	555	627	4.1	0.99	C402_0420 LM505U	600	835	41.75	7056/169	3500	3200	5500	17	12.0	22	45
86	320	340	2.6	1.7	C402_0350 LM503U	550	794	34.82	975/28	3500	3200	5500	11	12.0	22	41
86	463	523	3.7	1.2	C402_0350 LM505U	550	794	34.82	975/28	3500	3200	5500	18	12.0	22	45
86	651	718	5.2	0.85	C402_0350 LM704U	550	1100	34.82	975/28	3500	3200	5500	37	12.0	22	51
96	286	304	2.4	1.9	C402_0310 LM503U	568	711	31.15	405/13	3500	3200	5500	11	12.0	22	41
96	414	467	3.5	1.3	C402_0310 LM505U	568	711	31.15	405/13	3500	3200	5500	18	12.0	22	45
96	582	642	4.9	0.94	C402_0310 LM704U	600	1100	31.15	405/13	3500	3200	5500	37	12.0	22	51
108	521	574	4.7	1.1	C402_0280 LM704U	550	1100	27.86	195/7	3500	3200	5500	38	12.0	22	51
120	466	514	4.4	1.2	C402_0250 LM704U	600	1100	24.92	324/13	3500	3200	5500	38	12.0	22	51
120	621	720	5.9	0.89	C402_0250 LM706U	600	1100	24.92	324/13	3500	3200	5500	55	12.0	22	58
128	437	482	4.3	1.3	C402_0230 LM704U	550	1100	23.36	1495/64	3500	3200	5500	38	12.0	22	51
128	582	675	5.7	0.95	C402_0230 LM706U	550	1100	23.36	1495/64	3500	3200	5500	55	12.0	22	58
144	391	431	4.0	1.4	C402_0210 LM704U	600	1100	20.90	4347/208	3500	3200	5500	38	12.0	22	51
144	520	604	5.4	1.1	C402_0210 LM706U	600	1100	20.90	4347/208	3500	3200	5500	55	12.0	22	58
170	329	363	3.7	1.7	C402_0175 LM704U	550	1100	17.60	845/48	3300	2800	5000	39	12.0	22	51
170	438	509	4.9	1.3	C402_0175 LM706U	550	1100	17.60	845/48	3300	2800	5000	56	12.0	22	58
190	294	325	3.5	1.9	C402_0160 LM704U	600	1065	15.75	63/4	3300	2800	5000	39	12.0	22	51
190	392	455	4.7	1.4	C402_0160 LM706U	600	1065	15.75	63/4	3300	2800	5000	56	12.0	22	58
214	262	289	3.4	2.0	C402_0140 LM704U	550	1018	13.99	2015/144	3300	2800	5000	40	12.0	22	51
214	348	404	4.5	1.5	C402_0140 LM706U	550	1018	13.99	2015/144	3300	2800	5000	57	12.0	22	58
240	234	258	3.4	2.2	C402_0125 LM704U	500	911	12.52	651/52	3300	2800	5000	40	12.0	22	51
240	312	362	4.5	1.6	C402_0125 LM706U	600	911	12.52	651/52	3300	2800	5000	57	12.0	22	58
258	217	240	3.3	2.3	C402_0115 LM704U	465	847	11.64	1885/162	2900	2500	4500	41	12.0	22	51

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2,3,4 [rpm]	n_{1maxDB} EL5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
C4 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 600 Nm)																
258	290	336	4.4	1.7	C402_0115 LM706U	550	847	11.64	1885/162	2900	2500	4500	58	12.0	22	58
288	195	215	3.2	2.5	C402_0105 LM704U	416	757	10.41	406/39	2900	2500	4500	41	12.0	22	51
288	259	301	4.3	1.9	C402_0105 LM706U	600	757	10.41	406/39	2900	2500	4500	58	12.0	22	58
384	146	161	4.3	2.2	C402_0078 LM704U	312	450	7.816	2001/256	3500	3200	5500	39	15.0	17	51
384	195	226	5.7	1.6	C402_0078 LM706U	360	450	7.816	2001/256	3500	3200	5500	56	15.0	17	58
509	110	121	4.1	2.6	C402_0059 LM704U	235	399	5.891	377/64	3300	2800	5000	40	15.0	17	51
509	147	170	5.5	2.0	C402_0059 LM706U	319	399	5.891	377/64	3300	2800	5000	57	15.0	17	58
641	88	97	4.0	3.0	C402_0047 LM704U	187	341	4.682	899/192	3300	2800	5000	41	15.0	17	51
641	117	135	5.3	2.3	C402_0047 LM706U	273	341	4.682	899/192	3300	2800	5000	58	15.0	17	58
770	73	80	4.2	3.1	C402_0039 LM704U	156	283	3.894	841/216	2900	2500	4500	42	15.0	17	51
770	97	113	5.6	2.3	C402_0039 LM706U	227	283	3.894	841/216	2900	2500	4500	60	15.0	17	58
C5 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 920 Nm)																
28	985	1046	3.3	0.81	C503_1090 LM503U	850	1600	108.6	31291/288	3400	3000	5000	11	12.0	23	56
33	819	870	3.0	0.98	C503_0900 LM503U	850	1491	90.32	8671/96	3400	3000	5000	11	12.0	23	56
37	730	776	2.8	1.1	C503_0810 LM503U	920	1331	80.60	19343/240	3400	3000	5000	11	12.0	23	56
43	643	683	2.7	1.2	C502_0700 LM503U	850	1406	69.97	10075/144	3400	3000	5000	11	12.0	23	52
43	930	1050	3.9	0.86	C502_0700 LM505U	850	1406	69.97	10075/144	3400	3000	5000	17	12.0	23	57
48	574	610	2.8	1.2	C502_0620 LM503U	857	1254	62.43	4495/72	3400	3000	5000	11	12.0	23	52
48	830	937	4.1	0.86	C502_0620 LM505U	857	1254	62.43	4495/72	3400	3000	5000	17	12.0	23	57
54	513	545	2.4	1.6	C502_0560 LM503U	850	1117	55.83	335/6	3400	3000	5000	11	12.0	23	52
54	742	838	3.5	1.1	C502_0560 LM505U	850	1117	55.83	335/6	3400	3000	5000	17	12.0	23	57
60	458	487	2.3	1.7	C502_0500 LM503U	797	997	49.82	1943/39	3400	3000	5000	11	12.0	23	52
60	662	748	3.3	1.2	C502_0500 LM505U	797	997	49.82	1943/39	3400	3000	5000	17	12.0	23	57
60	931	1027	4.6	0.86	C502_0500 LM704U	920	1600	49.82	1943/39	3400	3000	5000	37	12.0	23	63
64	873	963	4.5	0.92	C502_0470 LM704U	850	1600	46.72	1495/32	3400	3000	5000	37	12.0	23	63
72	779	860	4.2	1.0	C502_0420 LM704U	920	1600	41.69	667/16	3400	3000	5000	37	12.0	23	63
86	654	722	3.9	1.2	C502_0350 LM704U	850	1600	35.00	35/1	3400	3000	5000	38	12.0	23	63
86	871	1012	5.2	0.92	C502_0350 LM706U	850	1600	35.00	35/1	3400	3000	5000	55	12.0	23	70
96	584	644	3.7	1.4	C502_0310 LM704U	920	1524	31.23	406/13	3400	3000	5000	38	12.0	23	63
96	778	903	4.9	1.0	C502_0310 LM706U	920	1524	31.23	406/13	3400	3000	5000	55	12.0	23	70
107	525	579	3.5	1.5	C502_0280 LM704U	850	1600	28.10	5395/192	3400	3000	5000	39	12.0	23	63
107	700	812	4.6	1.1	C502_0280 LM706U	850	1600	28.10	5395/192	3400	3000	5000	56	12.0	23	70
120	469	517	3.3	1.7	C502_0250 LM704U	920	1444	25.07	2407/96	3400	3000	5000	39	12.0	23	63
120	624	725	4.4	1.3	C502_0250 LM706U	920	1444	25.07	2407/96	3400	3000	5000	56	12.0	23	70
128	437	482	3.2	1.8	C502_0230 LM704U	850	1491	23.36	1495/64	3400	3000	5000	39	12.0	23	63
128	582	675	4.2	1.4	C502_0230 LM706U	850	1491	23.36	1495/64	3400	3000	5000	57	12.0	23	70
144	390	430	3.0	2.1	C502_0210 LM704U	832	1331	20.84	667/32	3400	3000	5000	40	12.0	23	63
144	519	603	4.0	1.5	C502_0210 LM706U	920	1331	20.84	667/32	3400	3000	5000	57	12.0	23	70
215	260	287	2.4	3.1	C502_0140 LM704U	556	1013	13.93	195/14	3100	2700	4500	43	12.0	23	63
215	347	403	3.3	2.3	C502_0140 LM706U	811	1013	13.93	195/14	3100	2700	4500	60	12.0	23	70
241	232	256	2.6	3.1	C502_0125 LM704U	496	904	12.43	87/7	3100	2700	4500	43	12.0	23	63
241	309	359	3.4	2.3	C502_0125 LM706U	723	904	12.43	87/7	3100	2700	4500	60	12.0	23	70
386	145	160	3.7	2.7	C502_0078 LM704U	310	496	7.763	621/80	3400	3000	5000	40	14.0	21	63
386	193	224	4.9	2.1	C502_0078 LM706U	396	496	7.763	621/80	3400	3000	5000	58	14.0	21	70
648	87	95	4.2	3.1	C502_0046 LM704U	185	337	4.629	162/35	3100	2700	4500	45	14.0	21	63
648	115	134	5.6	2.3	C502_0046 LM706U	269	337	4.629	162/35	3100	2700	4500	62	14.0	21	70
C6 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1650 Nm)																
17	1589	1687	2.8	0.82	C613_1750 LM503U	1380	1992	175.3	7888/45	3200	2900	4500	11	10.0	74	76
22	1222	1298	2.4	1.1	C613_1350 LM503U	1376	1720	134.8	15776/117	3200	2900	4500	11	10.0	74	76
28	961	1021	2.2	1.3	C613_1060 LM503U	1277	1597	106.1	3712/35	3200	2900	4500	11	10.0	74	76
28	1389	1569	3.2	0.90	C613_1060 LM505U	1277	1597	106.1	3712/35	3200	2900	4500	17	10.0	74	81
31	1799	1984	3.8	0.81	C613_0980 LM704U	1650	2900	97.63	243695/2496	3200	2900	4500	37	10.0	74	86
39	1415	1561	3.3	1.0	C613_0770 LM704U	1650	2560	76.80	8601/112	3200	2900	4500	37	10.0	74	86
40	687	730	2.6	1.3	C613_0760 LM503U	913	1141	75.81	5307/70	3200	2900	4500	11	10.0	74	76
40	993	1121	3.8	0.90	C613_0760 LM505U	913	1141	75.81	5307/70	3200	2900	4500	17	10.0	74	81
44	1288	1421	3.6	1.0	C612_0690 LM704U	1380	2289	68.89	620/9	3200	2900	4500	38	10.0	74	78
47	1169	1290	3.2	1.2	C613_0630 LM704U	1650	2296	63.46	48739/768	3200	2900	4500	37	10.0	74	86
47	1557	1808	4.2	0.89	C613_0630 LM706U	1650	2296	63.46	48739/768	3200	2900	4500	55	10.0	74	94
54	1030	1137	3.2	1.3	C612_0550 LM704U	1380	2230	55.11	496/9	3200	2900	4500	38	10.0	74	78
54	1372	1593	4.3	0.95	C612_0550 LM706U	1380	2230	55.11	496/9	3200	2900	4500	55	10.0	74	85
61	908	1002	3.0	1.4	C613_0490 LM704U	1545	1931	49.28	31537/640	3200	2900	4500	38	10.0	74	86
61	1209	1404	4.0	1.1	C613_0490 LM706U	1545	1931	49.28	31537/640	3200	2900	4500	55	10.0	74	94
66	847	935	2.9	1.5	C612_0450 LM704U	1380	1992	45.33	136/3	3200	2900	4500	39	10.0	74	78
66	1129	1310	3.9	1.2	C612_0450 LM706U	1380	1992	45.33	136/3	3200	2900	4500	56	10.0	74	85

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,3,4	n_{1maxDB} EL5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[Nm/ arcmin]	[kg]
C6 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1650 Nm)																
76	736	812	2.9	1.7	C612_0390 LM704U	1276	1595	39.40	1891/48	3200	2900	4500	38	10.0	74	78
76	981	1139	3.8	1.2	C612_0390 LM706U	1276	1595	39.40	1891/48	3200	2900	4500	55	10.0	74	85
86	652	719	2.5	2.0	C612_0350 LM704U	1376	1720	34.87	1360/39	3200	2900	4500	40	10.0	74	78
86	868	1008	3.4	1.5	C612_0350 LM706U	1376	1720	34.87	1360/39	3200	2900	4500	57	10.0	74	85
93	606	668	2.8	1.9	C612_0320 LM704U	1139	1424	32.41	1037/32	3200	2900	4500	39	10.0	74	78
93	807	937	3.7	1.4	C612_0320 LM706U	1139	1424	32.41	1037/32	3200	2900	4500	56	10.0	74	85
109	513	566	2.3	2.5	C612_0270 LM704U	1095	1597	27.43	192/7	3200	2900	4500	42	10.0	74	78
109	683	793	3.1	1.9	C612_0270 LM706U	1277	1597	27.43	192/7	3200	2900	4500	59	10.0	74	85
120	466	514	2.8	2.1	C612_0250 LM704U	984	1230	24.93	5185/208	3200	2900	4500	40	10.0	74	78
120	621	721	3.8	1.6	C612_0250 LM706U	984	1230	24.93	5185/208	3200	2900	4500	57	10.0	74	85
153	366	404	2.7	2.5	C612_0195 LM704U	783	1141	19.61	549/28	3200	2900	4500	42	10.0	74	78
153	488	567	3.6	1.9	C612_0195 LM706U	913	1141	19.61	549/28	3200	2900	4500	59	10.0	74	85
C7 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 2760 Nm)																
23	2439	2690	3.4	0.81	C713_1320 LM704U	2760	3710	132.4	33887/256	3100	2900	4500	37	10.0	122	126
30	1826	2015	3.1	1.0	C713_0990 LM704U	2536	3170	99.14	6345/64	3100	2900	4500	37	10.0	122	126
37	1492	1646	3.0	1.2	C713_0810 LM704U	2257	2821	80.97	20727/256	3100	2900	4500	38	10.0	122	126
37	1987	2307	4.0	0.89	C713_0810 LM706U	2257	2821	80.97	20727/256	3100	2900	4500	55	10.0	122	134
43	1300	1434	2.5	1.5	C712_0700 LM704U	2116	2646	69.55	765/11	3100	2900	4500	39	10.0	122	113
43	1732	2010	3.3	1.2	C712_0700 LM706U	2116	2646	69.55	765/11	3100	2900	4500	56	10.0	122	120
53	1062	1172	2.4	1.8	C712_0570 LM704U	1899	2374	56.82	625/11	3100	2900	4500	40	10.0	122	113
53	1415	1642	3.2	1.3	C712_0570 LM706U	1899	2374	56.82	625/11	3100	2900	4500	57	10.0	122	120
73	767	846	2.8	1.8	C712_0410 LM704U	1371	1714	41.02	2625/64	3100	2900	4500	40	10.0	122	113
73	1021	1186	3.7	1.3	C712_0410 LM706U	1371	1714	41.02	2625/64	3100	2900	4500	57	10.0	122	120
86	655	723	2.3	2.4	C712_0350 LM704U	1400	1958	35.07	2700/77	3100	2900	4500	44	10.0	122	113
86	873	1014	3.0	1.8	C712_0350 LM706U	1566	1958	35.07	2700/77	3100	2900	4500	61	10.0	122	120
119	473	522	2.7	2.4	C712_0250 LM704U	1011	1413	25.31	405/16	3100	2900	4500	44	10.0	122	113
119	630	732	3.5	1.8	C712_0250 LM706U	1131	1413	25.31	405/16	3100	2900	4500	62	10.0	122	120
C8 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 4140 Nm)																
14	3907	4311	2.8	0.85	C813_2120 LM704U	4140	6248	212.1	8272/39	2900	2700	4300	38	10.0	204	185
17	3286	3625	2.6	0.97	C813_1780 LM704U	4140	5251	178.4	6956/39	2900	2700	4300	38	10.0	204	185
22	2549	2813	2.4	1.2	C813_1380 LM704U	3718	4648	138.4	2491/18	2900	2700	4300	38	10.0	204	185
22	3396	3943	3.3	0.89	C813_1380 LM706U	3718	4648	138.4	2491/18	2900	2700	4300	55	10.0	204	193
28	1982	2186	2.3	1.4	C813_1080 LM704U	3371	4214	107.6	4841/45	2900	2700	4300	39	10.0	204	185
28	2640	3065	3.0	1.1	C813_1080 LM706U	3371	4214	107.6	4841/45	2900	2700	4300	56	10.0	204	193
33	1673	1846	2.2	1.6	C813_0910 LM704U	2846	3558	90.82	18800/207	2900	2700	4300	39	10.0	204	185
33	2229	2587	2.9	1.2	C813_0910 LM706U	2846	3558	90.82	18800/207	2900	2700	4300	56	10.0	204	193
38	1462	1613	2.6	1.4	C813_0790 LM704U	2486	3108	79.34	285619/3600	2900	2700	4300	39	10.0	204	185
38	1947	2260	3.5	1.1	C813_0790 LM706U	2486	3108	79.34	285619/3600	2900	2700	4300	56	10.0	204	193

9.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gearbox dimensions, motor dimensions and geared motor dimensions.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Tolerances

Axis height in accordance with DIN 747	Tolerance
Up to 50 mm	-0.4 mm
Up to 250 mm	-0.5 mm
Up to 630 mm	-0.6 mm

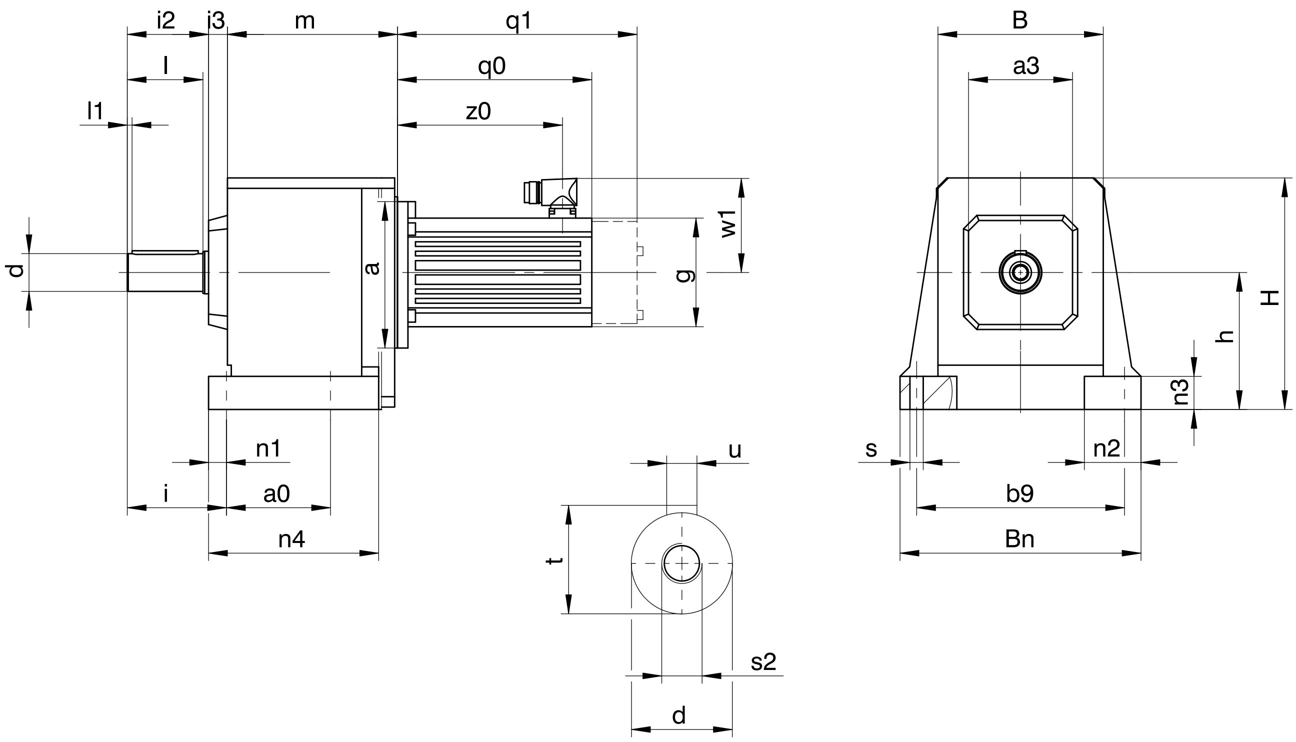
Solid shaft	Tolerance
Shaft ∅ fit ≤ 50 mm	DIN 748-1, ISO k6
Shaft ∅ fit > 50 mm	DIN 748-1, ISO m6
Feather keys	DIN 6885-1, high form A

Flange	Pilot tolerance
Up to 300 mm	ISO j6
Starting at 350 mm	ISO h6

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

9.3.1 Solid shaft design with feather key, N housing design (base)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

C203, C303, C612, C613: Motor and gearbox are sometimes non-coaxial.

Options: C0 – C5 also available with solid shaft without feather key; on request starting at C6.

Dimensions of gearboxes

Type	a0	a3	b9	B	Bn	Ød	h	H	i	i2	i3	l	l1	n1	n2	n3	n4	Øs	s2	t	u
C0	62	60	110	92	132	20_{k6}	82	144	55	44	13	40	3	11	35	20	95.0	7	M6	22.5	A6×6×32
C1	70	80	150	124	176	25_{k6}	102	177	67	54	15	50	5	13	42	25	117.5	9	M10	28.0	A8×7×40
C2	85	95	170	138	200	30_{k6}	115	195	79	65	21	60	5	14	50	30	134.5	11	M10	33.0	A8×7×50
C3	105	95	185	150	215	30_{k6}	130	215	79	65	20	60	5	14	50	30	153.5	11	M10	33.0	A8×7×50
C4	110	110	220	175	255	40_{k6}	145	245	105	86	20	80	5	19	60	35	180.0	14	M16	43.0	A12×8×70
C5	130	130	245	192	290	40_{k6}	170	290	108	86	21	80	5	22	70	40	197.0	18	M16	43.0	A12×8×70
C6	215	177	245	225	300	50_{k6}	200	315	130	106	47	100	5	25	75	40	265.0	18	M16	53.5	A14×9×90
C7	235	192	300	265	365	60_{m6}	235	375	163	127	58	120	5	25	90	50	285.0	18	M20	64.0	A18×11×100
C8	300	223	340	310	435	70_{m6}	290	450	190	148	70	140	5	29	95	55	360.0	22	M20	74.5	A20×12×125

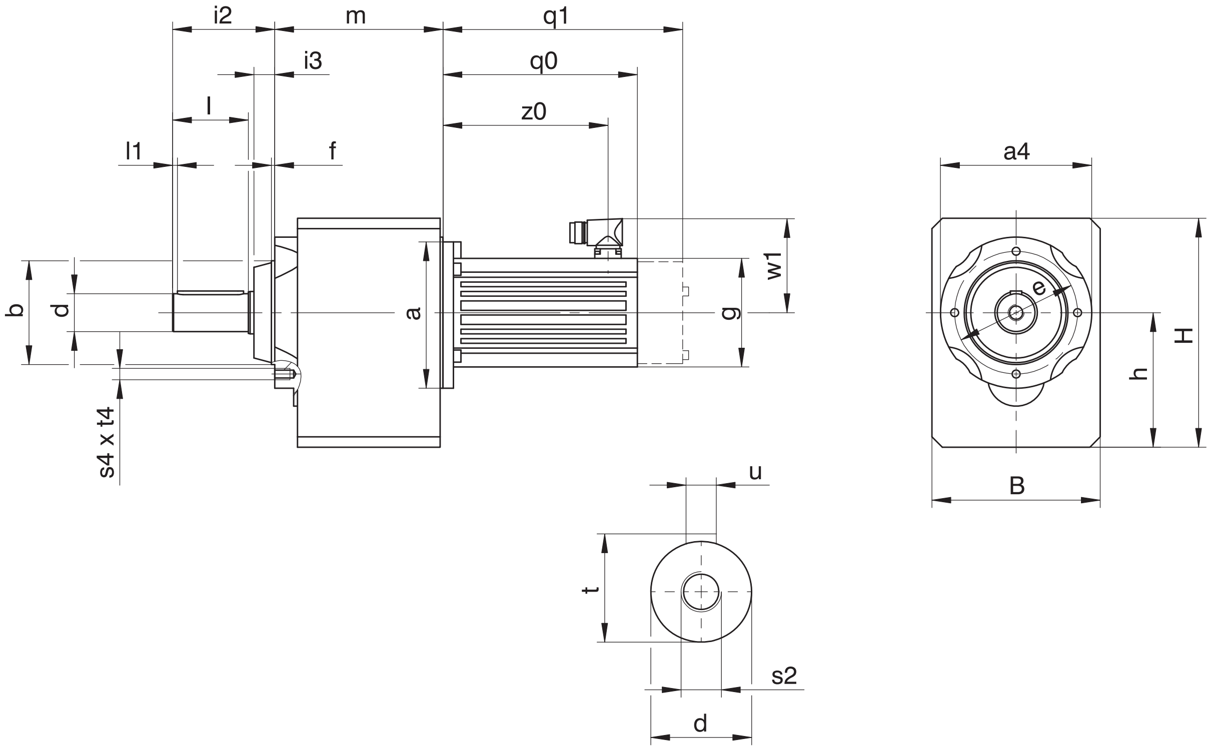
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

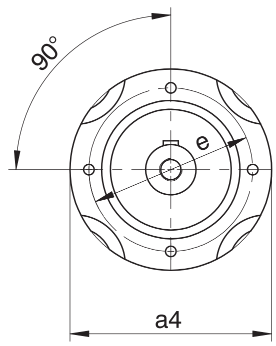
Dimensions of geared motors

Type	LM4		LM5		LM7	
	a	m	a	m	a	m
C002	□98	97.5	□115	101.5	–	–
C102	□98	118.0	□115	122.0	□145	124.0
C202	∅140	129.0	□115	133.0	□145	135.0
C203	∅140	166.0	–	–	–	–
C302	–	–	∅160	152.5	□145	154.5
C303	∅140	185.5	–	–	–	–
C402	–	–	∅160	180.0	□145	182.0
C502	–	–	∅160	200.0	∅200	202.0
C503	–	–	∅160	243.0	–	–
C612	–	–	–	–	∅200	180.0
C613	–	–	∅160	222.0	∅200	242.0
C712	–	–	–	–	∅200	201.0
C713	–	–	–	–	∅200	262.0
C813	–	–	–	–	∅200	296.0

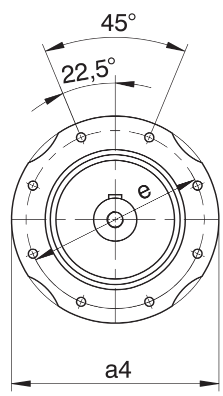
9.3.2 Solid shaft design with feather key, G housing design (pitch circle diameter)



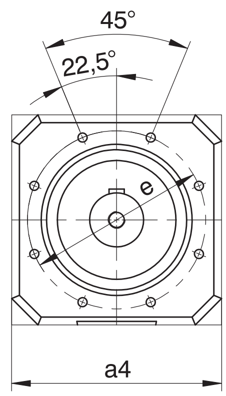
C0 – C4



C5



C6 – C8



q0 Applies to motors without brake. q1 Applies to motors with brake.

C203, C303, C612, C613: Motor and gearbox are sometimes non-coaxial.

Options: C0 – C5 also available with solid shaft without feather key; on request starting at C6.

Dimensions of gearboxes

Type	a4	∅b	B	∅d	∅e	f	h	H	i2	i3	l	l1	s2	s4	t	t4	u
C0	∅87	55_{j6}	97	20_{k6}	75	3.0	79.0	141.0	58	14	40	3	M6	M6	22.5	10	A6×6×32
C1	∅120	80_{j6}	130	25_{k6}	100	3.0	100.0	175.0	71	17	50	5	M10	M6	28.0	13	A8×7×40
C2	∅140	95_{j6}	142	30_{k6}	115	3.0	112.0	192.0	87	22	60	5	M10	M8	33.0	13	A8×7×50
C3	∅140	95_{j6}	154	30_{k6}	115	3.0	127.0	212.0	87	22	60	5	M10	M8	33.0	13	A8×7×50
C4	∅160	110_{j6}	178	40_{k6}	130	3.5	142.5	242.5	108	22	80	5	M16	M10	43.0	16	A12×8×70
C5	∅192	130_{j6}	195	40_{k6}	165	3.5	166.0	286.0	109	23	80	5	M16	M10	43.0	16	A12×8×70
C6	□180	140_{j6}	225	50_{k6}	165	5.0	195.0	310.0	136	30	100	5	M16	M10	53.5	16	A14×9×90
C7	□195	155_{j6}	265	60_{m6}	185	8.0	231.0	371.0	164	37	120	5	M20	M12	64.0	19	A18×11×100
C8	□226	185_{j6}	310	70_{m6}	215	5.0	285.0	445.0	185	37	140	5	M20	M12	74.5	19	A20×12×125

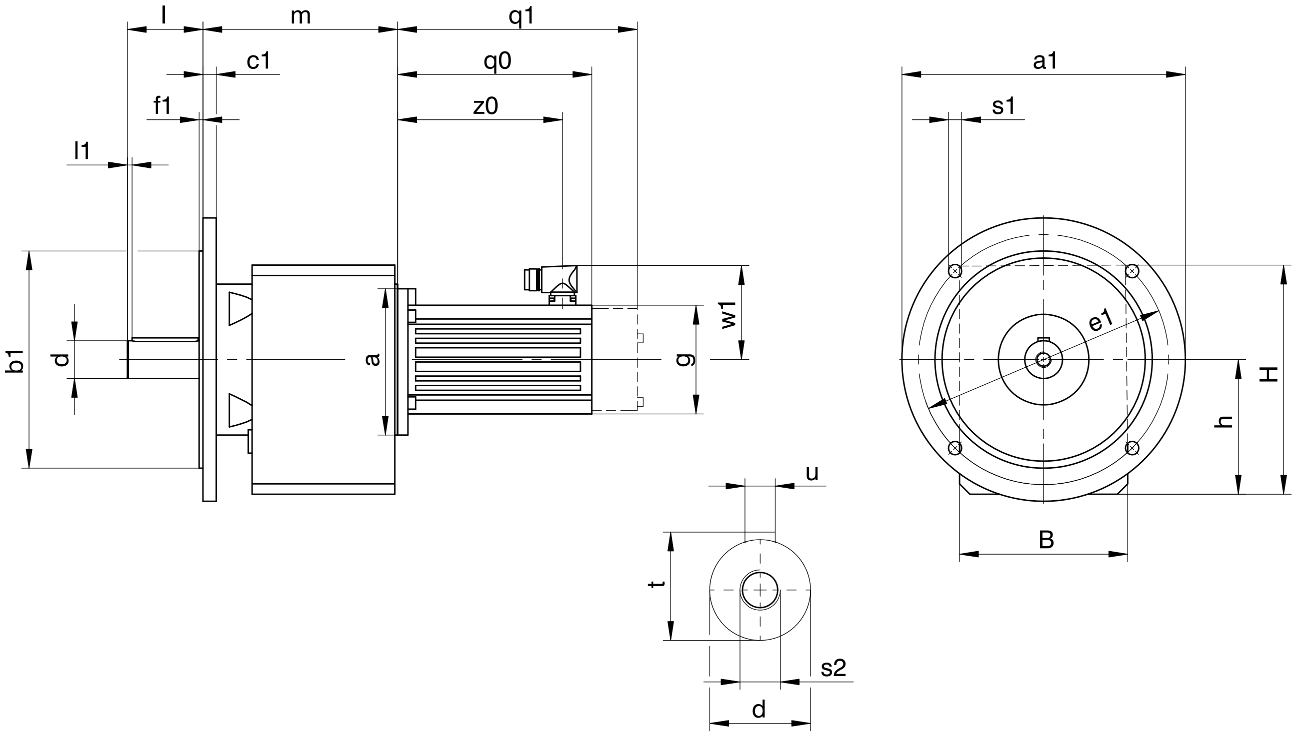
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4		LM5		LM7	
	a	m	a	m	a	m
C002	□98	96	□115	100	–	–
C102	□98	116	□115	120	□145	122
C202	∅140	128	□115	132	□145	134
C203	∅140	165	–	–	–	–
C302	–	–	∅160	151	□145	153
C303	∅140	184	–	–	–	–
C402	–	–	∅160	178	□145	180
C502	–	–	∅160	198	∅200	200
C503	–	–	∅160	241	–	–
C612	–	–	–	–	∅200	197
C613	–	–	∅160	239	∅200	259
C712	–	–	–	–	∅200	222
C713	–	–	–	–	∅200	283
C813	–	–	–	–	∅200	329

9.3.3 Solid shaft design with feather key, F housing design (round flange)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

C203, C303, C612, C613: Motor and gearbox are sometimes non-coaxial.

Options: C0 – C5 also available with solid shaft without feather key; on request starting at C6.

Dimensions of gearboxes

Type	⌀a1	⌀b1	B	c1	⌀d	⌀e1	f1	h	H	l	l1	⌀s1	s2	t	u
C0	160	110_{j6}	97	10	20_{k6}	130	3.0	79.0	141.0	40	3	9	M6	22.5	A6×6×32
C1	200	130_{j6}	130	12	25_{k6}	165	3.5	100.0	175.0	50	5	11	M10	28.0	A8×7×40
C2	200	130_{j6}	142	12	30_{k6}	165	3.5	112.0	192.0	60	5	11	M10	33.0	A8×7×50
C3	250	180_{j6}	154	12	30_{k6}	215	4.0	127.0	212.0	60	5	14	M10	33.0	A8×7×50
C4	250	180_{j6}	178	14	40_{k6}	215	4.0	142.5	242.5	80	5	14	M16	43.0	A12×8×70
C5	300	230_{j6}	195	16	40_{k6}	265	4.0	166.0	286.0	80	5	14	M16	43.0	A12×8×70
C6	300	230_{j6}	225	17	50_{k6}	265	4.0	195.0	310.0	100	5	14	M16	53.5	A14×9×90
C7	350	250_{h6}	265	18	60_{m6}	300	5.0	231.0	371.0	120	5	18	M20	64.0	A18×11×100
C8	400	300_{h6}	310	20	70_{m6}	350	5.0	285.0	445.0	140	5	18	M20	74.5	A20×12×125

Dimensions of additional round flanges

Type	⌀a1	⌀b1	c1	⌀e1	f1	⌀s1
C0	120	80_{j6}	10	100	3.0	7
C0	140	95_{j6}	10	115	3.0	9
C1	140	95_{j6}	8	115	3.5	9
C1	160	110_{j6}	10	130	3.5	9
C2	160	110_{j6}	10	130	3.5	9
C2	250	180_{j6}	12	215	4.0	14
C3	160	110_{j6}	10	130	3.5	9
C3	200	130_{j6}	12	165	3.5	11
C4	200	130_{j6}	14	165	3.5	11
C4	300	230_{j6}	14	265	4.0	14
C5	250	180_{j6}	14	215	4.0	14
C8	350	250_{h6}	18	300	5.0	18
C8	450	350_{h6}	20	400	5.0	18

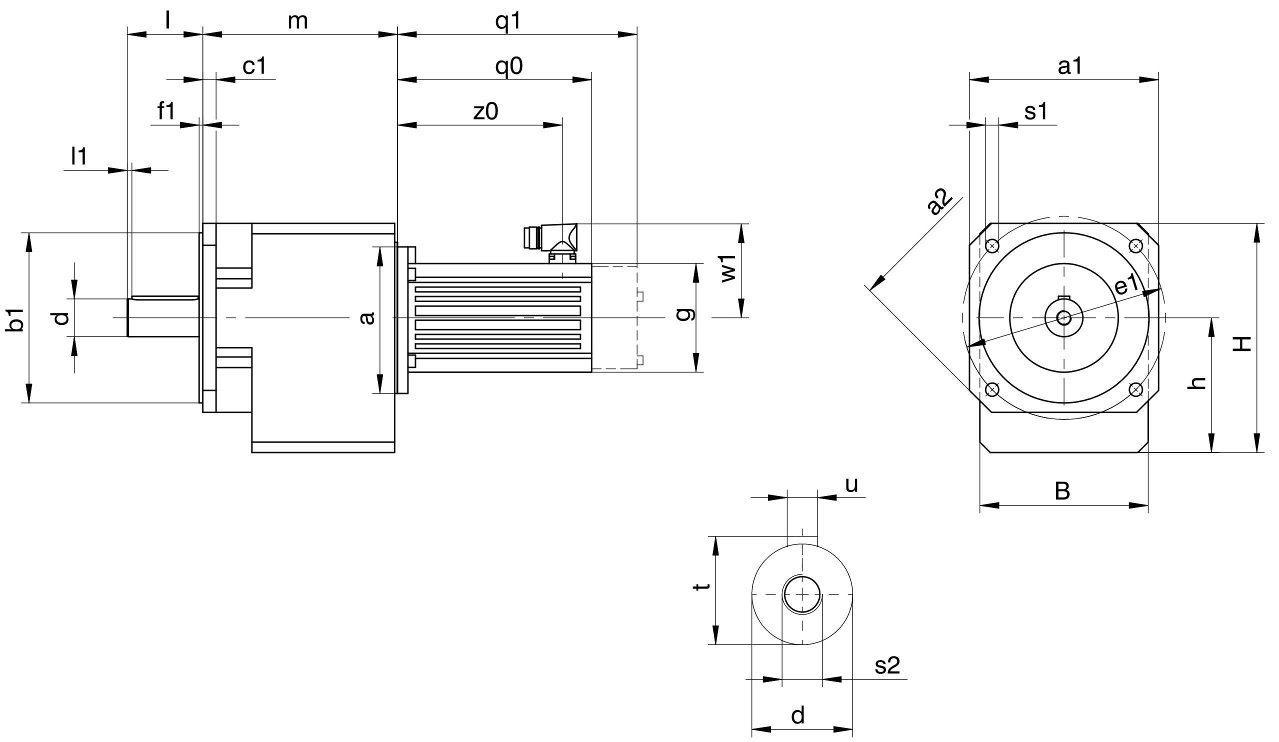
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4		LM5		LM7	
	a	m	a	m	a	m
C002	□98	114	□115	118	–	–
C102	□98	137	□115	141	□145	143
C202	∅140	155	□115	159	□145	161
C203	∅140	192	–	–	–	–
C302	–	–	∅160	178	□145	180
C303	∅140	211	–	–	–	–
C402	–	–	∅160	206	□145	208
C502	–	–	∅160	227	∅200	229
C503	–	–	∅160	270	–	–
C612	–	–	–	–	∅200	233
C613	–	–	∅160	275	∅200	295
C712	–	–	–	–	∅200	266
C713	–	–	–	–	∅200	327
C813	–	–	–	–	∅200	374

9.3.4 Solid shaft design with feather key, Q housing design (square flange)



q0 Applies to motors without brake. q1 Applies to motors with brake.

C203, C303: Motor and gearbox are sometimes non-coaxial.

Options: C0 – C5 also available with solid shaft without feather key; on request starting at C6.

Dimensions of gearboxes

Type	□a1	□a2	∅b1	B	c1	∅d	∅e1	f1	h	H	l	l1	∅s1	s2	t	u
C0	124	160	110_{j6}	97	9	20_{k6}	130	3.0	79.0	141.0	40	3	9	M6	22.5	A6×6×32
C1	145	192	130_{j6}	130	11	25_{k6}	165	3.5	100.0	175.0	50	5	11	M10	28.0	A8×7×40
C2	145	192	130_{j6}	142	11	30_{k6}	165	3.5	112.0	192.0	60	5	11	M10	33.0	A8×7×50
C3	200	250	180_{j6}	154	14	30_{k6}	215	4.0	127.0	212.0	60	5	14	M10	33.0	A8×7×50
C4	200	250	180_{j6}	178	14	40_{k6}	215	4.0	142.5	242.5	80	5	14	M16	43.0	A12×8×70

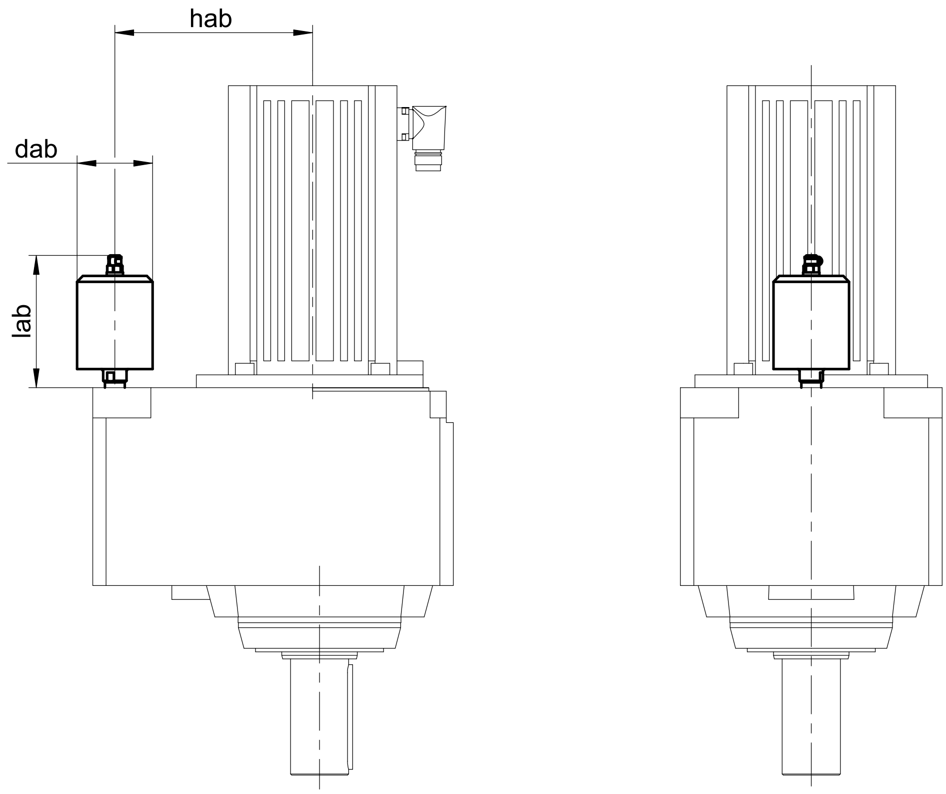
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4		LM5		LM7	
	a	m	a	m	a	m
C002	□98	114	□115	118	–	–
C102	□98	137	□115	141	□145	143
C202	∅140	155	□115	159	□145	161
C203	∅140	192	–	–	–	–
C302	–	–	∅160	178	□145	180
C303	∅140	211	–	–	–	–
C402	–	–	∅160	206	□145	208

9.3.5 Oil expansion tank



Dimensions

Type	LM7		
	dab	hab	lab
C612	65	170	114.5
C712	73	205	129.5

More information can be found in Chapter [▸ 9.6.4]

9.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

C	2	0	2	N	0280	LM403U

Explanation

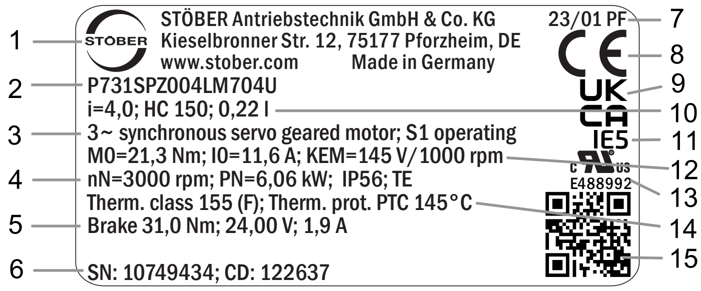
Code	Designation	Design
C	Type	Helical gearbox
2	Size	2 (example)
0	Generation	Generation 0
1		Generation 1
2	Stages	Two-stage
3		Three-stage
G	Housing	Pitch circle diameter
F		Round flange
Q		Square flange
N		Foot
0280	Transmission ratio (i x 10 rounded)	i = 28.24 (example)
LM403U	Motor	LM Lean motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▸ 2]
- The mounting position, see the chapter [▸ 9.5.5]
- The position of the plug connector, see the chapter [▸ 9.5.7]
- Oil expansion tank (recommended for gearboxes in mounting position EL5), see the chapter [▸ 9.6.4]
- Standard or reinforced output bearing

9.4.1 Nameplate

In the following figure, the nameplate of a P731_LM704 Lean geared motor is explained as an example.

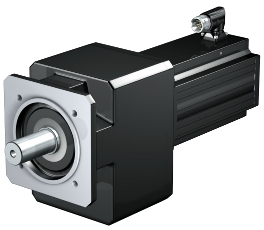


Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004LM704U	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=3000 rpm PN=6.06 kW IP56 TE	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004
5	Brake 31.0 Nm 24.00 V 1.9 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749434 CD: 122637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	IE5	IEC energy efficiency
12	M0=21.3 Nm I0=11.6 A KEM=145 V/1000 rpm	Stall torque Stall current Voltage constant
13	cURus E488992	cURus test symbol, registered under UL number E488992
14	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
15	QR code	Link to product information

9.5 Product description

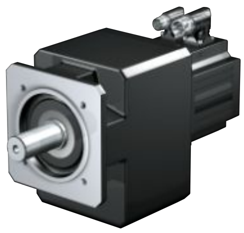
9.5.1 Input options

LM Lean motor



Catalog ID 443016_en

EZ synchronous servo motor



Catalog ID 442437_en

MB motor adapter +
EZ synchronous servo motor

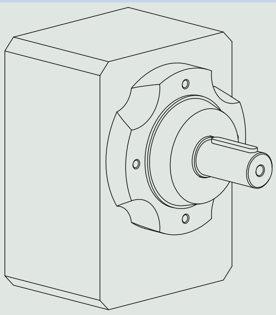
Catalog ID 443311_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

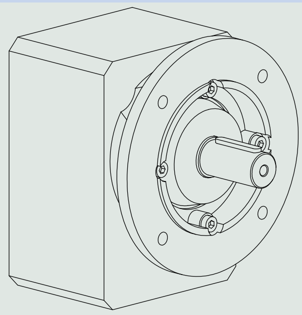
Enter the ID of the catalog in the Search term field.

9.5.2 Housing design

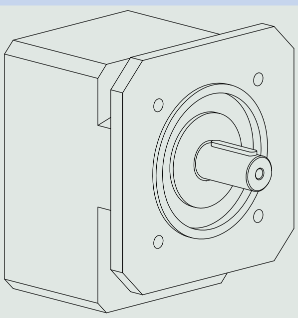
Pitch circle diameter G



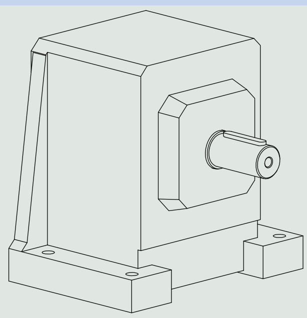
Round flange F



Square flange Q



Foot N



	G	F	Q	N
C0	✓	✓	✓	✓
C1	✓	✓	✓	✓
C2	✓	✓	✓	✓
C3	✓	✓	✓	✓
C4	✓	✓	✓	✓
C5	✓	✓	–	✓
C6	✓	✓	–	✓
C7	✓	✓	–	✓
C8	✓	✓	–	✓
C9	✓	✓	–	✓

9.5.3 Shaft design

Gearboxes in sizes C0 – C9 come standard with a solid shaft with feather key.

Gearboxes in sizes C0 – C5 can be ordered with the option of a solid shaft without feather key. Only upon request starting at size C6.

9.5.4 Installation conditions

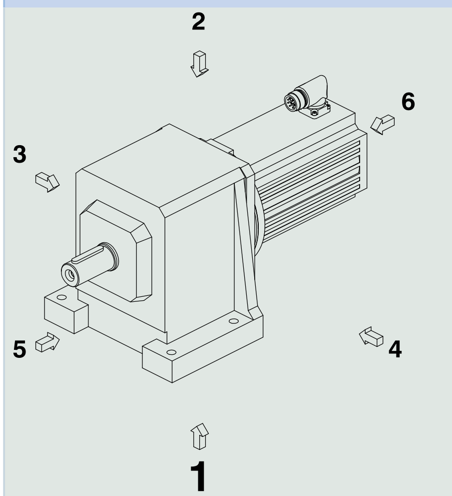
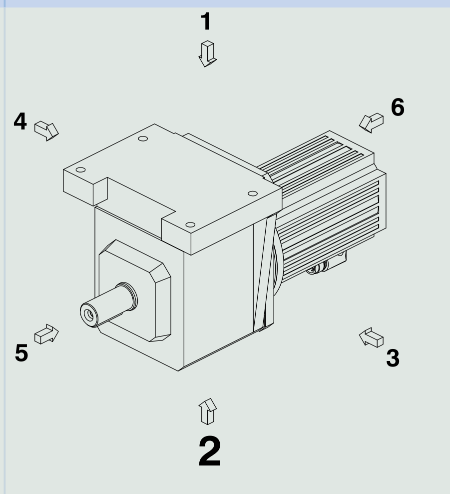
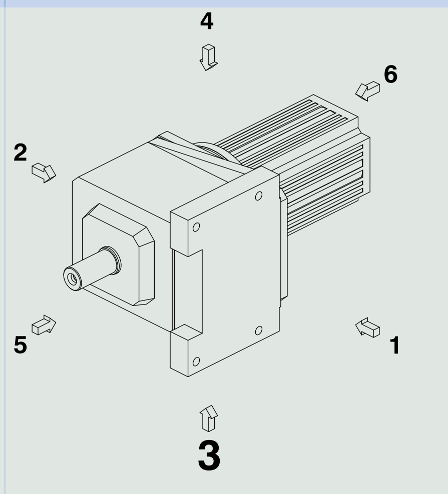
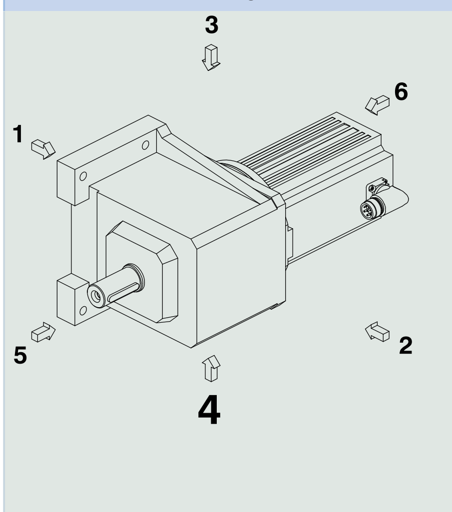
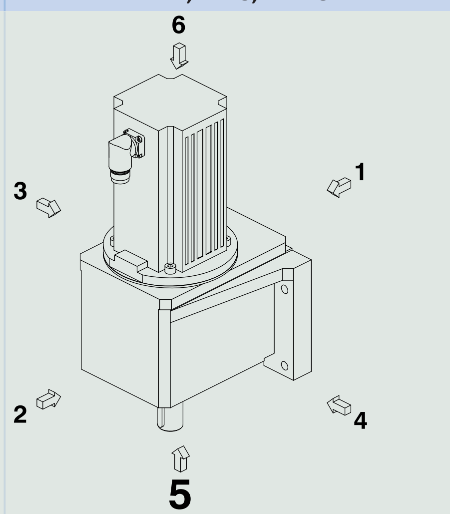
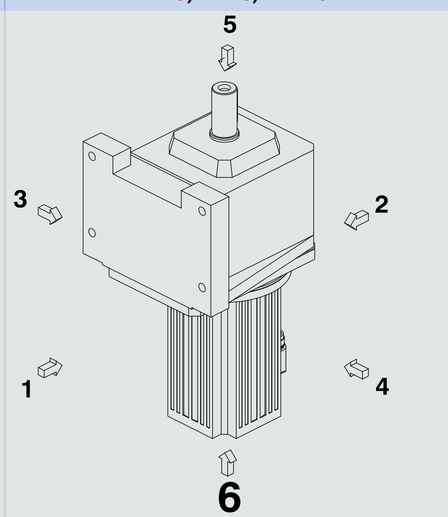
Fastening the gearboxes on the machine side using the pitch circle diameter

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

9.5.5 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gearbox sides. The mounting position is defined by the gearbox side facing downwards.

<table>
<tr><th>EL1
IMB3, IMB5, IMB14, IMB34, IMB35</th><th>EL2
IMB8</th><th>EL3
IMB7</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><th>EL4
IMB6</th><th>EL5
IMV1, IMV5, IMV18</th><th>EL6
IMV3, IMV6, IMV19</th></tr>
<tr><td></td><td></td><td></td></tr>
</table>

Since the lubricant filling volume of the gearbox depends on the mounting position, the mounting position must be specified when ordering.

9.5.6 Lubricants

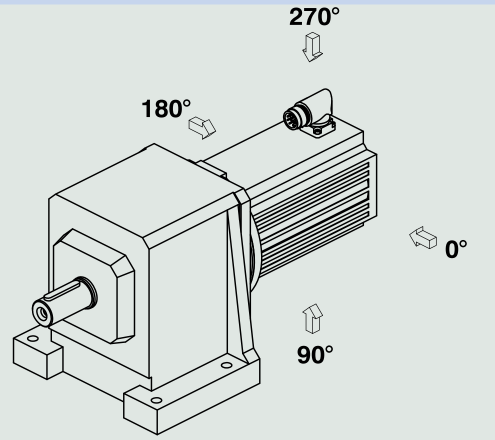
STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gearboxes depend on the mounting position.

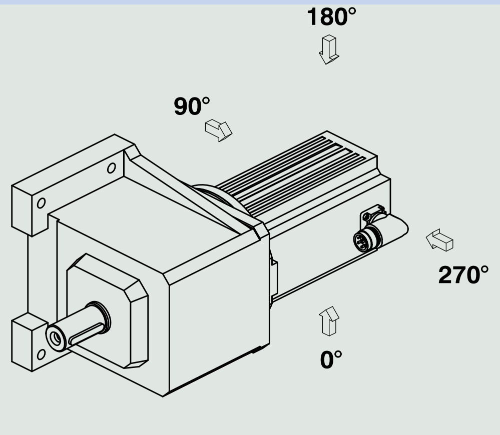
Only install the gearboxes in the intended mounting position! Reposition the gearboxes only after consulting STOBER. Otherwise, STOBER assumes no liability for the gearboxes.

You will receive lubricants for use in the food industry upon request.

9.5.7 Position of the plug connector

Mounting position EL1	**Mounting position EL4**
Plug connector in 270° position (standard)	Plug connector in 270° position (standard)





Indicate variations for your geared motor in the order.

Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

9.5.8 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} two-stage	97%
η_{get} three-stage	96%
Protection class:[1]	
Gearbox	IP65
Motor	IP56, optionally IP66

9.5.9 Maintenance

The instructions for maintenance can be found in the operating manual, ID 443365_en, at http://www.stoeber.de/en/downloads/. Enter the ID of the documentation in the Search... field.

Ventilation

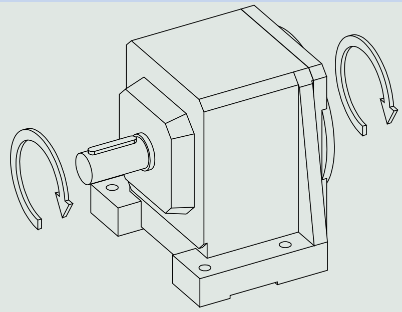
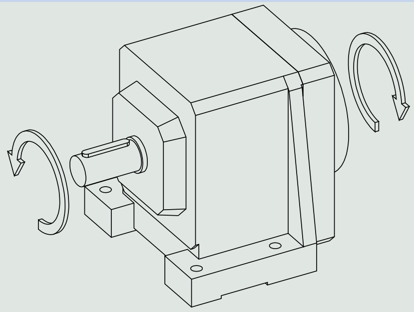
Air release valves are fitted as a standard feature and independently of installation position for gearbox sizes C6 to C9.

For the position and dimensions of the air release valve, refer to the 3D model.

Download the 3D model at https://configurator.stoeber.de/en-US/.

[1] Observe the protection class of all the components.

9.5.10 Direction of rotation

C002 – C912	C103 – C913
	
The input and output rotate in the same direction.	The input and output rotate in opposite directions.

The pictures show mounting position EL1.

9.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

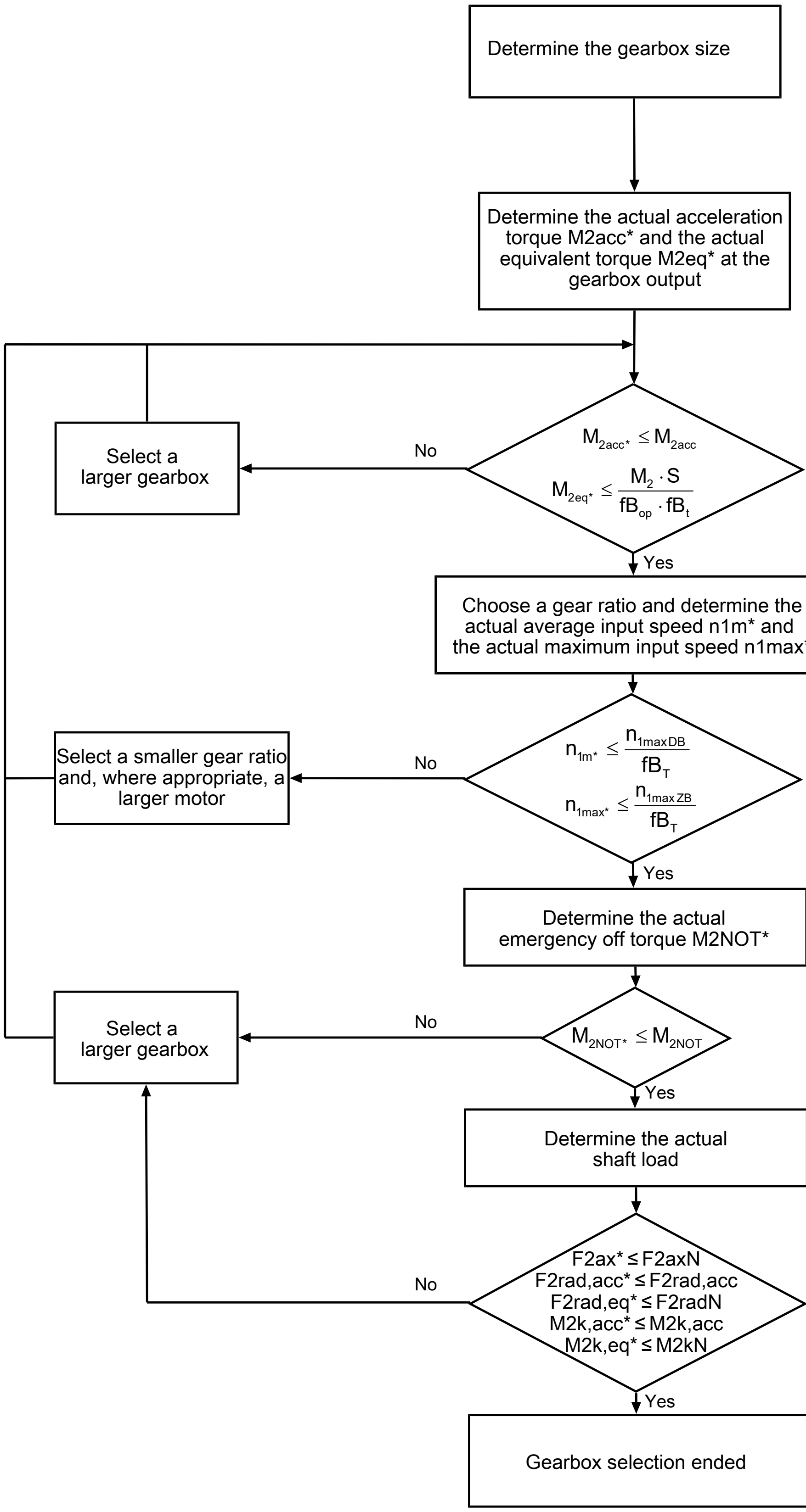
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in the Chapter [▸ 15.1].

The formula symbols for values actually present in the application are marked with *.

9.6.1 Drive selection

Drive selection for gearboxes

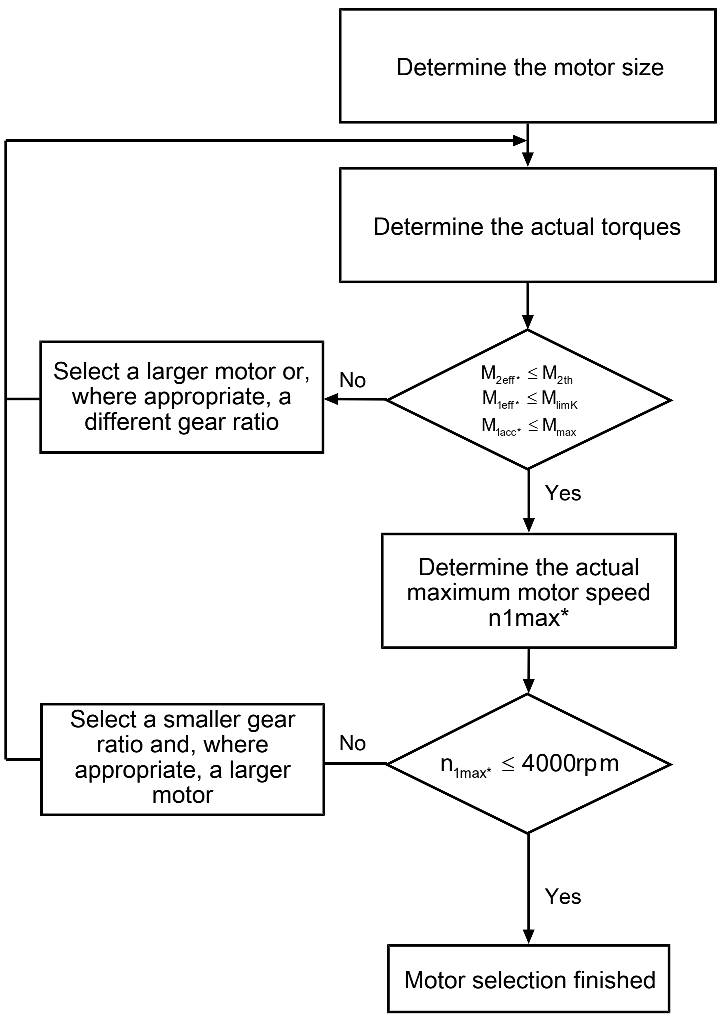


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_2 and S.

The values for fB_T, fB_{op} and fB_t can be found in the corresponding tables in this chapter.

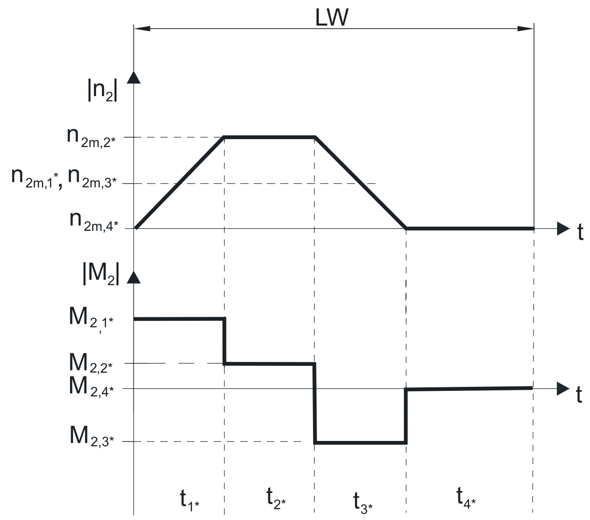
Drive selection for motors



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [▷ 2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc^*} = J_{tot} \cdot \frac{\Delta n_2}{9{,}55 \cdot \Delta t} + M_{L^*}$$

$$M_{1acc^*} = \frac{M_{2acc^*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9{,}55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If t_{1*} + ... + t_{3*} ≥ 6 min, calculate n_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}^{\,2} + \ldots + t_{n^*} \cdot M_{2,n^*}^{\,2}}{t_{1^*} + \ldots + t_{n^*}}}$$

Calculation of the actual emergency off torque

$$M_{2NOT^*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L^*}$$

Calculation of the actual equivalent torque

$$M_{2eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2,1^*}^{\,3}| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2,n^*}^{\,3}|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th}$ ≤ 0 you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

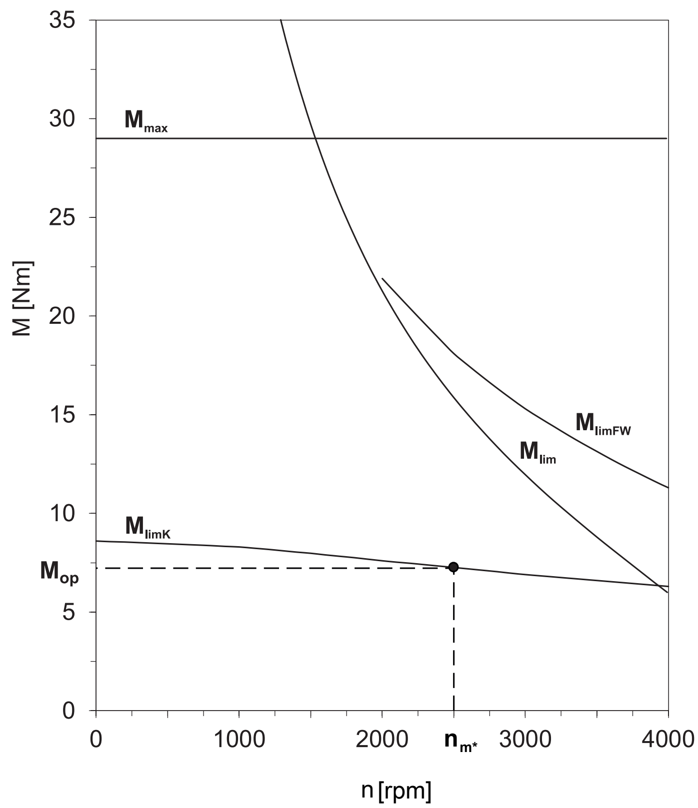
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot athEL \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for a_{thEL} and fB_T can be found in the corresponding tables in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter [▶ 2.3]. Note the size of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Parameter a_{thEL}

Mounting position	a_{thEL}
EL1, 2, 5, 6	1.0
EL3, 4	1.1

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.25
Reversing load cyclic operation	1.40

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gearbox torques (M_{2acc}, M_{2NOT}) in the selection tables.

9.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m*} \leq 20$ rpm ($F_{2axN} = F_{2ax20}$; $F_{2radN} = F_{2rad20}$; $M_{2kN} = M_{2k20}$)
- Only if radial forces on the gearbox are stabilized by its pilots for the pitch circle diameter and flange housing design

Permitted shaft loads

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
C0	20.0	500	1900	1900	80	80
C1	30.0	850	3400	3400	190	190
C2	30.0	1050	4200	4200	260	260
C3	30.0	1400	5650	5650	350	350
C4	35.0	2400	9700	9700	750	750
C5	42.0	3000	11000	11000	900	900
C6	40.0	4000	16000	16000	1500	1500
C7	45.0	5500	22000	22000	2400	2400
C8	50.0	7500	30000	30000	3700	3700
C9	55.0	9500	37000	37000	5200	5200

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m*} > 20 rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m*}}{20\text{ rpm}}}} \qquad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m*}}{20\text{ rpm}}}} \qquad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m*}}{20\text{ rpm}}}}$$

The values for F_{2ax20}, F_{2rad20} and M_{2k20} can be found in the table "Permitted shaft loads" in this chapter.

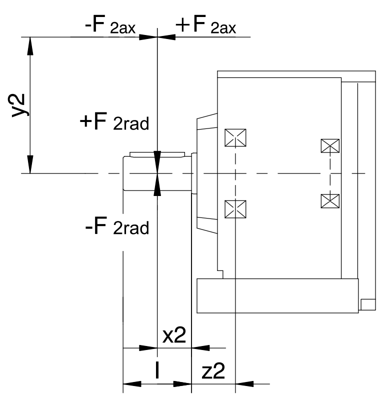


Fig. 1: Force application points

The specified values for F_{2rad20} and $F_{2rad,acc}$ refer to an application of force at the center of the output shaft: $x_2 = l/2$.

Shaft dimensions can be found in the "Dimensional drawings" chapter.

The following applies to other force application points:

$$M_{2k,acc*} = \frac{2 \cdot F_{2ax*} \cdot y_2 + F_{2rad,acc*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

9.6.3 Radial shaft seal rings

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

9.6.4 Oil expansion tank

The gearboxes have a higher fill level in mounting position EL5. The oil expansion tank prevents oil from escaping out of the gearbox.

Notes

- We recommend using an oil expansion tank in mounting position EL5 (additional cost) for fast running gearboxes with an input speed n_1 > 1750 rpm and gear ratios i < 20.
- It is not possible to use an oil expansion tank if the plug connector is at 90°!
- The oil expansion tank can only be used with certain sizes; see the chapter [9.3.5]

9.7 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual gearboxes, geared motors C	443365_en

10 F offset helical geared motors

Table of contents

10 Offset helical geared motors

F

10.1 Overview

Offset helical geared motors with large axial distances

Features

Power density	★☆☆☆☆
Backlash	★★★☆☆
Price category	€
Shaft load	★★★☆☆
Smooth operation	★★★☆☆
Torsional stiffness	★★☆☆☆
Mass moment of inertia	★★★★★
Helical gearing	✓
Maintenance-free	✓
FKM seal ring at the input	✓
Large axial distances, suitable for confined situations	✓
Compact and dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

i	4.3 – 366
M_{2acc}	19 – 1100 Nm
$\Delta\varphi_2$	5 – 11 arcmin
η_{get}	96 – 97 %

10.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Drives with convection-cooled motors
- Weight specification for mounting position EL1, housing design G

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the Chapter [▷ 15.1].

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,3,4	n_{1maxDB} EL5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2redII}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
F1 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 120 Nm)																	
54	122	132	2.7	0.98	F102_0560 LM401U	120	240	55.97	2015/36	4000	4000	7000	1.7	11.0	6.0	7.7	16
65	101	109	2.5	1.2	F102_0460 LM401U	120	240	46.43	325/7	4000	4000	7000	1.8	11.0	6.0	7.7	16
86	76	83	2.4	1.4	F102_0350 LM401U	120	240	35.05	3575/102	4000	4000	6500	1.8	11.0	6.0	7.7	16
107	61	66	2.3	1.7	F102_0280 LM401U	120	205	28.17	169/6	4000	4000	6500	1.9	11.0	6.0	7.7	16
107	120	123	4.5	0.85	F102_0280 LM402U	120	240	28.17	169/6	4000	4000	6500	3.2	11.0	6.0	7.7	17
130	50	54	2.2	1.9	F102_0230 LM401U	101	168	23.08	3185/138	3700	3600	6000	1.9	11.0	6.0	7.7	16
130	99	101	4.3	0.97	F102_0230 LM402U	120	240	23.08	3185/138	3700	3600	6000	3.3	11.0	6.0	7.7	17
163	40	44	2.1	2.2	F102_0185 LM401U	81	134	18.46	1495/81	3700	3600	6000	2.0	11.0	6.0	7.7	16
163	79	81	4.2	1.1	F102_0185 LM402U	120	240	18.46	1495/81	3700	3600	6000	3.3	11.0	6.0	7.7	17
163	108	111	5.7	0.82	F102_0185 LM403U	120	240	18.46	1495/81	3700	3600	6000	4.6	11.0	6.0	7.7	19
221	30	32	2.0	2.7	F102_0135 LM401U	59	99	13.59	231/17	4000	4000	6500	1.9	11.0	8.0	6.5	16
221	58	59	4.0	1.4	F102_0135 LM402U	105	200	13.59	231/17	4000	4000	6500	3.2	11.0	8.0	6.5	17
221	80	82	5.4	1.0	F102_0135 LM403U	105	200	13.59	231/17	4000	4000	6500	4.5	11.0	8.0	6.5	19
275	24	26	2.3	2.7	F102_0110 LM401U	48	79	10.92	273/25	4000	4000	6500	2.0	11.0	8.0	6.5	16
275	47	48	3.8	1.6	F102_0110 LM402U	103	200	10.92	273/25	4000	4000	6500	3.3	11.0	8.0	6.5	17
275	64	66	5.2	1.2	F102_0110 LM403U	105	200	10.92	273/25	4000	4000	6500	4.6	11.0	8.0	6.5	19
335	20	21	2.5	2.7	F102_0089 LM401U	39	65	8.948	1029/115	3700	3600	6000	2.1	11.0	8.0	6.5	16
335	38	39	3.7	1.8	F102_0089 LM402U	84	200	8.948	1029/115	3700	3600	6000	3.4	11.0	8.0	6.5	17
335	53	54	5.1	1.3	F102_0089 LM403U	105	200	8.948	1029/115	3700	3600	6000	4.7	11.0	8.0	6.5	19
335	82	87	7.9	0.84	F102_0089 LM503U	105	200	8.948	1029/115	3700	3600	6000	11	11.0	8.0	6.5	22
419	16	17	2.8	2.7	F102_0072 LM401U	31	52	7.156	322/45	3700	3600	6000	2.3	11.0	8.0	6.5	16
419	31	31	3.6	2.1	F102_0072 LM402U	67	200	7.156	322/45	3700	3600	6000	3.6	11.0	8.0	6.5	17
419	42	43	4.9	1.5	F102_0072 LM403U	89	200	7.156	322/45	3700	3600	6000	4.9	11.0	8.0	6.5	19
419	66	70	7.6	0.98	F102_0072 LM503U	105	200	7.156	322/45	3700	3600	6000	11	11.0	8.0	6.5	22
464	28	28	3.5	2.3	F102_0065 LM402U	61	188	6.462	84/13	3500	3000	6000	3.8	11.0	8.0	6.5	17
464	38	39	4.8	1.6	F102_0065 LM403U	80	188	6.462	84/13	3500	3000	6000	5.1	11.0	8.0	6.5	19
464	59	63	7.5	1.0	F102_0065 LM503U	105	188	6.462	84/13	3500	3000	6000	11	11.0	8.0	6.5	22
696	9.4	10	3.6	2.7	F102_0043 LM401U	19	31	4.308	56/13	3500	3000	6000	3.2	11.0	8.0	6.5	16
696	18	19	3.3	3.0	F102_0043 LM402U	41	125	4.308	56/13	3500	3000	6000	4.5	11.0	8.0	6.5	17
696	25	26	4.5	2.2	F102_0043 LM403U	54	125	4.308	56/13	3500	3000	6000	5.8	11.0	8.0	6.5	19
696	40	42	7.0	1.4	F102_0043 LM503U	85	125	4.308	56/13	3500	3000	6000	12	11.0	8.0	6.5	22
696	57	65	10	0.95	F102_0043 LM505U	100	125	4.308	56/13	3500	3000	6000	18	11.0	8.0	6.5	26
F2 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 270 Nm)																	
27	246	266	2.1	0.98	F202_1130 LM401U	270	480	112.7	1240/11	4000	3900	6500	1.7	11.0	6.0	18	24
32	205	221	1.9	1.2	F202_0940 LM401U	270	480	93.82	1032/11	4000	3900	6500	1.7	11.0	6.0	18	24
43	153	165	1.7	1.6	F202_0700 LM401U	270	435	70.13	5400/77	4000	3900	6500	1.8	11.0	6.0	18	24
43	300	306	3.3	0.80	F202_0700 LM402U	270	480	70.13	5400/77	4000	3900	6500	3.1	11.0	6.0	18	25
53	243	248	3.0	0.99	F202_0570 LM402U	270	480	56.73	624/11	4000	3900	6500	3.2	11.0	6.0	18	25
64	103	111	1.4	2.3	F202_0470 LM401U	206	342	47.05	1035/22	4000	3900	6500	1.9	11.0	6.0	18	24
64	201	205	2.7	1.2	F202_0470 LM402U	270	480	47.05	1035/22	4000	3900	6500	3.2	11.0	6.0	18	25
64	277	282	3.7	0.87	F202_0470 LM403U	270	480	47.05	1035/22	4000	3900	6500	4.5	11.0	6.0	18	27
85	77	84	1.4	2.7	F202_0350 LM401U	155	258	35.46	390/11	3800	3500	6000	2.0	11.0	6.0	18	24
85	152	155	2.6	1.4	F202_0350 LM402U	270	480	35.46	390/11	3800	3500	6000	3.4	11.0	6.0	18	25
85	208	213	3.5	1.0	F202_0350 LM403U	270	480	35.46	390/11	3800	3500	6000	4.7	11.0	6.0	18	27
107	120	123	2.5	1.7	F202_0280 LM402U	265	480	28.11	4020/143	3800	3500	6000	3.5	11.0	6.0	18	25
107	165	169	3.4	1.2	F202_0280 LM403U	270	480	28.11	4020/143	3800	3500	6000	4.8	11.0	6.0	18	27
128	51	55	1.7	2.7	F202_0230 LM401U	103	171	23.43	2320/99	3600	3100	6000	2.3	11.0	6.0	18	24
128	100	102	2.4	1.9	F202_0230 LM402U	220	480	23.43	2320/99	3600	3100	6000	3.7	11.0	6.0	18	25
128	138	141	3.3	1.4	F202_0230 LM403U	270	480	23.43	2320/99	3600	3100	6000	5.0	11.0	6.0	18	27
128	215	229	5.1	0.88	F202_0230 LM503U	270	480	23.43	2320/99	3600	3100	6000	11	11.0	6.0	18	30
161	80	81	2.3	2.2	F202_0185 LM402U	175	480	18.65	6360/341	3600	3100	6000	3.9	11.0	6.0	18	25
161	110	112	3.2	1.6	F202_0185 LM403U	232	480	18.65	6360/341	3600	3100	6000	5.2	11.0	6.0	18	27

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,3,4	n_{1maxDB} EL5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2redII}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
F2 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 270 Nm)																	
161	172	182	5.0	1.0	F202_0185 LM503U	270	480	18.65	6360/341	3600	3100	6000	11	11.0	6.0	18	30
220	30	32	2.2	2.7	F202_0135 LM401U	60	99	13.63	109/8	3800	3500	6000	2.3	11.0	8.0	16	24
220	58	59	2.2	2.7	F202_0135 LM402U	128	397	13.63	109/8	3800	3500	6000	3.7	11.0	8.0	16	25
220	80	82	3.0	2.0	F202_0135 LM403U	170	397	13.63	109/8	3800	3500	6000	5.0	11.0	8.0	16	27
220	125	133	4.7	1.3	F202_0135 LM503U	210	397	13.63	109/8	3800	3500	6000	11	11.0	8.0	16	30
220	181	204	6.8	0.88	F202_0135 LM505U	210	397	13.63	109/8	3800	3500	6000	17	11.0	8.0	16	34
278	46	47	2.1	3.2	F202_0110 LM402U	102	314	10.80	7303/676	3800	3500	6000	4.0	11.0	8.0	16	25
278	64	65	2.9	2.3	F202_0110 LM403U	134	314	10.80	7303/676	3800	3500	6000	5.3	11.0	8.0	16	27
278	99	106	4.5	1.5	F202_0110 LM503U	210	314	10.80	7303/676	3800	3500	6000	11	11.0	8.0	16	30
278	144	162	6.5	1.0	F202_0110 LM505U	210	314	10.80	7303/676	3800	3500	6000	18	11.0	8.0	16	34
333	20	21	2.7	2.7	F202_0090 LM401U	39	66	9.006	3161/351	3600	3100	6000	3.0	11.0	8.0	16	24
333	39	39	2.0	3.6	F202_0090 LM402U	85	262	9.006	3161/351	3600	3100	6000	4.3	11.0	8.0	16	25
333	53	54	2.8	2.6	F202_0090 LM403U	112	262	9.006	3161/351	3600	3100	6000	5.6	11.0	8.0	16	27
333	83	88	4.4	1.7	F202_0090 LM503U	178	262	9.006	3161/351	3600	3100	6000	12	11.0	8.0	16	30
333	120	135	6.3	1.2	F202_0090 LM505U	210	262	9.006	3161/351	3600	3100	6000	18	11.0	8.0	16	34
333	168	186	8.9	0.82	F202_0090 LM704U	210	400	9.006	3161/351	3600	3100	6000	38	11.0	8.0	16	40
419	31	31	2.0	4.2	F202_0072 LM402U	67	209	7.167	5777/806	3600	3100	6000	4.9	11.0	8.0	16	25
419	42	43	2.7	3.0	F202_0072 LM403U	89	209	7.167	5777/806	3600	3100	6000	6.2	11.0	8.0	16	27
419	66	70	4.2	1.9	F202_0072 LM503U	142	209	7.167	5777/806	3600	3100	6000	12	11.0	8.0	16	30
419	95	108	6.1	1.3	F202_0072 LM505U	167	209	7.167	5777/806	3600	3100	6000	19	11.0	8.0	16	34
419	134	148	8.6	0.96	F202_0072 LM704U	210	400	7.167	5777/806	3600	3100	6000	38	11.0	8.0	16	40
540	104	114	8.2	1.1	F202_0056 LM704U	210	400	5.552	5341/962	3100	2600	5000	39	11.0	8.0	16	40
540	138	160	11	0.85	F202_0056 LM706U	210	400	5.552	5341/962	3100	2600	5000	57	11.0	8.0	16	47
641	28	28	2.6	4.0	F202_0047 LM403U	58	136	4.680	2616/559	3100	2600	5000	8.4	11.0	8.0	16	27
641	43	46	4.0	2.5	F202_0047 LM503U	92	136	4.680	2616/559	3100	2600	5000	14	11.0	8.0	16	30
641	62	70	5.8	1.8	F202_0047 LM505U	109	136	4.680	2616/559	3100	2600	5000	21	11.0	8.0	16	34
641	87	97	8.0	1.3	F202_0047 LM704U	187	340	4.680	2616/559	3100	2600	5000	41	11.0	8.0	16	40
641	117	135	11	0.96	F202_0047 LM706U	210	340	4.680	2616/559	3100	2600	5000	58	11.0	8.0	16	47
F3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 450 Nm)																	
14	476	514	1.9	0.84	F303_2210 LM401U	450	800	221.2	191149/864	4000	3900	6500	1.7	11.0	7.0	22	36
16	398	429	1.8	1.0	F303_1850 LM401U	450	800	184.8	29939/162	4000	3900	6500	1.7	11.0	7.0	22	36
21	307	332	1.6	1.3	F302_1410 LM401U	450	603	140.6	7595/54	4000	3900	6500	1.7	11.0	6.0	22	31
27	483	493	2.7	0.83	F302_1130 LM402U	450	800	112.8	3724/33	4000	3900	6500	3.1	11.0	6.0	22	33
32	401	409	2.5	1.0	F302_0940 LM402U	450	800	93.64	4214/45	4000	3900	6500	3.2	11.0	6.0	22	33
43	301	307	2.2	1.3	F302_0700 LM402U	450	800	70.36	2744/39	4000	3900	6500	3.3	11.0	6.0	22	33
43	414	422	3.0	0.97	F302_0700 LM403U	450	800	70.36	2744/39	4000	3900	6500	4.6	11.0	6.0	22	35
53	242	247	1.9	1.7	F302_0560 LM402U	450	800	56.49	4067/72	4000	3900	6500	3.4	11.0	6.0	22	33
53	332	339	2.7	1.2	F302_0560 LM403U	450	800	56.49	4067/72	4000	3900	6500	4.7	11.0	6.0	22	35
64	202	206	1.8	2.0	F302_0470 LM402U	444	800	47.19	1274/27	4000	3900	6500	3.5	11.0	6.0	22	33
64	277	283	2.4	1.4	F302_0470 LM403U	450	800	47.19	1274/27	4000	3900	6500	4.8	11.0	6.0	22	35
64	434	461	3.8	0.92	F302_0470 LM503U	450	800	47.19	1274/27	4000	3900	6500	11	11.0	6.0	22	38
86	150	153	1.7	2.4	F302_0350 LM402U	330	800	35.03	7252/207	3700	3500	5500	3.8	11.0	6.0	22	33
86	206	210	2.3	1.8	F302_0350 LM403U	436	800	35.03	7252/207	3700	3500	5500	5.1	11.0	6.0	22	35
86	322	342	3.6	1.1	F302_0350 LM503U	450	800	35.03	7252/207	3700	3500	5500	11	11.0	6.0	22	38
106	121	123	1.6	2.8	F302_0280 LM402U	266	800	28.23	6860/243	3700	3500	5500	4.0	11.0	6.0	22	33
106	166	170	2.2	2.0	F302_0280 LM403U	351	800	28.23	6860/243	3700	3500	5500	5.3	11.0	6.0	22	35
106	260	276	3.5	1.3	F302_0280 LM503U	450	800	28.23	6860/243	3700	3500	5500	11	11.0	6.0	22	38
106	375	424	5.0	0.90	F302_0280 LM505U	450	800	28.23	6860/243	3700	3500	5500	18	11.0	6.0	22	42
128	101	103	1.6	3.2	F302_0240 LM402U	221	685	23.52	588/25	3500	3100	5000	4.4	11.0	6.0	22	33
128	138	141	2.2	2.3	F302_0240 LM403U	293	685	23.52	588/25	3500	3100	5000	5.7	11.0	6.0	22	35
128	216	230	3.4	1.5	F302_0240 LM503U	450	685	23.52	588/25	3500	3100	5000	12	11.0	6.0	22	38
128	313	353	4.9	1.0	F302_0240 LM505U	450	685	23.52	588/25	3500	3100	5000	18	11.0	6.0	22	42
160	351	387	6.6	0.84	F302_0190 LM704U	450	800	18.77	4900/261	3500	3100	5000	38	11.0	6.0	22	48
224	57	58	1.4	4.6	F302_0135 LM402U	126	390	13.38	7696/575	3700	3500	5500	4.3	11.0	8.0	20	33
224	79	80	2.0	3.3	F302_0135 LM403U	167	390	13.38	7696/575	3700	3500	5500	5.6	11.0	8.0	20	35
224	123	131	3.1	2.1	F302_0135 LM503U	264	390	13.38	7696/575	3700	3500	5500	12	11.0	8.0	20	38
224	178	201	4.4	1.5	F302_0135 LM505U	312	390	13.38	7696/575	3700	3500	5500	18	11.0	8.0	20	42
224	250	276	6.2	1.1	F302_0135 LM704U	350	650	13.38	7696/575	3700	3500	5500	38	11.0	8.0	20	48
278	63	65	1.9	3.9	F302_0110 LM403U	134	314	10.79	1456/135	3700	3500	5500	6.2	11.0	8.0	20	35
278	99	105	3.0	2.5	F302_0110 LM503U	213	314	10.79	1456/135	3700	3500	5500	12	11.0	8.0	20	38
278	143	162	4.3	1.7	F302_0110 LM505U	251	314	10.79	1456/135	3700	3500	5500	19	11.0	8.0	20	42
278	202	222	6.0	1.2	F302_0110 LM704U	350	650	10.79	1456/135	3700	3500	5500	38	11.0	8.0	20	48
278	269	312	8.0	0.91	F302_0110 LM706U	350	650	10.79	1456/135	3700	3500	5500	56	11.0	8.0	20	55
334	53	54	2.0	4.0	F302_0090 LM403U	112	262	8.986	5616/625	3500	3100	5000	6.9	11.0	8.0	20	35

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,3,4	n_{1maxDB} EL5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2redII}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
F3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 450 Nm)																	
334	83	88	3.2	2.5	F302_0090 LM503U	178	262	8.986	5616/625	3500	3100	5000	13	11.0	8.0	20	38
334	119	135	4.6	1.8	F302_0090 LM505U	209	262	8.986	5616/625	3500	3100	5000	19	11.0	8.0	20	42
334	168	185	5.8	1.4	F302_0090 LM704U	350	650	8.986	5616/625	3500	3100	5000	39	11.0	8.0	20	48
334	224	260	7.8	1.0	F302_0090 LM706U	350	650	8.986	5616/625	3500	3100	5000	56	11.0	8.0	20	55
418	134	148	5.6	1.6	F302_0072 LM704U	286	522	7.172	208/29	3500	3100	5000	40	11.0	8.0	20	48
418	179	207	7.5	1.2	F302_0072 LM706U	350	522	7.172	208/29	3500	3100	5000	58	11.0	8.0	20	55
524	107	118	5.4	1.9	F302_0057 LM704U	228	416	5.720	143/25	3000	2600	4500	42	11.0	8.0	20	48
524	142	165	7.2	1.4	F302_0057 LM706U	333	416	5.720	143/25	3000	2600	4500	60	11.0	8.0	20	55
646	87	96	5.2	2.1	F302_0046 LM704U	185	338	4.644	4992/1075	3000	2600	4500	45	11.0	8.0	20	48
646	116	134	7.0	1.6	F302_0046 LM706U	270	338	4.644	4992/1075	3000	2600	4500	62	11.0	8.0	20	55
F4 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 700 Nm)																	
8.2	786	849	1.5	0.89	F403_3660 LM401U	700	1400	365.6	3290/9	3800	3500	6000	1.7	10.0	6.0	39	44
11	590	637	1.3	1.2	F403_2740 LM401U	700	1400	274.4	59267/216	3800	3500	6000	1.7	10.0	6.0	39	44
14	472	509	1.2	1.5	F403_2190 LM401U	700	1400	219.2	94705/432	3800	3500	6000	1.8	10.0	6.0	39	44
16	395	427	1.1	1.8	F403_1840 LM401U	700	1179	183.9	39715/216	3800	3500	6000	1.8	10.0	6.0	39	44
16	775	791	2.1	0.90	F403_1840 LM402U	700	1179	183.9	39715/216	3800	3500	6000	3.1	10.0	6.0	39	46
32	858	912	3.3	0.82	F402_0930 LM503U	700	1400	93.33	280/3	3800	3500	6000	11	10.0	5.0	39	46
43	644	684	2.9	1.1	F402_0700 LM503U	700	1400	70.06	1261/18	3800	3500	6000	11	10.0	5.0	39	46
54	515	547	2.6	1.4	F402_0560 LM503U	700	1400	55.97	2015/36	3800	3500	6000	11	10.0	5.0	39	46
54	744	840	3.7	0.94	F402_0560 LM505U	700	1400	55.97	2015/36	3800	3500	6000	17	10.0	5.0	39	50
64	432	459	2.5	1.5	F402_0470 LM503U	700	1366	46.94	845/18	3800	3500	6000	11	10.0	5.0	39	46
64	624	704	3.6	1.1	F402_0470 LM505U	700	1366	46.94	845/18	3800	3500	6000	18	10.0	5.0	39	50
86	656	723	4.8	0.91	F402_0350 LM704U	700	1400	35.08	2210/63	3500	3100	5500	38	10.0	5.0	39	56
107	523	577	4.6	1.1	F402_0280 LM704U	700	1400	27.99	2015/72	3500	3100	5500	38	10.0	5.0	39	56
129	434	479	4.5	1.2	F402_0230 LM704U	700	1400	23.21	325/14	3200	2800	4800	39	10.0	5.0	39	56
129	578	671	6.0	0.90	F402_0230 LM706U	700	1400	23.21	325/14	3200	2800	4800	56	10.0	5.0	39	63
161	348	384	4.3	1.4	F402_0185 LM704U	700	1355	18.62	3575/192	3200	2800	4800	40	10.0	5.0	39	56
161	464	538	5.8	1.0	F402_0185 LM706U	700	1355	18.62	3575/192	3200	2800	4800	57	10.0	5.0	39	63
221	254	280	4.1	1.7	F402_0135 LM704U	542	932	13.57	5984/441	3500	3100	5500	39	10.0	7.0	39	56
221	338	392	5.5	1.3	F402_0135 LM706U	550	932	13.57	5984/441	3500	3100	5500	56	10.0	7.0	39	63
277	202	223	3.9	2.0	F402_0110 LM704U	432	788	10.83	682/63	3500	3100	5500	40	10.0	7.0	39	56
277	270	313	5.3	1.5	F402_0110 LM706U	550	788	10.83	682/63	3500	3100	5500	57	10.0	7.0	39	63
334	168	185	3.8	2.3	F402_0090 LM704U	359	653	8.980	440/49	3200	2800	4800	41	10.0	7.0	39	56
334	224	260	5.1	1.7	F402_0090 LM706U	523	653	8.980	440/49	3200	2800	4800	59	10.0	7.0	39	63
417	135	149	3.7	2.6	F402_0072 LM704U	288	524	7.202	605/84	3200	2800	4800	43	10.0	7.0	39	56
417	179	208	4.9	2.0	F402_0072 LM706U	419	524	7.202	605/84	3200	2800	4800	61	10.0	7.0	39	63
F6 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1100 Nm)																	
21	1285	1365	3.0	0.86	F602_1400 LM503U	1100	2000	139.8	559/4	3500	3200	5500	11	10.0	5.0	77	73
27	1032	1096	2.7	1.1	F602_1120 LM503U	1100	2000	112.2	9425/84	3500	3200	5500	11	10.0	5.0	77	73
32	858	912	2.4	1.3	F602_0930 LM503U	1100	1867	93.33	280/3	3500	3200	5500	11	10.0	5.0	77	73
32	1240	1401	3.5	0.89	F602_0930 LM505U	1100	1867	93.33	280/3	3500	3200	5500	17	10.0	5.0	77	77
43	640	680	2.1	1.7	F602_0700 LM503U	1100	1588	69.64	975/14	3500	3200	5500	11	10.0	5.0	77	73
43	925	1045	3.0	1.2	F602_0700 LM505U	1100	1588	69.64	975/14	3500	3200	5500	18	10.0	5.0	77	77
43	1302	1436	4.3	0.85	F602_0700 LM704U	1100	2000	69.64	975/14	3500	3200	5500	37	10.0	5.0	77	83
54	1041	1149	3.8	1.1	F602_0560 LM704U	1100	2000	55.71	390/7	3500	3200	5500	38	10.0	5.0	77	83
64	873	963	3.5	1.3	F602_0470 LM704U	1100	2000	46.72	1495/32	3500	3200	5500	38	10.0	5.0	77	83
64	1163	1350	4.6	0.95	F602_0470 LM706U	1100	2000	46.72	1495/32	3500	3200	5500	56	10.0	5.0	77	90
85	658	726	3.3	1.5	F602_0350 LM704U	1100	2000	35.21	845/24	3300	2800	5000	39	10.0	5.0	77	83
85	877	1018	4.4	1.1	F602_0350 LM706U	1100	2000	35.21	845/24	3300	2800	5000	57	10.0	5.0	77	90
107	523	577	3.2	1.8	F602_0280 LM704U	1100	2000	27.99	2015/72	3300	2800	5000	41	10.0	5.0	77	83
107	697	809	4.3	1.3	F602_0280 LM706U	1100	2000	27.99	2015/72	3300	2800	5000	58	10.0	5.0	77	90
129	435	480	3.1	2.0	F602_0230 LM704U	929	1693	23.27	1885/81	2900	2500	4500	42	10.0	5.0	77	83
129	579	673	4.1	1.5	F602_0230 LM706U	1100	1693	23.27	1885/81	2900	2500	4500	59	10.0	5.0	77	90
220	254	281	2.8	2.9	F602_0135 LM704U	543	921	13.61	871/64	3300	2800	5000	42	10.0	7.0	73	83
220	339	393	3.8	2.2	F602_0135 LM706U	736	921	13.61	871/64	3300	2800	5000	59	10.0	7.0	73	90
277	202	223	2.9	3.1	F602_0110 LM704U	432	787	10.82	2077/192	3300	2800	5000	44	10.0	7.0	73	83
277	269	313	3.9	2.3	F602_0110 LM706U	630	787	10.82	2077/192	3300	2800	5000	62	10.0	7.0	73	90
334	168	185	3.2	3.1	F602_0090 LM704U	359	655	8.995	1943/216	2900	2500	4500	47	10.0	7.0	73	83
334	224	260	4.3	2.3	F602_0090 LM706U	524	655	8.995	1943/216	2900	2500	4500	65	10.0	7.0	73	90

10.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gearbox dimensions, motor dimensions and geared motor dimensions.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Tolerances

Axis height in accordance with DIN 747	Tolerance
Up to 50 mm	-0.4 mm
Up to 250 mm	-0.5 mm
Up to 630 mm	-0.6 mm

Solid shaft	Tolerance
Shaft ∅ fit ≤ 50 mm	DIN 748-1, ISO k6
Shaft ∅ fit > 50 mm	DIN 748-1, ISO m6
Feather keys	DIN 6885-1, high form A

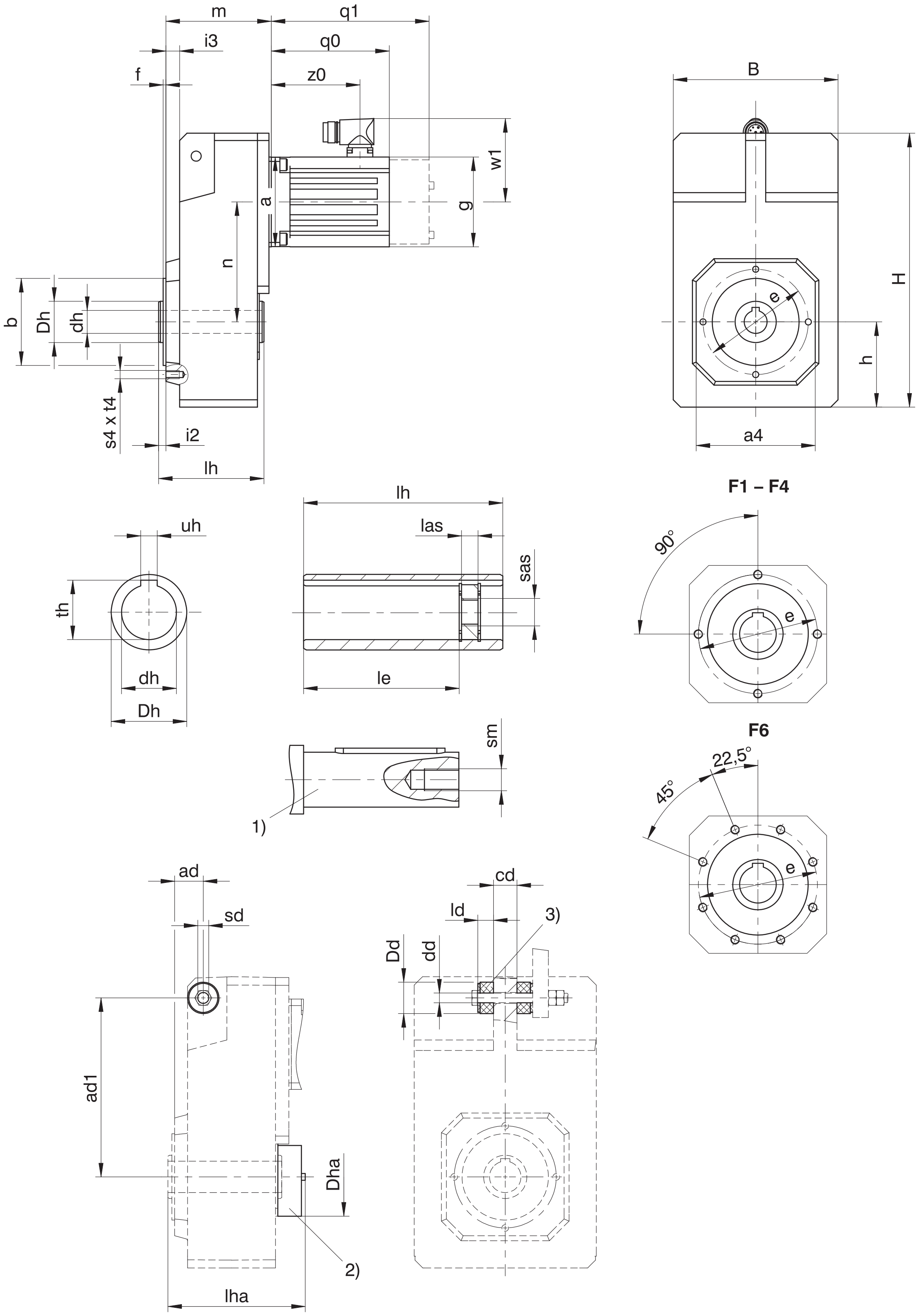
Hollow shaft	Tolerance
Hollow shaft hole fit	ISO H7
Feather keys	DIN 6885-1, high form

Flange	Pilot tolerance
Up to 300 mm	ISO j6
Starting at 350 mm	ISO h6

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

10.3.1 A shaft design (hollow shaft), G housing design (pitch circle diameter)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

1) The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.

2) Cover (optional)

3) Rubber buffer for torque arm bracket (optional). Dimension ∅Dd = outer diameter of the rubber buffer when not tensioned.

Dimensions of gearboxes

Type	□a4	ad	ad1	∅b	B	cd	∅dd	∅dh	∅Dd	∅Dh	∅Dha	∅e	f	h	H	i2	i3	ld	le	lh	las	lha	s4	sd	sm	sas	t4	th	uh
F1	100	28.5	150	70_{j6}	145	20	$11.0^{+0,5}$	20^{H7}	30	35	70	85	2.5	74	238.0	6.5	12.5	15	73	95	12	112	M8	M10	M6	M8	13	22.8	6^{JS9}
F2	130	32.0	181	95_{j6}	180	22	$11.0^{+0,5}$	25^{H7}	30	45	82	115	3.0	93	299.0	8.0	15.0	15	92	115	12	132	M8	M10	M10	M12	13	28.3	8^{JS9}
F3	150	36.5	205	110_{j6}	206	30	$14.0^{+0,5}$	30^{H7}	37	50	88	130	3.5	106	335.5	8.5	16.5	20	103	130	12	157	M10	M12	M10	M12	16	33.3	8^{JS9}
F4	150	36.5	228	110_{j6}	230	30	$14.0^{+0,5}$	40^{H7}	37	55	100	130	3.5	116	370.0	8.5	16.5	20	114	145	12	175	M10	M12	M16	M20	16	43.3	12^{JS9}
F6	180	44.5	270	130_{j6}	265	35	$22.0^{+0,5}$	50^{H7}	60	70	115	165	3.5	137	433.0	10.5	20.5	30	143	180	12	194	M10	M20	M16	M20	16	53.8	14^{JS9}

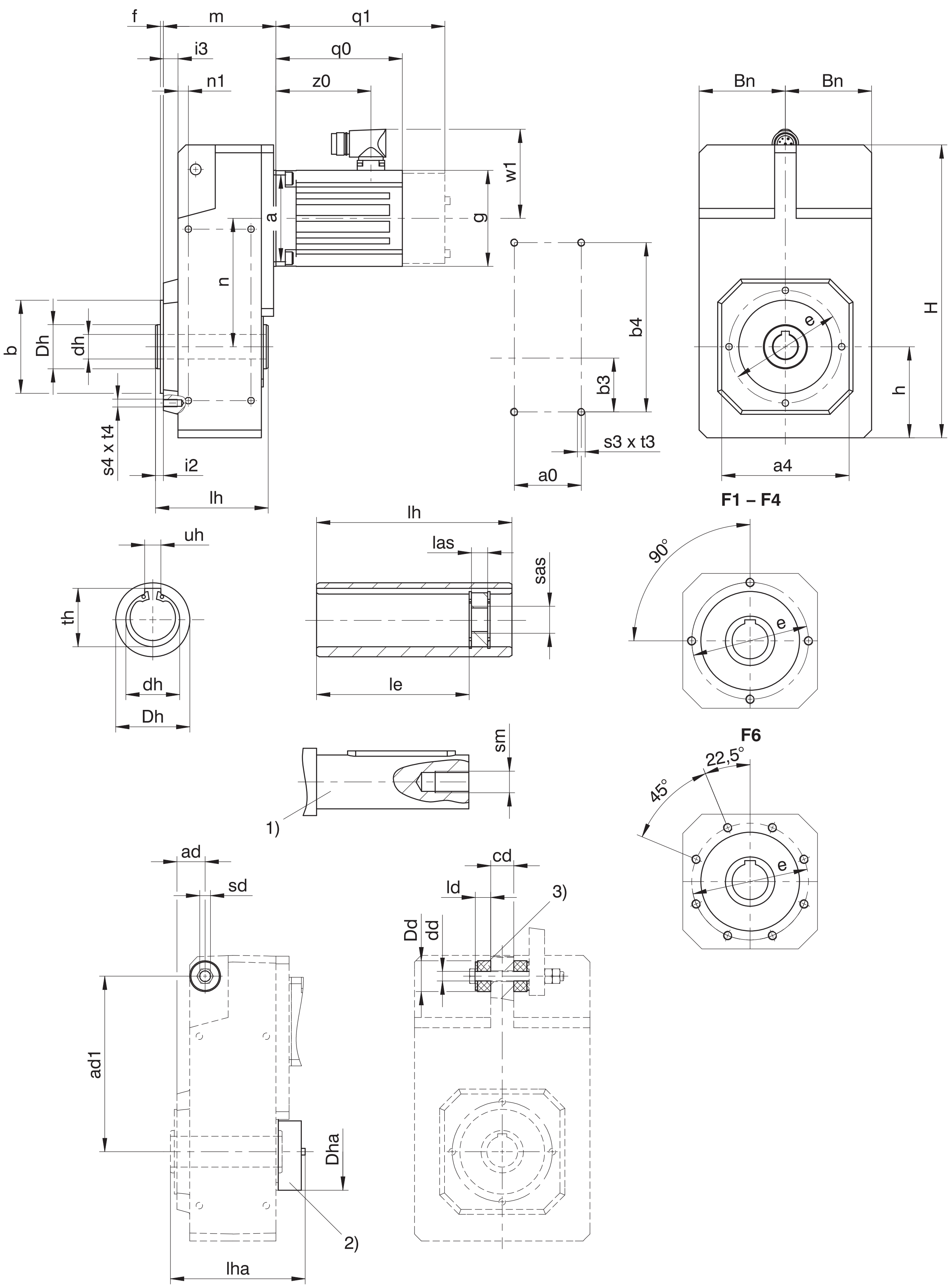
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	97.5	102.0	□115	101.5	102.0	–	–	–
F202	□98	115.0	131.0	□115	119.0	131.0	□145	121.0	131.0
F302	∅140	129.5	149.5	□115	133.5	149.5	□145	135.5	149.5
F303	∅140	166.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	148.5	169.0	□145	150.5	169.0
F403	∅140	181.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	179.5	196.0	□145	181.5	196.0

10.3.2 A shaft design (hollow shaft), GN housing design (pitch circle diameter + side fastening)



q0 Applies to motors without brake.

1) The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.

3) Rubber buffer for torque arm bracket (optional). Dimension ∅Dd = outer diameter of the rubber buffer when not tensioned.

q1 Applies to motors with brake.

2) Cover (optional)

Dimensions of gearboxes

Type	a0	□a4	ad	ad1	∅b	b3	b4	Bn	cd	∅dd	∅dh	∅Dd	∅Dh	∅Dha	∅e	f	h	H
F1	50	100	28.5	150	70_{j6}	40	140	71	20	$11.0^{+0,5}$	20^{H7}	30	35	70	85	2.5	74	238.0
F2	64	130	32.0	181	95_{j6}	55	175	88	22	$11.0^{+0,5}$	25^{H7}	30	45	82	115	3.0	93	299.0
F3	72	150	36.5	205	110_{j6}	60	200	102	30	$14.0^{+0,5}$	30^{H7}	37	50	88	130	3.5	106	335.5
F4	87	150	36.5	228	110_{j6}	70	220	114	30	$14.0^{+0,5}$	40^{H7}	37	55	100	130	3.5	116	370.0
F6	108	180	44.5	270	130_{j6}	85	270	131	35	$22.0^{+0,5}$	50^{H7}	60	70	115	165	3.5	137	433.0

Type	i2	i3	ld	le	lh	las	lha	n1	s3	s4	sd	sm	sas	t3	t4	th	uh
F1	6.5	12.5	15	73	95	12	112	10.0	M6	M8	M10	M6	M8	11	13	22.8	6^{JS9}
F2	8.0	15.0	15	92	115	12	132	10.5	M8	M8	M10	M10	M12	13	13	28.3	8^{JS9}
F3	8.5	16.5	20	103	130	12	157	12.5	M10	M10	M12	M10	M12	16	16	33.3	8^{JS9}
F4	8.5	16.5	20	114	145	12	175	12.5	M10	M10	M12	M16	M20	16	16	43.3	12^{JS9}
F6	10.5	20.5	30	143	180	12	194	15.5	M12	M10	M20	M16	M20	19	16	53.8	14^{JS9}

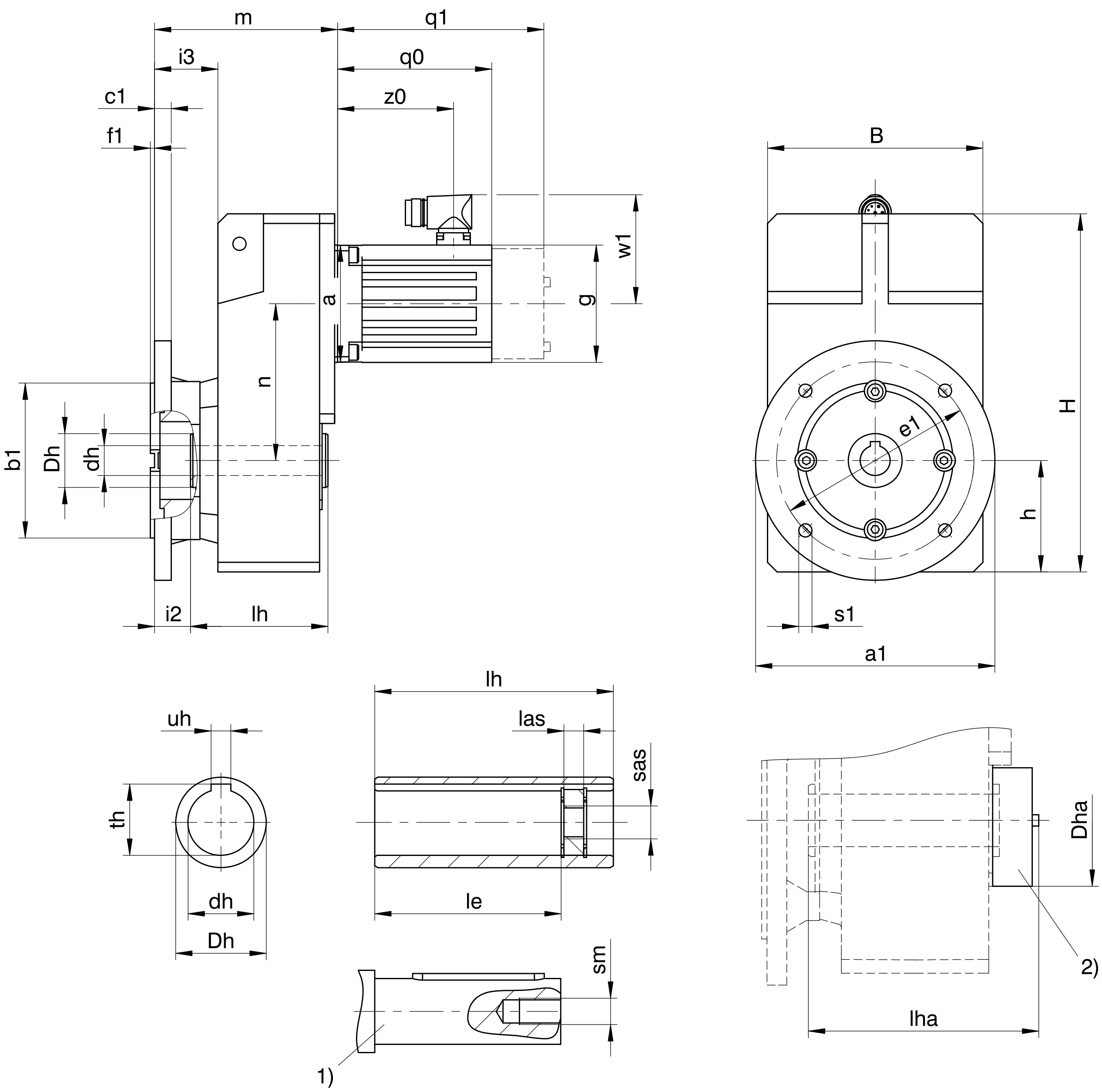
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	97.5	102.0	□115	101.5	102.0	–	–	–
F202	□98	115.0	131.0	□115	119.0	131.0	□145	121.0	131.0
F302	∅140	129.5	149.5	□115	133.5	149.5	□145	135.5	149.5
F303	∅140	166.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	148.5	169.0	□145	150.5	169.0
F403	∅140	181.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	179.5	196.0	□145	181.5	196.0

10.3.3 A shaft design (hollow shaft), F housing design (round flange)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

1) The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.

2) Cover (optional)

Dimensions of gearboxes

Type	∅a1	∅b1	B	c1	∅dh	∅Dh	∅Dha	∅e1	f1	h	H	i2	i3	le	lh	las	lha	∅s1	sm	sas	th	uh
F1	160	110_{j6}	145	10	20^{H7}	35	70	130	3.5	74	238.0	25.5	44.5	73	95	12	112	9	M6	M8	22.8	6^{JS9}
F2	200	130_{j6}	180	14	25^{H7}	45	82	165	3.5	93	299.0	30.0	53.0	92	115	12	132	11	M10	M12	28.3	8^{JS9}
F3	250	180_{j6}	206	15	30^{H7}	50	88	215	4.0	106	335.5	31.5	56.5	103	130	12	157	14	M10	M12	33.3	8^{JS9}
F4	250	180_{j6}	230	15	40^{H7}	55	100	215	4.0	116	370.0	31.5	56.5	114	145	12	175	14	M16	M20	43.3	12^{JS9}
F6	300	230_{j6}	265	17	50^{H7}	70	115	265	4.0	137	433.0	29.5	60.5	143	180	12	194	14	M16	M20	53.8	14^{JS9}

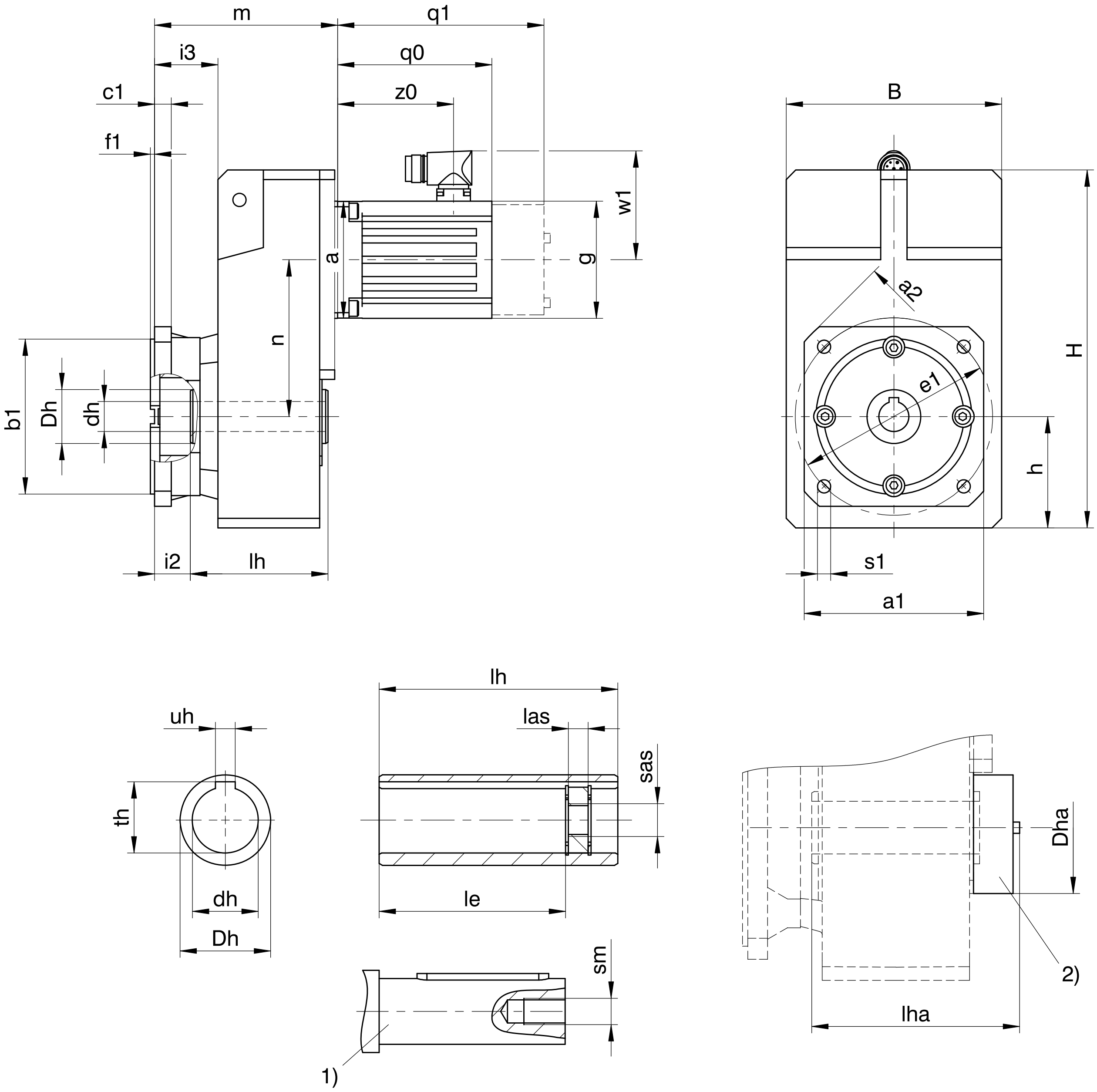
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	129.5	102.0	□115	133.5	102.0	–	–	–
F202	□98	153.0	131.0	□115	157.0	131.0	□145	159.0	131.0
F302	∅140	169.5	149.5	□115	173.5	149.5	□145	175.5	149.5
F303	∅140	206.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	188.5	169.0	□145	190.5	169.0
F403	∅140	221.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	219.5	196.0	□145	221.5	196.0

10.3.4 A shaft design (hollow shaft), Q housing design (square flange)



q0	Applies to motors without brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.
q1	Applies to motors with brake.
2)	Cover (optional)

Dimensions of gearboxes

Type	□a1	□a2	⌀b1	B	c1	⌀dh	⌀Dh	⌀Dha	⌀e1	f1	h	H	i2	i3	le	lh	las	lha	⌀s1	sm	sas	th	uh
F1	125	160	110_{j6}	145	10	20^{H7}	35	70	130	3.5	74	238.0	25.5	44.5	73	95	12	112	9	M6	M8	22.8	6^{JS9}
F2	150	195	130_{j6}	180	14	25^{H7}	45	82	165	3.5	93	299.0	30.0	53.0	92	115	12	132	11	M10	M12	28.3	8^{JS9}
F3	200	260	180_{j6}	206	15	30^{H7}	50	88	215	4.0	106	335.5	31.5	56.5	103	130	12	157	14	M10	M12	33.3	8^{JS9}
F4	200	260	180_{j6}	230	15	40^{H7}	55	100	215	4.0	116	370.0	31.5	56.5	114	145	12	175	14	M16	M20	43.3	12^{JS9}
F6	250	325	230_{j6}	265	17	50^{H7}	70	115	265	4.0	137	433.0	29.5	60.5	143	180	12	194	14	M16	M20	53.8	14^{JS9}

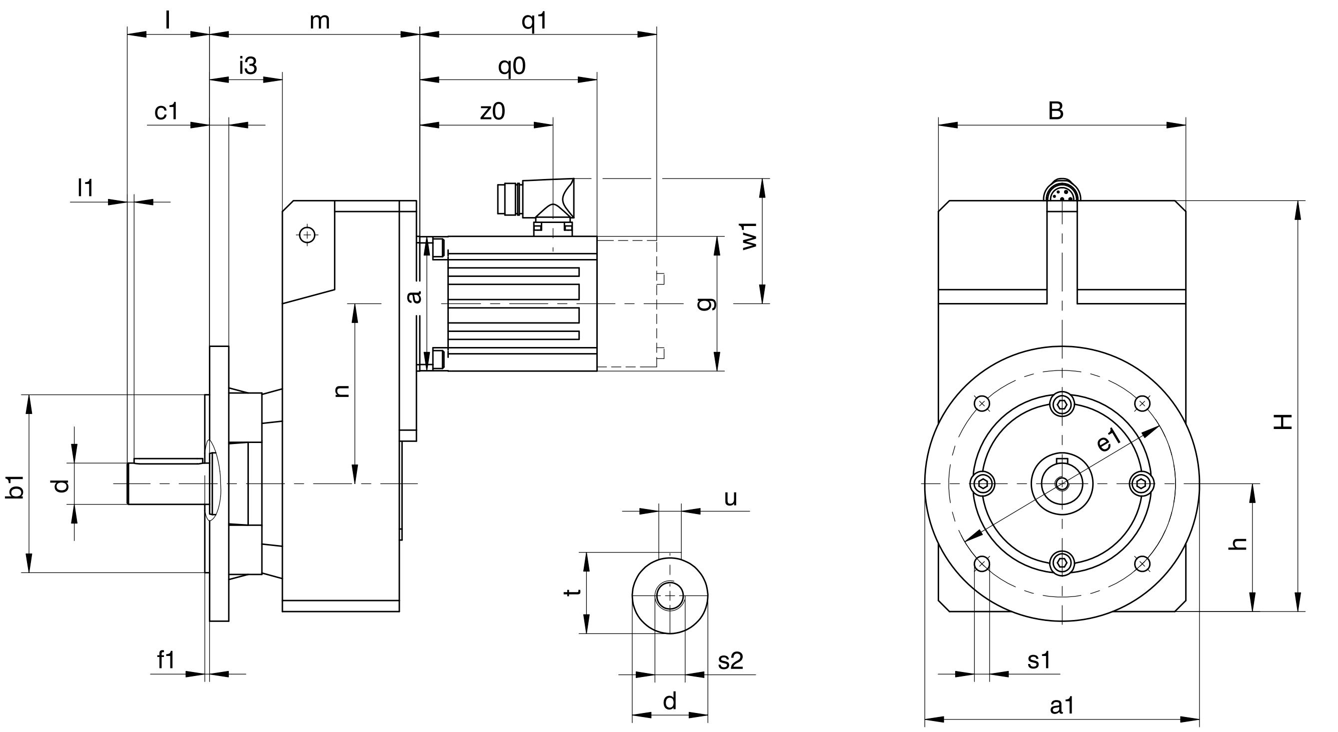
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	129.5	102.0	□115	133.5	102.0	–	–	–
F202	□98	153.0	131.0	□115	157.0	131.0	□145	159.0	131.0
F302	⌀140	169.5	149.5	□115	173.5	149.5	□145	175.5	149.5
F303	⌀140	206.5	149.5	–	–	–	–	–	–
F402	–	–	–	⌀160	188.5	169.0	□145	190.5	169.0
F403	⌀140	221.5	169.0	–	–	–	–	–	–
F602	–	–	–	⌀160	219.5	196.0	□145	221.5	196.0

10.3.5 V shaft design (solid shaft), F housing design (round flange)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

Dimensions of gearboxes

Type	∅a1	∅b1	B	c1	∅d	∅e1	f1	h	H	i3	l	l1	∅s1	s2	t	u
F1	160	110_{j6}	145	10	25_{k6}	130	3.5	74	238.0	44.5	50	5	9	M10	28.0	A8×7×40
F2	200	130_{j6}	180	14	30_{k6}	165	3.5	93	299.0	53.0	60	5	11	M10	33.0	A8×7×50
F3	250	180_{j6}	206	15	35_{k6}	215	4.0	106	335.5	56.5	70	5	14	M12	38.0	A10×8×60
F4	250	180_{j6}	230	15	40_{k6}	215	4.0	116	370.0	56.5	80	5	14	M16	43.0	A12×8×70
F6	300	230_{j6}	265	17	50_{k6}	265	4.0	137	433.0	60.5	100	5	14	M16	53.5	A14×9×90

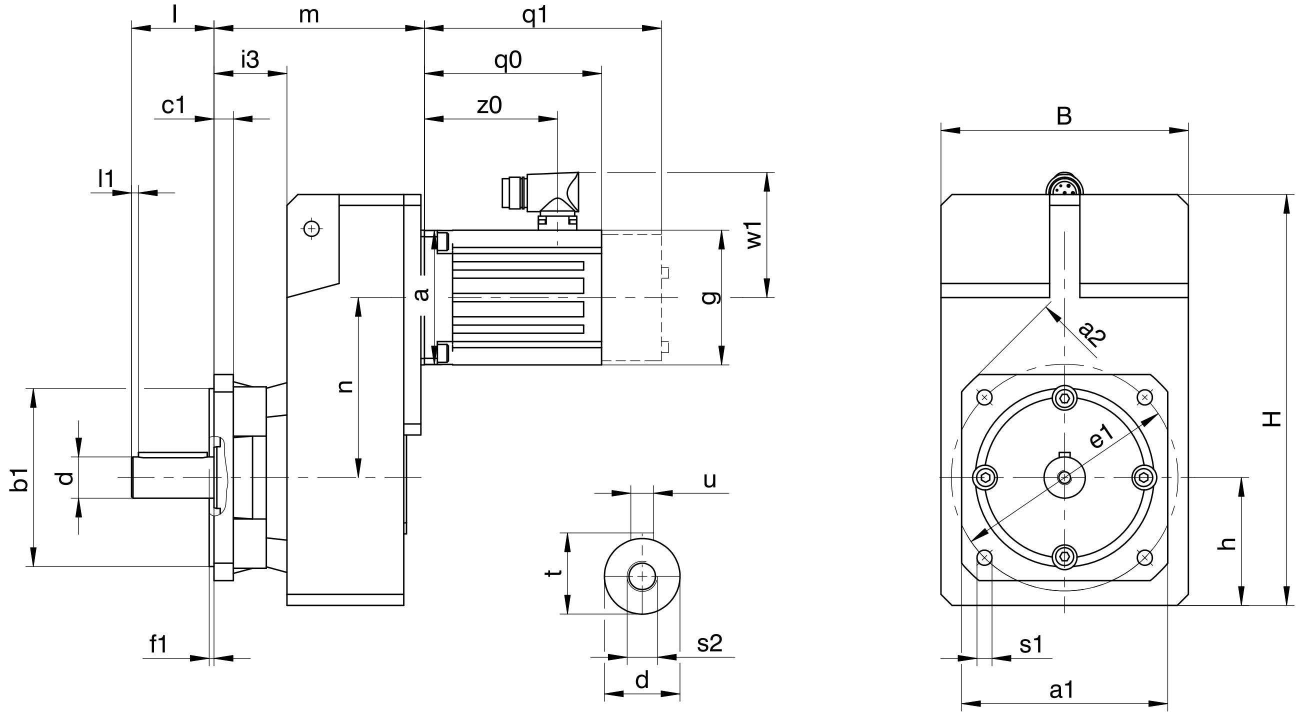
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	129.5	102.0	□115	133.5	102.0	–	–	–
F202	□98	153.0	131.0	□115	157.0	131.0	□145	159.0	131.0
F302	∅140	169.5	149.5	□115	173.5	149.5	□145	175.5	149.5
F303	∅140	206.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	188.5	169.0	□145	190.5	169.0
F403	∅140	221.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	219.5	196.0	□145	221.5	196.0

10.3.6 V shaft design (solid shaft), Q housing design (square flange)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

Dimensions of gearboxes

Type	□a1	□a2	∅b1	c1	B	∅d	∅e1	f1	h	H	i3	l	l1	∅s1	s2	t	u
F1	125	160	110_{j6}	10	145	25_{k6}	130	3.5	74	238.0	44.5	50	5	9	M10	28.0	A8×7×40
F2	150	195	130_{j6}	14	180	30_{k6}	165	3.5	93	299.0	53.0	60	5	11	M10	33.0	A8×7×50
F3	200	260	180_{j6}	15	206	35_{k6}	215	4.0	106	335.5	56.5	70	5	14	M12	38.0	A10×8×60
F4	200	260	180_{j6}	15	230	40_{k6}	215	4.0	116	370.0	56.5	80	5	14	M16	43.0	A12×8×70
F6	250	325	230_{j6}	17	265	50_{k6}	265	4.0	137	433.0	60.5	100	5	14	M16	53.5	A14×9×90

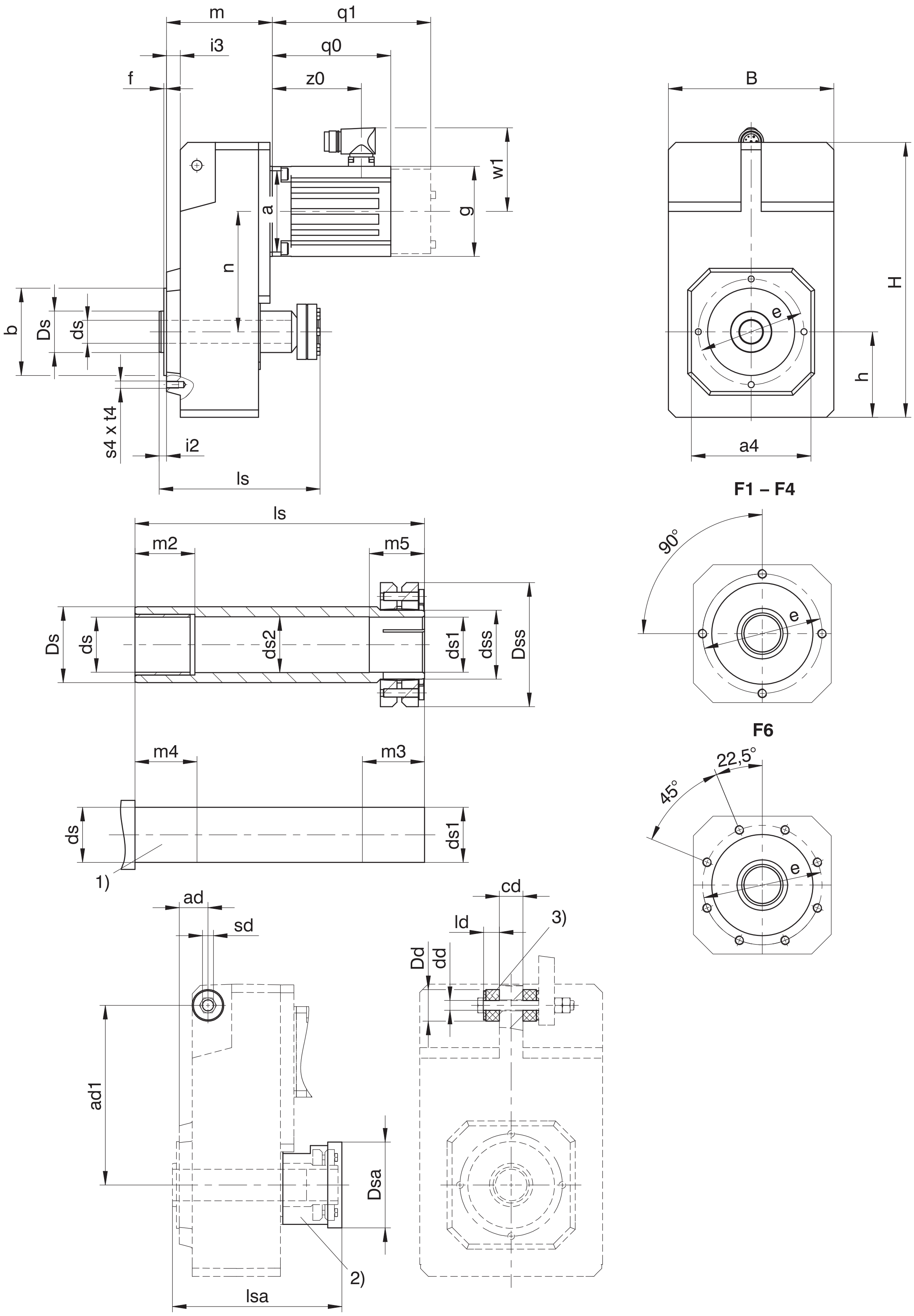
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	129.5	102.0	□115	133.5	102.0	–	–	–
F202	□98	153.0	131.0	□115	157.0	131.0	□145	159.0	131.0
F302	∅140	169.5	149.5	□115	173.5	149.5	□145	175.5	149.5
F303	∅140	206.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	188.5	169.0	□145	190.5	169.0
F403	∅140	221.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	219.5	196.0	□145	221.5	196.0

10.3.7 S shaft design (hollow shaft with shrink disk), G housing design (pitch circle diameter)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)
3)	Rubber buffer for torque arm bracket (optional). Dimension ∅Dd = outer diameter of the rubber buffer when not tensioned.		

Dimensions of gearboxes

Type	□a4	ad	ad1	∅b	B	cd	∅dd	∅ds	∅ds1	∅ds2	∅dss	∅Dd	∅Ds	∅Dsa	∅Dss	∅e	f	h	H	i2	i3	ld	ls	lsa	m2	m3	m4	m5	s4	sd	t4
F1	100	28.5	150	70_{j6}	145	20	$11.0^{+0,5}$	20_{h9}	20_{h9}^{H7}	20.5	24	30	35	63	50	85	2.5	74	238.0	6.5	12.5	15	146	150	20	31	25	26	M8	M10	13
F2	130	32.0	181	95_{j6}	180	22	$11.0^{+0,5}$	25_{h9}	25_{h9}^{H7}	25.5	30	30	45	73	60	115	3.0	93	299.0	8.0	15.0	15	175	180	20	37	25	32	M8	M10	13
F3	150	36.5	205	110_{j6}	206	30	$14.0^{+0,5}$	30_{h9}	30_{h9}^{H7}	30.5	36	37	50	83	72	130	3.5	106	335.5	8.5	16.5	20	192	196	25	37	30	32	M10	M12	16
F4	150	36.5	228	110_{j6}	230	30	$14.0^{+0,5}$	40_{h9}	40_{h9}^{H7}	40.5	50	37	55	108	90	130	3.5	116	370.0	8.5	16.5	20	210	215	40	45	45	40	M10	M12	16
F6	180	44.5	270	130_{j6}	265	35	$22.0^{+0,5}$	50_{h9}	50_{h9}^{H7}	50.5	62	60	70	128	106	165	3.5	137	433.0	10.5	20.5	30	248	251	40	47	45	42	M10	M20	16

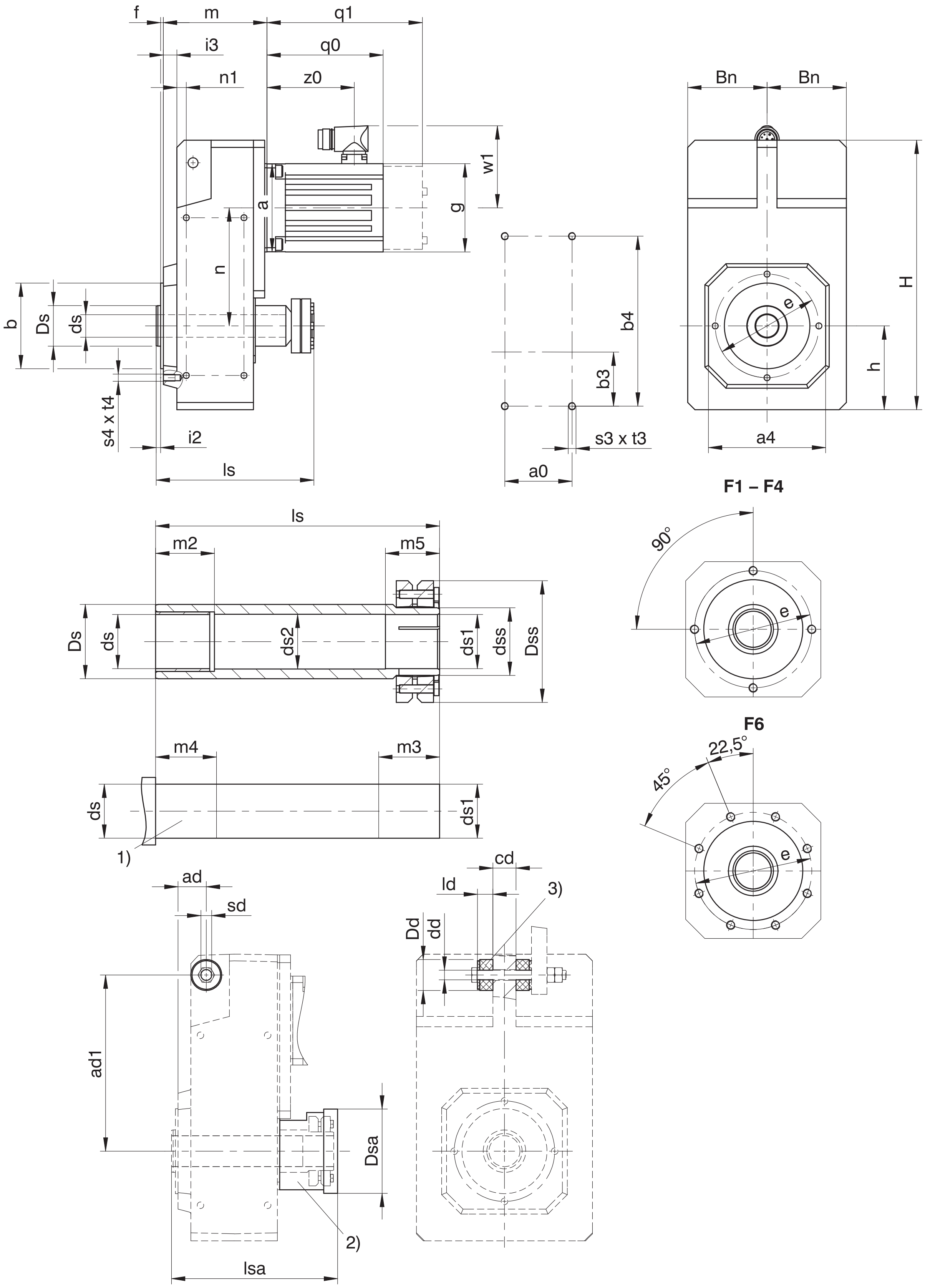
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	97.5	102.0	□115	101.5	102.0	–	–	–
F202	□98	115.0	131.0	□115	119.0	131.0	□145	121.0	131.0
F302	∅140	129.5	149.5	□115	133.5	149.5	□145	135.5	149.5
F303	∅140	166.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	148.5	169.0	□145	150.5	169.0
F403	∅140	181.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	179.5	196.0	□145	181.5	196.0

10.3.8 S shaft design (hollow shaft with shrink disk), GN housing design (pitch circle diameter + side fastening)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

1) Machine shaft: The dimension ls must meet or exceed the specified value.

2) Cover (optional)

3) Rubber buffer for torque arm bracket (optional). Dimension ∅Dd = outer diameter of the rubber buffer when not tensioned.

Dimensions of gearboxes

Type	a0	□a4	ad	ad1	Øb	b3	b4	Bn	cd	Ødd	Øds	Øds1	Øds2	Ødss	ØDd	ØDs	ØDsa	ØDss
F1	50	100	28.5	150	70_{j6}	40	140	71	20	$11.0^{+0.5}$	20_{h9}	20_{h9}^{H7}	20.5	24	30	35	63	50
F2	64	130	32.0	181	95_{j6}	55	175	88	22	$11.0^{+0.5}$	25_{h9}	25_{h9}^{H7}	25.5	30	30	45	73	60
F3	72	150	36.5	205	110_{j6}	60	200	102	30	$14.0^{+0.5}$	30_{h9}	30_{h9}^{H7}	30.5	36	37	50	83	72
F4	87	150	36.5	228	110_{j6}	70	220	114	30	$14.0^{+0.5}$	40_{h9}	40_{h9}^{H7}	40.5	50	37	55	108	90
F6	108	180	44.5	270	130_{j6}	85	270	131	35	$22.0^{+0.5}$	50_{h9}	50_{h9}^{H7}	50.5	62	60	70	128	106

Type	Øe	f	h	H	i2	i3	ld	ls	lsa	n1	m2	m3	m4	m5	s3	s4	sd	t3	t4
F1	85	2.5	74	238.0	6.5	12.5	15	146	150	10	20	31	25	26	M6	M8	M10	11	13
F2	115	3.0	93	299.0	8.0	15.0	15	175	180	10.5	20	37	25	32	M8	M8	M10	13	13
F3	130	3.5	106	335.5	8.5	16.5	20	192	196	12.5	25	37	30	32	M10	M10	M12	16	16
F4	130	3.5	116	370.0	8.5	16.5	20	210	215	12.5	40	45	45	40	M10	M10	M12	16	16
F6	165	3.5	137	433.0	10.5	20.5	30	248	251	15.5	40	47	45	42	M12	M10	M20	19	16

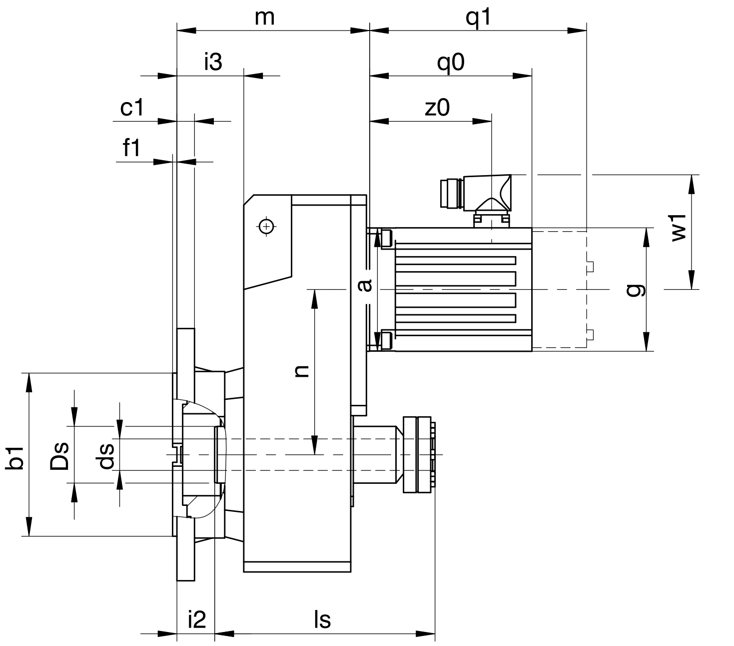
Dimensions of motors

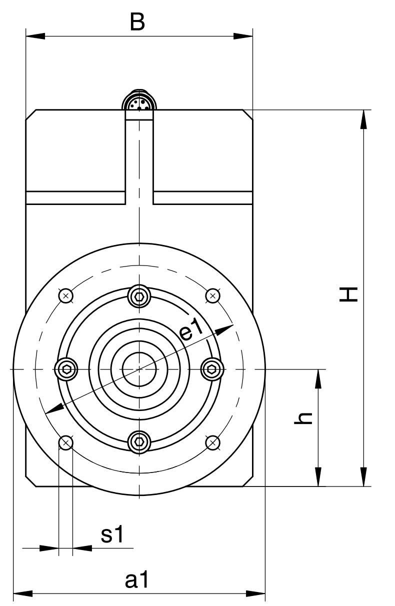
Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

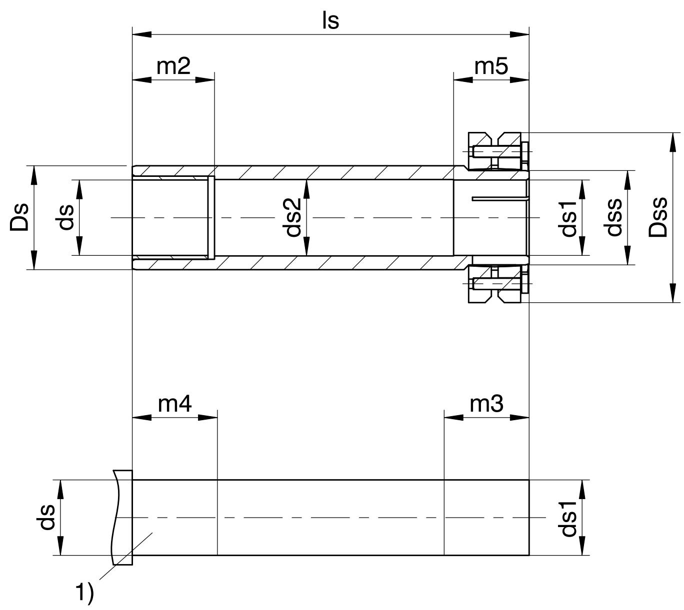
Dimensions of geared motors

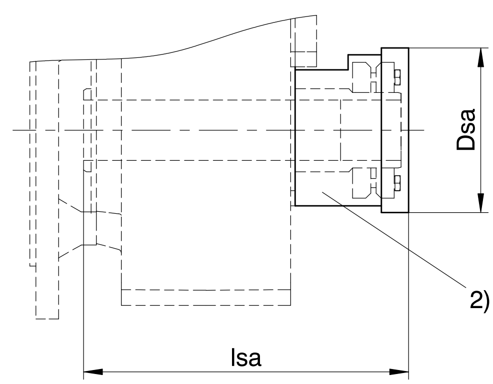
Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	97.5	102.0	□115	101.5	102.0	–	–	–
F202	□98	115.0	131.0	□115	119.0	131.0	□145	121.0	131.0
F302	Ø140	129.5	149.5	□115	133.5	149.5	□145	135.5	149.5
F303	Ø140	166.5	149.5	–	–	–	–	–	–
F402	–	–	–	Ø160	148.5	169.0	□145	150.5	169.0
F403	Ø140	181.5	169.0	–	–	–	–	–	–
F602	–	–	–	Ø160	179.5	196.0	□145	181.5	196.0

10.3.9 S shaft design (hollow shaft with shrink disk), F housing design (round flange)









q0 Applies to motors without brake.

q1 Applies to motors with brake.

1) Machine shaft: The dimension ls must meet or exceed the specified value.

2) Cover (optional)

Dimensions of gearboxes

Type	∅a1	∅b1	B	c1	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss	∅e1	f1	h	H	i2	i3	ls	lsa	m2	m3	m4	m5	∅s1
F1	160	110_{j6}	145	10	20_{h9}	20_{h9}^{H7}	20.5	24	35	63	50	130	3.5	74	238.0	25.5	44.5	146	150	20	31	25	26	9
F2	200	130_{j6}	180	14	25_{h9}	25_{h9}^{H7}	25.5	30	45	73	60	165	3.5	93	299.0	30.0	53.0	175	180	20	37	25	32	11
F3	250	180_{j6}	206	15	30_{h9}	30_{h9}^{H7}	30.5	36	50	83	72	215	4.0	106	335.5	31.5	56.5	192	196	25	37	30	32	14
F4	250	180_{j6}	230	15	40_{h9}	40_{h9}^{H7}	40.5	50	55	108	90	215	4.0	116	370.0	31.5	56.5	210	215	40	45	45	40	14
F6	300	230_{j6}	265	17	50_{h9}	50_{h9}^{H7}	50.5	62	70	128	106	265	4.0	137	433.0	29.5	60.5	248	251	40	47	45	42	14

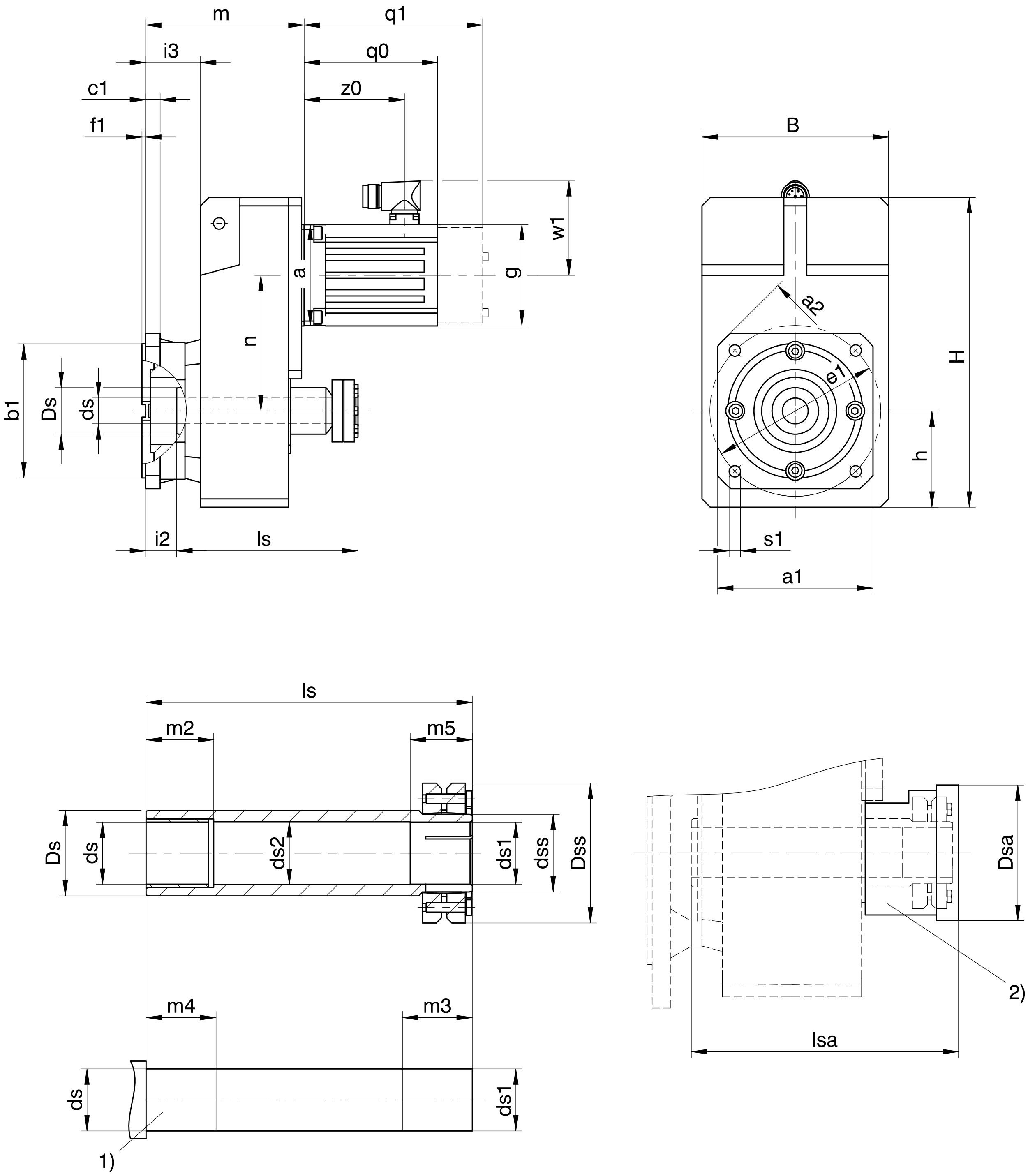
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	129.5	102.0	□115	133.5	102.0	–	–	–
F202	□98	153.0	131.0	□115	157.0	131.0	□145	159.0	131.0
F302	∅140	169.5	149.5	□115	173.5	149.5	□145	175.5	149.5
F303	∅140	206.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	188.5	169.0	□145	190.5	169.0
F403	∅140	221.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	219.5	196.0	□145	221.5	196.0

10.3.10 S shaft design (hollow shaft with shrink disk), Q housing design (square flange)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)

Dimensions of gearboxes

Type	□a1	□a2	∅b1	B	c1	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss	∅e1	f1	h	H	i2	i3	ls	lsa	m2	m3	m4	m5	∅s1
F1	125	160	110_{j6}	145	10	20_{h9}	20_{h9}^{H7}	20.5	24	35	63	50	130	3.5	74	238.0	25.5	44.5	146	150	20	31	25	26	9
F2	150	195	130_{j6}	180	14	25_{h9}	25_{h9}^{H7}	25.5	30	45	73	60	165	3.5	93	299.0	30.0	53.0	175	180	20	37	25	32	11
F3	200	260	180_{j6}	206	15	30_{h9}	30_{h9}^{H7}	30.5	36	50	83	72	215	4.0	106	335.5	31.5	56.5	192	196	25	37	30	32	14
F4	200	260	180_{j6}	230	15	40_{h9}	40_{h9}^{H7}	40.5	50	55	108	90	215	4.0	116	370.0	31.5	56.5	210	215	40	45	45	40	14
F6	250	325	230_{j6}	265	17	50_{h9}	50_{h9}^{H7}	50.5	62	70	128	106	265	4.0	137	433.0	29.5	60.5	248	251	40	47	45	42	14

Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
F102	□98	129.5	102.0	□115	133.5	102.0	–	–	–
F202	□98	153.0	131.0	□115	157.0	131.0	□145	159.0	131.0
F302	∅140	169.5	149.5	□115	173.5	149.5	□145	175.5	149.5
F303	∅140	206.5	149.5	–	–	–	–	–	–
F402	–	–	–	∅160	188.5	169.0	□145	190.5	169.0
F403	∅140	221.5	169.0	–	–	–	–	–	–
F602	–	–	–	∅160	219.5	196.0	□145	221.5	196.0

10.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

F	2	0	2	A	G	0280	LM403U

Explanation

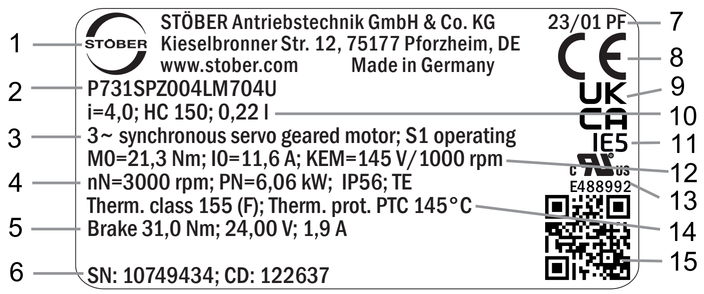
Code	Designation	Design
F	Type	Offset helical gearbox
2	Size	2 (example)
0	Generation	Generation 0
2	Stages	Two-stage
3		Three-stage
A	Shaft	Hollow shaft with keyway
S		Hollow shaft with shrink ring
V		Solid shaft
G	Housing	Pitch circle diameter
F		Round flange
Q		Square flange
GN		Pitch circle diameter + side fastening
0280	Transmission ratio (i x 10 rounded)	i = 28.24 (example)
LM403U	Motor	LM Lean motor

To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▹ 2]
- The mounting position, see the chapter [▹ 10.5.5]
- The position of the plug connector, see the chapter [▹ 10.5.7]

10.4.1 Nameplate

In the following figure, the nameplate of a P731_LM704 Lean geared motor is explained as an example.



Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004LM704U	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=3000 rpm PN=6.06 kW IP56 TE	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004
5	Brake 31.0 Nm 24.00 V 1.9 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749434 CD: 122637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	IE5	IEC energy efficiency
12	M0=21.3 Nm I0=11.6 A KEM=145 V/1000 rpm	Stall torque Stall current Voltage constant
13	cURus E488992	cURus test symbol, registered under UL number E488992
14	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
15	QR code	Link to product information

10.5 Product description

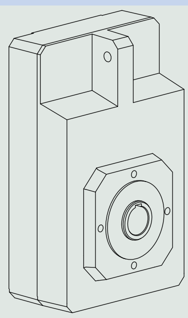
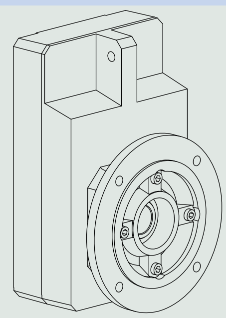
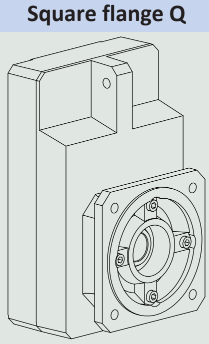
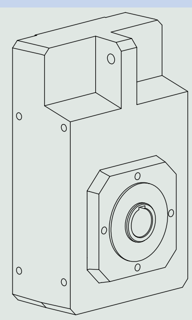
10.5.1 Input options

LM Lean motor	EZ synchronous servo motor	MB motor adapter + EZ synchronous servo motor
		
Catalog ID 443016_en	Catalog ID 442437_en	Catalog ID 443311_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

10.5.2 Housing design

Pitch circle diameter G	Round flange F
	
Square flange Q	**Pitch circle diameter + side fastening GN**
	

	G	F	Q	GN
F1	✓	✓	✓	✓
F2	✓	✓	✓	✓
F3	✓	✓	✓	✓
F4	✓	✓	✓	✓
F6	✓	✓	✓	✓

10.5.3 Combinatorial shaft/housing design

	Housing design				
Shaft design	**Code**	**G**	**F**	**Q**	**GN**
Hollow shaft with keyway	**A**	AG	AF	AQ	AGN
Hollow shaft with shrink ring	**S**	SG	SF	SQ	SGN
Solid shaft	**V**	–	VF	VQ	–

10.5.4 Installation conditions

Hollow shaft

The hollow shaft hole tolerance is ISO H7. The tolerance of the machine shaft must be ISO k6.

Take care to align the machine shaft with the gearbox hollow shaft when attaching the gearbox.

Maximum deviation ≤ 0.03 mm.

For simpler assembly and disassembly of the machine shaft, the hollow shafts are equipped with a spiral groove (as a grease deposit).

A hardened, threaded keeper plate is included in the scope of delivery. You also have the option to order the hollow shaft without a keeper plate.

Hollow shaft with shrink ring

The tolerance of the hollow shaft hole is ISO H7.

The machine shaft must be ISO h9.

Select a material for the machine shaft with a permitted surface pressure of p ≥ 325 N/mm^2.

Possible materials:

- C45E +QT
- 42CrMo4

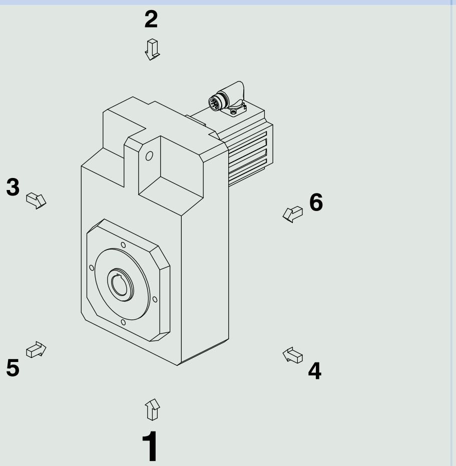
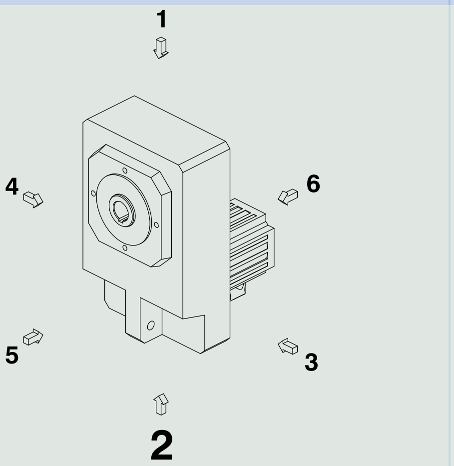
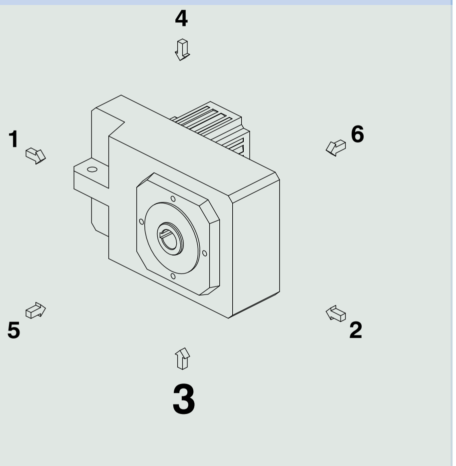
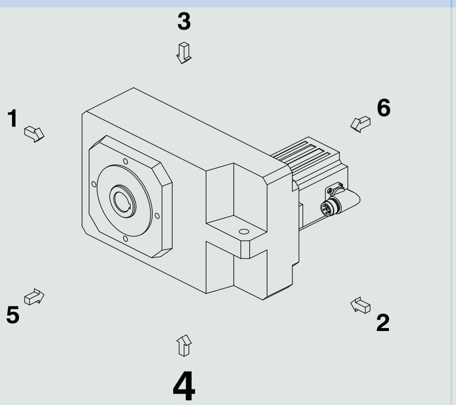
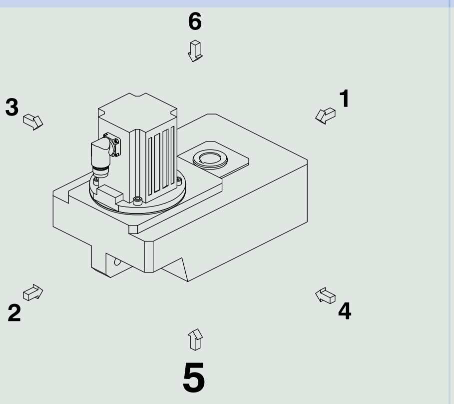
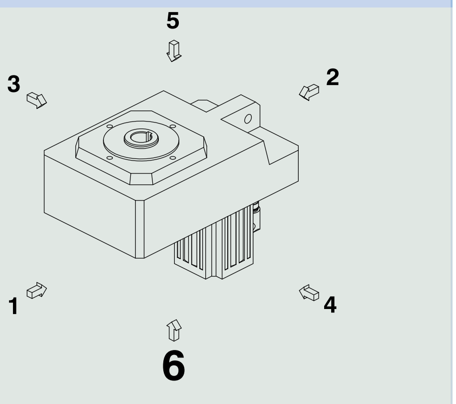
Fastening the gearboxes on the machine side using the pitch circle diameter

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

10.5.5 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gearbox sides. The mounting position is defined by the gearbox side facing downwards.

EL1	EL2	EL3
		
EL4	**EL5**	**EL6**
		

Since the lubricant filling volume of the gearbox depends on the mounting position, the mounting position must be specified when ordering.

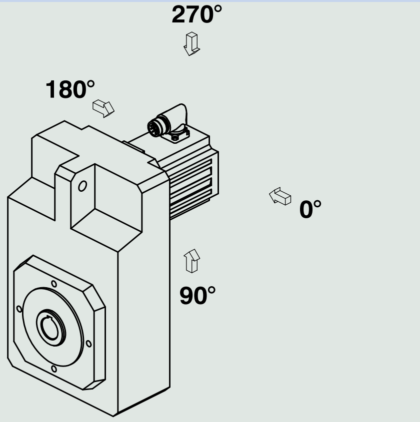
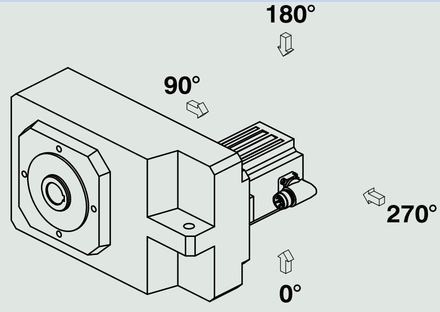
10.5.6 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gearboxes depend on the mounting position.

Only install the gearboxes in the intended mounting position! Reposition the gearboxes only after consulting STOBER. Otherwise, STOBER assumes no liability for the gearboxes.

You will receive lubricants for use in the food industry upon request.

10.5.7 Position of the plug connector

<table>
<tr><th>Mounting position EL1
Plug connector in 270° position (standard)</th><th>Mounting position EL4
Plug connector in 270° position (standard)</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Indicate variations for your geared motor in the order.

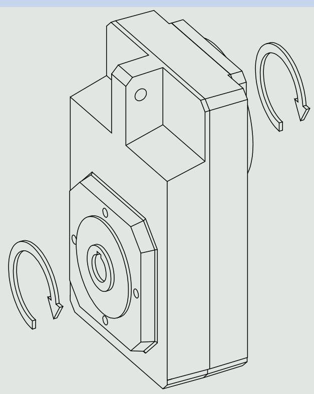
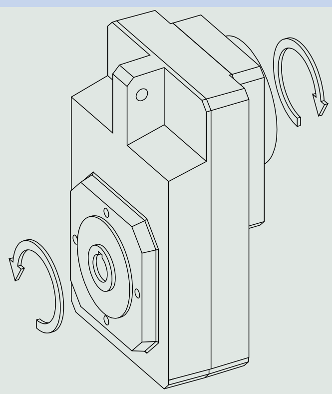
Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

10.5.8 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} two-stage	97%
η_{get} three-stage	96%
Protection class:[1]	
Gearbox	IP65
Motor	IP56, optionally IP66

10.5.9 Direction of rotation

Solid shaft (V), hollow shaft with keyway (A), hollow shaft with shrink ring (S)

F102 – F602	F203 – F603
	
The input and output rotate in the same direction.	The input and output rotate in opposite directions.

The pictures show mounting position EL1.

[1] Observe the protection class of all the components.

10.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

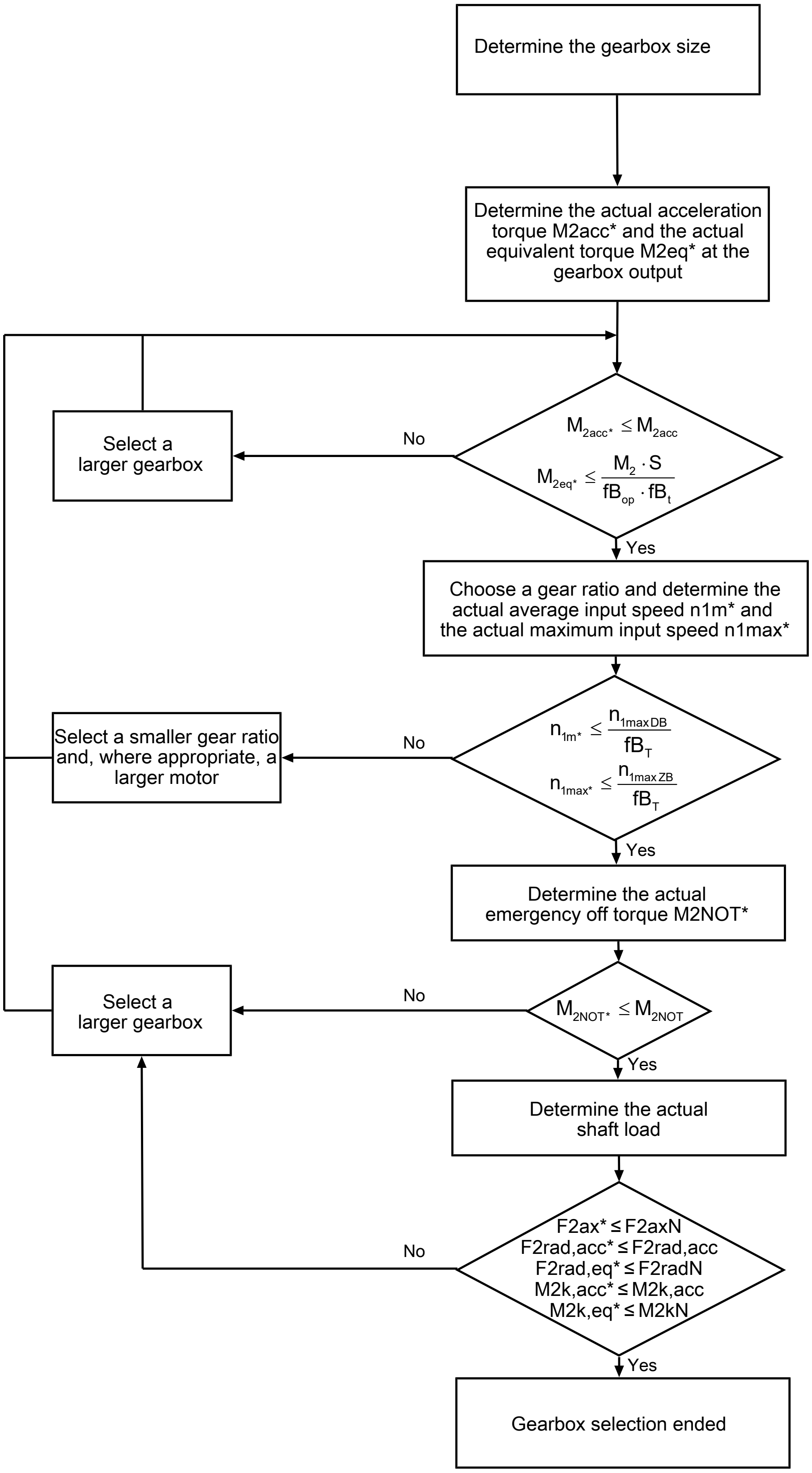
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in the Chapter [▸ 15.1].

The formula symbols for values actually present in the application are marked with *.

10.6.1 Drive selection

Drive selection for gearboxes

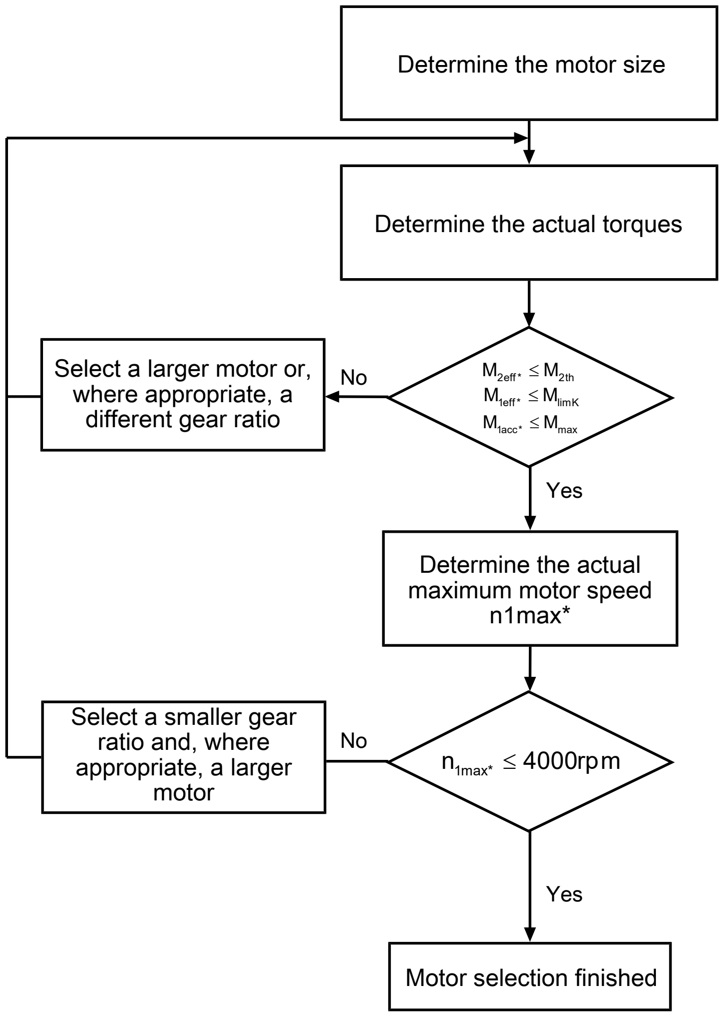


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_2 and S.

The values for fB_T, fB_{op} and fB_t can be found in the corresponding tables in this chapter.

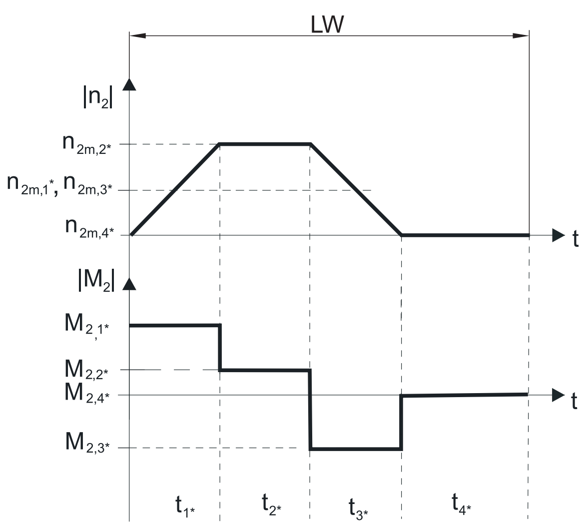
Drive selection for motors



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [▸ 2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc^*} = J_{tot} \cdot \frac{\Delta n_2}{9{,}55 \cdot \Delta t} + M_{L^*}$$

$$M_{1acc^*} = \frac{M_{2acc^*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9{,}55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If $t_{1^*} + \ldots + t_{3^*} \geq 6$ min, calculate n_{2m^*} without the rest phase t_{4^*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}{}^2 + \ldots + t_{n^*} \cdot M_{2,n^*}{}^2}{t_{1^*} + \ldots + t_{n^*}}}$$

Calculation of the actual emergency off torque

$$M_{2NOT^*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L^*}$$

Calculation of the actual equivalent torque

$$M_{2eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m^*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select another geared motor size.)

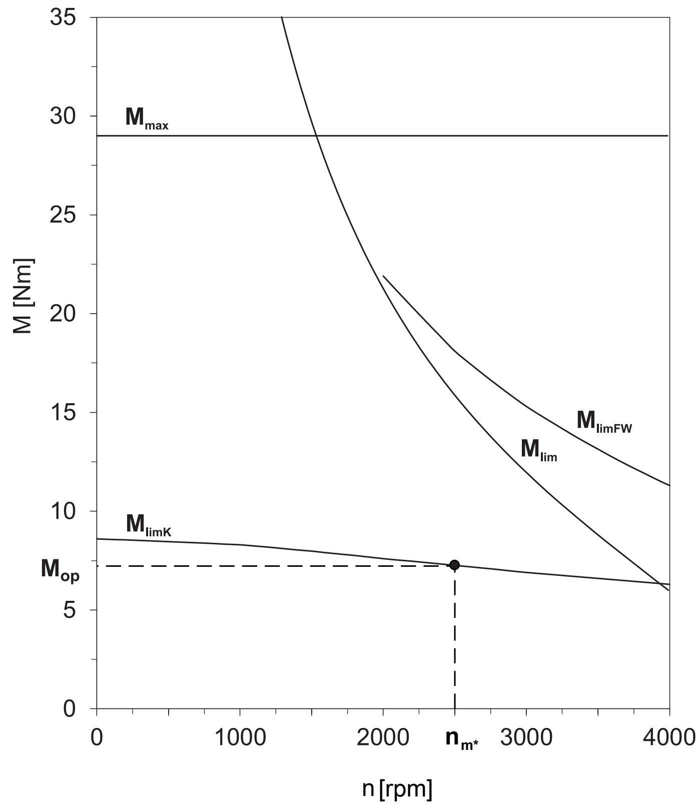
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot athEL \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for a_{thEL} and fB_T can be found in the corresponding tables in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m^*} can be found in the motor characteristic curve in the chapter [▸ 2.3]. Note the size of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Parameter a_{thEL}

Mounting position	a_{thEL}
EL1, 2, 5, 6	1.0
EL3, 4	1.1

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.25
Reversing load cyclic operation	1.40

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gearbox torques (M_{2acc}, M_{2NOT}) in the selection tables.

10.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m^*} \leq 20$ rpm ($F_{2axN} = F_{2ax20}$; $F_{2radN} = F_{2rad20}$; $M_{2kN} = M_{2k20}$)
- Only if radial forces on the gearbox are stabilized by its pilots for the pitch circle diameter and flange housing design

10.6.2.1 V shaft design

Permitted shaft loads for V shaft design (solid shaft)

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
F1	35.0	1100	4200	4200	260	260
F2	41.0	1400	5400	5400	400	400
F3	43.0	1900	7500	7500	600	600
F4	44.0	2350	9250	9250	800	800
F6	44.0	3100	12500	12500	1200	1200

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds $n_{2m^*} > 20$ rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20\,\text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20\,\text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20\,\text{rpm}}}}$$

The values for F_{2ax20}, F_{2rad20} and M_{2k20} can be found in the table "Permitted shaft loads" in this chapter.

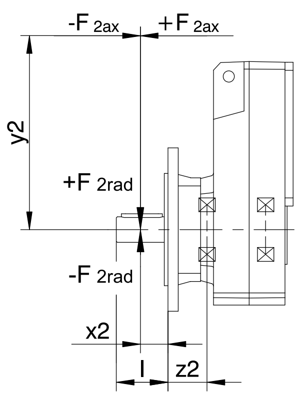


Fig. 1: Force application points for solid shaft

The specified values for F_{2rad20} and $F_{2rad,acc}$ refer to an application of force at the center of the output shaft: $x_2 = l/2$.

Shaft dimensions can be found in the "Dimensional drawings" chapter.

The following applies to other force application points:

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

10.6.2.2 A and S shaft design

Permitted shaft loads for A shaft design (hollow shaft with keyway)

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
F1	30.0	900	4200	4200	175	175
F2	33.0	1200	5400	5400	250	250
F3	33.0	1350	7500	7500	375	375
F4	39.0	1900	9250	9250	550	550
F6	45.0	2200	12500	12500	800	800

Permitted shaft loads for S shaft design (hollow shaft with shrink ring)

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
F1	30.0	900	4200	4200	175	175
F2	33.0	1200	5400	5400	250	250
F3	33.0	1350	7500	7500	375	375
F4	39.0	1900	9250	9250	550	550
F6	45.0	2200	12500	12500	800	800

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m^*} > 20 rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}}$$

The values for F_{2ax20}, F_{2rad20} and M_{2k20} can be found in the table "Permitted shaft loads" in this chapter.

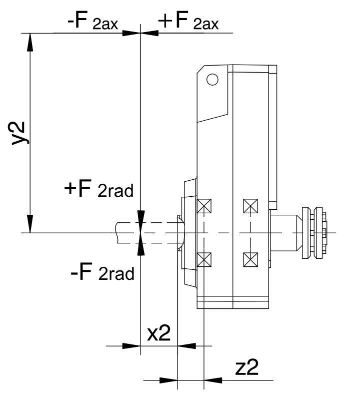


Fig. 2: Force application points for hollow shaft

You can determine the permitted radial forces from the permitted tilting torque M_{2kN} and $M_{2k,acc}$. The actual radial forces may not exceed the permitted radial forces. The permitted radial forces pertain to the shaft end (x2 = 0).

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{2k,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{2k,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{2rad,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{2rad,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

10.6.3 Radial shaft seal rings

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

10.7 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual gearboxes, geared motors F	443366_en

11 PKX right-angle planetary gearbox motors

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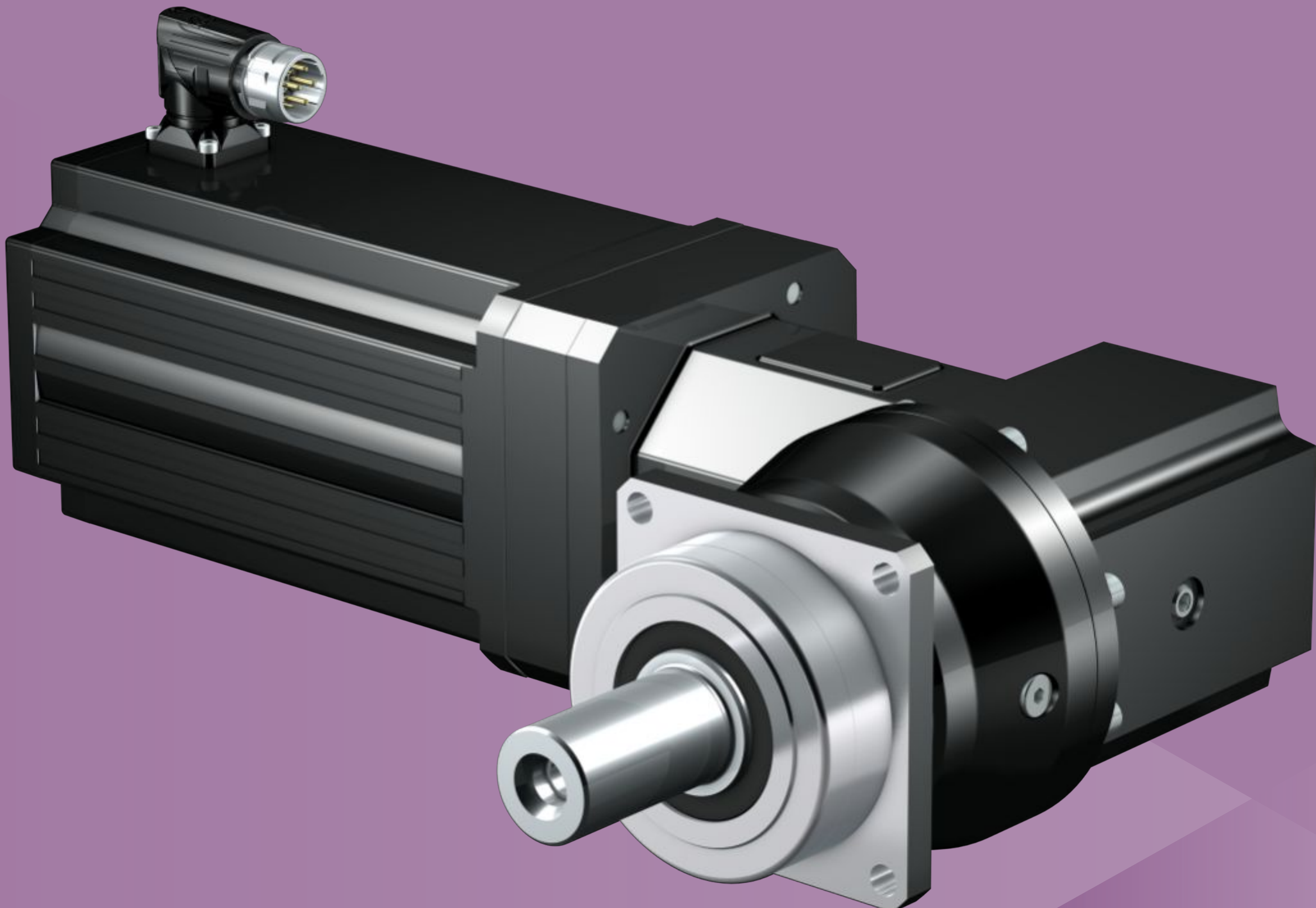


11

Right-angle planetary gearbox motors

PKX

11.1 Overview

Helical-geared precision right-angle planetary geared motors

Features

Power density	★★★★☆
Backlash	★★★★☆
Price category	€€€
Shaft load	★★★★☆
Smooth operation	★★☆☆☆
Torsional stiffness	★★★☆☆
Mass moment of inertia	★★★☆☆
Helical gearing	✓
Maintenance-free	✓
Small installation space	✓
Continuous operation without cooling	✓
Reinforced output bearing	✓ (optional)
Compact and dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

i	3 – 210
M_{2acc}	13 – 3300 Nm
$\Delta\phi_2$	2 – 8.5 arcmin
η_{get}	94 – 96 %

11.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Drives with convection-cooled motors
- M_{2acc}, M_{2accHT}: Solid shaft design without feather key (we generally recommend this shaft design for cyclic operation)

An explanation of the formula symbols can be found in the Chapter [15.1].

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2accHT}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,5,6	n_{1maxDB} EL3,4	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2red}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
P231KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 25 Nm)																		
375	17	19	61	0.93	P231_0040KX301_0020 MF LM401U	25	–	51	8.000	8/1	3500	3000	5500	2.5	8.5	–	1.5	7.4
429	15	16	107	0.90	P231_0070KX301_0010 MF LM401U	23	–	46	7.000	7/1	3000	2500	4500	2.7	7.5	–	1.7	7.4
600	11	12	76	1.3	P231_0050KX301_0010 MF LM401U	22	–	51	5.000	5/1	3000	2500	4500	2.7	8.0	–	1.6	7.4
750	8.6	9.3	61	1.6	P231_0040KX301_0010 MF LM401U	17	–	51	4.000	4/1	3000	2500	4500	2.7	8.5	–	1.5	7.4
750	17	17	120	0.80	P231_0040KX301_0010 MF LM402U	25	–	51	4.000	4/1	3000	2500	4500	4.1	8.5	–	1.5	9.1
P331KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 69 Nm)																		
143	45	49	42	1.0	P331_0070KX301_0030 MF LM401U	69	75	138	21.00	21/1	3500	3500	6000	2.4	5.5	3.5	4.2	8.2
150	43	46	68	0.84	P331_0100KX301_0020 MF LM401U	60	60	120	20.00	20/1	3500	3000	5500	2.5	5.0	3.0	4.0	8.2
188	34	37	49	1.2	P331_0080KX301_0020 MF LM401U	63	65	126	16.00	16/1	3500	3000	5500	2.5	5.5	3.5	4.1	8.2
200	32	35	32	1.3	P331_0050KX301_0030 MF LM401U	63	63	129	15.00	15/1	3500	3500	6000	2.4	6.0	4.0	3.8	8.2
214	30	33	38	1.5	P331_0070KX301_0020 MF LM401U	60	60	138	14.00	14/1	3500	3000	5500	2.5	5.5	3.5	4.2	8.2
250	26	28	32	1.3	P331_0040KX301_0030 MF LM401U	50	50	103	12.00	12/1	3500	3500	6000	2.4	6.5	4.5	3.3	8.2
300	21	23	29	2.0	P331_0050KX301_0020 MF LM401U	43	43	129	10.00	10/1	3500	3000	5500	2.5	6.0	4.0	3.8	8.2
300	42	43	57	1.0	P331_0050KX301_0020 MF LM402U	63	63	129	10.00	10/1	3500	3000	5500	3.8	6.0	4.0	3.8	9.9
375	17	19	29	2.0	P331_0040KX301_0020 MF LM401U	34	34	103	8.000	8/1	3500	3000	5500	2.5	6.5	4.5	3.3	8.2
375	34	34	57	1.0	P331_0040KX301_0020 MF LM402U	50	50	103	8.000	8/1	3500	3000	5500	3.8	6.5	4.5	3.3	9.9
429	15	16	37	2.6	P331_0070KX301_0010 MF LM401U	30	30	138	7.000	7/1	3000	2500	4500	2.7	5.5	3.5	4.2	8.2
429	29	30	72	1.3	P331_0070KX301_0010 MF LM402U	65	65	138	7.000	7/1	3000	2500	4500	4.1	5.5	3.5	4.2	9.9
429	41	41	99	0.97	P331_0070KX301_0010 MF LM403U	69	75	138	7.000	7/1	3000	2500	4500	5.4	5.5	3.5	4.2	11
500	13	14	29	2.0	P331_0030KX301_0020 MF LM401U	26	26	77	6.000	6/1	3500	3000	5500	2.5	7.5	5.5	2.4	8.2
500	25	26	57	1.0	P331_0030KX301_0020 MF LM402U	38	38	77	6.000	6/1	3500	3000	5500	3.9	7.5	5.5	2.4	9.9
600	11	12	26	3.7	P331_0050KX301_0010 MF LM401U	22	22	113	5.000	5/1	3000	2500	4500	2.8	6.0	4.0	3.8	8.2
600	21	21	51	1.9	P331_0050KX301_0010 MF LM402U	46	46	113	5.000	5/1	3000	2500	4500	4.1	6.0	4.0	3.8	9.9
600	29	30	71	1.4	P331_0050KX301_0010 MF LM403U	61	61	113	5.000	5/1	3000	2500	4500	5.4	6.0	4.0	3.8	11
750	8.6	9.3	24	3.9	P331_0040KX301_0010 MF LM401U	17	17	91	4.000	4/1	3000	2500	4500	2.8	6.5	4.5	3.3	8.2
750	17	17	48	2.0	P331_0040KX301_0010 MF LM402U	37	37	91	4.000	4/1	3000	2500	4500	4.1	6.5	4.5	3.3	9.9
750	23	24	66	1.5	P331_0040KX301_0010 MF LM403U	49	49	91	4.000	4/1	3000	2500	4500	5.4	6.5	4.5	3.3	11
1000	6.4	7.0	24	3.9	P331_0030KX301_0010 MF LM401U	13	13	68	3.000	3/1	3000	2500	4500	3.0	7.5	5.5	2.4	8.2
1000	13	13	48	2.0	P331_0030KX301_0010 MF LM402U	28	28	68	3.000	3/1	3000	2500	4500	4.3	7.5	5.5	2.4	9.9
1000	17	18	66	1.5	P331_0030KX301_0010 MF LM403U	37	37	68	3.000	3/1	3000	2500	4500	5.6	7.5	5.5	2.4	11
P431KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 140 Nm)																		
100	64	70	41	1.2	P431_0100KX401_0030 MF LM401U	115	115	230	30.00	30/1	3000	3000	5500	3.1	5.0	3.0	8.4	12
125	52	56	31	1.6	P431_0080KX401_0030 MF LM401U	103	103	239	24.00	24/1	3000	3000	5500	3.1	5.5	3.5	8.5	12
143	45	49	24	2.0	P431_0070KX401_0030 MF LM401U	90	90	271	21.00	21/1	3000	3000	5500	3.1	5.5	3.5	9.2	12
143	88	90	47	1.0	P431_0070KX401_0030 MF LM402U	135	143	271	21.00	21/1	3000	3000	5500	4.5	5.5	3.5	9.2	13
150	43	46	37	1.7	P431_0100KX401_0020 MF LM401U	86	86	230	20.00	20/1	2500	2500	5000	3.3	5.0	3.0	8.4	12
150	84	86	72	0.89	P431_0100KX401_0020 MF LM402U	115	115	230	20.00	20/1	2500	2500	5000	4.6	5.0	3.0	8.4	13
188	34	37	28	2.3	P431_0080KX401_0020 MF LM401U	69	69	239	16.00	16/1	2500	2500	5000	3.3	5.5	3.5	8.5	12
188	67	69	54	1.2	P431_0080KX401_0020 MF LM402U	120	125	239	16.00	16/1	2500	2500	5000	4.7	5.5	3.5	8.5	13
188	93	95	74	0.86	P431_0080KX401_0020 MF LM403U	120	125	239	16.00	16/1	2500	2500	5000	6.0	5.5	3.5	8.5	15
200	32	35	18	2.6	P431_0050KX401_0030 MF LM401U	65	65	258	15.00	15/1	3000	3000	5500	3.1	6.0	4.0	8.6	12
200	63	64	35	1.3	P431_0050KX401_0030 MF LM402U	121	121	258	15.00	15/1	3000	3000	5500	4.5	6.0	4.0	8.6	13
200	87	89	49	0.98	P431_0050KX401_0030 MF LM403U	121	121	258	15.00	15/1	3000	3000	5500	5.8	6.0	4.0	8.6	15
214	30	33	21	3.0	P431_0070KX401_0020 MF LM401U	60	60	271	14.00	14/1	2500	2500	5000	3.3	5.5	3.5	9.2	12
214	59	60	42	1.5	P431_0070KX401_0020 MF LM402U	130	130	271	14.00	14/1	2500	2500	5000	4.7	5.5	3.5	9.2	13
214	81	83	58	1.1	P431_0070KX401_0020 MF LM403U	135	143	271	14.00	14/1	2500	2500	5000	6.0	5.5	3.5	9.2	15
250	26	28	18	2.6	P431_0040KX401_0030 MF LM401U	52	52	206	12.00	12/1	3000	3000	5500	3.1	6.5	4.5	7.3	12
250	51	52	35	1.3	P431_0040KX401_0030 MF LM402U	97	97	206	12.00	12/1	3000	3000	5500	4.5	6.5	4.5	7.3	13
250	69	71	49	0.98	P431_0040KX401_0030 MF LM403U	97	97	206	12.00	12/1	3000	3000	5500	5.8	6.5	4.5	7.3	15
300	21	23	16	3.9	P431_0050KX401_0020 MF LM401U	43	43	258	10.00	10/1	2500	2500	5000	3.3	6.0	4.0	8.6	12
300	42	43	32	2.0	P431_0050KX401_0020 MF LM402U	93	93	258	10.00	10/1	2500	2500	5000	4.7	6.0	4.0	8.6	13
300	58	59	44	1.5	P431_0050KX401_0020 MF LM403U	121	121	258	10.00	10/1	2500	2500	5000	6.0	6.0	4.0	8.6	15

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2accHT}	M_{2NOT}	i	i_{exakt}	n_{1maxDB}		n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2red}$	C_2	m
											EL1,2,5,6	EL3,4						
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
P431KX (n_{1N} = 3000 min⁻¹, $M_{2acc,max}$ = 140 Nm)																		
300	91	96	69	0.94	P431_0050KX401_0020 MF LM503U	121	121	258	10.00	10/1	2500	2500	5000	12	6.0	4.0	8.6	18
375	17	19	16	3.9	P431_0040KX401_0020 MF LM401U	34	34	206	8.000	8/1	2500	2500	5000	3.4	6.5	4.5	7.3	12
375	34	34	32	2.0	P431_0040KX401_0020 MF LM402U	74	74	206	8.000	8/1	2500	2500	5000	4.7	6.5	4.5	7.3	13
375	46	47	44	1.5	P431_0040KX401_0020 MF LM403U	97	97	206	8.000	8/1	2500	2500	5000	6.0	6.5	4.5	7.3	15
375	72	77	69	0.94	P431_0040KX401_0020 MF LM503U	97	97	206	8.000	8/1	2500	2500	5000	12	6.5	4.5	7.3	18
429	15	16	22	4.9	P431_0070KX401_0010 MF LM401U	30	30	271	7.000	7/1	2500	2000	4000	4.1	5.5	3.5	9.2	12
429	29	30	43	2.5	P431_0070KX401_0010 MF LM402U	65	65	271	7.000	7/1	2500	2000	4000	5.5	5.5	3.5	9.2	13
429	41	41	59	1.8	P431_0070KX401_0010 MF LM403U	86	86	271	7.000	7/1	2500	2000	4000	6.8	5.5	3.5	9.2	15
429	63	67	92	1.2	P431_0070KX401_0010 MF LM503U	135	136	271	7.000	7/1	2500	2000	4000	13	5.5	3.5	9.2	18
429	92	103	133	0.81	P431_0070KX401_0010 MF LM505U	135	143	271	7.000	7/1	2500	2000	4000	19	5.5	3.5	9.2	22
500	13	14	17	3.9	P431_0030KX401_0020 MF LM401U	26	26	155	6.000	6/1	2500	2500	5000	3.5	7.5	5.5	5.3	12
500	25	26	32	2.0	P431_0030KX401_0020 MF LM402U	56	56	155	6.000	6/1	2500	2500	5000	4.8	7.5	5.5	5.3	13
500	35	35	45	1.4	P431_0030KX401_0020 MF LM403U	73	73	155	6.000	6/1	2500	2500	5000	6.1	7.5	5.5	5.3	15
500	54	58	70	0.92	P431_0030KX401_0020 MF LM503U	73	73	155	6.000	6/1	2500	2500	5000	12	7.5	5.5	5.3	18
600	21	21	31	3.5	P431_0050KX401_0010 MF LM402U	46	46	258	5.000	5/1	2500	2000	4000	5.6	6.0	4.0	8.6	13
600	29	30	42	2.6	P431_0050KX401_0010 MF LM403U	61	61	258	5.000	5/1	2500	2000	4000	6.9	6.0	4.0	8.6	15
600	45	48	66	1.6	P431_0050KX401_0010 MF LM503U	97	97	258	5.000	5/1	2500	2000	4000	13	6.0	4.0	8.6	18
600	65	74	95	1.1	P431_0050KX401_0010 MF LM505U	121	121	258	5.000	5/1	2500	2000	4000	19	6.0	4.0	8.6	22
600	92	102	134	0.81	P431_0050KX401_0010 MF LM704U	121	121	258	5.000	5/1	2500	2000	4000	39	6.0	4.0	8.6	28
750	17	17	27	4.0	P431_0040KX401_0010 MF LM402U	37	37	206	4.000	4/1	2500	2000	4000	5.7	6.5	4.5	7.3	13
750	23	24	37	2.9	P431_0040KX401_0010 MF LM403U	49	49	206	4.000	4/1	2500	2000	4000	7.0	6.5	4.5	7.3	15
750	36	38	58	1.9	P431_0040KX401_0010 MF LM503U	78	78	206	4.000	4/1	2500	2000	4000	13	6.5	4.5	7.3	18
750	52	59	83	1.3	P431_0040KX401_0010 MF LM505U	97	97	206	4.000	4/1	2500	2000	4000	19	6.5	4.5	7.3	22
750	74	81	117	0.92	P431_0040KX401_0010 MF LM704U	97	97	206	4.000	4/1	2500	2000	4000	39	6.5	4.5	7.3	28
1000	13	13	31	3.5	P431_0030KX401_0010 MF LM402U	28	28	155	3.000	3/1	2500	2000	4000	6.1	7.5	5.5	5.3	13
1000	17	18	43	2.5	P431_0030KX401_0010 MF LM403U	37	37	155	3.000	3/1	2500	2000	4000	7.4	7.5	5.5	5.3	15
1000	27	29	67	1.6	P431_0030KX401_0010 MF LM503U	58	58	155	3.000	3/1	2500	2000	4000	14	7.5	5.5	5.3	18
1000	39	44	97	1.1	P431_0030KX401_0010 MF LM505U	73	73	155	3.000	3/1	2500	2000	4000	20	7.5	5.5	5.3	22
P432KX (n_{1N} = 3000 min⁻¹, $M_{2acc,max}$ = 130 Nm)																		
54	118	127	71	0.81	P432_0280KX301_0020 MF LM401U	130	130	260	56.00	56/1	3500	3000	5500	2.5	5.5	3.5	12	11
60	105	114	60	0.95	P432_0250KX301_0020 MF LM401U	134	139	268	50.00	50/1	3500	3000	5500	2.5	5.5	3.5	12	11
75	84	91	51	1.1	P432_0200KX301_0020 MF LM401U	134	139	268	40.00	40/1	3500	3000	5500	2.5	5.5	3.5	12	11
86	74	80	69	1.4	P432_0350KX301_0010 MF LM401U	133	138	266	35.00	35/1	3000	2500	4500	2.7	5.5	3.5	12	11
94	67	73	43	1.3	P432_0160KX301_0020 MF LM401U	130	130	260	32.00	32/1	3500	3000	5500	2.5	5.5	3.5	11	11
P531KX (n_{1N} = 3000 min⁻¹, $M_{2acc,max}$ = 330 Nm)																		
100	64	70	19	2.8	P531_0100KX501_0030 MF LM401U	129	129	575	30.00	30/1	3000	3000	5000	6.5	4.0	2.0	24	17
100	126	129	37	1.4	P531_0100KX501_0030 MF LM402U	278	278	575	30.00	30/1	3000	3000	5000	7.8	4.0	2.0	24	19
100	174	177	51	1.0	P531_0100KX501_0030 MF LM403U	288	288	575	30.00	30/1	3000	3000	5000	9.1	4.0	2.0	24	21
125	52	56	14	3.9	P531_0080KX501_0030 MF LM401U	103	103	592	24.00	24/1	3000	3000	5000	6.5	4.5	2.5	21	17
125	101	103	27	2.0	P531_0080KX501_0030 MF LM402U	222	222	592	24.00	24/1	3000	3000	5000	7.8	4.5	2.5	21	19
125	139	142	37	1.4	P531_0080KX501_0030 MF LM403U	294	294	592	24.00	24/1	3000	3000	5000	9.1	4.5	2.5	21	21
125	217	231	57	0.92	P531_0080KX501_0030 MF LM503U	296	300	592	24.00	24/1	3000	3000	5000	15	4.5	2.5	21	24
143	45	49	11	4.7	P531_0070KX501_0030 MF LM401U	90	90	667	21.00	21/1	3000	3000	5000	6.5	4.5	2.5	25	17
143	88	90	22	2.4	P531_0070KX501_0030 MF LM402U	195	195	667	21.00	21/1	3000	3000	5000	7.8	4.5	2.5	25	19
143	122	124	30	1.7	P531_0070KX501_0030 MF LM403U	257	257	667	21.00	21/1	3000	3000	5000	9.1	4.5	2.5	25	21
143	190	202	48	1.1	P531_0070KX501_0030 MF LM503U	333	380	667	21.00	21/1	3000	3000	5000	15	4.5	2.5	25	24
150	43	46	17	4.2	P531_0100KX501_0020 MF LM401U	86	86	575	20.00	20/1	2500	2500	4500	7.0	4.0	2.0	24	17
150	84	86	33	2.1	P531_0100KX501_0020 MF LM402U	185	185	575	20.00	20/1	2500	2500	4500	8.3	4.0	2.0	24	19
150	116	118	46	1.6	P531_0100KX501_0020 MF LM403U	245	245	575	20.00	20/1	2500	2500	4500	9.6	4.0	2.0	24	21
150	181	192	72	0.99	P531_0100KX501_0020 MF LM503U	288	288	575	20.00	20/1	2500	2500	4500	16	4.0	2.0	24	24
188	67	69	24	3.0	P531_0080KX501_0020 MF LM402U	148	148	592	16.00	16/1	2500	2500	4500	8.3	4.5	2.5	21	19
188	93	95	33	2.2	P531_0080KX501_0020 MF LM403U	196	196	592	16.00	16/1	2500	2500	4500	9.6	4.5	2.5	21	21
188	145	154	52	1.4	P531_0080KX501_0020 MF LM503U	296	300	592	16.00	16/1	2500	2500	4500	16	4.5	2.5	21	24
188	209	236	75	0.96	P531_0080KX501_0020 MF LM505U	296	300	592	16.00	16/1	2500	2500	4500	22	4.5	2.5	21	28
200	63	64	16	3.4	P531_0050KX501_0030 MF LM402U	139	139	644	15.00	15/1	3000	3000	5000	7.9	5.0	3.0	22	19
200	87	89	22	2.4	P531_0050KX501_0030 MF LM403U	184	184	644	15.00	15/1	3000	3000	5000	9.2	5.0	3.0	22	21
200	136	144	34	1.6	P531_0050KX501_0030 MF LM503U	292	292	644	15.00	15/1	3000	3000	5000	15	5.0	3.0	22	24
200	196	222	49	1.1	P531_0050KX501_0030 MF LM505U	306	306	644	15.00	15/1	3000	3000	5000	22	5.0	3.0	22	28
214	59	60	20	3.6	P531_0070KX501_0020 MF LM402U	130	130	667	14.00	14/1	2500	2500	4500	8.4	4.5	2.5	25	19
214	81	83	28	2.6	P531_0070KX501_0020 MF LM403U	172	172	667	14.00	14/1	2500	2500	4500	9.7	4.5	2.5	25	21
214	127	135	43	1.7	P531_0070KX501_0020 MF LM503U	272	272	667	14.00	14/1	2500	2500	4500	16	4.5	2.5	25	24
214	183	207	62	1.1	P531_0070KX501_0020 MF LM505U	333	380	667	14.00	14/1	2500	2500	4500	22	4.5	2.5	25	28
214	258	284	88	0.82	P531_0070KX501_0020 MF LM704U	333	380	667	14.00	14/1	2500	2500	4500	42	4.5	2.5	25	34
250	51	52	16	3.4	P531_0040KX501_0030 MF LM402U	111	111	515	12.00	12/1	3000	3000	5000	7.9	5.5	3.5	18	19

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2accHT} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2,5,6 [rpm]	n_{1maxDB} EL3,4 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2red}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
P531KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 330 Nm)																		
250	69	71	22	2.4	P531_0040KX501_0030 MF LM403U	147	147	515	12.00	12/1	3000	3000	5000	9.2	5.5	3.5	18	21
250	109	115	34	1.6	P531_0040KX501_0030 MF LM503U	234	234	515	12.00	12/1	3000	3000	5000	15	5.5	3.5	18	24
250	157	177	49	1.1	P531_0040KX501_0030 MF LM505U	244	244	515	12.00	12/1	3000	3000	5000	22	5.5	3.5	18	28
300	58	59	20	3.7	P531_0050KX501_0020 MF LM403U	123	123	644	10.00	10/1	2500	2500	4500	9.8	5.0	3.0	22	21
300	91	96	31	2.3	P531_0050KX501_0020 MF LM503U	195	195	644	10.00	10/1	2500	2500	4500	16	5.0	3.0	22	24
300	131	148	44	1.6	P531_0050KX501_0020 MF LM505U	306	306	644	10.00	10/1	2500	2500	4500	22	5.0	3.0	22	28
300	184	203	62	1.2	P531_0050KX501_0020 MF LM704U	306	306	644	10.00	10/1	2500	2500	4500	42	5.0	3.0	22	34
300	245	285	83	0.86	P531_0050KX501_0020 MF LM706U	306	306	644	10.00	10/1	2500	2500	4500	59	5.0	3.0	22	41
375	46	47	20	3.7	P531_0040KX501_0020 MF LM403U	98	98	515	8.000	8/1	2500	2500	4500	9.9	5.5	3.5	18	21
375	72	77	31	2.3	P531_0040KX501_0020 MF LM503U	156	156	515	8.000	8/1	2500	2500	4500	16	5.5	3.5	18	24
375	105	118	44	1.6	P531_0040KX501_0020 MF LM505U	244	244	515	8.000	8/1	2500	2500	4500	22	5.5	3.5	18	28
375	147	163	62	1.2	P531_0040KX501_0020 MF LM704U	244	244	515	8.000	8/1	2500	2500	4500	42	5.5	3.5	18	34
375	196	228	83	0.86	P531_0040KX501_0020 MF LM706U	244	244	515	8.000	8/1	2500	2500	4500	59	5.5	3.5	18	41
429	41	41	27	4.5	P531_0070KX501_0010 MF LM403U	86	86	667	7.000	7/1	2500	2000	3500	12	4.5	2.5	25	21
429	63	67	41	2.9	P531_0070KX501_0010 MF LM503U	136	136	667	7.000	7/1	2500	2000	3500	18	4.5	2.5	25	24
429	92	103	60	2.0	P531_0070KX501_0010 MF LM505U	214	214	667	7.000	7/1	2500	2000	3500	25	4.5	2.5	25	28
429	129	142	84	1.4	P531_0070KX501_0010 MF LM704U	275	275	667	7.000	7/1	2500	2000	3500	44	4.5	2.5	25	34
429	172	199	112	1.1	P531_0070KX501_0010 MF LM706U	333	380	667	7.000	7/1	2500	2000	3500	62	4.5	2.5	25	41
500	25	26	15	4.7	P531_0030KX501_0020 MF LM402U	56	56	387	6.000	6/1	2500	2500	4500	9.0	6.5	4.5	13	19
500	35	35	21	3.5	P531_0030KX501_0020 MF LM403U	74	74	387	6.000	6/1	2500	2500	4500	10	6.5	4.5	13	21
500	54	58	32	2.2	P531_0030KX501_0020 MF LM503U	117	117	387	6.000	6/1	2500	2500	4500	16	6.5	4.5	13	24
500	79	89	47	1.5	P531_0030KX501_0020 MF LM505U	183	183	387	6.000	6/1	2500	2500	4500	23	6.5	4.5	13	28
500	110	122	66	1.1	P531_0030KX501_0020 MF LM704U	183	183	387	6.000	6/1	2500	2500	4500	42	6.5	4.5	13	34
500	147	171	88	0.82	P531_0030KX501_0020 MF LM706U	183	183	387	6.000	6/1	2500	2500	4500	60	6.5	4.5	13	41
600	45	48	30	4.1	P531_0050KX501_0010 MF LM503U	97	97	644	5.000	5/1	2500	2000	3500	19	5.0	3.0	22	24
600	65	74	43	2.8	P531_0050KX501_0010 MF LM505U	153	153	644	5.000	5/1	2500	2000	3500	25	5.0	3.0	22	28
600	92	102	60	2.0	P531_0050KX501_0010 MF LM704U	197	197	644	5.000	5/1	2500	2000	3500	45	5.0	3.0	22	34
600	123	142	80	1.5	P531_0050KX501_0010 MF LM706U	293	293	644	5.000	5/1	2500	2000	3500	62	5.0	3.0	22	41
750	36	38	26	4.7	P531_0040KX501_0010 MF LM503U	78	78	515	4.000	4/1	2500	2000	3500	19	5.5	3.5	18	24
750	52	59	37	3.2	P531_0040KX501_0010 MF LM505U	123	123	515	4.000	4/1	2500	2000	3500	25	5.5	3.5	18	28
750	74	81	52	2.3	P531_0040KX501_0010 MF LM704U	157	157	515	4.000	4/1	2500	2000	3500	45	5.5	3.5	18	34
750	98	114	69	1.7	P531_0040KX501_0010 MF LM706U	234	234	515	4.000	4/1	2500	2000	3500	62	5.5	3.5	18	41
1000	27	29	31	3.9	P531_0030KX501_0010 MF LM503U	58	58	387	3.000	3/1	2500	2000	3500	21	6.5	4.5	13	24
1000	39	44	45	2.7	P531_0030KX501_0010 MF LM505U	92	92	387	3.000	3/1	2500	2000	3500	27	6.5	4.5	13	28
1000	55	61	63	1.9	P531_0030KX501_0010 MF LM704U	118	118	387	3.000	3/1	2500	2000	3500	47	6.5	4.5	13	34
1000	74	85	84	1.4	P531_0030KX501_0010 MF LM706U	176	176	387	3.000	3/1	2500	2000	3500	64	6.5	4.5	13	41
P532KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 360 Nm)																		
20	316	341	56	0.85	P532_0500KX401_0030 MF LM401U	352	352	704	150.0	150/1	3000	3000	5500	3.1	4.0	2.0	32	16
21	295	318	72	0.89	P532_0700KX401_0020 MF LM401U	345	357	690	140.0	140/1	2500	2500	5000	3.3	4.0	2.0	30	16
25	253	273	56	0.85	P532_0400KX401_0030 MF LM401U	300	300	600	120.0	120/1	3000	3000	5500	3.1	4.5	2.5	31	16
29	221	239	39	1.2	P532_0350KX401_0030 MF LM401U	352	352	704	105.0	105/1	3000	3000	5500	3.1	4.5	2.5	32	16
30	211	227	50	1.3	P532_0500KX401_0020 MF LM401U	352	352	704	100.0	100/1	2500	2500	5000	3.3	4.0	2.0	32	16
36	177	191	36	1.3	P532_0280KX401_0030 MF LM401U	300	300	600	84.00	84/1	3000	3000	5500	3.1	4.5	2.5	31	16
38	168	182	51	1.3	P532_0400KX401_0020 MF LM401U	300	300	600	80.00	80/1	2500	2500	5000	3.3	4.5	2.5	31	16
40	158	171	29	1.6	P532_0250KX401_0030 MF LM401U	317	317	710	75.00	75/1	3000	3000	5500	3.1	4.5	2.5	31	16
40	309	316	56	0.84	P532_0250KX401_0030 MF LM402U	355	357	710	75.00	75/1	3000	3000	5500	4.5	4.5	2.5	31	18
43	147	159	35	1.8	P532_0350KX401_0020 MF LM401U	295	295	704	70.00	70/1	2500	2500	5000	3.3	4.5	2.5	32	16
43	289	295	69	0.94	P532_0350KX401_0020 MF LM402U	352	352	704	70.00	70/1	2500	2500	5000	4.7	4.5	2.5	32	18
47	135	146	36	1.8	P532_0320KX401_0020 MF LM401U	270	270	624	64.00	64/1	2500	2500	5000	3.4	4.5	2.5	25	16
47	264	269	71	0.91	P532_0320KX401_0020 MF LM402U	312	363	624	64.00	64/1	2500	2500	5000	4.7	4.5	2.5	25	18
50	126	136	24	2.0	P532_0200KX401_0030 MF LM401U	253	253	710	60.00	60/1	3000	3000	5500	3.1	4.5	2.5	31	16
50	248	253	47	1.0	P532_0200KX401_0030 MF LM402U	355	364	710	60.00	60/1	3000	3000	5500	4.5	4.5	2.5	31	18
54	118	127	33	2.0	P532_0280KX401_0020 MF LM401U	236	236	600	56.00	56/1	2500	2500	5000	3.3	4.5	2.5	31	16
54	231	236	64	1.0	P532_0280KX401_0020 MF LM402U	300	300	600	56.00	56/1	2500	2500	5000	4.7	4.5	2.5	31	18
60	105	114	26	2.5	P532_0250KX401_0020 MF LM401U	211	211	710	50.00	50/1	2500	2500	5000	3.3	4.5	2.5	31	16
60	206	211	51	1.3	P532_0250KX401_0020 MF LM402U	355	357	710	50.00	50/1	2500	2500	5000	4.7	4.5	2.5	31	18
60	284	290	70	0.92	P532_0250KX401_0020 MF LM403U	355	357	710	50.00	50/1	2500	2500	5000	6.0	4.5	2.5	31	19
75	84	91	22	3.0	P532_0200KX401_0020 MF LM401U	169	169	710	40.00	40/1	2500	2500	5000	3.4	4.5	2.5	31	16
75	165	168	42	1.5	P532_0200KX401_0020 MF LM402U	355	363	710	40.00	40/1	2500	2500	5000	4.7	4.5	2.5	31	18
75	227	232	58	1.1	P532_0200KX401_0020 MF LM403U	355	364	710	40.00	40/1	2500	2500	5000	6.0	4.5	2.5	31	19
86	74	80	30	3.6	P532_0350KX401_0010 MF LM401U	148	148	704	35.00	35/1	2500	2000	4000	4.1	4.5	2.5	32	16
86	144	147	59	1.8	P532_0350KX401_0010 MF LM402U	318	318	704	35.00	35/1	2500	2000	4000	5.5	4.5	2.5	32	18
86	198	203	81	1.3	P532_0350KX401_0010 MF LM403U	352	352	704	35.00	35/1	2500	2000	4000	6.8	4.5	2.5	32	19
86	310	330	127	0.85	P532_0350KX401_0010 MF LM503U	352	352	704	35.00	35/1	2500	2000	4000	13	4.5	2.5	32	22

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2accHT}	M_{2NOT}	i	i_{exakt}	n_{1maxDB}		n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2red}$	C_2	m
											EL1,2,5,6	EL3,4						
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
P532KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 360 Nm)																		
94	67	73	20	3.3	P532_0160KX401_0020 MF LM401U	135	135	600	32.00	32/1	2500	2500	5000	3.4	4.5	2.5	29	16
94	132	135	39	1.7	P532_0160KX401_0020 MF LM402U	290	290	600	32.00	32/1	2500	2500	5000	4.7	4.5	2.5	29	18
94	181	185	53	1.2	P532_0160KX401_0020 MF LM403U	300	300	600	32.00	32/1	2500	2500	5000	6.0	4.5	2.5	29	19
P731KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 810 Nm)																		
100	272	289	123	1.3	P731_0100KX701_0030 MF LM503U	575	575	1150	30.00	30/1	2100	2100	4000	23	4.0	2.0	52	37
100	393	443	177	0.89	P731_0100KX701_0030 MF LM505U	575	575	1150	30.00	30/1	2100	2100	4000	29	4.0	2.0	52	42
125	217	231	86	1.8	P731_0080KX701_0030 MF LM503U	467	467	1336	24.00	24/1	2100	2100	4000	23	4.5	2.5	53	37
125	314	355	124	1.3	P731_0080KX701_0030 MF LM505U	668	700	1336	24.00	24/1	2100	2100	4000	29	4.5	2.5	53	42
125	442	488	175	0.91	P731_0080KX701_0030 MF LM704U	668	700	1336	24.00	24/1	2100	2100	4000	49	4.5	2.5	53	47
143	190	202	68	2.3	P731_0070KX701_0030 MF LM503U	409	409	1610	21.00	21/1	2100	2100	4000	23	4.5	2.5	54	37
143	275	310	99	1.6	P731_0070KX701_0030 MF LM505U	643	643	1610	21.00	21/1	2100	2100	4000	29	4.5	2.5	54	42
143	387	427	139	1.1	P731_0070KX701_0030 MF LM704U	805	826	1610	21.00	21/1	2100	2100	4000	49	4.5	2.5	54	47
143	515	598	185	0.85	P731_0070KX701_0030 MF LM706U	805	840	1610	21.00	21/1	2100	2100	4000	66	4.5	2.5	54	55
150	181	192	111	1.9	P731_0100KX701_0020 MF LM503U	389	389	1150	20.00	20/1	1800	1800	3500	25	4.0	2.0	52	37
150	262	296	160	1.3	P731_0100KX701_0020 MF LM505U	575	575	1150	20.00	20/1	1800	1800	3500	32	4.0	2.0	52	42
150	368	406	225	0.95	P731_0100KX701_0020 MF LM704U	575	575	1150	20.00	20/1	1800	1800	3500	51	4.0	2.0	52	47
188	145	154	78	2.8	P731_0080KX701_0020 MF LM503U	311	311	1336	16.00	16/1	1800	1800	3500	25	4.5	2.5	53	37
188	209	236	112	1.9	P731_0080KX701_0020 MF LM505U	490	490	1336	16.00	16/1	1800	1800	3500	32	4.5	2.5	53	42
188	295	325	158	1.4	P731_0080KX701_0020 MF LM704U	629	629	1336	16.00	16/1	1800	1800	3500	51	4.5	2.5	53	47
188	392	456	210	1.0	P731_0080KX701_0020 MF LM706U	668	700	1336	16.00	16/1	1800	1800	3500	69	4.5	2.5	53	55
200	136	144	51	3.1	P731_0050KX701_0030 MF LM503U	292	292	1289	15.00	15/1	2100	2100	4000	23	5.0	3.0	52	37
200	196	222	73	2.2	P731_0050KX701_0030 MF LM505U	460	460	1289	15.00	15/1	2100	2100	4000	29	5.0	3.0	52	42
200	276	305	103	1.5	P731_0050KX701_0030 MF LM704U	590	590	1289	15.00	15/1	2100	2100	4000	49	5.0	3.0	52	47
200	368	427	137	1.2	P731_0050KX701_0030 MF LM706U	606	606	1289	15.00	15/1	2100	2100	4000	66	5.0	3.0	52	55
214	127	135	62	3.5	P731_0070KX701_0020 MF LM503U	272	272	1610	14.00	14/1	1800	1800	3500	25	4.5	2.5	54	37
214	183	207	89	2.4	P731_0070KX701_0020 MF LM505U	429	429	1610	14.00	14/1	1800	1800	3500	32	4.5	2.5	54	42
214	258	284	125	1.7	P731_0070KX701_0020 MF LM704U	551	551	1610	14.00	14/1	1800	1800	3500	51	4.5	2.5	54	47
214	343	399	167	1.3	P731_0070KX701_0020 MF LM706U	805	821	1610	14.00	14/1	1800	1800	3500	69	4.5	2.5	54	55
250	109	115	51	3.1	P731_0040KX701_0030 MF LM503U	234	234	1031	12.00	12/1	2100	2100	4000	23	5.5	3.5	47	37
250	157	177	73	2.2	P731_0040KX701_0030 MF LM505U	368	368	1031	12.00	12/1	2100	2100	4000	30	5.5	3.5	47	42
250	221	244	103	1.5	P731_0040KX701_0030 MF LM704U	472	472	1031	12.00	12/1	2100	2100	4000	49	5.5	3.5	47	47
250	294	342	137	1.2	P731_0040KX701_0030 MF LM706U	485	485	1031	12.00	12/1	2100	2100	4000	67	5.5	3.5	47	55
300	91	96	46	4.7	P731_0050KX701_0020 MF LM503U	195	195	1289	10.00	10/1	1800	1800	3500	26	5.0	3.0	52	37
300	131	148	66	3.2	P731_0050KX701_0020 MF LM505U	306	306	1289	10.00	10/1	1800	1800	3500	32	5.0	3.0	52	42
300	184	203	93	2.3	P731_0050KX701_0020 MF LM704U	393	393	1289	10.00	10/1	1800	1800	3500	52	5.0	3.0	52	47
300	245	285	124	1.7	P731_0050KX701_0020 MF LM706U	586	586	1289	10.00	10/1	1800	1800	3500	69	5.0	3.0	52	55
375	72	77	46	4.7	P731_0040KX701_0020 MF LM503U	156	156	1031	8.000	8/1	1800	1800	3500	26	5.5	3.5	47	37
375	105	118	66	3.2	P731_0040KX701_0020 MF LM505U	245	245	1031	8.000	8/1	1800	1800	3500	32	5.5	3.5	47	42
375	147	163	93	2.3	P731_0040KX701_0020 MF LM704U	315	315	1031	8.000	8/1	1800	1800	3500	52	5.5	3.5	47	47
375	196	228	124	1.7	P731_0040KX701_0020 MF LM706U	469	469	1031	8.000	8/1	1800	1800	3500	70	5.5	3.5	47	55
429	92	103	86	4.2	P731_0070KX701_0010 MF LM505U	214	214	1588	7.000	7/1	1800	1600	3000	43	4.5	2.5	54	42
429	129	142	121	3.0	P731_0070KX701_0010 MF LM704U	275	275	1588	7.000	7/1	1800	1600	3000	63	4.5	2.5	54	47
429	172	199	161	2.2	P731_0070KX701_0010 MF LM706U	410	410	1588	7.000	7/1	1800	1600	3000	80	4.5	2.5	54	55
500	54	58	46	4.7	P731_0030KX701_0020 MF LM503U	117	117	773	6.000	6/1	1800	1800	3500	27	6.5	4.5	38	37
500	79	89	66	3.2	P731_0030KX701_0020 MF LM505U	184	184	773	6.000	6/1	1800	1800	3500	34	6.5	4.5	38	42
500	110	122	93	2.3	P731_0030KX701_0020 MF LM704U	236	236	773	6.000	6/1	1800	1800	3500	53	6.5	4.5	38	47
500	147	171	124	1.7	P731_0030KX701_0020 MF LM706U	352	352	773	6.000	6/1	1800	1800	3500	71	6.5	4.5	38	55
600	92	102	86	4.2	P731_0050KX701_0010 MF LM704U	197	197	1134	5.000	5/1	1800	1600	3000	64	5.0	3.0	52	47
600	123	142	115	3.1	P731_0050KX701_0010 MF LM706U	293	293	1134	5.000	5/1	1800	1600	3000	81	5.0	3.0	52	55
750	74	81	78	4.6	P731_0040KX701_0010 MF LM704U	157	157	907	4.000	4/1	1800	1600	3000	65	5.5	3.5	47	47
750	98	114	104	3.5	P731_0040KX701_0010 MF LM706U	234	234	907	4.000	4/1	1800	1600	3000	83	5.5	3.5	47	55
1000	55	61	81	4.4	P731_0030KX701_0010 MF LM704U	118	118	680	3.000	3/1	1800	1600	3000	70	6.5	4.5	38	47
1000	74	85	108	3.3	P731_0030KX701_0010 MF LM706U	176	176	680	3.000	3/1	1800	1600	3000	88	6.5	4.5	38	55
P732KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 810 Nm)																		
14	442	478	40	1.3	P732_0700KX501_0030 MF LM401U	762	799	1525	210.0	210/1	3000	3000	5000	6.5	4.0	2.0	59	27
15	421	455	71	1.0	P732_1000KX501_0020 MF LM401U	550	550	1100	200.0	200/1	2500	2500	4500	7.0	4.0	2.0	54	27
20	316	341	29	1.8	P732_0500KX501_0030 MF LM401U	633	633	1540	150.0	150/1	3000	3000	5000	6.5	4.0	2.0	62	27
20	619	632	58	0.91	P732_0500KX501_0030 MF LM402U	770	805	1540	150.0	150/1	3000	3000	5000	7.8	4.0	2.0	62	28
21	295	318	36	2.0	P732_0700KX501_0020 MF LM401U	591	591	1525	140.0	140/1	2500	2500	4500	7.0	4.0	2.0	59	27
21	578	590	71	1.0	P732_0700KX501_0020 MF LM402U	762	799	1525	140.0	140/1	2500	2500	4500	8.3	4.0	2.0	59	28
25	253	273	29	1.8	P732_0400KX501_0030 MF LM401U	506	506	1400	120.0	120/1	3000	3000	5000	6.5	4.5	2.5	62	27
25	495	505	57	0.92	P732_0400KX501_0030 MF LM402U	700	700	1400	120.0	120/1	3000	3000	5000	7.8	4.5	2.5	62	28
29	221	239	22	2.4	P732_0350KX501_0030 MF LM401U	443	443	1540	105.0	105/1	3000	3000	5000	6.5	4.5	2.5	62	27
29	433	442	42	1.2	P732_0350KX501_0030 MF LM402U	770	805	1540	105.0	105/1	3000	3000	5000	7.8	4.5	2.5	62	28

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2accHT}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,5,6	n_{1maxDB} EL3,4	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2red}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
P732KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 810 Nm)																		
29	595	608	58	0.91	P732_0350KX501_0030 MF LM403U	770	805	1540	105.0	105/1	3000	3000	5000	9.1	4.5	2.5	62	30
30	211	227	27	2.7	P732_0500KX501_0020 MF LM401U	422	422	1540	100.0	100/1	2500	2500	4500	7.0	4.0	2.0	62	27
30	413	421	52	1.4	P732_0500KX501_0020 MF LM402U	770	805	1540	100.0	100/1	2500	2500	4500	8.3	4.0	2.0	62	28
30	567	579	72	1.0	P732_0500KX501_0020 MF LM403U	770	805	1540	100.0	100/1	2500	2500	4500	9.6	4.0	2.0	62	30
36	177	191	17	3.0	P732_0280KX501_0030 MF LM401U	355	355	1400	84.00	84/1	3000	3000	5000	6.5	4.5	2.5	62	27
36	347	354	34	1.6	P732_0280KX501_0030 MF LM402U	700	700	1400	84.00	84/1	3000	3000	5000	7.8	4.5	2.5	62	28
36	476	487	47	1.1	P732_0280KX501_0030 MF LM403U	700	700	1400	84.00	84/1	3000	3000	5000	9.1	4.5	2.5	62	30
38	168	182	26	2.7	P732_0400KX501_0020 MF LM401U	338	338	1400	80.00	80/1	2500	2500	4500	7.0	4.5	2.5	62	27
38	330	337	52	1.4	P732_0400KX501_0020 MF LM402U	700	700	1400	80.00	80/1	2500	2500	4500	8.3	4.5	2.5	62	28
38	454	463	71	1.0	P732_0400KX501_0020 MF LM403U	700	700	1400	80.00	80/1	2500	2500	4500	9.6	4.5	2.5	62	30
40	158	171	17	3.2	P732_0250KX501_0030 MF LM401U	317	317	1610	75.00	75/1	3000	3000	5000	6.5	4.5	2.5	62	27
40	309	316	33	1.6	P732_0250KX501_0030 MF LM402U	681	681	1610	75.00	75/1	3000	3000	5000	7.9	4.5	2.5	62	28
40	425	434	45	1.2	P732_0250KX501_0030 MF LM403U	805	805	1610	75.00	75/1	3000	3000	5000	9.2	4.5	2.5	62	30
43	147	159	19	3.7	P732_0350KX501_0020 MF LM401U	295	295	1540	70.00	70/1	2500	2500	4500	7.0	4.5	2.5	62	27
43	289	295	38	1.9	P732_0350KX501_0020 MF LM402U	635	635	1540	70.00	70/1	2500	2500	4500	8.4	4.5	2.5	62	28
43	397	405	52	1.4	P732_0350KX501_0020 MF LM403U	770	805	1540	70.00	70/1	2500	2500	4500	9.7	4.5	2.5	62	30
43	621	660	82	0.87	P732_0350KX501_0020 MF LM503U	770	805	1540	70.00	70/1	2500	2500	4500	16	4.5	2.5	62	33
47	135	146	20	3.5	P732_0320KX501_0020 MF LM401U	270	270	1460	64.00	64/1	2500	2500	4500	7.2	4.5	2.5	56	27
47	264	269	40	1.8	P732_0320KX501_0020 MF LM402U	581	581	1460	64.00	64/1	2500	2500	4500	8.5	4.5	2.5	56	28
47	363	371	55	1.3	P732_0320KX501_0020 MF LM403U	730	730	1460	64.00	64/1	2500	2500	4500	9.8	4.5	2.5	56	30
47	568	603	86	0.83	P732_0320KX501_0020 MF LM503U	730	730	1460	64.00	64/1	2500	2500	4500	16	4.5	2.5	56	33
50	126	136	14	3.6	P732_0200KX501_0030 MF LM401U	253	253	1610	60.00	60/1	3000	3000	5000	6.6	4.5	2.5	60	27
50	248	253	28	1.9	P732_0200KX501_0030 MF LM402U	545	545	1610	60.00	60/1	3000	3000	5000	7.9	4.5	2.5	60	28
50	340	348	39	1.4	P732_0200KX501_0030 MF LM403U	720	720	1610	60.00	60/1	3000	3000	5000	9.2	4.5	2.5	60	30
50	532	565	61	0.86	P732_0200KX501_0030 MF LM503U	805	805	1610	60.00	60/1	3000	3000	5000	15	4.5	2.5	60	33
54	118	127	16	4.6	P732_0280KX501_0020 MF LM401U	236	236	1400	56.00	56/1	2500	2500	4500	7.0	4.5	2.5	62	27
54	231	236	31	2.3	P732_0280KX501_0020 MF LM402U	508	508	1400	56.00	56/1	2500	2500	4500	8.4	4.5	2.5	62	28
54	318	324	42	1.7	P732_0280KX501_0020 MF LM403U	672	672	1400	56.00	56/1	2500	2500	4500	9.7	4.5	2.5	62	30
54	497	528	66	1.1	P732_0280KX501_0020 MF LM503U	700	700	1400	56.00	56/1	2500	2500	4500	16	4.5	2.5	62	33
60	105	114	15	4.8	P732_0250KX501_0020 MF LM401U	211	211	1610	50.00	50/1	2500	2500	4500	7.1	4.5	2.5	62	27
60	206	211	29	2.4	P732_0250KX501_0020 MF LM402U	454	454	1610	50.00	50/1	2500	2500	4500	8.4	4.5	2.5	62	28
60	284	290	40	1.8	P732_0250KX501_0020 MF LM403U	600	600	1610	50.00	50/1	2500	2500	4500	9.7	4.5	2.5	62	30
60	444	471	63	1.1	P732_0250KX501_0020 MF LM503U	805	805	1610	50.00	50/1	2500	2500	4500	16	4.5	2.5	62	33
75	165	168	26	2.8	P732_0200KX501_0020 MF LM402U	363	363	1610	40.00	40/1	2500	2500	4500	8.5	4.5	2.5	60	28
75	227	232	35	2.0	P732_0200KX501_0020 MF LM403U	480	480	1610	40.00	40/1	2500	2500	4500	9.8	4.5	2.5	60	30
75	355	377	55	1.3	P732_0200KX501_0020 MF LM503U	762	762	1610	40.00	40/1	2500	2500	4500	16	4.5	2.5	60	33
75	513	579	80	0.90	P732_0200KX501_0020 MF LM505U	805	805	1610	40.00	40/1	2500	2500	4500	22	4.5	2.5	60	37
86	144	147	32	3.7	P732_0350KX501_0010 MF LM402U	318	318	1540	35.00	35/1	2500	2000	3500	11	4.5	2.5	62	28
86	198	203	44	2.7	P732_0350KX501_0010 MF LM403U	420	420	1540	35.00	35/1	2500	2000	3500	12	4.5	2.5	62	30
86	310	330	69	1.7	P732_0350KX501_0010 MF LM503U	667	667	1540	35.00	35/1	2500	2000	3500	18	4.5	2.5	62	33
86	449	507	100	1.2	P732_0350KX501_0010 MF LM505U	770	805	1540	35.00	35/1	2500	2000	3500	25	4.5	2.5	62	37
86	631	696	140	0.86	P732_0350KX501_0010 MF LM704U	770	805	1540	35.00	35/1	2500	2000	3500	44	4.5	2.5	62	43
94	132	135	21	3.4	P732_0160KX501_0020 MF LM402U	290	290	1400	32.00	32/1	2500	2500	4500	8.5	4.5	2.5	59	28
94	181	185	29	2.5	P732_0160KX501_0020 MF LM403U	384	384	1400	32.00	32/1	2500	2500	4500	9.8	4.5	2.5	59	30
94	284	302	45	1.6	P732_0160KX501_0020 MF LM503U	610	610	1400	32.00	32/1	2500	2500	4500	16	4.5	2.5	59	33
94	410	463	65	1.1	P732_0160KX501_0020 MF LM505U	700	700	1400	32.00	32/1	2500	2500	4500	22	4.5	2.5	59	37
P831KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1210 Nm)																		
100	272	289	51	3.1	P831_0100KX701_0030 MF LM503U	584	584	2577	30.00	30/1	2100	2100	4000	23	4.0	2.0	130	53
100	393	443	73	2.2	P831_0100KX701_0030 MF LM505U	919	919	2577	30.00	30/1	2100	2100	4000	29	4.0	2.0	130	57
100	552	609	103	1.5	P831_0100KX701_0030 MF LM704U	1180	1180	2577	30.00	30/1	2100	2100	4000	49	4.0	2.0	130	63
100	736	854	137	1.2	P831_0100KX701_0030 MF LM706U	1213	1213	2577	30.00	30/1	2100	2100	4000	67	4.0	2.0	130	70
125	217	231	51	3.1	P831_0080KX701_0030 MF LM503U	467	467	2062	24.00	24/1	2100	2100	4000	23	4.5	2.5	128	53
125	314	355	73	2.2	P831_0080KX701_0030 MF LM505U	735	735	2062	24.00	24/1	2100	2100	4000	30	4.5	2.5	128	57
125	442	488	103	1.5	P831_0080KX701_0030 MF LM704U	944	944	2062	24.00	24/1	2100	2100	4000	49	4.5	2.5	128	63
125	589	683	137	1.2	P831_0080KX701_0030 MF LM706U	970	970	2062	24.00	24/1	2100	2100	4000	67	4.5	2.5	128	70
143	190	202	51	3.1	P831_0070KX701_0030 MF LM503U	409	409	1804	21.00	21/1	2100	2100	4000	23	4.5	2.5	125	53
143	275	310	73	2.2	P831_0070KX701_0030 MF LM505U	643	643	1804	21.00	21/1	2100	2100	4000	30	4.5	2.5	125	57
143	387	427	103	1.5	P831_0070KX701_0030 MF LM704U	826	826	1804	21.00	21/1	2100	2100	4000	49	4.5	2.5	125	63
143	515	598	137	1.2	P831_0070KX701_0030 MF LM706U	849	849	1804	21.00	21/1	2100	2100	4000	67	4.5	2.5	125	70
150	181	192	46	4.7	P831_0100KX701_0020 MF LM503U	389	389	2577	20.00	20/1	1800	1800	3500	26	4.0	2.0	130	53
150	262	296	66	3.2	P831_0100KX701_0020 MF LM505U	613	613	2577	20.00	20/1	1800	1800	3500	32	4.0	2.0	130	57
150	368	406	93	2.3	P831_0100KX701_0020 MF LM704U	787	787	2577	20.00	20/1	1800	1800	3500	52	4.0	2.0	130	63
150	491	569	124	1.7	P831_0100KX701_0020 MF LM706U	1172	1172	2577	20.00	20/1	1800	1800	3500	69	4.0	2.0	130	70
188	145	154	46	4.7	P831_0080KX701_0020 MF LM503U	311	311	2062	16.00	16/1	1800	1800	3500	26	4.5	2.5	128	53

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2accHT}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,5,6	EL3,4	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2red}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
P831KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1210 Nm)																		
188	209	236	66	3.2	P831_0080KX701_0020 MF LM505U	490	490	2062	16.00	16/1	1800	1800	3500	33	4.5	2.5	128	57
188	295	325	93	2.3	P831_0080KX701_0020 MF LM704U	629	629	2062	16.00	16/1	1800	1800	3500	52	4.5	2.5	128	63
188	392	456	124	1.7	P831_0080KX701_0020 MF LM706U	938	938	2062	16.00	16/1	1800	1800	3500	70	4.5	2.5	128	70
200	136	144	51	3.1	P831_0050KX701_0030 MF LM503U	292	292	1289	15.00	15/1	2100	2100	4000	24	5.0	3.0	104	53
200	196	222	73	2.2	P831_0050KX701_0030 MF LM505U	460	460	1289	15.00	15/1	2100	2100	4000	30	5.0	3.0	104	57
200	276	305	103	1.5	P831_0050KX701_0030 MF LM704U	590	590	1289	15.00	15/1	2100	2100	4000	50	5.0	3.0	104	63
200	368	427	137	1.2	P831_0050KX701_0030 MF LM706U	606	606	1289	15.00	15/1	2100	2100	4000	67	5.0	3.0	104	70
214	127	135	46	4.7	P831_0070KX701_0020 MF LM503U	272	272	1804	14.00	14/1	1800	1800	3500	27	4.5	2.5	125	53
214	183	207	66	3.2	P831_0070KX701_0020 MF LM505U	429	429	1804	14.00	14/1	1800	1800	3500	33	4.5	2.5	125	57
214	258	284	93	2.3	P831_0070KX701_0020 MF LM704U	551	551	1804	14.00	14/1	1800	1800	3500	53	4.5	2.5	125	63
214	343	399	124	1.7	P831_0070KX701_0020 MF LM706U	821	821	1804	14.00	14/1	1800	1800	3500	70	4.5	2.5	125	70
250	109	115	51	3.1	P831_0040KX701_0030 MF LM503U	234	234	1031	12.00	12/1	2100	2100	4000	25	5.5	3.5	84	53
250	157	177	73	2.2	P831_0040KX701_0030 MF LM505U	368	368	1031	12.00	12/1	2100	2100	4000	31	5.5	3.5	84	57
250	221	244	103	1.5	P831_0040KX701_0030 MF LM704U	472	472	1031	12.00	12/1	2100	2100	4000	51	5.5	3.5	84	63
250	294	342	137	1.2	P831_0040KX701_0030 MF LM706U	485	485	1031	12.00	12/1	2100	2100	4000	68	5.5	3.5	84	70
300	184	203	98	3.7	P831_0100KX701_0010 MF LM704U	393	393	2268	10.00	10/1	1800	1600	3000	64	4.0	2.0	130	63
300	245	285	131	2.8	P831_0100KX701_0010 MF LM706U	586	586	2268	10.00	10/1	1800	1600	3000	82	4.0	2.0	130	70
375	147	163	78	4.6	P831_0080KX701_0010 MF LM704U	315	315	1814	8.000	8/1	1800	1600	3000	66	4.5	2.5	128	63
375	196	228	104	3.5	P831_0080KX701_0010 MF LM706U	469	469	1814	8.000	8/1	1800	1600	3000	83	4.5	2.5	128	70
429	129	142	78	4.6	P831_0070KX701_0010 MF LM704U	275	275	1588	7.000	7/1	1800	1600	3000	67	4.5	2.5	125	63
429	172	199	104	3.5	P831_0070KX701_0010 MF LM706U	410	410	1588	7.000	7/1	1800	1600	3000	84	4.5	2.5	125	70
500	54	58	46	4.7	P831_0030KX701_0020 MF LM503U	117	117	773	6.000	6/1	1800	1800	3500	36	6.5	4.5	59	53
500	79	89	66	3.2	P831_0030KX701_0020 MF LM505U	184	184	773	6.000	6/1	1800	1800	3500	42	6.5	4.5	59	57
500	110	122	93	2.3	P831_0030KX701_0020 MF LM704U	236	236	773	6.000	6/1	1800	1800	3500	62	6.5	4.5	59	63
500	147	171	124	1.7	P831_0030KX701_0020 MF LM706U	352	352	773	6.000	6/1	1800	1800	3500	79	6.5	4.5	59	70
600	92	102	78	4.6	P831_0050KX701_0010 MF LM704U	197	197	1134	5.000	5/1	1800	1600	3000	72	5.0	3.0	104	63
600	123	142	104	3.5	P831_0050KX701_0010 MF LM706U	293	293	1134	5.000	5/1	1800	1600	3000	89	5.0	3.0	104	70
750	74	81	78	4.6	P831_0040KX701_0010 MF LM704U	157	157	907	4.000	4/1	1800	1600	3000	80	5.5	3.5	84	63
750	98	114	104	3.5	P831_0040KX701_0010 MF LM706U	234	234	907	4.000	4/1	1800	1600	3000	97	5.5	3.5	84	70
1000	55	61	78	4.6	P831_0030KX701_0010 MF LM704U	118	118	680	3.000	3/1	1800	1600	3000	103	6.5	4.5	59	63
1000	74	85	104	3.5	P831_0030KX701_0010 MF LM706U	176	176	680	3.000	3/1	1800	1600	3000	120	6.5	4.5	59	70
P832KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1840 Nm)																		
20	1331	1413	148	1.1	P832_0500KX701_0030 MF LM503U	1840	2000	3230	150.0	150/1	2100	2100	4000	23	4.0	2.0	172	57
21	1242	1319	215	1.0	P832_0700KX701_0020 MF LM503U	1610	1610	3220	140.0	140/1	1800	1800	3500	25	4.0	2.0	163	57
25	1065	1131	153	1.0	P832_0400KX701_0030 MF LM503U	1600	1600	3200	120.0	120/1	2100	2100	4000	23	4.5	2.5	166	57
29	931	989	104	1.5	P832_0350KX701_0030 MF LM503U	1840	2000	3230	105.0	105/1	2100	2100	4000	23	4.5	2.5	173	57
29	1346	1520	150	1.1	P832_0350KX701_0030 MF LM505U	1840	2000	3230	105.0	105/1	2100	2100	4000	29	4.5	2.5	173	62
30	887	942	134	1.6	P832_0500KX701_0020 MF LM503U	1840	1906	3230	100.0	100/1	1800	1800	3500	25	4.0	2.0	172	57
30	1282	1448	194	1.1	P832_0500KX701_0020 MF LM505U	1840	2000	3230	100.0	100/1	1800	1800	3500	32	4.0	2.0	172	62
36	745	792	107	1.5	P832_0280KX701_0030 MF LM503U	1600	1600	3200	84.00	84/1	2100	2100	4000	23	4.5	2.5	168	57
36	1077	1216	155	1.0	P832_0280KX701_0030 MF LM505U	1600	1600	3200	84.00	84/1	2100	2100	4000	29	4.5	2.5	168	62
38	710	754	138	1.5	P832_0400KX701_0020 MF LM503U	1525	1525	3200	80.00	80/1	1800	1800	3500	25	4.5	2.5	166	57
38	1026	1158	200	1.1	P832_0400KX701_0020 MF LM505U	1600	1600	3200	80.00	80/1	1800	1800	3500	32	4.5	2.5	166	62
40	665	707	81	2.0	P832_0250KX701_0030 MF LM503U	1430	1430	3230	75.00	75/1	2100	2100	4000	23	4.5	2.5	172	57
40	961	1086	117	1.4	P832_0250KX701_0030 MF LM505U	1840	2000	3230	75.00	75/1	2100	2100	4000	29	4.5	2.5	172	62
40	1352	1492	164	0.96	P832_0250KX701_0030 MF LM704U	1840	2000	3230	75.00	75/1	2100	2100	4000	49	4.5	2.5	172	68
43	621	660	94	2.3	P832_0350KX701_0020 MF LM503U	1334	1334	3230	70.00	70/1	1800	1800	3500	25	4.5	2.5	173	57
43	897	1013	136	1.6	P832_0350KX701_0020 MF LM505U	1840	2000	3230	70.00	70/1	1800	1800	3500	32	4.5	2.5	173	62
43	1262	1393	191	1.1	P832_0350KX701_0020 MF LM704U	1840	2000	3230	70.00	70/1	1800	1800	3500	51	4.5	2.5	173	68
43	1681	1952	254	0.84	P832_0350KX701_0020 MF LM706U	1840	2000	3230	70.00	70/1	1800	1800	3500	69	4.5	2.5	173	75
47	568	603	104	2.1	P832_0320KX701_0020 MF LM503U	1220	1220	3049	64.00	64/1	1800	1800	3500	26	4.5	2.5	157	57
47	820	926	150	1.4	P832_0320KX701_0020 MF LM505U	1525	1595	3049	64.00	64/1	1800	1800	3500	32	4.5	2.5	157	62
47	1154	1273	211	1.0	P832_0320KX701_0020 MF LM704U	1525	1595	3049	64.00	64/1	1800	1800	3500	52	4.5	2.5	157	68
50	532	565	67	2.3	P832_0200KX701_0030 MF LM503U	1144	1144	3230	60.00	60/1	2100	2100	4000	23	4.5	2.5	169	57
50	769	869	97	1.6	P832_0200KX701_0030 MF LM505U	1801	1801	3230	60.00	60/1	2100	2100	4000	30	4.5	2.5	169	62
50	1082	1194	137	1.2	P832_0200KX701_0030 MF LM704U	1840	2000	3230	60.00	60/1	2100	2100	4000	49	4.5	2.5	169	68
50	1441	1673	182	0.87	P832_0200KX701_0030 MF LM706U	1840	2000	3230	60.00	60/1	2100	2100	4000	67	4.5	2.5	169	75
54	497	528	97	2.2	P832_0280KX701_0020 MF LM503U	1067	1067	3200	56.00	56/1	1800	1800	3500	25	4.5	2.5	168	57
54	718	811	140	1.5	P832_0280KX701_0020 MF LM505U	1600	1600	3200	56.00	56/1	1800	1800	3500	32	4.5	2.5	168	62
54	1010	1114	197	1.1	P832_0280KX701_0020 MF LM704U	1600	1600	3200	56.00	56/1	1800	1800	3500	52	4.5	2.5	168	68
54	1345	1562	262	0.82	P832_0280KX701_0020 MF LM706U	1600	1600	3200	56.00	56/1	1800	1800	3500	69	4.5	2.5	168	75
60	444	471	73	2.9	P832_0250KX701_0020 MF LM503U	953	953	3230	50.00	50/1	1800	1800	3500	26	4.5	2.5	172	57
60	641	724	106	2.0	P832_0250KX701_0020 MF LM505U	1500	1500	3230	50.00	50/1	1800	1800	3500	32	4.5	2.5	172	62
60	902	995	148	1.4	P832_0250KX701_0020 MF LM704U	1840	1926	3230	50.00	50/1	1800	1800	3500	52	4.5	2.5	172	68

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2accHT}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2,5,6	n_{1maxDB} EL3,4	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2red}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[Nm/arcmin]	[kg]
P832KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1840 Nm)																		
60	1201	1394	198	1.1	P832_0250KX701_0020 MF LM706U	1840	2000	3230	50.00	50/1	1800	1800	3500	69	4.5	2.5	172	75
75	355	377	61	3.5	P832_0200KX701_0020 MF LM503U	762	762	3230	40.00	40/1	1800	1800	3500	26	4.5	2.5	169	57
75	513	579	88	2.4	P832_0200KX701_0020 MF LM505U	1200	1200	3230	40.00	40/1	1800	1800	3500	32	4.5	2.5	169	62
75	721	796	124	1.7	P832_0200KX701_0020 MF LM704U	1541	1541	3230	40.00	40/1	1800	1800	3500	52	4.5	2.5	169	68
75	961	1115	165	1.3	P832_0200KX701_0020 MF LM706U	1840	2000	3230	40.00	40/1	1800	1800	3500	70	4.5	2.5	169	75
86	310	330	89	4.1	P832_0350KX701_0010 MF LM503U	667	667	3230	35.00	35/1	1800	1600	3000	37	4.5	2.5	173	57
86	449	507	128	2.8	P832_0350KX701_0010 MF LM505U	1050	1050	3230	35.00	35/1	1800	1600	3000	43	4.5	2.5	173	62
86	631	696	180	2.0	P832_0350KX701_0010 MF LM704U	1348	1348	3230	35.00	35/1	1800	1600	3000	63	4.5	2.5	173	68
86	841	976	240	1.5	P832_0350KX701_0010 MF LM706U	1840	2000	3230	35.00	35/1	1800	1600	3000	80	4.5	2.5	173	75
94	284	302	55	3.9	P832_0160KX701_0020 MF LM503U	610	610	3200	32.00	32/1	1800	1800	3500	26	4.5	2.5	163	57
94	410	463	80	2.7	P832_0160KX701_0020 MF LM505U	960	960	3200	32.00	32/1	1800	1800	3500	33	4.5	2.5	163	62
94	577	637	112	1.9	P832_0160KX701_0020 MF LM704U	1233	1233	3200	32.00	32/1	1800	1800	3500	52	4.5	2.5	163	68
94	769	892	150	1.4	P832_0160KX701_0020 MF LM706U	1600	1600	3200	32.00	32/1	1800	1800	3500	70	4.5	2.5	163	75
P932KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 3300 Nm)																		
14	1863	1979	123	1.3	P932_0700KX701_0030 MF LM503U	3156	–	6312	210.0	210/1	2100	2100	4000	23	4.0	–	369	82
14	2692	3040	178	0.89	P932_0700KX701_0030 MF LM505U	3156	–	6312	210.0	210/1	2100	2100	4000	29	4.0	–	369	87
15	1774	1885	224	0.95	P932_1000KX701_0020 MF LM503U	2200	–	4400	200.0	200/1	1800	1800	3500	26	4.0	–	320	82
20	1331	1413	92	1.7	P932_0500KX701_0030 MF LM503U	2859	–	6400	150.0	150/1	2100	2100	4000	23	4.0	–	393	82
20	1923	2171	132	1.2	P932_0500KX701_0030 MF LM505U	3200	–	6400	150.0	150/1	2100	2100	4000	29	4.0	–	393	87
20	2705	2984	186	0.85	P932_0500KX701_0030 MF LM704U	3200	–	6400	150.0	150/1	2100	2100	4000	49	4.0	–	393	93
21	1242	1319	111	1.9	P932_0700KX701_0020 MF LM503U	2669	–	6312	140.0	140/1	1800	1800	3500	26	4.0	–	369	82
21	1795	2027	161	1.3	P932_0700KX701_0020 MF LM505U	3156	–	6312	140.0	140/1	1800	1800	3500	32	4.0	–	369	87
21	2524	2785	226	0.95	P932_0700KX701_0020 MF LM704U	3156	–	6312	140.0	140/1	1800	1800	3500	52	4.0	–	369	93
25	1065	1131	84	1.9	P932_0400KX701_0030 MF LM503U	2287	–	6000	120.0	120/1	2100	2100	4000	23	4.5	–	384	82
25	1538	1737	121	1.3	P932_0400KX701_0030 MF LM505U	3000	–	6000	120.0	120/1	2100	2100	4000	30	4.5	–	384	87
25	2164	2387	171	0.92	P932_0400KX701_0030 MF LM704U	3000	–	6000	120.0	120/1	2100	2100	4000	49	4.5	–	384	93
29	931	989	62	2.6	P932_0350KX701_0030 MF LM503U	2001	–	6600	105.0	105/1	2100	2100	4000	23	4.5	–	391	82
29	1346	1520	89	1.8	P932_0350KX701_0030 MF LM505U	3151	–	6600	105.0	105/1	2100	2100	4000	30	4.5	–	391	87
29	1893	2089	126	1.3	P932_0350KX701_0030 MF LM704U	3300	–	6600	105.0	105/1	2100	2100	4000	49	4.5	–	391	93
29	2522	2928	168	0.94	P932_0350KX701_0030 MF LM706U	3300	–	6600	105.0	105/1	2100	2100	4000	67	4.5	–	391	100
30	887	942	83	2.6	P932_0500KX701_0020 MF LM503U	1906	–	6400	100.0	100/1	1800	1800	3500	26	4.0	–	393	82
30	1282	1448	120	1.8	P932_0500KX701_0020 MF LM505U	3001	–	6400	100.0	100/1	1800	1800	3500	32	4.0	–	393	87
30	1803	1989	168	1.3	P932_0500KX701_0020 MF LM704U	3200	–	6400	100.0	100/1	1800	1800	3500	52	4.0	–	393	93
30	2402	2789	224	0.96	P932_0500KX701_0020 MF LM706U	3200	–	6400	100.0	100/1	1800	1800	3500	69	4.0	–	393	100
36	745	792	52	3.1	P932_0280KX701_0030 MF LM503U	1601	–	6000	84.00	84/1	2100	2100	4000	23	4.5	–	381	82
36	1077	1216	75	2.1	P932_0280KX701_0030 MF LM505U	2521	–	6000	84.00	84/1	2100	2100	4000	30	4.5	–	381	87
36	1515	1671	105	1.5	P932_0280KX701_0030 MF LM704U	3000	–	6000	84.00	84/1	2100	2100	4000	50	4.5	–	381	93
36	2018	2342	140	1.1	P932_0280KX701_0030 MF LM706U	3000	–	6000	84.00	84/1	2100	2100	4000	67	4.5	–	381	100
38	710	754	76	2.8	P932_0400KX701_0020 MF LM503U	1525	–	6000	80.00	80/1	1800	1800	3500	26	4.5	–	384	82
38	1026	1158	110	2.0	P932_0400KX701_0020 MF LM505U	2401	–	6000	80.00	80/1	1800	1800	3500	32	4.5	–	384	87
38	1443	1592	154	1.4	P932_0400KX701_0020 MF LM704U	3000	–	6000	80.00	80/1	1800	1800	3500	52	4.5	–	384	93
38	1922	2231	206	1.0	P932_0400KX701_0020 MF LM706U	3000	–	6000	80.00	80/1	1800	1800	3500	69	4.5	–	384	100
40	665	707	51	3.1	P932_0250KX701_0030 MF LM503U	1430	–	6579	75.00	75/1	2100	2100	4000	24	4.5	–	381	82
40	961	1086	73	2.2	P932_0250KX701_0030 MF LM505U	2251	–	6579	75.00	75/1	2100	2100	4000	30	4.5	–	381	87
40	1352	1492	103	1.5	P932_0250KX701_0030 MF LM704U	2889	–	6579	75.00	75/1	2100	2100	4000	50	4.5	–	381	93
40	1802	2091	137	1.2	P932_0250KX701_0030 MF LM706U	2969	–	6579	75.00	75/1	2100	2100	4000	67	4.5	–	381	100
43	621	660	56	3.8	P932_0350KX701_0020 MF LM503U	1334	–	6600	70.00	70/1	1800	1800	3500	26	4.5	–	391	82
43	897	1013	81	2.6	P932_0350KX701_0020 MF LM505U	2101	–	6600	70.00	70/1	1800	1800	3500	33	4.5	–	391	87
43	1262	1393	114	1.9	P932_0350KX701_0020 MF LM704U	2697	–	6600	70.00	70/1	1800	1800	3500	53	4.5	–	391	93
43	1681	1952	151	1.4	P932_0350KX701_0020 MF LM706U	3300	–	6600	70.00	70/1	1800	1800	3500	70	4.5	–	391	100
50	532	565	51	3.1	P932_0200KX701_0030 MF LM503U	1144	–	5263	60.00	60/1	2100	2100	4000	25	4.5	–	368	82
50	769	869	73	2.2	P932_0200KX701_0030 MF LM505U	1801	–	5263	60.00	60/1	2100	2100	4000	31	4.5	–	368	87
50	1082	1194	103	1.5	P932_0200KX701_0030 MF LM704U	2311	–	5263	60.00	60/1	2100	2100	4000	51	4.5	–	368	93
50	1441	1673	137	1.2	P932_0200KX701_0030 MF LM706U	2375	–	5263	60.00	60/1	2100	2100	4000	68	4.5	–	368	100
54	497	528	47	4.6	P932_0280KX701_0020 MF LM503U	1067	–	6000	56.00	56/1	1800	1800	3500	27	4.5	–	381	82
54	718	811	67	3.2	P932_0280KX701_0020 MF LM505U	1681	–	6000	56.00	56/1	1800	1800	3500	33	4.5	–	381	87
54	1010	1114	95	2.3	P932_0280KX701_0020 MF LM704U	2157	–	6000	56.00	56/1	1800	1800	3500	53	4.5	–	381	93
54	1345	1562	126	1.7	P932_0280KX701_0020 MF LM706U	3000	–	6000	56.00	56/1	1800	1800	3500	70	4.5	–	381	100
60	444	471	46	4.7	P932_0250KX701_0020 MF LM503U	953	–	6579	50.00	50/1	1800	1800	3500	28	4.5	–	381	82
60	641	724	66	3.2	P932_0250KX701_0020 MF LM505U	1500	–	6579	50.00	50/1	1800	1800	3500	34	4.5	–	381	87
60	902	995	93	2.3	P932_0250KX701_0020 MF LM704U	1926	–	6579	50.00	50/1	1800	1800	3500	54	4.5	–	381	93
60	1201	1394	124	1.7	P932_0250KX701_0020 MF LM706U	2870	–	6579	50.00	50/1	1800	1800	3500	71	4.5	–	381	100
75	355	377	46	4.7	P932_0200KX701_0020 MF LM503U	762	–	5263	40.00	40/1	1800	1800	3500	30	4.5	–	368	82
75	513	579	66	3.2	P932_0200KX701_0020 MF LM505U	1200	–	5263	40.00	40/1	1800	1800	3500	36	4.5	–	368	87

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2accHT} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2,5,6 [rpm]	n_{1maxDB} EL3,4 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2red}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
P932KX (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 3300 Nm)																		
75	721	796	93	2.3	P932_0200KX701_0020 MF LM704U	1541	–	5263	40.00	40/1	1800	1800	3500	56	4.5	–	368	93
75	961	1115	124	1.7	P932_0200KX701_0020 MF LM706U	2296	–	5263	40.00	40/1	1800	1800	3500	73	4.5	–	368	100
86	631	696	96	3.8	P932_0350KX701_0010 MF LM704U	1348	–	6600	35.00	35/1	1800	1600	3000	67	4.5	–	391	93
86	841	976	127	2.8	P932_0350KX701_0010 MF LM706U	2009	–	6600	35.00	35/1	1800	1600	3000	84	4.5	–	391	100
94	284	302	46	4.7	P932_0160KX701_0020 MF LM503U	610	–	4211	32.00	32/1	1800	1800	3500	30	4.5	–	348	82
94	410	463	66	3.2	P932_0160KX701_0020 MF LM505U	960	–	4211	32.00	32/1	1800	1800	3500	36	4.5	–	348	87
94	577	637	93	2.3	P932_0160KX701_0020 MF LM704U	1233	–	4211	32.00	32/1	1800	1800	3500	56	4.5	–	348	93
94	769	892	124	1.7	P932_0160KX701_0020 MF LM706U	1837	–	4211	32.00	32/1	1800	1800	3500	73	4.5	–	348	100
107	505	557	80	4.5	P932_0280KX701_0010 MF LM704U	1079	–	6000	28.00	28/1	1800	1600	3000	67	4.5	–	381	93
107	673	781	106	3.4	P932_0280KX701_0010 MF LM706U	1607	–	6000	28.00	28/1	1800	1600	3000	85	4.5	–	381	100
120	451	497	78	4.6	P932_0250KX701_0010 MF LM704U	963	–	5789	25.00	25/1	1800	1600	3000	72	4.5	–	381	93
120	601	697	104	3.5	P932_0250KX701_0010 MF LM706U	1435	–	5789	25.00	25/1	1800	1600	3000	89	4.5	–	381	100
150	361	398	78	4.6	P932_0200KX701_0010 MF LM704U	770	–	4632	20.00	20/1	1800	1600	3000	80	4.5	–	368	93
150	480	558	104	3.5	P932_0200KX701_0010 MF LM706U	1148	–	4632	20.00	20/1	1800	1600	3000	97	4.5	–	368	100
188	289	318	78	4.6	P932_0160KX701_0010 MF LM704U	616	–	3705	16.00	16/1	1800	1600	3000	81	4.5	–	348	93
188	384	446	104	3.5	P932_0160KX701_0010 MF LM706U	919	–	3705	16.00	16/1	1800	1600	3000	98	4.5	–	348	100

11.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gearbox dimensions, motor dimensions and geared motor dimensions.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

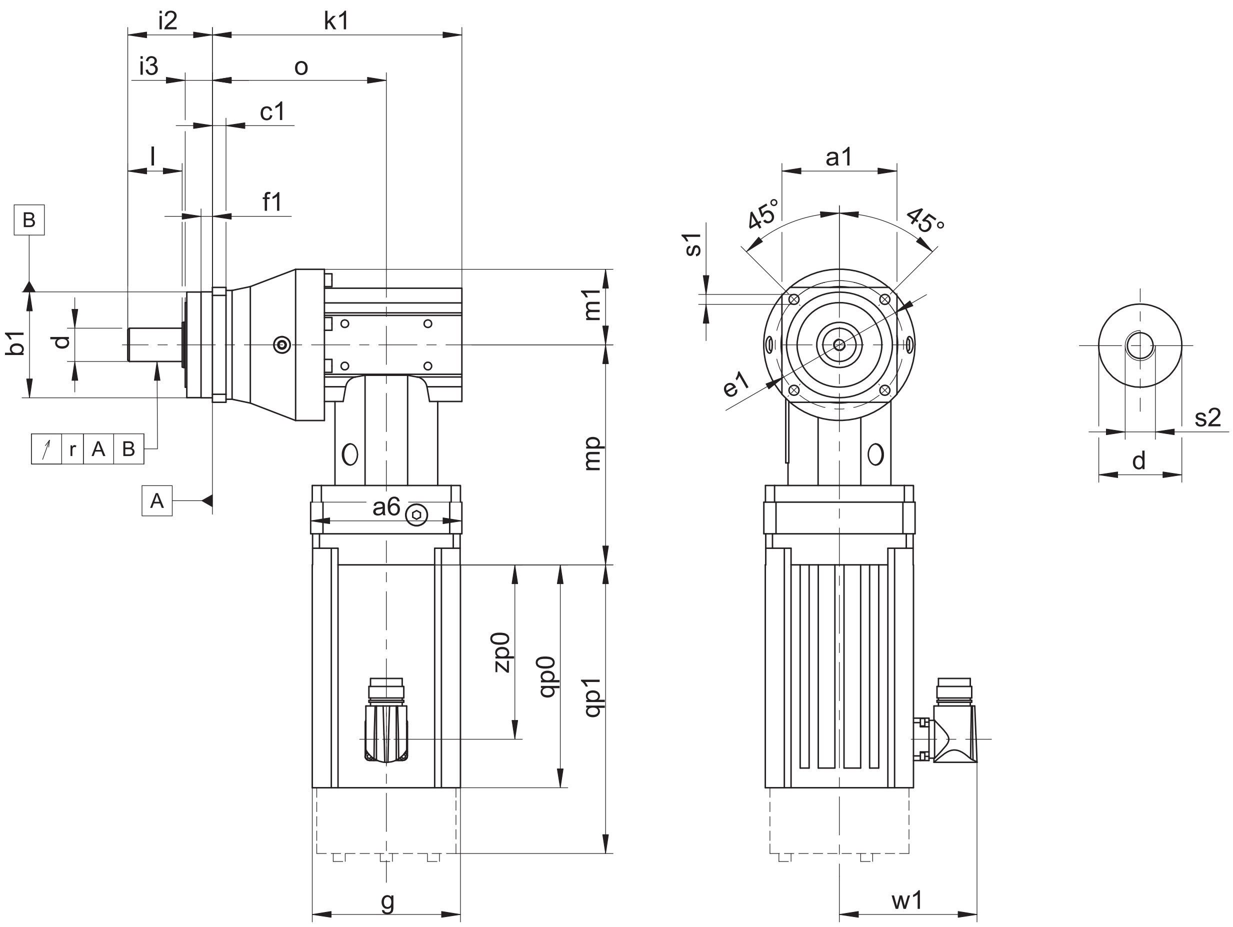
Tolerances

Solid shaft	Tolerance
Fit	ISO k6
Feather keys	DIN 6885-1, high form A
Balancing	With half feather key

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

11.3.1 G shaft design (solid shaft without feather key)



qp0	Applies to motors without brake.
qp1	Applies to motors with brake.
–	The radial runout specification applies only to the reinforced bearing D.

Dimensions of gearboxes

Type	□a1	∅b1	c1	∅d	∅e1	f1	i2	i3	k1	l	m1	o	r	∅s1	s2
P231_KX301_	55	50_{h6}	6	12_{k6}	63	7.0	36	12	124.0	22	31.0	84.0	–	5.5	M4
P331_KX301_	72	60_{h6}	7	16_{k6}	75	7.5	48	18	131.0	28	36.0	91.0	0.025	5.5	M5
P431_KX401_	76	70_{h6}	9	22_{k6}	85	7.5	56	18	165.0	36	49.0	115.0	0.025	6.6	M8
P432_KX301_	76	70_{h6}	9	22_{k6}	85	7.5	56	18	180.0	36	50.0	140.0	0.025	6.6	M8
P531_KX501_	101	90_{h6}	10	32_{k6}	120	15.0	88	28	187.5	58	57.5	128.5	0.030	9.0	M12
P532_KX401_	101	90_{h6}	10	32_{k6}	120	15.0	88	28	207.0	58	60.0	157.0	0.030	9.0	M12
P731_KX701_	144	130_{h6}	15	40_{k6}	165	3.5	112	27	232.5	82	75.0	158.5	0.035	11.0	M16
P732_KX501_	144	130_{h6}	15	40_{k6}	165	3.5	112	27	255.5	82	75.0	196.5	0.035	11.0	M16
P831_KX701_	190	160_{h6}	15	55_{k6}	215	10.0	112	27	267.0	82	102.0	193.0	0.035	13.5	M20
P832_KX701_	190	160_{h6}	15	55_{k6}	215	10.0	112	27	324.5	82	102.0	250.5	0.035	13.5	M20
P932_KX701_	212	180_{h6}	17	75_{k6}	250	10.0	143	34	388.0	105	115.0	314.0	0.040	17.5	M20

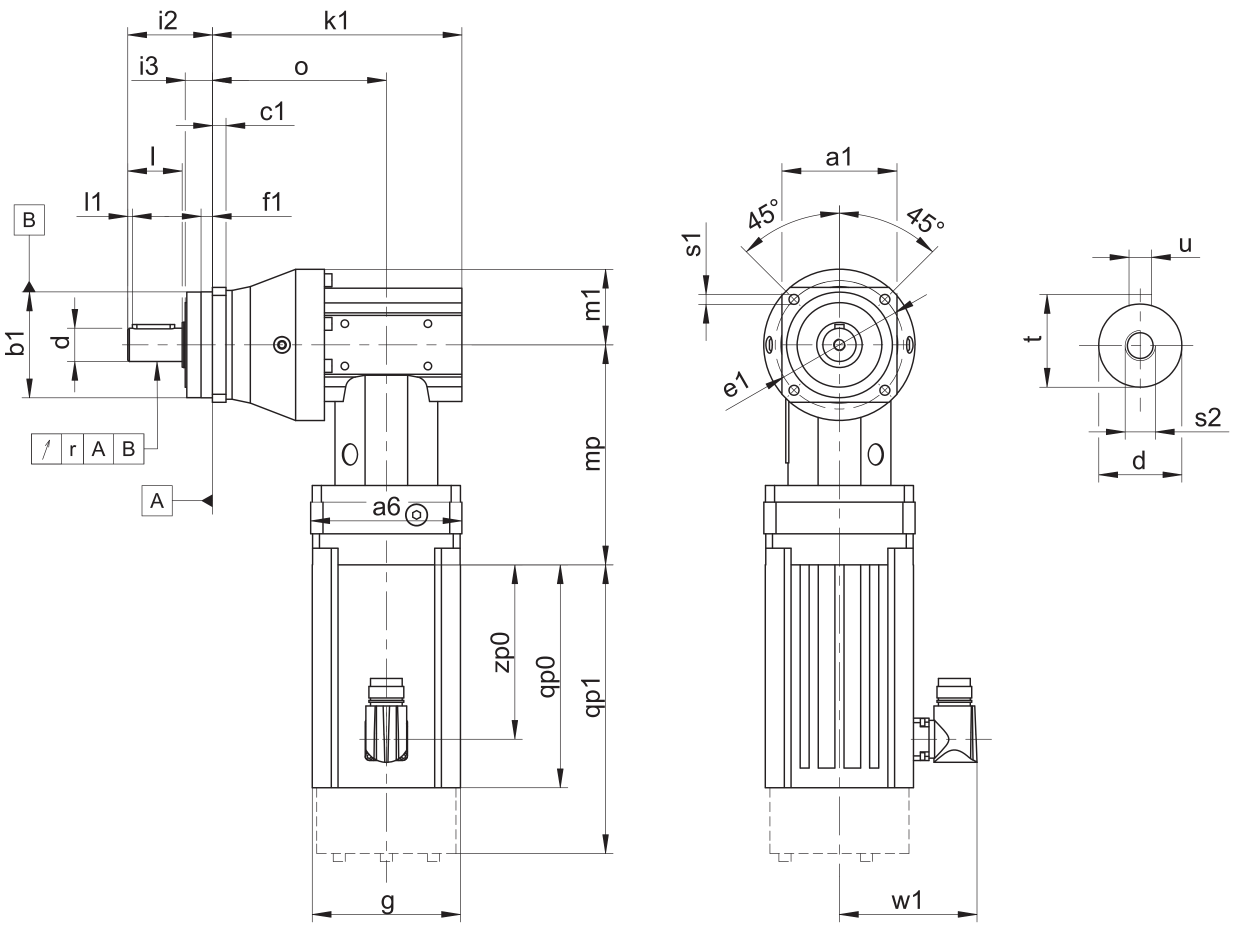
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152.0	91	76.5
LM402U	98	147.5	191.0	91	115.5
LM403U	98	178.5	222.0	91	146.5
LM503U	115	186.5	234.5	100	156.0
LM505U	115	256.5	304.5	100	226.0
LM704U	145	236.5	295.5	115	204.0
LM706U	145	306.5	365.5	115	274.0

Dimensions of geared motors

Type	LM4		LM5		LM7	
	□a6	mp	□a6	mp	□a6	mp
P231_KX301_	100	134.0	–	–	–	–
P331_KX301_	100	134.0	–	–	–	–
P431_KX401_	100	145.5	115	150.0	140	153.0
P432_KX301_	100	134.0	–	–	–	–
P531_KX501_	120	176.5	120	172.0	140	183.0
P532_KX401_	100	145.5	115	150.0	–	–
P731_KX701_	–	–	150	214.5	150	217.5
P732_KX501_	120	176.5	120	172.0	140	183.0
P831_KX701_	–	–	150	214.5	150	217.5
P832_KX701_	–	–	150	214.5	150	217.5
P932_KX701_	–	–	150	214.5	150	217.5

11.3.2 P shaft design (solid shaft with feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

– The radial runout specification applies only to the reinforced bearing D.

Dimensions of gearboxes

Type	□a1	∅b1	c1	∅d	∅e1	f1	i2	i3	k1	l	l1	m1	o	r	∅s1	s2	t	u
P231_KX301_	55	50_{h6}	6	12_{k6}	63	7.0	36	12	124.0	22	2	31.0	84.0	–	5.5	M4	13.5	A4×4×18
P331_KX301_	72	60_{h6}	7	16_{k6}	75	7.5	48	18	131.0	28	2	36.0	91.0	0.025	5.5	M5	18.0	A5×5×22
P431_KX401_	76	70_{h6}	9	22_{k6}	85	7.5	56	18	165.0	36	3	49.0	115.0	0.025	6.6	M8	24.5	A6×6×28
P432_KX301_	76	70_{h6}	9	22_{k6}	85	7.5	56	18	180.0	36	3	50.0	140.0	0.025	6.6	M8	24.5	A6×6×28
P531_KX501_	101	90_{h6}	10	32_{k6}	120	15.0	88	28	187.5	58	3	57.5	128.5	0.030	9.0	M12	35.0	A10×8×50
P532_KX401_	101	90_{h6}	10	32_{k6}	120	15.0	88	28	207.0	58	3	60.0	157.0	0.030	9.0	M12	35.0	A10×8×50
P731_KX701_	144	130_{h6}	15	40_{k6}	165	3.5	112	27	232.5	82	4	75.0	158.5	0.035	11.0	M16	43.0	A12×8×70
P732_KX501_	144	130_{h6}	15	40_{k6}	165	3.5	112	27	255.5	82	4	75.0	196.5	0.035	11.0	M16	43.0	A12×8×70
P831_KX701_	190	160_{h6}	15	55_{k6}	215	10.0	112	27	267.0	82	6	102.0	193.0	0.035	13.5	M20	59.0	A16×10×70
P832_KX701_	190	160_{h6}	15	55_{k6}	215	10.0	112	27	324.5	82	6	102.0	250.5	0.035	13.5	M20	59.0	A16×10×70
P932_KX701_	212	180_{h6}	17	75_{k6}	250	10.0	143	34	388.0	105	7	115.0	314.0	0.040	17.5	M20	79.5	A20×12×90

Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152.0	91	76.5
LM402U	98	147.5	191.0	91	115.5
LM403U	98	178.5	222.0	91	146.5
LM503U	115	186.5	234.5	100	156.0
LM505U	115	256.5	304.5	100	226.0
LM704U	145	236.5	295.5	115	204.0
LM706U	145	306.5	365.5	115	274.0

Dimensions of geared motors

Type	LM4		LM5		LM7	
	□a6	mp	□a6	mp	□a6	mp
P231_KX301_	100	134.0	–	–	–	–
P331_KX301_	100	134.0	–	–	–	–
P431_KX401_	100	145.5	115	150.0	140	153.0
P432_KX301_	100	134.0	–	–	–	–
P531_KX501_	120	176.5	120	172.0	140	183.0
P532_KX401_	100	145.5	115	150.0	–	–
P731_KX701_	–	–	150	214.5	150	217.5
P732_KX501_	120	176.5	120	172.0	140	183.0
P831_KX701_	–	–	150	214.5	150	217.5
P832_KX701_	–	–	150	214.5	150	217.5
P932_KX701_	–	–	150	214.5	150	217.5

11.4 Type designation

In this chapter, you can find an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

P	7	3	1	S	G	S	S	0050	KX701VF	0030	MF	LM704U

Explanation

Code	Designation	Design
P	Type	Planetary gearbox
7	Size	7 (example)
3	Generation	Generation 3
1	Stages	Single-stage
2		Two-stage
S	Housing	Standard
G	Shaft	Solid shaft without feather key
P		Solid shaft with feather key
S	Bearing	Standard bearing
D		Axially reinforced bearing (P3 – P9)
Z		Radially reinforced bearing (P3 – P9)[1]
S	Backlash	Standard
R		Reduced
0050	Transmission ratio of output (i x 10)	i = 5 (example)
KX701 VF	Input	KX7 right-angle geared motor (example)
0030	Transmission ratio of input (i x 10)	i = 3 (example)
MF	Attachment to motor	MF motor adapter
LM704U	Motor	LM Lean motor

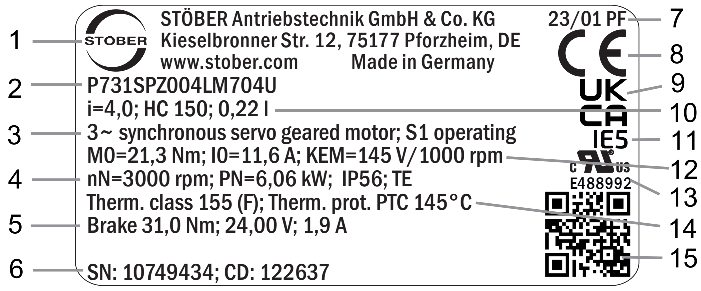
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▷ 2]
- The mounting position, see the chapter [▷ 11.5.3]
- Radial shaft seal rings at the output made of NBR or FKM, see the chapter [▷ 11.6.3]
- The position of the plug connector, see the chapter [▷ 11.5.5]
- For reverse operation of the output shaft from ± 20° to ± 90° and horizontal installation, see the chapter [▷ 11.6.4]

[1] Not for reduced-backlash option.

11.4.1 Nameplate

In the following figure, the nameplate of a P731_LM704 Lean geared motor is explained as an example.

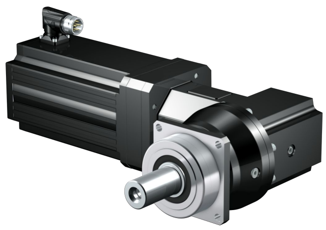


Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004LM704U	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=3000 rpm PN=6.06 kW IP56 TE	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004
5	Brake 31.0 Nm 24.00 V 1.9 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749434 CD: 122637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	IE5	IEC energy efficiency
12	M0=21.3 Nm I0=11.6 A KEM=145 V/1000 rpm	Stall torque Stall current Voltage constant
13	cURus E488992	cURus test symbol, registered under UL number E488992
14	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
15	QR code	Link to product information

11.5 Product description

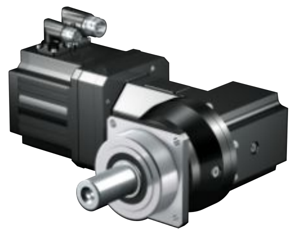
11.5.1 Input options

LM Lean motor



Catalog ID 443016_en

EZ synchronous servo motor



Catalog ID 442437_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

11.5.2 Installation conditions

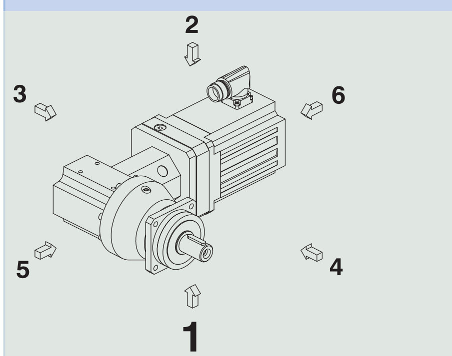
The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 12.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

11.5.3 Mounting positions

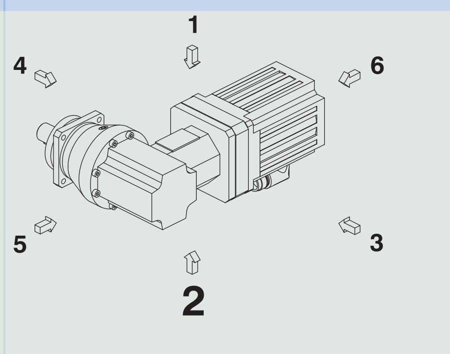
The following table shows the standard mounting positions.

The numbers identify the gearbox sides. The mounting position is defined by the gearbox side facing downwards.

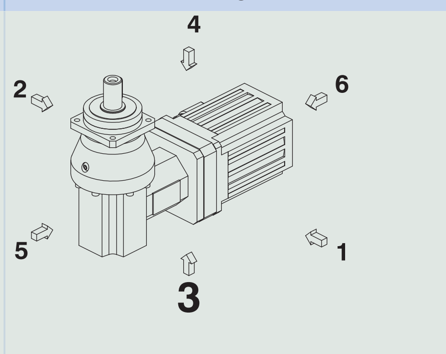
EL1



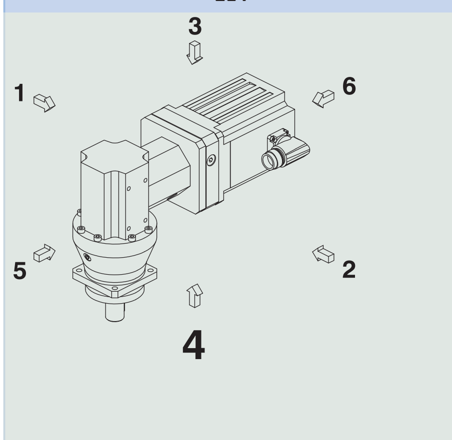
EL2



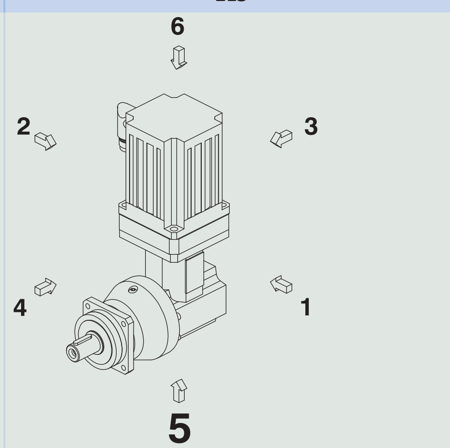
EL3



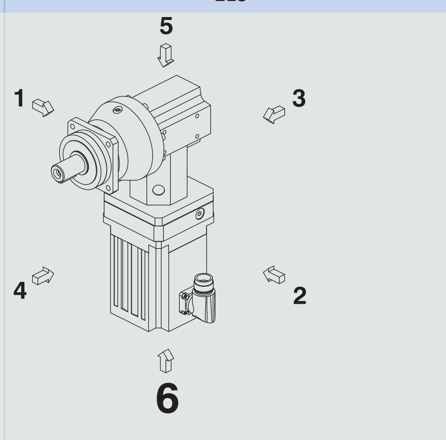
EL4



EL5



EL6



Since the lubricant filling volume of the gearbox depends on the mounting position, the mounting position must be specified when ordering.

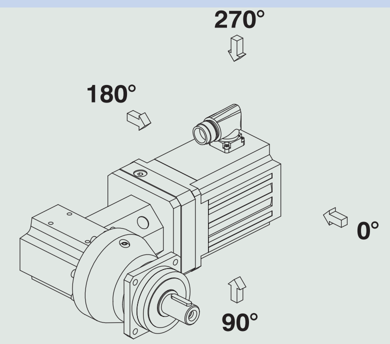
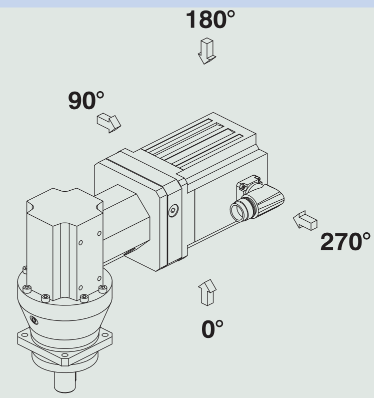
11.5.4 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gearboxes depend on the mounting position.

Only install the gearboxes in the intended mounting position! Reposition the gearboxes only after consulting STOBER. Otherwise, STOBER assumes no liability for the gearboxes.

You will receive lubricants for use in the food industry upon request.

11.5.5 Position of the plug connector

Mounting position EL1	Mounting position EL4
Plug connector in 270° position (standard)	Plug connector in 270° position (standard)
	

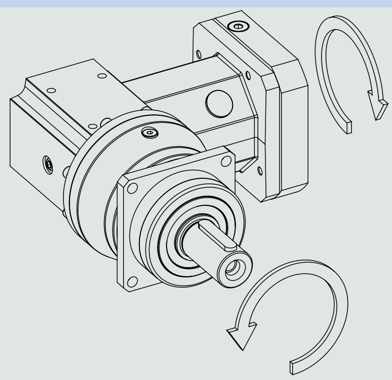
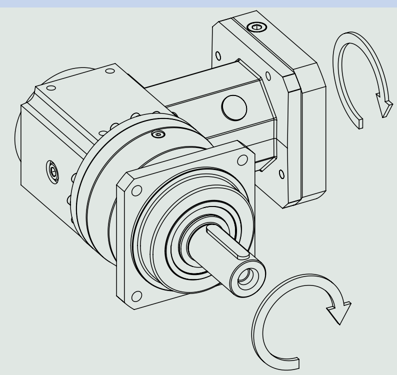
Indicate variations for your geared motor in the order.

Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

11.5.6 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 90 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} two-stage	96%
η_{get} three-stage	94%
Protection class:[2]	
Gearbox	IP65
Motor	IP56, optionally IP66

11.5.7 Direction of rotation

P_KX3 – P_KX5	P_KX7
	

The figures show mounting position EL1.

[2] Observe the protection class of all the components.

11.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

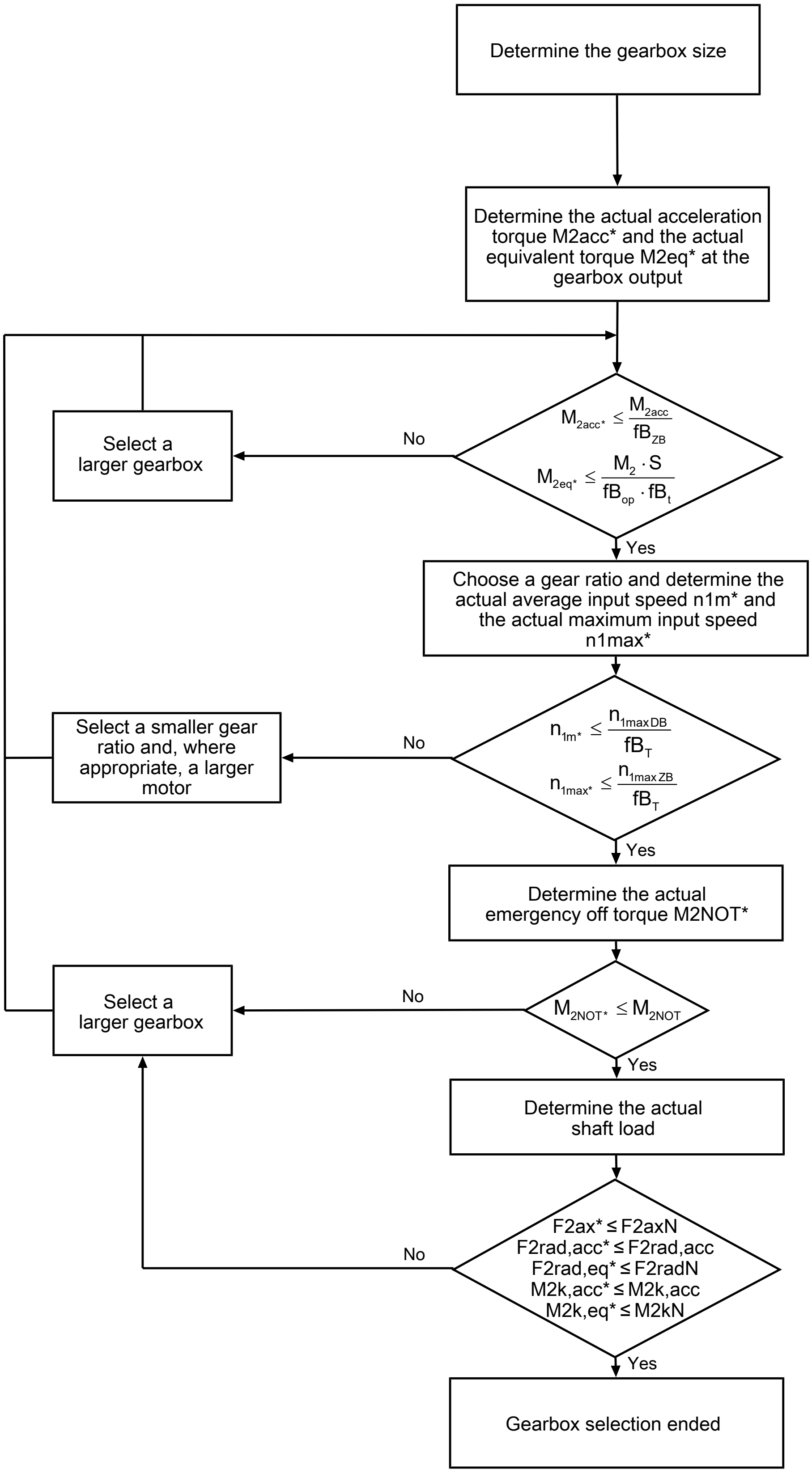
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in the Chapter [▶ 15.1].

The formula symbols for values actually present in the application are marked with *.

11.6.1 Drive selection

Drive selection for gearboxes

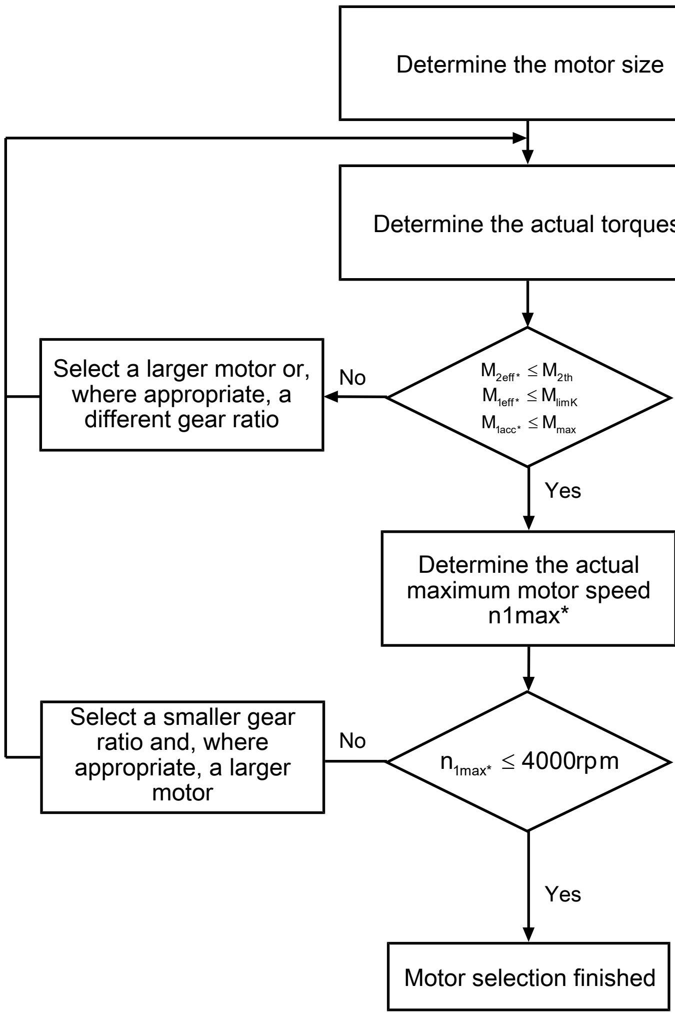


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc} (M_{2accHT} for reduced backlash), M_{2NOT}, M_2 and S.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

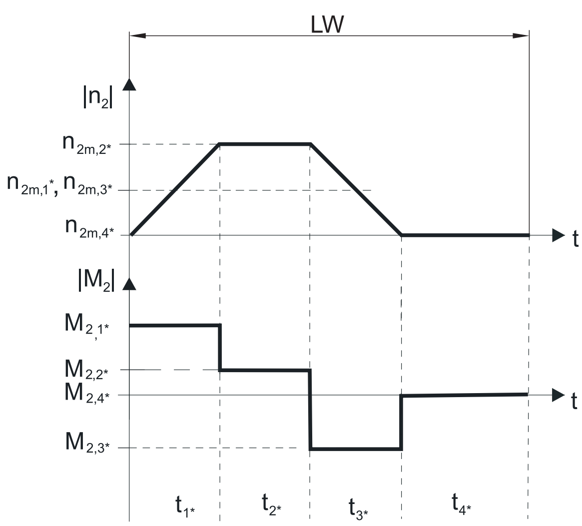
Drive selection for motors



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [▷ 2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc^*} = J_{tot} \cdot \frac{\Delta n_2}{9{,}55 \cdot \Delta t} + M_{L^*}$$

$$M_{1acc^*} = \frac{M_{2acc^*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9{,}55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If t_{1*} + ... + $t_{3*} \geq 6$ min, calculate n_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}{}^2 + \ldots + t_{n^*} \cdot M_{2,n^*}{}^2}{t_{1^*} + \ldots + t_{n^*}}}$$

Calculation of the actual emergency off torque

$$M_{2NOT^*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L^*}$$

Calculation of the actual equivalent torque

$$M_{2eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{2,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{2,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

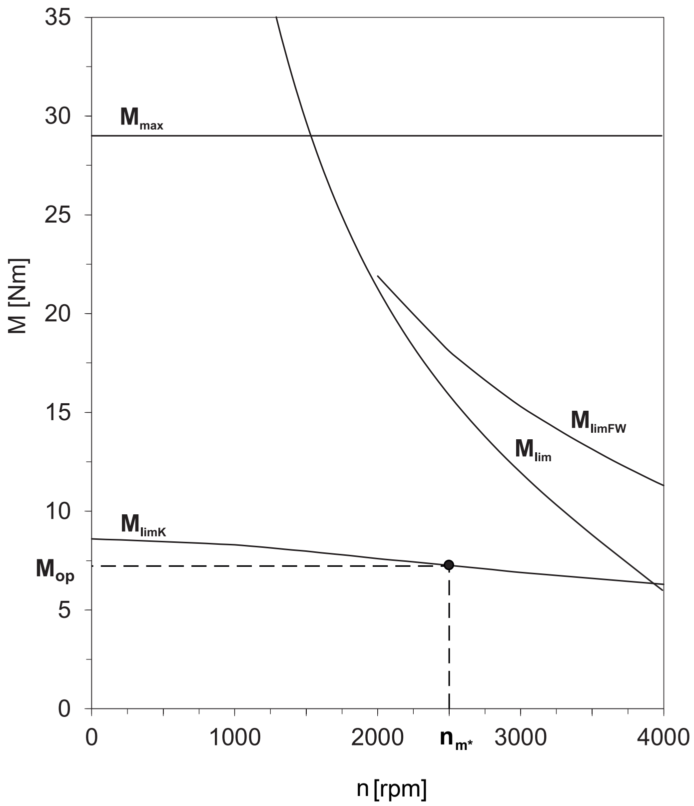
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}9 - \frac{a_{th}}{1000} \cdot athEL \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

Refer to the selection tables for the values of i and a_{th}.

The values for a_{thEL} and fB_T can be found in the corresponding tables in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter [▸ 2.3]. Note the size of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Parameter a_{thEL}

Mounting position	a_{thEL}
EL1, 2, 5, 6	1.0
EL3, 4	1.1

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.25
Reversing load cyclic operation	1.40

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gearbox torques (M_{2acc}, M_{2NOT}) in the selection tables.

11.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m*} \leq 100$ rpm ($F^{2axN} = F_{2ax100}$; $F_{2radN} = F_{2rad100}$; $M_{2kN} = M_{2k100}$)
- Only if radial forces on the gearbox are stabilized by its pilots (housing, flange shaft)

Permitted shaft loads for standard bearing S

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
P2	17.0	500	1200	1300	34	36
P3	17.5	1000	2500	2500	79	79
P4	18.5	1500	4000	4500	146	164
P5	19.5	2300	6500	7000	315	340
P7	23.0	2900	8500	9000	544	576
P8	24.5	4700	13000	18000	852	1179
P9	33.0	6000	18000	27000	1539	2309

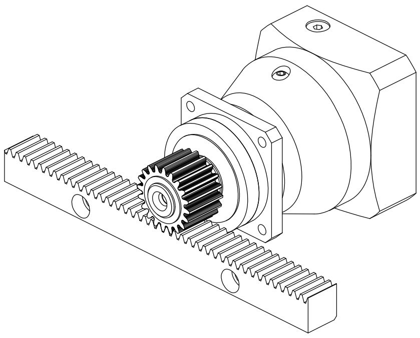


Fig. 1: Recommendation for bearing assignment S (e.g. for straight-cut gearing)

Permitted shaft loads for axially reinforced bearing D

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
P3	20.0	2500	2750	2750	94	94
P4	22.5	4000	4500	5000	182	203
P5	25.5	6000	7000	8000	382	436
P7	29.0	10000	9500	10000	665	700
P8	32.0	15500	15000	18000	1095	1314
P9	44.0	25000	20000	30000	1930	2895

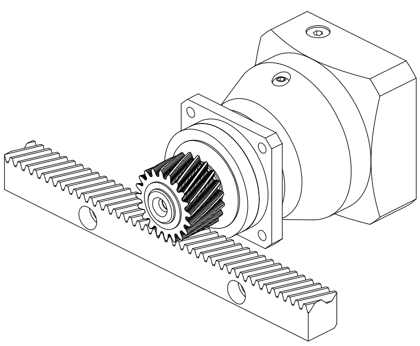


Fig. 2: Recommendation for bearing assignment D (e.g. for helical gearing)

Permitted shaft loads for radially reinforced bearing Z

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
P3	17.5	600	3000	3000	95	95
P4	18.5	1000	5000	5000	183	183
P5	19.5	1600	8000	8000	388	388
P7	23.0	2000	10000	10000	640	640
P8	24.5	3600	18000	18000	1179	1179
P9	33.0	5000	27000	35000	2309	2993

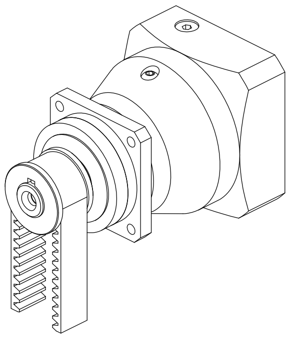


Fig. 3: Recommendation for bearing assignment Z (e.g. for belt drives)

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m*} > 100 rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table "Permitted shaft loads" in this chapter.

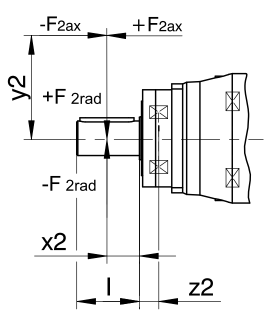


Fig. 4: Force application points

The specified values for $F_{2rad100}$ and $F_{2rad,acc}$ refer to an application of force at the center of the output shaft: x_2 = l/2.

Shaft dimensions can be found in the "Dimensional drawings" chapter.

The following applies to other force application points:

$$M_{2k,acc*} = \frac{2 \cdot F_{2ax*} \cdot y_2 + F_{2rad,acc*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax100}, $F_{2rad100}$ and M_{2k100} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{2k,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{2k,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|F_{2rad,acc,1^*}{}^3\right| + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|F_{2rad,acc,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + \ldots + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

The following apply to the bearing service life L_{10h} (ED_{10} ≤ 40%):

L_{10h} > 10000 h with 1 < M_{2kN}/M_{2k^*} < 1.25

L_{10h} > 20000 h with 1.25 < M_{2kN}/M_{2k^*} < 1.5

L_{10h} > 30000 h with 1.5 < M_{2kN}/M_{2k^*}

For different duty cycles:

$$L_{10h} > L_{10h(ED_{10}=40\%)} \cdot \frac{40\%}{ED_{10}}$$

11.6.3 Recommendation for radial shaft seal rings

For a duty cycle > 60% and higher surrounding temperatures, we recommend radial shaft seal rings made of FKM at the output.

Properties:

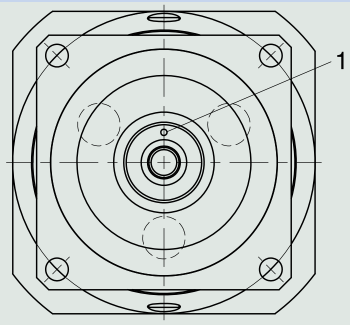
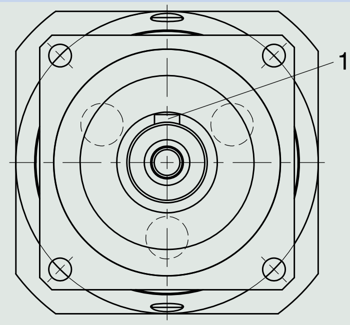
- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance in oils and greases
- For use in the food, beverage and pharmaceutical industries

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

11.6.4 Reverse operation

To ensure lubrication for circulating gearing parts during cyclic reverse operation from ± 20° to ± 90° at the output, pay careful attention to the position of the output shaft for the horizontal mounting of the gearbox, as shown in the diagrams below. The images show the center position of reverse operation. Cyclic reverse operation ≤ ± 20° on request.

Solid shaft without feather key	Solid shaft with feather key
	
1 Position of the mark: top	1 Position of the feather key: top

Notes

- If you use the solid shaft without a feather key (G), you must note the position of the mark during assembly.
- As an alternative, you can use the solid shaft with a feather key (P). In that case, the feather key functions for position orientation. For a backlash-free connection, also use a clamp.

11.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual gearboxes, geared motors P23KX – P93KX	443361_en

12 KL helical bevel geared motors

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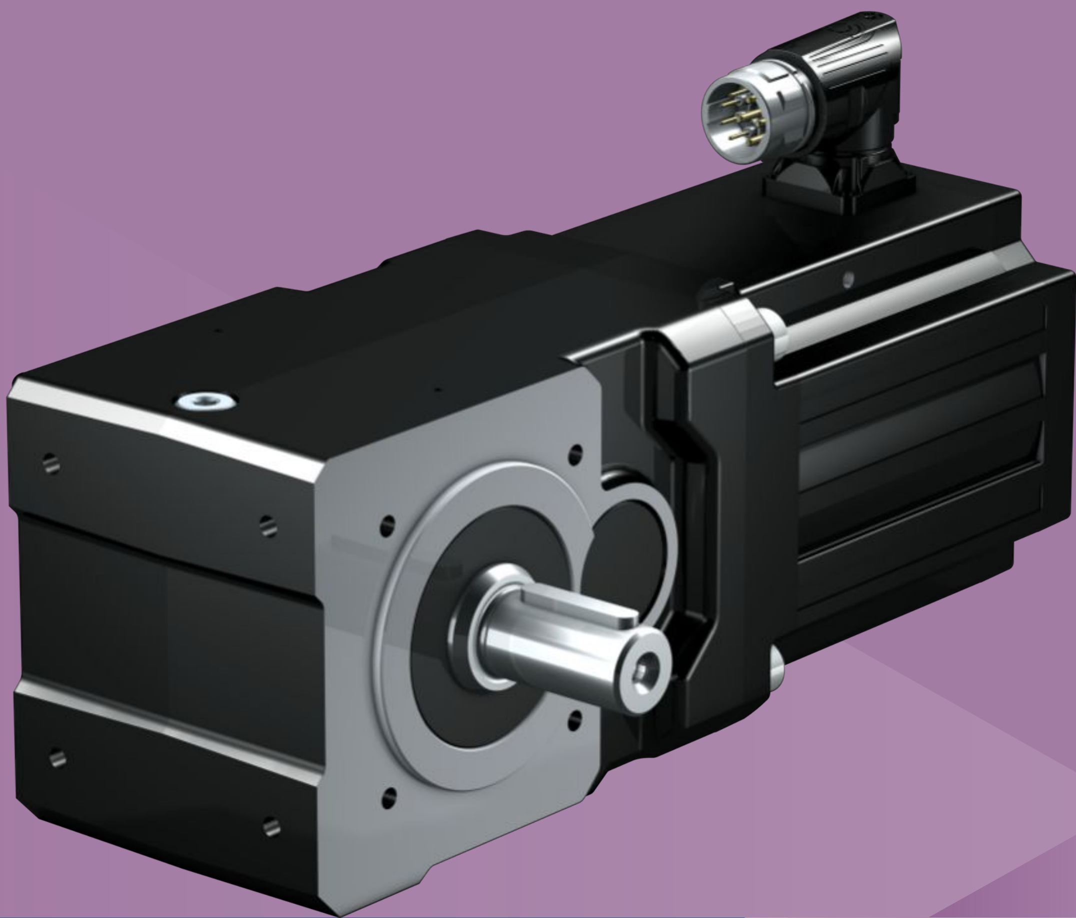


12 **Helical bevel geared motors** **KL**

12.1 Overview

Compact helical-geared right-angle geared motors

Features

Power density	★★☆☆☆
Backlash	★☆☆☆☆
Price category	€
Shaft load	★★☆☆☆
Smooth operation	★★☆☆☆
Torsional stiffness	★★☆☆☆
Mass moment of inertia	★★★★★
Helical gearing	✓
Maintenance-free	✓
Any mounting position	✓
Small installation space	✓
FKM seal ring at the input	✓
Compact and dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

i	4 – 16
M_{2acc}	35 – 60 Nm
$\Delta\phi_2$	16 – 20 arcmin
η_{get}	97 %

12.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Drives with convection-cooled motors

An explanation of the formula symbols can be found in the Chapter [15.1].

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
KL2 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 60 Nm)															
188	35	38	22	1.4	KL202_0160 LM401U	60	118	16.00	16/1	4000	6000	1.8	16.0	4.0	12
375	17	19	36	1.4	KL202_0080 LM401U	35	59	8.000	8/1	4000	6000	1.8	20.0	2.4	12
375	34	35	45	1.2	KL202_0080 LM402U	60	120	8.000	8/1	3500	6000	3.3	16.0	4.0	14
375	47	48	62	0.84	KL202_0080 LM403U	60	120	8.000	8/1	3500	6000	4.6	16.0	4.0	15
750	17	17	54	1.6	KL202_0040 LM402U	38	108	4.000	4/1	3500	6000	3.5	20.0	2.4	14
750	24	24	74	1.2	KL202_0040 LM403U	50	108	4.000	4/1	3500	6000	4.8	20.0	2.4	15

12.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gearbox dimensions, motor dimensions and geared motor dimensions.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Tolerances

Axis height in accordance with DIN 747	Tolerance
Up to 50 mm	-0.4 mm
Up to 250 mm	-0.5 mm
Up to 630 mm	-0.6 mm

Solid shaft	Tolerance
Shaft ∅ fit ≤ 50 mm	DIN 748-1, ISO k6
Shaft ∅ fit > 50 mm	DIN 748-1, ISO m6
Feather keys	DIN 6885-1, high form A

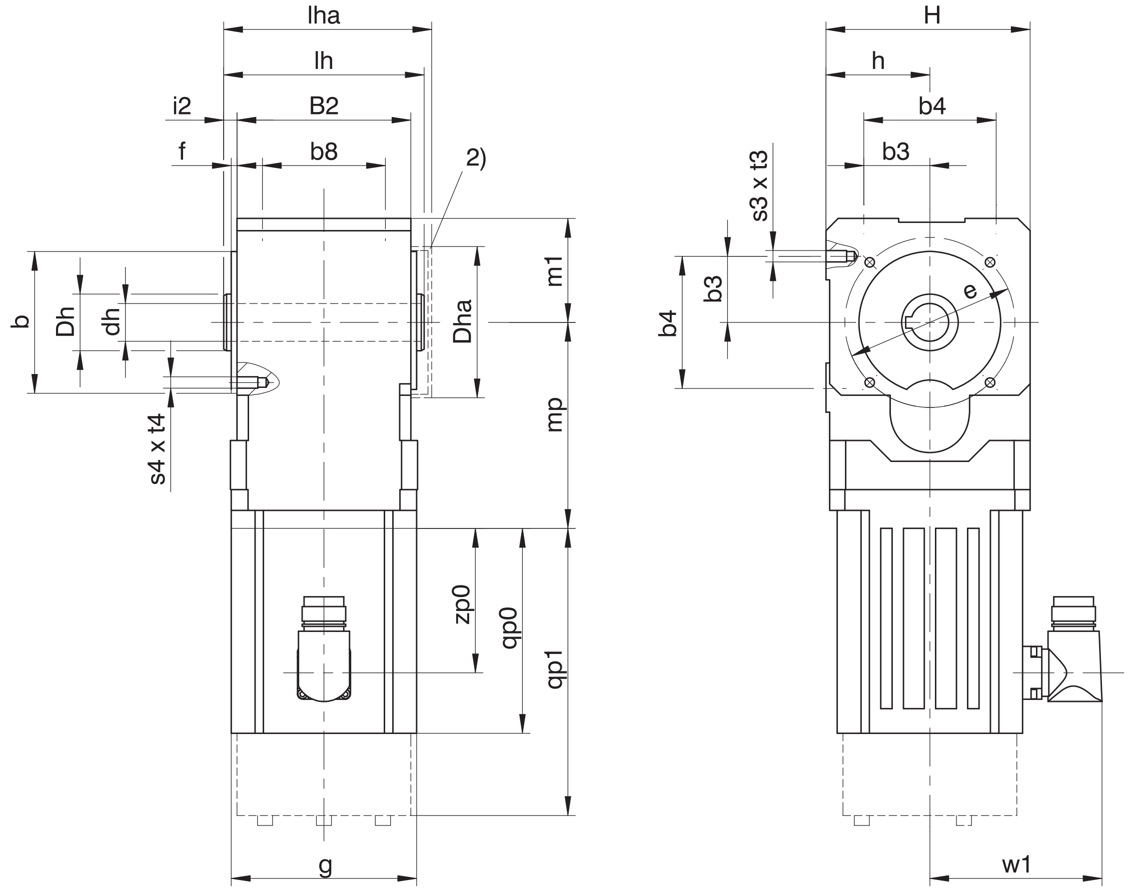
Centering holes in solid shafts in accordance with DIN 332-2, DR shape

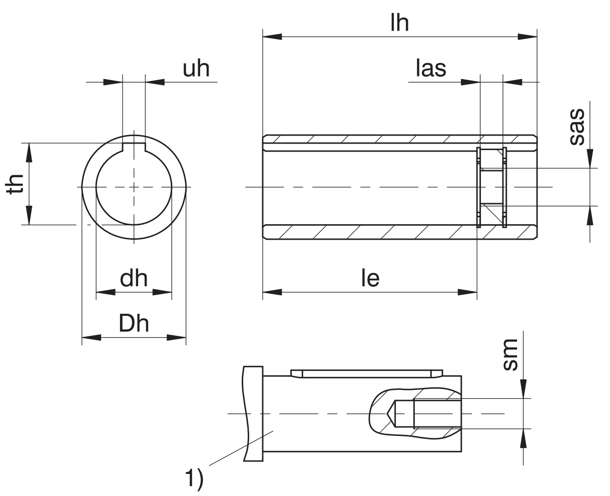
Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

Hollow shaft	Tolerance
Hollow shaft hole fit	ISO G7
Feather keys	DIN 6885-1, high form

Flange	Pilot tolerance
Up to 300 mm	ISO j6
Starting at 350 mm	ISO h6

12.3.1 A shaft design (hollow shaft), G housing design (pitch circle diameter)





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.	2)	Cover (optional)

Dimensions of gearboxes

Type	∅b	b3	b4	b8	B2	∅dh	Dh	Dha	∅e	f	h	H	i2	le	lh	las	lha	m1	s3	s4	sm	sas	t3	t4	th	uh
KL2	75_{j6}	35	70	65	92	20^{H7}	30	80	90	3	55	108	7	79.5	106	12	110	55	M6	M6	M6	M8	13	13	22.8	6^{JS9}

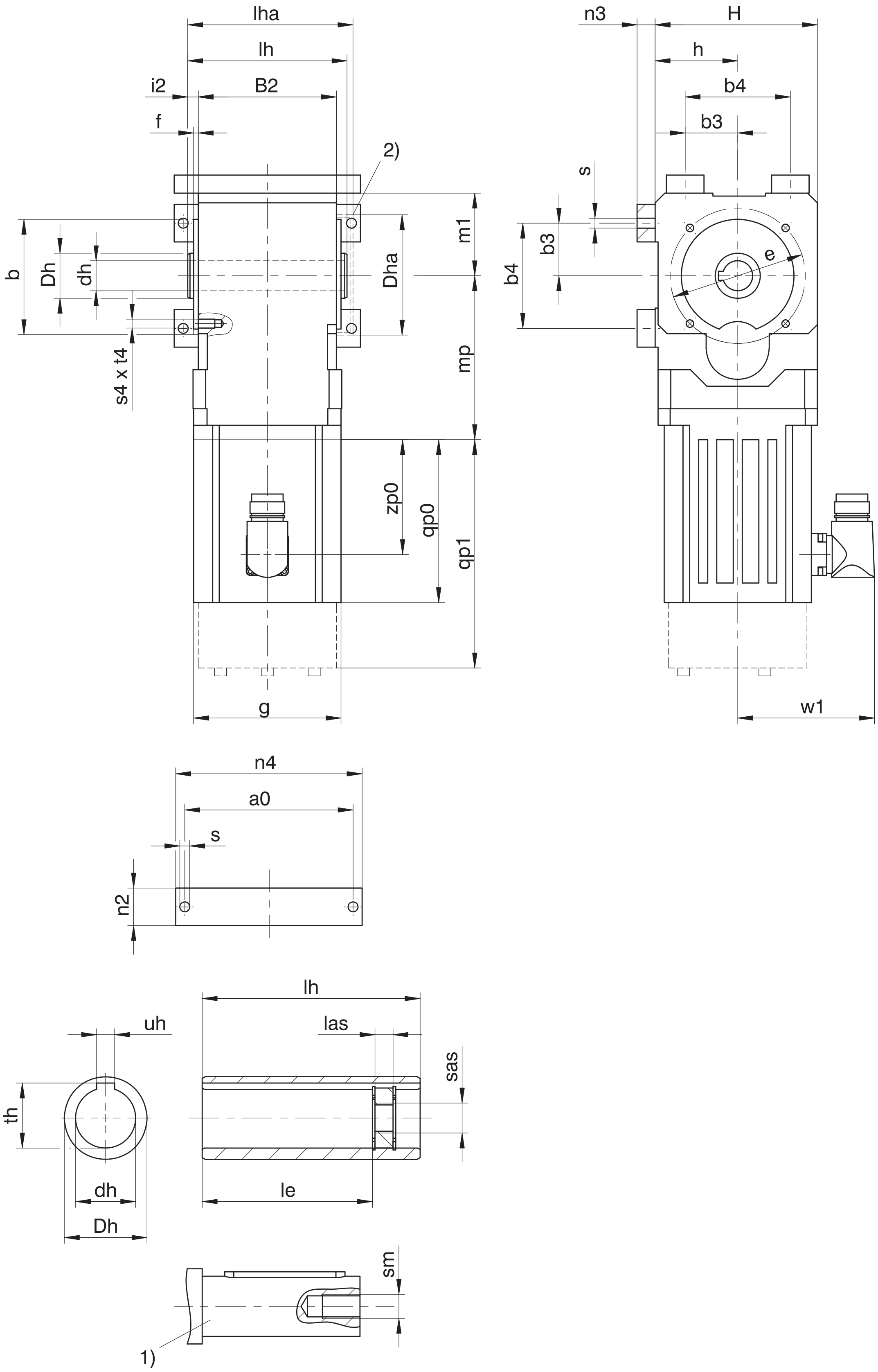
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.2 A shaft design (hollow shaft), NG housing design (base + pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.	2)	Cover (optional)

Dimensions of gearboxes

Type	a0	∅b	b3	b4	B2	∅dh	Dh	Dha	∅e	f	h	H	i2	le	lh	las	lha	m1	n2	n3	n4	∅s	s4	sm	sas	t4	th	uh
KL2	112	75_{j6}	35	70	92	20^{H7}	30	80	90	3	55	108	7	79.5	106	12	110	55	25	12	124	6.6	M6	M6	M8	13	22.8	6^{JS9}

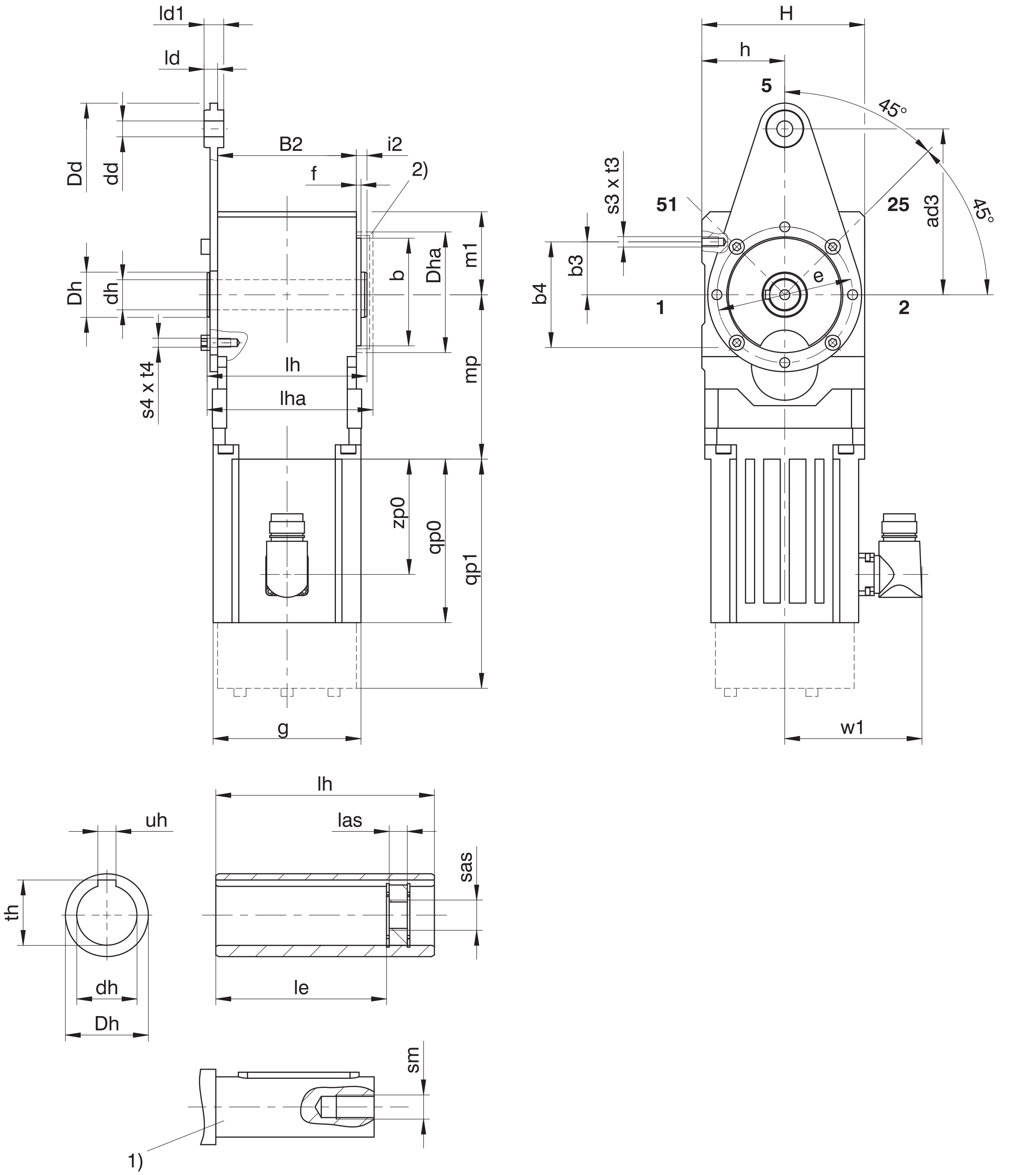
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.3 A shaft design (hollow shaft), GD housing design (pitch circle diameter + torque arm bracket)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.	2)	Cover (optional)

Dimensions of gearboxes

Type	ad3	∅b	b3	b4	B2	∅dd	∅dh	∅Dd	∅Dh	∅Dha	∅e	f	h	H	i2	le	lh	las	ld	ld1	lha	m1	s3	s4	sm	sas	t3	t4	th	uh
KL2	110	75_{j6}	35	70	92	10.5	20^{H7}	34	30	80	90	3	55	108	7	79.5	106	12	9	13	110	55	M6	M6	M6	M8	13	13	22.8	6^{JS9}

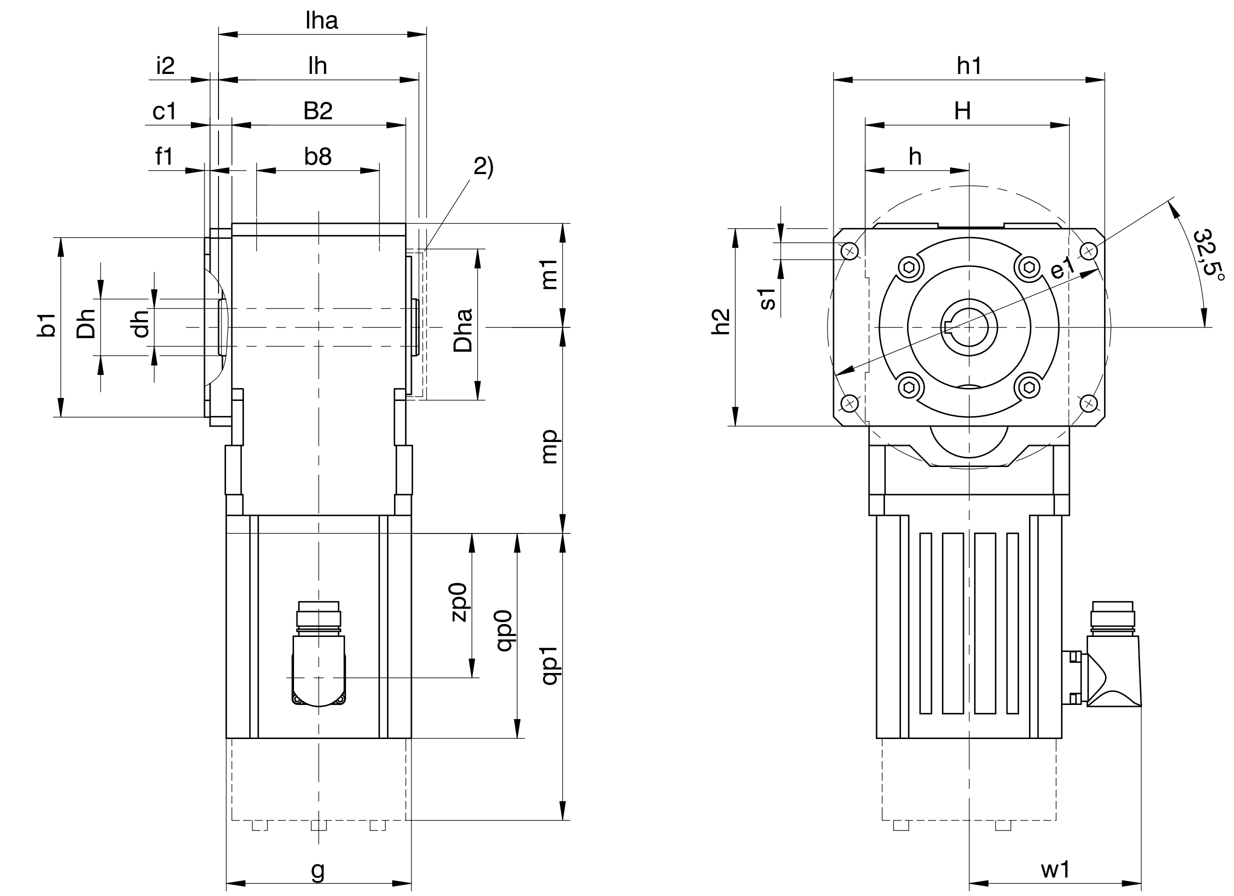
Dimensions of motors

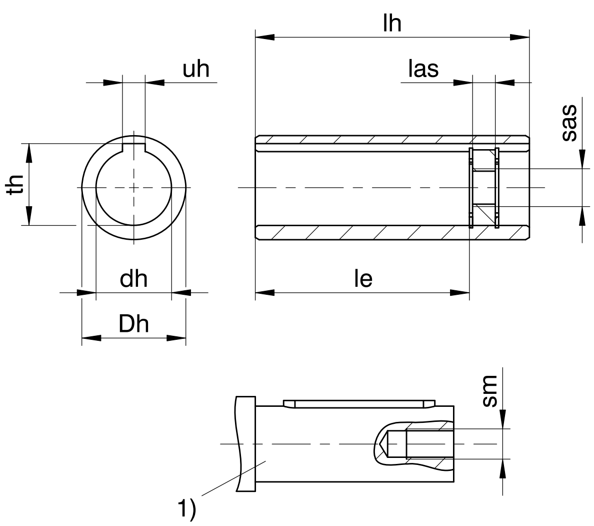
Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.4 A shaft design (hollow shaft), F housing design (flange)





qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

1) The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.

2) Cover (optional)

Dimensions of gearboxes

Type	∅b1	b8	B2	c1	∅dh	Dh	Dha	∅e1	f1	h	h1	h2	H	i2	le	lh	las	lha	m1	∅s1	sm	sas	th	uh
KL2	95_{j6}	65	92	11.5	20^{H7}	30	80	150	3	55	143.5	104.5	108	4.5	79.5	106	12	110	55	9	M6	M8	22.8	6^{JS9}

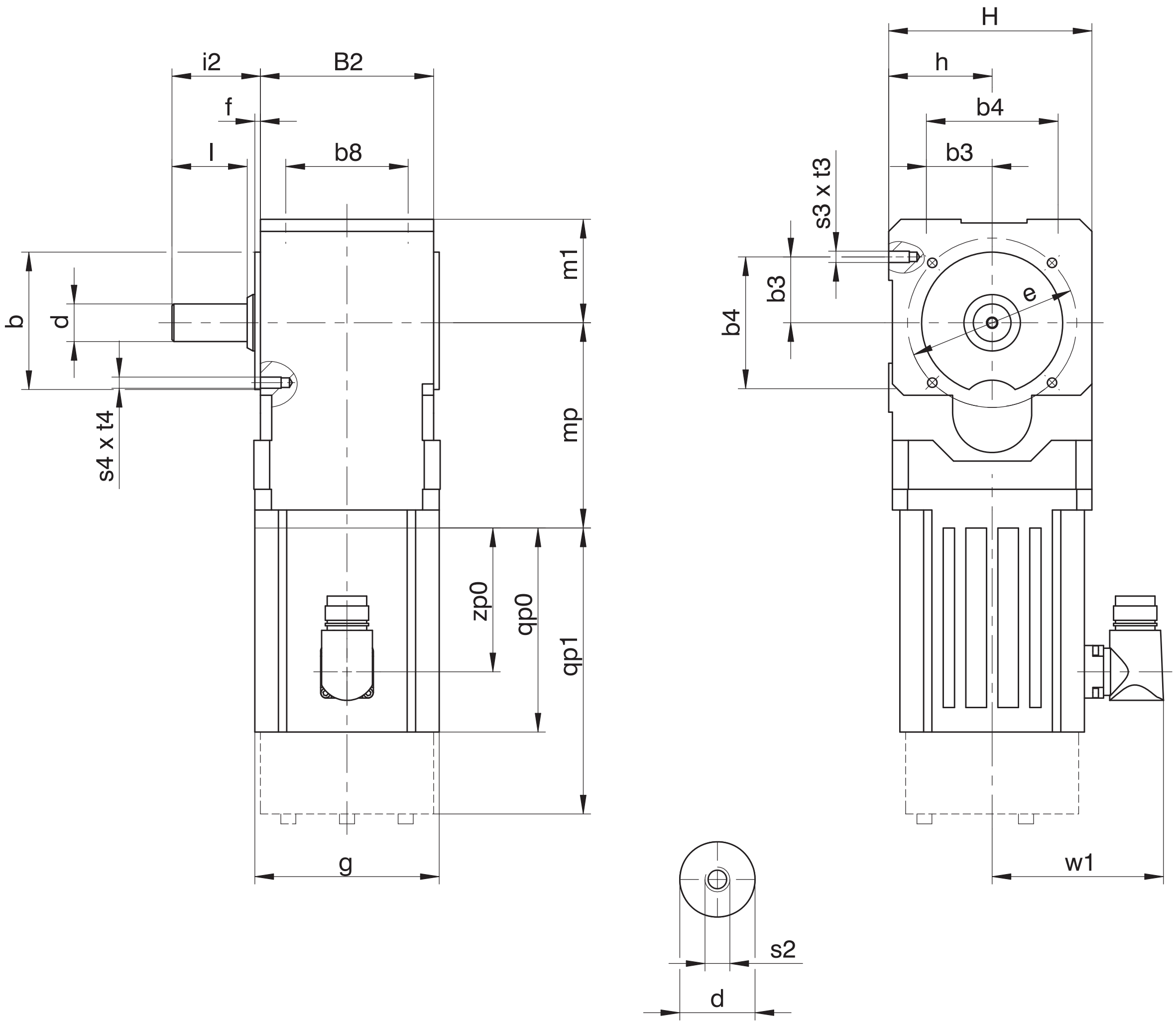
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.5 G shaft design (solid shaft without feather key), G housing design (pitch circle diameter)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

Dimensions of gearboxes

Type	∅b	b3	b4	b8	B2	∅d	∅e	f	h	H	i2	l	m1	s2	s3	s4	t3	t4
KL2	75_{j6}	35	70	65	92	20_{k6}	90	3	55	108	47	40	55	M6	M6	M6	13	13

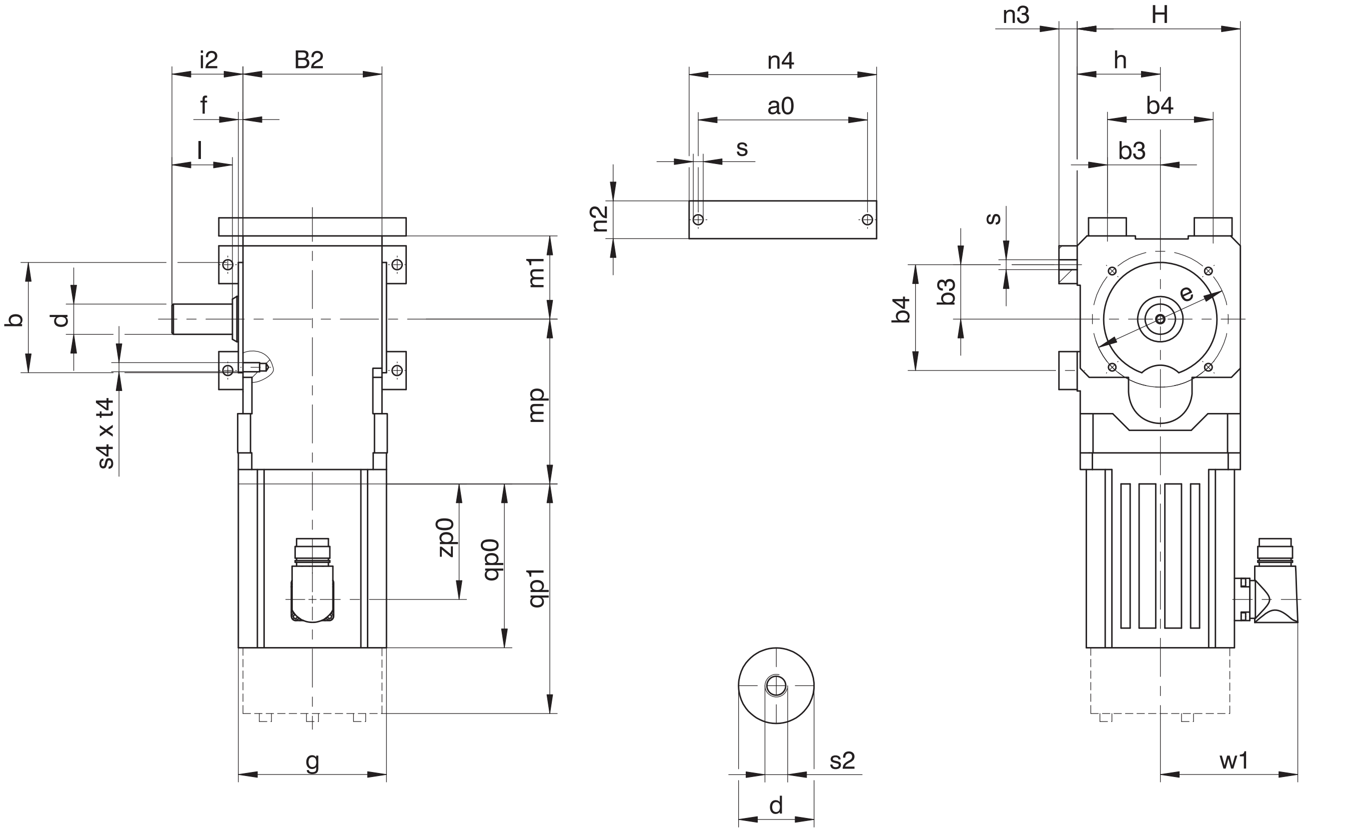
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.6 G shaft design (solid shaft without feather key), NG housing design (base + pitch circle diameter)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

Dimensions of gearboxes

Type	a0	∅b	b3	b4	B2	∅d	∅e	f	h	H	i2	l	m1	n2	n3	n4	∅s	s2	s4	t4
KL2	112	75_{j6}	35	70	92	20_{k6}	90	3	55	108	47	40	55	25	12	124	6.6	M6	M6	13

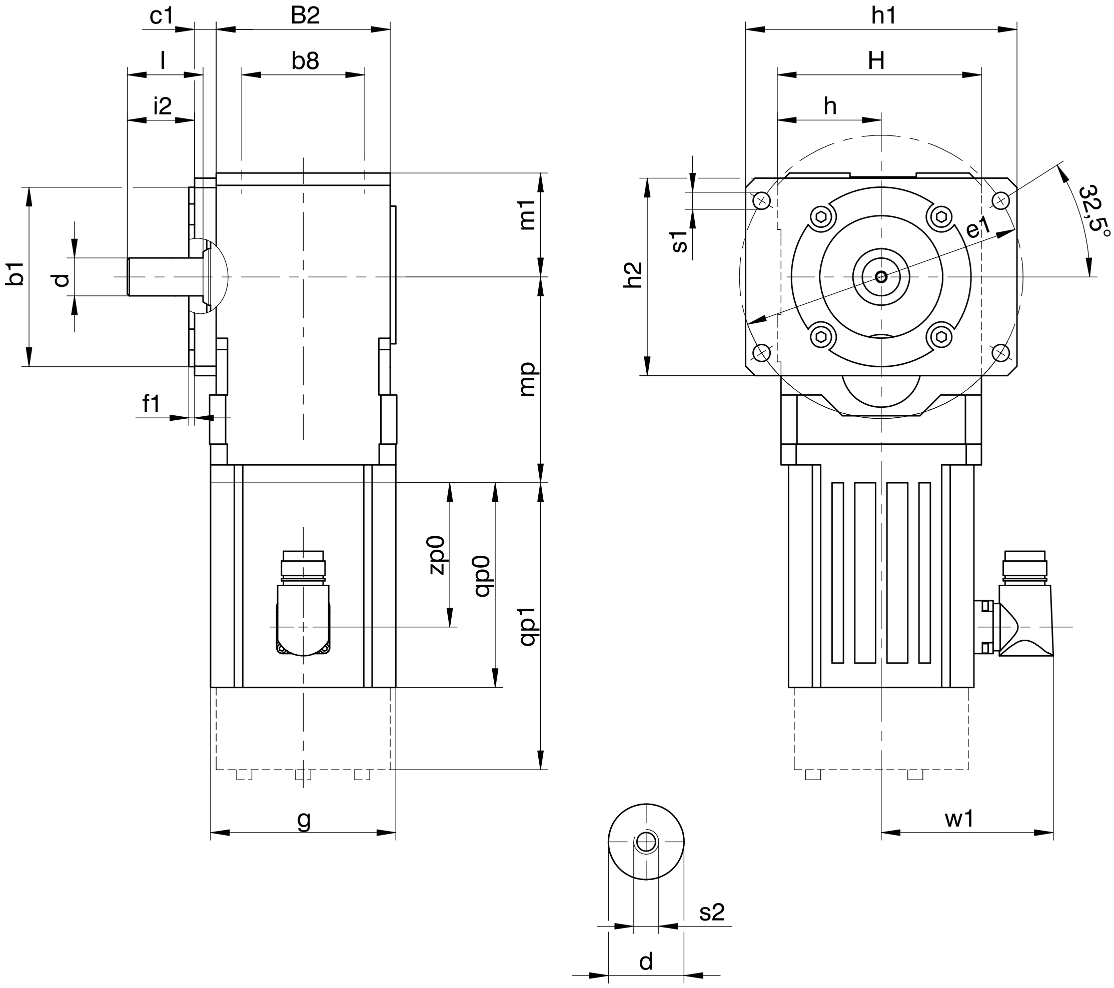
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.7 G shaft design (solid shaft without feather key), F housing design (flange)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

Dimensions of gearboxes

Type	∅b1	b8	B2	c1	∅d	∅e1	f1	h	h1	h2	H	i2	l	m1	∅s1	s2
KL2	95_{j6}	65	92	11.5	20_{k6}	150	3	55	143.5	104.5	108	35.5	40	55	9	M6

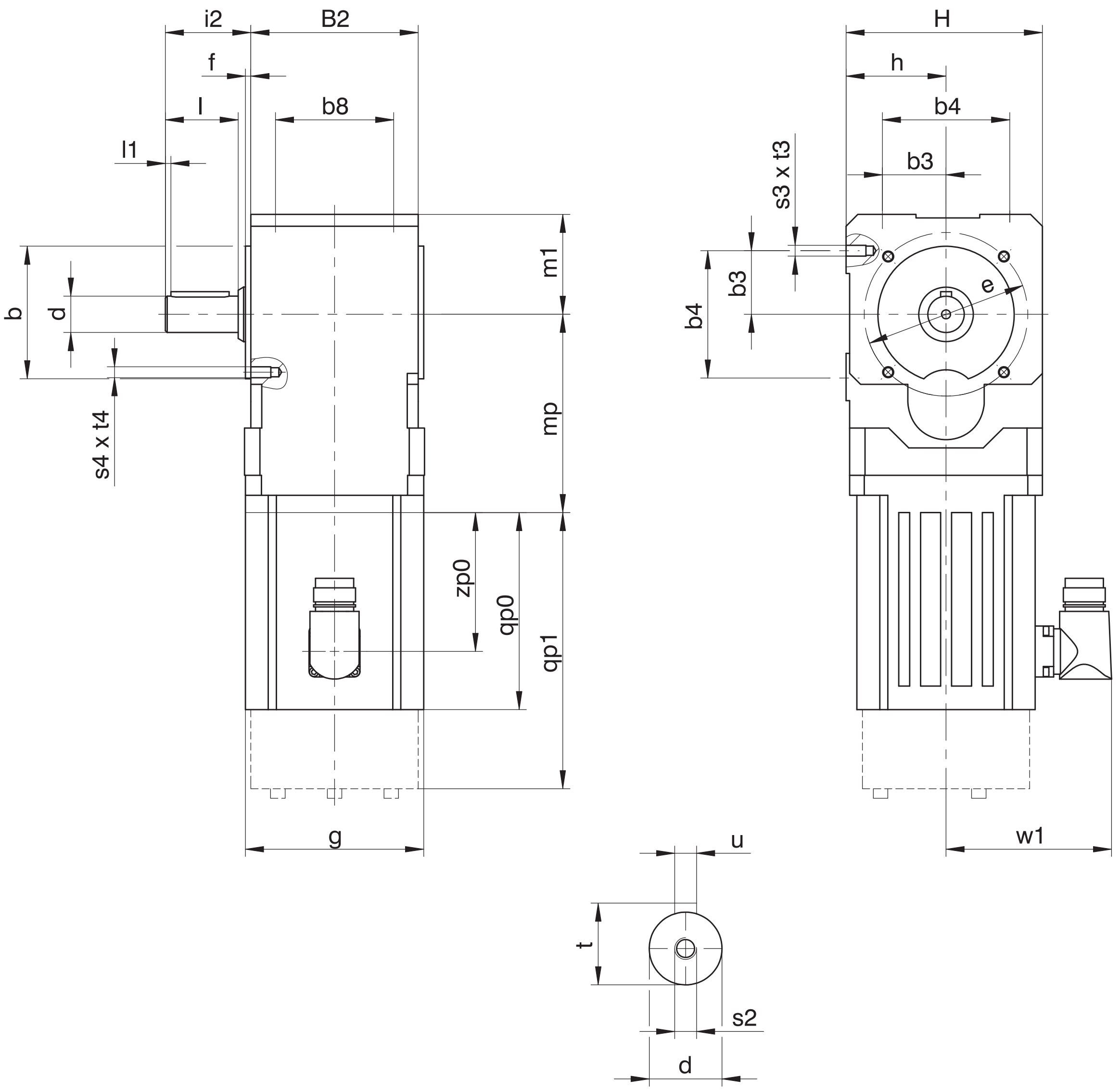
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.8 P shaft design (solid shaft with feather key), G housing design (pitch circle diameter)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

Dimensions of gearboxes

Type	⌀b	b3	b4	b8	B2	⌀d	⌀e	f	h	H	i2	l	l1	m1	s2	s3	s4	t	t3	t4	u
KL2	75_{j6}	35	70	65	92	20_{k6}	90	3	55	108	47	40	3	55	M6	M6	M6	22.5	13	13	A6×6×32

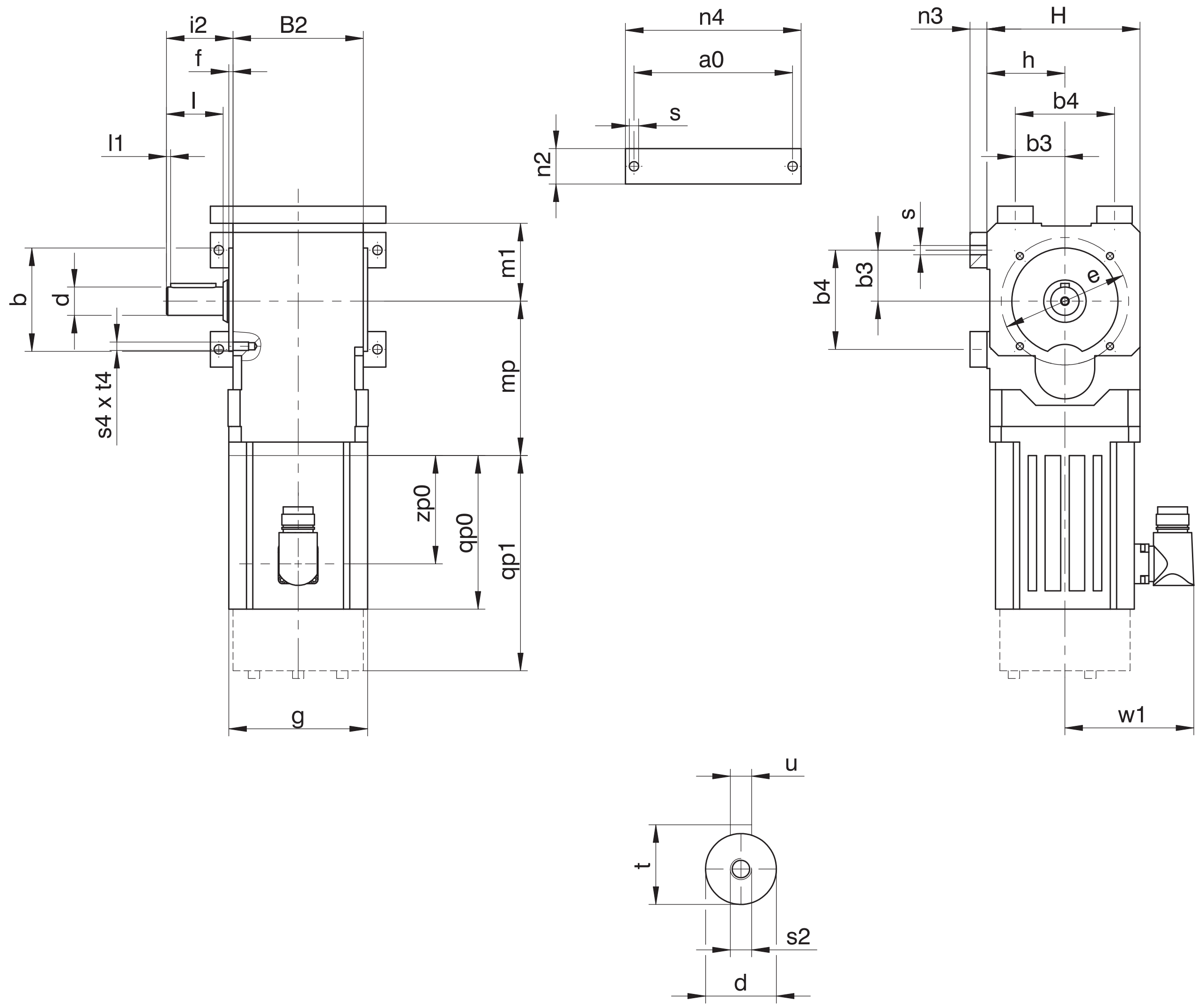
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.9 P shaft design (solid shaft with feather key), NG housing design (base + pitch circle diameter)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

Dimensions of gearboxes

Type	a0	∅b	b3	b4	B2	∅d	∅e	f	h	H	i2	l	l1	m1	n2	n3	n4	∅s	s2	s4	t	t4	u
KL2	112	75_{j6}	35	70	92	20_{k6}	90	3	55	108	47	40	3	55	25	12	124	6.6	M6	M6	22.5	13	A6×6×32

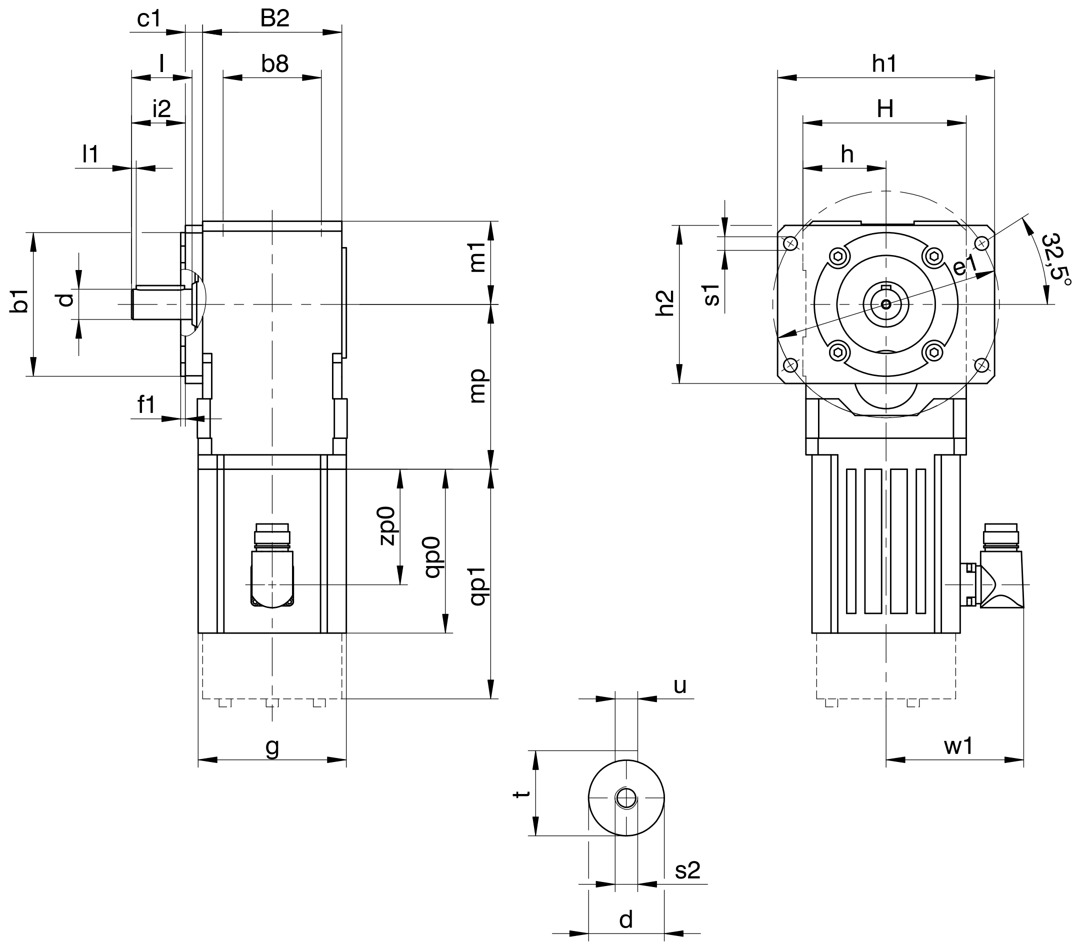
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.10 P shaft design (solid shaft with feather key), F housing design (flange)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

Dimensions of gearboxes

Type	∅b1	b8	B2	c1	∅d	∅e1	f1	h	h1	h2	H	i2	l	l1	m1	∅s1	s2	t	u
KL2	95_{j6}	65	92	11.5	20_{k6}	150	3	55	143.5	104.5	108	35.5	40	3	55	9	M6	22.5	A6×6×32

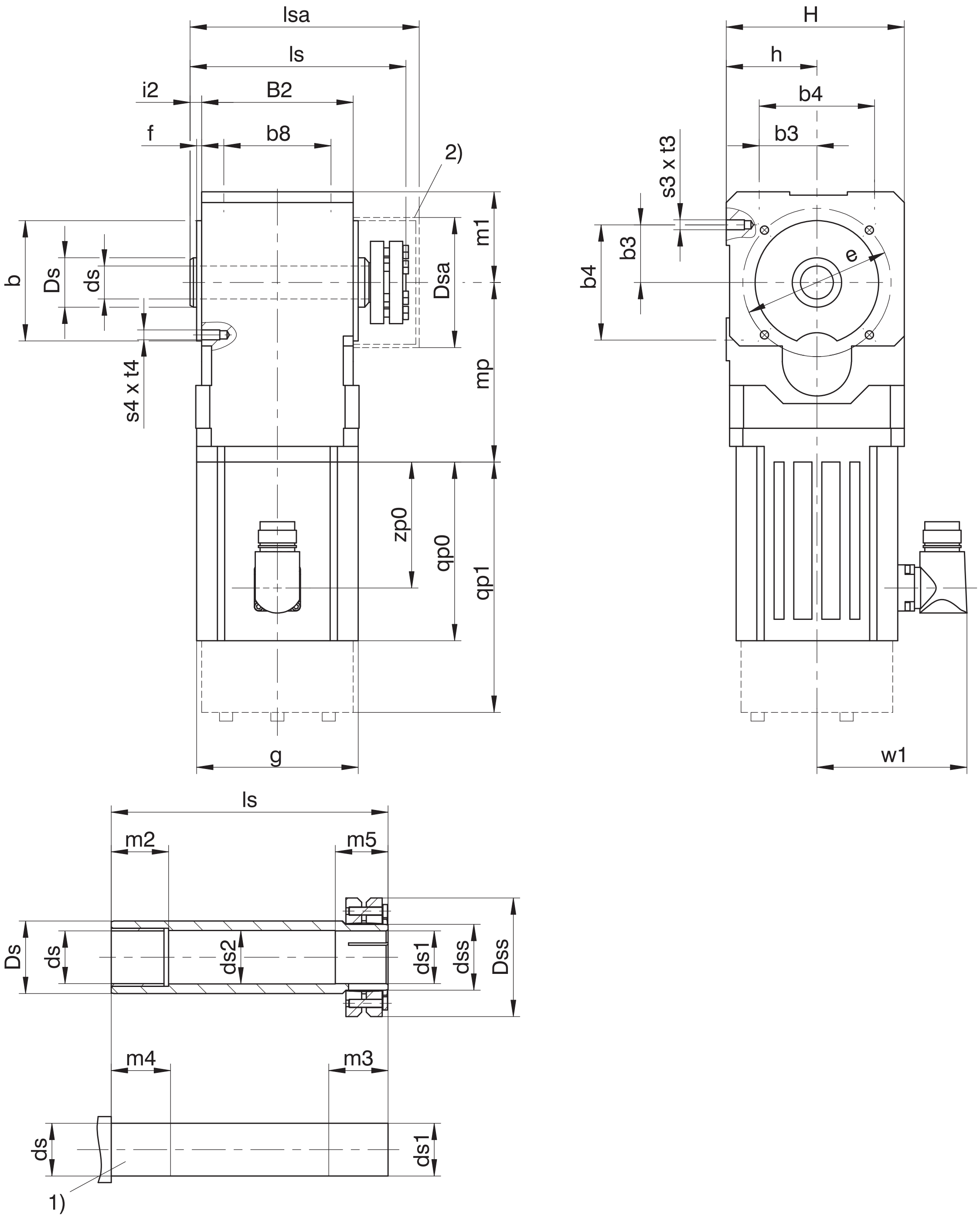
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.11 S shaft design (hollow shaft with shrink disk), G housing design (pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)

Dimensions of gearboxes

Type	∅b	b3	b4	b8	B2	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss	∅e	f	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	s3	s4	t3	t4
KL2	75_{j6}	35	70	65	92	20^{H7}	20_{h6}^{H7}	21.5	24	30	79	50	90	3	55	108	7	131	139	55	22	27	31	26	M6	M6	13	13

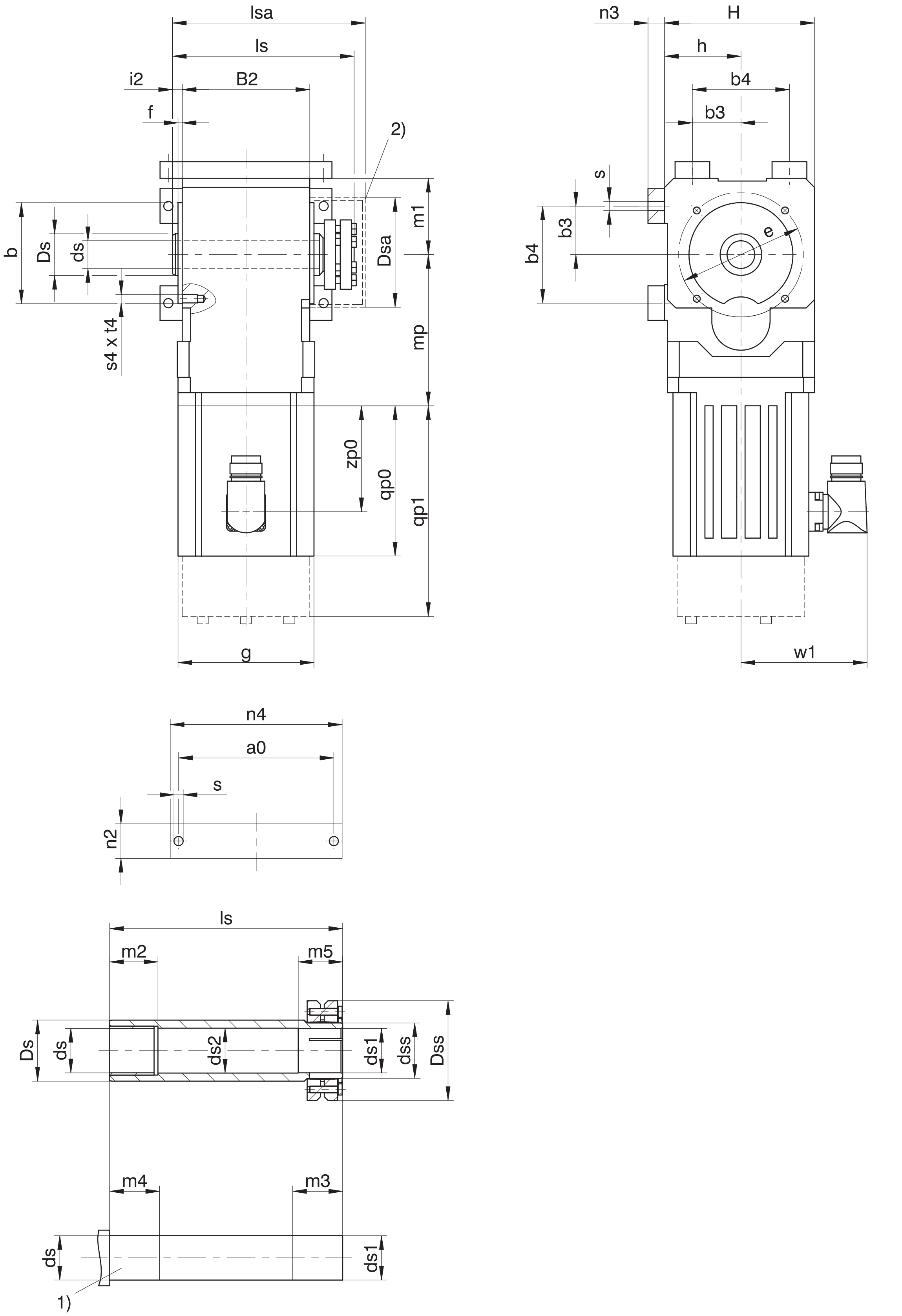
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.12 S shaft design (hollow shaft with shrink disk), NG housing design (base + pitch circle diameter)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

1) Machine shaft: The dimension ls must meet or exceed the specified value.

2) Cover (optional)

Dimensions of gearboxes

Type	a0	∅b	b3	b4	B2	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss	∅e	f	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	n2	n3	n4	∅s	s4	t4
KL2	112	75_{j6}	35	70	92	20^{H7}	20_{h6}^{H7}	21.5	24	30	79	50	90	3	55	108	7	131	139	55	22	27	31	26	25	12	124	6.6	M6	13

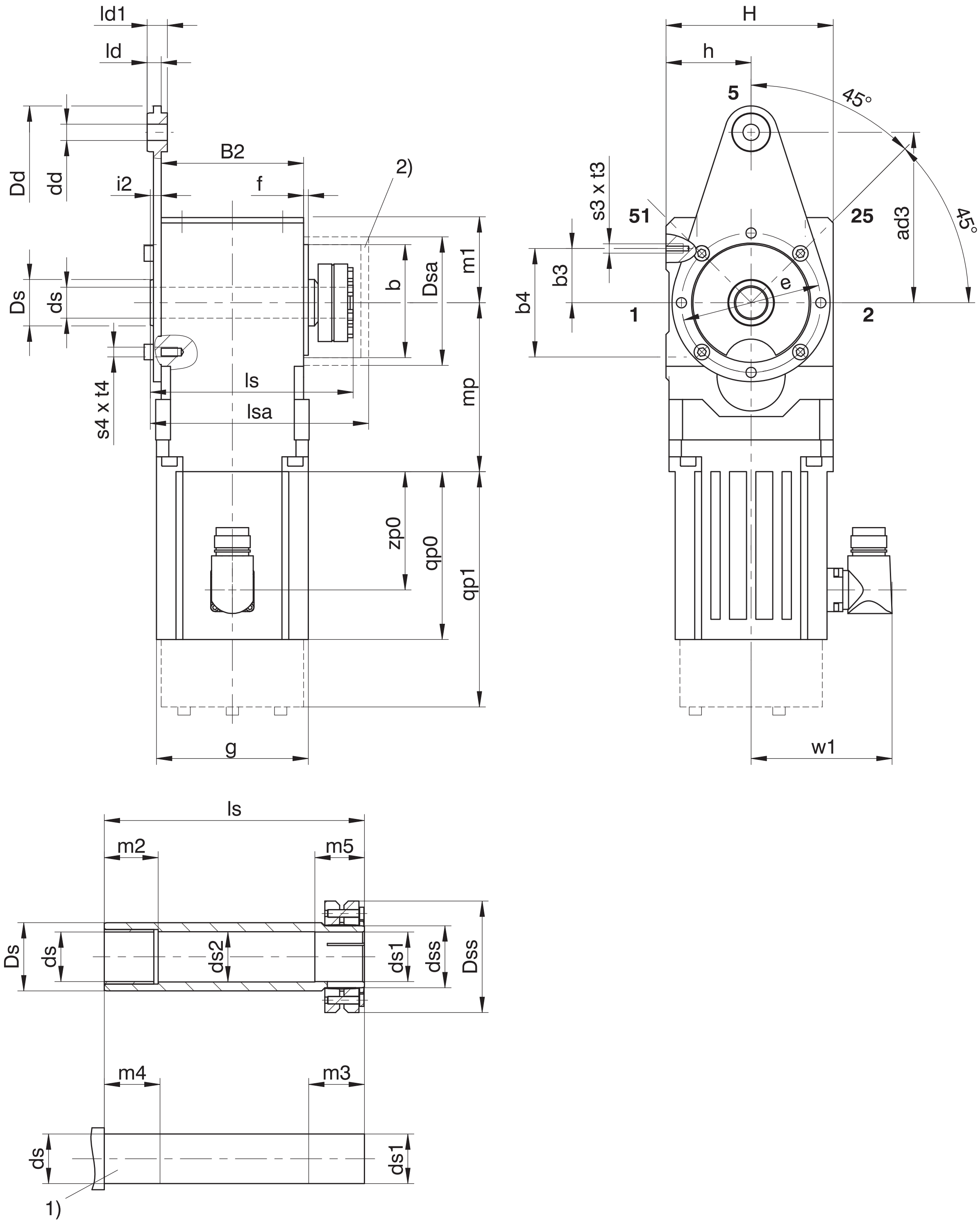
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.13 S shaft design (hollow shaft with shrink ring), GD housing design (pitch circle diameter + torque arm bracket)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

1) Machine shaft: The dimension ls must meet or exceed the specified value.

2) Cover (optional)

Dimensions of gearboxes

Type	ad3	∅b	b3	b4	B2	∅dd	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss	∅e	f	h	H	i2	ld	ld1	ls	lsa	m1	m2	m3	m4	m5	s3	s4	t3	t4
KL2	110	75_{j6}	35	70	92	10.5	20^{H7}	20_{h6}^{H7}	21.5	24	30	79	50	90	3	55	108	7	9	13	131	139.0	55	22	27	31	26	M6	M6	13	13

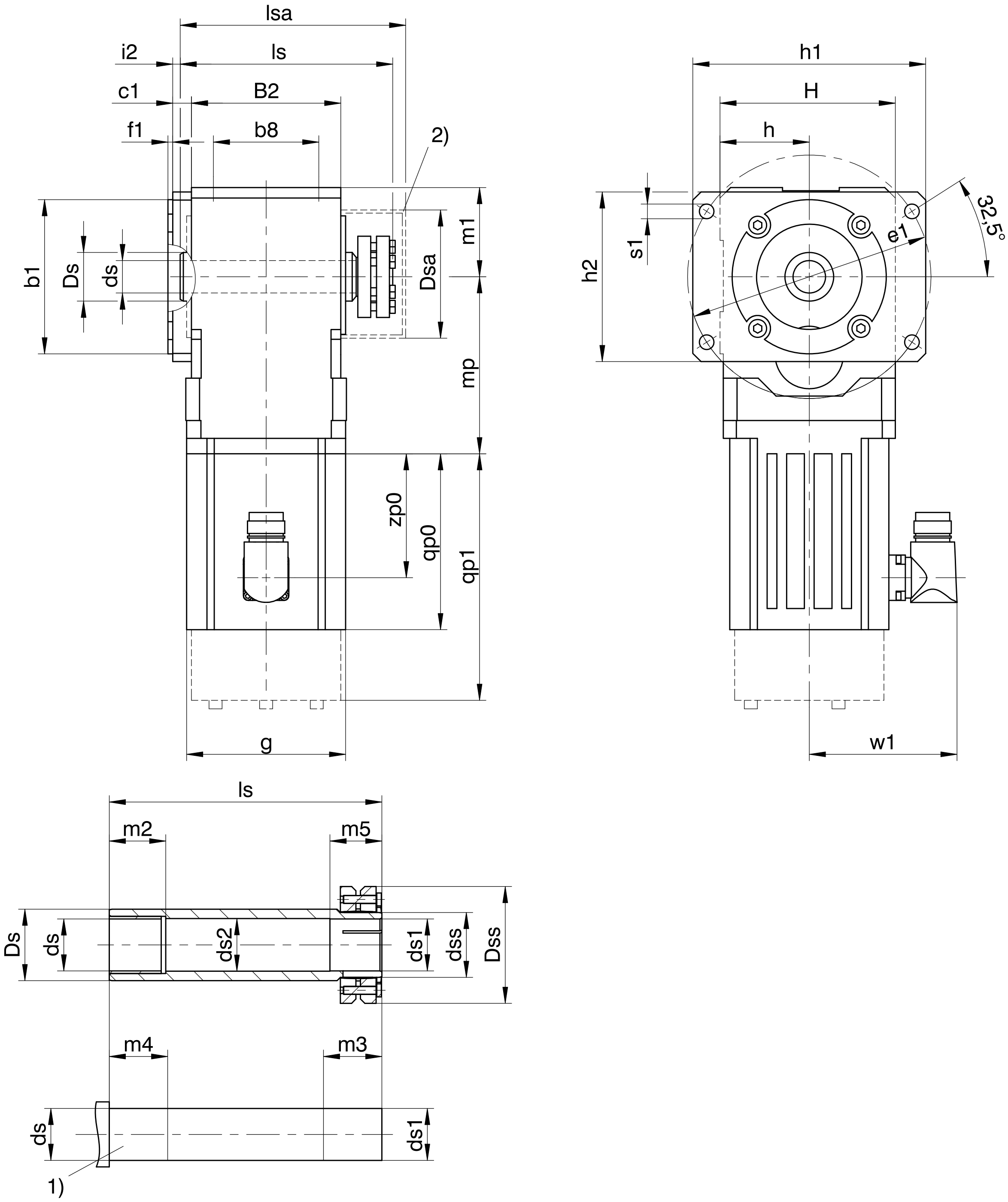
Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.3.14 S shaft design (hollow shaft with shrink disk), F housing design (flange)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)

Dimensions of gearboxes

Type	∅b1	b8	B2	c1	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss	∅e1	f1	h	h1	h2	H	i2	ls	lsa	m1	m2	m3	m4	m5	∅s1
KL2	95_{j6}	65	92	11.5	20^{H7}	20_{h6}^{H7}	21.5	24	30	79	50	150	3	55	143.5	104.5	108	4.5	131	139	55	22	27	31	26	9

Dimensions of motors

Type	□g	qp0	qp1	w1	zp0
LM401U	98	108.5	152	91	76.5
LM402U	98	147.5	191	91	115.5
LM403U	98	178.5	222	91	146.5

Dimensions of geared motors

Type	LM4
	mp
KL202	109

12.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

KL	2	0	2	P	G	0080	LM401U

Explanation

Code	Designation	Design
KL	Type	Helical bevel gearbox
2	Size	2 (example)
0	Generation	Generation 0
2	Stages	Two-stage
A	Shaft	Hollow shaft with keyway
S		Hollow shaft with shrink ring
G		Solid shaft without feather key
P		Solid shaft with feather key
G	Housing	Pitch circle diameter
F		Flange
NG		Foot + pitch circle diameter
GD		Pitch circle diameter + torque arm bracket
0080	Transmission ratio (i x 10)	i = 8 (example)
LM401U	Motor	LM Lean motor

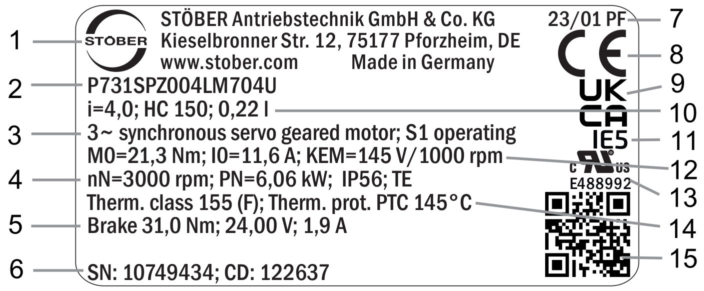
To complete the type designation, also specify the following in your order:

- A detailed type designation of the motor, see the chapter [▶ 2]
- Attachment of solid shaft: gearbox side 3 or 4; solid shaft on both sides
- Attachment of hollow shaft with keyway: insertion side 3 or 4
- Attachment of hollow shaft with shrink ring: shrink ring on gearbox side 3 or 4
- Attachment of foot plates: gearbox side 1 or 5
- Attachment of flange: gearbox side 3 or 4
- Pitch circle diameter: gearbox side 3 or 4
- The position of the plug connector, see the chapter [▶ 12.5.7]

An explanation of the gearbox sides can be found in the chapter [▶ 12.5.5].

12.4.1 Nameplate

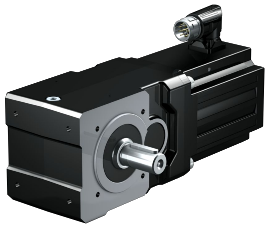
In the following figure, the nameplate of a P731_LM704 Lean geared motor is explained as an example.



Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004LM704U	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=3000 rpm PN=6.06 kW IP56 TE	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004
5	Brake 31.0 Nm 24.00 V 1.9 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749434 CD: 122637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	IE5	IEC energy efficiency
12	M0=21.3 Nm I0=11.6 A KEM=145 V/1000 rpm	Stall torque Stall current Voltage constant
13	cURus E488992	cURus test symbol, registered under UL number E488992
14	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
15	QR code	Link to product information

12.5 Product description

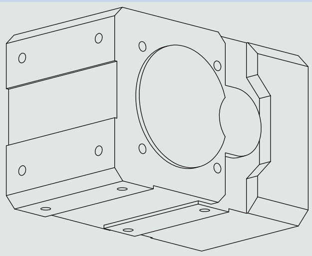
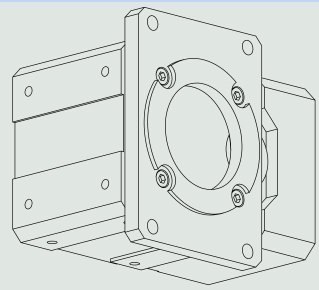
12.5.1 Input options

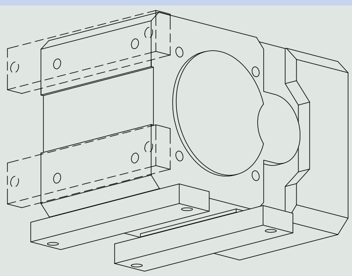
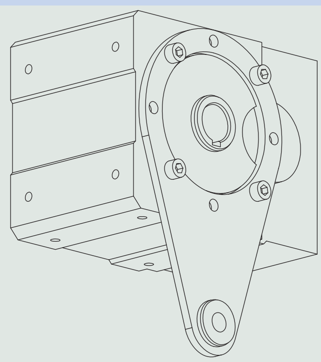
LM Lean motor	EZ synchronous servo motor
	
Catalog ID 443016_en	Catalog ID 442437_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the catalog in the Search term field.

12.5.2 Housing design

Pitch circle diameter G	Flange F
	

Foot + pitch circle diameter NG	Pitch circle diameter + torque arm bracket GD
	

	G	F	NG	GD
KL1	✓	✓	✓	–
KL2	✓	✓	✓	✓

12.5.3 Combinatorial shaft/housing design

	Housing design				
Shaft design	**Code**	**G**	**F**	**NG**	**GD**
Hollow shaft with keyway	**A**	AG	AF	ANG	AGD
Hollow shaft with shrink ring	**S**	SG	SF	SNG	SGD
Solid shaft without feather key	**G**	GG	GF	GNG	–
Solid shaft with feather key	**P**	PG	PF	PNG	–

12.5.4 Installation conditions

Hollow shaft

The hollow shaft hole tolerance is ISO H7. The tolerance of the machine shaft must be ISO k6.

Take care to align the machine shaft with the gearbox hollow shaft when attaching the gearbox.

Maximum deviation ≤ 0.03 mm.

For simpler assembly and disassembly of the machine shaft, the hollow shafts are equipped with a spiral groove (as a grease deposit).

A hardened, threaded keeper plate is included in the scope of delivery. You also have the option to order the hollow shaft without a keeper plate.

Hollow shaft with shrink ring

The tolerance of the hollow shaft hole is ISO H7.

The machine shaft must be ISO h9.

Select a material for the machine shaft with a permitted surface pressure of p ≥ 325 N/mm^2.

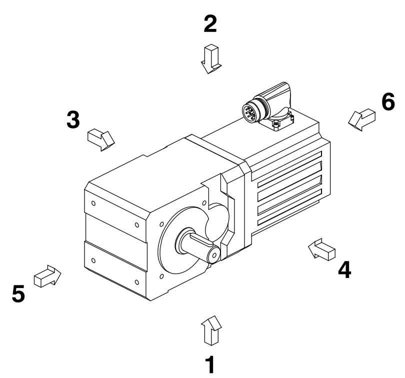
Possible materials:

- C45E +QT
- 42CrMo4

Fastening the gearboxes on the machine side using the pitch circle diameter

The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

12.5.5 Gearbox sides



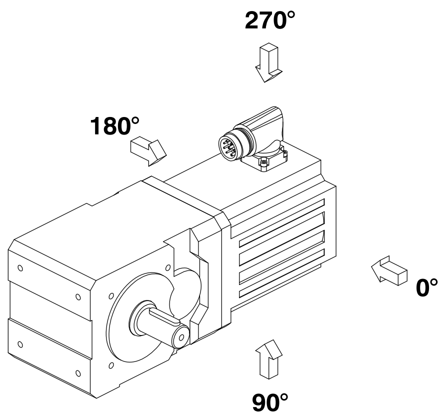
The numbers identify the gearbox sides.

12.5.6 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate.

You will receive lubricants for use in the food industry upon request.

12.5.7 Position of the plug connector



In the standard version, the plug connector is attached in the 270° position.

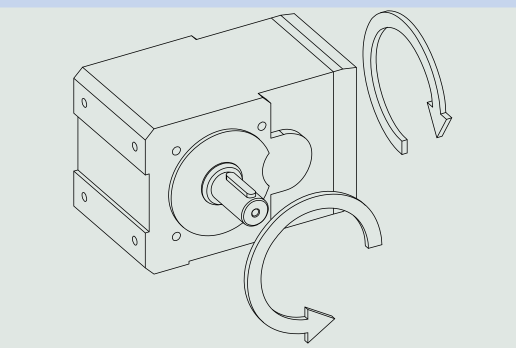
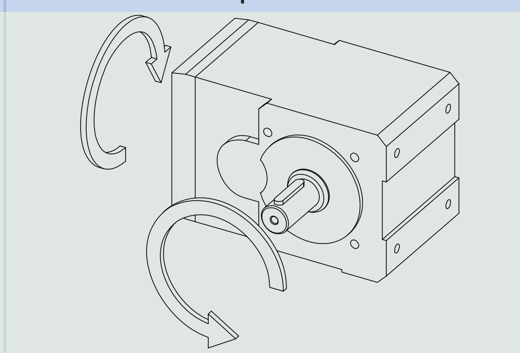
Indicate variations for your geared motor in the order.

12.5.8 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} two-stage	97%
Protection class:[1]	
Gearbox	IP65
Motor	IP56, optionally IP66

12.5.9 Direction of rotation

Solid shaft (P and G), solid shaft on both sides (P and G), hollow shaft with keyway (A)

Output side 4	Output side 3
	

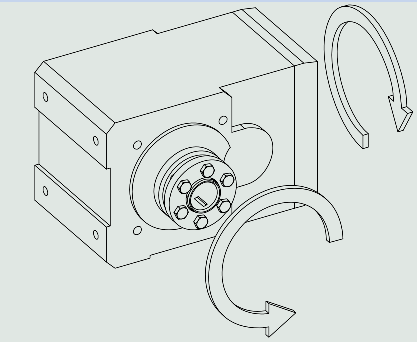
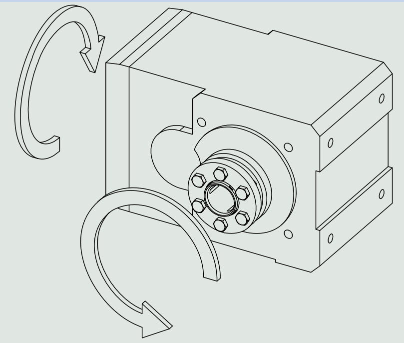
The specified directions of rotation also apply to gearboxes with hollow shaft (A) if the entry side of the machine shaft corresponds to the side of the solid shaft that is shown.

The direction of rotation for the shaft design of a solid shaft on both sides corresponds to the direction of rotation for output side 4.

The pictures show mounting position EL1.

[1] Observe the protection class of all the components.

Hollow shaft with shrink ring (S)

Shrink ring side 4	Shrink ring side 3
	

The pictures show mounting position EL1.

12.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

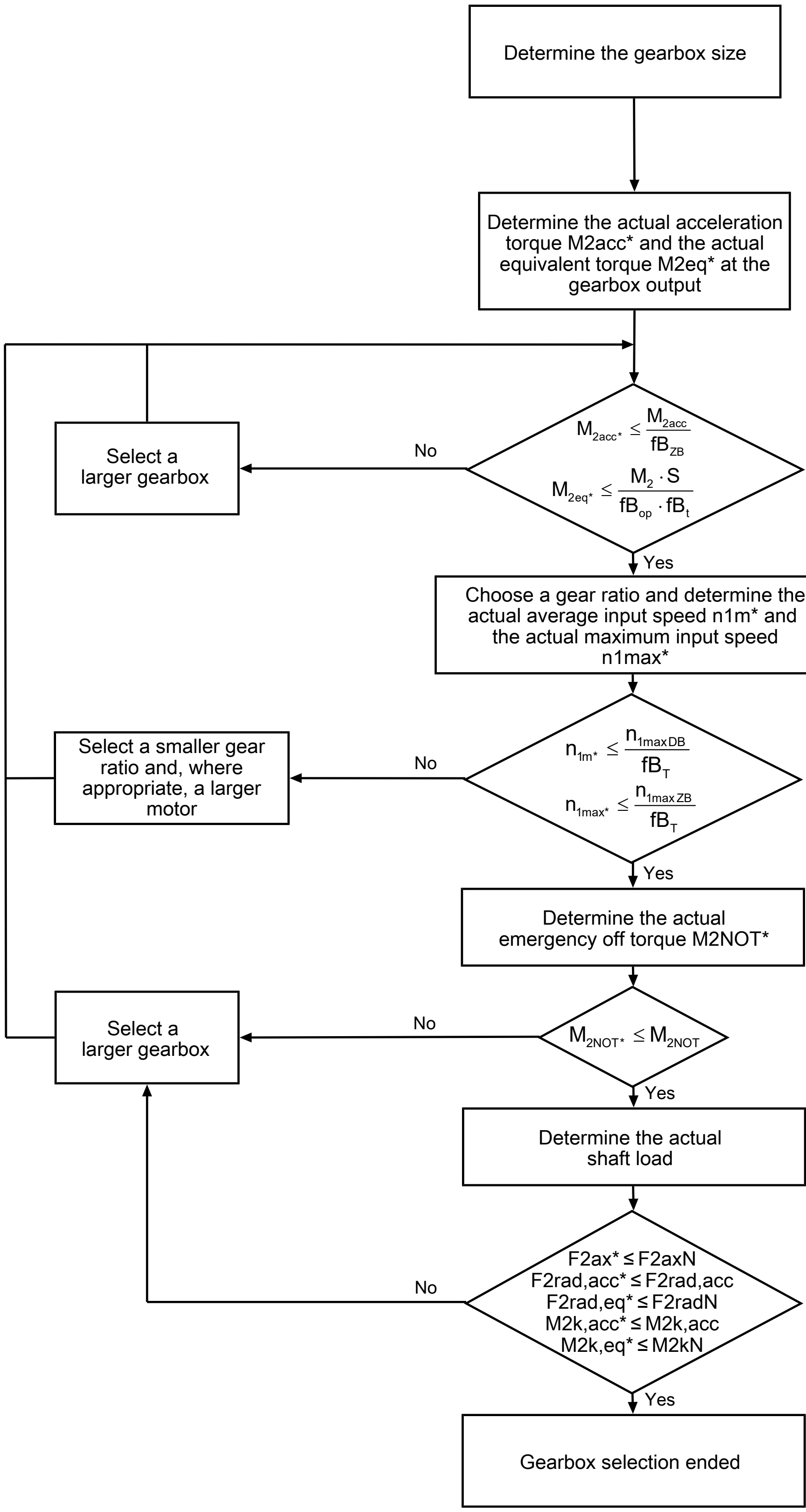
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in the Chapter [▸ 15.1].

The formula symbols for values actually present in the application are marked with *.

12.6.1 Drive selection

Drive selection for gearboxes

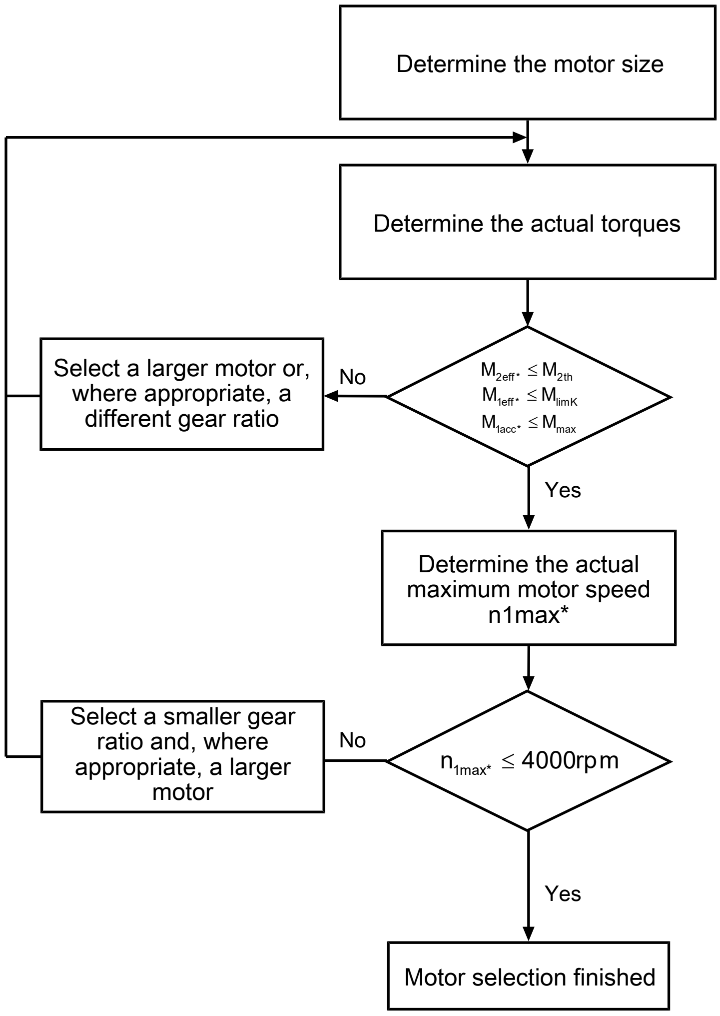


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_2 and S.

The values for fB_T, fB_{op}, fB_t and fB_{ZB} can be found in the corresponding tables in this chapter.

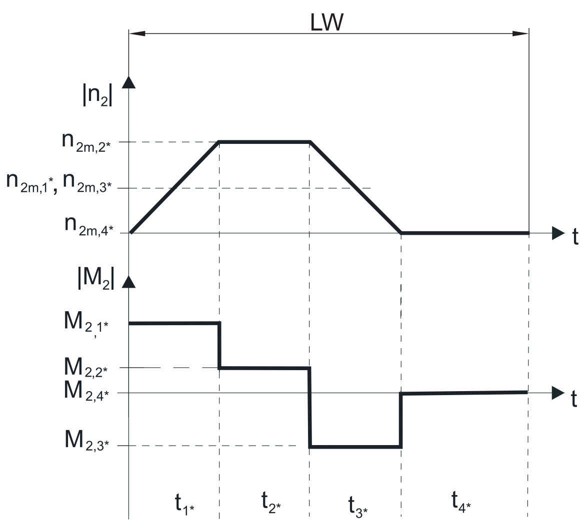
Drive selection for motors



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc^*} = J_{tot} \cdot \frac{\Delta n_2}{9,55 \cdot \Delta t} + M_{L^*}$$

$$M_{1acc^*} = \frac{M_{2acc^*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9,55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \ldots + t_{n^*}}$$

If t_{1*} + ... + $t_{3*} \geq 6$ min, calculate n_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}{}^2 + \ldots + t_{n^*} \cdot M_{2,n^*}{}^2}{t_{1^*} + \ldots + t_{n^*}}}$$

Calculation of the actual emergency off torque

$$M_{2NOT^*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L^*}$$

Calculation of the actual equivalent torque

$$M_{2eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

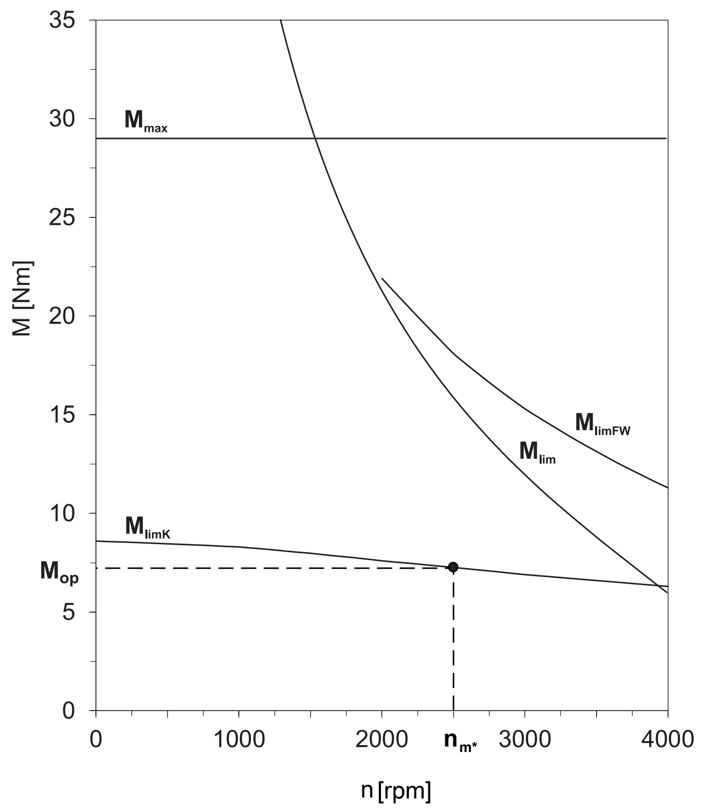
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0,9 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^2$$

Refer to the selection tables for the values of i and a_{th}.

The values for fB_T can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter [▶ 2.3]. Note the size of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.25
Reversing load cyclic operation	1.40

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Cyclic operation	fB_{ZB}
≤ 1000 load changes/hour (LW/h)	1.00
> 1000 load changes/hour (LW/h)	1.15

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gearbox torques (M_{2acc}, M_{2NOT}) in the selection tables.

12.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m^*} \leq 100$ rpm ($F^{2axN} = F_{2ax100}$; $F_{2radN} = F_{2rad100}$; $M_{2kN} = M_{2k100}$)
- Only if radial forces on the gearbox are stabilized by its pilots (housing, flange shaft)

12.6.2.1 G and P shaft designs

Permitted shaft loads for G and P shaft designs (solid shaft)

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
KL1	20.0	380	1900	1900	68	68
KL2	22.0	560	2800	2800	118	118

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m^*} > 100 rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\dfrac{n_{2m^*}}{100\,\text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\dfrac{n_{2m^*}}{100\,\text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\dfrac{n_{2m^*}}{100\,\text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table "Permitted shaft loads" in this chapter.

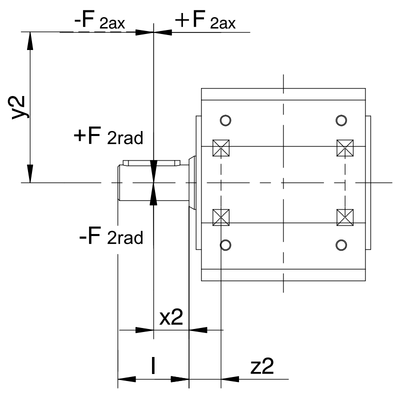


Fig. 1: Force application points for solid shaft

The specified values for $F_{2rad100}$ refer to force application on the center of the output shaft: $x_2 = l/2$.

Shaft dimensions can be found in the "Dimensional drawings" chapter.

The following applies to other force application points:

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

12.6.2.2 A and S shaft design

Permitted shaft loads for A shaft design (hollow shaft with keyway)

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
KL1	18.5	250	1250	1250	43	43
KL2	22.0	560	2800	2800	118	118

Permitted shaft loads for S shaft design (hollow shaft with shrink ring)

Type	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	$F_{2rad,acc}$ [N]	M_{2k100} [Nm]	$M_{2k,acc}$ [Nm]
KL1	18.5	250	1250	1250	43	43
KL2	22.0	560	2800	2800	118	118

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m^*} > 100 rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table "Permitted shaft loads" in this chapter.

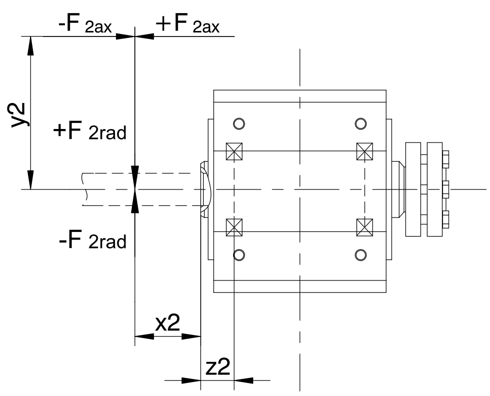


Fig. 2: Force application points for hollow shaft

You can determine the permitted radial forces from the permitted tilting torque M_{2kN} and $M_{2k,acc}$. The actual radial forces may not exceed the permitted radial forces. The permitted radial forces pertain to the shaft end (x2 = 0).

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

12.6.3 Radial shaft seal rings

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

12.7 Additional documentation

Additional documentation related to the product can be found at http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual gearboxes, geared motors KL	443363_en

13 K helical bevel geared motors

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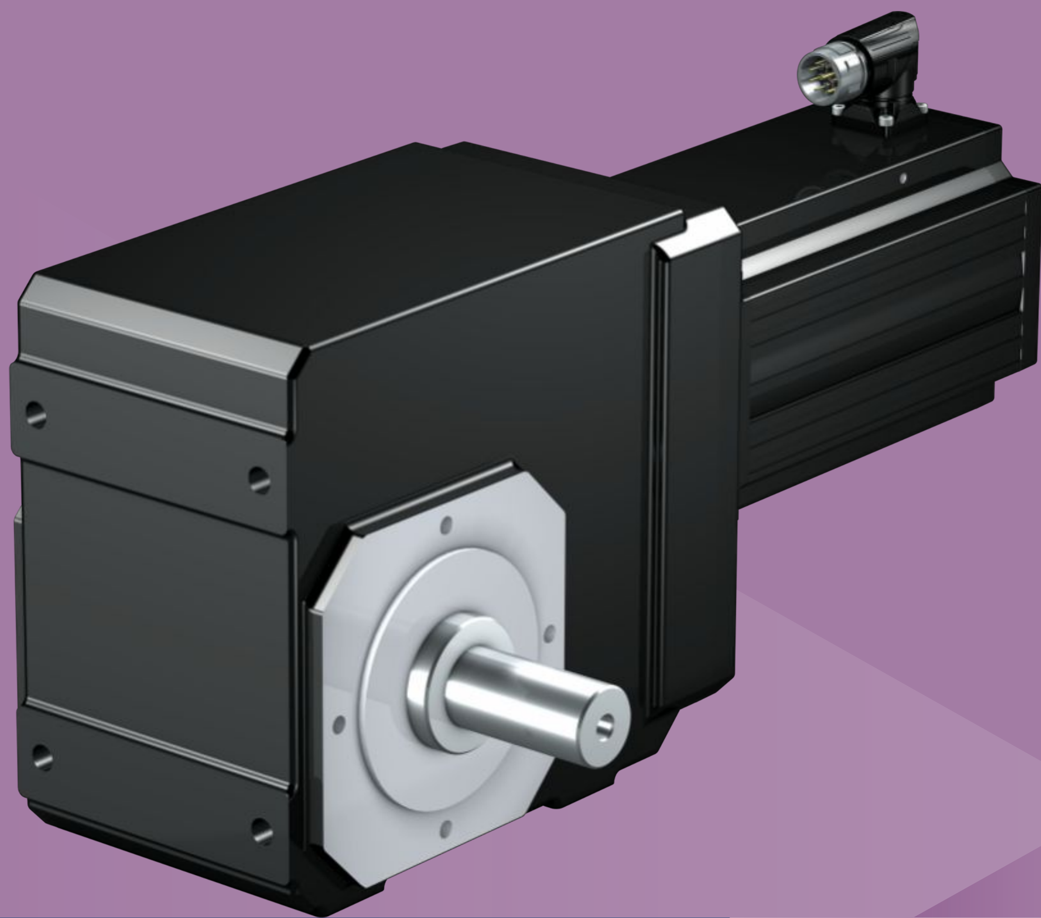


13 Helical bevel geared motors

K

13.1 Overview

Highly rigid helical-geared right-angle geared motor

Features

Power density	★★☆☆☆
Backlash	★★★☆☆
Price category	€€
Shaft load	★★★☆☆
Smooth operation	★★★☆☆
Torsional stiffness	★★☆☆☆
Mass moment of inertia	★★★★★
Helical gearing	✓
Maintenance-free (K1 – K4)	✓
FKM seal ring at the input	✓
Reinforced output bearing (K5 – K8)	✓ (on request)
Compact and dynamic due to direct motor attachment	✓

Key ★☆☆☆☆ good | ★★★★★ excellent
€ Economy | €€€€€ Premium

Technical data

i	4 – 294
M_{2acc}	17 – 6820 Nm
$\Delta\phi_2$	1.5 – 12 arcmin
η_{get}	94 – 97 %

13.2 Selection tables

The technical data specified in the selection tables applies to:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0 °C to 40 °C
- Drives with convection-cooled motors
- Weight specification for mounting position EL1, housing design G

For all other technical data, refer to https://configurator.stoeber.de/en-US/.

An explanation of the formula symbols can be found in the Chapter [▸ 15.1].

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2 [rpm]	n_{1maxDB} EL3,4,5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2redII}$ [arcmin]	$\Delta\varphi_{2redI}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
K1 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 140 Nm)																		
64	102	111	13	0.99	K102_0470 LM401U	122	203	46.92	2299/49	4000	4000	7000	1.7	12.0	6.0	–	6.8	14
85	77	83	11	1.4	K102_0350 LM401U	135	196	35.11	3686/105	4000	4000	7000	1.7	12.0	6.0	–	6.8	14
89	74	79	16	0.99	K102_0340 LM401U	88	146	33.71	4719/140	4000	4000	7000	1.7	12.0	6.0	–	6.8	14
107	61	66	11	1.6	K102_0280 LM401U	123	169	28.05	589/21	4000	4000	7000	1.7	12.0	6.0	–	6.8	14
107	120	122	22	0.83	K102_0280 LM402U	135	240	28.05	589/21	4000	4000	7000	3.1	12.0	6.0	–	6.8	16
119	55	59	12	1.7	K102_0250 LM401U	110	141	25.22	1261/50	4000	4000	7000	1.7	12.0	6.0	–	6.8	14
119	108	110	23	0.89	K102_0250 LM402U	115	192	25.22	1261/50	4000	4000	7000	3.1	12.0	6.0	–	6.8	16
129	51	55	12	1.8	K102_0230 LM401U	102	159	23.27	1140/49	4000	4000	7000	1.8	12.0	6.0	–	6.8	14
129	100	102	23	0.93	K102_0230 LM402U	135	240	23.27	1140/49	4000	4000	7000	3.1	12.0	6.0	–	6.8	16
149	44	47	12	2.0	K102_0200 LM401U	88	121	20.15	403/20	4000	4000	7000	1.7	12.0	6.0	–	6.8	14
149	86	88	23	1.0	K102_0200 LM402U	125	220	20.15	403/20	4000	4000	7000	3.1	12.0	6.0	–	6.8	16
171	38	41	12	2.2	K102_0175 LM401U	77	128	17.56	2090/119	4000	3800	6000	1.8	12.0	6.0	–	6.8	14
171	75	77	23	1.1	K102_0175 LM402U	135	240	17.56	2090/119	4000	3800	6000	3.1	12.0	6.0	–	6.8	16
171	103	105	32	0.82	K102_0175 LM403U	135	240	17.56	2090/119	4000	3800	6000	4.4	12.0	6.0	–	6.8	17
179	36	39	12	2.3	K102_0165 LM401U	73	114	16.71	117/7	4000	4000	7000	1.8	12.0	6.0	–	6.8	14
179	71	73	23	1.2	K102_0165 LM402U	125	220	16.71	117/7	4000	4000	7000	3.1	12.0	6.0	–	6.8	16
179	98	100	32	0.85	K102_0165 LM403U	125	220	16.71	117/7	4000	4000	7000	4.4	12.0	6.0	–	6.8	17
213	31	33	12	2.6	K102_0140 LM401U	62	103	14.11	494/35	4000	3800	6000	1.9	12.0	6.0	–	6.8	14
213	60	62	24	1.3	K102_0140 LM402U	133	240	14.11	494/35	4000	3800	6000	3.2	12.0	6.0	–	6.8	16
213	83	85	33	0.95	K102_0140 LM403U	135	240	14.11	494/35	4000	3800	6000	4.5	12.0	6.0	–	6.8	17
238	28	30	13	2.7	K102_0125 LM401U	55	92	12.62	429/34	4000	3800	6000	1.8	12.0	6.0	–	6.8	14
238	54	55	24	1.4	K102_0125 LM402U	119	220	12.62	429/34	4000	3800	6000	3.2	12.0	6.0	–	6.8	16
238	74	76	33	1.0	K102_0125 LM403U	125	220	12.62	429/34	4000	3800	6000	4.5	12.0	6.0	–	6.8	17
259	25	27	13	2.7	K102_0115 LM401U	51	84	11.57	266/23	3600	3300	5500	1.9	12.0	6.0	–	6.8	14
259	49	50	24	1.5	K102_0115 LM402U	109	240	11.57	266/23	3600	3300	5500	3.3	12.0	6.0	–	6.8	16
259	68	69	33	1.1	K102_0115 LM403U	135	240	11.57	266/23	3600	3300	5500	4.5	12.0	6.0	–	6.8	17
296	22	24	15	2.7	K102_0100 LM401U	44	74	10.14	507/50	4000	3800	6000	1.9	12.0	6.0	–	6.8	14
296	43	44	24	1.6	K102_0100 LM402U	95	220	10.14	507/50	4000	3800	6000	3.2	12.0	6.0	–	6.8	16
296	60	61	33	1.2	K102_0100 LM403U	125	220	10.14	507/50	4000	3800	6000	4.5	12.0	6.0	–	6.8	17
324	20	22	16	2.7	K102_0092 LM401U	40	67	9.249	1748/189	3600	3300	5500	2.0	12.0	6.0	–	6.8	14
324	40	40	25	1.7	K102_0092 LM402U	87	240	9.249	1748/189	3600	3300	5500	3.3	12.0	6.0	–	6.8	16
324	54	56	34	1.3	K102_0092 LM403U	115	240	9.249	1748/189	3600	3300	5500	4.6	12.0	6.0	–	6.8	17
324	85	90	53	0.80	K102_0092 LM503U	129	240	9.249	1748/189	3600	3300	5500	11	12.0	6.0	–	6.8	20
361	18	20	17	2.7	K102_0083 LM401U	36	60	8.309	1911/230	3600	3300	5500	2.0	12.0	6.0	–	6.8	14
361	36	36	25	1.9	K102_0083 LM402U	78	220	8.309	1911/230	3600	3300	5500	3.3	12.0	6.0	–	6.8	16
361	49	50	34	1.4	K102_0083 LM403U	103	220	8.309	1911/230	3600	3300	5500	4.6	12.0	6.0	–	6.8	17
361	76	81	53	0.86	K102_0083 LM503U	125	220	8.309	1911/230	3600	3300	5500	11	12.0	6.0	–	6.8	20
452	15	16	20	2.7	K102_0066 LM401U	29	48	6.644	299/45	3600	3300	5500	2.1	12.0	6.0	–	6.8	14
452	28	29	25	2.2	K102_0066 LM402U	63	193	6.644	299/45	3600	3300	5500	3.4	12.0	6.0	–	6.8	16
452	39	40	35	1.6	K102_0066 LM403U	83	193	6.644	299/45	3600	3300	5500	4.7	12.0	6.0	–	6.8	17
452	61	65	54	1.0	K102_0066 LM503U	116	193	6.644	299/45	3600	3300	5500	11	12.0	6.0	–	6.8	20
500	26	26	25	2.3	K102_0060 LM402U	56	175	6.000	6/1	3300	2800	5000	3.5	12.0	6.0	–	6.8	16
500	35	36	35	1.7	K102_0060 LM403U	75	175	6.000	6/1	3300	2800	5000	4.8	12.0	6.0	–	6.8	17
500	55	59	55	1.1	K102_0060 LM503U	112	175	6.000	6/1	3300	2800	5000	11	12.0	6.0	–	6.8	20
539	12	13	23	2.7	K102_0056 LM401U	24	41	5.568	1520/273	3300	2800	5000	2.3	12.0	6.0	–	6.8	14
539	24	24	26	2.4	K102_0056 LM402U	52	162	5.568	1520/273	3300	2800	5000	3.7	12.0	6.0	–	6.8	16
539	33	33	35	1.8	K102_0056 LM403U	69	162	5.568	1520/273	3300	2800	5000	5.0	12.0	6.0	–	6.8	17
539	51	54	55	1.1	K102_0056 LM503U	109	162	5.568	1520/273	3300	2800	5000	11	12.0	6.0	–	6.8	20
750	8.7	9.4	30	2.7	K102_0040 LM401U	17	29	4.000	4/1	3300	2800	5000	2.5	12.0	6.0	–	6.8	14
750	17	17	26	3.0	K102_0040 LM402U	38	116	4.000	4/1	3300	2800	5000	3.9	12.0	6.0	–	6.8	16
750	24	24	36	2.2	K102_0040 LM403U	50	116	4.000	4/1	3300	2800	5000	5.2	12.0	6.0	–	6.8	17

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB}		n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2redII}$	$\Delta\varphi_{2redI}$	C_2	m
										EL1,2	EL3,4,5,6							
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
K1 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 140 Nm)																		
750	37	39	57	1.4	K102_0040 LM503U	79	116	4.000	4/1	3300	2800	5000	11	12.0	6.0	–	6.8	20
750	53	60	82	0.97	K102_0040 LM505U	93	116	4.000	4/1	3300	2800	5000	18	12.0	6.0	–	6.8	25
K2 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 220 Nm)																		
27	235	254	8.7	0.85	K203_1090 LM401U	220	400	109.5	26273/240	4000	3900	6500	1.7	10.0	6.0	2.5	11	25
33	195	211	8.3	1.0	K203_0910 LM401U	220	400	90.79	46483/512	4000	3900	6500	1.7	10.0	6.0	2.5	11	25
38	171	185	8.0	1.2	K203_0800 LM401U	220	400	79.62	26273/330	4000	3900	6500	1.7	10.0	6.0	2.5	11	25
43	152	164	12	0.87	K202_0690 LM401U	159	253	69.43	6665/96	4000	3900	6500	1.7	10.0	5.0	1.5	11	22
44	147	159	7.7	1.4	K203_0680 LM401U	220	400	68.42	26273/384	4000	3900	6500	1.7	10.0	6.0	2.5	11	25
45	142	153	7.7	1.4	K203_0660 LM401U	220	400	66.03	46483/704	4000	3900	6500	1.7	10.0	6.0	2.5	11	25
54	121	131	9.4	1.3	K202_0560 LM401U	191	270	55.54	1333/24	4000	3900	6500	1.7	10.0	5.0	1.5	11	22
55	117	126	7.3	1.7	K203_0540 LM401U	220	348	54.25	135407/2496	4000	3900	6500	1.8	10.0	6.0	2.5	11	25
55	229	233	14	0.87	K203_0540 LM402U	220	348	54.25	135407/2496	4000	3900	6500	3.1	10.0	6.0	2.5	11	26
59	110	119	15	0.87	K202_0500 LM401U	116	184	50.49	6665/132	4000	3900	6500	1.7	10.0	5.0	1.5	11	22
60	107	116	7.1	1.9	K203_0500 LM401U	215	319	49.76	26273/528	4000	3900	6500	1.7	10.0	6.0	2.5	11	25
60	210	214	14	0.95	K203_0500 LM402U	220	319	49.76	26273/528	4000	3900	6500	3.1	10.0	6.0	2.5	11	26
65	101	109	7.1	2.0	K202_0460 LM401U	202	258	46.23	1849/40	4000	3900	6500	1.7	10.0	5.0	1.5	11	22
65	198	202	14	1.0	K202_0460 LM402U	220	400	46.23	1849/40	4000	3900	6500	3.1	10.0	5.0	1.5	11	23
66	97	105	7.0	2.1	K203_0450 LM401U	195	290	45.22	58609/1296	4000	3900	6500	1.8	10.0	6.0	2.5	11	25
66	191	195	14	1.0	K203_0450 LM402U	220	290	45.22	58609/1296	4000	3900	6500	3.1	10.0	6.0	2.5	11	26
74	88	95	12	1.3	K202_0400 LM401U	139	196	40.39	1333/33	4000	3900	6500	1.7	10.0	5.0	1.5	11	22
76	85	92	6.8	2.3	K203_0390 LM401U	170	253	39.45	135407/3432	4000	3900	6500	1.8	10.0	6.0	2.5	11	25
76	166	170	13	1.2	K203_0390 LM402U	202	253	39.45	135407/3432	4000	3900	6500	3.1	10.0	6.0	2.5	11	26
87	75	81	7.7	2.3	K202_0350 LM401U	151	214	34.55	1935/56	4000	3900	6500	1.8	10.0	5.0	1.5	11	22
87	148	151	14	1.3	K202_0350 LM402U	220	400	34.55	1935/56	4000	3900	6500	3.1	10.0	5.0	1.5	11	23
87	203	207	19	0.93	K202_0350 LM403U	220	400	34.55	1935/56	4000	3900	6500	4.4	10.0	5.0	1.5	11	25
89	73	79	8.8	2.0	K202_0340 LM401U	147	188	33.62	1849/55	4000	3900	6500	1.8	10.0	5.0	1.5	11	22
89	144	147	17	1.1	K202_0340 LM402U	185	308	33.62	1849/55	4000	3900	6500	3.1	10.0	5.0	1.5	11	23
107	120	122	14	1.5	K202_0280 LM402U	220	400	27.95	559/20	4000	3900	6500	3.2	10.0	5.0	1.5	11	23
107	164	168	19	1.1	K202_0280 LM403U	220	400	27.95	559/20	4000	3900	6500	4.5	10.0	5.0	1.5	11	25
119	55	59	9.8	2.3	K202_0250 LM401U	110	156	25.13	1935/77	4000	3900	6500	1.8	10.0	5.0	1.5	11	22
119	107	110	14	1.6	K202_0250 LM402U	220	400	25.13	1935/77	4000	3900	6500	3.1	10.0	5.0	1.5	11	23
119	148	151	19	1.2	K202_0250 LM403U	220	400	25.13	1935/77	4000	3900	6500	4.4	10.0	5.0	1.5	11	25
129	51	55	8.9	2.7	K202_0230 LM401U	101	169	23.18	2967/128	4000	3900	6500	1.9	10.0	5.0	1.5	11	22
129	99	101	14	1.7	K202_0230 LM402U	218	400	23.18	2967/128	4000	3900	6500	3.2	10.0	5.0	1.5	11	23
129	136	139	19	1.2	K202_0230 LM403U	220	400	23.18	2967/128	4000	3900	6500	4.5	10.0	5.0	1.5	11	25
148	87	89	14	1.8	K202_0200 LM402U	191	400	20.33	1118/55	4000	3900	6500	3.2	10.0	5.0	1.5	11	23
148	119	122	20	1.3	K202_0200 LM403U	220	400	20.33	1118/55	4000	3900	6500	4.5	10.0	5.0	1.5	11	25
148	187	199	31	0.85	K202_0200 LM503U	220	400	20.33	1118/55	4000	3900	6500	11	10.0	5.0	1.5	11	28
172	38	41	11	2.7	K202_0175 LM401U	76	127	17.47	559/32	3900	3500	5500	2.0	10.0	5.0	1.5	11	22
172	75	76	14	2.0	K202_0175 LM402U	164	400	17.47	559/32	3900	3500	5500	3.4	10.0	5.0	1.5	11	23
172	103	105	20	1.5	K202_0175 LM403U	217	400	17.47	559/32	3900	3500	5500	4.7	10.0	5.0	1.5	11	25
172	161	171	31	0.94	K202_0175 LM503U	220	400	17.47	559/32	3900	3500	5500	11	10.0	5.0	1.5	11	28
178	37	40	11	2.7	K202_0170 LM401U	74	123	16.86	2967/176	4000	3900	6500	1.9	10.0	5.0	1.5	11	22
178	72	74	15	2.1	K202_0170 LM402U	159	400	16.86	2967/176	4000	3900	6500	3.3	10.0	5.0	1.5	11	23
178	99	101	20	1.5	K202_0170 LM403U	210	400	16.86	2967/176	4000	3900	6500	4.6	10.0	5.0	1.5	11	25
178	155	165	31	0.96	K202_0170 LM503U	220	400	16.86	2967/176	4000	3900	6500	11	10.0	5.0	1.5	11	28
217	59	60	15	2.4	K202_0140 LM402U	130	400	13.85	2881/208	3900	3500	5500	3.5	10.0	5.0	1.5	11	23
217	81	83	20	1.7	K202_0140 LM403U	172	400	13.85	2881/208	3900	3500	5500	4.8	10.0	5.0	1.5	11	25
217	127	135	32	1.1	K202_0140 LM503U	220	400	13.85	2881/208	3900	3500	5500	11	10.0	5.0	1.5	11	28
236	28	30	14	2.7	K202_0125 LM401U	56	92	12.71	559/44	3900	3500	5500	2.1	10.0	5.0	1.5	11	22
236	54	55	15	2.5	K202_0125 LM402U	120	370	12.71	559/44	3900	3500	5500	3.4	10.0	5.0	1.5	11	23
236	75	76	20	1.8	K202_0125 LM403U	158	370	12.71	559/44	3900	3500	5500	4.7	10.0	5.0	1.5	11	25
236	117	124	32	1.2	K202_0125 LM503U	220	370	12.71	559/44	3900	3500	5500	11	10.0	5.0	1.5	11	28
236	169	191	46	0.80	K202_0125 LM505U	220	370	12.71	559/44	3900	3500	5500	17	10.0	5.0	1.5	11	32
260	25	27	15	2.7	K202_0115 LM401U	51	84	11.55	1247/108	3500	3100	5000	2.3	10.0	5.0	1.5	11	22
260	49	50	15	2.7	K202_0115 LM402U	109	336	11.55	1247/108	3500	3100	5000	3.7	10.0	5.0	1.5	11	23
260	68	69	21	1.9	K202_0115 LM403U	144	336	11.55	1247/108	3500	3100	5000	5.0	10.0	5.0	1.5	11	25
260	106	113	32	1.2	K202_0115 LM503U	220	336	11.55	1247/108	3500	3100	5000	11	10.0	5.0	1.5	11	28
260	153	173	47	0.86	K202_0115 LM505U	220	336	11.55	1247/108	3500	3100	5000	17	10.0	5.0	1.5	11	32
298	43	44	15	2.9	K202_0100 LM402U	95	293	10.07	2881/286	3900	3500	5500	3.6	10.0	5.0	1.5	11	23
298	59	60	21	2.1	K202_0100 LM403U	125	293	10.07	2881/286	3900	3500	5500	4.9	10.0	5.0	1.5	11	25
298	93	98	33	1.4	K202_0100 LM503U	199	293	10.07	2881/286	3900	3500	5500	11	10.0	5.0	1.5	11	28
298	134	151	47	0.94	K202_0100 LM505U	220	293	10.07	2881/286	3900	3500	5500	17	10.0	5.0	1.5	11	32
326	39	40	15	3.1	K202_0092 LM402U	86	268	9.190	2279/248	3500	3100	5000	3.9	10.0	5.0	1.5	11	23

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2 [rpm]	n_{1maxDB} EL3,4,5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2redI}$ [arcmin]	$\Delta\varphi_{2redII}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
K2 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 220 Nm)																		
326	54	55	21	2.3	K202_0092 LM403U	114	268	9.190	2279/248	3500	3100	5000	5.2	10.0	5.0	1.5	11	25
326	85	90	33	1.4	K202_0092 LM503U	182	268	9.190	2279/248	3500	3100	5000	11	10.0	5.0	1.5	11	28
326	122	138	47	1.0	K202_0092 LM505U	214	268	9.190	2279/248	3500	3100	5000	18	10.0	5.0	1.5	11	32
357	18	20	19	2.7	K202_0084 LM401U	37	61	8.397	2494/297	3500	3100	5000	2.4	10.0	5.0	1.5	11	22
357	36	37	15	3.3	K202_0084 LM402U	79	244	8.397	2494/297	3500	3100	5000	3.8	10.0	5.0	1.5	11	23
357	49	50	21	2.4	K202_0084 LM403U	105	244	8.397	2494/297	3500	3100	5000	5.1	10.0	5.0	1.5	11	25
357	77	82	33	1.5	K202_0084 LM503U	166	244	8.397	2494/297	3500	3100	5000	11	10.0	5.0	1.5	11	28
357	112	126	48	1.1	K202_0084 LM505U	196	244	8.397	2494/297	3500	3100	5000	18	10.0	5.0	1.5	11	32
421	133	147	68	0.84	K202_0071 LM704U	211	400	7.118	2107/296	3000	2600	4500	38	10.0	5.0	1.5	11	38
449	29	29	16	3.8	K202_0067 LM402U	63	195	6.683	2279/341	3500	3100	5000	4.1	10.0	5.0	1.5	11	23
449	39	40	22	2.8	K202_0067 LM403U	83	195	6.683	2279/341	3500	3100	5000	5.4	10.0	5.0	1.5	11	25
449	61	65	34	1.8	K202_0067 LM503U	132	195	6.683	2279/341	3500	3100	5000	11	10.0	5.0	1.5	11	28
449	89	100	49	1.2	K202_0067 LM505U	156	195	6.683	2279/341	3500	3100	5000	18	10.0	5.0	1.5	11	32
449	125	138	69	0.88	K202_0067 LM704U	207	400	6.683	2279/341	3500	3100	5000	38	10.0	5.0	1.5	11	38
500	26	26	16	4.1	K202_0060 LM402U	56	175	6.000	6/1	3000	2600	4500	4.7	10.0	5.0	1.5	11	23
500	35	36	22	3.0	K202_0060 LM403U	75	175	6.000	6/1	3000	2600	4500	6.0	10.0	5.0	1.5	11	25
500	55	59	34	1.9	K202_0060 LM503U	119	175	6.000	6/1	3000	2600	4500	12	10.0	5.0	1.5	11	28
500	80	90	49	1.3	K202_0060 LM505U	140	175	6.000	6/1	3000	2600	4500	18	10.0	5.0	1.5	11	32
500	112	124	69	0.94	K202_0060 LM704U	200	400	6.000	6/1	3000	2600	4500	38	10.0	5.0	1.5	11	38
579	97	107	70	1.0	K202_0052 LM704U	190	377	5.177	2107/407	3000	2600	4500	38	10.0	5.0	1.5	11	38
687	26	26	22	3.7	K202_0044 LM403U	54	127	4.364	48/11	3000	2600	4500	6.4	10.0	5.0	1.5	11	25
687	40	43	35	2.4	K202_0044 LM503U	86	127	4.364	48/11	3000	2600	4500	12	10.0	5.0	1.5	11	28
687	58	65	51	1.6	K202_0044 LM505U	102	127	4.364	48/11	3000	2600	4500	19	10.0	5.0	1.5	11	32
687	82	90	71	1.2	K202_0044 LM704U	174	317	4.364	48/11	3000	2600	4500	39	10.0	5.0	1.5	11	38
687	109	126	95	0.88	K202_0044 LM706U	180	317	4.364	48/11	3000	2600	4500	56	10.0	5.0	1.5	11	45
750	75	82	72	1.2	K202_0040 LM704U	160	291	4.000	4/1	3000	2600	4500	39	10.0	5.0	1.5	11	38
750	100	116	95	0.93	K202_0040 LM706U	174	291	4.000	4/1	3000	2600	4500	56	10.0	5.0	1.5	11	45
K3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 390 Nm)																		
17	389	421	6.3	0.88	K303_1810 LM401U	385	688	181.0	86903/480	3800	3500	6000	1.7	10.0	5.0	2.5	16	32
22	293	316	5.8	1.2	K303_1360 LM401U	385	700	136.0	14147/104	3800	3500	6000	1.7	10.0	5.0	2.5	16	32
27	235	254	5.5	1.5	K303_1090 LM401U	385	700	109.2	167743/1536	3800	3500	6000	1.7	10.0	5.0	2.5	16	32
33	196	212	5.2	1.8	K303_0910 LM401U	385	585	91.23	26273/288	3800	3500	6000	1.7	10.0	5.0	2.5	16	32
33	385	392	10	0.91	K303_0910 LM402U	385	585	91.23	26273/288	3800	3500	6000	3.1	10.0	5.0	2.5	16	33
38	171	185	6.2	1.7	K303_0790 LM401U	342	509	79.42	167743/2112	3800	3500	6000	1.7	10.0	5.0	2.5	16	32
38	335	342	12	0.85	K303_0790 LM402U	385	509	79.42	167743/2112	3800	3500	6000	3.1	10.0	5.0	2.5	16	33
43	152	164	8.2	1.4	K302_0690 LM401U	238	298	69.43	6665/96	3800	3500	6000	1.7	10.0	4.0	1.5	16	27
44	146	157	5.0	2.3	K303_0680 LM401U	292	434	67.73	74777/1104	3800	3500	6000	1.8	10.0	5.0	2.5	16	32
44	286	291	9.7	1.2	K303_0680 LM402U	347	434	67.73	74777/1104	3800	3500	6000	3.1	10.0	5.0	2.5	16	33
45	143	154	6.3	1.9	K303_0660 LM401U	286	425	66.35	26273/396	3800	3500	6000	1.8	10.0	5.0	2.5	16	32
45	280	285	12	0.96	K303_0660 LM402U	340	425	66.35	26273/396	3800	3500	6000	3.1	10.0	5.0	2.5	16	33
54	238	243	12	1.1	K302_0560 LM402U	318	529	55.71	2451/44	3800	3500	6000	3.1	10.0	4.0	1.5	16	28
54	327	334	17	0.81	K302_0560 LM403U	318	529	55.71	2451/44	3800	3500	6000	4.4	10.0	4.0	1.5	16	30
55	117	127	5.7	2.4	K303_0550 LM401U	235	350	54.58	70735/1296	3800	3500	6000	1.8	10.0	5.0	2.5	16	32
55	230	235	11	1.2	K303_0550 LM402U	280	350	54.58	70735/1296	3800	3500	6000	3.1	10.0	5.0	2.5	16	33
59	110	119	10	1.4	K302_0500 LM401U	173	217	50.49	6665/132	3800	3500	6000	1.8	10.0	4.0	1.5	16	27
61	106	114	6.3	2.3	K303_0490 LM401U	212	316	49.26	74777/1518	3800	3500	6000	1.8	10.0	5.0	2.5	16	32
61	208	212	12	1.2	K303_0490 LM402U	253	316	49.26	74777/1518	3800	3500	6000	3.1	10.0	5.0	2.5	16	33
65	198	202	8.9	1.7	K302_0460 LM402U	385	688	46.23	1849/40	3800	3500	6000	3.2	10.0	4.0	1.5	16	28
65	272	278	12	1.3	K302_0460 LM403U	385	688	46.23	1849/40	3800	3500	6000	4.5	10.0	4.0	1.5	16	30
65	425	452	19	0.81	K302_0460 LM503U	385	688	46.23	1849/40	3800	3500	6000	11	10.0	4.0	1.5	16	33
67	407	432	18	0.86	K303_0450 LM503U	385	700	44.89	11223/250	3800	3500	6000	11	10.0	5.0	2.5	16	38
74	173	177	15	1.1	K302_0410 LM402U	231	385	40.51	4902/121	3800	3500	6000	3.1	10.0	4.0	1.5	16	28
74	238	243	21	0.81	K302_0410 LM403U	231	385	40.51	4902/121	3800	3500	6000	4.4	10.0	4.0	1.5	16	30
77	355	377	18	0.97	K303_0390 LM503U	385	698	39.19	34916/891	3800	3500	6000	11	10.0	5.0	2.5	16	38
84	325	345	18	1.0	K303_0360 LM503U	385	639	35.83	215/6	3800	3500	6000	11	10.0	5.0	2.5	16	38
86	149	152	8.6	2.2	K302_0350 LM402U	327	700	34.73	903/26	3800	3500	6000	3.3	10.0	4.0	1.5	16	28
86	204	209	12	1.6	K302_0350 LM403U	385	700	34.73	903/26	3800	3500	6000	4.6	10.0	4.0	1.5	16	30
86	319	339	18	1.0	K302_0350 LM503U	385	700	34.73	903/26	3800	3500	6000	11	10.0	4.0	1.5	16	33
89	144	147	11	1.7	K302_0340 LM402U	300	501	33.62	1849/55	3800	3500	6000	3.2	10.0	4.0	1.5	16	28
89	198	202	16	1.3	K302_0340 LM403U	300	501	33.62	1849/55	3800	3500	6000	4.5	10.0	4.0	1.5	16	30
89	309	328	24	0.81	K302_0340 LM503U	300	501	33.62	1849/55	3800	3500	6000	11	10.0	4.0	1.5	16	33
92	296	314	18	1.1	K303_0330 LM503U	385	582	32.65	44892/1375	3800	3500	6000	11	10.0	5.0	2.5	16	38
108	119	122	8.8	2.6	K302_0280 LM402U	262	700	27.88	3569/128	3800	3500	6000	3.4	10.0	4.0	1.5	16	28
108	164	167	12	1.9	K302_0280 LM403U	347	700	27.88	3569/128	3800	3500	6000	4.7	10.0	4.0	1.5	16	30

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2 [rpm]	n_{1maxDB} EL3,4,5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2redII}$ [arcmin]	$\Delta\varphi_{2redI}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
K3 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 390 Nm)																		
108	256	272	19	1.2	K302_0280 LM503U	385	700	27.88	3569/128	3800	3500	6000	11	10.0	4.0	1.5	16	33
108	371	418	27	0.83	K302_0280 LM505U	385	700	27.88	3569/128	3800	3500	6000	17	10.0	4.0	1.5	16	37
119	108	110	8.8	2.8	K302_0250 LM402U	238	602	25.26	3612/143	3800	3500	6000	3.3	10.0	4.0	1.5	16	28
119	148	152	12	2.0	K302_0250 LM403U	314	602	25.26	3612/143	3800	3500	6000	4.6	10.0	4.0	1.5	16	30
119	232	247	19	1.3	K302_0250 LM503U	385	602	25.26	3612/143	3800	3500	6000	11	10.0	4.0	1.5	16	33
119	336	379	27	0.89	K302_0250 LM505U	385	602	25.26	3612/143	3800	3500	6000	17	10.0	4.0	1.5	16	37
129	100	102	8.9	2.9	K302_0230 LM402U	219	645	23.29	559/24	3800	3500	6000	3.5	10.0	4.0	1.5	16	28
129	137	140	12	2.1	K302_0230 LM403U	290	645	23.29	559/24	3800	3500	6000	4.8	10.0	4.0	1.5	16	30
129	214	228	19	1.4	K302_0230 LM503U	385	645	23.29	559/24	3800	3500	6000	11	10.0	4.0	1.5	16	33
129	310	350	28	0.94	K302_0230 LM505U	385	645	23.29	559/24	3800	3500	6000	17	10.0	4.0	1.5	16	37
148	87	89	9.0	3.2	K302_0200 LM402U	191	513	20.28	3569/176	3800	3500	6000	3.4	10.0	4.0	1.5	16	28
148	119	122	12	2.3	K302_0200 LM403U	252	513	20.28	3569/176	3800	3500	6000	4.7	10.0	4.0	1.5	16	30
148	186	198	19	1.5	K302_0200 LM503U	385	513	20.28	3569/176	3800	3500	6000	11	10.0	4.0	1.5	16	33
148	269	304	28	1.0	K302_0200 LM505U	385	513	20.28	3569/176	3800	3500	6000	17	10.0	4.0	1.5	16	37
173	74	75	9.1	3.6	K302_0175 LM402U	163	503	17.29	1591/92	3500	3100	5000	3.8	10.0	4.0	1.5	16	28
173	102	104	13	2.6	K302_0175 LM403U	215	503	17.29	1591/92	3500	3100	5000	5.1	10.0	4.0	1.5	16	30
173	159	169	20	1.7	K302_0175 LM503U	342	503	17.29	1591/92	3500	3100	5000	11	10.0	4.0	1.5	16	33
173	230	259	28	1.1	K302_0175 LM505U	385	503	17.29	1591/92	3500	3100	5000	18	10.0	4.0	1.5	16	37
173	323	357	40	0.82	K302_0175 LM704U	385	700	17.29	1591/92	3500	3100	5000	37	10.0	4.0	1.5	16	43
177	72	74	9.1	3.6	K302_0170 LM402U	159	469	16.94	559/33	3800	3500	6000	3.6	10.0	4.0	1.5	16	28
177	100	102	13	2.6	K302_0170 LM403U	211	469	16.94	559/33	3800	3500	6000	4.8	10.0	4.0	1.5	16	30
177	156	165	20	1.7	K302_0170 LM503U	335	469	16.94	559/33	3800	3500	6000	11	10.0	4.0	1.5	16	33
177	225	254	28	1.2	K302_0170 LM505U	375	469	16.94	559/33	3800	3500	6000	17	10.0	4.0	1.5	16	37
177	317	349	40	0.83	K302_0170 LM704U	385	700	16.94	559/33	3800	3500	6000	37	10.0	4.0	1.5	16	43
215	60	61	9.3	4.1	K302_0140 LM402U	131	406	13.94	1505/108	3500	3100	5000	4.0	10.0	4.0	1.5	16	28
215	82	84	13	3.0	K302_0140 LM403U	173	406	13.94	1505/108	3500	3100	5000	5.3	10.0	4.0	1.5	16	30
215	128	136	20	1.9	K302_0140 LM503U	275	406	13.94	1505/108	3500	3100	5000	11	10.0	4.0	1.5	16	33
215	185	209	29	1.3	K302_0140 LM505U	325	406	13.94	1505/108	3500	3100	5000	18	10.0	4.0	1.5	16	37
215	260	287	41	0.94	K302_0140 LM704U	385	700	13.94	1505/108	3500	3100	5000	37	10.0	4.0	1.5	16	43
239	54	55	9.4	4.4	K302_0125 LM402U	118	366	12.58	3182/253	3500	3100	5000	3.9	10.0	4.0	1.5	16	28
239	74	76	13	3.2	K302_0125 LM403U	157	366	12.58	3182/253	3500	3100	5000	5.2	10.0	4.0	1.5	16	30
239	116	123	20	2.0	K302_0125 LM503U	249	366	12.58	3182/253	3500	3100	5000	11	10.0	4.0	1.5	16	33
239	167	189	29	1.4	K302_0125 LM505U	293	366	12.58	3182/253	3500	3100	5000	18	10.0	4.0	1.5	16	37
239	235	259	41	1.0	K302_0125 LM704U	385	700	12.58	3182/253	3500	3100	5000	37	10.0	4.0	1.5	16	43
258	50	51	9.4	4.6	K302_0115 LM402U	109	338	11.61	1161/100	3200	2800	4500	4.4	10.0	4.0	1.5	16	28
258	68	70	13	3.4	K302_0115 LM403U	144	338	11.61	1161/100	3200	2800	4500	5.7	10.0	4.0	1.5	16	30
258	107	113	20	2.2	K302_0115 LM503U	229	338	11.61	1161/100	3200	2800	4500	12	10.0	4.0	1.5	16	33
258	154	174	29	1.5	K302_0115 LM505U	270	338	11.61	1161/100	3200	2800	4500	18	10.0	4.0	1.5	16	37
258	217	239	41	1.1	K302_0115 LM704U	385	700	11.61	1161/100	3200	2800	4500	38	10.0	4.0	1.5	16	43
296	60	61	13	3.7	K302_0100 LM403U	126	295	10.14	3010/297	3500	3100	5000	5.5	10.0	4.0	1.5	16	30
296	93	99	20	2.4	K302_0100 LM503U	200	295	10.14	3010/297	3500	3100	5000	12	10.0	4.0	1.5	16	33
296	135	152	30	1.6	K302_0100 LM505U	236	295	10.14	3010/297	3500	3100	5000	18	10.0	4.0	1.5	16	37
296	189	209	42	1.2	K302_0100 LM704U	385	700	10.14	3010/297	3500	3100	5000	38	10.0	4.0	1.5	16	43
296	252	293	55	0.87	K302_0100 LM706U	385	700	10.14	3010/297	3500	3100	5000	55	10.0	4.0	1.5	16	50
324	173	191	42	1.2	K302_0093 LM704U	370	674	9.267	1075/116	3200	2800	4500	38	10.0	4.0	1.5	16	43
324	231	268	56	0.93	K302_0093 LM706U	385	674	9.267	1075/116	3200	2800	4500	56	10.0	4.0	1.5	16	50
355	50	51	14	4.0	K302_0084 LM403U	105	246	8.444	2322/275	3200	2800	4500	5.9	10.0	4.0	1.5	16	30
355	78	82	22	2.5	K302_0084 LM503U	167	246	8.444	2322/275	3200	2800	4500	12	10.0	4.0	1.5	16	33
355	112	127	32	1.8	K302_0084 LM505U	197	246	8.444	2322/275	3200	2800	4500	18	10.0	4.0	1.5	16	37
355	158	174	42	1.3	K302_0084 LM704U	337	614	8.444	2322/275	3200	2800	4500	38	10.0	4.0	1.5	16	43
355	210	244	56	0.99	K302_0084 LM706U	385	614	8.444	2322/275	3200	2800	4500	55	10.0	4.0	1.5	16	50
406	138	152	43	1.4	K302_0074 LM704U	295	538	7.391	473/64	2700	2300	4000	39	10.0	4.0	1.5	16	43
406	184	214	57	1.1	K302_0074 LM706U	375	538	7.391	473/64	2700	2300	4000	56	10.0	4.0	1.5	16	50
445	126	139	43	1.5	K302_0067 LM704U	269	490	6.740	2150/319	3200	2800	4500	39	10.0	4.0	1.5	16	43
445	168	195	57	1.1	K302_0067 LM706U	364	490	6.740	2150/319	3200	2800	4500	56	10.0	4.0	1.5	16	50
500	112	124	43	1.7	K302_0060 LM704U	240	436	6.000	6/1	2700	2300	4000	40	10.0	4.0	1.5	16	43
500	149	173	58	1.2	K302_0060 LM706U	349	436	6.000	6/1	2700	2300	4000	57	10.0	4.0	1.5	16	50
558	100	111	44	1.8	K302_0054 LM704U	215	391	5.375	43/8	2700	2300	4000	40	10.0	4.0	1.5	16	43
558	134	155	58	1.3	K302_0054 LM706U	313	391	5.375	43/8	2700	2300	4000	57	10.0	4.0	1.5	16	50
687	82	90	45	2.0	K302_0044 LM704U	174	317	4.364	48/11	2700	2300	4000	41	10.0	4.0	1.5	16	43
687	109	126	59	1.5	K302_0044 LM706U	254	317	4.364	48/11	2700	2300	4000	58	10.0	4.0	1.5	16	50
750	75	82	45	2.2	K302_0040 LM704U	160	291	4.000	4/1	2700	2300	4000	41	10.0	4.0	1.5	16	43
750	100	116	60	1.6	K302_0040 LM706U	233	291	4.000	4/1	2700	2300	4000	59	10.0	4.0	1.5	16	50

n_2 [rpm]	M_2 [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1maxDB} EL1,2 [rpm]	n_{1maxDB} EL3,4,5,6 [rpm]	n_{1maxZB} [rpm]	J_1 [kgcm²]	$\Delta\varphi_2$ [arcmin]	$\Delta\varphi_{2redII}$ [arcmin]	$\Delta\varphi_{2redI}$ [arcmin]	C_2 [Nm/arcmin]	m [kg]
K4 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 600 Nm)																		
14	469	507	5.9	0.90	K403_2180 LM401U	508	847	218.2	38399/176	3600	3300	5500	1.7	10.0	5.0	2.5	31	44
17	390	421	4.8	1.3	K403_1810 LM401U	600	977	181.4	14147/78	3600	3300	5500	1.7	10.0	5.0	2.5	31	44
22	293	316	4.8	1.6	K403_1360 LM401U	587	811	136.1	196037/1440	3600	3300	5500	1.7	10.0	5.0	2.5	31	44
22	574	586	9.4	0.81	K403_1360 LM402U	600	811	136.1	196037/1440	3600	3300	5500	3.1	10.0	5.0	2.5	31	46
28	234	253	4.7	1.9	K403_1090 LM401U	469	697	108.8	62651/576	3600	3300	5500	1.8	10.0	5.0	2.5	31	44
28	459	468	9.3	0.96	K403_1090 LM402U	558	697	108.8	62651/576	3600	3300	5500	3.1	10.0	5.0	2.5	31	46
33	196	212	4.8	2.1	K403_0910 LM401U	393	585	91.23	26273/288	3600	3300	5500	1.8	10.0	5.0	2.5	31	44
33	385	392	9.3	1.1	K403_0910 LM402U	468	585	91.23	26273/288	3600	3300	5500	3.1	10.0	5.0	2.5	31	46
38	170	184	6.0	1.9	K403_0790 LM401U	341	507	79.11	62651/792	3600	3300	5500	1.8	10.0	5.0	2.5	31	44
38	334	340	12	0.96	K403_0790 LM402U	406	507	79.11	62651/792	3600	3300	5500	3.1	10.0	5.0	2.5	31	46
45	610	648	14	0.90	K403_0670 LM503U	600	1100	67.30	21199/315	3600	3300	5500	11	10.0	5.0	2.5	31	50
45	143	154	6.0	2.1	K403_0660 LM401U	286	425	66.35	26273/396	3600	3300	5500	1.8	10.0	5.0	2.5	31	44
45	280	285	12	1.1	K403_0660 LM402U	340	425	66.35	26273/396	3600	3300	5500	3.1	10.0	5.0	2.5	31	46
46	594	631	14	0.93	K403_0650 LM503U	600	1013	65.50	32422/495	3600	3300	5500	11	10.0	5.0	2.5	31	50
54	512	544	18	0.83	K402_0560 LM503U	508	847	55.71	2451/44	3600	3300	5500	11	10.0	4.0	1.5	31	46
56	487	517	13	1.1	K403_0540 LM503U	600	957	53.69	38657/720	3600	3300	5500	11	10.0	5.0	2.5	31	50
61	444	471	13	1.2	K403_0490 LM503U	600	869	48.94	169592/3465	3600	3300	5500	11	10.0	5.0	2.5	31	50
61	641	724	19	0.86	K403_0490 LM505U	600	869	48.94	169592/3465	3600	3300	5500	17	10.0	5.0	2.5	31	55
65	426	452	13	1.3	K402_0460 LM503U	600	977	46.31	602/13	3600	3300	5500	11	10.0	4.0	1.5	31	46
65	615	695	19	0.87	K402_0460 LM505U	600	977	46.31	602/13	3600	3300	5500	17	10.0	4.0	1.5	31	51
67	404	429	13	1.3	K403_0450 LM503U	600	794	44.54	1247/28	3600	3300	5500	11	10.0	5.0	2.5	31	50
67	583	659	19	0.93	K403_0450 LM505U	600	794	44.54	1247/28	3600	3300	5500	17	10.0	5.0	2.5	31	55
74	373	396	23	0.83	K402_0410 LM503U	370	616	40.51	4902/121	3600	3300	5500	11	10.0	4.0	1.5	31	46
77	354	376	13	1.4	K403_0390 LM503U	557	696	39.05	38657/990	3600	3300	5500	11	10.0	5.0	2.5	31	50
77	511	577	19	0.99	K403_0390 LM505U	557	696	39.05	38657/990	3600	3300	5500	17	10.0	5.0	2.5	31	55
84	324	344	13	1.6	K403_0360 LM503U	509	637	35.72	13717/384	3600	3300	5500	11	10.0	5.0	2.5	31	50
84	468	528	19	1.1	K403_0360 LM505U	509	637	35.72	13717/384	3600	3300	5500	17	10.0	5.0	2.5	31	55
86	320	340	13	1.6	K402_0350 LM503U	600	811	34.76	4171/120	3600	3300	5500	11	10.0	4.0	1.5	31	46
86	462	522	19	1.1	K402_0350 LM505U	600	811	34.76	4171/120	3600	3300	5500	17	10.0	4.0	1.5	31	51
89	310	329	17	1.3	K402_0340 LM503U	467	710	33.68	4816/143	3600	3300	5500	11	10.0	4.0	1.5	31	46
89	448	505	25	0.87	K402_0340 LM505U	467	710	33.68	4816/143	3600	3300	5500	17	10.0	4.0	1.5	31	51
93	294	312	14	1.6	K403_0320 LM503U	462	577	32.39	2494/77	3600	3300	5500	11	10.0	5.0	2.5	31	50
93	424	479	20	1.1	K403_0320 LM505U	462	577	32.39	2494/77	3600	3300	5500	17	10.0	5.0	2.5	31	55
108	255	271	14	1.8	K402_0280 LM503U	549	746	27.77	1333/48	3600	3300	5500	11	10.0	4.0	1.5	31	46
108	369	417	20	1.3	K402_0280 LM505U	597	746	27.77	1333/48	3600	3300	5500	17	10.0	4.0	1.5	31	51
108	519	573	28	0.89	K402_0280 LM704U	600	1100	27.77	1333/48	3600	3300	5500	37	10.0	4.0	1.5	31	57
119	232	247	14	1.9	K402_0250 LM503U	472	589	25.28	4171/165	3600	3300	5500	11	10.0	4.0	1.5	31	46
119	336	379	20	1.3	K402_0250 LM505U	472	589	25.28	4171/165	3600	3300	5500	17	10.0	4.0	1.5	31	51
119	473	521	28	0.95	K402_0250 LM704U	600	1001	25.28	4171/165	3600	3300	5500	37	10.0	4.0	1.5	31	57
129	214	228	14	2.0	K402_0230 LM503U	460	678	23.29	559/24	3600	3300	5500	11	10.0	4.0	1.5	31	46
129	310	350	20	1.4	K402_0230 LM505U	542	678	23.29	559/24	3600	3300	5500	18	10.0	4.0	1.5	31	51
129	435	480	28	1.0	K402_0230 LM704U	600	1100	23.29	559/24	3600	3300	5500	37	10.0	4.0	1.5	31	57
149	186	197	14	2.2	K402_0200 LM503U	399	542	20.20	1333/66	3600	3300	5500	11	10.0	4.0	1.5	31	46
149	268	303	20	1.6	K402_0200 LM505U	434	542	20.20	1333/66	3600	3300	5500	17	10.0	4.0	1.5	31	51
149	378	417	29	1.1	K402_0200 LM704U	600	1100	20.20	1333/66	3600	3300	5500	37	10.0	4.0	1.5	31	57
149	503	584	38	0.83	K402_0200 LM706U	600	1100	20.20	1333/66	3600	3300	5500	55	10.0	4.0	1.5	31	64
172	325	359	29	1.2	K402_0175 LM704U	600	1100	17.41	731/42	3400	3000	5000	38	10.0	4.0	1.5	31	57
172	433	503	39	0.91	K402_0175 LM706U	600	1100	17.41	731/42	3400	3000	5000	55	10.0	4.0	1.5	31	64
177	156	165	14	2.5	K402_0170 LM503U	335	493	16.94	559/33	3600	3300	5500	11	10.0	4.0	1.5	31	46
177	225	254	21	1.7	K402_0170 LM505U	394	493	16.94	559/33	3600	3300	5500	18	10.0	4.0	1.5	31	51
177	317	349	29	1.2	K402_0170 LM704U	600	1013	16.94	559/33	3600	3300	5500	37	10.0	4.0	1.5	31	57
177	422	490	39	0.93	K402_0170 LM706U	600	1013	16.94	559/33	3600	3300	5500	55	10.0	4.0	1.5	31	64
216	260	286	29	1.4	K402_0140 LM704U	554	1010	13.89	1333/96	3400	3000	5000	38	10.0	4.0	1.5	31	57
216	346	401	39	1.1	K402_0140 LM706U	600	1010	13.89	1333/96	3400	3000	5000	56	10.0	4.0	1.5	31	64
237	237	261	30	1.5	K402_0125 LM704U	505	869	12.66	2924/231	3400	3000	5000	38	10.0	4.0	1.5	31	57
237	315	366	40	1.1	K402_0125 LM706U	600	869	12.66	2924/231	3400	3000	5000	55	10.0	4.0	1.5	31	64
260	215	238	30	1.6	K402_0115 LM704U	460	838	11.52	645/56	3000	2600	4500	39	10.0	4.0	1.5	31	57
260	287	333	40	1.2	K402_0115 LM706U	600	838	11.52	645/56	3000	2600	4500	56	10.0	4.0	1.5	31	64
297	189	208	30	1.8	K402_0100 LM704U	403	735	10.10	1333/132	3400	3000	5000	39	10.0	4.0	1.5	31	57
297	251	292	40	1.3	K402_0100 LM706U	588	735	10.10	1333/132	3400	3000	5000	56	10.0	4.0	1.5	31	64
325	173	191	30	1.9	K402_0092 LM704U	369	672	9.238	2365/256	3000	2600	4500	40	10.0	4.0	1.5	31	57
325	230	267	41	1.4	K402_0092 LM706U	538	672	9.238	2365/256	3000	2600	4500	57	10.0	4.0	1.5	31	64
358	157	173	31	2.0	K402_0084 LM704U	335	610	8.377	645/77	3000	2600	4500	39	10.0	4.0	1.5	31	57
358	209	242	41	1.5	K402_0084 LM706U	488	610	8.377	645/77	3000	2600	4500	57	10.0	4.0	1.5	31	64

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2	n_{1maxDB} EL3,4,5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2redII}$	$\Delta\varphi_{2redI}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
K4 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 600 Nm)																		
446	126	139	31	2.3	K402_0067 LM704U	268	489	6.719	215/32	3000	2600	4500	41	10.0	4.0	1.5	31	57
446	167	194	42	1.7	K402_0067 LM706U	391	489	6.719	215/32	3000	2600	4500	58	10.0	4.0	1.5	31	64
K5 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1000 Nm)																		
24	1114	1184	17	0.81	K514_1250 LM503U	1000	1800	124.9	599633/4800	3400	3000	5000	11	10.0	6.0	3.0	50	57
27	1007	1069	16	0.89	K514_1130 LM503U	1000	1656	112.8	135401/1200	3400	3000	5000	11	10.0	6.0	3.0	50	57
31	876	930	19	0.87	K513_0970 LM503U	916	1392	96.64	38657/400	3400	3000	5000	11	10.0	5.0	2.0	50	52
32	840	892	15	1.1	K514_0940 LM503U	1000	1622	94.15	338923/3600	3400	3000	5000	11	10.0	6.0	3.0	50	57
34	791	840	20	0.87	K513_0870 LM503U	827	1258	87.29	8729/100	3400	3000	5000	11	10.0	5.0	2.0	50	52
35	759	806	15	1.2	K514_0850 LM503U	1000	1465	85.03	76531/900	3400	3000	5000	11	10.0	6.0	3.0	50	57
35	1096	1238	22	0.82	K514_0850 LM505U	1000	1465	85.03	76531/900	3400	3000	5000	17	10.0	6.0	3.0	50	61
39	703	747	15	1.3	K513_0780 LM503U	1000	1396	77.59	26071/336	3400	3000	5000	11	10.0	5.0	2.0	50	52
39	1016	1148	21	0.89	K513_0780 LM505U	1000	1396	77.59	26071/336	3400	3000	5000	17	10.0	5.0	2.0	50	57
43	635	675	16	1.3	K513_0700 LM503U	985	1261	70.08	841/12	3400	3000	5000	11	10.0	5.0	2.0	50	52
43	918	1036	23	0.89	K513_0700 LM505U	985	1261	70.08	841/12	3400	3000	5000	17	10.0	5.0	2.0	50	57
46	585	621	14	1.5	K513_0650 LM503U	1000	1272	64.54	12586/195	3400	3000	5000	11	10.0	5.0	2.0	50	52
46	845	955	20	1.1	K513_0650 LM505U	1000	1272	64.54	12586/195	3400	3000	5000	17	10.0	5.0	2.0	50	57
51	528	561	14	1.7	K513_0580 LM503U	919	1149	58.30	11368/195	3400	3000	5000	11	10.0	5.0	2.0	50	52
51	764	862	20	1.2	K513_0580 LM505U	919	1149	58.30	11368/195	3400	3000	5000	17	10.0	5.0	2.0	50	57
51	1074	1185	28	0.84	K513_0580 LM704U	1000	1800	58.30	11368/195	3400	3000	5000	37	10.0	5.0	2.0	50	62
62	436	464	13	2.0	K513_0480 LM503U	866	1082	48.16	2697/56	3400	3000	5000	11	10.0	5.0	2.0	50	52
62	631	712	19	1.4	K513_0480 LM505U	866	1082	48.16	2697/56	3400	3000	5000	18	10.0	5.0	2.0	50	57
62	887	979	26	1.0	K513_0480 LM704U	1000	1800	48.16	2697/56	3400	3000	5000	37	10.0	5.0	2.0	50	62
69	394	419	14	2.0	K513_0440 LM503U	782	977	43.50	87/2	3400	3000	5000	11	10.0	5.0	2.0	50	52
69	570	643	21	1.4	K513_0440 LM505U	782	977	43.50	87/2	3400	3000	5000	18	10.0	5.0	2.0	50	57
69	801	884	25	1.1	K513_0440 LM704U	1000	1800	43.50	87/2	3400	3000	5000	37	10.0	5.0	2.0	50	62
69	1068	1239	34	0.84	K513_0440 LM706U	1000	1800	43.50	87/2	3400	3000	5000	55	10.0	5.0	2.0	50	70
78	710	783	24	1.3	K513_0390 LM704U	1000	1800	38.53	2697/70	3400	3000	5000	38	10.0	5.0	2.0	50	62
78	946	1098	33	0.95	K513_0390 LM706U	1000	1800	38.53	2697/70	3400	3000	5000	55	10.0	5.0	2.0	50	70
86	641	707	24	1.4	K513_0350 LM704U	1000	1781	34.80	174/5	3400	3000	5000	38	10.0	5.0	2.0	50	62
86	854	991	32	1.1	K513_0350 LM706U	1000	1781	34.80	174/5	3400	3000	5000	55	10.0	5.0	2.0	50	70
93	595	657	23	1.5	K513_0320 LM704U	1000	1800	32.31	20677/640	3400	3000	5000	38	10.0	5.0	2.0	50	62
93	793	920	31	1.1	K513_0320 LM706U	1000	1800	32.31	20677/640	3400	3000	5000	56	10.0	5.0	2.0	50	70
103	538	593	23	1.6	K513_0290 LM704U	1000	1656	29.18	4669/160	3400	3000	5000	38	10.0	5.0	2.0	50	62
103	716	831	31	1.2	K513_0290 LM706U	1000	1656	29.18	4669/160	3400	3000	5000	56	10.0	5.0	2.0	50	70
123	449	495	23	1.8	K513_0240 LM704U	958	1622	24.35	11687/480	2800	2500	4200	39	10.0	5.0	2.0	50	62
123	598	694	31	1.4	K513_0240 LM706U	1000	1622	24.35	11687/480	2800	2500	4200	57	10.0	5.0	2.0	50	70
136	405	447	23	2.0	K513_0220 LM704U	866	1465	21.99	2639/120	2800	2500	4200	40	10.0	5.0	2.0	50	62
136	540	627	31	1.5	K513_0220 LM706U	1000	1465	21.99	2639/120	2800	2500	4200	57	10.0	5.0	2.0	50	70
155	357	393	24	2.1	K513_0195 LM704U	762	1387	19.35	27869/1440	2800	2500	4200	40	10.0	5.0	2.0	50	62
155	475	551	31	1.6	K513_0195 LM706U	1000	1387	19.35	27869/1440	2800	2500	4200	58	10.0	5.0	2.0	50	70
172	322	355	24	2.3	K513_0175 LM704U	688	1253	17.48	6293/360	2800	2500	4200	41	10.0	5.0	2.0	50	62
172	429	498	31	1.7	K513_0175 LM706U	1000	1253	17.48	6293/360	2800	2500	4200	58	10.0	5.0	2.0	50	70
186	296	327	24	2.4	K513_0160 LM704U	633	1153	16.09	26071/1620	2300	2200	3600	42	10.0	5.0	2.0	50	62
186	395	458	32	1.8	K513_0160 LM706U	923	1153	16.09	26071/1620	2300	2200	3600	59	10.0	5.0	2.0	50	70
206	268	295	24	2.6	K513_0145 LM704U	572	1042	14.54	5887/405	2300	2200	3600	42	10.0	5.0	2.0	50	62
206	357	414	32	1.9	K513_0145 LM706U	833	1042	14.54	5887/405	2300	2200	3600	59	10.0	5.0	2.0	50	70
K6 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1600 Nm)																		
16	1646	1749	13	0.88	K614_1850 LM503U	1600	2294	184.6	383873/2080	3100	2800	4500	11	10.0	6.0	3.0	83	77
18	1487	1580	13	0.97	K614_1670 LM503U	1600	2072	166.7	86681/520	3100	2800	4500	11	10.0	6.0	3.0	83	77
20	1322	1404	12	1.1	K614_1480 LM503U	1600	2174	148.2	4551637/30720	3100	2800	4500	11	10.0	6.0	3.0	83	77
22	1194	1268	12	1.2	K614_1340 LM503U	1571	1964	133.8	1027789/7680	3100	2800	4500	11	10.0	6.0	3.0	83	77
24	1099	1167	11	1.3	K614_1230 LM503U	1600	2003	123.2	1261297/10240	3100	2800	4500	11	10.0	6.0	3.0	83	77
24	1588	1793	17	0.91	K614_1230 LM505U	1600	2003	123.2	1261297/10240	3100	2800	4500	17	10.0	6.0	3.0	83	82
27	992	1054	12	1.3	K614_1110 LM503U	1448	1809	111.3	284809/2560	3100	2800	4500	11	10.0	6.0	3.0	83	77
27	1434	1620	18	0.93	K614_1110 LM505U	1448	1809	111.3	284809/2560	3100	2800	4500	17	10.0	6.0	3.0	83	82
31	865	919	15	1.2	K613_0950 LM503U	1290	1888	95.41	293105/3072	3100	2800	4500	11	10.0	5.0	2.0	83	74
31	1250	1411	21	0.86	K613_0950 LM505U	1290	1888	95.41	293105/3072	3100	2800	4500	17	10.0	5.0	2.0	83	78
35	781	830	16	1.2	K613_0860 LM503U	1165	1706	86.18	66185/768	3100	2800	4500	11	10.0	5.0	2.0	83	74
35	1129	1275	23	0.86	K613_0860 LM505U	1165	1706	86.18	66185/768	3100	2800	4500	17	10.0	5.0	2.0	83	78
39	690	733	12	1.7	K613_0760 LM503U	1200	1501	76.14	126697/1664	3100	2800	4500	11	10.0	5.0	2.0	83	74
39	997	1126	18	1.2	K613_0760 LM505U	1200	1501	76.14	126697/1664	3100	2800	4500	18	10.0	5.0	2.0	83	78
39	1403	1548	21	1.0	K613_0760 LM704U	1600	2900	76.14	126697/1664	3100	2800	4500	37	10.0	5.0	2.0	83	84
44	623	662	13	1.7	K613_0690 LM503U	1084	1355	68.77	28609/416	3100	2800	4500	11	10.0	5.0	2.0	83	74
44	901	1017	19	1.2	K613_0690 LM505U	1084	1355	68.77	28609/416	3100	2800	4500	18	10.0	5.0	2.0	83	78

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB} EL1,2	n_{1maxDB} EL3,4,5,6	n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2redII}$	$\Delta\varphi_{2redI}$	C_2	m
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
K6 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 1600 Nm)																		
44	1267	1398	22	1.0	K613_0690 LM704U	1577	2628	68.77	28609/416	3100	2800	4500	37	10.0	5.0	2.0	83	84
47	1174	1295	19	1.2	K613_0640 LM704U	1600	2900	63.71	130479/2048	3100	2800	4500	38	10.0	5.0	2.0	83	84
47	1563	1815	26	0.93	K613_0640 LM706U	1600	2900	63.71	130479/2048	3100	2800	4500	55	10.0	5.0	2.0	83	91
52	1060	1170	19	1.4	K613_0580 LM704U	1600	2781	57.55	29463/512	3100	2800	4500	38	10.0	5.0	2.0	83	84
52	1412	1639	25	1.0	K613_0580 LM706U	1600	2781	57.55	29463/512	3100	2800	4500	55	10.0	5.0	2.0	83	91
63	879	970	19	1.5	K613_0480 LM704U	1600	2294	47.73	39711/832	3100	2800	4500	38	10.0	5.0	2.0	83	84
63	1171	1360	25	1.2	K613_0480 LM706U	1600	2294	47.73	39711/832	3100	2800	4500	56	10.0	5.0	2.0	83	91
70	794	876	19	1.7	K613_0430 LM704U	1600	2072	43.11	8967/208	3100	2800	4500	38	10.0	5.0	2.0	83	84
70	1058	1228	25	1.2	K613_0430 LM706U	1600	2072	43.11	8967/208	3100	2800	4500	56	10.0	5.0	2.0	83	91
78	706	779	19	1.8	K613_0380 LM704U	1508	2174	38.32	156953/4096	3100	2800	4500	39	10.0	5.0	2.0	83	84
78	940	1092	26	1.3	K613_0380 LM706U	1600	2174	38.32	156953/4096	3100	2800	4500	56	10.0	5.0	2.0	83	91
87	638	703	19	1.9	K613_0350 LM704U	1362	1964	34.61	35441/1024	3100	2800	4500	39	10.0	5.0	2.0	83	84
87	849	986	26	1.4	K613_0350 LM706U	1571	1964	34.61	35441/1024	3100	2800	4500	57	10.0	5.0	2.0	83	91
94	587	647	19	2.0	K613_0320 LM704U	1254	2003	31.86	130479/4096	3100	2800	4500	40	10.0	5.0	2.0	83	84
94	782	908	26	1.5	K613_0320 LM706U	1600	2003	31.86	130479/4096	3100	2800	4500	57	10.0	5.0	2.0	83	91
104	530	585	19	2.2	K613_0290 LM704U	1132	1809	28.77	29463/1024	3100	2800	4500	40	10.0	5.0	2.0	83	84
104	706	820	26	1.6	K613_0290 LM706U	1448	1809	28.77	29463/1024	3100	2800	4500	58	10.0	5.0	2.0	83	91
158	350	386	20	2.9	K613_0190 LM704U	748	1361	18.99	17019/896	2600	2300	4000	44	10.0	5.0	2.0	83	84
158	466	541	26	2.1	K613_0190 LM706U	1089	1361	18.99	17019/896	2600	2300	4000	61	10.0	5.0	2.0	83	91
175	316	349	20	3.1	K613_0170 LM704U	675	1229	17.16	549/32	2600	2300	4000	45	10.0	5.0	2.0	83	84
175	421	489	26	2.3	K613_0170 LM706U	984	1229	17.16	549/32	2600	2300	4000	62	10.0	5.0	2.0	83	91
K7 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 2600 Nm)																		
12	2237	2376	11	0.89	K714_2510 LM503U	2245	2807	250.7	320943/1280	2900	2600	4200	11	10.0	6.0	3.0	126	110
13	2020	2146	12	0.89	K714_2260 LM503U	2028	2535	226.5	72471/320	2900	2600	4200	11	10.0	6.0	3.0	126	110
16	1721	1828	11	1.1	K714_1930 LM503U	1938	2423	192.9	320943/1664	2900	2600	4200	11	10.0	6.0	3.0	126	110
17	1554	1651	12	1.1	K714_1740 LM503U	1751	2189	174.2	72471/416	2900	2600	4200	11	10.0	6.0	3.0	126	110
20	2786	3074	16	0.86	K714_1540 LM704U	2600	4800	153.7	39339/256	2900	2600	4200	37	10.0	6.0	3.0	126	121
20	1353	1438	11	1.3	K714_1520 LM503U	1800	2250	151.7	24273/160	2900	2600	4200	11	10.0	6.0	3.0	126	110
20	1956	2208	16	0.91	K714_1520 LM505U	1800	2250	151.7	24273/160	2900	2600	4200	17	10.0	6.0	3.0	126	115
22	2517	2777	16	0.95	K714_1390 LM704U	2600	4558	138.8	8883/64	2900	2600	4200	37	10.0	6.0	3.0	126	121
22	1222	1298	12	1.3	K714_1370 LM503U	1626	2032	137.0	5481/40	2900	2600	4200	11	10.0	6.0	3.0	126	110
22	1766	1995	17	0.91	K714_1370 LM505U	1626	2032	137.0	5481/40	2900	2600	4200	17	10.0	6.0	3.0	126	115
24	2303	2541	16	1.0	K714_1270 LM704U	2600	4524	127.0	520149/4096	2900	2600	4200	37	10.0	6.0	3.0	126	121
26	2080	2295	15	1.2	K714_1150 LM704U	2600	4087	114.7	117453/1024	2900	2600	4200	37	10.0	6.0	3.0	126	121
26	2771	3216	20	0.87	K714_1150 LM706U	2600	4087	114.7	117453/1024	2900	2600	4200	55	10.0	6.0	3.0	126	128
30	1788	1973	14	1.3	K714_0990 LM704U	2600	3805	98.60	1009701/10240	2900	2600	4200	38	10.0	6.0	3.0	126	121
30	2382	2765	19	1.0	K714_0990 LM706U	2600	3805	98.60	1009701/10240	2900	2600	4200	55	10.0	6.0	3.0	126	128
30	1815	2003	19	1.0	K713_0990 LM704U	2221	3225	98.54	100905/1024	2900	2600	4200	38	10.0	5.0	2.0	126	112
34	1615	1782	15	1.4	K714_0890 LM704U	2600	3437	89.06	227997/2560	2900	2600	4200	38	10.0	6.0	3.0	126	121
34	2151	2497	20	1.1	K714_0890 LM706U	2600	3437	89.06	227997/2560	2900	2600	4200	55	10.0	6.0	3.0	126	128
34	1640	1809	20	1.0	K713_0890 LM704U	2006	2913	89.00	22785/256	2900	2600	4200	38	10.0	5.0	2.0	126	112
38	1452	1602	14	1.7	K713_0790 LM704U	2514	3143	78.83	20181/256	2900	2600	4200	38	10.0	5.0	2.0	126	112
38	1935	2246	18	1.2	K713_0790 LM706U	2514	3143	78.83	20181/256	2900	2600	4200	56	10.0	5.0	2.0	126	119
42	1312	1447	15	1.7	K713_0710 LM704U	2271	2839	71.20	4557/64	2900	2600	4200	38	10.0	5.0	2.0	126	112
42	1747	2028	19	1.2	K713_0710 LM706U	2271	2839	71.20	4557/64	2900	2600	4200	56	10.0	5.0	2.0	126	119
46	1195	1318	14	1.9	K713_0650 LM704U	2245	2807	64.85	33201/512	2900	2600	4200	39	10.0	5.0	2.0	126	112
46	1591	1847	18	1.4	K713_0650 LM706U	2245	2807	64.85	33201/512	2900	2600	4200	56	10.0	5.0	2.0	126	119
51	1079	1190	15	1.9	K713_0590 LM704U	2028	2535	58.57	7497/128	2900	2600	4200	39	10.0	5.0	2.0	126	112
51	1437	1669	20	1.4	K713_0590 LM706U	2028	2535	58.57	7497/128	2900	2600	4200	56	10.0	5.0	2.0	126	119
60	919	1014	15	2.1	K713_0500 LM704U	1938	2423	49.88	166005/3328	2900	2600	4200	40	10.0	5.0	2.0	126	112
60	1224	1421	20	1.6	K713_0500 LM706U	1938	2423	49.88	166005/3328	2900	2600	4200	58	10.0	5.0	2.0	126	119
67	830	916	16	2.1	K713_0450 LM704U	1751	2189	45.05	37485/832	2900	2600	4200	40	10.0	5.0	2.0	126	112
67	1106	1284	21	1.6	K713_0450 LM706U	1751	2189	45.05	37485/832	2900	2600	4200	58	10.0	5.0	2.0	126	119
76	723	797	15	2.5	K713_0390 LM704U	1544	2250	39.23	2511/64	2900	2600	4200	42	10.0	5.0	2.0	126	112
76	963	1118	20	1.9	K713_0390 LM706U	1800	2250	39.23	2511/64	2900	2600	4200	60	10.0	5.0	2.0	126	119
85	653	720	16	2.5	K713_0350 LM704U	1395	2032	35.44	567/16	2900	2600	4200	42	10.0	5.0	2.0	126	112
85	870	1010	21	1.9	K713_0350 LM706U	1626	2032	35.44	567/16	2900	2600	4200	60	10.0	5.0	2.0	126	119
K8 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 4650 Nm)																		
12	4646	5125	13	0.81	K814_2560 LM704U	4650	7073	256.2	8854189/34560	2800	2500	4000	37	10.0	6.0	3.0	196	179
13	4196	4629	14	0.81	K814_2310 LM704U	4650	6388	231.4	1999333/8640	2800	2500	4000	37	10.0	6.0	3.0	196	179
16	3479	3839	13	1.0	K814_1920 LM704U	4650	6043	191.9	85963/448	2800	2500	4000	38	10.0	6.0	3.0	196	179
17	3143	3467	14	1.0	K814_1730 LM704U	4366	5458	173.3	2773/16	2800	2500	4000	38	10.0	6.0	3.0	196	179
19	2842	3135	13	1.2	K814_1570 LM704U	4302	5377	156.7	601741/3840	2800	2500	4000	38	10.0	6.0	3.0	196	179
19	3785	4394	17	0.89	K814_1570 LM706U	4302	5377	156.7	601741/3840	2800	2500	4000	55	10.0	6.0	3.0	196	186

n_2	M_2	$M_{2,0}$	a_{th}	S	Type	M_{2acc}	M_{2NOT}	i	i_{exakt}	n_{1maxDB}		n_{1maxZB}	J_1	$\Delta\varphi_2$	$\Delta\varphi_{2redII}$	$\Delta\varphi_{2redI}$	C_2	m
										EL1,2	EL3,4,5,6							
[rpm]	[Nm]	[Nm]				[Nm]	[Nm]			[rpm]	[rpm]	[rpm]	[kgcm²]	[arcmin]	[arcmin]	[arcmin]	[Nm/ arcmin]	[kg]
K8 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 4650 Nm)																		
21	2567	2832	14	1.2	K814_1420 LM704U	3885	4856	141.5	135877/960	2800	2500	4000	38	10.0	6.0	3.0	196	179
21	3419	3969	18	0.89	K814_1420 LM706U	3885	4856	141.5	135877/960	2800	2500	4000	55	10.0	6.0	3.0	196	186
24	2300	2538	12	1.4	K814_1270 LM704U	3916	4895	126.9	1461371/11520	2800	2500	4000	38	10.0	6.0	3.0	196	179
24	3064	3557	17	1.1	K814_1270 LM706U	3916	4895	126.9	1461371/11520	2800	2500	4000	55	10.0	6.0	3.0	196	186
26	2078	2292	13	1.4	K814_1150 LM704U	3537	4421	114.6	329987/2880	2800	2500	4000	38	10.0	6.0	3.0	196	179
26	2768	3213	18	1.1	K814_1150 LM706U	3537	4421	114.6	329987/2880	2800	2500	4000	55	10.0	6.0	3.0	196	186
31	1790	1975	13	1.6	K813_0970 LM704U	2913	3641	97.17	31093/320	2800	2500	4000	39	10.0	5.0	2.0	196	166
31	2385	2768	17	1.2	K813_0970 LM706U	2913	3641	97.17	31093/320	2800	2500	4000	56	10.0	5.0	2.0	196	173
34	1617	1784	14	1.6	K813_0880 LM704U	2630	3288	87.76	7021/80	2800	2500	4000	39	10.0	5.0	2.0	196	166
34	2154	2500	19	1.2	K813_0880 LM706U	2630	3288	87.76	7021/80	2800	2500	4000	57	10.0	5.0	2.0	196	173
38	1462	1613	14	1.8	K813_0790 LM704U	2614	3267	79.38	45725/576	2800	2500	4000	40	10.0	5.0	2.0	196	166
38	1948	2262	18	1.3	K813_0790 LM706U	2614	3267	79.38	45725/576	2800	2500	4000	58	10.0	5.0	2.0	196	173
42	1321	1457	15	1.8	K813_0720 LM704U	2361	2951	71.70	10325/144	2800	2500	4000	40	10.0	5.0	2.0	196	166
42	1760	2043	19	1.3	K813_0720 LM706U	2361	2951	71.70	10325/144	2800	2500	4000	58	10.0	5.0	2.0	196	173
61	903	996	14	2.4	K813_0490 LM704U	1928	2694	48.99	5487/112	2800	2500	4000	45	10.0	5.0	2.0	196	166
61	1202	1396	19	1.8	K813_0490 LM706U	2155	2694	48.99	5487/112	2800	2500	4000	63	10.0	5.0	2.0	196	173
68	815	899	15	2.4	K813_0440 LM704U	1742	2433	44.25	177/4	2800	2500	4000	46	10.0	5.0	2.0	196	166
68	1086	1261	20	1.8	K813_0440 LM706U	1946	2433	44.25	177/4	2800	2500	4000	63	10.0	5.0	2.0	196	173
K9 (n_{1N} = 3000 min^{-1}, $M_{2acc,max}$ = 6820 Nm)																		
10	5327	5877	12	0.85	K914_2940 LM704U	6820	8525	293.8	977647/3328	2600	2500	3800	38	10.0	5.0	–	379	293
12	4479	4942	12	0.97	K914_2470 LM704U	5731	7164	247.0	3288449/13312	2600	2500	3800	38	10.0	5.0	–	379	293
16	3476	3834	12	1.2	K914_1920 LM704U	5073	6341	191.7	4710481/24576	2600	2500	3800	38	10.0	5.0	–	379	293
16	4630	5375	16	0.89	K914_1920 LM706U	5073	6341	191.7	4710481/24576	2600	2500	3800	56	10.0	5.0	–	379	300
20	2702	2981	12	1.4	K914_1490 LM704U	4600	5750	149.0	9154331/61440	2600	2500	3800	39	10.0	5.0	–	379	293
20	3599	4178	16	1.1	K914_1490 LM706U	4600	5750	149.0	9154331/61440	2600	2500	3800	56	10.0	5.0	–	379	300
24	2281	2516	12	1.6	K914_1260 LM704U	3883	4854	125.8	2221925/17664	2600	2500	3800	40	10.0	5.0	–	379	293
24	3038	3527	15	1.2	K914_1260 LM706U	3883	4854	125.8	2221925/17664	2600	2500	3800	57	10.0	5.0	–	379	300
32	1700	1876	14	1.7	K914_0940 LM704U	2895	3619	93.78	4177219/44544	2600	2500	3800	41	10.0	5.0	–	379	293
32	2265	2630	18	1.3	K914_0940 LM706U	2895	3619	93.78	4177219/44544	2600	2500	3800	58	10.0	5.0	–	379	300

13.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gearbox dimensions, motor dimensions and geared motor dimensions.

Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

We reserve the right to make dimensional changes due to ongoing technical development.

You can download 3D models of our standard drives at https://configurator.stoeber.de/en-US/.

Tolerances

Axis height in accordance with DIN 747	Tolerance
Up to 50 mm	-0.4 mm
Up to 250 mm	-0.5 mm
Up to 630 mm	-0.6 mm

Solid shaft	Tolerance
Shaft ∅ fit ≤ 50 mm	DIN 748-1, ISO k6
Shaft ∅ fit > 50 mm	DIN 748-1, ISO m6
Feather keys	DIN 6885-1, high form A

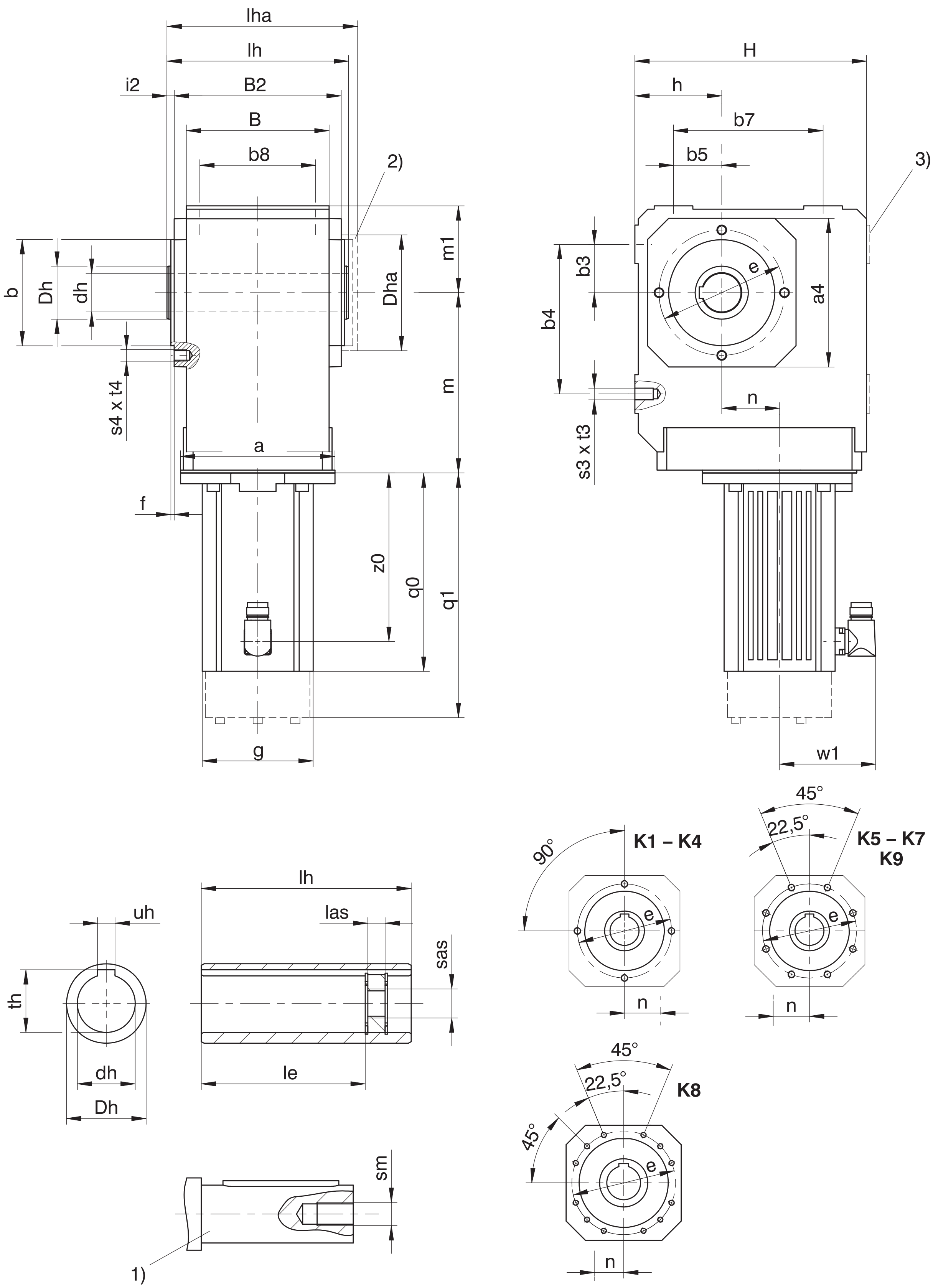
Hollow shaft	Tolerance
Hollow shaft hole fit	ISO H7
Feather keys	DIN 6885-1, high form K1 ∅30: DIN 6885-3, low form

Flange	Pilot tolerance
Up to 300 mm	ISO j6
Starting at 350 mm	ISO h6

Centering holes in solid shafts in accordance with DIN 332-2, DR shape

Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth [mm]	10	12.5	16	19	22	28	36	42	50

13.3.1 A shaft design (hollow shaft), G housing design (pitch circle diameter)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.	2)	Cover (optional)
3)	Only for K1 (other sizes on request)		

Dimensions of gearboxes

Type	□a4	∅b	b3	b4	b5	b7	b8	B	B2	∅dh	∅Dh	Dha	∅e	f	h	H	i2	le	lh	las	lha	m1	s3	s4	sm	sas	t3	t4	th	uh
K1	105	75_{j6}	30	90	30	90	70	90	106	20^{H7}	40	□105	90	3.0	60	160	7.0	98.0	120	12	127.0	60	M8	M8	M6	M8	13	13	22.8	6^{JS9}
K1	105	75_{j6}	30	90	30	90	70	90	106	25^{H7}	40	□105	90	3.0	60	160	7.0	98.0	120	12	127.0	60	M8	M8	M10	M12	13	13	28.3	8^{JS9}
K1	105	75_{j6}	30	90	30	90	70	90	106	30^{H7}	40	□105	90	3.0	60	160	7.0	93.5	120	12	127.0	60	M8	M8	M10	M12	13	13	32.0	8^{JS9}
K2	116	82_{j6}	35	115	35	115	90	115	134	30^{H7}	45	□116	100	3.0	65	190	7.0	121.5	148	12	156.0	65	M10	M8	M10	M12	16	13	33.3	8^{JS9}
K3	132	95_{j6}	40	130	40	130	105	130	146	35^{H7}	50	□132	115	3.0	75	213	7.0	125.0	160	12	168.0	75	M10	M8	M12	M16	16	13	38.3	10^{JS9}
K4	152	110_{j6}	50	155	50	155	120	148	173	40^{H7}	55	□152	130	3.5	90	240	7.5	157.0	188	12	197.5	90	M12	M10	M16	M20	19	16	43.3	12^{JS9}
K5	145	110_{j6}	40	140	100	140	125	160	185	50^{H7}	65	□145	130	3.5	160	260	7.5	164.0	200	12	209.5	100	M16	M10	M16	M20	26	16	53.8	14^{JS9}
K6	180	140_{j6}	50	160	110	160	130	168	200	50^{H7}	70	∅183	165	3.5	190	310	7.5	179.0	215	12	224.5	120	M16	M10	M16	M20	26	16	53.8	14^{JS9}
K7	195	155_{j6}	55	180	125	180	145	190	226	60^{H7}	85	∅205	185	3.5	212	342	8.0	214.0	242	12	252.0	125	M20	M12	M20	M24	33	19	64.4	18^{JS9}
K8	226	185_{j6}	75	240	165	240	185	235	282	70^{H7}	100	∅184	215	4.0	265	410	9.0	263.0	300	20	311.0	145	M24	M12	M20	M24	38	19	74.9	20^{JS9}
K9	280	230_{j6}	95	280	185	280	225	285	330	90^{H7}	120	∅230	265	5.0	315	495	10.0	302.0	350	26	361.0	180	M30	M16	M24	M30	48	26	95.4	25^{JS9}

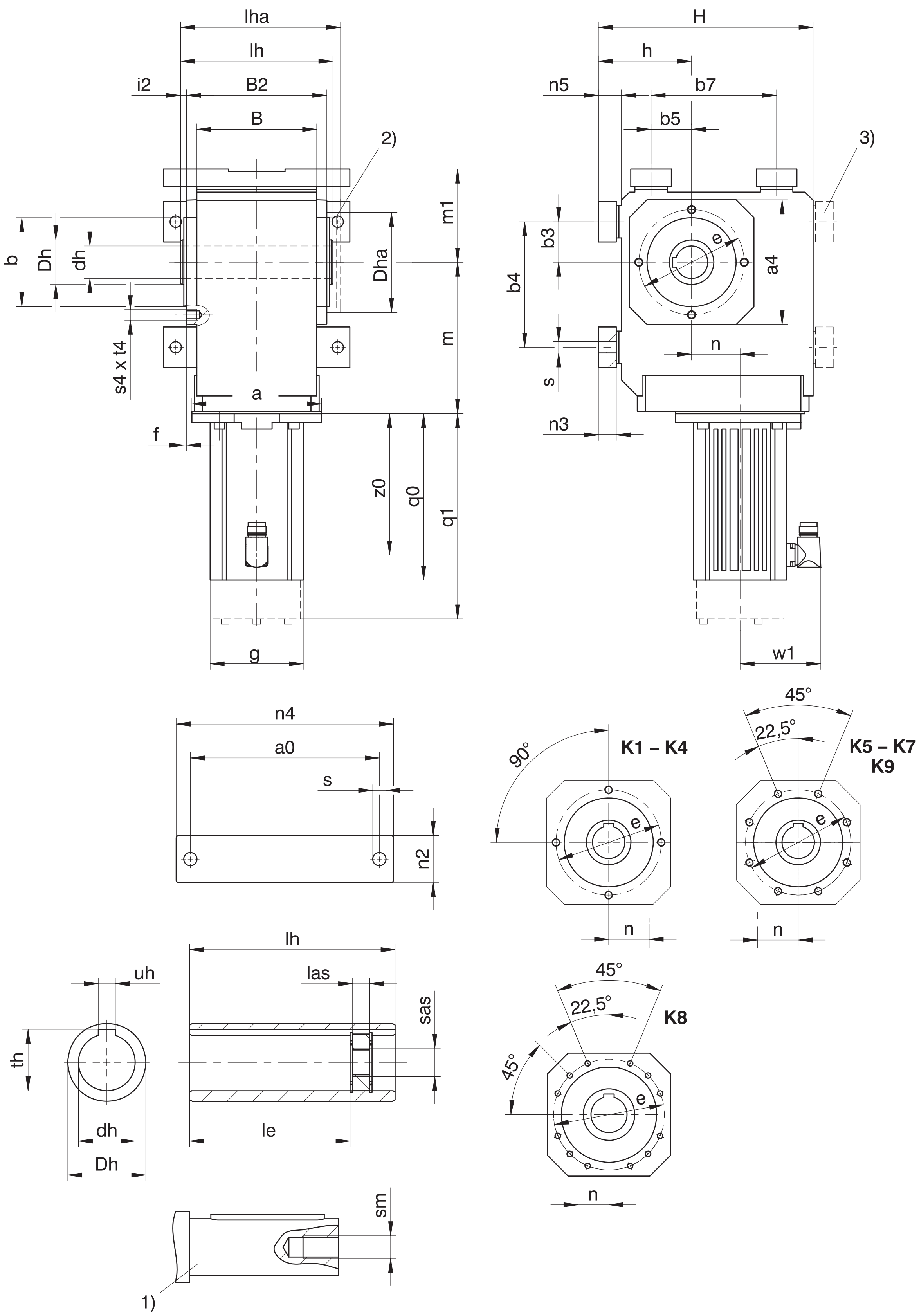
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.2 A shaft design (hollow shaft), NG housing design (base + pitch circle diameter)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.	2)	Cover (optional)
3)	Only for K1 (other sizes on request)		

Dimensions of gearboxes

Type	a0	□a4	∅b	b3	b4	b5	b7	B	B2	∅dh	∅Dh	Dha	∅e	f	h	H	i2	le	lh	las	lha	m1	n2	n3	n4	n5	∅s	s4	sm	sas	t4	th	uh
K1	115	105	75_{j6}	30	90	30	90	90	106	20^{H7}	40	□105	90	3.0	75	175	7.0	98.0	120	12	127.0	75	30	13	140	15	9.0	M8	M6	M8	13	22.8	6^{JS9}
K1	115	105	75_{j6}	30	90	30	90	90	106	25^{H7}	40	□105	90	3.0	75	175	7.0	98.0	120	12	127.0	75	30	13	140	15	9.0	M8	M10	M12	13	28.3	8^{JS9}
K1	115	105	75_{j6}	30	90	30	90	90	106	30^{H7}	40	□105	90	3.0	75	175	7.0	93.5	120	12	127.0	75	30	13	140	15	9.0	M8	M10	M12	13	32.0	8^{JS9}
K2	155	116	82_{j6}	35	115	35	115	115	134	30^{H7}	45	□116	100	3.0	88	213	7.0	121.5	148	12	156.0	88	40	20	185	23	11.0	M8	M10	M12	13	33.3	8^{JS9}
K3	170	132	95_{j6}	40	130	40	130	130	146	35^{H7}	50	□132	115	3.0	98	236	7.0	125.0	160	12	168.0	98	45	20	200	23	11.0	M8	M12	M16	13	38.3	10^{JS9}
K4	200	152	110_{j6}	50	155	50	155	148	173	40^{H7}	55	□152	130	3.5	115	265	7.5	157.0	188	12	197.5	115	50	22	230	25	14.0	M10	M16	M20	16	43.3	12^{JS9}
K5	200	145	110_{j6}	40	140	100	140	160	185	50^{H7}	65	□145	130	3.5	190	290	7.5	164.0	200	12	209.5	130	60	27	240	30	18.0	M10	M16	M20	16	53.8	14^{JS9}
K6	210	180	140_{j6}	50	160	110	160	168	200	50^{H7}	70	∅183	165	3.5	220	340	7.5	179.0	215	12	224.5	150	65	27	250	30	18.5	M10	M16	M20	16	53.8	14^{JS9}
K7	241	195	155_{j6}	55	180	125	180	190	226	60^{H7}	85	∅205	185	3.5	250	380	8.0	214.0	242	12	252.0	163	70	35	290	38	23.0	M12	M20	M24	19	64.4	18^{JS9}
K8	300	226	185_{j6}	75	240	165	240	235	282	70^{H7}	100	∅184	215	4.0	310	455	9.0	263.0	300	20	311.0	190	85	41	360	45	27.0	M12	M20	M24	19	74.9	20^{JS9}
K9	360	280	230_{j6}	95	280	185	280	285	330	90^{H7}	120	∅230	265	5.0	365	545	10.0	302.0	350	26	361.0	230	95	46	430	50	31.0	M16	M24	M30	26	95.4	25^{JS9}

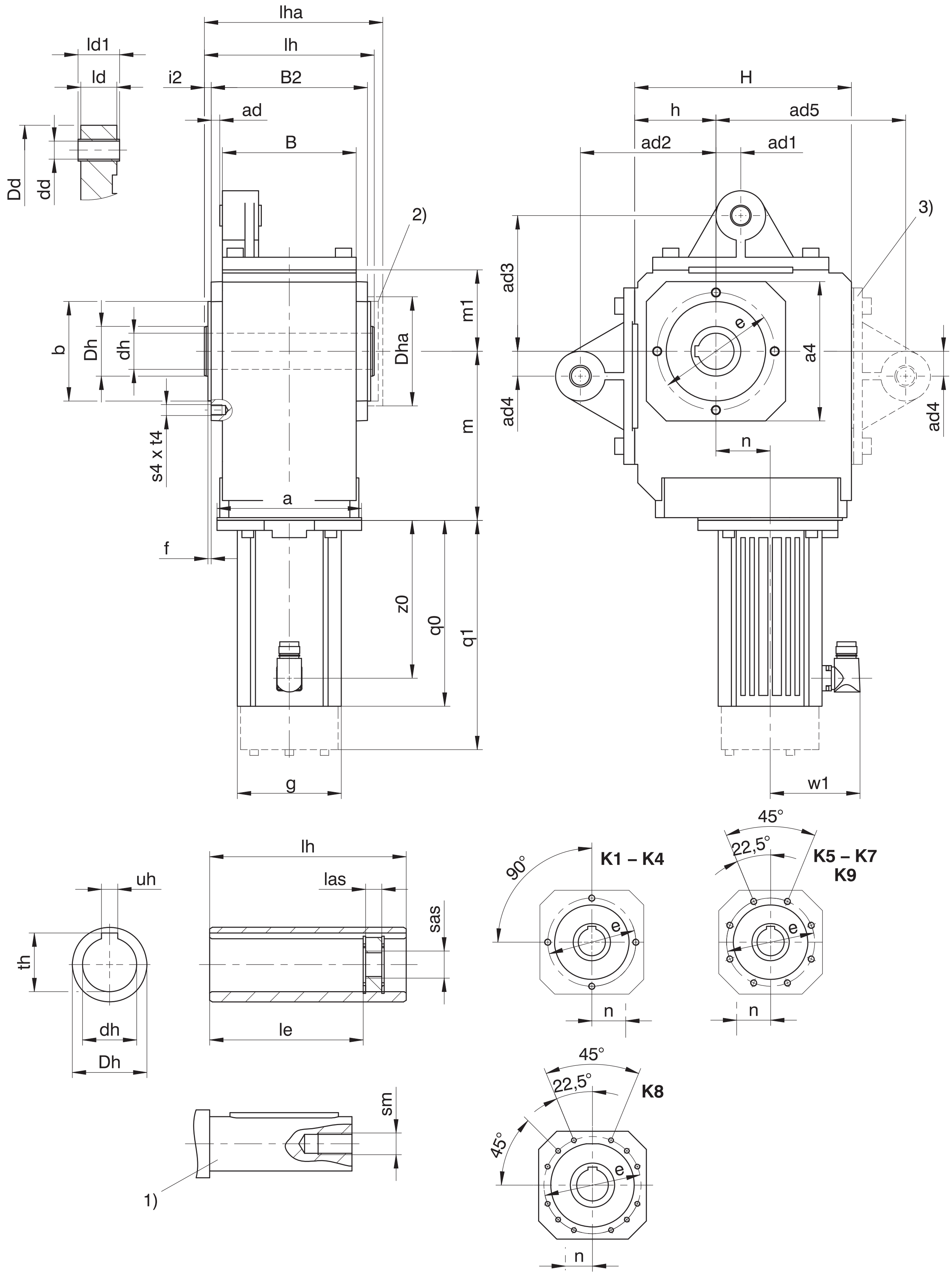
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.3 A shaft design (hollow shaft), GD housing design (pitch circle diameter + torque arm bracket)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

1) The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.

2) Cover (optional)

3) Only for K1 (other sizes on request)

– If you brace the gearboxes without the torque arm brackets provided by the manufacturer for this purpose, the dimensions for ad2 and ad3 must meet the specified value.

Dimensions of gearboxes

Type	□a4	ad	ad1	ad2	ad3	ad4	ad5	⌀b	B	B2	⌀dd	⌀dh	⌀Dd	⌀Dh	Dha	⌀e	f
K1	105	6.0	15.0	90	90	15.0	130	75_{j6}	90	106	12^{H9}	20^{H7}	43	40	□105	90	3.0
K1	105	6.0	15.0	90	90	15.0	130	75_{j6}	90	106	12^{H9}	25^{H7}	43	40	□105	90	3.0
K1	105	6.0	15.0	90	90	15.0	130	75_{j6}	90	106	12^{H9}	30^{H7}	43	40	□105	90	3.0
K2	116	6.5	22.5	100	100	22.5	–	82_{j6}	115	134	16^{H9}	30^{H7}	45	45	□116	100	3.0
K3	132	5.0	25.0	120	120	25.0	–	95_{j6}	130	146	16^{H9}	35^{H7}	45	50	□132	115	3.0
K4	152	9.5	27.5	150	150	27.5	–	110_{j6}	148	173	20^{H9}	40^{H7}	55	55	□152	130	3.5
K5	145	9.5	30.0	250	190	30.0	–	110_{j6}	160	185	20^{H9}	50^{H7}	58	65	□145	130	3.5
K6	180	13.0	30.0	250	180	30.0	–	140_{j6}	168	200	20^{H9}	50^{H7}	58	70	⌀183	165	3.5
K7	195	15.0	35.0	300	213	35.0	–	155_{j6}	190	226	20^{H9}	60^{H7}	68	85	⌀205	185	3.5
K8	226	17.0	45.0	350	230	45.0	–	185_{j6}	235	282	24^{H9}	70^{H7}	72	100	⌀184	215	4.0
K9	280	16.0	45.0	450	315	45.0	–	230_{j6}	285	330	24^{H9}	90^{H7}	75	120	⌀230	265	5.0

Dimensions of gearboxes

Type	h	H	i2	ld	ld1	le	lh	las	lha	m1	s4	sm	sas	t4	th	uh
K1	60	160	7.0	24	28	98.0	120	12	127.0	60	M8	M6	M8	13	22.8	6^{JS9}
K1	60	160	7.0	24	28	98.0	120	12	127.0	60	M8	M10	M12	13	28.3	8^{JS9}
K1	60	160	7.0	24	28	93.5	120	12	127.0	60	M8	M10	M12	13	32.0	8^{JS9}
K2	65	190	7.0	32	38	121.5	148	12	156.0	65	M8	M10	M12	13	33.3	8^{JS9}
K3	75	213	7.0	32	38	125.0	160	12	168.0	75	M8	M12	M16	13	38.3	10^{JS9}
K4	90	240	7.5	40	46	157.0	188	12	197.5	90	M10	M16	M20	16	43.3	12^{JS9}
K5	160	260	7.5	40	46	164.0	200	12	209.5	100	M10	M16	M20	16	53.8	14^{JS9}
K6	190	310	7.5	40	46	179.0	215	12	224.5	120	M10	M16	M20	16	53.8	14^{JS9}
K7	212	342	8.0	64	70	214.0	242	12	252.0	125	M12	M20	M24	19	64.4	18^{JS9}
K8	265	410	9.0	102	115	263.0	300	20	311.0	145	M12	M20	M24	19	74.9	20^{JS9}
K9	315	495	10.0	102	115	302.0	350	26	361.0	180	M16	M24	M30	26	95.4	25^{JS9}

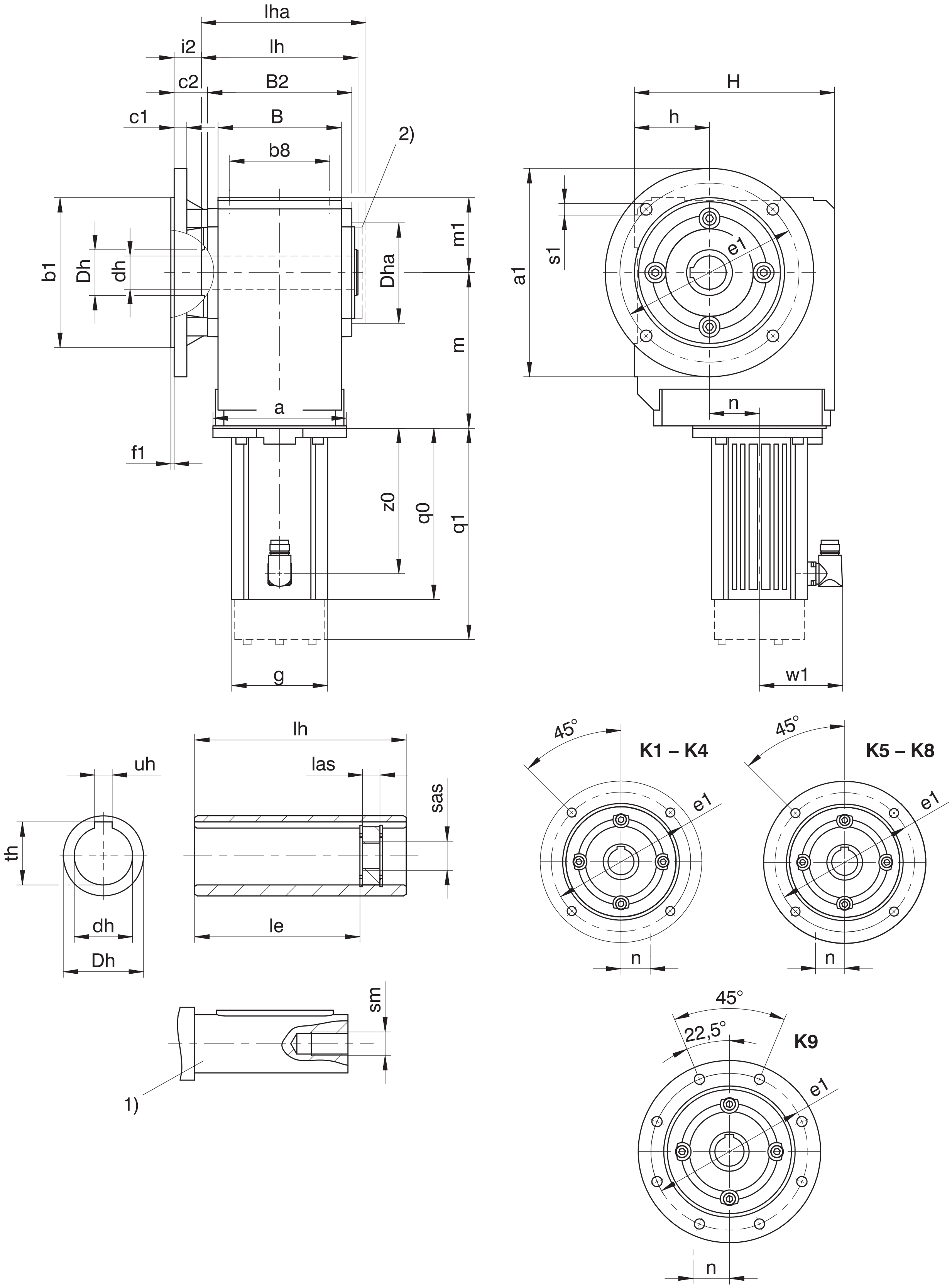
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	⌀140	180	46.0	–	–	–	–	–	–
K302	⌀140	163	52.5	□115	167	52.5	□145	169	52.5
K303	⌀140	200	52.5	⌀160	210	16.0	–	–	–
K402	–	–	–	⌀160	187	60.0	□145	189	60.0
K403	⌀140	220	60.0	⌀160	230	23.0	–	–	–
K513	–	–	–	⌀160	172	15.0	□145	174	15.0
K514	–	–	–	⌀160	215	15.0	–	–	–
K613	–	–	–	⌀160	191	18.0	⌀200	193	18.0
K614	–	–	–	⌀160	234	18.0	–	–	–
K713	–	–	–	–	–	–	⌀200	221	20.0
K714	–	–	–	⌀160	263	20.0	⌀200	283	20.0
K813	–	–	–	–	–	–	⌀200	247	24.0
K814	–	–	–	–	–	–	⌀200	308	24.0
K914	–	–	–	–	–	–	⌀200	353	25.0

13.3.4 A shaft design (hollow shaft), F housing design (round flange)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.	2)	Cover (optional)

Dimensions of gearboxes

Type	∅a1	∅b1	b8	B	B2	c1	c2	∅dh	∅Dh	Dha	∅e1	f1	h	H	i2	le	lh	las	lha	m1	∅s1	sm	sas	th	uh
K1	160	110_{j6}	70	90	106	10	32.0	20^{H7}	40	□105	130	3.5	60	160	25.0	98.0	120	12	127.0	60	9	M6	M8	22.8	6^{JS9}
K1	160	110_{j6}	70	90	106	10	32.0	25^{H7}	40	□105	130	3.5	60	160	25.0	98.0	120	12	127.0	60	9	M10	M12	28.3	8^{JS9}
K1	160	110_{j6}	70	90	106	10	32.0	30^{H7}	40	□105	130	3.5	60	160	25.0	93.5	120	12	127.0	60	9	M10	M12	32.0	8^{JS9}
K2	200	130_{j6}	90	115	134	12	32.0	30^{H7}	45	□116	165	3.5	65	190	25.0	121.5	148	12	156.0	65	11	M10	M12	33.3	8^{JS9}
K3	200	130_{j6}	105	130	146	14	38.0	35^{H7}	50	□132	165	3.5	75	213	31.0	125.0	160	12	168.0	75	11	M12	M16	38.3	10^{JS9}
K4	250	180_{j6}	120	148	173	15	40.0	40^{H7}	55	□152	215	4.0	90	240	32.5	157.0	188	12	197.5	90	14	M16	M20	43.3	12^{JS9}
K5	250	180_{j6}	125	160	185	15	39.5	50^{H7}	65	□145	215	4.0	160	260	32.0	164.0	200	12	209.5	100	14	M16	M20	53.8	14^{JS9}
K6	300	230_{j6}	130	168	200	17	36.0	50^{H7}	70	∅183	265	4.0	190	310	28.5	179.0	215	12	224.5	120	14	M16	M20	53.8	14^{JS9}
K7	350	250_{h6}	145	190	226	18	44.0	60^{H7}	85	∅205	300	5.0	212	342	36.0	214.0	242	12	252.0	125	18	M20	M24	64.4	18^{JS9}
K8	400	300_{h6}	185	235	282	20	45.0	70^{H7}	100	∅184	350	5.0	265	410	36.0	263.0	300	20	311.0	145	18	M20	M24	74.9	20^{JS9}
K9	450	350_{h6}	225	285	330	23	50.0	90^{H7}	120	∅230	400	5.0	315	495	40.0	302.0	350	26	361.0	180	18	M24	M30	95.4	25^{JS9}

Dimensions of additional round flanges

Type	∅a1	∅b1	c1	∅e1	f1	∅s1
K1	140	95_{j6}	10	115	3.0	9
K2	160	110_{j6}	12	130	3.5	9
K3	160	110_{j6}	14	130	3.5	9
K3	250	180_{j6}	14	215	4.0	14
K8	350	250_{h6}	18	300	5.0	18
K8	450	350_{h6}	20	400	5.0	18

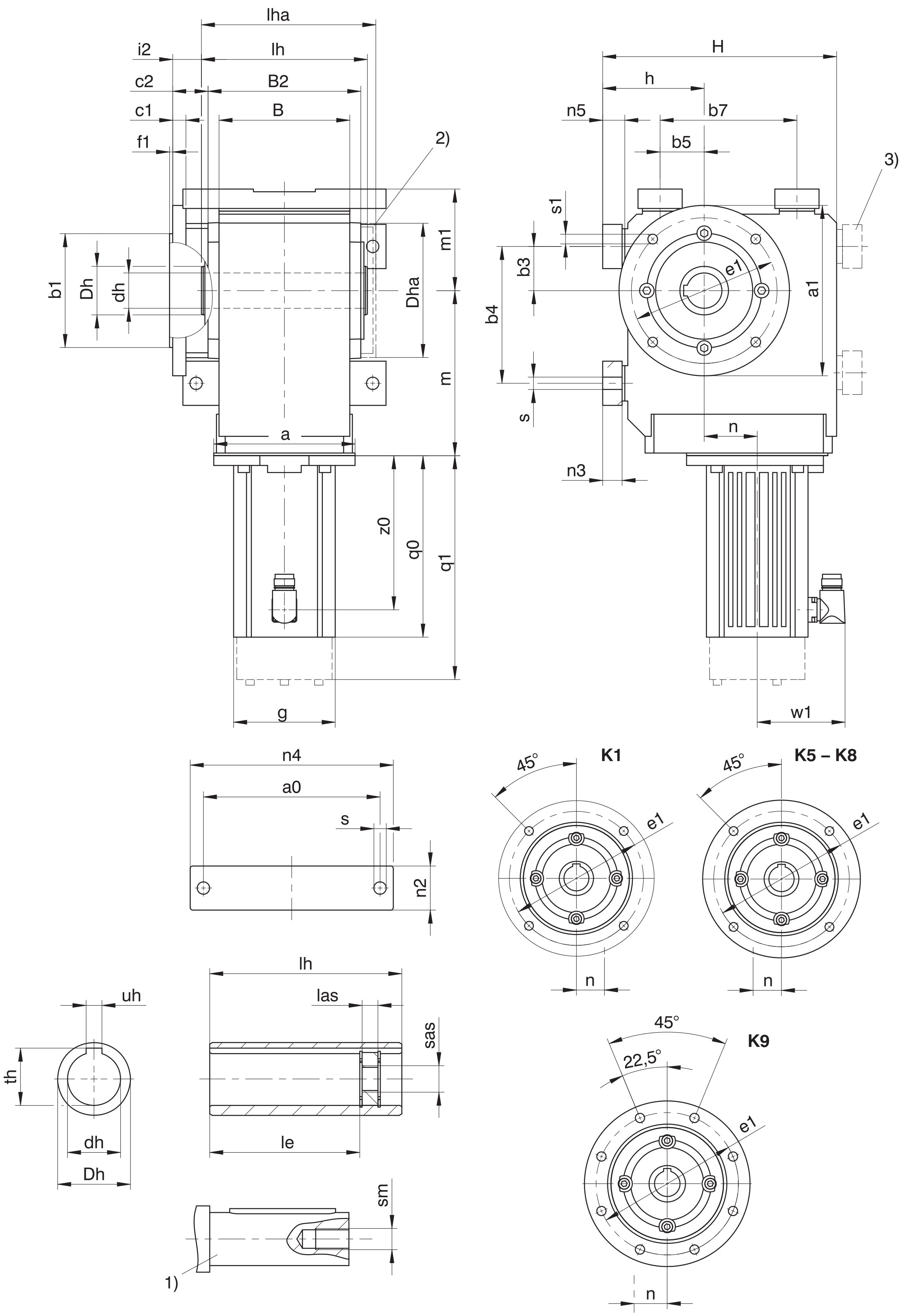
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.5 A shaft design (hollow shaft), NF housing design (base + round flange)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.	2)	Cover (optional)
3)	Only for K1 (other sizes on request)		

Dimensions of gearboxes

Type	a0	Øa1	Øb1	b3	b4	b5	b7	B	B2	c1	c2	Ødh	ØDh	Dha	Øe1	f1	h
K1	115	160	110_{j6}	30	90	30	90	90	106	10	32.0	20^{H7}	40	□105	130	3.5	75
K1	115	160	110_{j6}	30	90	30	90	90	106	10	32.0	25^{H7}	40	□105	130	3.5	75
K1	115	160	110_{j6}	30	90	30	90	90	106	10	32.0	30^{H7}	40	□105	130	3.5	75
K5	200	250	180_{j6}	40	140	100	140	160	185	15	39.5	50^{H7}	65	□145	215	4.0	190
K6	210	300	230_{j6}	50	160	110	160	168	200	17	36.0	50^{H7}	70	Ø183	265	4.0	220
K7	241	350	250_{h6}	55	180	125	180	190	226	18	44.0	60^{H7}	85	Ø205	300	5.0	250
K8	300	400	300_{h6}	75	240	165	240	235	282	20	45.0	70^{H7}	100	Ø184	350	5.0	310
K9	360	450	350_{h6}	95	280	185	280	285	330	23	50.0	90^{H7}	120	Ø230	400	5.0	365

Dimensions of gearboxes

Type	H	i2	le	lh	las	lha	m1	n2	n3	n4	n5	Øs	Øs1	sm	sas	th	uh
K1	175	25.0	98.0	120	12	127.0	75	30	13	140	15	9.0	9	M6	M8	22.8	6^{JS9}
K1	175	25.0	98.0	120	12	127.0	75	30	13	140	15	9.0	9	M10	M12	28.3	8^{JS9}
K1	175	25.0	93.5	120	12	127.0	75	30	13	140	15	9.0	9	M10	M12	32.0	8^{JS9}
K5	290	32.0	164.0	200	12	209.5	130	60	27	240	30	18.0	14	M16	M20	53.8	14^{JS9}
K6	340	28.5	179.0	215	12	224.5	150	65	27	250	30	18.5	14	M16	M20	53.8	14^{JS9}
K7	380	36.0	214.0	242	12	252.0	163	70	35	290	38	23.0	18	M20	M24	64.4	18^{JS9}
K8	455	36.0	263.0	300	20	311.0	190	85	41	360	45	27.0	18	M20	M24	74.9	20^{JS9}
K9	545	40.0	302.0	350	26	361.0	230	95	46	430	50	31.0	18	M24	M30	95.4	25^{JS9}

Dimensions of additional round flanges

Type	Øa1	Øb1	c1	Øe1	f1	Øs1
K1	140	95_{j6}	10	115	3	9
K8	350	250_{h6}	18	300	5	18
K8	450	350_{h6}	20	400	5	18

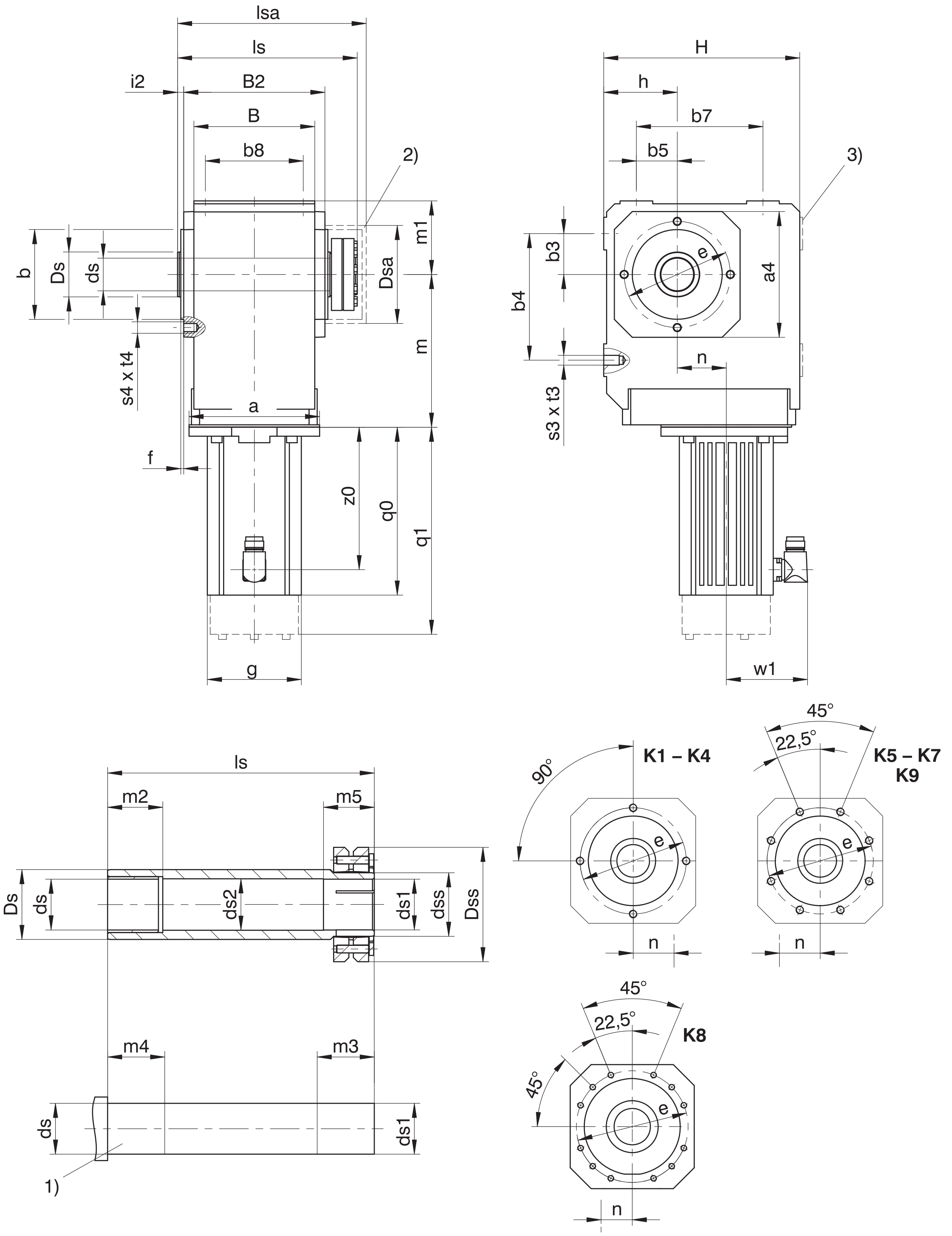
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K513	–	–	–	Ø160	172	15.0	□145	174	15.0
K514	–	–	–	Ø160	215	15.0	–	–	–
K613	–	–	–	Ø160	191	18.0	Ø200	193	18.0
K614	–	–	–	Ø160	234	18.0	–	–	–
K713	–	–	–	–	–	–	Ø200	221	20.0
K714	–	–	–	Ø160	263	20.0	Ø200	283	20.0
K813	–	–	–	–	–	–	Ø200	247	24.0
K814	–	–	–	–	–	–	Ø200	308	24.0
K914	–	–	–	–	–	–	Ø200	353	25.0

13.3.6 S shaft design (hollow shaft with shrink disk), G housing design (pitch circle diameter)



q0	Applies to motors without brake.
q1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.
2)	Cover (optional)
3)	Only for K1 (other sizes on request)

Dimensions of gearboxes

Type	□a4	∅b	b3	b4	b5	b7	b8	B	B2	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss	∅e	f	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	s3	s4	t3	t4
K1	105	75_{j6}	30	90	30	90	70	90	106	25_{h9}	25_{h9}^{H7}	25.5	30	40	80.0	60	90	3.0	60	160	7.0	149	163	60	20	34	25	29	M8	M8	13	13
K2	116	82_{j6}	35	115	35	115	90	115	134	30_{h9}	30_{h9}^{H7}	30.5	36	45	88.0	72	100	3.0	65	190	7.0	178	193	65	25	39	30	34	M10	M8	16	13
K3	132	95_{j6}	40	130	40	130	105	130	146	35_{h9}	35_{h9}^{H7}	35.5	44	50	101.0	80	115	3.0	75	213	7.0	190	206	75	30	39	35	34	M10	M8	16	13
K4	152	110_{j6}	50	155	50	155	120	148	173	40_{h9}	40_{h9}^{H7}	40.5	50	55	114.0	88	130	3.5	90	240	7.5	220	243	90	40	39	45	34	M12	M10	19	16
K5	145	110_{j6}	40	140	100	140	125	160	185	50_{h9}	50_{h9}^{H7}	50.5	62	65	116.0	106	130	3.5	160	260	7.5	237	254	100	40	44	45	39	M16	M10	26	16
K6	180	140_{j6}	50	160	110	160	130	168	200	50_{h9}	50_{h9}^{H7}	50.5	62	70	128.0	106	165	3.5	190	310	7.5	254	276	120	40	45	45	40	M16	M10	26	16
K7	195	155_{h6}	55	180	125	180	145	190	226	60_{h6}	60_{h6}^{H7}	62.0	75	85	161.5	138	185	3.5	212	342	8.0	278	314	125	40	45	45	40	M20	M12	33	19
K8	226	185_{h6}	75	240	165	240	185	235	282	70_{h6}	70_{h6}^{H7}	72.0	90	100	193.0	155	215	4.0	265	410	9.0	352	378	145	50	60	60	50	M24	M12	38	19
K9	280	230_{h6}	95	280	185	280	225	285	330	90_{h6}	90_{h6}^{H7}	92.0	120	120	244.0	200	265	5.0	315	495	10.0	418	428	180	60	70	70	60	M30	M16	48	26

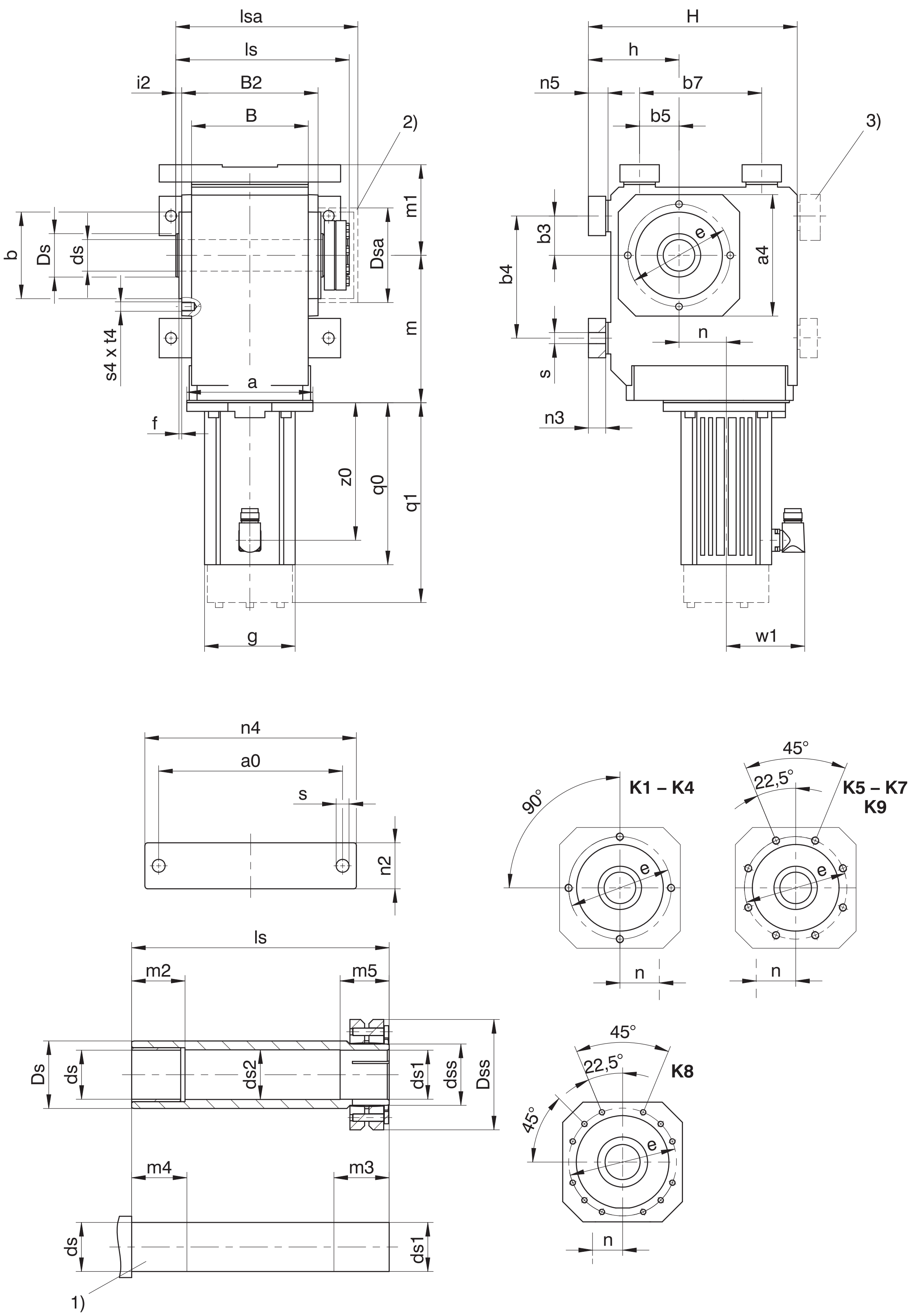
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.7 S shaft design (hollow shaft with shrink disk), NG housing design (base + pitch circle diameter)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)
3)	Only for K1 (other sizes on request)		

Dimensions of gearboxes

Type	a0	a4	∅b	b3	b4	b5	b7	B	B2	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa
K1	115	105	75_{j6}	30	90	30	90	90	106	25_{h9}	25_{h9}^{H7}	25.5	30	40	80
K2	155	116	82_{j6}	35	115	35	115	115	134	30_{h9}	30_{h9}^{H7}	30.5	36	45	88
K3	170	132	95_{j6}	40	130	40	130	130	146	35_{h9}	35_{h9}^{H7}	35.5	44	50	101
K4	200	152	110_{j6}	50	155	50	155	148	173	40_{h9}	40_{h9}^{H7}	40.5	50	55	114
K5	200	145	110_{j6}	40	140	100	140	160	185	50_{h9}	50_{h9}^{H7}	50.5	62	65	116
K6	210	180	140_{j6}	50	160	110	160	168	200	50_{h9}	50_{h9}^{H7}	50.5	62	70	128
K7	241	195	155_{j6}	55	180	125	180	190	226	60_{h6}	60_{h6}^{H7}	62.0	75	85	161.5
K8	300	226	185_{j6}	75	240	165	240	235	282	70_{h6}	70_{h6}^{H7}	72.0	90	100	193
K9	360	280	230_{j6}	95	280	185	280	285	330	90_{h6}	90_{h6}^{H7}	92.0	120	120	244

Dimensions of gearboxes

Type	∅Dss	∅e	f	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	n2	n3	n4	n5	∅s	s4	t4
K1	60	90	3.0	75	175	7.0	149	163	75	20	34	25	29	30	13	140	15	9.0	M8	13
K2	72	100	3.0	88	213	7.0	178	193	88	25	39	30	34	40	20	185	23	11.0	M8	13
K3	80	115	3.0	98	236	7.0	190	206	98	30	39	35	34	45	20	200	23	11.0	M8	13
K4	88	130	3.5	115	265	7.5	220	243	115	40	39	45	34	50	22	230	25	14.0	M10	16
K5	106	130	3.5	190	290	7.5	237	254	130	40	44	45	39	60	27	240	30	18.0	M10	16
K6	106	165	3.5	220	340	7.5	254	276	150	40	45	45	40	65	27	250	30	18.5	M10	16
K7	138	185	3.5	250	380	8.0	278	314	163	40	45	45	40	70	35	290	38	23.0	M12	19
K8	155	215	4.0	310	455	9.0	352	378	190	50	60	60	50	85	41	360	45	27.0	M12	19
K9	200	265	5.0	365	545	10.0	418	428	230	60	70	70	60	95	46	430	50	31.0	M16	26

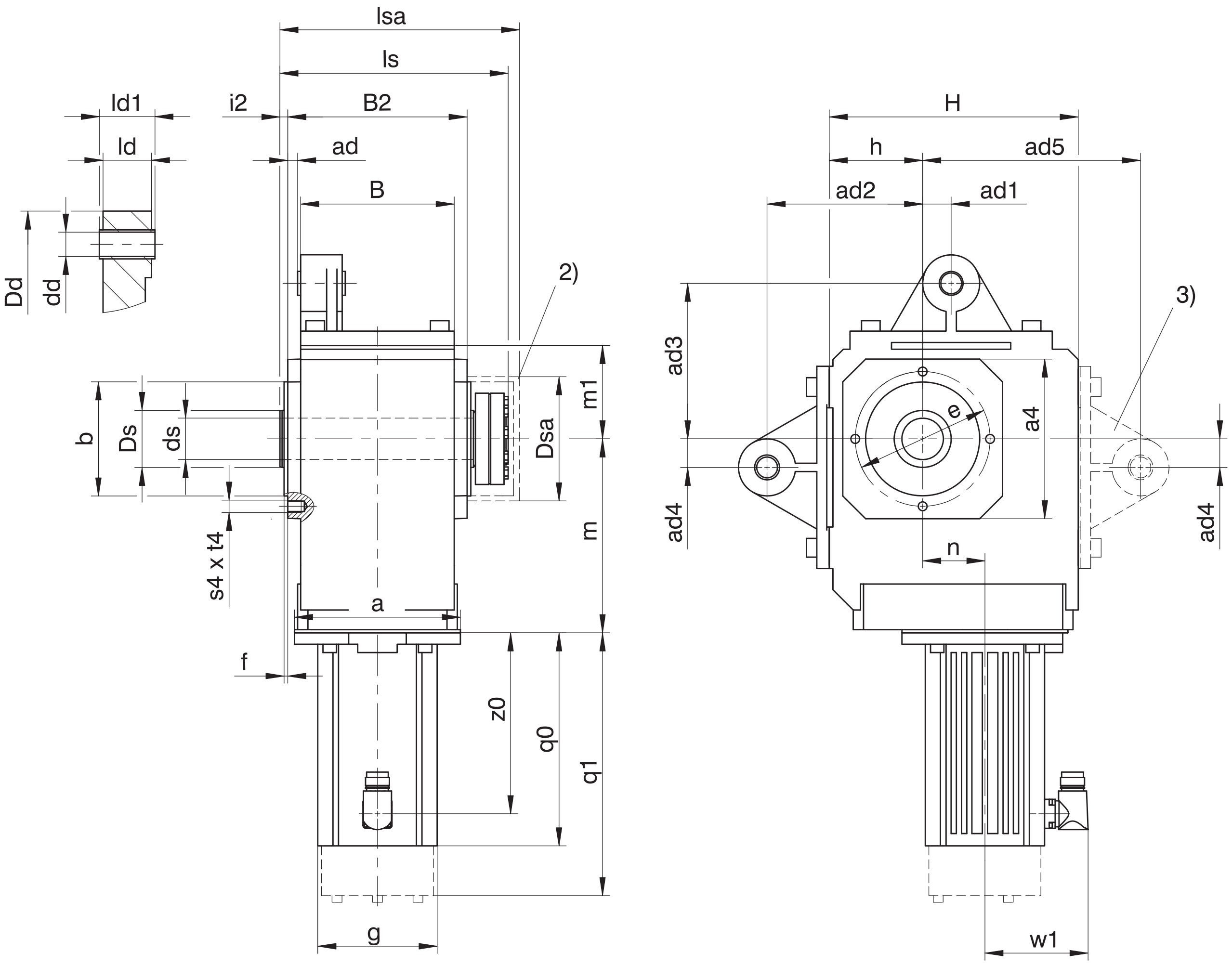
Dimensions of motors

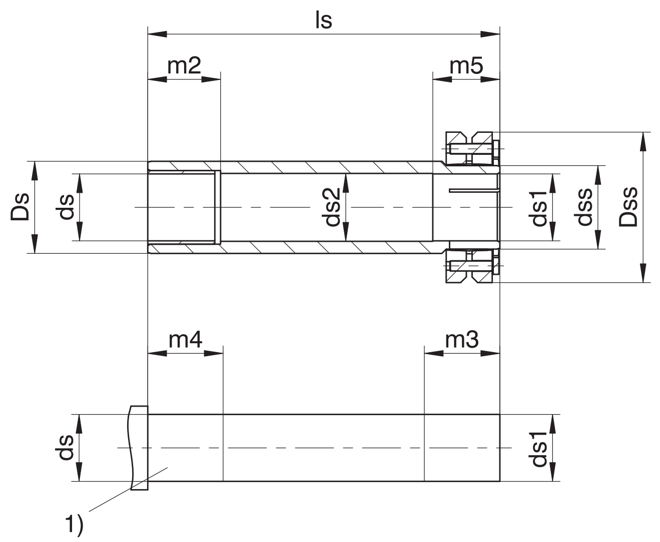
Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

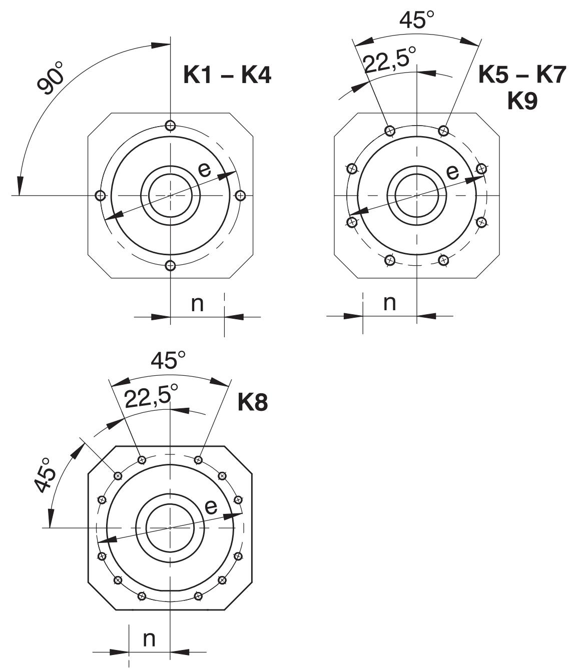
Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.8 S shaft design (hollow shaft with shrink disk), GD housing design (pitch circle diameter + torque arm bracket)







q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)
3)	Only for K1 (other sizes on request)	–	If you brace the gearboxes without the torque arm brackets provided by the manufacturer for this purpose, the dimensions for ad2 and ad3 must meet the specified value.

Dimensions of gearboxes

Type	□a4	ad	ad1	ad2	ad3	ad4	ad5	∅b	B	B2	∅dd	∅ds	∅ds1	∅ds2	∅dss	∅Dd	∅Ds	∅Dsa
K1	105	6.0	15.0	90	90	15.0	130	75_{j6}	90	106	12^{H9}	25_{h9}	25_{h9}^{H7}	25.5	30	43	40	80
K2	116	6.5	22.5	100	100	22.5	–	82_{j6}	115	134	16^{H9}	30_{h9}	30_{h9}^{H7}	30.5	36	45	45	88
K3	132	5.0	25.0	120	120	25.0	–	95_{j6}	130	146	16^{H9}	35_{h9}	35_{h9}^{H7}	35.5	44	45	50	101
K4	152	9.5	27.5	150	150	27.5	–	110_{j6}	148	173	20^{H9}	40_{h9}	40_{h9}^{H7}	40.5	50	55	55	114
K5	145	9.5	30.0	250	190	30.0	–	110_{j6}	160	185	20^{H9}	50_{h9}	50_{h9}^{H7}	50.5	62	58	65	116
K6	180	13.0	30.0	250	180	30.0	–	140_{j6}	168	200	20^{H9}	50_{h9}	50_{h9}^{H7}	50.5	62	58	70	128
K7	195	15.0	35.0	300	213	35.0	–	155_{h6}	190	226	20^{H9}	60_{h6}	60_{h6}^{H7}	62.0	75	68	85	161.5
K8	226	17.0	45.0	350	230	45.0	–	185_{h6}	235	282	24^{H9}	70_{h6}	70_{h6}^{H7}	72.0	90	72	100	193
K9	280	16.0	45.0	450	315	45.0	–	230_{h6}	285	330	24^{H9}	90_{h6}	90_{h6}^{H7}	92.0	120	75	120	244

Dimensions of gearboxes

Type	∅Dss	∅e	f	h	H	i2	ld	ld1	ls	lsa	m1	m2	m3	m4	m5	s4	t4
K1	60	90	3.0	60	160	7.0	24	28	149	163	60	20	34	25	29	M8	13
K2	72	100	3.0	65	190	7.0	32	38	178	193	65	25	39	30	34	M8	13
K3	80	115	3.0	75	213	7.0	32	38	190	206	75	30	39	35	34	M8	13
K4	88	130	3.5	90	240	7.5	40	46	220	243	90	40	39	45	34	M10	16
K5	106	130	3.5	160	260	7.5	40	46	237	254	100	40	44	45	39	M10	16
K6	106	165	3.5	190	310	7.5	40	46	254	276	120	40	45	45	40	M10	16
K7	138	185	3.5	212	342	8.0	64	70	278	314	125	40	45	45	40	M12	19
K8	155	215	4.0	265	410	9.0	102	115	352	378	145	50	60	60	50	M12	19
K9	200	265	5.0	315	495	10.0	102	115	418	428	180	60	70	70	60	M16	26

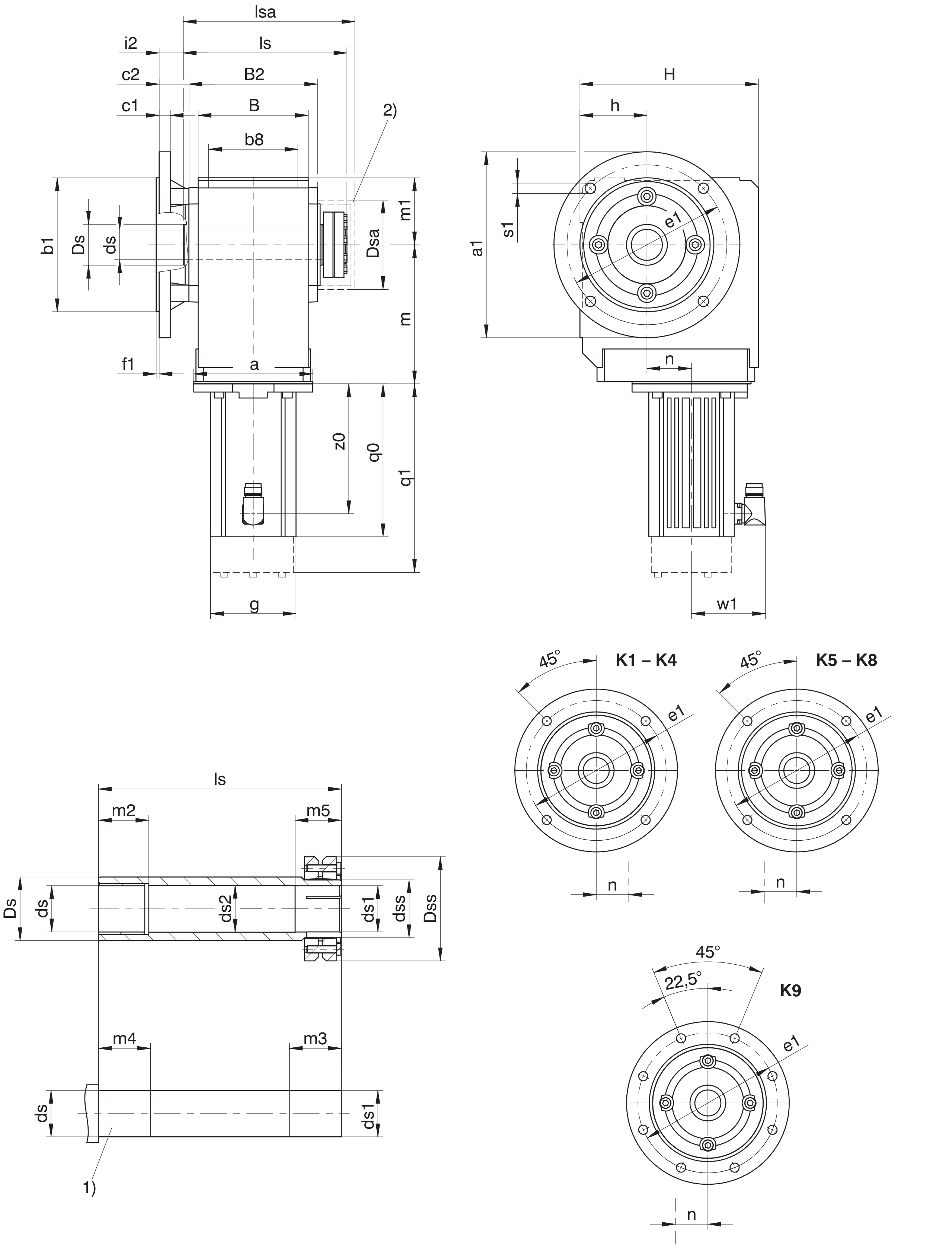
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.9 S shaft design (hollow shaft with shrink disk), F housing design (round flange)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)

Dimensions of gearboxes

Type	Øa1	Øb1	b8	B	B2	c1	c2	Øds	Øds1	Øds2	Ødss	ØDs	ØDsa	ØDss	Øe1	f1	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	Øs1
K1	160	110_{j6}	70	90	106	10	32.0	25_{h9}	25_{h9}^{H7}	25.5	30	40	80	60	130	3.5	60	160	25.0	149	163	60	20	34	25	29	9
K2	200	130_{j6}	90	115	134	12	32.0	30_{h9}	30_{h9}^{H7}	30.5	36	45	88	72	165	3.5	65	190	25.0	178	193	65	25	39	30	34	11
K3	200	130_{j6}	105	130	146	14	38.0	35_{h9}	35_{h9}^{H7}	35.5	44	50	101	80	165	3.5	75	213	31.0	190	206	75	30	39	35	34	11
K4	250	180_{j6}	120	148	173	15	40.0	40_{h9}	40_{h9}^{H7}	40.5	50	55	114	88	215	4.0	90	240	32.5	220	243	90	40	39	45	34	14
K5	250	180_{j6}	125	160	185	15	39.5	50_{h9}	50_{h9}^{H7}	50.5	62	65	116	106	215	4.0	160	260	32.0	237	254	100	40	44	45	39	14
K6	300	230_{j6}	130	168	200	17	36.0	50_{h9}	50_{h9}^{H7}	50.5	62	70	128	106	265	4.0	190	310	28.5	254	276	120	40	45	45	40	14
K7	350	250_{h6}	145	190	226	18	44.0	60_{h6}	60_{h6}^{H7}	62.0	75	85	161.5	138	300	5.0	212	342	36.0	278	314	125	40	45	45	40	18
K8	400	300_{h6}	185	235	282	20	45.0	70_{h6}	70_{h6}^{H7}	72.0	90	100	193	155	350	5.0	265	410	36.0	352	378	145	50	60	60	50	18
K9	450	350_{h6}	225	285	330	23	50.0	90_{h6}	90_{h6}^{H7}	92.0	120	120	244	200	400	5.0	315	495	40.0	418	428	180	60	70	70	60	18

Dimensions of additional round flanges

Type	Øa1	Øb1	c1	Øe1	f1	Øs1
K1	140	95_{j6}	10	115	3.0	9
K2	160	110_{j6}	12	130	3.5	9
K3	160	110_{j6}	14	130	3.5	9
K3	250	180_{j6}	14	215	4.0	14
K8	350	250_{h6}	18	300	5.0	18
K8	450	350_{h6}	20	400	5.0	18

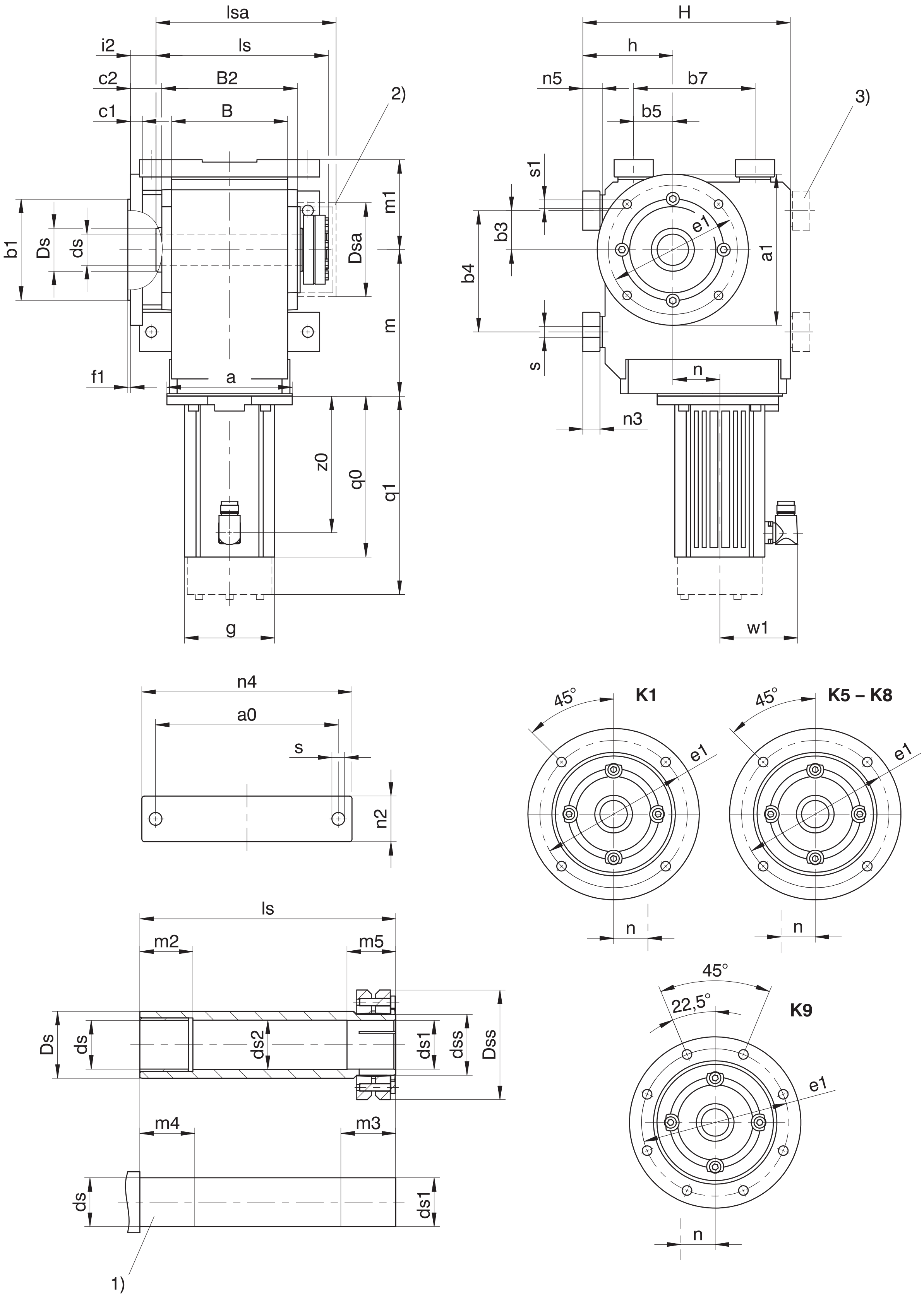
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	Ø140	180	46.0	–	–	–	–	–	–
K302	Ø140	163	52.5	□115	167	52.5	□145	169	52.5
K303	Ø140	200	52.5	Ø160	210	16.0	–	–	–
K402	–	–	–	Ø160	187	60.0	□145	189	60.0
K403	Ø140	220	60.0	Ø160	230	23.0	–	–	–
K513	–	–	–	Ø160	172	15.0	□145	174	15.0
K514	–	–	–	Ø160	215	15.0	–	–	–
K613	–	–	–	Ø160	191	18.0	Ø200	193	18.0
K614	–	–	–	Ø160	234	18.0	–	–	–
K713	–	–	–	–	–	–	Ø200	221	20.0
K714	–	–	–	Ø160	263	20.0	Ø200	283	20.0
K813	–	–	–	–	–	–	Ø200	247	24.0
K814	–	–	–	–	–	–	Ø200	308	24.0
K914	–	–	–	–	–	–	Ø200	353	25.0

13.3.10 S shaft design (hollow shaft with shrink disk), NF housing design (base + round flange)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
1)	Machine shaft: The dimension ls must meet or exceed the specified value.	2)	Cover (optional)
3)	Only for K1 (other sizes on request)		

Dimensions of gearboxes

Type	a0	∅a1	∅b1	b3	b4	b5	b7	B	B2	c1	c2	∅ds	∅ds1	∅ds2	∅dss	∅Ds	∅Dsa	∅Dss
K1	115	160	110_{j6}	30	90	30	90	90	106	10	32.0	25_{h9}	25_{h9}^{H7}	25.5	30	40	80.0	60
K5	200	250	180_{j6}	40	140	100	140	160	185	15	39.5	50_{h9}	50_{h9}^{H7}	50.5	62	65	116.0	106
K6	210	300	230_{j6}	50	160	110	160	168	200	17	36.0	50_{h9}	50_{h9}^{H7}	50.5	62	70	128.0	106
K7	241	350	250_{h6}	55	180	125	180	190	226	18	44.0	60_{h6}	60_{h6}^{H7}	62.0	75	85	161.5	138
K8	300	400	300_{h6}	75	240	165	240	235	282	20	45.0	70_{h6}	70_{h6}^{H7}	72.0	90	100	193.0	155
K9	360	450	350_{h6}	95	280	185	280	285	330	23	50.0	90_{h6}	90_{h6}^{H7}	92.0	120	120	244.0	200

Dimensions of gearboxes

Type	∅e1	f1	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	n2	n3	n4	n5	∅s	∅s1
K1	130	3.5	75	175	25.0	149	163	75	20	34	25	29	30	13	140	15	9.0	9
K5	215	4.0	190	290	32.0	237	254	130	40	44	45	39	60	27	240	30	18.0	14
K6	265	4.0	220	340	28.5	254	276	150	40	45	45	40	65	27	250	30	18.5	14
K7	300	5.0	250	380	36.0	278	314	163	40	45	45	40	70	35	290	38	23.0	18
K8	350	5.0	310	455	36.0	352	378	190	50	60	60	50	85	41	360	45	27.0	18
K9	400	5.0	365	545	40.0	418	428	230	60	70	70	60	95	46	430	50	31.0	18

Dimensions of additional round flanges

Type	∅a1	∅b1	c1	∅e1	f1	∅s1
K1	140	95_{j6}	10	115	3	9
K8	350	250_{h6}	18	300	5	18
K8	450	350_{h6}	20	400	5	18

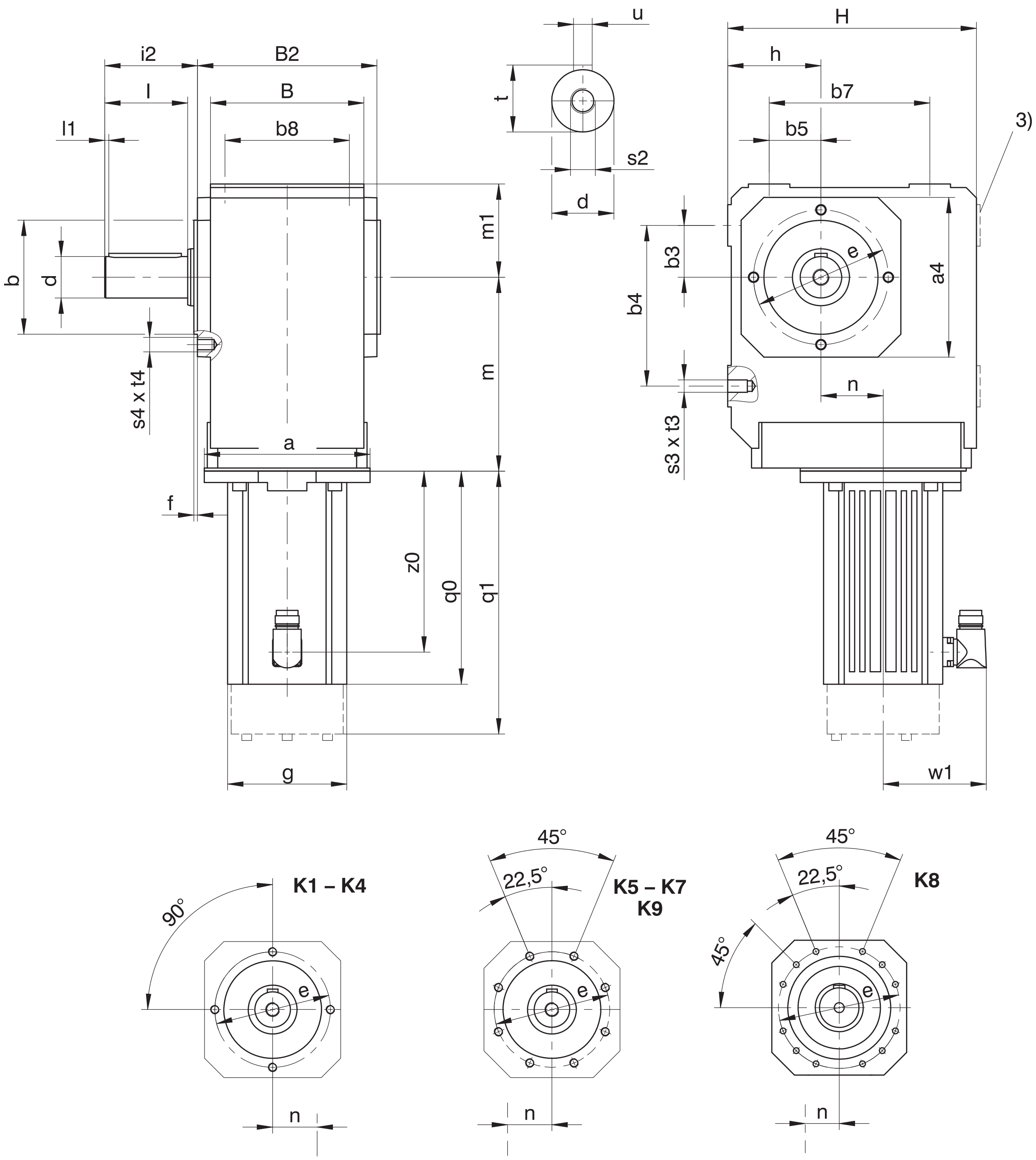
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.11 A shaft design (solid shaft), G housing design (pitch circle diameter)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
3)	Only for K1 (other sizes on request)	–	K1 – K4: Solid shaft without feather key available, on request starting at K5.
–	K1 – K9: Solid shaft on both sides available.		

Dimensions of gearboxes

Type	□a4	∅b	b3	b4	b5	b7	b8	B	B2	∅d	∅e	f	h	H	i2	l	l1	m1	s2	s3	s4	t	t3	t4	u
K1	105	75_{j6}	30	90	30	90	70	90	106	25_{k6}	90	3.0	60	160	62.0	50	4	60	M10	M8	M8	28.0	13	13	A8×7×40
K2	116	82_{j6}	35	115	35	115	90	115	134	30_{k6}	100	3.0	65	190	68.0	60	4	65	M10	M10	M8	33.0	16	13	A8×7×50
K3	132	95_{j6}	40	130	40	130	105	130	146	30_{k6}	115	3.0	75	213	69.0	60	4	75	M10	M10	M8	33.0	16	13	A8×7×50
K4	152	110_{j6}	50	155	50	155	120	148	173	40_{k6}	130	3.5	90	240	89.5	80	4	90	M16	M12	M10	43.0	19	16	A12×8×70
K5	145	110_{j6}	40	140	100	140	125	160	185	45_{k6}	130	3.5	160	260	129.5	90	4	100	M16	M16	M10	48.5	26	16	A14×9×80
K6	180	140_{j6}	50	160	110	160	130	168	200	50_{k6}	165	3.5	190	310	136.0	100	4	120	M16	M16	M10	53.5	26	16	A14×9×90
K7	195	155_{j6}	55	180	125	180	145	190	226	60_{m6}	185	3.5	212	342	164.0	120	4	125	M20	M20	M12	64.0	33	19	A18×11×110
K8	226	185_{j6}	75	240	165	240	185	235	282	70_{m6}	215	4.0	265	410	185.0	140	5	145	M20	M24	M12	74.5	38	19	A20×12×125
K9	280	230_{j6}	95	280	185	280	225	285	330	90_{m6}	265	5.0	315	495	220.0	170	8	180	M24	M30	M16	95.0	48	26	A25×14×140

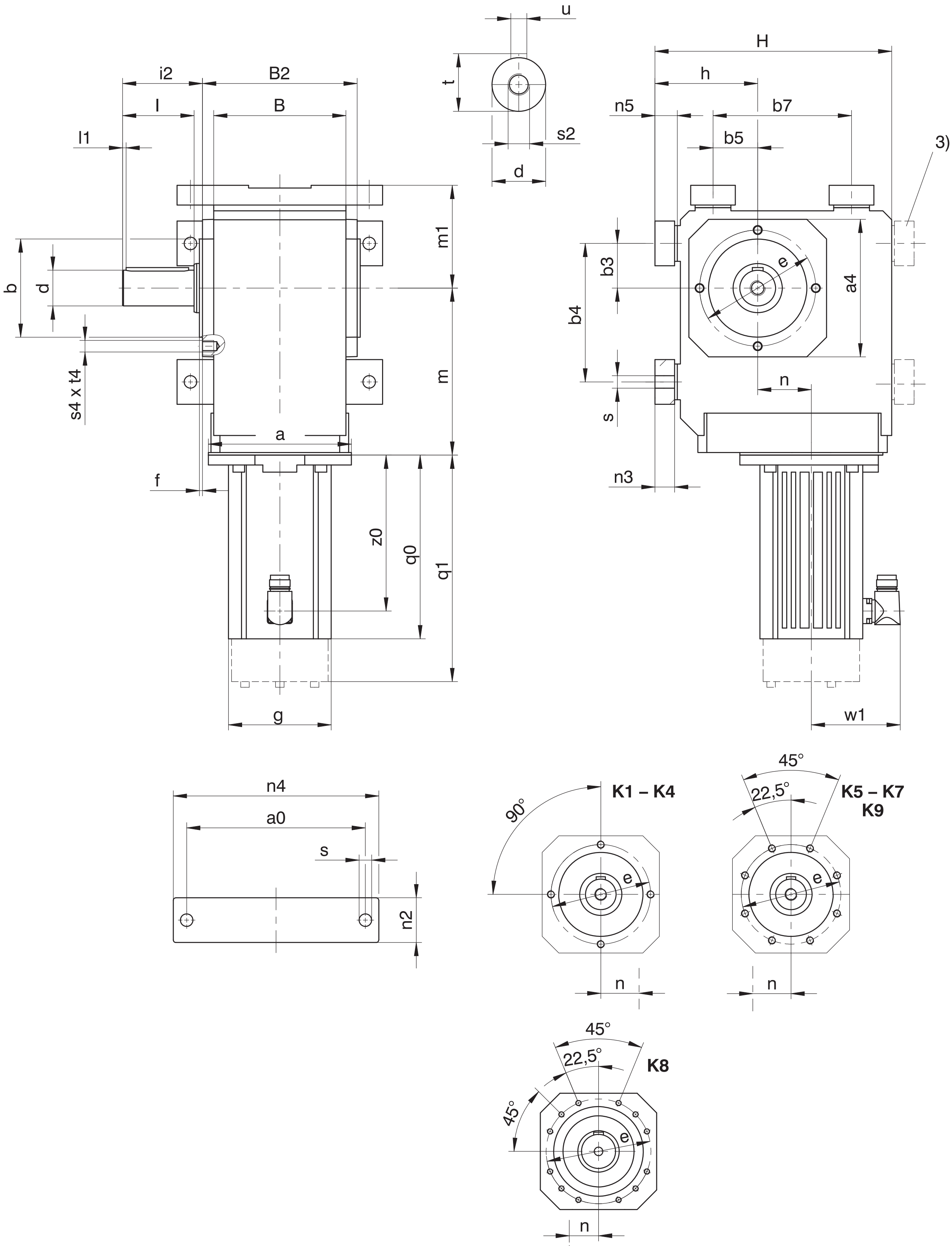
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.12 V shaft design (solid shaft), NG housing design (base + pitch circle diameter)



q0	Applies to motors without brake.	q1	Applies to motors with brake.
3)	Only for K1 (other sizes on request)	–	K1 – K4: Solid shaft without feather key available, on request starting at K5.
–	K1 – K10: Solid shaft on both sides available.		

Dimensions of gearboxes

Type	a0	□a4	∅b	b3	b4	b5	b7	B	B2	∅d	∅e	f	h	H	i2	l	l1	m1	n2	n3	n4	n5	∅s	s2	s4	t	t4	u
K1	115	105	75_{j6}	30	90	30	90	90	106	25_{k6}	90	3.0	75	175	62.0	50	4	75	30	13	140	15	9.0	M10	M8	28.0	13	A8×7×40
K2	155	116	82_{j6}	35	115	35	115	115	134	30_{k6}	100	3.0	88	213	68.0	60	4	88	40	20	185	23	11.0	M10	M8	33.0	13	A8×7×50
K3	170	132	95_{j6}	40	130	40	130	130	146	30_{k6}	115	3.0	98	236	69.0	60	4	98	45	20	200	23	11.0	M10	M8	33.0	13	A8×7×50
K4	200	152	110_{j6}	50	155	50	155	148	173	40_{k6}	130	3.5	115	265	89.5	80	4	115	50	22	230	25	14.0	M16	M10	43.0	16	A12×8×70
K5	200	145	110_{j6}	40	140	100	140	160	185	45_{k6}	130	3.5	190	290	129.5	90	4	130	60	27	240	30	18.0	M16	M10	48.5	16	A14×9×80
K6	210	180	140_{j6}	50	160	110	160	168	200	50_{k6}	165	3.5	220	340	136.0	100	4	150	65	27	250	30	18.5	M16	M10	53.5	16	A14×9×90
K7	241	195	155_{j6}	55	180	125	180	190	226	60_{m6}	185	3.5	250	380	164.0	120	4	163	70	35	290	38	23.0	M20	M12	64.0	19	A18×11×110
K8	300	226	185_{j6}	75	240	165	240	235	282	70_{m6}	215	4.0	310	455	185.0	140	5	190	85	41	360	45	27.0	M20	M12	74.5	19	A20×12×125
K9	360	280	230_{j6}	95	280	185	280	285	330	90_{m6}	265	5.0	365	545	220.0	170	8	230	95	46	430	50	31.0	M24	M16	95.0	26	A25×14×140

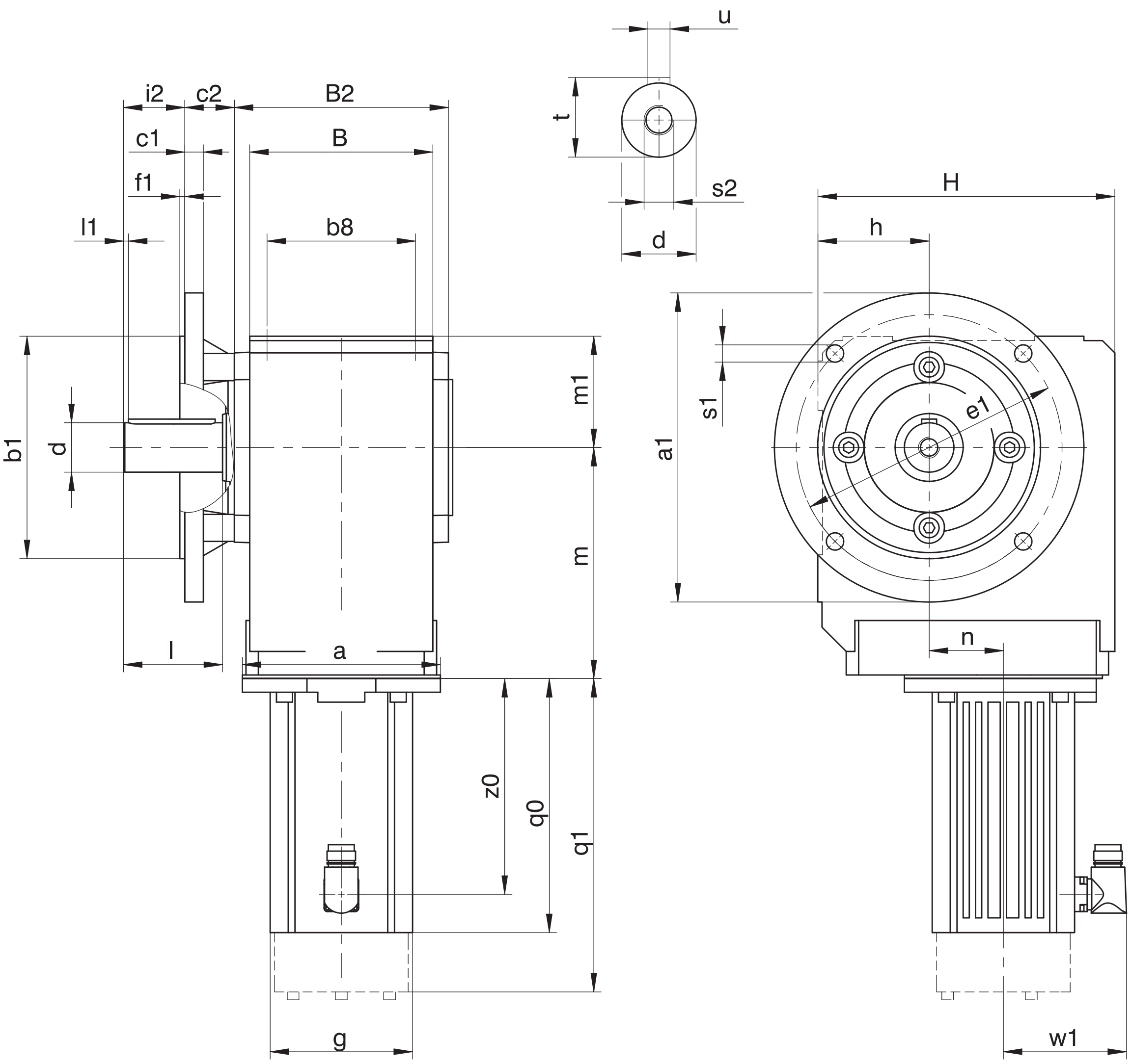
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

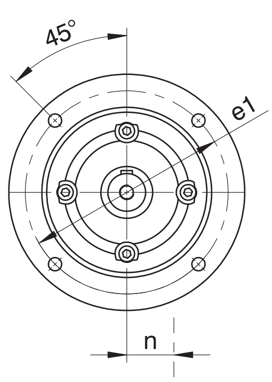
Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

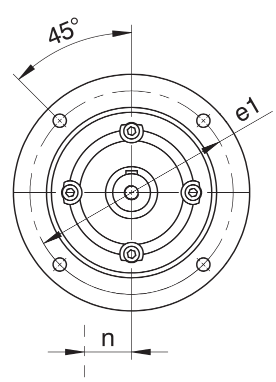
13.3.13 V shaft design (solid shaft), F housing design (round flange)



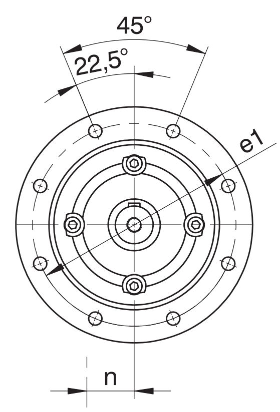
K1 – K4



K5 – K8



K9



q0	Applies to motors without brake.	q1	Applies to motors with brake.
–	K1 – K4: Solid shaft without feather key available, on request starting at K5.	–	K1 – K9: Solid shaft on both sides available.

Dimensions of gearboxes

Type	∅a1	∅b1	b8	B	B2	c1	c2	∅d	∅e1	f1	h	H	i2	l	l1	m1	∅s1	s2	t	u
K1	160	110_{j6}	70	90	106	10	32.0	25_{k6}	130	3.5	60	160	30.0	50	4	60	9	M10	28.0	A8×7×40
K2	200	130_{j6}	90	115	134	12	32.0	30_{k6}	165	3.5	65	190	36.0	60	4	65	11	M10	33.0	A8×7×50
K3	200	130_{j6}	105	130	146	14	38.0	30_{k6}	165	3.5	75	213	31.0	60	4	75	11	M10	33.0	A8×7×50
K4	250	180_{j6}	120	148	173	15	40.0	40_{k6}	215	4.0	90	240	49.5	80	4	90	14	M16	43.0	A12×8×70
K5	250	180_{j6}	125	160	185	15	39.5	45_{k6}	215	4.0	160	260	90.0	90	4	100	14	M16	48.5	A14×9×80
K6	300	230_{j6}	130	168	200	17	36.0	50_{k6}	265	4.0	190	310	100.0	100	4	120	14	M16	53.5	A14×9×90
K7	350	250_{h6}	145	190	226	18	44.0	60_{m6}	300	5.0	212	342	120.0	120	4	125	18	M20	64.0	A18×11×110
K8	400	300_{h6}	185	235	282	20	45.0	70_{m6}	350	5.0	265	410	140.0	140	5	145	18	M20	74.5	A20×12×125
K9	450	350_{h6}	225	285	330	23	50.0	90_{m6}	400	5.0	315	495	170.0	170	8	180	18	M24	95.0	A25×14×140

Dimensions of additional round flanges

Type	∅a1	∅b1	c1	∅e1	f1	∅s1
K1	140	95_{j6}	10	115	3.0	9
K2	160	110_{j6}	12	130	3.5	9
K3	160	110_{j6}	14	130	3.5	9
K3	250	180_{j6}	14	215	4.0	14
K8	350	250_{h6}	18	300	5.0	18
K8	450	350_{h6}	20	400	5.0	18

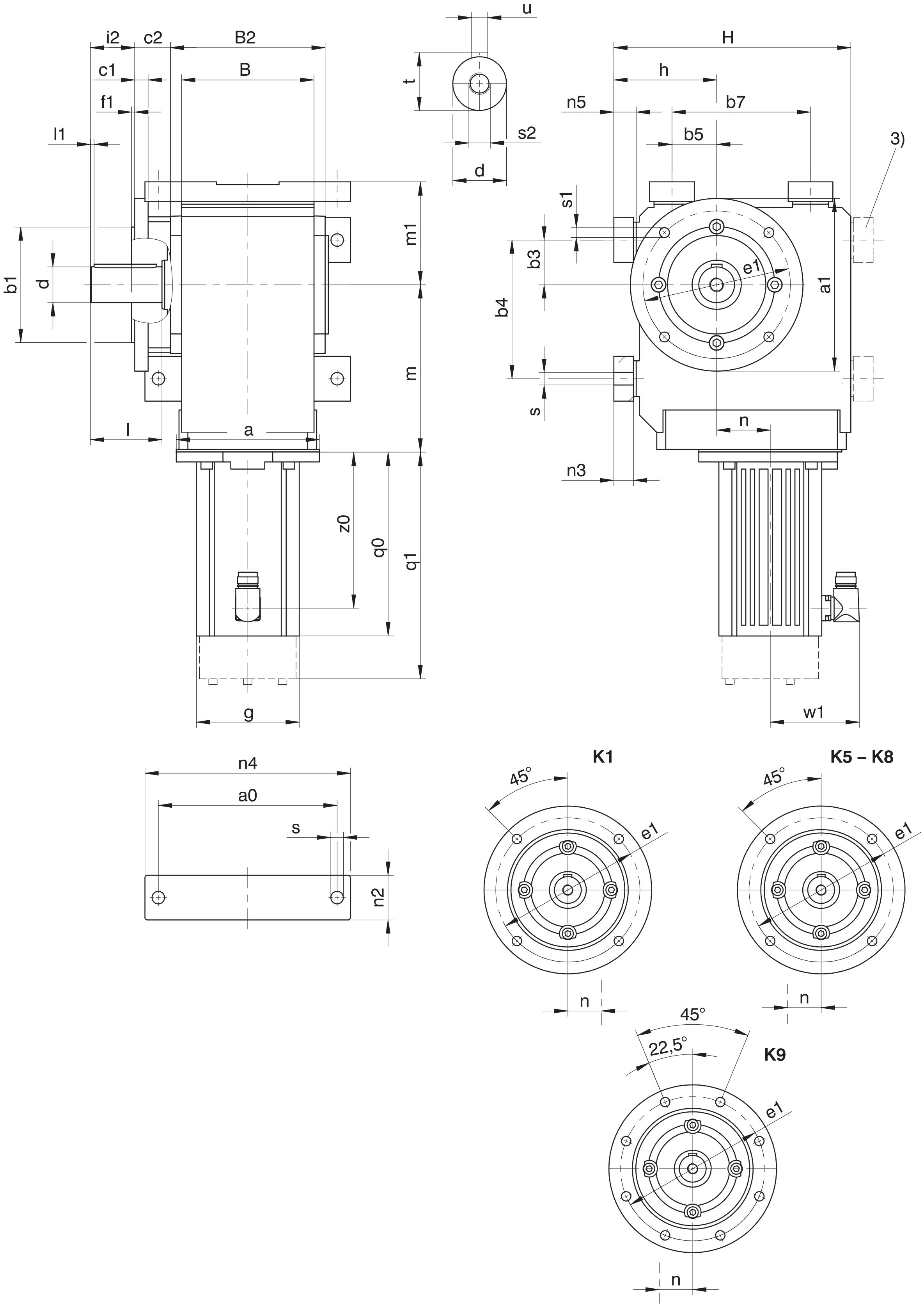
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K202	□98	143	46.0	□115	147	46.0	□145	149	46.0
K203	∅140	180	46.0	–	–	–	–	–	–
K302	∅140	163	52.5	□115	167	52.5	□145	169	52.5
K303	∅140	200	52.5	∅160	210	16.0	–	–	–
K402	–	–	–	∅160	187	60.0	□145	189	60.0
K403	∅140	220	60.0	∅160	230	23.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.14 V shaft design (solid shaft), NF housing design (base + round flange)



q0 Applies to motors without brake.

3) Only for K1 (other sizes on request)

– K1 – K10: Solid shaft on both sides available.

q1 Applies to motors with brake.

– K1 – K4: Solid shaft without feather key available, on request starting at K5.

Dimensions of gearboxes

Type	a0	∅a1	∅b1	b3	b4	b5	b7	B	B2	c1	c2	∅d	∅e1	f1	h	H	i2	l	l1	m1	n2	n3	n4	n5	∅s	∅s1	s2	t	u
K1	115	160	110_{j6}	30	90	30	90	90	106	10	32.0	25_{k6}	130	3.5	75	175	30.0	50	4	75	30	13	140	15	9.0	9	M10	28.0	A8×7×40
K5	200	250	180_{j6}	40	140	100	140	160	185	15	39.5	45_{k6}	215	4.0	190	290	90.0	90	4	130	60	27	240	30	18.0	14	M16	48.5	A14×9×80
K6	210	300	230_{j6}	50	160	110	160	168	200	17	36.0	50_{k6}	265	4.0	220	340	100.0	100	4	150	65	27	250	30	18.5	14	M16	53.5	A14×9×90
K7	241	350	250_{h6}	55	180	125	180	190	226	18	44.0	60_{m6}	300	5.0	250	380	120.0	120	4	163	70	35	290	38	23.0	18	M20	64.0	A18×11×110
K8	300	400	300_{h6}	75	240	165	240	235	282	20	45.0	70_{m6}	350	5.0	310	455	140.0	140	5	190	85	41	360	45	27.0	18	M20	74.5	A20×12×125
K9	360	450	350_{h6}	95	280	185	280	285	330	23	50.0	90_{m6}	400	5.0	365	545	170.0	170	8	230	95	46	430	50	31.0	18	M24	95.0	A25×14×140

Dimensions of additional round flanges

Type	∅a1	∅b1	c1	∅e1	f1	∅s1
K1	140	95_{j6}	10	115	3	9
K8	350	250_{h6}	18	300	5	18
K8	450	350_{h6}	20	400	5	18

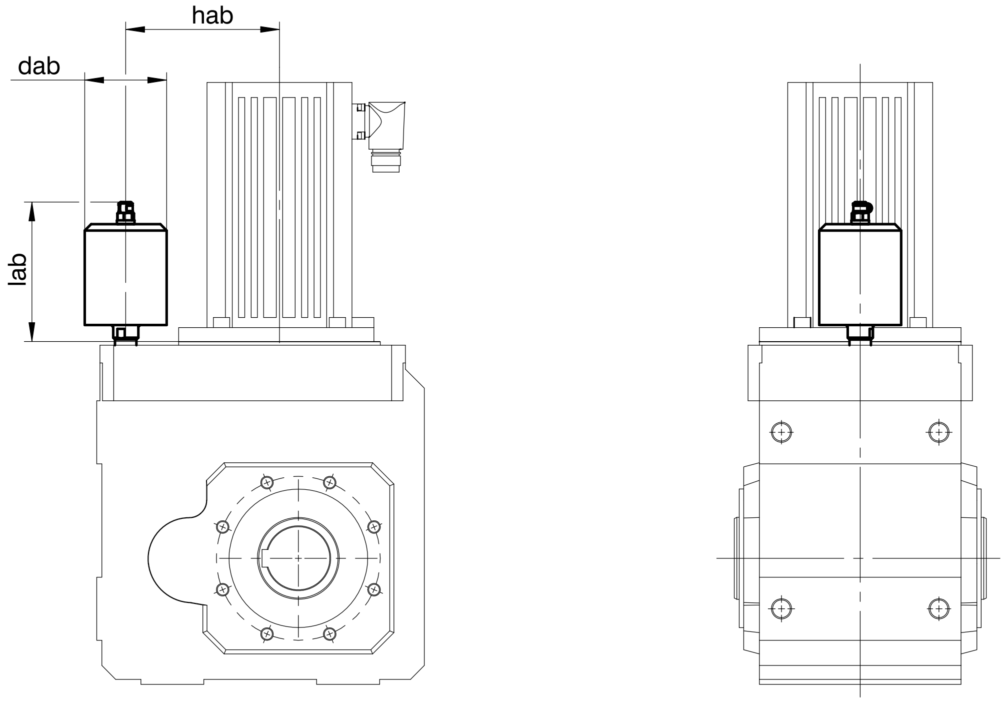
Dimensions of motors

Type	□g	q0	q1	w1	z0
LM401U	98	129.0	172.5	91	97
LM402U	98	168.0	211.5	91	136
LM403U	98	199.0	242.5	91	167
LM503U	115	205.5	253.5	100	175
LM505U	115	275.5	323.5	100	245
LM704U	145	259.5	318.5	115	227
LM706U	145	329.5	388.5	115	297

Dimensions of geared motors

Type	LM4			LM5			LM7		
	a	m	n	a	m	n	a	m	n
K102	□98	124	36.0	□115	128	36.0	–	–	–
K513	–	–	–	∅160	172	15.0	□145	174	15.0
K514	–	–	–	∅160	215	15.0	–	–	–
K613	–	–	–	∅160	191	18.0	∅200	193	18.0
K614	–	–	–	∅160	234	18.0	–	–	–
K713	–	–	–	–	–	–	∅200	221	20.0
K714	–	–	–	∅160	263	20.0	∅200	283	20.0
K813	–	–	–	–	–	–	∅200	247	24.0
K814	–	–	–	–	–	–	∅200	308	24.0
K914	–	–	–	–	–	–	∅200	353	25.0

13.3.15 Oil expansion tank



Dimensions

Type	LM5			LM7		
	dab	hab	lab	dab	hab	lab
K513	65	122.0	113.5	65	122.0	113.5
K613	65	148.5	116.5	65	148.5	116.5
K713	–	–	–	65	170.0	114.5
K813	–	–	–	73	205.0	129.5

More information can be found in Chapter [▸ 13.6.4]

13.4 Type designation

This chapter shows you an explanation of the type designation with the associated options.

Additional ordering information not included in the type designation can be found at the end of the chapter.

Example code

K	4	0	2	A	G	0280	LM704U

Explanation

Code	Designation	Design
K	Type	Helical bevel gearbox
4	Size	4 (example)
0	Generation	Generation 0
1		Generation 1
2	Stages	Two-stage
3		Three-stage
4		Four-stage
A	Shaft	Hollow shaft with keyway
S		Hollow shaft with shrink ring
V		Solid shaft
G	Housing	Pitch circle diameter
F		Round flange
NG		Foot + pitch circle diameter
NF		Foot + round flange
GD		Pitch circle diameter + torque arm bracket
NGD		Foot + pitch circle diameter + torque arm bracket
0280	Transmission ratio (i x 10 rounded)	i = 28.24 (example)
LM704U	Motor	LM Lean motor

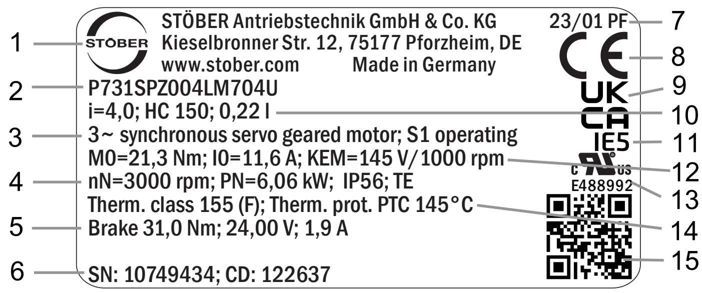
To complete the type designation, also specify the following in your order:

- For a detailed type designation of the motor, see the chapter [▹ 2]
- For the mounting position, see the chapter [▹ 13.5.5]
- Attachment of solid shaft: gearbox side 3 or 4; solid shaft on both sides
- Attachment of hollow shaft with keyway: entry side 3 or 4
- Attachment of hollow shaft with shrink ring: shrink ring on gearbox side 3 or 4
- Attachment of foot plates: gearbox side 1 or 5
- Attachment of flange: gearbox side 3 or 4
- Pitch circle diameter: gearbox side 3 or 4
- Attachment of torque arm bracket: torque arm bracket on gearbox side 1 or 5, eye on gearbox side 3 or 4
- The position of the plug connector, see the chapter [▹ 13.5.7]
- Oil expansion tank (recommended for gearboxes in mounting position EL5), see the chapter [▹ 13.6.4]
- Backlash: Standard/class II/class I. Backlash class II and class I for an additional charge.
- Standard or reinforced output bearing

An explanation of the gearbox sides can be found in the chapter [▹ 13.5.5].

13.4.1 Nameplate

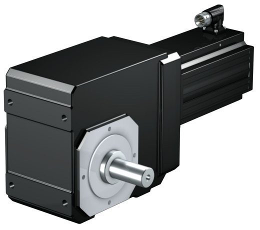
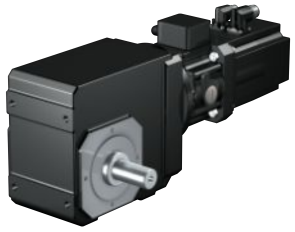
In the following figure, the nameplate of a P731_LM704 Lean geared motor is explained as an example.



Line	Value	Description
1	STÖBER Antriebstechnik GmbH + Co. KG	Logo and address of the manufacturer
2	P731SPZ004LM704U	Type designation of the geared motor
3	3~ synchronous servo geared motor S1 operating	Geared motor type: three-phase synchronous servo geared motor Operating mode
4	nN=3000 rpm PN=6.06 kW IP56 TE	Nominal speed Nominal power Protection class of the motor Protection class in accordance with UL1004
5	Brake 31.0 Nm 24.00 V 1.9 A	Holding brake (optional) Static braking torque at 100 °C Nominal voltage (DC) of the holding brake Nominal current of the holding brake at 20 °C
6	SN: 10749434 CD: 122637	Serial number of the motor Customer-specific data
7	23/01 PF	Date of manufacture (year/calendar week) Place of manufacture (abbreviation)
8	CE	CE mark
9	UKCA	UKCA mark
10	i=4.0 HC 150 0.22 l	Gear ratio of the gearbox Lubricant specification Lubricant fill volume
11	IE5	IEC energy efficiency
12	M0=21.3 Nm I0=11.6 A KEM=145 V/1000 rpm	Stall torque Stall current Voltage constant
13	cURus E488992	cURus test symbol, registered under UL number E488992
14	Therm. class 155 (F) Therm. prot. PTC 145 °C	Thermal class Type of temperature sensor
15	QR code	Link to product information

13.5 Product description

13.5.1 Input options

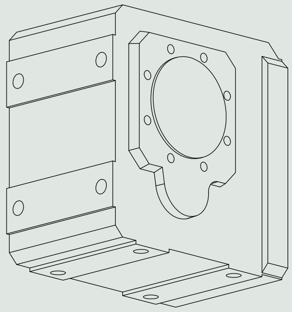
LM Lean motor	EZ synchronous servo motor	MB motor adapter + EZ synchronous servo motor
		
Catalog ID 443016_en	Catalog ID 442437_en	Catalog ID 443311_en

The corresponding catalogs can be found at http://www.stoeber.de/en/downloads/

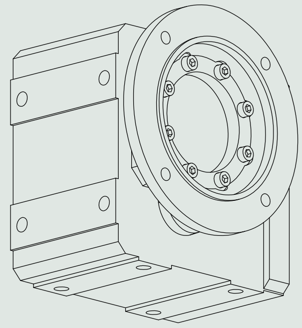
Enter the ID of the catalog in the Search term field.

13.5.2 Housing design

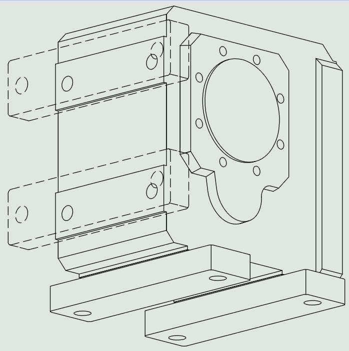
Pitch circle diameter G



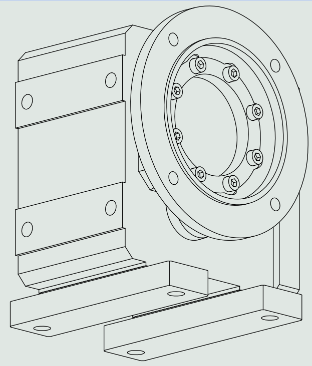
Round flange F



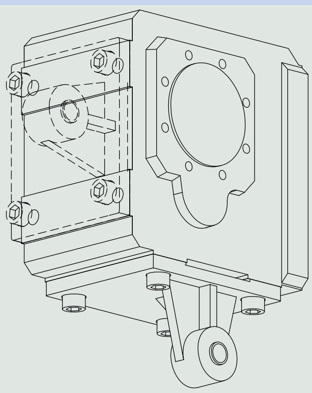
Foot + pitch circle diameter NG



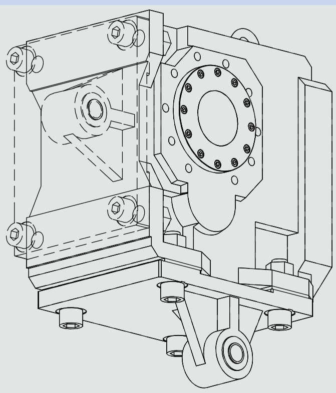
Foot + round flange NF



Pitch circle diameter + torque arm bracket GD



Foot + pitch circle diameter + torque arm bracket NGD



	G	F	NG	NF	GD	NGD
K1	✓	✓	✓	✓	✓	–
K2	✓	✓	✓	–	✓	–
K3	✓	✓	✓	–	✓	–
K4	✓	✓	✓	–	✓	–
K5	✓	✓	✓	✓	✓	–
K6	✓	✓	✓	✓	✓	–
K7	✓	✓	✓	✓	✓	–
K8	✓	✓	✓	✓	✓	–
K9	✓	✓	✓	✓	✓	–
K10	–	–	✓	✓	–	✓

13.5.3 Combinatorial shaft/housing design

	Housing design						
Shaft design	**Code**	**G**	**F**	**NG**	**NF**	**GD**	**NGD**
Hollow shaft with keyway	**A**	AG	AF	ANG	ANF	AGD	ANGD
Hollow shaft with shrink ring	**S**	SG	SF	SNG	SNF	SGD	SNGD
Solid shaft [1)]	**V**	VG	VF	VNG	VNF	–	–

[1)] Gearboxes in sizes K1 – K10 come with a solid shaft with feather key as standard. Gearboxes in sizes K1 – K4 can be ordered with the option of a solid shaft without feather key. Only upon request starting at size K5.

13.5.4 Installation conditions

Hollow shaft

The hollow shaft hole tolerance is ISO H7. The tolerance of the machine shaft must be ISO k6.

Take care to align the machine shaft with the gearbox hollow shaft when attaching the gearbox.

Maximum deviation ≤ 0.03 mm.

For simpler assembly and disassembly of the machine shaft, the hollow shafts are equipped with a spiral groove (as a grease deposit).

A hardened, threaded keeper plate is included in the scope of delivery. You also have the option to order the hollow shaft without a keeper plate.

Hollow shaft with shrink ring

The tolerance of the hollow shaft hole is ISO H7.

The machine shaft must be executed as follows:

Gearbox type	Tolerance
K1 to K6	ISO h9
K7 to K10	ISO h6

Select a material for the machine shaft with a permitted surface pressure of p ≥ 325 N/mm^2.

Possible materials:

- C45E +QT
- 42CrMo4

Fastening the gearboxes on the machine side using the pitch circle diameter

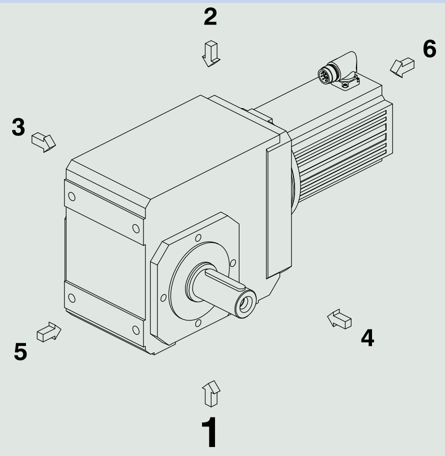
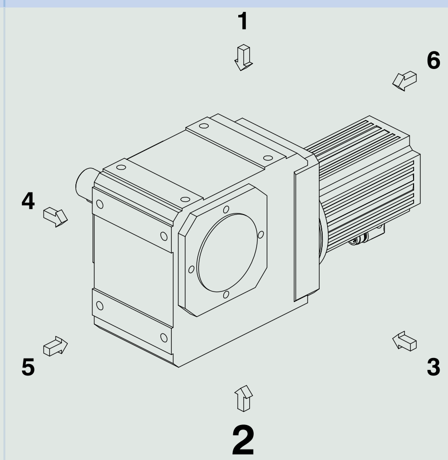
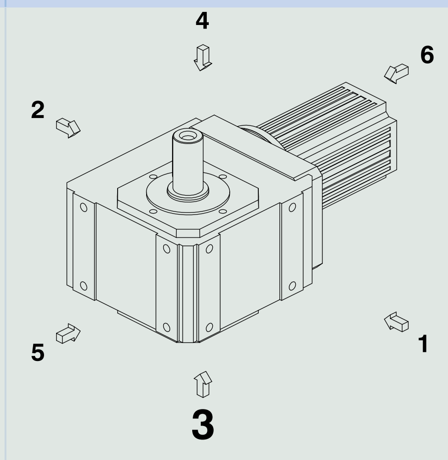
The specified torques and forces only apply when gearboxes are fastened on the machine side using screws of strength class 10.9. In addition, the gear housings must be adjusted at the pilot. The machine-side fit must be H7.

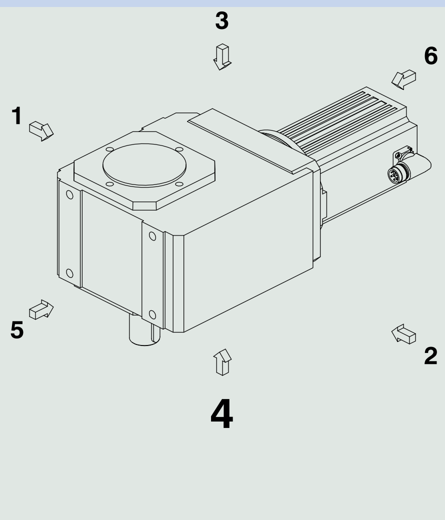
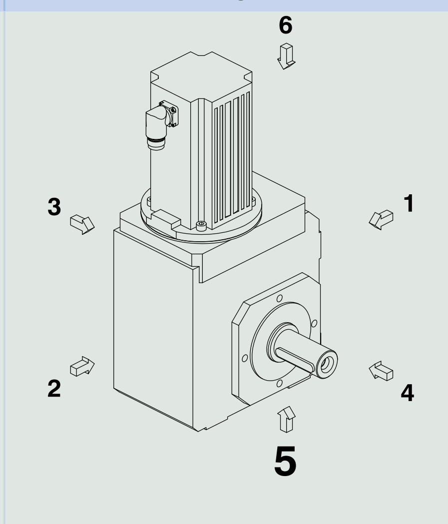
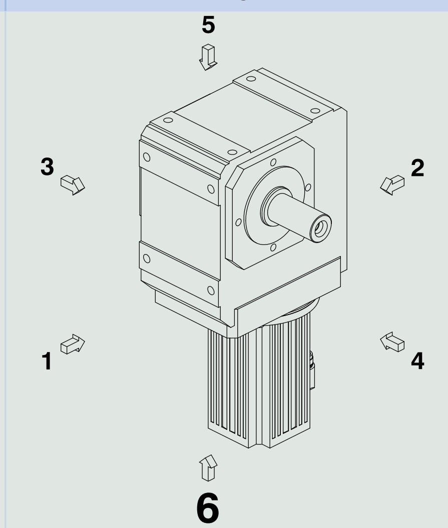
13.5.5 Mounting positions

The following table shows the standard mounting positions.

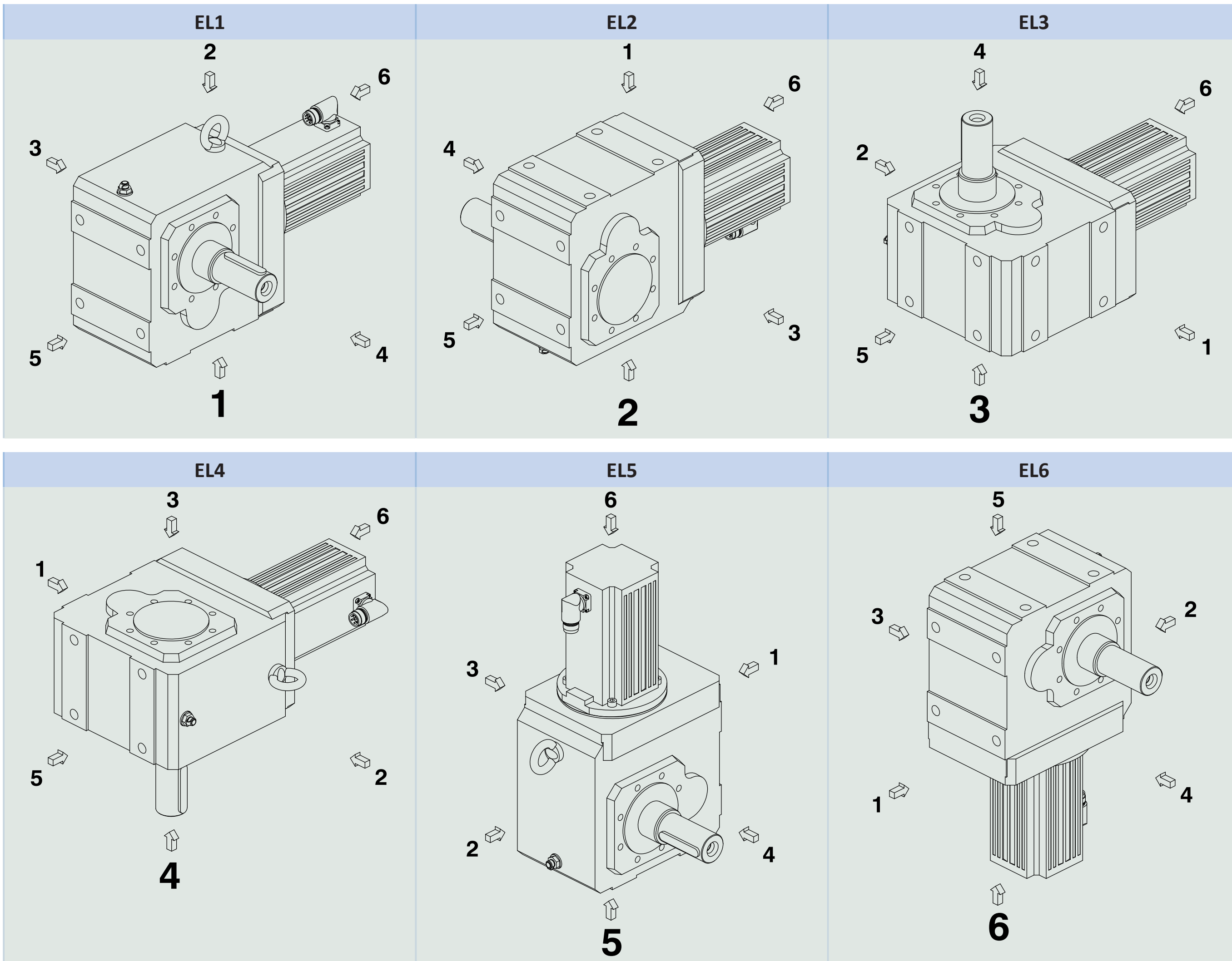
The numbers identify the gearbox sides. The mounting position is defined by the gearbox side facing downwards.

Mounting positions for gearbox sizes K1 – K4

EL1	EL2	EL3
		

EL4	EL5	EL6
		

Mounting positions for gearbox sizes K5 – K10



Since the lubricant filling volume of the gearbox depends on the mounting position, the mounting position must be specified when ordering.

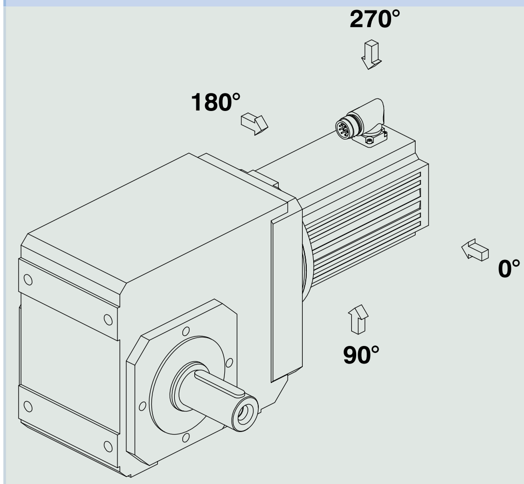
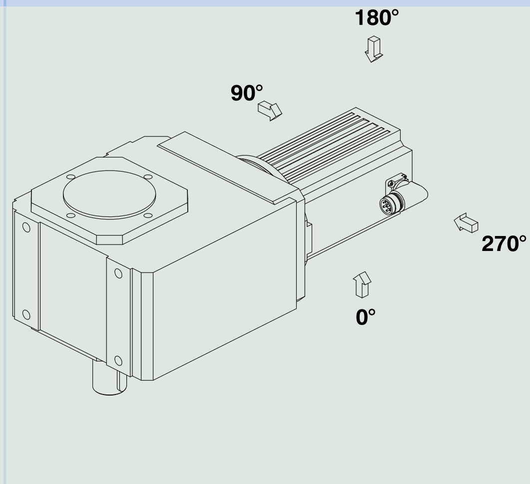
13.5.6 Lubricants

STOBER fills the gearboxes with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gearboxes depend on the mounting position.

Only install the gearboxes in the intended mounting position! Reposition the gearboxes only after consulting STOBER. Otherwise, STOBER assumes no liability for the gearboxes.

You will receive lubricants for use in the food industry upon request.

13.5.7 Position of the plug connector

Mounting position EL1 Plug connector in 270° position (standard)	Mounting position EL4 Plug connector in 270° position (standard)
	

Indicate variations for your geared motor in the order.

Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

13.5.8 Other product features

Feature	Value
Max. permitted gearbox temperature (on the surface of the gearbox)	≤ 80 °C
Paint	Black RAL 9005
Explosion-proof design in accordance with (ATEX) Directive 2014/34/EU (optional)	Not available
Efficiency:	
η_{get} two-stage	97%
η_{get} three-stage	96%
η_{get} four-stage	94%
Protection class:[1]	
Gearbox	IP65
Motor	IP56, optionally IP66

13.5.9 Maintenance

The instructions for maintenance can be found in the operating manual, ID 443364_en, at http://www.stoeber.de/en/downloads/. Enter the ID of the documentation in the Search... field.

Ventilation

Air release valves are fitted as a standard feature and independently of installation position for gearbox sizes K5 to K10.

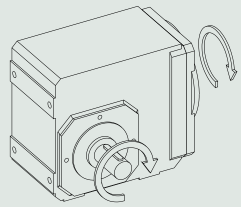
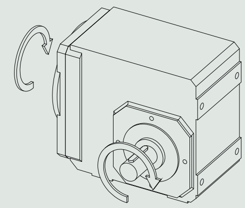
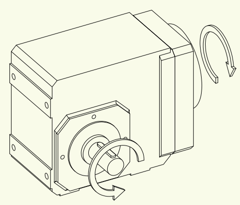
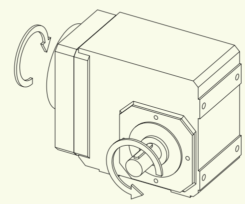
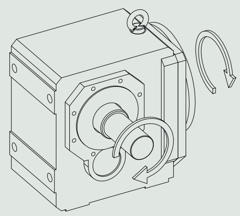
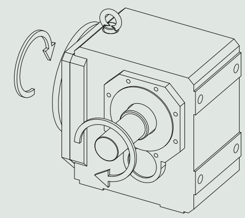
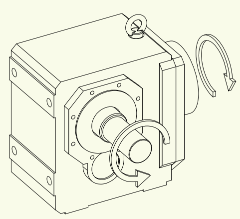
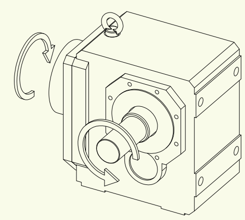
For the position and dimensions of the air release valve, refer to the 3D model.

Download the 3D model at https://configurator.stoeber.de/en-US/.

[1] Observe the protection class of all the components.

13.5.10 Direction of rotation

Solid shaft (V), solid shaft on both sides (V), hollow shaft with keyway (A)

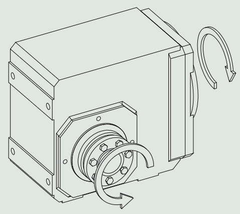
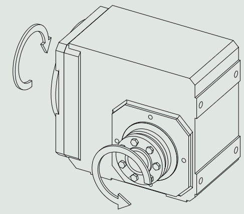
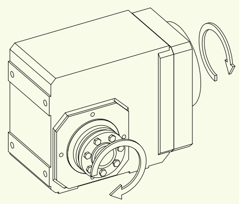
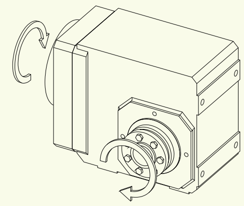
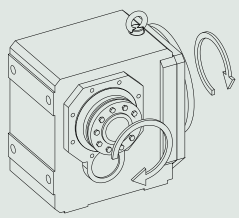
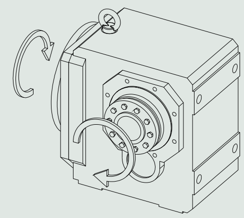
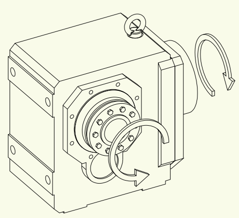
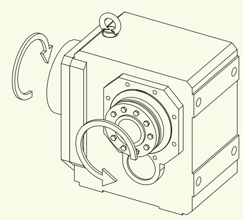
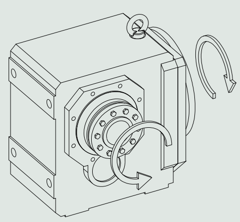
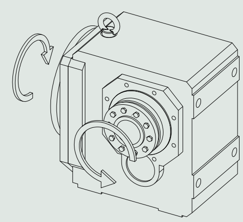
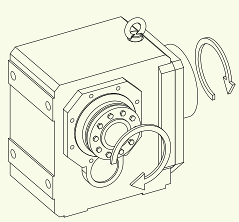
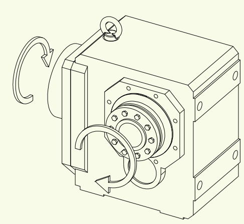
Type	Output side 4	Output side 3
K102 – K402		
K203 – K403		
K513 – K1013		
K514 – K1014		

The specified directions of rotation also apply to gearboxes with hollow shaft (A) if the entry side of the machine shaft corresponds to the side of the solid shaft that is shown.

The direction of rotation for the shaft design of a solid shaft on both sides corresponds to the direction of rotation for output side 4.

The pictures show mounting position EL1.

Hollow shaft with shrink ring (S)

Type	Shrink ring side 4	Shrink ring side 3
K102 – K402		
K203 – K403		
K513 – K813		
K514 – K814		
K913 – K1013		
K914 – K1014		

The pictures show mounting position EL1.

13.6 Project configuration

Project your drives using our SERVOsoft designing software. Download SERVOsoft free of charge after registration at https://www.stoeber.de/en/services/info-servosoft/.

It is the most convenient and reliable method of drive selection, as the entire torque/speed curve of the application is displayed and evaluated here in the curve of the geared motor.

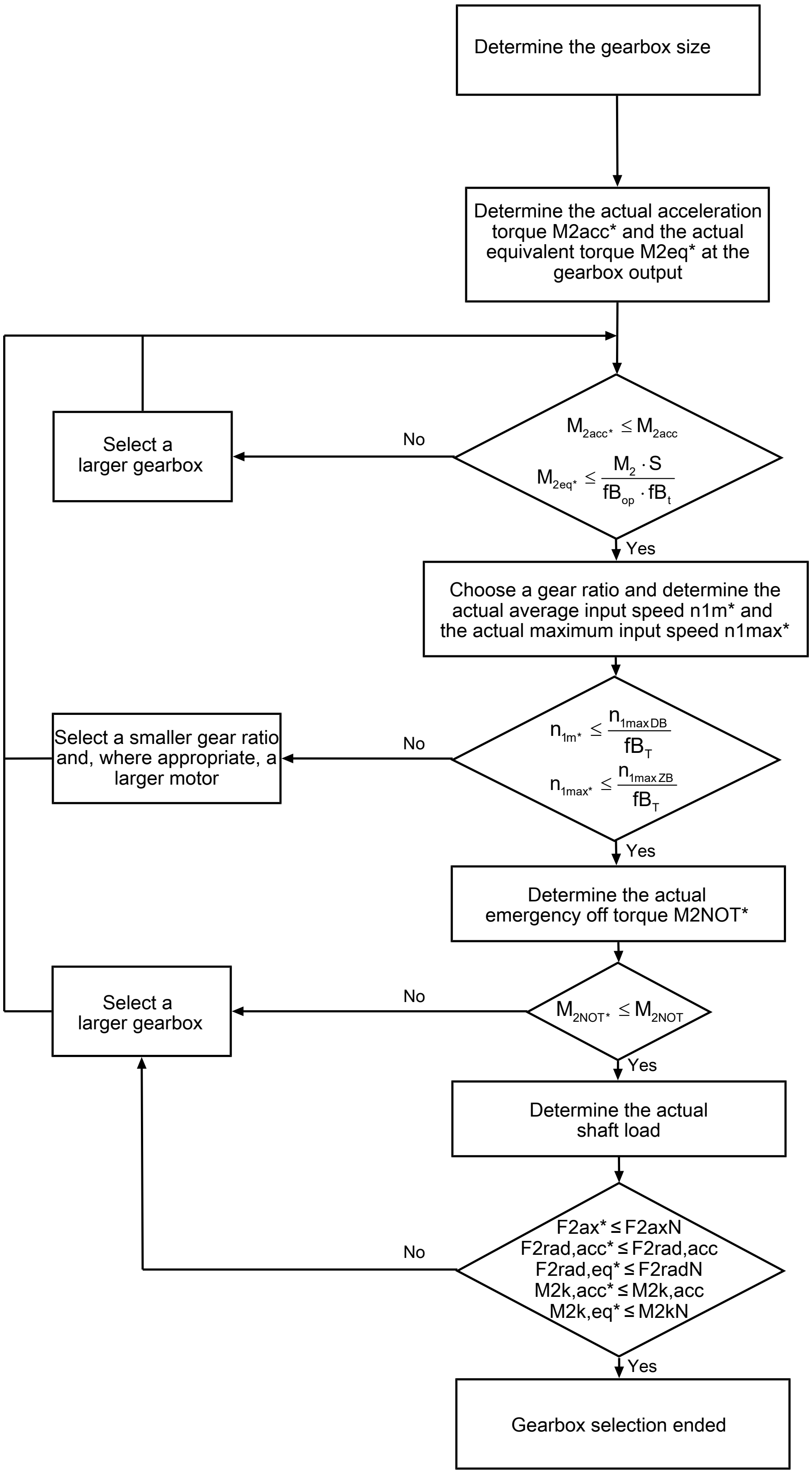
In this chapter, only limit values for specific operating points can be taken into consideration for manual drive selection.

An explanation of the formula symbols can be found in the Chapter [▷ 15.1].

The formula symbols for values actually present in the application are marked with *.

13.6.1 Drive selection

Drive selection for gearboxes

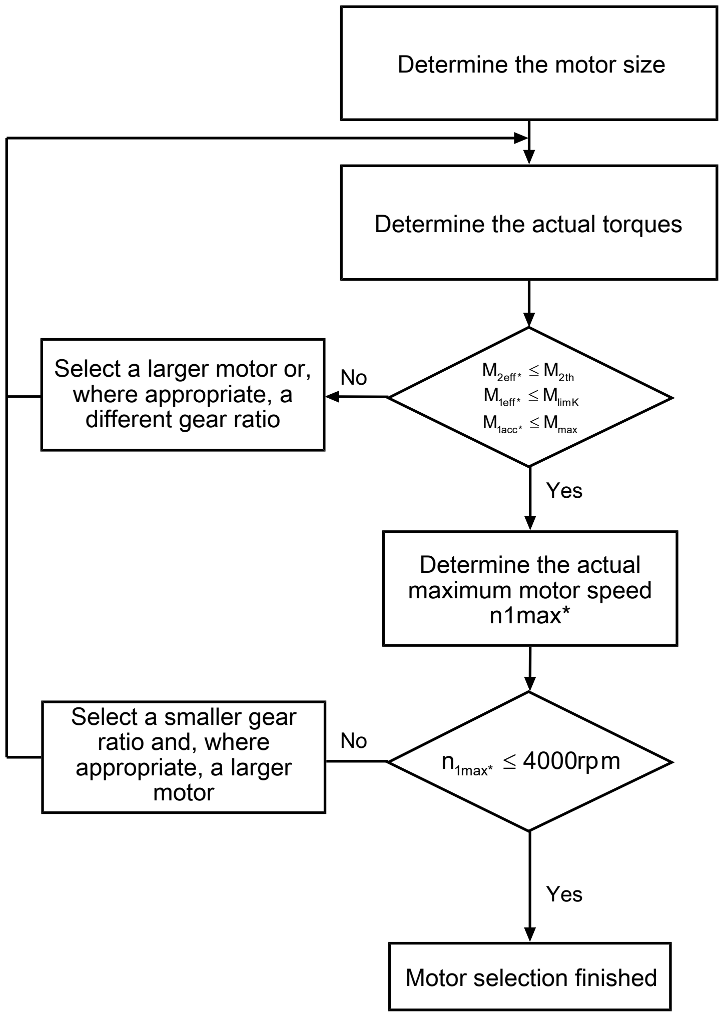


Calculate the forces and tilting torques in the chapter Permitted shaft loads.

Refer to the selection tables for the values for i, n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_2 and S.

The values for fB_T, fB_{op} and fB_t can be found in the corresponding tables in this chapter.

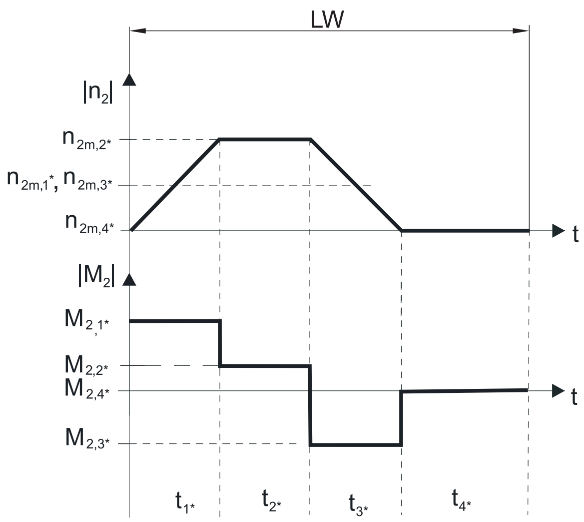
Drive selection for motors



The value for M_{limK} and M_{max} can be found in the motor characteristic curve in the chapter [▸ 2.3]. Note the size of the motor.

Example of cyclic operation

The following calculations are based on a representation of the power taken from the output based in accordance with the following example:



Calculation of the actual maximum acceleration torques

$$M_{2acc*} = J_{tot} \cdot \frac{\Delta n_2}{9{,}55 \cdot \Delta t} + M_{L*}$$

$$M_{1acc*} = \frac{M_{2acc*}}{i \cdot \eta_{get}} + J_1 \cdot \frac{\Delta n_1}{9{,}55 \cdot \Delta t}$$

Calculation of the actual average input speed

$$n_{1m*} = n_{2m*} \cdot i$$

$$n_{2m*} = \frac{\left|n_{2m,1*}\right| \cdot t_{1*} + \ldots + \left|n_{2m,n*}\right| \cdot t_{n*}}{t_{1*} + \ldots + t_{n*}}$$

If t_{1*} + ... + $t_{3*} \geq 6$ min, calculate n_{2m*} without the rest phase t_{4*}.

The values for the ratio i can be found in the selection tables.

Calculation of the actual effective torque

$$M_{2eff*} = \sqrt{\frac{t_{1*} \cdot M_{2,1*}^{\;2} + \ldots + t_{n*} \cdot M_{2,n*}^{\;2}}{t_{1*} + \ldots + t_{n*}}}$$

Calculation of the actual emergency off torque

$$M_{2NOT*} = J_{tot} \cdot \frac{\Delta n_2}{9.55 \cdot \Delta t} + M_{L*}$$

Calculation of the actual equivalent torque

$$M_{2eq*} = \sqrt[3]{\frac{\left|n_{2m,1*}\right| \cdot t_{1*} \cdot \left|M_{2,1*}^{\;3}\right| + \ldots + \left|n_{2m,n*}\right| \cdot t_{n*} \cdot \left|M_{2,n*}^{\;3}\right|}{\left|n_{2m,1*}\right| \cdot t_{1*} + \ldots + \left|n_{2m,n*}\right| \cdot t_{n*}}}$$

Calculation of the thermal limit torque

Calculate the thermal limit torque M_{2th} for a duty cycle ED_{10} > 50% and the actual average input speed n_{1m*}. (At $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m*} accordingly or select another geared motor size.)

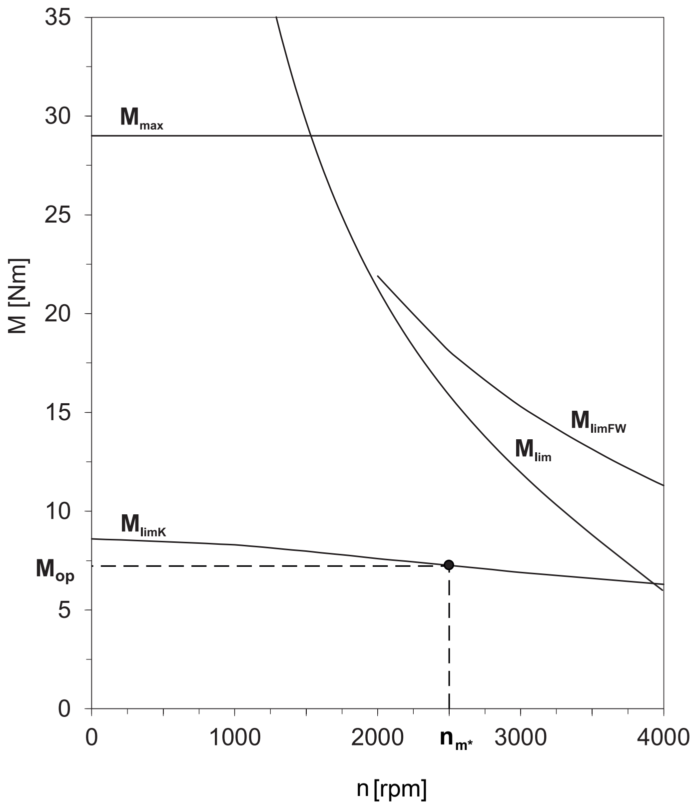
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}95 - \frac{a_{th}}{1000} \cdot athEL \cdot fB_T \cdot \left(\frac{n_{1m*}}{1000}\right)^2$$

Refer to the selection tables for the values of i and a_{th}.

The values for a_{thEL} and fB_T can be found in the corresponding tables in this chapter.

The value for the torque of the motor at operating point M_{op} with the determined average input speed n_{1m*} can be found in the motor characteristic curve in the chapter [▶ 2.3]. Note the size of the motor. The figure below shows an example of reading the torque M_{op} at the operating point.



Operating factors

Parameter a_{thEL}

Mounting position	a_{thEL}
EL1, 2	1.0
EL3, 4, 5, 6	1.1

Operating mode	fB_{op}
Uniform continuous operation	1.00
Cyclic operation	1.25
Reversing load cyclic operation	1.40

Run time	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation	≤ 20 °C	0.9
	≤ 30 °C	1.0
	≤ 40 °C	1.15
Motor with convection cooling	≤ 20 °C	1.0
	≤ 30 °C	1.1
	≤ 40 °C	1.25

Notes

- The maximum permitted gearbox temperature (see the "Other product features" chapter) must not be exceeded. Doing so may result in damage to the geared motor.
- For braking from full speed (for example when the power fails or when setting up the machine), note the permitted gearbox torques (M_{2acc}, M_{2NOT}) in the selection tables.

13.6.2 Permitted shaft loads for the output shaft

The values specified in the tables apply to the permitted shaft loads:

- For shaft dimensions in accordance with the catalog
- For output speeds $n_{2m^*} \leq 20$ rpm ($F_{2axN} = F_{2ax20}$; $F_{2radN} = F_{2rad20}$; $M_{2kN} = M_{2k20}$)
- Only if radial forces on the gearbox are stabilized by its pilots for the pitch circle diameter and flange housing design

13.6.2.1 V shaft design

Permitted shaft loads for V shaft design (solid shaft)

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
K1	40.0	1900	5000	5000	325	325
K2	42.0	2100	6000	6000	430	430
K3	45.0	2400	7000	7000	525	525
K4	52.0	3500	11200	11200	1050	1050
K5	72.0	3500	13450	13450	1580	1580
K6	72.0	4000	16000	16000	1960	1960
K7	85.0	5500	22000	22000	3200	3200
K8	60.0	7250	29000	29000	3800	3800
K9	87.0	16500	65000	65000	11200	11200
K10	84.0	25000	80000	80000	15200	15200

Reduced values apply in the case of a V shaft design (solid shaft) in conjunction with an NF housing design (foot + round flange):

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
K10	132.0	25000	64000	64000	15200	15200

For the V solid shaft design on both sides, the values for F_{2rad20} and M_{2k20} must be multiplied by a factor of 0.7.

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds $n_{2m^*} > 20$ rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}}$$

The values for F_{2ax20}, F_{2rad20} and M_{2k20} can be found in the table "Permitted shaft loads" in this chapter.

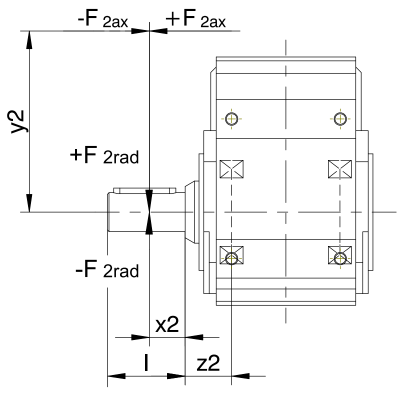


Fig. 1: Force application points for solid shaft

The specified values for F_{2rad20} and $F_{2rad,acc}$ refer to an application of force at the center of the output shaft: $x_2 = l/2$.

Shaft dimensions can be found in the "Dimensional drawings" chapter.

The following applies to other force application points:

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

13.6.2.2 A and S shaft design

Permitted shaft loads for A shaft design (hollow shaft with keyway)

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
K1	40.0	1900	5000	5000	240	240
K2	42.0	2100	6000	6000	310	310
K3	45.0	2400	7000	7000	380	380
K4	52.0	3500	11200	11200	740	740
K5	39.0	2500	13450	13450	1000	1000
K6	42.0	3000	16000	16000	1300	1300
K7	45.0	4100	22000	22000	2100	2100
K8	50.0	5300	29000	29000	2600	2600
K9	56.0	7000	65000	65000	3600	3600
K10	56.0	9000	80000	80000	5000	5000

Permitted shaft loads for S shaft design (hollow shaft with shrink ring)

Type	z_2 [mm]	F_{2ax20} [N]	F_{2rad20} [N]	$F_{2rad,acc}$ [N]	M_{2k20} [Nm]	$M_{2k,acc}$ [Nm]
K1	40.0	1900	5000	5000	240	240
K2	42.0	2100	6000	6000	310	310
K3	45.0	2400	7000	7000	380	380
K4	52.0	3500	11200	11200	740	740
K5	39.0	2500	13450	13450	1000	1000
K6	42.0	3000	16000	16000	1300	1300
K7	45.0	4100	22000	22000	2100	2100
K8	50.0	5300	29000	29000	2600	2600
K9	56.0	7000	65000	65000	3600	3600
K10	56.0	9000	80000	80000	5000	5000

For other output speeds, download diagrams at https://configurator.stoeber.de/en-US/.

The following applies to output speeds n_{2m^*} > 20 rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20\ \text{rpm}}}}$$

The values for F_{2ax20}, F_{2rad20} and M_{2k20} can be found in the table "Permitted shaft loads" in this chapter.

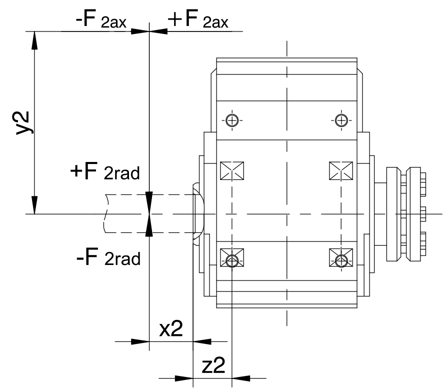


Fig. 2: Force application points for hollow shaft

You can determine the permitted radial forces from the permitted tilting torque M_{2kN} and $M_{2k,acc}$. The actual radial forces may not exceed the permitted radial forces. The permitted radial forces pertain to the shaft end (x2 = 0).

$$M_{2k,acc^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad,acc^*} \cdot (x_2 + z_2)}{1000}$$

For applications with multiple axial and/or radial forces, you must add the forces as vectors.

In the event of EMERGENCY OFF operation (max. 1000 load changes), you can multiply the permitted forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of two.

Also note the calculation for equivalent values:

$$M_{2k,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |M_{2k,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |M_{2k,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

$$F_{2rad,eq^*} = \sqrt[3]{\frac{|n_{2m,1^*}| \cdot t_{1^*} \cdot |F_{2rad,acc,1^*}{}^3| + \ldots + |n_{2m,n^*}| \cdot t_{n^*} \cdot |F_{2rad,acc,n^*}{}^3|}{|n_{2m,1^*}| \cdot t_{1^*} + \ldots + |n_{2m,n^*}| \cdot t_{n^*}}}$$

13.6.3 Radial shaft seal rings

Leak-proofness

Our gearboxes are equipped with high-quality radial shaft seal rings and checked for leaks. However, a leak cannot be fully ruled out over the length of use of a gearbox. If you use a gearbox with goods incompatible with the lubricant, you must take measures to prevent direct contact with the gearbox lubricant in case of a leak.

13.6.4 Oil expansion tank

The gearboxes have a higher fill level in mounting position EL5. The oil expansion tank prevents oil from escaping out of the gearbox.

Notes

- We recommend using an oil expansion tank in mounting position EL5 (additional cost) for fast running gearboxes with an input speed n_1 > 1750 rpm and gear ratios i < 20.
- It is not possible to use an oil expansion tank if the plug connector is at 90°!
- The oil expansion tank can only be used with certain sizes; see the chapter [▶ 13.3.15]

13.7 Additional documentation

Additional documentation related to the product can be found at
http://www.stoeber.de/en/downloads/

Enter the ID of the documentation in the Search term field.

Documentation	ID
Operating manual gearboxes, geared motors K	443364_en

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15 Appendix

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15.1 Formula symbols

Symbol	Unit	Explanation
a_{th}	–	Parameter for calculating $K_{mot,th}$
C_2	Nm/ arcmin	Torsional stiffness relative to the gearbox output
C_{maxPU}	F	Maximum charging capacity of the power unit
C_{PU}	F	Self-capacitance of the power unit
ΔJ_B	$kgcm^2$	Additive mass moment of inertia of a motor with brake
Δm_B	kg	Additive weight of a motor with brake
$\Delta\phi_2$	arcmin	Backlash at the output shaft with a blocked input
$\Delta\phi_{2red}$	arcmin	Reduced backlash at the output shaft with a blocked input
$\Delta\vartheta$	K	Temperature difference
D_{IA}	%	Reduction in the nominal current depending on the installation altitude
D_T	%	Reduction in the nominal current depending on the surrounding temperature
ED_{10}	%	Duty cycle based on 10 minutes
η_{get}	%	Efficiency of the gearbox at nominal torque
η_{mot}	%	Efficiency of the motor
F_{2ax*}	N	Actual axial force at the gearbox output
F_{2ax100}	N	Permitted axial force at the gearbox output for $n_{2m*} \leq 100$ rpm (without radial force)
F_{2ax20}	N	Permitted axial force at the gearbox output for $n_{2m*} \leq 20$ rpm (without radial force)
F_{2axN}	N	Permitted nominal axial force at the gearbox output (without radial force)
f_{2PU}	Hz	Output frequency of the power unit
$F_{2rad100}$	N	Permitted radial force at the gearbox output for $n_{2m*} \leq 100$ rpm
F_{2rad20}	N	Permitted radial force on the gearbox output for $n_{2m*} \leq 20$ rpm
$F_{2rad,acc}$	N	Permitted radial acceleration force at the gearbox output
$F_{2rad,acc*}$	N	Radial acceleration force present at the gearbox output
$F_{2rad,acc,1*}$	N	Radial acceleration force present at the gearbox output in the first time period
$F_{2rad,acc,n*}$	N	Radial acceleration force present at the gearbox output in the nth time period
$F_{2rad,eq*}$	N	Actual equivalent force at the gearbox output
F_{2radN}	N	Permitted nominal radial force at the gearbox output
F_{ax}	N	Permitted axial force on the output
F_{ax*}	N	Actual axial force on the output
F_{ax100}	N	Permitted axial force on the output for $n_{m*} \leq 100$ rpm
fB_{op}	–	Operating mode operating factor
fB_t	–	Runtime operating factor
fB_T	–	Temperature operating factor
fB_{ZB}	–	Operating factor for cyclic operation
f_N	Hz	Rotating magnetic field frequency at nominal speed
$f_{PWM,PU}$	kHz	Frequency of the pulse width modulation of the power unit
F_{rad}	N	Permitted radial force on the output
F_{rad*}	N	Actual radial force on the output
F_{rad100}	N	Permitted radial force on the output for $n_{m*} \leq 100$ rpm
H	m	Installation altitude above sea level
i	–	Gear ratio
i_{exact}	–	Mathematically exact gear ratio
I_0	A	Stall current
I_{1maxCU}	A	Maximum input current of the control unit
I_{1maxPU}	%	Maximum input current of the power unit (in relation to the nominal input current)
$I_{1N,PU}$	A	Nominal input current of the power unit
I_{2maxPU}	%	Maximum output current of the power unit (in relation to the nominal output current)
$I_{2N,PU}$	A	Nominal output current of the power unit
$I_{2N,PU(red)}$	A	Reduced nominal output current of the power unit

Symbol	Unit	Explanation
$I_{2N,PU}/I_0$	A	Ratio of the nominal output current of the power unit to the stall current
$I_{2PU(A)}$	A	Output current of the power unit for axis A
$I_{2PU(B)}$	A	Output current of the power unit for axis B
I_{max}	A	Maximum current
		Exceeding I_{max} may lead to irreversible damage (demagnetization) of the rotor.
I_N	A	Nominal current
$I_{N,B}$	A	Nominal current of the brake at 20 °C
$I_{N,MF}$	A	Nominal current of the choke or motor filter
J	$kgcm^2$	Mass moment of inertia
J_1	$kgcm^2$	Mass moment of inertia relative to the gearbox input
J_{Bstop}	$kgcm^2$	Reference mass moment of inertia when braking from full speed: $J_{Bstop} = J \times 2$
J_{tot}	kgm^2	Total mass moment of inertia (based on the motor shaft)
K_{EM}	V/1000 rpm	Voltage constant: peak value of the induced voltage between the phases U, V, W of the motor at operating temperature at a speed of 1000 rpm
K_H	–	Derating factor for installation altitude
$K_{M,N}$	Nm/A	Torque constant: ratio of the nominal torque M_N to the nominal current I_N; $K_{M,N} = M_N / I_N$ (tolerance ±10%)
$K_{mot,th}$	–	Factor for determining the thermal limit torque
K_ϑ	–	Derating factor for surrounding temperature
l	mm	Length of the output shaft
L_{10h}	h	Bearing service life
m	kg	Weight (for gearboxes without lubricant)
M	Nm	Torque
M_0	Nm	Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance ±5%)
M_2	Nm	Torque at the gearbox output
$M_{2.0}$	Nm	Stall torque on the gearbox output
$M_{2.1*} – M_{2.4*}$	Nm	Actual torque in the respective time segment (1 to 4)
M_{2acc}	Nm	Maximum permitted acceleration torque on the gearbox output
M_{2acc*}	Nm	Actual acceleration torque on the gearbox output
$M_{2acc,max}$	Nm	Maximum permitted acceleration torque of a group of geared motors whose size and nominal torque n_{1N} are the same
M_{2accHT}	Nm	Maximum permitted acceleration torque on the gearbox output with reduced backlash
M_{2eff*}	Nm	Actual effective torque on the gearbox output
M_{2eq*}	Nm	Equivalent torque present on the gearbox output
M_{2k*}	Nm	Actual tilting torque on the gearbox output
M_{2k100}	Nm	Permitted tilting torque on the gearbox output for $n_{2m*} \leq 100$ rpm
M_{2k20}	Nm	Permitted tilting torque on the gearbox output for $n_{2m*} \leq 20$ rpm
$M_{2k,acc}$	Nm	Permitted acceleration tilting torque at the gearbox output
$M_{2k,acc*}$	Nm	Acceleration tilting torque present at the gearbox output
$M_{2k,acc,1*}$	Nm	Acceleration tilting torque present at the gearbox output in the first time period
$M_{2k,acc,n*}$	Nm	Acceleration tilting torque present at the gearbox output in the nth time period
$M_{2k,eq*}$	Nm	Actual equivalent tilting torque on the gearbox output
M_{2kN}	Nm	Permitted nominal tilting torque at the gearbox output
M_{2NOT}	Nm	Gearbox emergency off torque on the gearbox output for max. 1000 load changes
M_{2NOT*}	Nm	Actual emergency off torque for the gearbox on the gearbox output
M_{2th}	Nm	Thermal limit torque on the gearbox output
M_{Bdyn}	Nm	Dynamic braking torque at 100 °C
M_{Bstat}	Nm	Static braking torque of the motor brake at 100 °C
M_{eff*}	Nm	Actual effective torque of the motor
M_k	Nm	Permitted tilting torque on the output
M_{k*}	Nm	Actual tilting torque on the output
M_{k100}	Nm	Permitted tilting torque on the output for $n_{m*} \leq 100$ rpm

Symbol	Unit	Explanation
M_L	Nm	Load torque
M_{lim}	Nm	Torque limit without field weakening
M_{limFW}	Nm	Torque limit with field weakening (applies to operation on STOBER drive controllers only)
M_{limK}	Nm	Torque curve of the motor with convection cooling in continuous operation
M_{max}	Nm	Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance ±10%)
M_N	Nm	Nominal torque: the maximum torque of a motor in S1 mode at nominal speed n_N (tolerance ±5%)
M_{n*}	Nm	Actual torque of the motor in the n-th time segment
M_{Nred}	Nm	Reduced nominal torque of the motor
M_{op}	Nm	Torque of motor at the operating point from the motor characteristic curve at n_{1m*}
M_R	Nm	Frictional torque (of the bearings and seals) of a motor at winding temperature $\Delta\vartheta$ = 100 K
n	rpm	Speed
n_{1m*}	rpm	Actual average input speed
n_{1max*}	rpm	Actual maximum input speed
n_{1maxDB}	min^{-1}	Maximum permitted input speed of the gearbox in continuous operation
		(at surrounding temperature of 20 °C)
$n_{1maxDBEL1,2}$	rpm	Maximum permitted input speed of the gearbox in continuous operation Mounting positions EL1, EL2
		(at surrounding temperature of 20 °C)
$n_{1maxDBEL1,2,3,4}$	rpm	Maximum permitted input speed of the gearbox in continuous operation Mounting positions EL1, EL2, EL3, EL4
		(at surrounding temperature of 20 °C)
$n_{1maxDBEL1,2,5,6}$	rpm	Maximum permitted input speed of the gearbox in continuous operation Mounting positions EL1, EL2, EL5, EL6
		(at surrounding temperature of 20 °C)
$n_{1maxDBEL3,4}$	rpm	Maximum permitted input speed of the gearbox in continuous operation Mounting positions EL3, EL4
		(at surrounding temperature of 20 °C)
$n_{1maxDBEL3,4,5,6}$	rpm	Maximum permitted input speed of the gearbox in continuous operation Mounting positions EL3, EL4, EL5, EL6
		(at surrounding temperature of 20 °C)
$n_{1maxDBEL5,6}$	rpm	Maximum permitted input speed of the gearbox in continuous operation Mounting positions EL5, EL6
		(at surrounding temperature of 20 °C)
n_{1maxZB}	min^{-1}	Maximum permitted input speed of the gearbox in cyclic operation
		(at surrounding temperature of 20 °C)
n_{1N}	rpm	Nominal speed at the gearbox input
n_2	rpm	Speed at the gearbox output
n_{2m*}	rpm	Actual average output speed
$n_{2m,1*} - n_{2m,4*}$	rpm	Actual average output speed in the respective time segment (1 to 4)
$n_{2m,n*}$	rpm	Actual average output speed in the n-th time segment
N_{Bstop}	–	Permitted number of braking processes from full speed (n = 3000 rpm) with J_{Bstop} (M_L = 0). The following applies if the values of n and J_{Bstop} differ: N_{Bstop} = $W_{B,Rlim}$ / $W_{B,R/B}$.
n_{m*}	rpm	Actual average motor speed
$n_{m,1*} - n_{m,4*}$	rpm	Actual average speed of the motor in the respective time segment (1 to 4)
$n_{m,n*}$	rpm	Actual average speed of the motor in the n-th time segment
n_N	rpm	Nominal speed: The speed for which the nominal torque M_N is specified
p	–	Number of pole pairs
P_{effRB}	W	Effective power at the external braking resistor
P_{maxRB}	W	Maximum power at the external braking resistor
P_N	kW	Nominal power: the power the motor is able to deliver long term in S1 mode at the nominal point (tolerance ±5 %)
$P_{2N,PU}$	W	Nominal output power of the power unit

Symbol	Unit	Explanation
P_V	W	Power loss
$P_{V,CU}$	W	Power loss of the control unit
R_{2minRB}	Ω	Minimum resistance of the external braking resistor
S	–	Service factor: Quotient of the nominal torque from the gearbox and the motor without consideration for thermal limiting performance. Represents a value for the reserve of the geared motor.
ϑ_{amb}	°C	Surrounding temperature
$\vartheta_{amb,max}$	°C	Maximum surrounding temperature
$t_{1*} - t_{4*}$	s	Duration of the respective time segment (1 to 4)
t_{1B}	ms	Linking time: time from when the current is turned off until the nominal braking torque is reached
t_{11B}	ms	Response delay: time from when the current is turned off until the torque increases
t_{2B}	ms	Disengagement time: time from when the current is turned on until the torque begins to drop
t_{dec}	ms	Stop time
t_{n*}	s	Duration of the n-th time segment
ϑ_{NAT}	°C	Nominal response temperature
t	s	Time
τ_{th}	°C	Thermal time constant
U_{1CU}	V	Input voltage of the control unit
U_{1PU}	V	Input voltage of the power unit
U_{2PU}	V	Output voltage of the power unit
$U_{2PU,ZK}$	V	Output voltage of the power unit for the DC link connection (typical values: 400 V_{AC} corresponds to 560 V_{DC}, 480 V_{AC} corresponds to 680 V_{DC})
U_{max}	V	Maximum voltage
$U_{N,B}$	V	Nominal voltage of brake
U_{offCH}	V	Switch-off threshold of the brake chopper
U_{onCH}	V	On limit of the brake chopper
U_{ZK}	V	DC link voltage: characteristic value of a drive controller
$W_{B,R/B}$	J	Work done by friction for braking
$W_{B,Rlim}$	kJ	Work done by friction until wear limit is reached
$W_{B,Rmax/h}$	kJ/h	Maximum permitted work done by friction per hour with individual braking
x_2	mm	Distance of the shaft shoulder to the force application point
$x_{B,N}$	mm	Nominal air gap of brake
y_2	mm	Distance of the shaft axis to the axial force application point
z_2	mm	Distance of the shaft shoulder to the middle of the output bearing

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