

## Lean motors

Sensorless drives



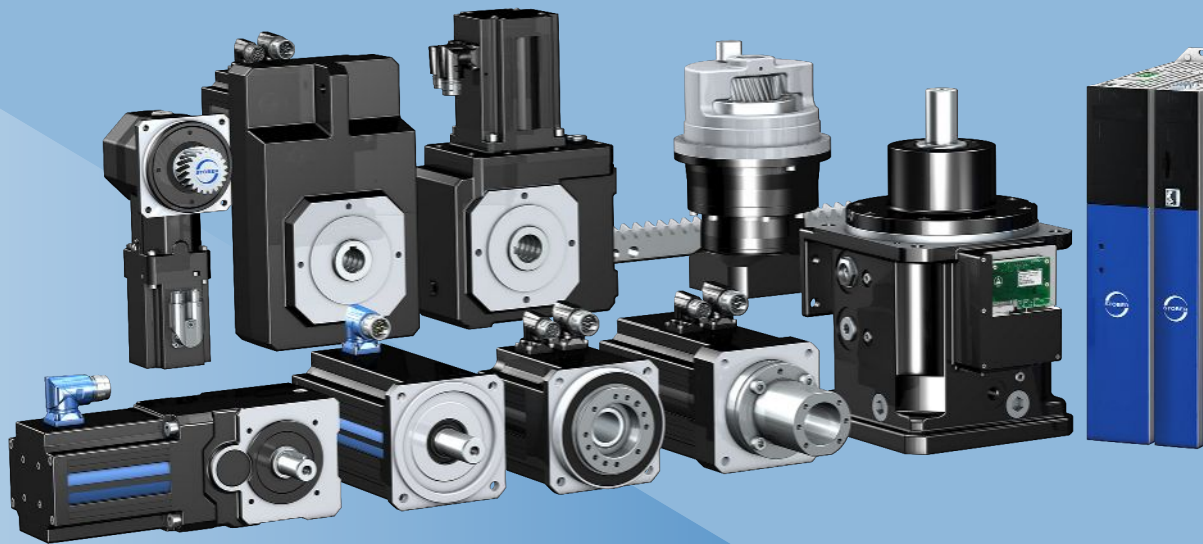


**Lean motors**

**Sensorless drives**

# STOBER drive technology for perfectionists

Sooner or later, design engineers never satisfied with the second-best solution end up at STOBER. That is because they can find everything here, with the broadest range of all imaginable drive technology components. Available with the highest level of design granularity to satisfy any individualized requirements perfectly. And the result is a complete STOBER system, from the gear rack and geared motor to open-loop or closed-loop control to intuitive project configuration software. With open interfaces based on established industry standards and reliably functioning communication between the individual components. The STOBER system also includes a complete package of services and practical support. Find out more on the following pages.



## You can put your trust in STOBER

STOBER has been building excellent drive technology for more than 80 years. As a medium-sized, owner-operated company, STOBER understands the needs of its customers. Our company is down-to-earth, innovative, dynamic and focused on the customer. Our customers can find certified experts in every area, whether in research and development, production, technical consultation or design support. This goes beyond the technical qualifications. It also includes an equal measure of dedication, dependability and friendly, clear communication.











## STOBER in motion

Despite our sense of tradition, we always enjoy something new. We continue to push ourselves forward and to refine our products further. We do this by implementing suggestions from real-world use, giving due consideration to customer requests and constantly seeking out even better solutions. This is all made possible by the competitive spirit with which we face every exciting challenge. The strong STOBER team spirit provides for productive collaboration. Both at work and outside the company doors. Our customers benefit from the extraordinary constancy of our employee base. This provides the astounding result where we can provide contacts familiar with a customer's industry and who can identify with a customer's needs.









# The team that works well together wins

## STOBER supplies the complete system: controller, automation, geared motors

STOBER has its roots in developing and building geared motors. We have also been developing and manufacturing drive controllers for decades. These STOBER components form drive systems with dependable functionality thanks to their plug-and-play design. Electronics and mechanical systems that speak the same language are critical for this. They understand each other without any adapters. All of the system components can recognize each other by their "electronic nameplate."



### Systematic quality assurance

We check every single component and how it works together with others. Mass-producers are not able to do that. We assume responsibility for the complete system. This means certified operational reliability and the highest machine availability are guaranteed.

## Technical system advantages

The STOBER system is flexible. One example is the freedom to choose between drive-based mode and controller-based mode. Or the feature allowing you to combine drive controllers in a multi-axis drive system and stand-alone controllers with special functions as you wish. This allows the modular design and free scalability of a drive system. This enables full utilization of capacity.



## STOBER engineering software

Our AS6 engineering software based on Codesys plays a leading role in the STOBER system. The AS6 has a whole series of new and useful features integrated into it that make your work easier in every phase of the project. Comprehensive libraries provide direct access to STOBER products from every level of the drive system. You can find detailed technical information and have ready access to presets for standard functions.



## STOBER is your partner

Our role does not end with the delivery of hardware and software. If you like, we will accompany and support you throughout your entire project. You can call on programming manpower at STOBER. Our experienced Codesys professionals will be happy to handle tricky special tasks or help you find the right template. This is even possible if components from other manufacturers are part of the bigger picture. You have direct, one-on-one contact with your project engineer. Your personal contact understands your needs and works with you to find the ideal solution.



You receive quick, professional feedback using the 24-hour hotline. You are not a number—you are our priority. We at STOBER do not have anything like a "service ticket."

Geographic proximity is also an intrinsic part of this personal contact. STOBER has four customer support centers throughout Germany. These support centers provide you with a high level of decision-making expertise. Your contacts have technical experience. And STOBER is international. We have 10 subsidiaries across 3 continents. This is also a valuable part of being near to our customers.



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# 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 [\[ 14.1 \]](#).

### Features

|                               |                              |
|-------------------------------|------------------------------|
| Efficiency                    | ★★★★★                        |
| Key:                          | ★☆☆☆☆ good   ★★★★★ excellent |
| <b>Shaft design</b>           |                              |
| Solid shaft with feather key  | ✓                            |
| <b>Cooling</b>                |                              |
| Convection cooling            | ✓                            |
| <b>Brake</b>                  |                              |
| Spring-loaded holding brake   | ✓                            |
| <b>Marks and test symbols</b> |                              |
| CE                            | ✓                            |
| cURus                         | ✓                            |

# 1 Selection tool

## 1.2 Drive controllers



SC6



SI6

Product chapter

Chapter number

[ 3 ]

[ 4 ]

### Technical data

|              |              |              |
|--------------|--------------|--------------|
| $I_{2N,PU}$  | 4.5 – 19 A   | 5 – 50 A     |
| $I_{2N,PU}$  | 4 – 15 A     | 4.5 – 40 A   |
| $I_{2maxPU}$ | 9.5 – 39.9 A | 10.5 – 105 A |
| $I_{2maxPU}$ | 10 – 37.5 A  | 11.3 – 100 A |

An explanation of the formula symbols can be found in the Chapter [\[ 14.1 \]](#).

### Features

|                                 |             |                  |
|---------------------------------|-------------|------------------|
| <b>Optimal application area</b> |             |                  |
| Number of axes                  | 1 – 4       | > 4              |
| Application                     | Drive based | Controller based |
| <b>Motor types</b>              |             |                  |
| Lean motors                     | ✓           | ✓                |
| Asynchronous motors             | ✓           | ✓                |
| Synchronous servo motors        | ✓           | ✓                |
| Torque motors                   | ✓           | ✓                |
| <b>Encoder interfaces</b>       |             |                  |
| EnDat 2.2 digital               | ✓           | ✓                |
| Incremental                     | ✓           | ✓                |
| SSI                             | ✓           | ✓                |
| Resolver                        | ✓           | ✓                |
| Pulse/direction signals         | ✓           | ✓                |
| HIPERFACE DSL                   | ✓           | ✓                |
| <b>Motor temperature sensor</b> |             |                  |
| PTC thermistor                  | ✓           | ✓                |
| <b>Communication</b>            |             |                  |
| EtherCAT                        | ✓           | ✓                |
| PROFINET                        | ✓           | ✓                |
| <b>Safety functions</b>         |             |                  |
| STO, SS1: SIL 3, PL e (cat. 4)  | (✓)         | (✓)              |
| (✓): Safety module required     |             |                  |
| <b>Terminals</b>                |             |                  |
| I/O                             | ✓           | ✓                |



# 1 Selection tool

## 1.2 Drive controllers



SC6



SI6

Product chapter

Chapter number

[ 3 ]

[ 4 ]

### Features

#### Features

|                         |   |   |
|-------------------------|---|---|
| Multi-axis drive system |   | ✓ |
| Stand-alone             | ✓ |   |
| One Cable Solution      | ✓ | ✓ |
| Live firmware update    | ✓ | ✓ |
| Removable data storage  | ✓ | ✓ |
| DC link connection      | ✓ | ✓ |

#### Applications

|                    |   |   |
|--------------------|---|---|
| Torque/force mode  | ✓ | ✓ |
| Velocity mode      | ✓ | ✓ |
| Positioning mode   | ✓ | ✓ |
| Interpolating mode | ✓ | ✓ |

#### Conformity

|       |                  |   |
|-------|------------------|---|
| cULus | (In preparation) | ✓ |
| CE    | ✓                | ✓ |

# 1 Selection tool

## 1.3 Connection method



Product chapter

Cables

Chapter number

[ 5 ]

### Power cables

| <b>Design</b>           |                         | <b>Motor plug connector size</b> |                |                                  |                                  |
|-------------------------|-------------------------|----------------------------------|----------------|----------------------------------|----------------------------------|
|                         |                         | con.23                           |                |                                  |                                  |
| speedtec quick lock     |                         | ✓                                |                |                                  |                                  |
| <b>Power cores</b>      | <b>Brake</b>            | <b>Temperature sensor</b>        | <b>Cable Ø</b> | <b>Min. bending radius<br/>1</b> | <b>Min. bending radius<br/>2</b> |
| 4 × 1.5 mm <sup>2</sup> | 2 × 1.0 mm <sup>2</sup> | 2 × 0.5 mm <sup>2</sup>          | Max. 12.7 mm   | 127.0 mm                         | 63.5 mm                          |
| 4 × 2.5 mm <sup>2</sup> | 2 × 1.0 mm <sup>2</sup> | 2 × 1.0 mm <sup>2</sup>          | Max. 15.3 mm   | 153.0 mm                         | 76.5 mm                          |

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

# 1 Selection tool

## 1.4 Inline and Offset Geared Motors



Product chapter

P

PE

C

F

Chapter number

[ 6 ]

[ 7 ]

[ 8 ]

[ 9 ]

### Technical data

|                |              |               |                |               |
|----------------|--------------|---------------|----------------|---------------|
| $i$            | 3 – 56       | 3 – 20        | 2 – 178        | 4.3 – 274     |
| $M_{2acc}$     | 13 – 1600 Nm | 13 – 310 Nm   | 8.7 – 4140 Nm  | 19 – 1100 Nm  |
| $\Delta\phi_2$ | 3 – 5 arcmin | 8 – 10 arcmin | 10 – 20 arcmin | 5 – 11 arcmin |
| $\eta_{get}$   | $\leq 97\%$  | $\leq 97\%$   | $\leq 97\%$    | $\leq 97\%$   |

An explanation of the formula symbols can be found in the Chapter [ 14.1 ].

### Features

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

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

# 1 Selection tool

## 1.5 Right-angle geared motors



Product chapter

PKX

KL

K

Chapter number

[ 10 ]

[ 11 ]

[ 12 ]

### Technical data

|                | PKX            | KL             | K               |
|----------------|----------------|----------------|-----------------|
| $i$            | 3 – 210        | 4 – 16         | 4 – 294         |
| $M_{2acc}$     | 13 – 3000 Nm   | 35 – 60 Nm     | 17 – 6821 Nm    |
| $\Delta\phi_2$ | 4 – 8.5 arcmin | 16 – 20 arcmin | 1.5 – 12 arcmin |
| $\eta_{get}$   | ≤ 96 %         | ≤ 97 %         | ≤ 97 %          |

An explanation of the formula symbols can be found in the Chapter [ 14.1 ].

### Features

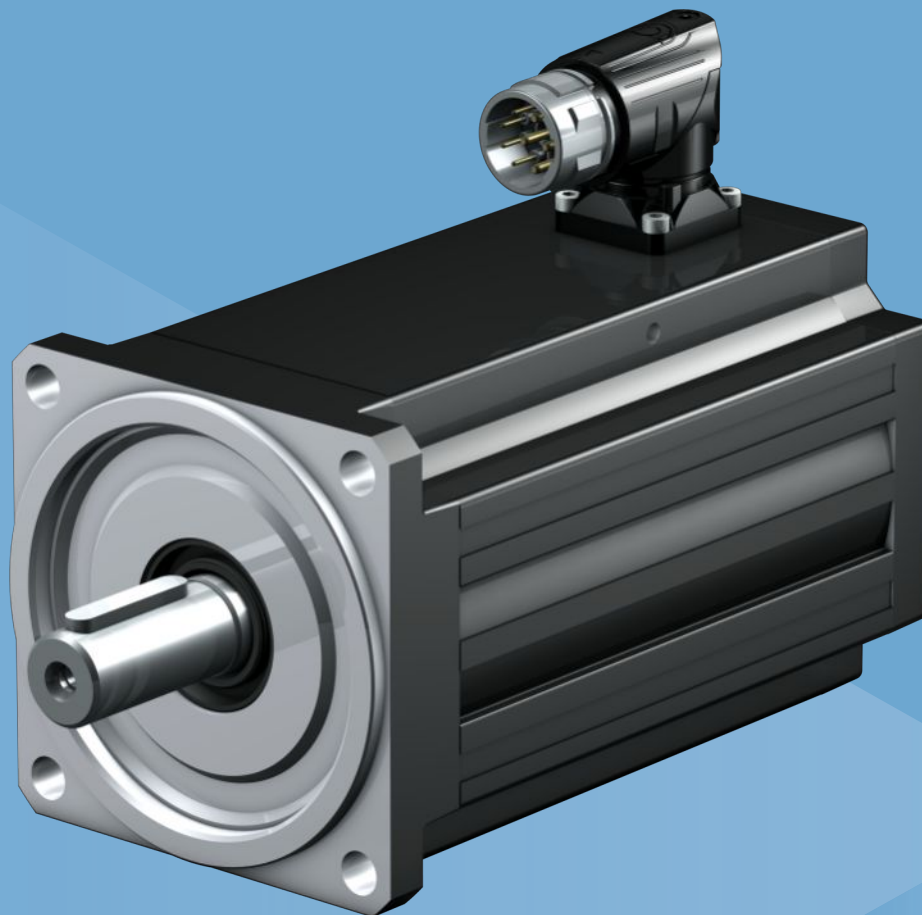
|                        |   |       |       |
|------------------------|---|-------|-------|
| Power density          | ★★★★☆   | ★★☆☆☆ | ★★☆☆☆ |
| Backlash               | ★★★★☆   | ★★☆☆☆ | ★★★★☆ |
| Price category         | €€€   | €     | €€    |
| Shaft load             | ★★★★☆   | ★★☆☆☆ | ★★★★☆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

| Shaft design                    | PKX | KL | K                                     |
|---------------------------------|-----|----|---------------------------------------|
| Solid shaft with feather key    | ✓   | ✓  | ✓                                     |
| Solid shaft without feather key | ✓   | ✓  | K1 – K4: ✓<br>Starting at K5: Request |
| Solid shaft on both sides       |     | ✓  | ✓                                     |
| Hollow shaft with keyway        |     | ✓  | ✓                                     |
| Hollow shaft with shrink ring   |     | ✓  | ✓                                     |
| Accessories                     | PKX | KL | K                                     |
| Flange                          |     | ✓  | ✓                                     |
| Baseboards                      |     | ✓  | ✓                                     |
| Torque arm bracket              |     |    | ✓                                     |
| Bearing design                  | PKX | KL | K                                     |
| 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 ✓
- Rotating plug connector with quick lock ✓

#### Technical data

|       |                |
|-------|----------------|
| $M_N$ | 2.25 – 25.7 Nm |
| $M_0$ | 2.43 – 29.8 Nm |

## 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  $-15\text{ °C}$  to  $+40\text{ °C}$
- Operation on a STOBBER drive controller
- DC link voltage  $U_{ZK} = \text{DC } 540\text{ V}$
- 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<br>(thickness x width x height) | Convection surface area<br>Steel mounting flange |
|----------|---|--|
| LM4, LM5 | 23 x 210 x 275 mm   | 0.16 m <sup>2</sup>                              |
| LM7      | 28 x 300 x 400 mm   | 0.3 m <sup>2</sup>                               |

Note the differing ambient conditions in Chapter [▶ 2.7.3](#)

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#).

| Type   | $K_{EM}$<br>[V/1000<br>rpm] | $n_N$<br>[rpm] | $M_N$<br>[Nm] | $I_N$<br>[A] | $K_{M,N}$<br>[Nm/A] | $P_N$<br>[kW] | $\eta_{mot}$<br>[%] | $M_0$<br>[Nm] | $I_0$<br>[A] | $M_R$<br>[Nm] | $M_{max}$            |                     | $I_{max}$            |                     | J<br>[10 <sup>-4</sup><br>kgm <sup>2</sup> ] | m<br>[kg] |
|--------|-----------------------------|----------------|---------------|--------------|---------------------|---------------|---------------------|---------------|--------------|---------------|----------------------|---------------------|----------------------|---------------------|--|-----------|
|        |                             |                |               |              |                     |               |                     |               |              |               | <1000<br>rpm<br>[Nm] | <1000<br>rpm<br>[A] | ≥1000<br>rpm<br>[Nm] | ≥1000<br>rpm<br>[A] |  |           |
| LM401U | 110                         | 3000           | 2.25          | 1.59         | 1.42                | 0.71          | 85.37               | 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           | 87.63               | 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           | 90.26               | 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           | 92.95               | 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           | 94.48               | 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           | 95.05               | 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           | 95.59               | 29.8          | 16.8         | 0.23          | 51.5                 | 27.7                | 61.4                 | 31.7                | 53.8   | 28.0      |

The efficiency  $\eta_{mot}$  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.

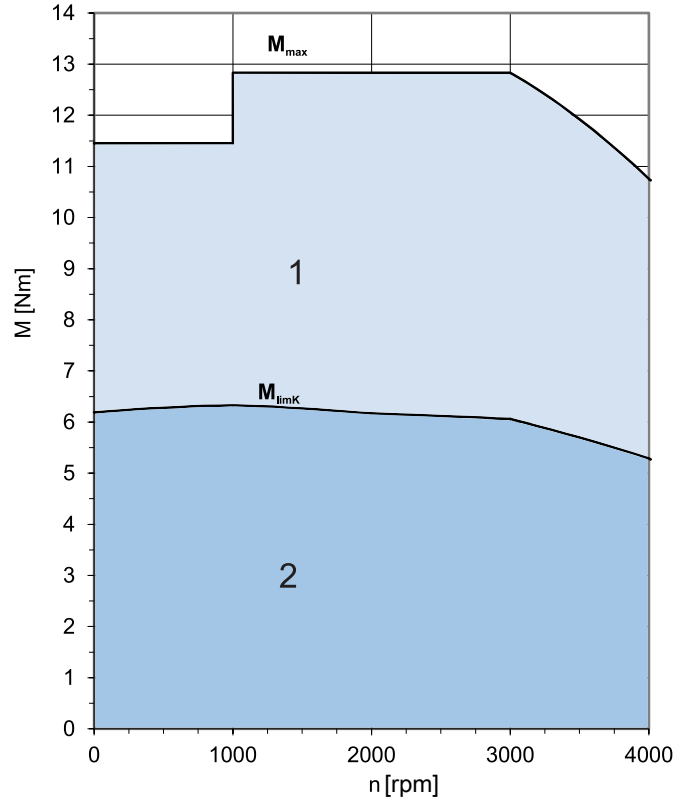
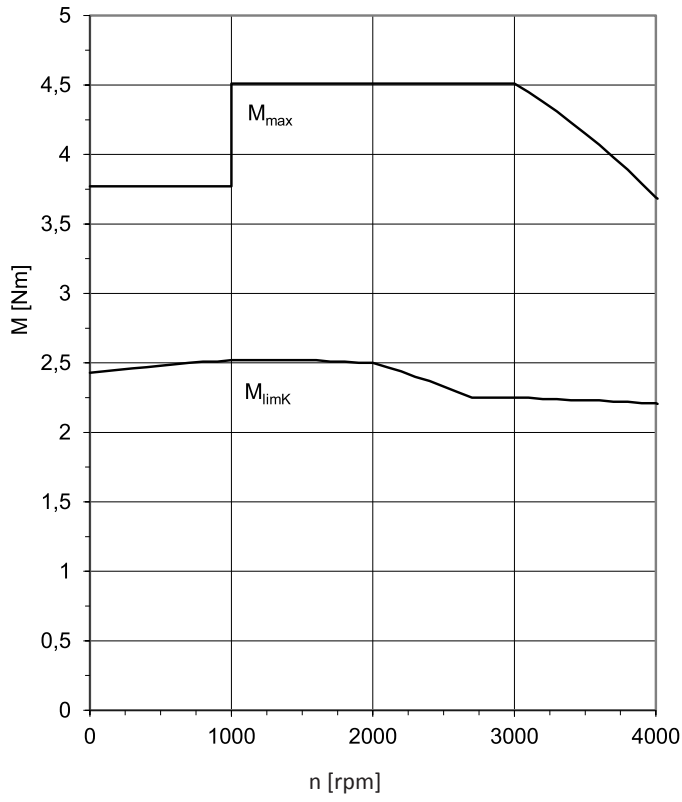


Fig. 1: Explanation of a torque/speed curve

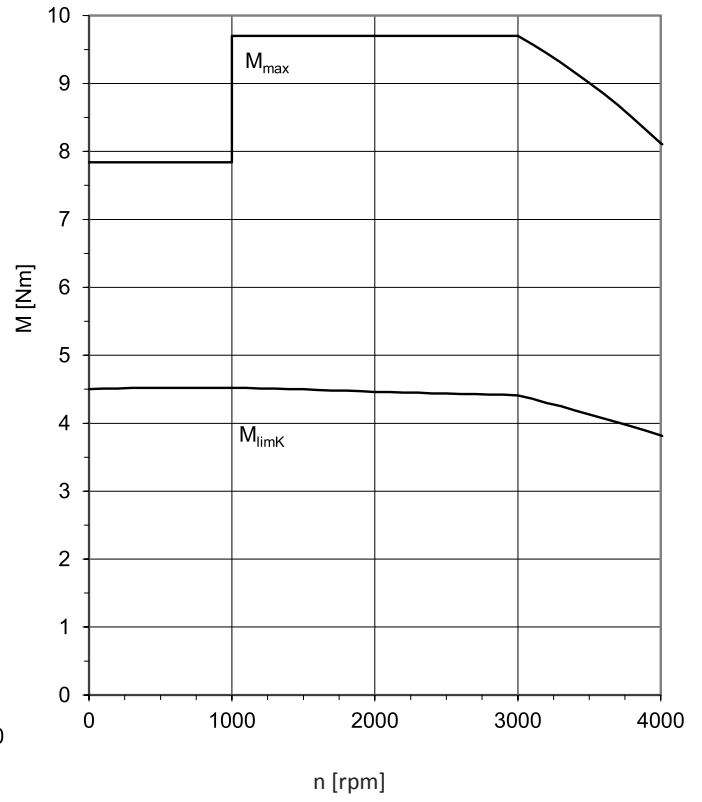
- |   |   |   |   |
|---|---|---|---|
| 1 | Torque range for brief operation ( $ED_{10} < 100\%$ ) with $\Delta\vartheta = 100$ K | 2 | Torque range for continuous operation with constant load (S1 mode, $ED_{10} = 100\%$ ) with $\Delta\vartheta = 100$ K |
|---|---|---|---|



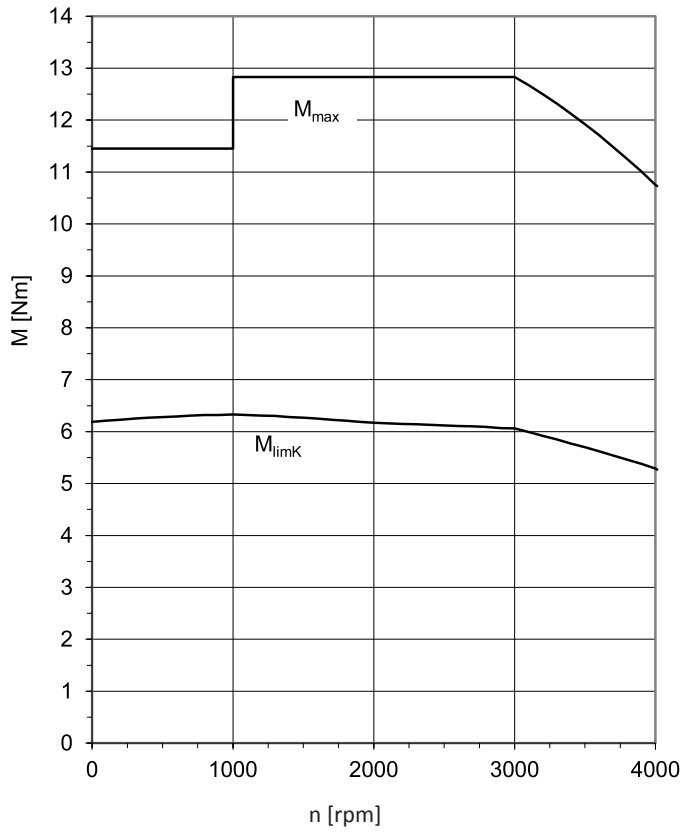
**LM401U** ( $n_N=3000$  rpm)



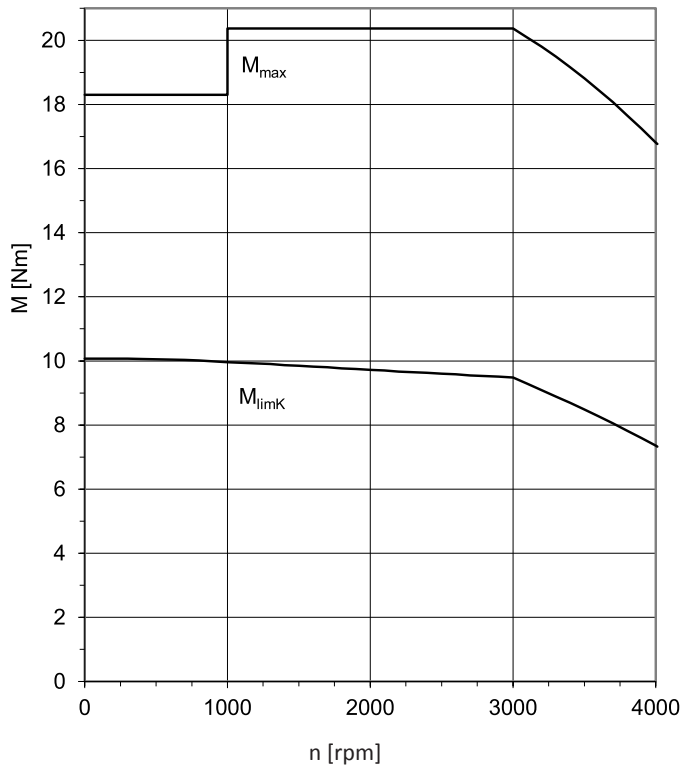
**LM402U** ( $n_N=3000$  rpm)



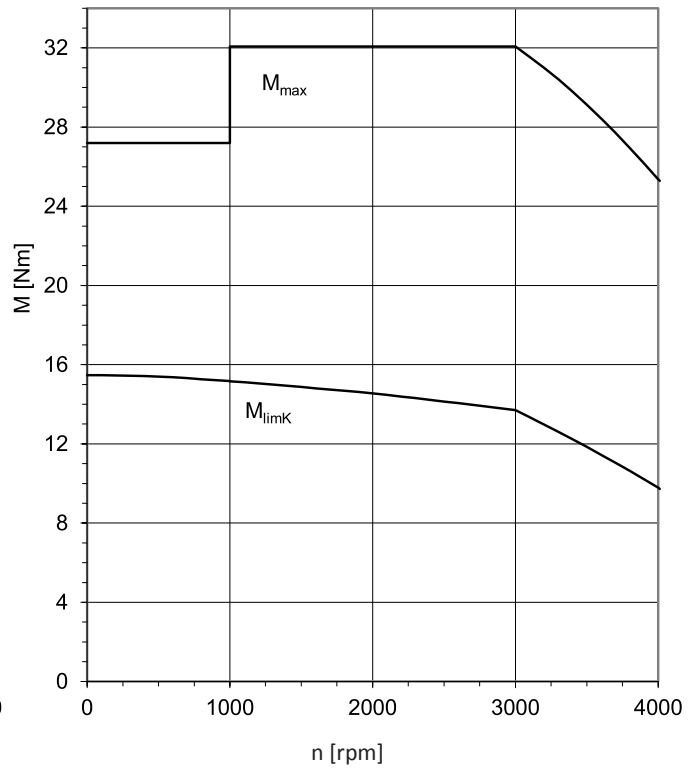
**LM403U** ( $n_N=3000$  rpm)



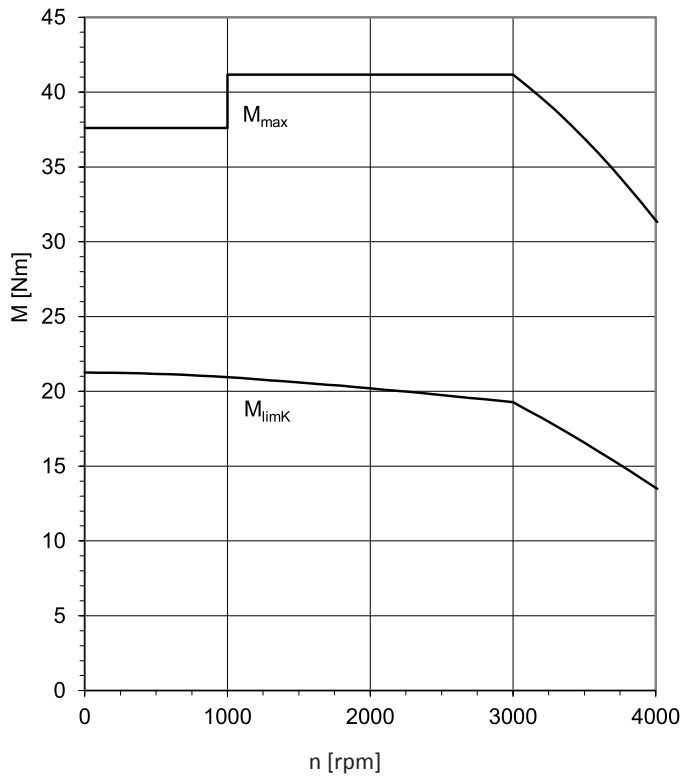
LM503U ( $n_N=3000$  rpm)



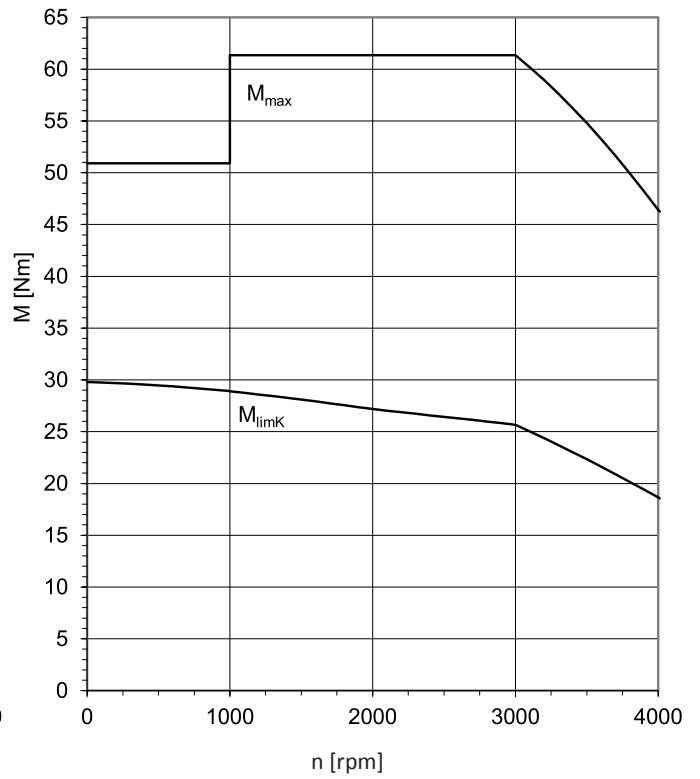
LM505U ( $n_N=3000$  rpm)



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.

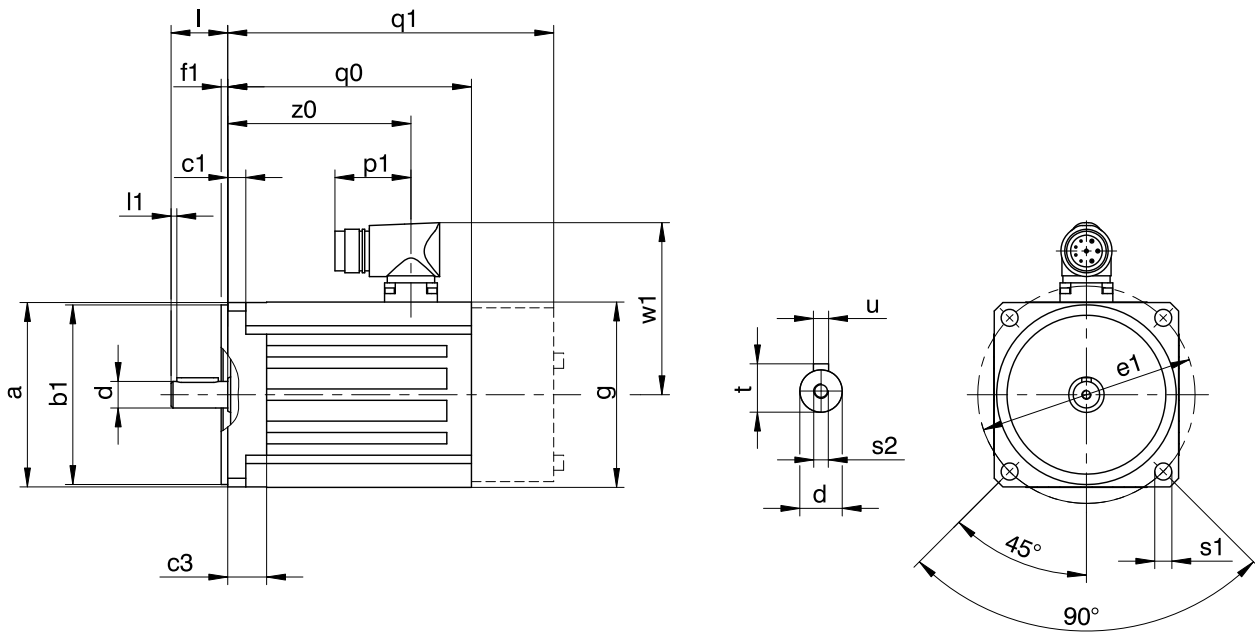
Dimensions can exceed the specifications of ISO 2768-mK due to casting tolerances or accumulation of individual tolerances.

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

You can download 3D models of our standard drives at <http://configurator.stoeber.de>.

### 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   | $\square a$ | $\varnothing b1$ | $c1$ | $c3$ | $\varnothing d$ | $\varnothing e1$ | $f1$ | $\square g$ | $l$ | $l1$ | $p1$ | $q0$  | $q1$  | $\varnothing s1$ | $s2$ | $t$  | $u$      | $w1$ | $z0$ |
|--------|-------------|------------------|------|------|-----------------|------------------|------|-------------|-----|------|------|-------|-------|------------------|------|------|----------|------|------|
| LM401U | 98          | $95_{\beta}$     | 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          | $95_{\beta}$     | 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          | $95_{\beta}$     | 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         | $110_{\beta}$    | 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         | $110_{\beta}$    | 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         | $130_{\beta}$    | 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         | $130_{\beta}$    | 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

### Sample 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          |
| S    | Design                    | Standard                    |
| AR   | Drive controller          | SC6                         |
| AT   |                           | SI6                         |
| O    | Brake                     | Without holding brake       |
| F    |                           | Spring-loaded holding brake |
| 110  | Voltage constant $K_{EM}$ | 100 V/1000 rpm (example)    |

## 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. Details can be found in the "Selection tables" chapter.

| Feature              | Description  |
|----------------------|--|
| DC link voltage      | DC 540 V (max. 620 V) on STOBBER 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   |
| Installation altitude                         | ≤ 1000 m above sea level   |
| Shock load                                    | ≤ 50 m/s <sup>2</sup> (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 gear units 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
- Thawing 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  $\pm 1^\circ$  and speed ripple factor  $\leq 1\%$  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.

## 2.6.5 Possible combinations with drive controllers

The Lean motor can be operated only with STOBER 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 STOBBER 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 $\vartheta_{NAT}$     | 145 °C ± 5 K  |
| Resistance R -20 °C up to $\vartheta_{NAT} - 20$ K | ≤ 250 Ω   |
| Resistance R with $\vartheta_{NAT} - 5$ K          | ≤ 550 Ω   |
| Resistance R with $\vartheta_{NAT} + 5$ K          | ≥ 1330 Ω  |
| Resistance R with $\vartheta_{NAT} + 15$ 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 $\Delta\vartheta = 100$ K) |

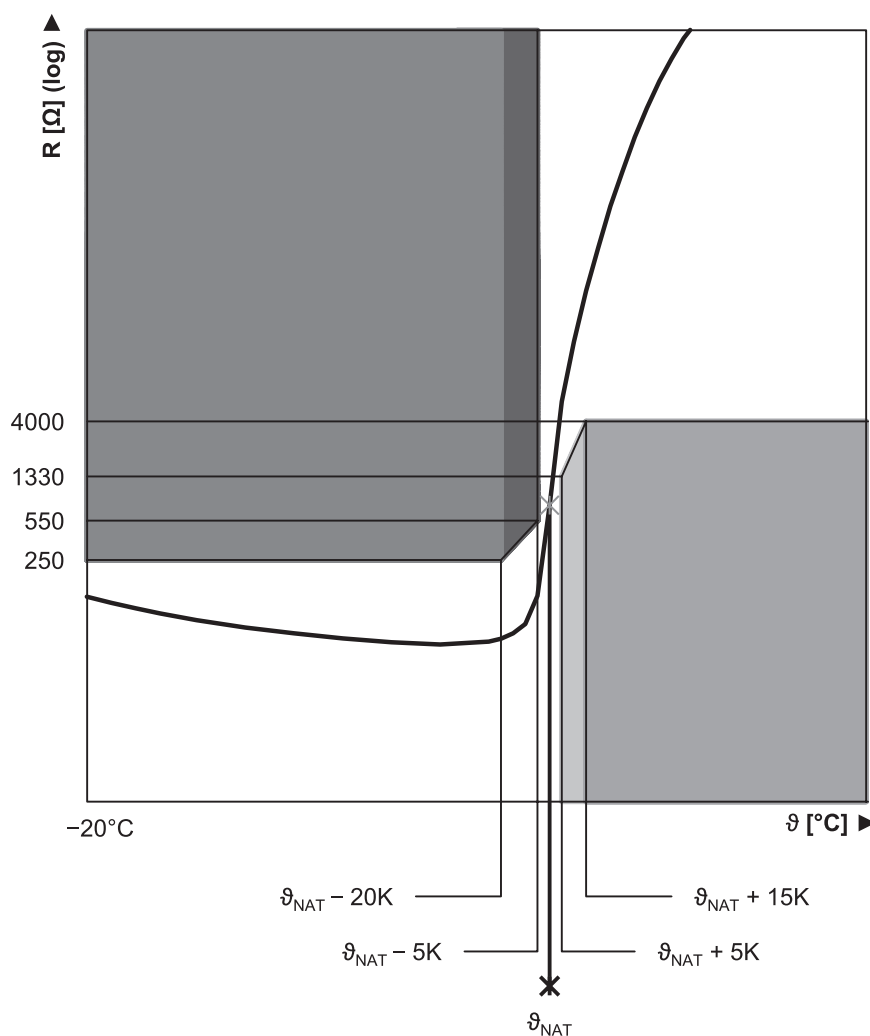


Fig. 2: PTC thermistor curve (single thermistor)

## 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  $\pm$  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 "Ambient conditions" chapter.

### Calculation of work done by friction per braking process

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

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

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

Switching behavior

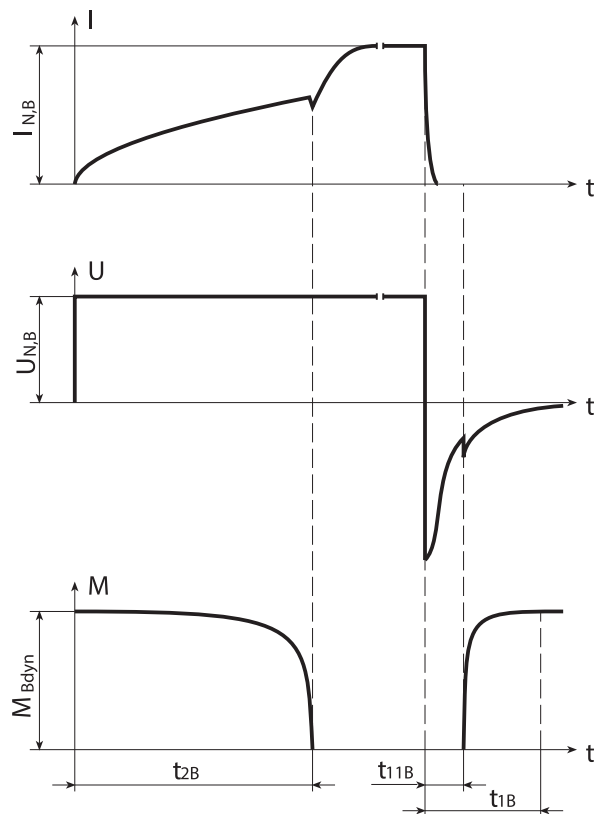


Fig. 3: Holding brake – Switching behavior

Technical data

| Type  | $M_{Bstat}$<br>[Nm] | $M_{Bdyn}$<br>[Nm] | $I_{N,B}$<br>[A] | $W_{B,Rmax/h}$<br>[kJ] | $N_{B,stop}$ | $J_{B,stop}$<br>[ $10^{-4}kgm^2$ ] | $W_{B,Rlim}$<br>[kJ] | $t_{2B}$<br>[ms] | $t_{11B}$<br>[ms] | $t_{1B}$<br>[ms] | $x_{B,N}$<br>[mm] | $\Delta J_B$<br>[ $10^{-4}kgm^2$ ] | $\Delta m_B$<br>[kg] |
|-------|---------------------|--------------------|------------------|------------------------|--------------|------------------------------------|----------------------|------------------|-------------------|------------------|-------------------|------------------------------------|----------------------|
| LM401 | 7.0                 | 6.0                | 0.90             | 3.0                    | 428000       | 3.78                               | 8000                 | 60               | 18                | 40               | 0.2               | 0.219                              | 1.80                 |
| LM402 | 7.0                 | 6.0                | 0.90             | 3.0                    | 250000       | 6.47                               | 8000                 | 60               | 18                | 40               | 0.2               | 0.219                              | 1.80                 |
| LM403 | 7.0                 | 6.0                | 0.90             | 3.0                    | 178000       | 9.06                               | 8000                 | 60               | 18                | 40               | 0.2               | 0.219                              | 1.80                 |
| LM503 | 13                  | 11                 | 0.90             | 6.0                    | 119000       | 22.1                               | 13000                | 80               | 27                | 27               | 0.3               | 0.686                              | 2.80                 |
| LM505 | 13                  | 11                 | 0.90             | 6.0                    | 75000        | 34.9                               | 13000                | 80               | 27                | 27               | 0.3               | 0.686                              | 2.80                 |
| LM704 | 31                  | 19                 | 1.9              | 7.0                    | 53000        | 76.4                               | 20000                | 100              | 50                | 125              | 0.2               | 1.771                              | 4.80                 |
| LM706 | 31                  | 19                 | 1.9              | 7.0                    | 36000        | 111                                | 20000                | 100              | 50                | 125              | 0.2               | 1.771                              | 4.80                 |

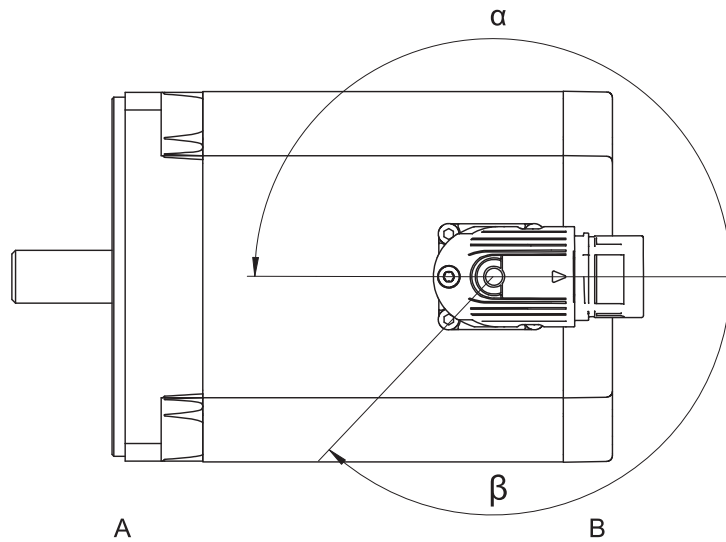
2.6.9 Connection method

2.6.9.1 Plug connectors

Lean motors are equipped with a twistable quick-lock plug connector in the standard version. 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 | Rear side of the motor |
|---|--|---|------------------------|


**Plug connector features**

| Motor type | Size   | Connection | Turning range |      |
|------------|--------|------------|---------------|------|
|            |        |            | α             | β    |
| LM4 – LM7  | con.23 | Quick lock | 180°          | 135° |

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 grounding conductor system of the machine in order to prevent personal injury and faulty triggering of residual current protective devices.

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.

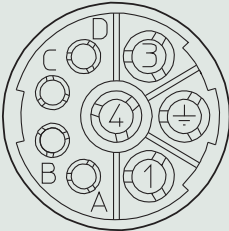

**2.6.9.3 Terminal assignment**

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.

The colors of the connecting wires inside the motor are specified in accordance with IEC 60757.

**Power connection**

**Plug connector size con.23 (1)**

| Connection diagram  | Pin   | Connection           | Color        |
|---|---|----------------------|--------------|
|  | 1   | U phase              | black        |
|   | 3   | V phase              | blue         |
|   | 4   | W phase              | red          |
|   | A   | Brake +              |              |
|   | B   | Brake -              |              |
|   | C   | Temperature sensor + |              |
|   | D   | Temperature sensor - |              |
|   |  | Grounding conductor  | green-yellow |

## 2.7 Project configuration

Project your drives using our SERVOfsoft designing software. You can receive SERVOfsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

### 2.7.1 Calculation of the operating point

In this chapter, you can find information needed to calculate the operating point.

Check the following conditions for operating points other than the nominal point  $M_N$  specified in the selection tables:

$$n_{m^*} \leq n_N$$

$$M_{eff^*} \leq M_{limK}$$

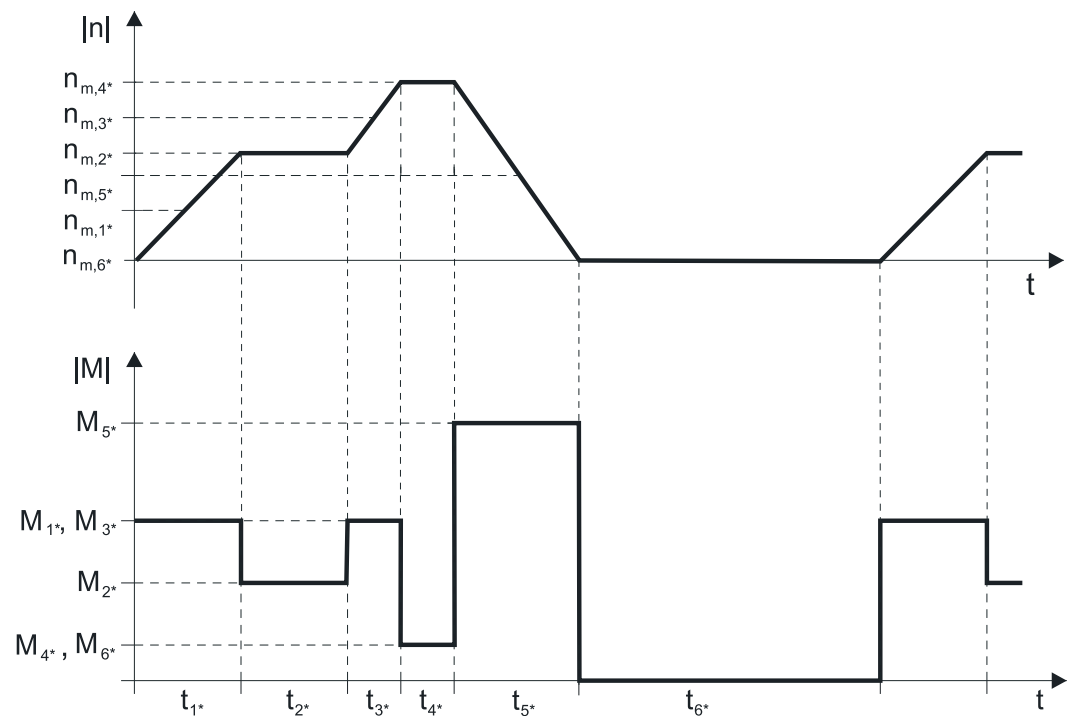
$$M_{max^*} < M_{max}$$

The values for  $M_N$ ,  $n_N$ ,  $M_{max}$  can be found in the selection tables.

The values for  $M_{limK}$  can be found in the torque/speed characteristic curves.

#### Example of cyclic operation

The following calculations refer to a representation of the power delivered at the motor shaft based on the following example:



#### Calculation of the actual average input speed

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

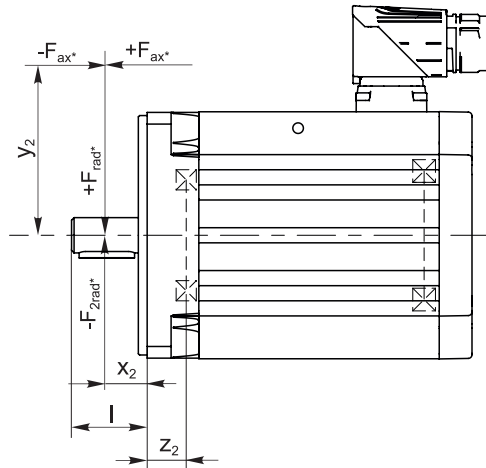
If  $t_{1^*} + \dots + t_{5^*} \geq 10 \text{ min}$ , determine  $n_{m^*}$  without the rest phase  $t_{6^*}$ .

#### Calculation of the actual effective torque

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

## 2.7.2 Permitted shaft loads

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



### Permitted shaft loads

| Type  | $z_2$<br>[mm] | $F_{ax100}$<br>[N] | $F_{rad100}$<br>[N] | $M_{k100}$<br>[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  $n_{m^*} \leq 100$  rpm ( $F_{ax} = F_{ax100}$ ;  $F_{rad} = F_{rad100}$ ;  $M_k = M_{k100}$ )

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

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

The following applies to other force application points:

$$M_{k^*} = \frac{2 \cdot F_{ax^*} \cdot y_2 + F_{rad^*} \cdot (x_2 + z_2)}{1000} \leq M_{k100}$$

$$F_{rad^*} \leq F_{rad100}$$

$$F_{ax^*} \leq F_{ax100}$$

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.

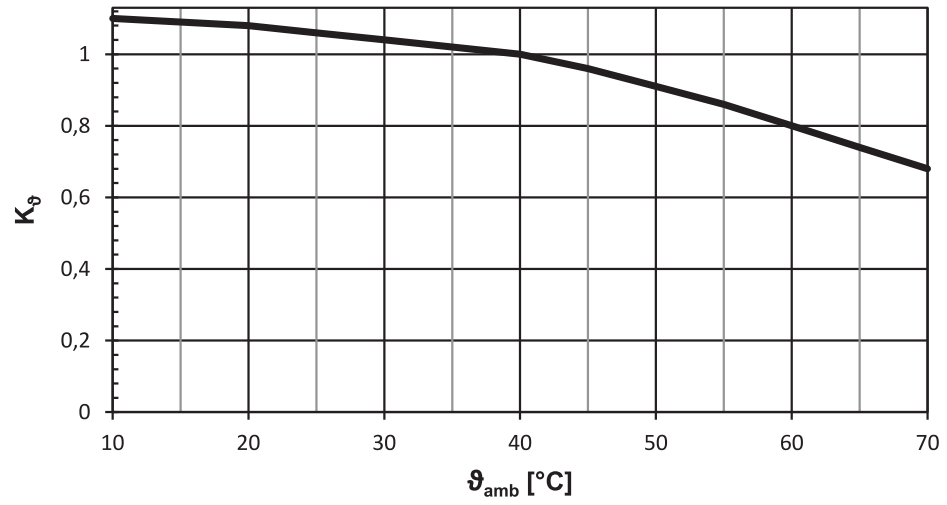


Fig. 4: Derating depending on the surrounding temperature

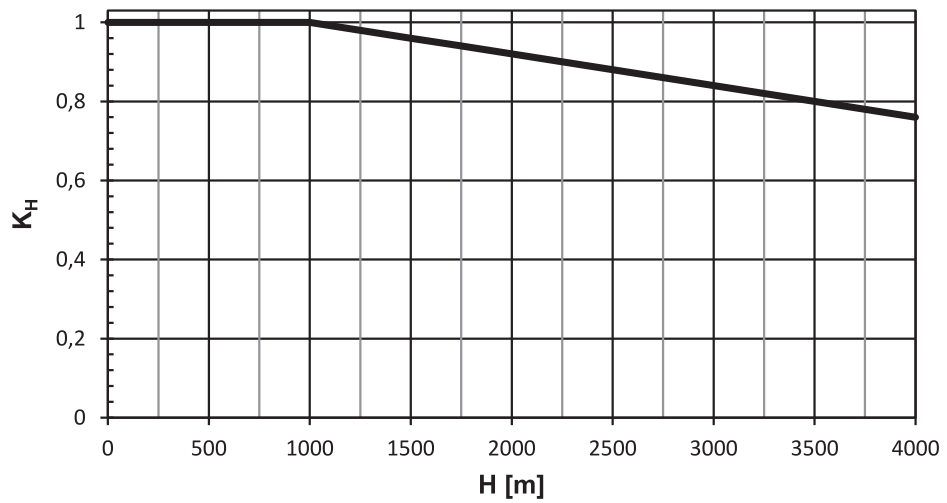


Fig. 5: Derating depending on the installation height

**Calculation**

If surrounding temperature  $\vartheta_{amb} > 40\text{ }^\circ\text{C}$ :

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

If installation altitude  $H > 1000\text{ m}$  above sea level:

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

If the surrounding temperature  $\vartheta_{amb} > 40\text{ }^\circ\text{C}$  and installation altitude  $H > 1000\text{ m}$  above sea level:

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

## 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 60034-5:2001 + A1:2007
- 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.



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

### 2.8.3 Additional documentation

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

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

| Documentation                       | ID        |
|-------------------------------------|-----------|
| Operating manual for LM Lean motors | 443048_en |



# 3 SC6 drive controllers

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## 3 Drive controllers

# SC6

### 3.1 Overview

Our more compact version for the encoderless Lean motor

#### Features

- Single or double-axis controller with a nominal output current up to 19 A and 250% overload capacity
- Sensorless position control by STOBBER Lean motors
- Control of rotary synchronous servo motors, asynchronous motors and torque motors
- HIPERFACE DSL One Cable Solution
- Electronic motor nameplate via HIPERFACE DSL or EnDat 2.2 digital encoder interface
- Integrated EtherCAT or PROFINET communication
- STO safety technology using terminals or STO and SS1 using FSoE (Safety over EtherCAT): SIL 3, PL e (cat. 4)
- Integrated brake control
- Single-ended nominal power consumption on double-axis controllers for operation of motors with different power
- Energy supply through direct power supply
- Flexible DC link connection for multi-axis applications



## 3.1.1 Features

The compact stand-alone SC6 drive controller allows for sensorless control of STOBER LM series Lean motors. These motors provide energy efficiency at the performance level of a synchronous servo motor. They also guarantee high investment protection, thanks to energy efficiency class IE5 and the corresponding higher efficiency compared to IE4 asynchronous motors. However, the SC6 can also be used in combination with asynchronous motors or synchronous servo motors with encoders (e.g. the STOBER EZ series). The 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.



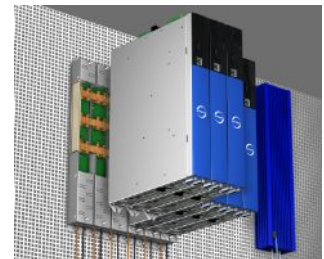
*The compact SC6 for Lean motors of the LM series*

### As small as a paperback

You save valuable space in your control cabinet because, with a width of just 45 mm, this drive controller is the most compact solution on the market. It offers all the features that a designer requires.

### 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. The Quick DC-Link rear structure element has been developed to set 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.

### Fewer clicks, less wiring

The installation of the drive controller is as easy as you could imagine. There is no difficult wiring. Even if you are connecting the drive controllers in a DC link, the patented Quick DC-Link modules allow for a simple "click" into the standard copper rails as well as the simple installation and connection of the drive controllers.

### Safety functions

The safety concept of the drive controller is based on the STO (Safe Torque Off) function. The concept corresponds to SIL 3 according to DIN EN 61800-5-2 and PL e (Cat. 4) according to DIN EN ISO 13849-1. For double-axis controllers, the STO safety function has a two-channel structure that acts upon both axes. For connection to a higher-level safety circuit, different interfaces are available (terminals or FSoE).

**Heavy duty**

There is an extremely robust design concealed behind the elegant exterior. All components—from the stable, well-shielded sheet steel housing to the motor connectors—far exceed the set values of industry standards. The inside is also anything but small-scale: ample computer capacities, high-quality components, careful workmanship.

**3.1.2 Software components****Project configuration and commissioning**

The 6th generation of 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**

Drive-based motion control is recommended for the decentralized motion control of sophisticated machines.

The drive-based application package from STOBBER is the right choice wherever universal and flexible solutions are needed. The STOBBER 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 application is also available, which includes both the controller-based and drive-based operating modes (csp, csv, cst, ip, pp, pv, pt).

**3.1.3 Application training**

STOBBER offers a multi-level training program that focuses essentially on application programming of the motion controller and 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 Advanced**

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

|    |   |   |   |   |   |   |
|----|---|---|---|---|---|---|
| SC | 6 | A | 0 | 6 | 2 | Z |
|----|---|---|---|---|---|---|

Tab. 1: Example code for type designation

| Code  | Designation        | Design                             |
|-------|--------------------|------------------------------------|
| SC    | Series             | ServoCompact                       |
| 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           |
| Y     |                    | SY6: STO and SS1 using FSoE        |

Tab. 2: Meaning of the example code

### 3.2.2 Sizes

| Type    | ID No. | Size   |
|---------|--------|--------|
| SC6A062 | 56690  | Size 0 |
| SC6A162 | 56691  | Size 1 |
| SC6A261 | 56692  | Size 2 |

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.

### 3.2.3 General technical data

The following specifications apply to all drive controller types.

| Device features                            |  |
|--|--|
| Protection class of the device             | IP20   |
| Protection class of the installation space | At least IP54  |
| Radio interference suppression             | Integrated line filter in accordance with EN 61800-3:2012, interference emission class C3                |
| Overvoltage category                       | III in accordance with EN 61800-5-1:2008   |
| Test symbols                               |  (cULus in preparation) |

Tab. 4: Device features

| Transport and storage conditions  |   |
|---|---|
| Storage/transport temperature   | -20 °C to +70 °C<br>Maximum change: 20 K/h  |
| Relative humidity   | Maximum relative humidity 85%, non-condensing   |
| Vibration (transport) in accordance with DIN EN 60068-2-6   | 5 Hz ≤ f ≤ 9 Hz: 3.5 mm<br>9 Hz ≤ f ≤ 200 Hz: 10 m/s <sup>2</sup><br>200 Hz ≤ f ≤ 500 Hz: 15 m/s <sup>2</sup> |
| Fall height for freefall <sup>1</sup><br>Weight < 100 kg<br>in accordance with DIN EN 61800-2<br>(or DIN EN 60721-3-2:1997,<br>class 2M1) | 0.25 m  |

Tab. 5: Transport and storage conditions

| Operating conditions                                      |  |
|---|--|
| Surrounding temperature during operation                  | 0 °C to 45 °C with nominal data<br>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<br>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 DIN EN 60068-2-6 | 5 Hz ≤ f ≤ 9 Hz: 0.35 mm<br>9 Hz ≤ f ≤ 200 Hz: 1 m/s <sup>2</sup>  |

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 SC6 sizes as well as the properties of the brake chopper can be found in the following sections.

#### Information

For the time span between two energizing processes, note that:

- a) Direct, repeat activation of the supply voltage is possible for power-on/power-off operation.
- b) A time span of > 15 must be observed between two energizing processes during continuous, cyclical power-on/power-off operation with increased charging capacity.

#### Information

The STO safety function is available for safe shutdown as an alternative to continuous, cyclical power-on/power-off operation.

An explanation of the symbols used for formulas can be found in Chapter [▶ 14.1](#).

#### 3.2.4.1 Control unit

| Electrical data | All types                      |
|-----------------|--------------------------------|
| $U_{1CU}$       | 24 V <sub>DC</sub> , +20%/–15% |
| $I_{1maxCU}$    | 0.5 A                          |

Tab. 8: Control unit electrical data

#### 3.2.4.2 Power unit: Size 0

| Electrical data | SC6A062   |
|-----------------|---|
| $U_{1PU}$       | 3 × 400 V <sub>AC</sub> , +32% / –50%, 50/60 Hz;<br>3 × 480 V <sub>AC</sub> , +10% / –58%, 50/60 Hz |
| $f_{2PU}$       | 0 – 700 Hz  |
| $U_{2PU}$       | 0 – max. $U_{1PU}$  |
| $C_{PU}$        | 270 μF  |
| $C_{maxPU}$     | 1400 μF   |

Tab. 9: SC6 electrical data, size 0

The maximum charging capacity depends on the time between energizing two devices:

#### Information

If a time span of ≥ 15 min is maintained between energizing two devices, the maximum charging capacity  $C_{maxPU}$  increases to 1880 μF.

#### 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 |

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

| Electrical data     | SC6A062      |
|---------------------|--------------|
| $f_{\text{PWM,PU}}$ | 8 kHz        |
| $I_{1\text{N,PU}}$  | 8.9 A        |
| $I_{2\text{N,PU}}$  | 2 × 4 A      |
| $I_{2\text{maxPU}}$ | 250% for 2 s |

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

| Electrical data     | SC6A062                   |
|---------------------|---------------------------|
| $U_{\text{onCH}}$   | 780 – 800 V <sub>DC</sub> |
| $U_{\text{offCH}}$  | 740 – 760 V <sub>DC</sub> |
| $R_{2\text{minRB}}$ | 100 Ω                     |
| $P_{\text{maxRB}}$  | 6.4 kW                    |
| $P_{\text{effRB}}$  | 2.9 kW                    |

Tab. 12: Brake chopper electrical data, size 0

### 3.2.4.3 Power unit: Size 1

| Electrical data    | SC6A162   |
|--------------------|---|
| $U_{1\text{PU}}$   | 3 × 400 V <sub>AC</sub> , +32% / -50%, 50/60 Hz;<br>3 × 480 V <sub>AC</sub> , +10% / -58%, 50/60 Hz |
| $f_{2\text{PU}}$   | 0 – 700 Hz  |
| $U_{2\text{PU}}$   | 0 – max. $U_{1\text{PU}}$   |
| $C_{\text{PU}}$    | 940 μF  |
| $C_{\text{maxPU}}$ | 1400 μF   |

Tab. 13: SC6 electrical data, size 1

#### Information

If a time span of ≥ 15 min is maintained between energizing two devices, the maximum charging capacity  $C_{\text{maxPU}}$  increases to 1880 μF.

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

| Electrical data     | SC6A162      |
|---------------------|--------------|
| $f_{\text{PWM,PU}}$ | 4 kHz        |
| $I_{1\text{N,PU}}$  | 23.2 A       |
| $I_{2\text{N,PU}}$  | 2 × 10 A     |
| $I_{2\text{maxPU}}$ | 210% for 2 s |

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

| Electrical data     | SC6A162      |
|---------------------|--------------|
| $f_{\text{PWM,PU}}$ | 8 kHz        |
| $I_{1\text{N,PU}}$  | 20.9 A       |
| $I_{2\text{N,PU}}$  | 2 × 9 A      |
| $I_{2\text{maxPU}}$ | 250% for 2 s |

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

| Electrical data     | SC6A162                   |
|---------------------|---------------------------|
| $U_{\text{onCH}}$   | 780 – 800 V <sub>DC</sub> |
| $U_{\text{offCH}}$  | 740 – 760 V <sub>DC</sub> |
| $R_{2\text{minRB}}$ | 47 Ω                      |
| $P_{\text{maxRB}}$  | 13.6 kW                   |
| $P_{\text{effRB}}$  | 6.2 kW                    |

Tab. 16: Brake chopper electrical data, size 1

## 3.2.4.4 Power unit: Size 2

| Electrical data | SC6A261   |
|-----------------|---|
| $U_{1PU}$       | $3 \times 400 V_{AC}$ , +32% / -50%, 50/60 Hz;<br>$3 \times 480 V_{AC}$ , +10% / -58%, 50/60 Hz |
| $f_{2PU}$       | 0 – 700 Hz  |
| $U_{2PU}$       | 0 – max. $U_{1PU}$  |
| $C_{PU}$        | 940 $\mu$ F   |
| $C_{maxPU}$     | 1400 $\mu$ F  |

Tab. 17: SC6 electrical data, size 2

## Information

If a time span of  $\geq 15$  min is maintained between energizing two devices, the maximum charging capacity  $C_{maxPU}$  increases to 1880  $\mu$ F.

## 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 |

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 |

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 $\Omega$        |
| $P_{maxRB}$     | 13.6 kW            |
| $P_{effRB}$     | 6.2 kW             |

Tab. 20: Brake chopper electrical data, size 2

### 3.2.4.5 Parallel connection

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

### 3.2.4.6 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 drive controller current if the continuous current of the second connected motor is lower than the nominal drive controller current. This enables economical combinations of double-axis controllers and motors.

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

**Example 1**

$$I_{2PU(B)} = I_{2N,PU} - (I_{2PU(A)} - I_{2N,PU}) \times \frac{3}{5} \quad \text{where} \quad 0 \leq I_{2PU(A)} \leq I_{2N,PU}$$

**Example 2**

$$I_{2PU(B)} = I_{2N,PU} - (I_{2PU(A)} - I_{2N,PU}) \times \frac{5}{3} \quad \text{where} \quad I_{2N,PU} \leq I_{2PU(A)} \leq 1,6 \times I_{2N,PU}$$

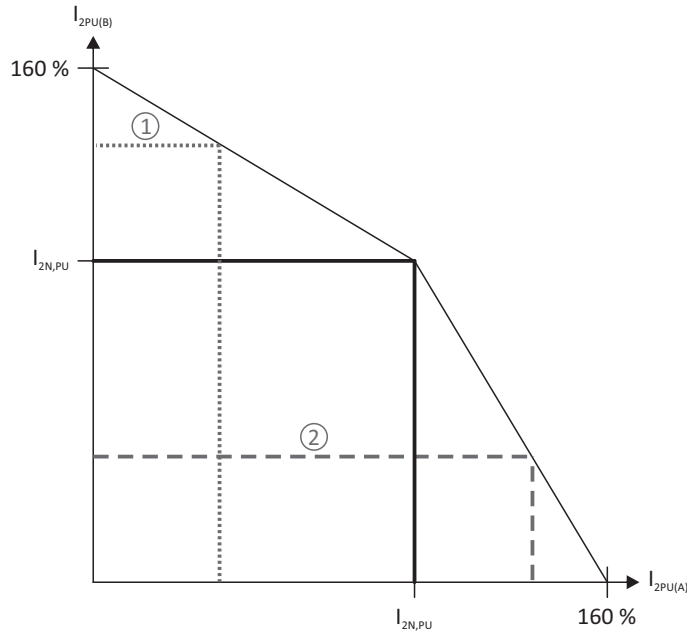


Fig. 1: Asymmetric load on double-axis controllers

**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.



### 3.2.4.7 Power loss data in accordance with EN 61800-9-2

| Type    | Nominal current<br>$I_{2N,PU}$ | Apparent power | Absolute losses<br>$P_{V,CU}^2$ | Operating points <sup>3</sup> |        |         |         |         |          |         |          | IE class <sup>4</sup> | Compar-<br>ison <sup>5</sup> |
|---------|--------------------------------|----------------|---------------------------------|-------------------------------|--------|---------|---------|---------|----------|---------|----------|-----------------------|------------------------------|
|         |                                |                |                                 | (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               |        |         |         |         |          |         |          |                       |                              |
|         | [A]                            | [kVA]          | [W]                             | $P_V$<br>[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

#### General conditions

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

The loss data applies to drive controllers without any accessories.

The power loss calculation is based on a three-phase supply voltage with 400 V<sub>AC</sub>/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<sub>DC</sub> power supply of the control electronics.

## 3.2.5 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.

### 3.2.5.1 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    | $I_{2N,PU}$<br>4 kHz [A] | $I_{2N,PU}$<br>8 kHz [A] | $I_{2N,PU}$<br>16 kHz [A] |
|---------|--------------------------|--------------------------|---------------------------|
| SC6A062 | 2 × 4.5                  | 2 × 4                    | 2 × 3                     |
| SC6A162 | 2 × 10                   | 2 × 9                    | 2 × 5                     |
| SC6A261 | 19                       | 15                       | 8                         |

Tab. 22: Nominal output current  $I_{2N,PU}$  dependent on the clock frequency

<sup>2</sup> Absolute losses for a power unit that is switched off

<sup>3</sup> Operating points for relative motor stator frequency in % and relative torque current in %

<sup>4</sup> IE class in accordance with EN 61800-9-2

<sup>5</sup> Comparison of the losses for the reference drive controller relative to IE2 in the nominal point (90, 100)

### 3.2.5.2 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

$$D_T = 100\% - 5 \times 2.5\% = 87.5\%$$

### 3.2.5.3 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:

$$D_{IA} = 100\% - 5 \times 1.5\% = 92.5\%$$

### 3.2.5.4 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 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:

$$D_T = 100\% - 5 \times 2.5\% = 87.5\%$$

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:

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

### 3.2.6 Dimensions

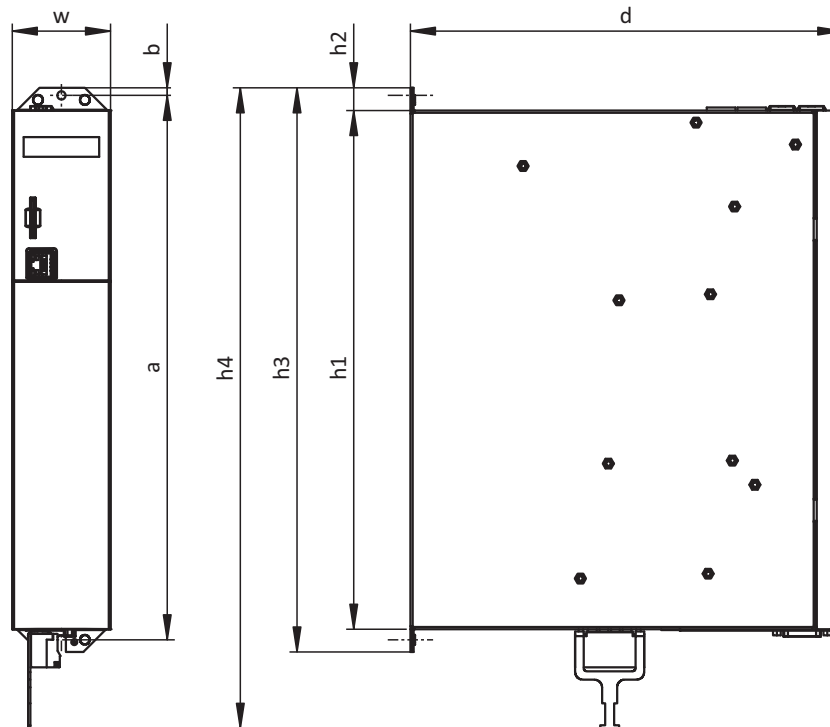


Fig. 2: SC6 dimensional drawing

| Dimension                           |                                      | Size 0            | Size 1 | Size 2 |
|-------------------------------------|--------------------------------------|-------------------|--------|--------|
| Drive Controllers                   | 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 holes (M5)                 | Vertical distance | a      | 360+2  |
| Vertical distance to the upper edge |                                      | b                 | 5      |        |

Tab. 23: SC6 dimensions [mm]

### 3.2.7 Weight

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

Tab. 24: SC6 weight [g]

### 3.2.8 Minimum clearances

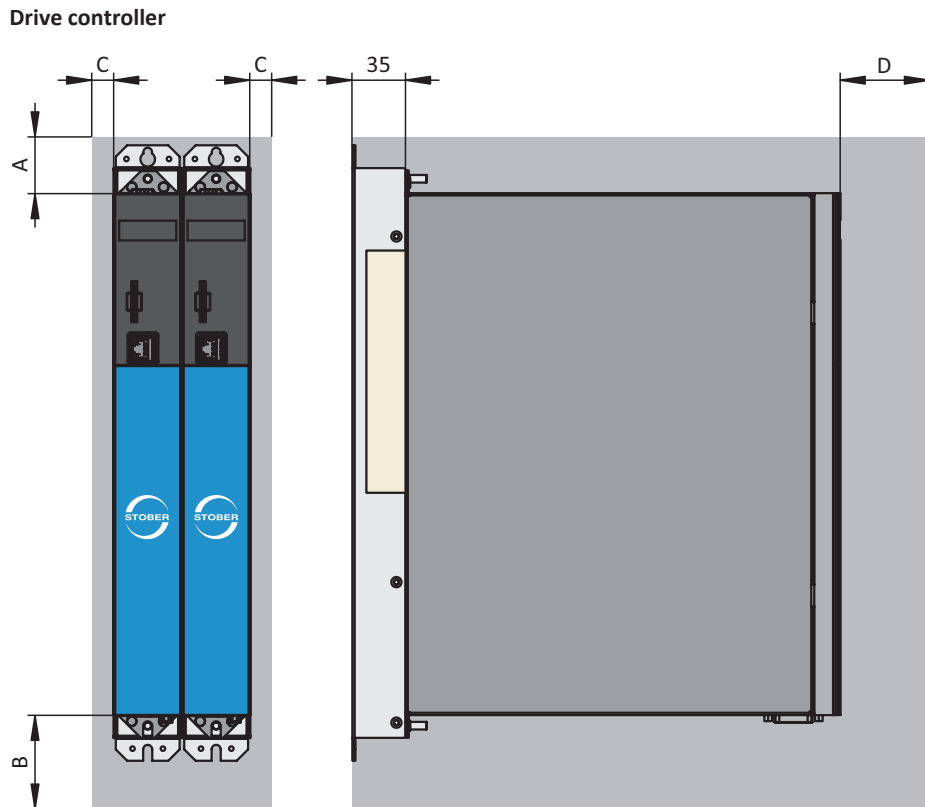


Fig. 3: Minimum clearances

The specified dimensions 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 <sup>6</sup> |

Tab. 25: Minimum clearances [mm]

#### 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.

## 3.3 Drive controller/motor combinations

An explanation of the symbols used for formulas can be found in Chapter [▶ 14.1](#).

### LM Lean motor ( $n_N = 3000$ rpm) – SC6

|       |                          |               |              |               |              | SC6A062                                    | SC6A162 | SC6A261 |
|-------|--------------------------|---------------|--------------|---------------|--------------|--|---------|---------|
|       |                          |               |              |               |              | $I_{2N,PU}$ [A]<br>( $f_{PWM,PU} = 4$ kHz) |         |         |
|       | $K_{EM}$<br>[V/1000 rpm] | $M_N$<br>[Nm] | $I_N$<br>[A] | $M_0$<br>[Nm] | $I_0$<br>[A] | 4.5  | 10      | 19      |
|       |                          |               |              |               |              | $I_{2N,PU} / I_0$                          |         |         |
| LM401 | 110                      | 2.25          | 1.59         | 2.43          | 1.82         | 2.5  | (X)     | (—)     |
| LM402 | 120                      | 4.41          | 2.88         | 4.50          | 2.94         | 1.5  | (X)     | (—)     |
| LM403 | 120                      | 6.06          | 3.92         | 6.19          | 4.08         | 1.1  | (X)     | (X)     |
| LM503 | 135                      | 9.48          | 5.62         | 10.07         | 5.95         | (X)  | 1.7     | (X)     |
| LM505 | 135                      | 13.70         | 7.83         | 15.47         | 8.83         | (X)  | 1.1     | (X)     |
| LM704 | 145                      | 19.27         | 10.64        | 21.26         | 11.57        | —  | (X)     | 1.6     |
| LM706 | 140                      | 25.67         | 14.69        | 29.80         | 16.80        | —  | (X)     | 1.1     |

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

## 3.4 Accessories

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

### 3.4.1 Safety technology

#### Information

Note that the drive controller is delivered as a standard version without safety technology (SZ6 option). 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  
 Standard version.

#### 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 DIN EN ISO 13849-1 and DIN EN 61800-5-2. Connection to higher-level safety circuit through terminal X12 (included in the terminal set scope of delivery).

#### 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 DIN EN ISO 13849-1 and DIN EN 61800-5-2. Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

## 3.4.2 Communication

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

### EtherCAT or PROFINET fieldbus system



Please specify the desired fieldbus system when placing your purchase order for the base device.



### EtherCAT cables



Ethernet patch cable, CAT5e, yellow.

The following designs are available:

ID No. 49313: Length approx. 0.2 m.

ID No. 49314: Length approx. 0.35 m.

### PC connecting cables



ID No. 49857

Cable for connecting the X9 service interface to the PC, CAT5e, blue, 5 m.

### USB 2.0 Ethernet adapter



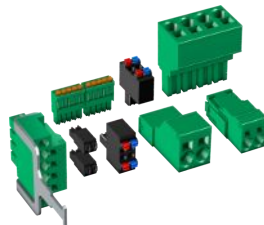
ID No. 49940

Adapter for connecting Ethernet to a USB port.

## 3.4.3 Terminal set

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

### Terminal set for drive controller



The following designs are available:

ID No. 138652

Terminal set for SC6A062Z/Y.

ID No. 138653

Terminal set for SC6A162Z/Y.

ID No. 138654

Terminal set for SC6A261Z/Y.

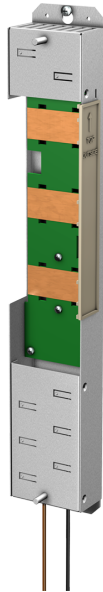
### 3.4.4 DC link connection

If you want to connect SC6 drive controllers into 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 are available separately.

#### Quick DC-Link DL6B 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.

### 3.4.5 Braking resistor

In addition to drive controllers, STOBBER 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       | 53895        |
| SC6A062 | X           | —            |
| SC6A162 | (X)         | X            |
| SC6A261 | (X)         | X            |

Tab. 26: Assignment of FZMU, FZZMU braking resistor – SC6 drive controller

|     |              |
|-----|--------------|
| X   | Recommended  |
| (X) | Possible     |
| —   | Not possible |

#### Properties

| Specification                      | FZMU 400×65  | FZZMU 400×65  |
|------------------------------------|--|---|
| ID No.                             | 49010  | 53895   |
| Type                               | Tubular fixed resistor   | Tubular fixed resistor  |
| Resistance [ $\Omega$ ]            | 100  | 47  |
| Power [W]                          | 600  | 1200  |
| Therm. time const. $\tau_{th}$ [s] | 40   | 40  |
| Pulse power for < 1 s [kW]         | 18   | 36  |
| $U_{max}$ [V]                      | 848  | 848   |
| Weight [kg]                        | Approx. 2.2  | Approx. 4.2   |
| Protection class                   | IP20   | IP20  |
| Test symbols                       |  |  |

Tab. 27: FZMU, FZZMU specification

#### Dimensions

| 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         | 450          |
| R         | 92          | 185          |
| U         | 64          | 150          |
| X         | 10          | 10           |

Tab. 28: FZMU, FZZMU dimensions [mm]



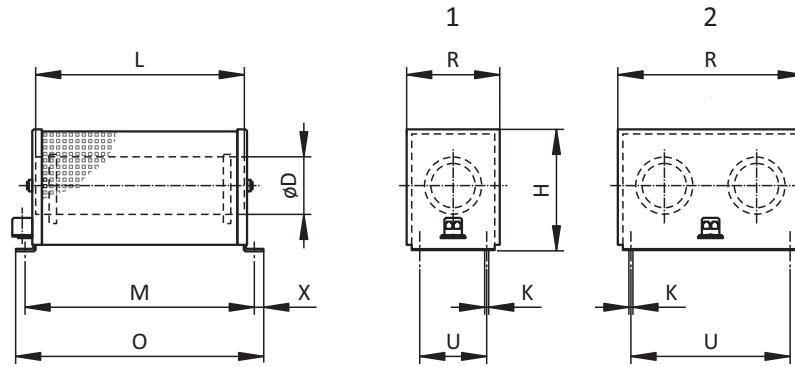


Fig. 4: FZMU (1), FZZMU (2) dimensional drawing

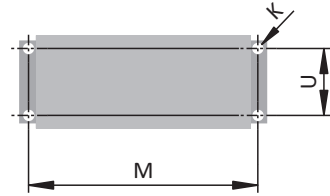


Fig. 5: FZMU, FZZMU drilling diagram

### 3.4.5.2 Flat resistor GVADU, GBADU

| 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. 29: Assignment of GVADU, GBADU braking resistor – SC6 drive controller

- X Recommended
- (X) Possible
- Not possible

#### Properties

| Specification                      | GVADU 210×20            | GBADU 265×30           | GBADU 335×30           |
|------------------------------------|-------------------------|------------------------|------------------------|
| ID No.                             | 55441                   | 55442                  | 55443                  |
| Type                               | Flat resistor           | Flat resistor          | Flat resistor          |
| Resistance [ $\Omega$ ]            | 100                     | 100                    | 47                     |
| Power [W]                          | 150                     | 300                    | 400                    |
| Therm. time const. $\tau_{th}$ [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                     | 500                    | 500                    |
| Conductor cross-section [AWG]      | 18/19                   | 14/19                  | 14/19                  |
|                                    | (0.82 mm <sup>2</sup> ) | (1.9 mm <sup>2</sup> ) | (1.9 mm <sup>2</sup> ) |
| Weight [g]                         | 300                     | 950                    | 1200                   |
| Protection class                   | IP54                    | IP54                   | IP54                   |
| Test symbols                       |                         |                        |                        |

Tab. 30: GVADU, GBADU specification

Dimensions

| 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          |
| $\beta$   | 65°          | 73°          | 73°          |

Tab. 31: GVADU, GBADU dimensions [mm]

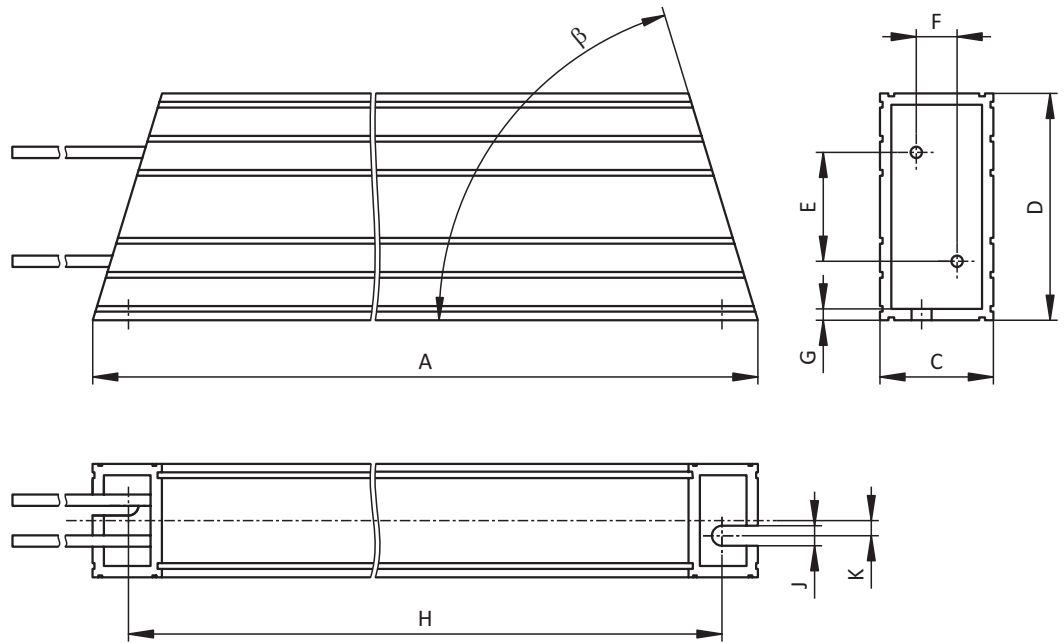


Fig. 6: GVADU, GBADU dimensional drawing

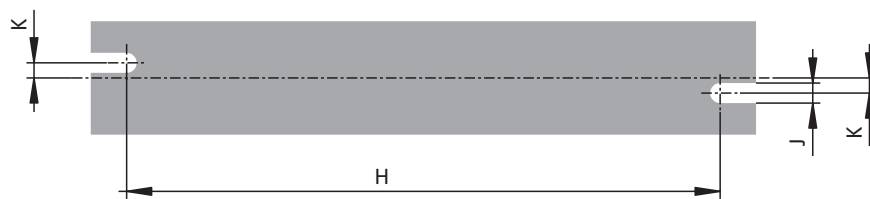


Fig. 7: GVADU, GBADU drilling diagram

## 3.5 Further information

### 3.5.1 Directives and standards

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

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2014/35/EU
- EMC Directive 2014/30/EU
- EN 61326-3-1:2008
- EN 61800-3:2004 and A1:2012
- EN 61800-5-1:2007
- EN 61800-5-2:2007
- EN 50178:1997
- IEC 61784-3:2010

### 3.5.2 Symbols, marks and test symbols



#### Grounding symbol

Grounding symbol in accordance with IEC 60417, symbol 5019.



#### 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

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

This component or material is recognized by UL. 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/download>

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

| Documentation                    | ID     |
|----------------------------------|--------|
| Manual for SC6 drive controllers | 442790 |



## 4 SI6 drive controllers

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## 4 Drive controllers

## SI6

### 4.1 Overview

Drive control in a multi-axis drive system

#### Features

- Single or double-axis controller with a nominal output current up to 50 A and 250% overload capacity
- Supply modules up to 20 kW nominal power
- Sensorless position control by STOBER Lean motors
- Control of rotary synchronous servo motors, asynchronous motors and torque motors
- HIPERFACE DSL One Cable Solution
- Electronic motor nameplate via HIPERFACE DSL and EnDat 2.2 digital encoder interfaces
- Integrated EtherCAT or PROFINET communication
- STO safety technology using terminals or STO and SS1 using FSoE (Safety over EtherCAT): SIL 3, PL e (cat. 4)
- 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

## 4.1.1 Features

The completely re-designed STOBBER multi-axis drive system consists of the SI6 drive controller and PS6 supply module combination. Matching Quick DC-Link modules handle the energy supply for the networked drive controllers. 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. The PS6 supply module is available in two sizes with a nominal power of 10 kW or 20 kW. As an economically attractive system with a minimized device width, the SI6 opens a new dimension in multi-axis applications.

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



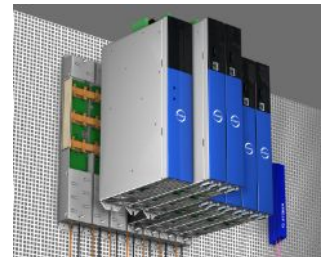
*Drive control in multi-axis drive systems with SI6 and PS6*

### As small as a paperback

You save valuable space in your control cabinet because, with a width of just 45 mm, this drive controller is the most compact solution on the market. It offers all the features that a designer requires.

### 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 STOBBER 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 other axes. A significant reduction in space and cost!

### Fewer clicks, less wiring

Installation is exceptionally simple. No difficult wiring. The patented Quick DC-Link modules allow for a simple "click" into the standard copper rails, as well as the simple installation and connection of the drive controllers.

### Safety functions

The safety concept of the drive controller is based on the STO (Safe Torque Off) function. The concept corresponds to SIL 3 according to DIN EN 61800-5-2 and PL e (Cat. 4) according to DIN EN ISO 13849-1. For double-axis controllers, the STO safety function has a two-channel structure that acts upon both axes. For connection to a higher-level safety circuit, different interfaces are available (terminals or FSoE).

### Heavy duty

There is an extremely robust design concealed behind the elegant exterior. All components—from the stable, well-shielded sheet steel housing to the motor connectors—far exceed the set values of industry standards. The inside is also anything but small-scale: ample computer capacities, high-quality components, careful workmanship.

## 4.1.2 Software components

### Project configuration and commissioning

The 6th generation of 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

Controller-based motion control is recommended for the central motion control of complex machines.

Using the controller-based operating modes of the CiA 402 application, you can implement applications with synchronized, cyclic set value specification (csp, csv, cst, ip) by a motion controller. In addition, the drive controllers can also independently handle motion tasks, such as referencing and jogging during commissioning.

Drive-based STOBER Drive Based and STOBER Drive Based Synchronous applications and drive-based operating modes (pp, pv, pt) of the CiA 402 application are also available for torque/force mode, velocity mode or positioning mode.

## 4.1.3 Application training

STOBER offers a multi-level training program that focuses essentially on application programming of the motion controller and 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 Advanced

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




## 4.2 Technical data

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

### 4.2.1 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   |
| Radio interference suppression             | Integrated line filter in accordance with DIN EN 61800-3:2012, interference emission class C3 |
| Overvoltage category                       | III in accordance with DIN EN 61800-5-1:2008  |
| Test symbols                               |              |

Tab. 1: Device features

| Transport and storage conditions  |   |
|---|---|
| Storage/transport temperature   | -20 °C to +70 °C<br>Maximum change: 20 K/h  |
| Relative humidity   | Maximum relative humidity 85%, non-condensing   |
| Vibration (transport) in accordance with DIN EN 60068-2-6   | 5 Hz ≤ f ≤ 9 Hz: 3.5 mm<br>9 Hz ≤ f ≤ 200 Hz: 10 m/s <sup>2</sup><br>200 Hz ≤ f ≤ 500 Hz: 15 m/s <sup>2</sup> |
| Fall height for freefall <sup>1</sup><br>Weight < 100 kg<br>in accordance with DIN EN 61800-2<br>(or DIN EN 60721-3-2:1997,<br>class 2M1) | 0.25 m  |

Tab. 2: Transport and storage conditions

| Operating conditions                                      |  |
|---|--|
| Surrounding temperature during operation                  | 0 °C to 45 °C with nominal data<br>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<br>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 DIN EN 60068-2-6 | 5 Hz ≤ f ≤ 9 Hz: 0.35 mm<br>9 Hz ≤ f ≤ 200 Hz: 1 m/s <sup>2</sup>  |

Tab. 3: Operating conditions

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

Tab. 4: Discharge times of the DC link circuit

<sup>1</sup>Only valid for components in original packaging

## 4.2.2 Supply module

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

### 4.2.2.1 Type designation

|    |   |   |   |   |
|----|---|---|---|---|
| PS | 6 | A | 2 | 4 |
|----|---|---|---|---|

Tab. 5: Example code for PS6 type designation

| Code  | Designation        | Design       |
|-------|--------------------|--------------|
| PS    | Series             | PowerSupply  |
| 6     | Generation         | Generation 6 |
| A     | Version            |              |
| 2 – 3 | Size               |              |
| 4     | Power output stage |              |

Tab. 6: Meaning of the PS6 example code

### 4.2.2.2 Sizes

| Type   | ID No. | Size   |
|--------|--------|--------|
| PS6A24 | 56650  | Size 2 |
| PS6A34 | 56651  | Size 3 |

Tab. 7: Available PS6 types and sizes



PS6 in sizes 2 and 3

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

### 4.2.2.3 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.

#### Information

The STO safety function is available for safe shutdown as an alternative to continuous, cyclical power-on/power-off operation.

An explanation of the symbols used for formulas can be found in Chapter [\[ 14.1 \]](#).

#### 4.2.2.3.1 Control unit

| Electrical data | All types                      |
|-----------------|--------------------------------|
| $U_{1CU}$       | 24 V <sub>DC</sub> , +20%/–15% |
| $I_{1maxCU}$    | 0.5 A                          |

Tab. 8: Control unit electrical data

#### 4.2.2.3.2 Power unit: Size 2

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

Tab. 9: PS6 electrical data, size 2

#### 4.2.2.3.3 Power unit: Size 3

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

Tab. 10: PS6 electrical data, size 3

#### 4.2.2.3.4 Parallel connection

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 grid 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 |
|-----------------|------------|------------|------------|------------|
| $P_{N,PU}$      | 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. 11: Electrical data for parallel connection: Example combinations

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

- Only the same sizes may be connected in parallel.
- You can connect a maximum of 3 PS6A34 in parallel.

4.2.2.3.5 Brake chopper

| Electrical data | All types                 |
|-----------------|---------------------------|
| $U_{onCH}$      | 780 – 800 V <sub>DC</sub> |
| $U_{offCH}$     | 740 – 760 V <sub>DC</sub> |
| $R_{2minRB}$    | 22 Ω                      |
| $P_{maxRB}$     | 29.1 kW                   |
| $P_{effRB}$     | 13.2 kW                   |

Tab. 12: Brake chopper electrical data

4.2.2.3.6 Fast discharge

Fast discharge is activated when no power supply 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.

4.2.2.4 Dimensions

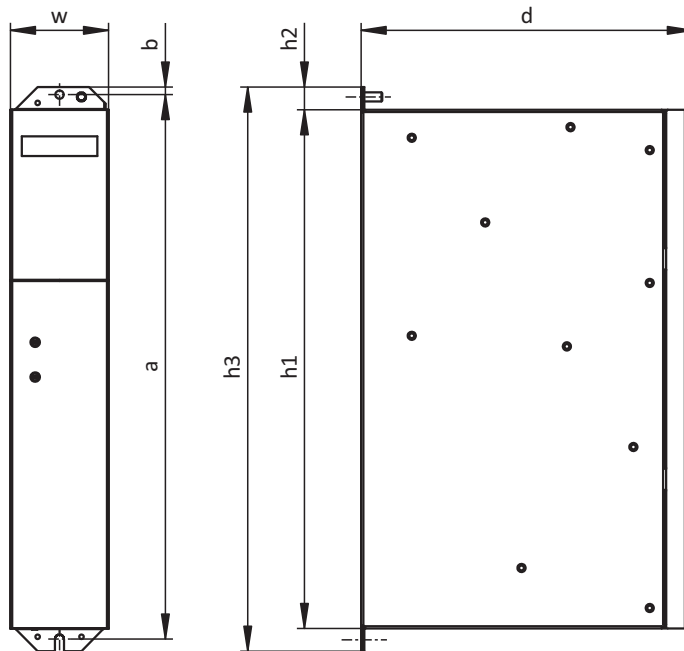


Fig. 1: PS6 dimensional drawing

| Dimension            |                                     | Size 2 | Size 3    |
|----------------------|-------------------------------------|--------|-----------|
| Supply module        | Width                               | w      | 45 / 65   |
|                      | Depth                               | d      | 204 / 219 |
|                      | Body height                         | h1     | 343       |
|                      | Fastening clip height               | h2     | 15        |
|                      | Height incl. fastening clips        | h3     | 373       |
| Fastening holes (M5) | Vertical distance                   | a      | 360+2     |
|                      | Vertical distance to the upper edge | b      | 5         |

Tab. 13: PS6 dimensions [mm]

### 4.2.2.5 Weight

| Type   | Weight without packaging [g] | Weight with packaging [g] |
|--------|------------------------------|---------------------------|
| PS6A24 | 2680                         | 4180                      |
| PS6A34 | 3820                         | 4920                      |

Tab. 14: PS6 weight [g]

## 4.2.3 Drive controllers

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

### 4.2.3.1 Type designation

|    |   |   |   |   |   |   |
|----|---|---|---|---|---|---|
| SI | 6 | A | 0 | 6 | 1 | Z |
|----|---|---|---|---|---|---|

Tab. 15: Example code for SI6 type designation

| Code  | Designation        | Design                             |
|-------|--------------------|------------------------------------|
| SI    | Series             | ServoInverter                      |
| 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           |
| Y     |                    | SY6: STO and SS1 using FSoE        |

Tab. 16: Meaning of the SI6 example code

### 4.2.3.2 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. 17: 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.

### 4.2.3.3 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 [▶ 14.1](#).

#### 4.2.3.3.1 Control unit

| Electrical data | All types                      |
|-----------------|--------------------------------|
| $U_{1CU}$       | 24 V <sub>DC</sub> , +20%/–15% |
| $I_{1maxCU}$    | 0.5 A                          |

Tab. 18: Control unit electrical data

#### 4.2.3.3.2 Power unit: Size 0

| Electrical data | SI6A061                             | SI6A062 |
|-----------------|-------------------------------------|---------|
| $U_{1PU}$       | 280 – 800 V <sub>DC</sub>           |         |
| $f_{2PU}$       | 0 – 700 Hz                          |         |
| $U_{2PU}$       | 0 – max. $\frac{U_{1PU}}{\sqrt{2}}$ |         |
| $C_{PU}$        | 180 µF                              | 270 µF  |

Tab. 19: 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 |         |

Tab. 20: 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 |           |

Tab. 21: SI6 electrical data, size 0, for 8 kHz clock frequency

## 4.2.3.3.3 Power unit: Size 1

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

Tab. 22: 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 |          |

Tab. 23: 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 |          |

Tab. 24: SI6 electrical data, size 1, for 8 kHz clock frequency

## 4.2.3.3.4 Power unit: Size 2

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

Tab. 25: 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 |          |

Tab. 26: 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 |          |

Tab. 27: SI6 electrical data, size 2, for 8 kHz clock frequency

4.2.3.3.5 Power unit: Size 3

| Electrical data | SI6A361                             |
|-----------------|-------------------------------------|
| $U_{1PU}$       | 280 – 800 V <sub>DC</sub>           |
| $f_{2PU}$       | 0 – 700 Hz                          |
| $U_{2PU}$       | 0 – max. $\frac{U_{1PU}}{\sqrt{2}}$ |
| $C_{PU}$        | 2250 µF                             |

Tab. 28: 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 |

Tab. 29: 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 |

Tab. 30: SI6 electrical data, size 3, for 8 kHz clock frequency



#### 4.2.3.3.6 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 drive controller current if the continuous current of the second connected motor is lower than the nominal drive controller current. This enables economical combinations of double-axis controllers and motors.

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

##### Example 1

$$I_{2PU(B)} = I_{2N,PU} - (I_{2PU(A)} - I_{2N,PU}) \times \frac{3}{5} \quad \text{where} \quad 0 \leq I_{2PU(A)} \leq I_{2N,PU}$$

##### Example 2

$$I_{2PU(B)} = I_{2N,PU} - (I_{2PU(A)} - I_{2N,PU}) \times \frac{5}{3} \quad \text{where} \quad I_{2N,PU} \leq I_{2PU(A)} \leq 1,6 \times I_{2N,PU}$$

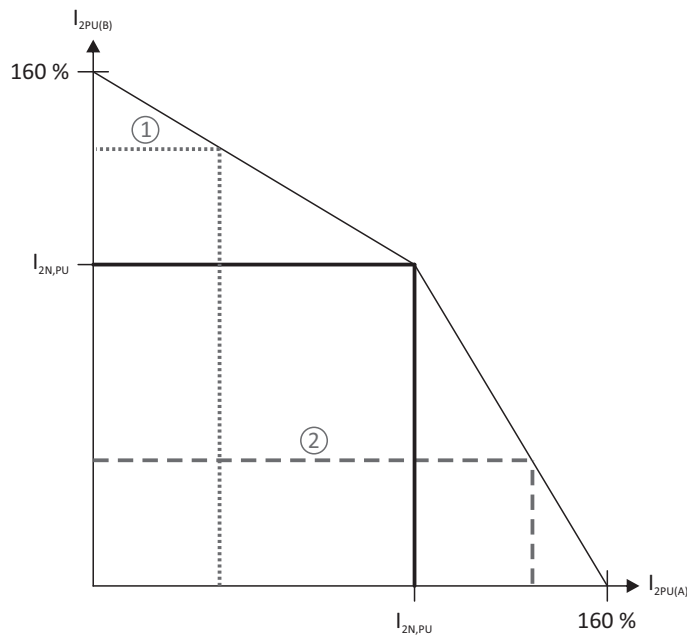


Fig. 2: Asymmetric load on double-axis controllers

#### 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.

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

| Type    | Nominal current<br>$I_{2N,PU}$ | Apparent power | Absolute losses<br>$P_{V,CU}^2$ | Operating points <sup>3</sup> |        |         |         |         |          |         |          | IE class <sup>4</sup> | Comparison <sup>5</sup> |
|---------|--------------------------------|----------------|---------------------------------|-------------------------------|--------|---------|---------|---------|----------|---------|----------|-----------------------|-------------------------|
|         |                                |                |                                 | (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. 31: 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, the values are to be multiplied by the number of axis controllers (x), e.g. x = 4 for 1 × PS6 and 2 × SI6A062.

The loss data applies to drive controllers without any accessories.

The power loss calculation is based on a three-phase supply voltage with 400 V<sub>AC</sub>/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<sub>DC</sub> power supply of the control electronics.

<sup>2</sup> Absolute losses for a power unit that is switched off

<sup>3</sup> Operating points for relative motor stator frequency in % and relative torque current in %

<sup>4</sup> IE class in accordance with EN 61800-9-2

<sup>5</sup> Comparison of the losses for the reference drive controller relative to IE2 in the nominal point (90, 100)

### 4.2.3.4 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.

#### 4.2.3.4.1 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    | $I_{2N,PU}$<br>4 kHz [A] | $I_{2N,PU}$<br>8 kHz [A] | $I_{2N,PU}$<br>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. 32: Nominal output current  $I_{2N,PU}$  dependent on the clock frequency

#### 4.2.3.4.2 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

$$D_T = 100\% - 5 \times 2.5\% = 87.5\%$$

#### 4.2.3.4.3 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  $-1.5\%/100\text{ m}$

##### 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:

$$D_{IA} = 100\% - 5 \times 1.5\% = 92.5\%$$

#### 4.2.3.4.4 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:

$$I_{2N,PU(red)} = 4.5 \text{ A} \times 0.875 \times 0.925 = 3.64 \text{ A}$$

## 4.2.3.5 Dimensions

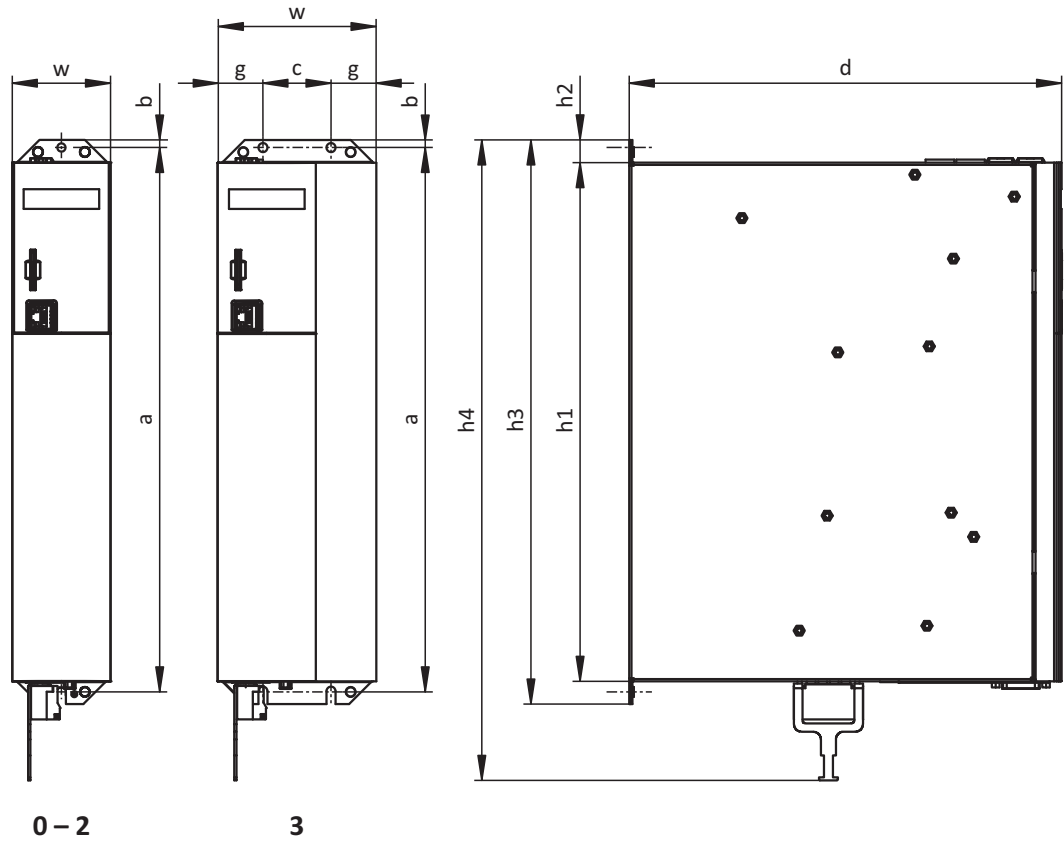


Fig. 3: SI6 dimensional drawing

| Dimension                                 |                                      | Size 0            | Size 1 | Size 2 <sup>6</sup> | Size 2 <sup>7</sup> | Size 3 |
|---|--------------------------------------|-------------------|--------|---------------------|---------------------|--------|
| Drive Controllers                         | 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 holes (M5)                 | Vertical distance | a      |                     | 360+2               |        |
| Vertical distance to the upper edge       |                                      | b                 |        | 5                   |                     |        |
| Horizontal spacing of the fastening holes |                                      | c                 |        | 45                  |                     |        |
| Horizontal distance to the side edge      |                                      | g                 |        | 30                  |                     |        |

Tab. 33: SI6 dimensions [mm]

<sup>6</sup> Single-axis controller<sup>7</sup> Double-axis controller

### 4.2.3.6 Weight

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

Tab. 34: SI6 weight [g]

## 4.2.4 DC link connection

The following section contains specifications for the electrical data, dimensions and weight of the DL6B modules Quick DC-Link.

### 4.2.4.1 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          |
| Protection class of the installation space | At least IP54 |

Tab. 35: Device features

| Transport and storage conditions  |   |
|---|---|
| Storage/<br>transport temperature   | -20 °C to +70 °C<br>Maximum change: 20 K/h  |
| Relative humidity   | Maximum relative humidity 85%, non-condensing   |
| Vibration (transport) in accordance with DIN EN 60068-2-6   | 5 Hz ≤ f ≤ 9 Hz: 3.5 mm<br>9 Hz ≤ f ≤ 200 Hz: 10 m/s <sup>2</sup><br>200 Hz ≤ f ≤ 500 Hz: 15 m/s <sup>2</sup> |
| Fall height for freefall <sup>8</sup><br>Weight < 100 kg<br>in accordance with DIN EN 61800-2 (or DIN EN 60721-3-2:1997, class 2M1) | 0.25 m  |

Tab. 36: Transport and storage conditions

| Operating conditions                                      |  |
|---|--|
| Surrounding temperature during operation                  | 0 °C to 45 °C with nominal data<br>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<br>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 DIN EN 60068-2-6 | 5 Hz ≤ f ≤ 9 Hz: 0.35 mm<br>9 Hz ≤ f ≤ 200 Hz: 1 m/s <sup>2</sup>  |

Tab. 37: Operating conditions

#### 4.2.4.2 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 |
|---------|--------|--------|--------|--------|--------|
| ID No.  | 56655  | 56656  | 56663  | 56657  | 56658  |
| SI6A061 | X      | —      | —      | —      | —      |
| SI6A062 | X      | —      | —      | —      | —      |
| SI6A161 | —      | X      | —      | —      | —      |
| SI6A162 | —      | X      | —      | —      | —      |
| SI6A261 | —      | X      | —      | —      | —      |
| SI6A262 | —      | —      | X      | —      | —      |
| SI6A361 | —      | —      | X      | —      | —      |
| PS6A24  | —      | —      | —      | X      | —      |
| PS6A34  | —      | —      | —      | —      | X      |

Tab. 38: DL6B assignment to SI6 and PS6

4.2.4.3 Dimensions

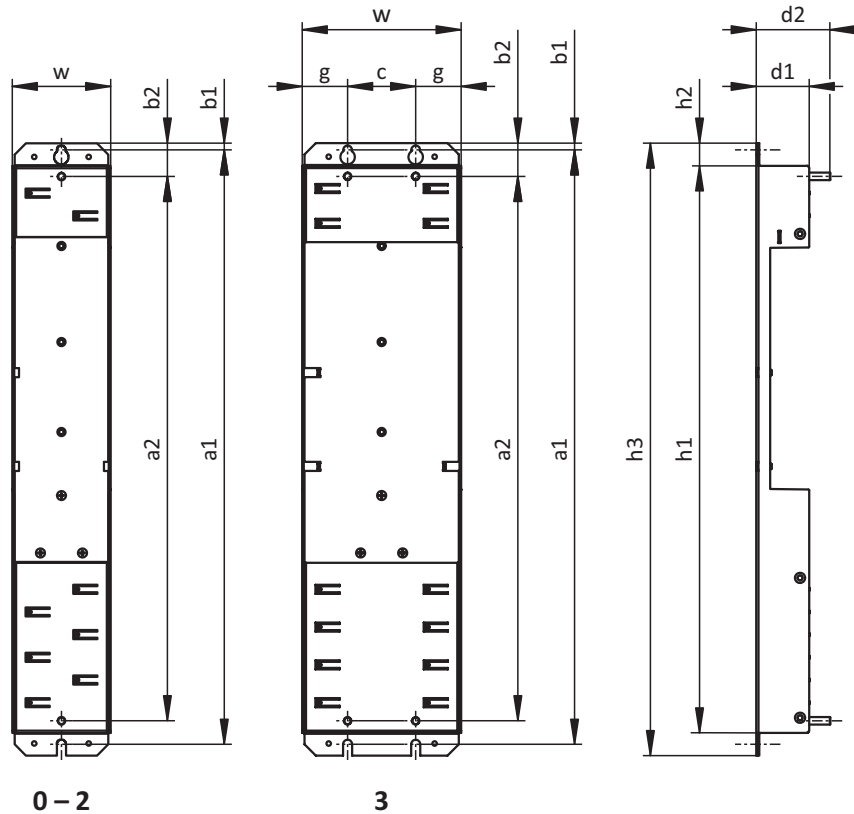


Fig. 4: DL6B dimensional drawing

| Dimension                                 |                              |                                   | DL6B10<br>DL6B20 | DL6B11<br>DL6B21 | DL6B12 |
|---|------------------------------|-----------------------------------|------------------|------------------|--------|
| Quick DC-Link                             | Width                        | w                                 | 45               | 65               | 105    |
|   | Depth                        | d1                                |                  | 35               |        |
|   | Depth incl. attachment bolts | d2                                |                  | 49               |        |
|   | Height                       | h1                                |                  | 375              |        |
|   | Fastening clip height        | h2                                |                  | 15               |        |
|   | Height incl. fastening clips | h3                                |                  | 405              |        |
|   | Fastening holes              | Vertical distance (wall mounting) | a1               |                  | 393+2  |
| Vertical distance (module mounting)       |                              | a2                                |                  | 360              |        |
| Vertical distance to the upper edge       |                              | b1                                |                  | 4.5              |        |
| Vertical distance to the upper edge       |                              | b2                                |                  | 22               |        |
| Horizontal spacing of the fastening holes |                              | c                                 |                  | —                | 45     |
| Horizontal distance to the side edge      |                              | g                                 |                  | —                | 30     |

Tab. 39: DL6B dimensions [mm]



#### 4.2.4.4 Weight

| Type   | Weight without packaging [g] | Weight with packaging [g] |
|--------|------------------------------|---------------------------|
| DL6B10 | 420                          | 460                       |
| DL6B11 | 560                          | 600                       |
| DL6B12 | 920                          | 960                       |
| DL6B20 | 480                          | 520                       |
| DL6B21 | 740                          | 780                       |

Tab. 40: DL6B weight [g]

#### 4.2.5 Minimum clearances

##### Drive controllers and supply modules

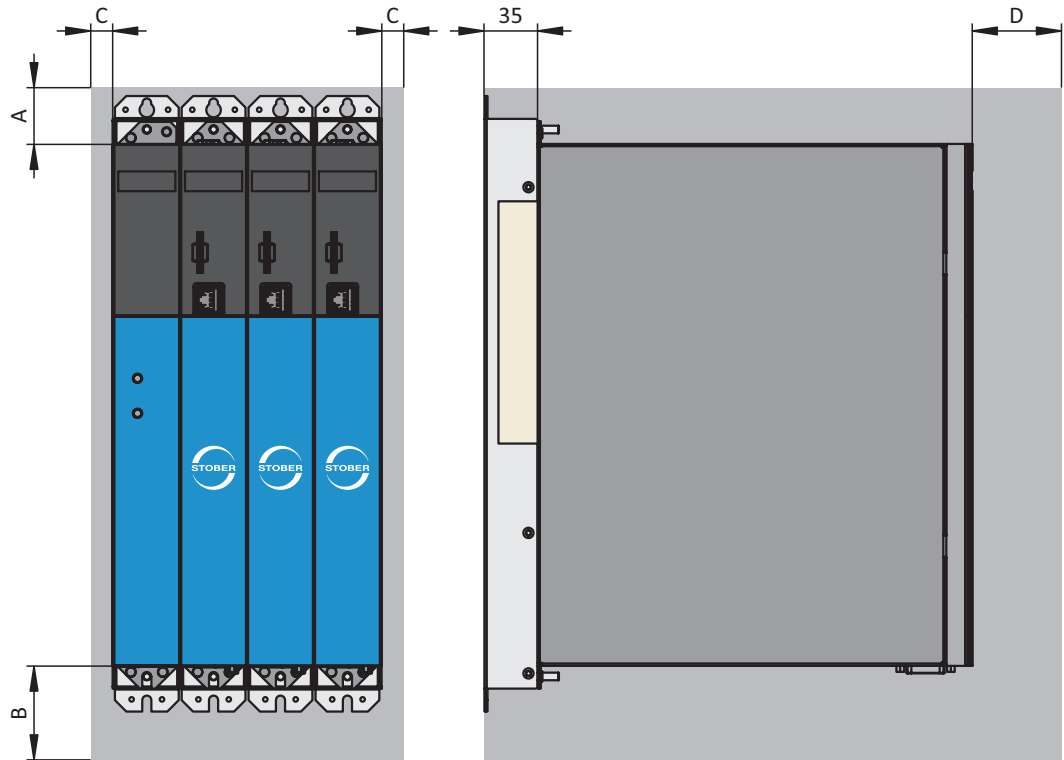


Fig. 5: Minimum clearances

The specified dimensions refer to the outside edges of the drive controller or supply module including the Quick DC-Link rear section module.

| Minimum clearance | A (above) | B (below) | C (on the side) | D (in front)    |
|-------------------|-----------|-----------|-----------------|-----------------|
| All sizes         | 100       | 200       | 5               | 50 <sup>9</sup> |

Tab. 41: 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.

<sup>9</sup> 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 [14.1](#).

### LM Lean motor ( $n_N = 3000$ rpm) – SI6

|       |                          |               |              |               |              | SI6A061                                    | SI6A161 | SI6A261 | SI6A262 | SI6A361 |
|-------|--------------------------|---------------|--------------|---------------|--------------|--|---------|---------|---------|---------|
|       |                          |               |              |               |              | SI6A062                                    | SI6A162 |         |         |         |
|       |                          |               |              |               |              | $I_{2N,PU}$ [A]<br>( $f_{PWM,PU} = 4$ kHz) |         |         |         |         |
|       | $K_{EM}$<br>[V/1000 rpm] | $M_N$<br>[Nm] | $I_N$<br>[A] | $M_0$<br>[Nm] | $I_0$<br>[A] | 5  | 12      | 22      | 25      | 50      |
|       |                          |               |              |               |              | $I_{2N,PU} / I_0$                          |         |         |         |         |
| LM401 | 110                      | 2.25          | 1.59         | 2.43          | 1.82         | 2.7  | (X)     | (—)     | (—)     | (—)     |
| LM402 | 120                      | 4.41          | 2.88         | 4.50          | 2.94         | 1.7  | (X)     | (—)     | (—)     | (—)     |
| LM403 | 120                      | 6.06          | 3.92         | 6.19          | 4.08         | 1.2  | (X)     | (X)     | (X)     | (—)     |
| LM503 | 135                      | 9.48          | 5.62         | 10.07         | 5.95         | (X)  | 2.0     | (X)     | (X)     | (—)     |
| LM505 | 135                      | 13.70         | 7.83         | 15.47         | 8.83         | (X)  | 1.4     | (X)     | (X)     | (—)     |
| LM704 | 145                      | 19.27         | 10.64        | 21.26         | 11.57        | —  | (X)     | 1.9     | 2.2     | (X)     |
| LM706 | 140                      | 25.67         | 14.69        | 29.80         | 16.80        | —  | (X)     | 1.3     | 1.5     | (X)     |

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

## 4.4 Accessories

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

### 4.4.1 Safety technology

#### Information

Note that the drive controller is delivered as a standard version without safety technology (SZ6 option). 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  
Standard version.

#### 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 DIN EN ISO 13849-1 and DIN EN 61800-5-2. Connection to higher-level safety circuit through terminal X12 (included in the terminal set scope of delivery).

#### 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 DIN EN ISO 13849-1 and DIN EN 61800-5-2. Connection to the higher-level safety circuit using Fail Safe over EtherCAT (FSoE).

## 4.4.2 Communication

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

### EtherCAT or PROFINET fieldbus system



Please specify the desired fieldbus system when placing your purchase order for the base device.



### EtherCAT cables



Ethernet patch cable, CAT5e, yellow.

The following designs are available:

ID No. 49313: Length approx. 0.2 m.

ID No. 49314: Length approx. 0.35 m.

### PC connecting cables



ID No. 49857

Cable for connecting the X9 service interface to the PC, CAT5e, blue, 5 m.

### USB 2.0 Ethernet adapter



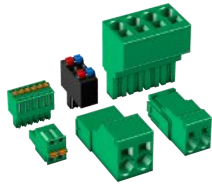
ID No. 49940

Adapter for connecting Ethernet to a USB port.

### 4.4.3 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



The following designs are available:

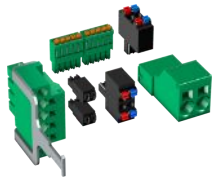
ID No. 138660

Terminal set for PS6A24.

ID No. 138661

Terminal set for PS6A34.

#### Terminal set for drive controller



The following designs are available:

ID No. 138655

Terminal set for SI6A061Z/Y.

ID No. 138656

Terminal set for SI6A062Z/Y.

ID No. 138657

Terminal set for SI6A161Z/Y.

ID No. 138658

Terminal set for SI6A162Z/Y.

ID No. 138659

Terminal set for SI6A261Z/Y.

ID No. 138662

Terminal set for SI6A262Z/Y.

ID No. 138663

Terminal set for SI6A361Z/Y.

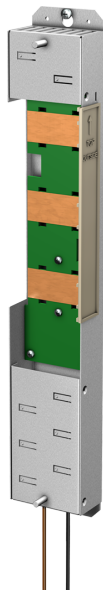
### 4.4.4 DC link connection

For the energy supply of the existing networked drive controllers, 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 are available separately.

#### Quick DC-Link DL6B 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

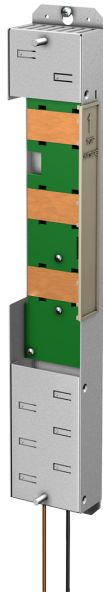
DL6B12

ID No. 56663

Rear section module for size 2 (double-axis controller) or 3 drive controller:

SI6A262 and SI6A361

**Quick DC-Link DL6B 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

**Quick DC-Link DL6B insulation end section**



ID No. 56659

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

2 pcs.

## 4.4.5 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.

### 4.4.5.1 Braking resistor assignment – PS6


| Type   | KWADQU | FZZMQU | FGFKQU |
|--------|--------|--------|--------|
| ID No. | 56634  | 56635  | 56636  |
| PS6A24 | (—)    | (X)    | X      |
| PS6A34 | (—)    | (X)    | X      |

Tab. 42: Braking resistor assignment to PS6 supply module

|     |                                 |
|-----|---------------------------------|
| X   | Recommended                     |
| (X) | Possible                        |
| (—) | Useful under certain conditions |

### 4.4.5.2 KWADQU flat resistor

#### Properties

| Specification                         | KWADQU 420×91   |
|---------------------------------------|---|
| ID No.                                | 56634   |
| Type                                  | Flat resistor with temperature switch<br>(incl. mounting bracket)                     |
| Resistance [ $\Omega$ ]               | 100   |
| Power [W]                             | 600   |
| Thermal time constant $\tau_{th}$ [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<br>(1.9 mm <sup>2</sup> )   |
| Weight [kg]                           | Approx. 2.6   |
| Protection class                      | IP54  |
| Test symbols                          |  |

Tab. 43: KWADQU specification

| Specification                                  | Temperature switch              |
|--|---------------------------------|
| Switching capacity                             | 2 A / 24 V <sub>DC</sub> (DC11) |
| Nominal response temperature $\vartheta_{NAT}$ | 180 °C ± 5 K                    |
| Type   | NC                              |
| Cable design                                   | FEP                             |
| Cable length [mm]                              | 500                             |
| Conductor cross-section [AWG]                  | 22                              |

Tab. 44: Temperature switch specification

Dimensions

| Dimension | KWADQU 420×91 |
|-----------|---------------|
| A         | 420           |

Tab. 45: KWADQU dimensions [mm]

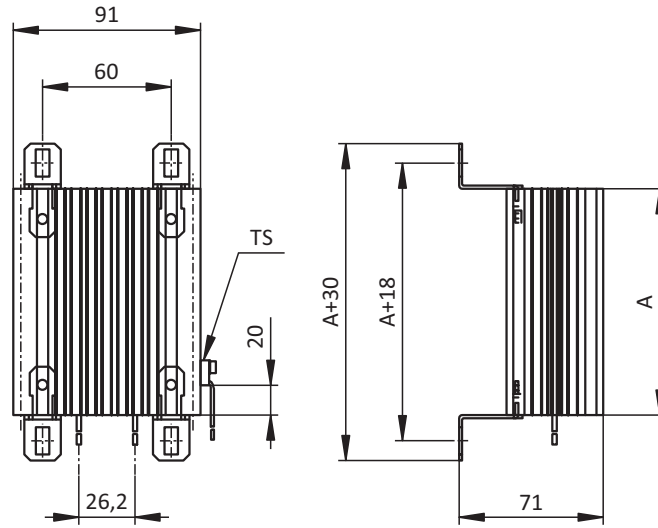


Fig. 6: KWADQU dimensional drawing

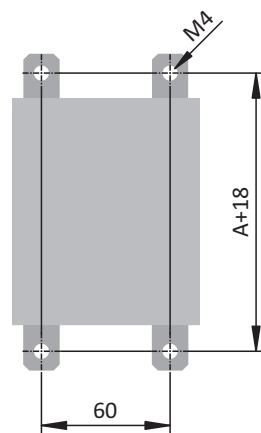



Fig. 7: KWADQU drilling diagram

### 4.4.5.3 FZZMQU tubular fixed resistor

#### Properties

| Specification                         | FZZMQU 400×65   |
|---------------------------------------|---|
| ID No.                                | 56635   |
| Type                                  | Tubular fixed resistor with temperature switch                                      |
| Resistance [ $\Omega$ ]               | 47  |
| Power [W]                             | 1200  |
| Thermal time constant $\tau_{th}$ [s] | 40  |
| Pulse power for < 1 s [kW]            | 36  |
| $U_{max}$ [V]                         | 848   |
| Weight [kg]                           | Approx. 4.2   |
| Protection class                      | IP20  |
| Test symbols                          |  |

Tab. 46: FZZMQU specification

| Specification                                  | Temperature switch              |
|--|---------------------------------|
| Switching capacity                             | 2 A / 24 V <sub>DC</sub> (DC11) |
| Nominal response temperature $\vartheta_{NAT}$ | 180 °C $\pm$ 5 K                |
| Type   | NC                              |
| Cable design                                   | FEP                             |
| Cable length [mm]                              | 500                             |
| Conductor cross-section [AWG]                  | 22                              |

Tab. 47: Temperature switch specification

#### Dimensions

| Dimension | FZZMQU 400×65 |
|-----------|---------------|
| L × D     | 400 × 65      |
| H         | 120           |
| K         | 6.5 × 12      |
| M         | 426           |
| O         | 475           |
| R         | 185           |
| U         | 150           |

Tab. 48: FZZMQU dimensions [mm]



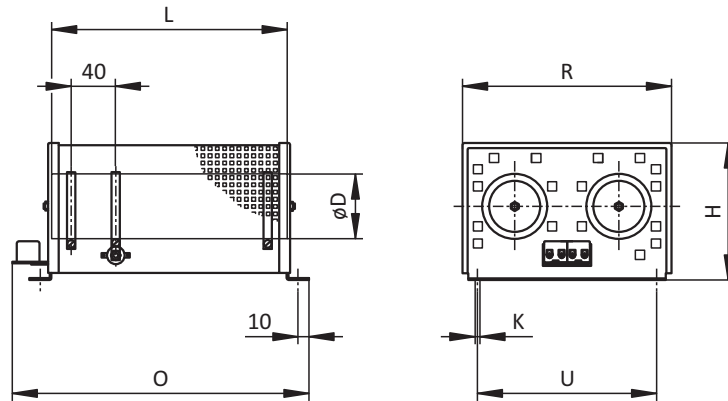


Fig. 8: FZMQU dimensional drawing

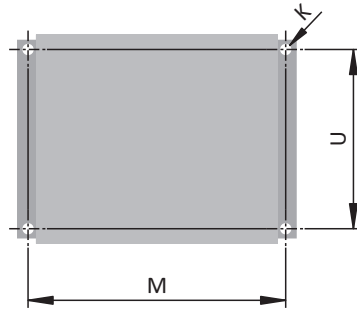



Fig. 9: FZMQU drilling diagram

#### 4.4.5.4 FGFKQU steel-grid fixed resistor

##### Properties

| Specification                         | FGFKQU 31005  |
|---------------------------------------|---|
| ID No.                                | 56636   |
| Type                                  | Steel-grid fixed resistor with temperature switch                                     |
| Resistance [ $\Omega$ ]               | 22  |
| Power [W]                             | 2500  |
| Thermal time constant $\tau_{th}$ [s] | 30  |
| Pulse power for < 1 s [kW]            | 50  |
| $U_{max}$ [V]                         | 848   |
| Weight [kg]                           | Approx. 7.5   |
| Protection class                      | IP20  |
| Test symbols                          |  |

Tab. 49: FGFKQU specification

| Specification                                  | Temperature switch              |
|--|---------------------------------|
| Switching capacity                             | 2 A / 24 V <sub>DC</sub> (DC11) |
| Nominal response temperature $\vartheta_{NAT}$ | 180 °C $\pm$ 5 K                |
| Type   | NC                              |
| Cable design                                   | FEP                             |
| Cable length [mm]                              | 500                             |
| Conductor cross-section [AWG]                  | 22                              |

Tab. 50: Temperature switch specification

Dimensions

| Dimension | FGFKQU 31005 |
|-----------|--------------|
| A         | 270          |
| B         | 295          |
| C         | 355          |

Tab. 51: FGFKQU dimensions [mm]

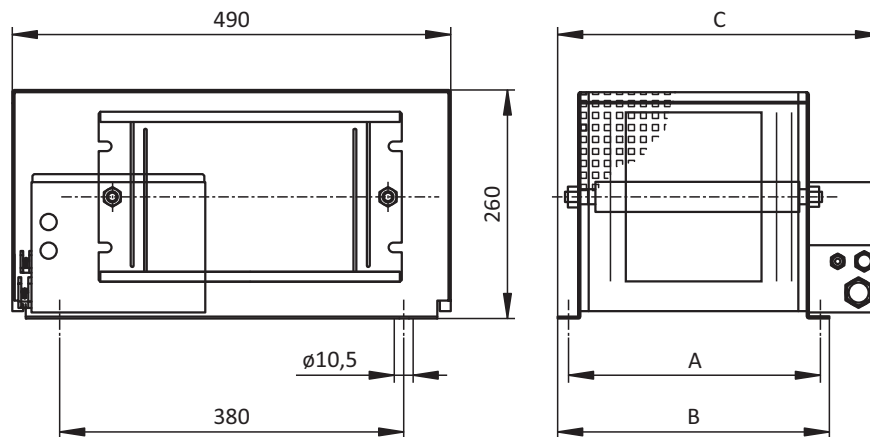


Fig. 10: FGFKQU dimensional drawing

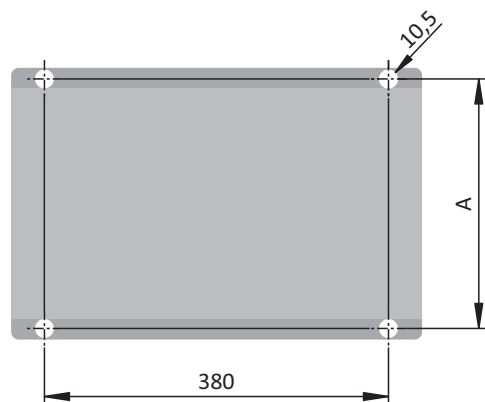



Fig. 11: FGFKQU drilling diagram

## 4.4.6 Choke

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

### 4.4.6.1 TEP power choke

#### Properties

| Specification                                      | 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 <sub>AC</sub><br>+32%/-50%<br>3 × 480 V <sub>AC</sub><br>+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 mm <sup>2</sup>  |
| Tightening torque                                  | 2.5 Nm  |
| Insulation stripping length                        | 17 mm   |
| Installation                                       | Screws  |
| Directive  | EN 61558-2-20   |
| UL Recognized Component (CAN; USA)                 | Yes   |
| Test symbol, symbol                                |  |

Tab. 52: TEP specification

**Derating – Effect of surrounding temperature**

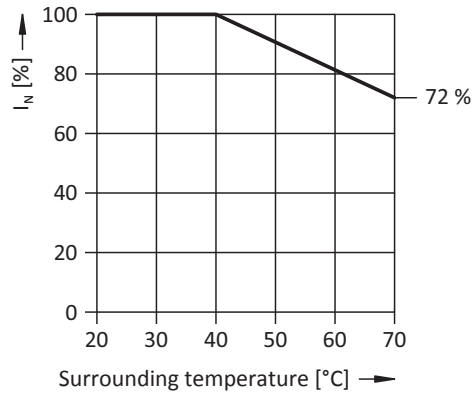


Fig. 12: Derating the nominal current based on surrounding temperature

**Derating – Effect of the installation elevation**

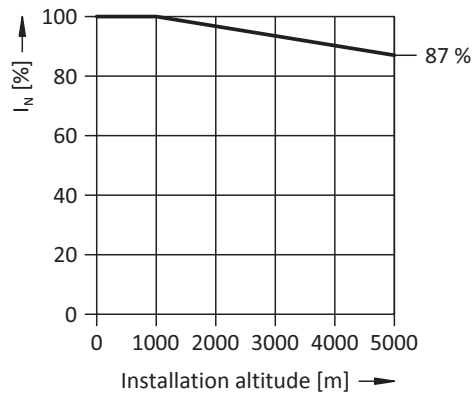


Fig. 13: Derating the nominal current depending on installation elevation

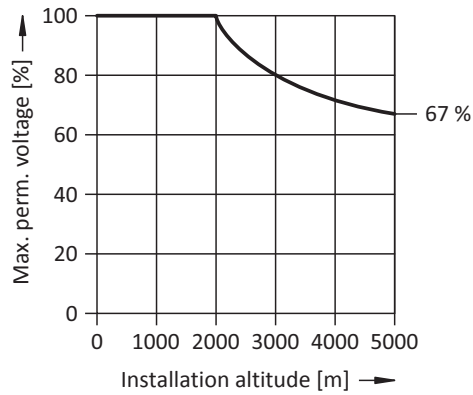


Fig. 14: Derating the voltage depending on installation elevation

**Dimensions and weight**

| Dimensions                                   | TEP4010-2US00 |
|--|---------------|
| Height [mm]                                  | 235           |
| Width [mm]                                   | 219           |
| Depth [mm]                                   | 118           |
| Vertical distance 1 – fastening holes [mm]   | 201           |
| Vertical distance 2 – Fastening holes [mm]   | 136           |
| Horizontal distance 1 – fastening holes [mm] | 88            |
| Horizontal distance 2 – Fastening holes [mm] | 75            |
| Drill holes – Depth [mm]                     | 7             |
| Drill holes – Width [mm]                     | 12            |
| Screw connection – M                         | M6            |
| Weight [g]                                   | 10000         |

Tab. 53: TEP dimensions and weight

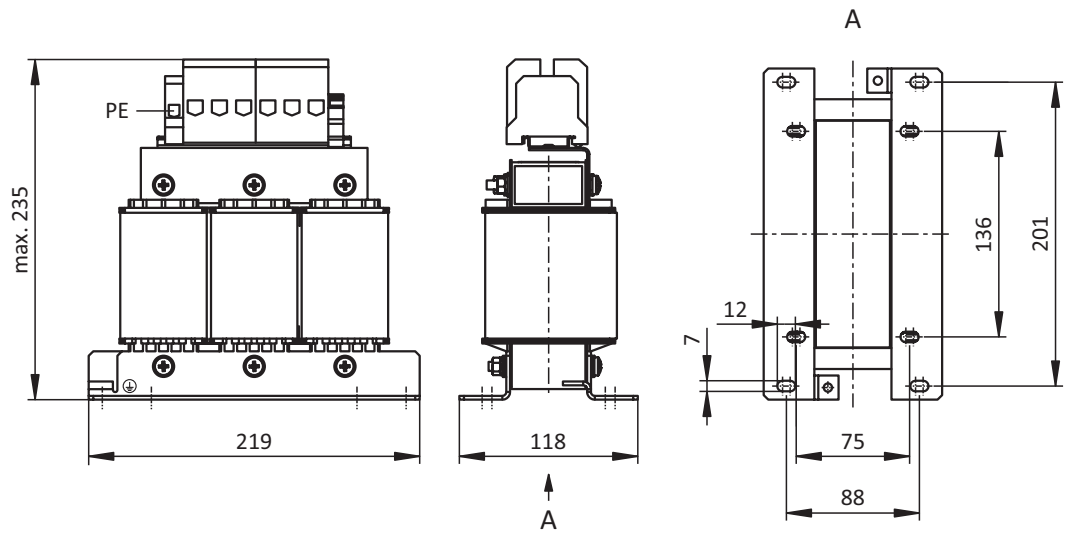


Fig. 15: Power choke dimensional drawing

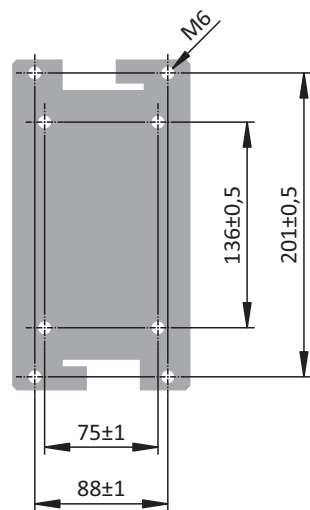


Fig. 16: Power choke drilling diagram

## 4.5 Further information

### 4.5.1 Directives and standards

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

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2014/35/EU
- EMC Directive 2014/30/EU
- EN 61326-3-1:2008
- EN 61800-3:2004 and A1:2012
- EN 61800-5-1:2007
- EN 61800-5-2:2007
- EN 50178:1997
- IEC 61784-3:2010

### 4.5.2 Symbols, marks and test symbols



**Grounding symbol**

Grounding symbol in accordance with IEC 60417, symbol 5019.



**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**

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**

This component or material is recognized by UL. 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/download>

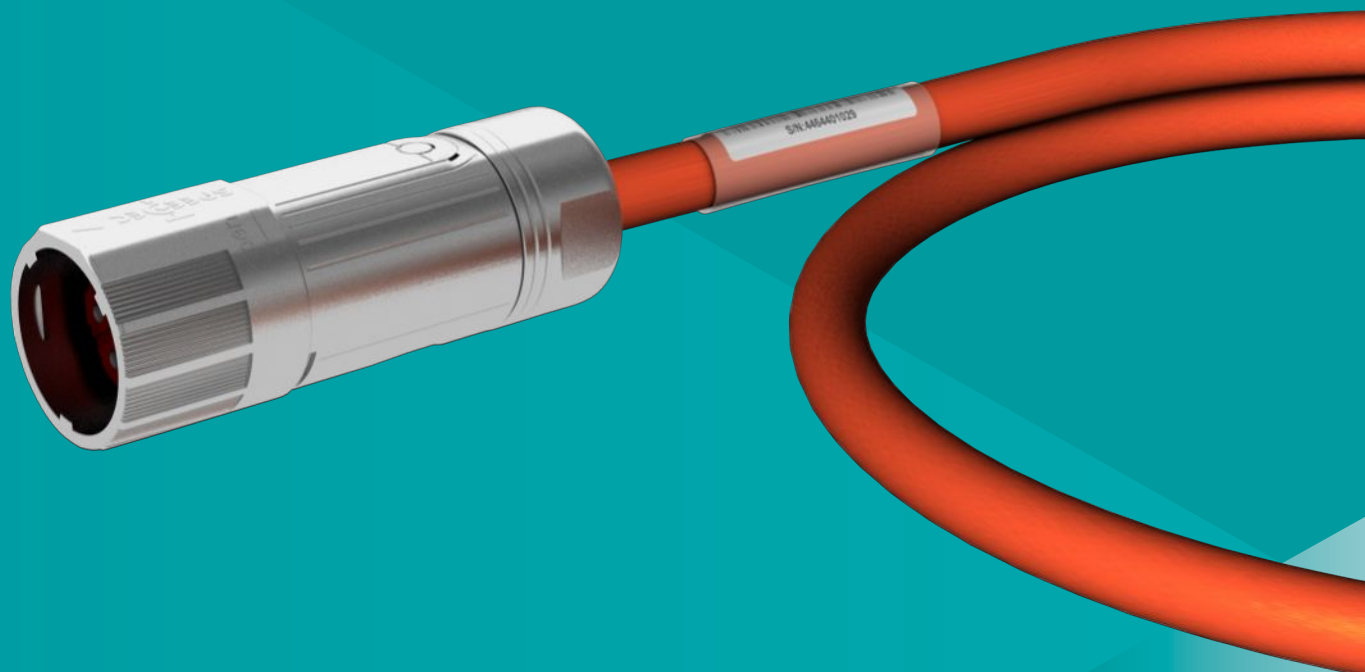
Enter the ID of the documentation in the Search... field.

| Documentation                    | ID     |
|----------------------------------|--------|
| Manual for SI6 drive controllers | 442728 |

# 5 Connection method

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## 5 Connection method

### 5.1 Overview

Coordinated connection methods for STOBBER drive controllers

#### Features

- Torsional stress  $\pm 30^\circ/\text{m}$
- 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.

Combining STOBBER motors, STOBBER cables and STOBBER drive controllers enables you to comply with these legal requirements.

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

Using unsuitable connection cables may void any claims made under the warranty.



## 5.2 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 and yellow) |
| Single-colored core: | BK/BN | BLACK/BROWN (black or brown)   |

## 5.3 Power cables

STOBER 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, 5.0 m, 7.5 m, 10.0 m, 12.5 m, 15.0 m, 18.0 m, 20.0 m, 25.0 m, 30.0 m.

Other lengths on request.

### 5.3.1 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

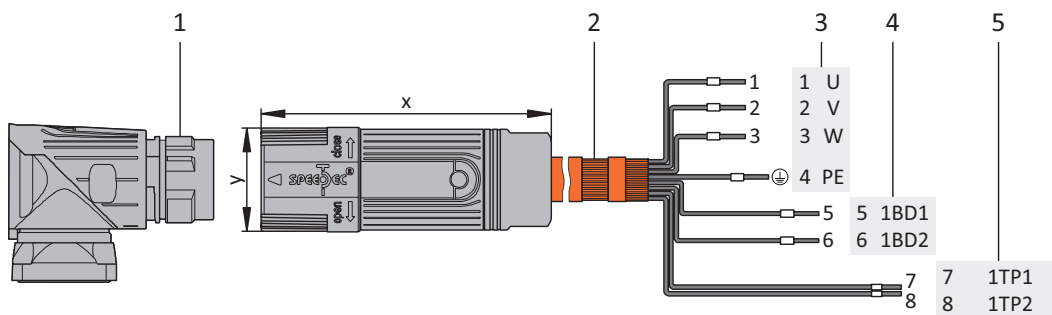
#### Assignment of LM Lean motors (nN = 3000 rpm)

|       | $K_{EM}$<br>V/1000<br>rpm | Plug connector size | Minimum cross-section<br>mm <sup>2</sup> |
|-------|---------------------------|---------------------|--|
| LM401 | 110                       | con.23              | 1.5                                      |
| LM402 | 120                       | con.23              | 1.5                                      |
| LM403 | 120                       | con.23              | 1.5                                      |
| LM503 | 135                       | con.23              | 1.5                                      |
| LM505 | 135                       | con.23              | 1.5                                      |
| LM704 | 145                       | con.23              | 2.5                                      |
| LM706 | 140                       | con.23              | 2.5                                      |

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

### 5.3.2 Connection description

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



- 1: Plug connectors
- 2: STOBER power cable, cable shield
- 3: Connection to terminal X20, motor
- 4: Connection of terminal X300/X5, brake
- 5: Connection to terminal X2, temperature sensor

The maximum cable length of the shielded power cable is 50 m.

#### Power cables – con.23 plug connector

| Motor connection diagram | Motor (1) |             |                       | Cable (2)            | Drive controller (3) – (5) |             |        |
|--------------------------|-----------|-------------|-----------------------|----------------------|----------------------------|-------------|--------|
|                          | Pin       | Designation | Int. motor Core color | Core No./ Core color | Pin X20                    | Pin X300/X5 | Pin X2 |
|                          | 1         | 1U1         | BK                    | 1                    | 1                          | —           | —      |
|                          | 3         | 1V1         | BU                    | 2                    | 2                          | —           | —      |
|                          | 4         | 1W1         | RD                    | 3                    | 3                          | —           | —      |
|                          | A         | 1BD1        | RD                    | 5                    | —                          | 5           | —      |
|                          | B         | 1BD2        | BK                    | 6                    | —                          | 6           | —      |
|                          | C         | 1TP1        | BK                    | 7                    | —                          | —           | 7      |
|                          | D         | 1TP2        | WH                    | 8                    | —                          | —           | 8      |
|                          | ⊕         | PE          | GNYE                  | GNYE                 | 4                          | —           | —      |
|                          | Housing   | Shield      | —                     | —                    | Shield contact             | —           | —      |

Tab. 2: con.23 power cable pin assignment

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

Tab. 3: con.23 connector dimensions

### 5.3.3 Technical data

#### IP protection class of the plug connectors

The plug connectors meet the IP 66/67 protection class (in accordance with IEC 60529). This information applies if both parts of the plug connector are connected together properly. Plug connectors have to be protected against environmental factors that affect functionality (dust, moisture, etc.) in accordance with the type approval laws.

#### Conductor construction

Ultra-fine stranded wire made of bare Cu wires in accordance with VDE 0295 class 6, table 4, column 3. Internal structure stranded tension-free. The wire structure for conductors with 0.34 mm<sup>2</sup> is based on DIN VDE 0812.

**Voltage****For cables 4 × 1.0 mm<sup>2</sup> to 4 × 4.0 mm<sup>2</sup>**

- Nominal voltage (DIN VDE): supply cores  $U_0/U = 0.6/1.0$  kV
- Voltage (UL/CSA): supply cores 1000 V
- Voltage (UL): pilot cores max. 300 V
- Voltage (CSA): pilot cores max. 1000 V

**Test voltage****For cables 4 × 1.0 mm<sup>2</sup> to 4 × 4.0 mm<sup>2</sup>**

- Core/core and core/shield: supply cores 4000 V
- Core/core and core/shield: pilot cores 2000 V

**Power cores**

|  |      |      |
|--|------|------|
| Conductor cross-section A [mm <sup>2</sup> ] | 1.5  | 2.5  |
| Nominal current $I_N$ [A]                    | 15.0 | 20.0 |

**Current carrying capacity**

In accordance with DIN VDE 0298, part 4, 2013-06, tables 9, 17, 15 and 20; 0.34 mm<sup>2</sup> in accordance with DIN VDE 0891, part 1

**Pilot cores – brake lines and temperature sensor**

|  |     |      |
|--|-----|------|
| Conductor cross-section A [mm <sup>2</sup> ] | 0.5 | 1.0  |
| Nominal current $I_N$ [A]                    | 5.0 | 12.5 |

**Insulation resistance at 20 °C**

Min. 100 MΩ × km

**Limit temperature**

| Temperature range/<br>Operating mode | DIN VDE          | UL/CSA       |
|--------------------------------------|------------------|--------------|
| Not in motion                        | -50 °C to +90 °C | Up to +80 °C |
| In motion                            | -40 °C to +90 °C | Up to +80 °C |

**Max. tensile stress when being laid**

50 N for each mm<sup>2</sup> of conductor cross-section

**Torsional stress**

± 30°/m

**Bending resistance**

Trailable with 5 million bending cycles at a travel speed of 120 m/min and an acceleration of 5 m/s<sup>2</sup> under optimum ambient conditions

**Resistance**

- Oil resistant: very good in accordance with VDE 0282, part 10+HD 22.10
- Chemical: good against acids, bases, solvents, hydraulic fluids, etc.; more detailed information on request

**Outer sheath**

PUR (TMPU in accordance with DIN VDE 0282, part 10)

**Banding**

Fleece tape with overlapping

**Core insulation**

TPE-E

**Marking**

- Conductors: black with numbers printed in white (1; 2; 3; yellow/green for PE; (5; 6 thick pair); (7; 8 thin pair))
- Sheath: color based on DESINA, similar to RAL 2003 with additional imprint "STÖBER 49893" for 1.0 mm<sup>2</sup>; "STÖBER 44211" for 1.5 mm<sup>2</sup>; with imprint of cable manufacturer (not STÖBER) starting from 4 × 2.5 +... mm<sup>2</sup>

**Shield coverage factor**

Braiding min. 80% (Cu, tinned); control pairs with shielding film and braiding

**Insulation material**

Halogen-free, silicone-free, PWIS non-critical (PWIS = free of paint-wetting impairment substances)

**Flammability**

Combustion behavior: flame retarding and self-extinguishing in accordance with IEC 60322-1, CSA FT1 and UL FT1

**RoHS conformity**

Free of hazardous substances according to the RoHS-2 2011/65/EU Directive

**Conductor cross-sections**

| Cable diameter | Description  |
|----------------|--|
| Max. 12.7 mm   | (4 × 1.5 + (2 × 1.0) + (2 × 0.50)) mm <sup>2</sup> |
| Max. 15.3 mm   | (4 × 2.5 + 2 × (2 × 1.0)) mm <sup>2</sup>          |

"(...)" = shield; other cross-sections on request

**Design**

UL/CSA (E172204)

**Capacitance, inductance**

| Capacitance in accordance with VDE 0472 part 504 test type A; core/core <sup>1</sup>      |                |
|---|----------------|
| <b>Conductor cross-section 1.5 mm<sup>2</sup>:</b>  |                |
| Core 1.5 mm <sup>2</sup>  | Max. 55 nF/km  |
| Pair 1.0 mm <sup>2</sup>  | Max. 70 nF/km  |
| Pair 0.5 mm <sup>2</sup>  | Max. 50 nF/km  |
| <b>Conductor cross-section 2.5 mm<sup>2</sup>:</b>  |                |
| Core 2.5 mm <sup>2</sup>  | Max. 65 nF/km  |
| Pair 1.0 mm <sup>2</sup>  | Max. 60 nF/km  |
| Capacitance in accordance with VDE 0472 part 504 test type B; core/remainder <sup>2</sup> |                |
| <b>Conductor cross-section 1.5 mm<sup>2</sup>:</b>  |                |
| Core 1.5 mm <sup>2</sup>  | Max. 300 nF/km |
| Pair 1.0 mm <sup>2</sup>  | Max. 550 nF/km |
| Pair 0.5 mm <sup>2</sup>  | Max. 450 nF/km |
| <b>Conductor cross-section 2.5 mm<sup>2</sup>:</b>  |                |
| Core 2.5 mm <sup>2</sup>  | Max. 325 nF/km |
| Pair 1.0 mm <sup>2</sup>  | Max. 600 nF/km |
| Inductance in accordance with EN 50289-1-12:2005; core/core <sup>3</sup>                  |                |
| <b>Conductor cross-section 1.5 mm<sup>2</sup>:</b>  |                |
| Core 1.5 mm <sup>2</sup>  | Max. 700 µH/km |
| Pair 1.0 mm <sup>2</sup>  | Max. 700 µH/km |
| Pair 0.5 mm <sup>2</sup>  | Max. 650 µH/km |
| <b>Conductor cross-section 2.5 mm<sup>2</sup>:</b>  |                |
| Core 2.5 mm <sup>2</sup>  | Max. 700 µH/km |
| Pair 1.0 mm <sup>2</sup>  | Max. 650 µH/km |

<sup>1</sup>Details in accordance with EN 50289-1-5:2001 in preparation

<sup>2</sup>Details in accordance with EN 50289-1-5:2001 in preparation

<sup>3</sup>Details in accordance with EN 50289-1-5:2001 in preparation

## 5.4 Additional documentation

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

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

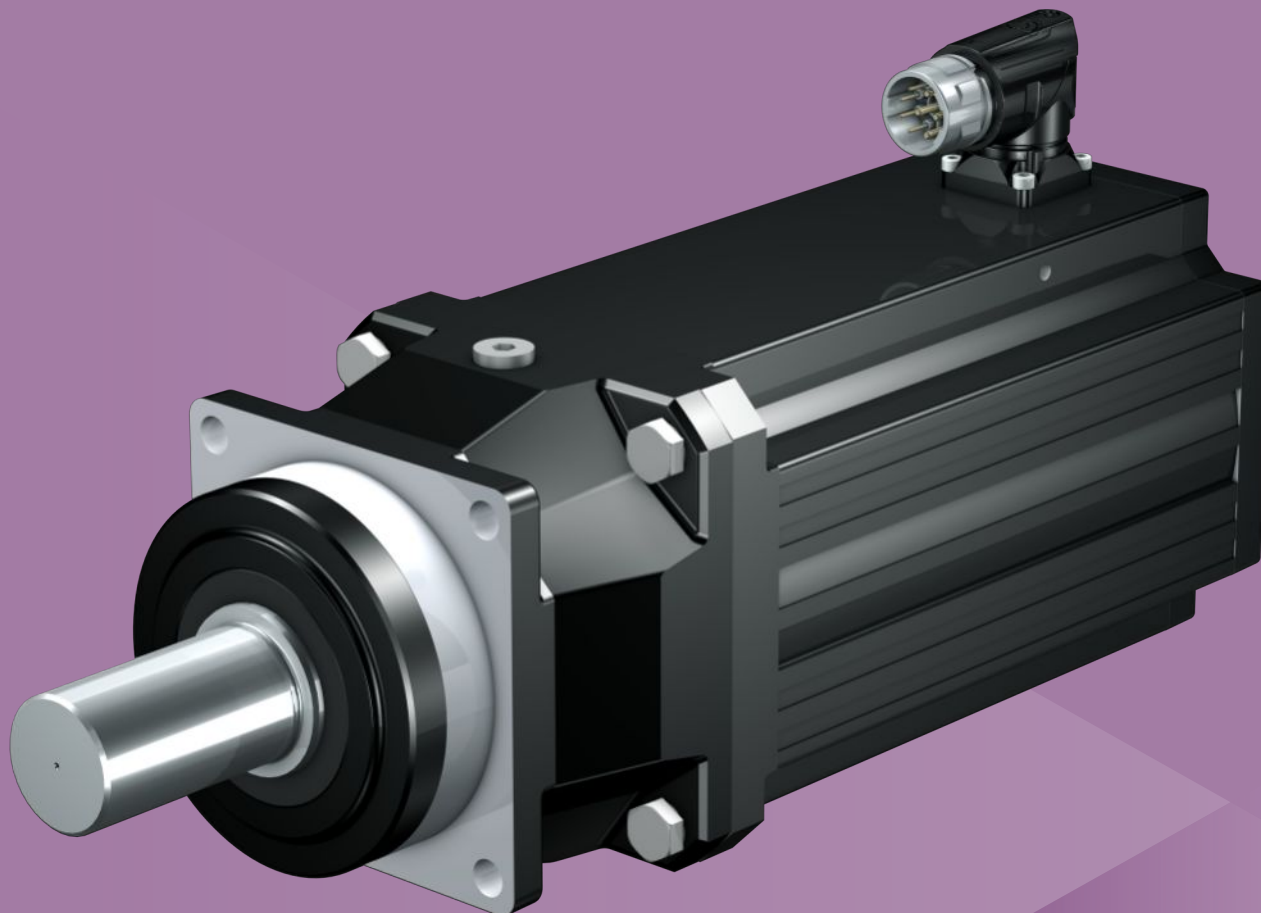
| Documentation            | ID     |
|--------------------------|--------|
| Connection method manual | 443102 |



## 6 P planetary geared motors

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## 6 Planetary geared motors

P

### 6.1 Overview

Helical-gear 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 – 56       |
| $M_{2acc}$     | 13 – 1600 Nm |
| $\Delta\phi_2$ | 3 – 5 arcmin |
| $\eta_{get}$   | ≤ 97 %       |



## 6.2 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

For all other technical data, refer to <http://configurator.stoeber.de>.

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#)].

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{in}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1max}$  | $n_{1max}$  | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|-------------|-------------|---|----------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | DB<br>[rpm] | ZB<br>[rpm] | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>P3 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 60</math> Nm)</b>  |          |           |          |      |                  |            |            |       |             |             |             |   |                |                 |      |
| 300  | 22       | 24        | 1.3      | 1.2  | P321_0100 LM401U | 44         | 100        | 10.00 | 10/1        | 4500        | 8000        | 1.7                                     | 4              | 4.0             | 5.9  |
| 375  | 17       | 19        | 1.3      | 2.0  | P321_0080 LM401U | 35         | 100        | 8.000 | 8/1         | 4500        | 8000        | 1.7                                     | 4              | 4.2             | 5.9  |
| 375  | 34       | 35        | 2.6      | 1.0  | P321_0080 LM402U | 50         | 100        | 8.000 | 8/1         | 4500        | 8000        | 3.0                                     | 4              | 4.2             | 7.5  |
| 429  | 15       | 17        | 1.4      | 2.6  | P321_0070 LM401U | 31         | 130        | 7.000 | 7/1         | 4500        | 8000        | 1.7                                     | 4              | 4.4             | 5.9  |
| 429  | 30       | 31        | 2.7      | 1.3  | P321_0070 LM402U | 60         | 130        | 7.000 | 7/1         | 4500        | 8000        | 3.0                                     | 4              | 4.4             | 7.5  |
| 600  | 11       | 12        | 2.1      | 3.6  | P321_0050 LM401U | 22         | 110        | 5.000 | 5/1         | 4000        | 7000        | 1.7                                     | 4              | 5.1             | 5.9  |
| 600  | 21       | 22        | 4.0      | 1.8  | P321_0050 LM402U | 47         | 110        | 5.000 | 5/1         | 4000        | 7000        | 3.1                                     | 4              | 5.1             | 7.5  |
| 750  | 8.7      | 9.4       | 2.7      | 4.5  | P321_0040 LM401U | 17         | 85         | 4.000 | 4/1         | 3700        | 6500        | 1.8                                     | 4              | 5.3             | 5.9  |
| 750  | 17       | 17        | 5.3      | 2.3  | P321_0040 LM402U | 38         | 85         | 4.000 | 4/1         | 3700        | 6500        | 3.1                                     | 4              | 5.3             | 7.5  |
| 1000   | 6.5      | 7.1       | 5.7      | 4.0  | P321_0030 LM401U | 13         | 64         | 3.000 | 3/1         | 3500        | 6000        | 1.9                                     | 4              | 5.7             | 5.9  |
| 1000   | 13       | 13        | 11       | 2.0  | P321_0030 LM402U | 28         | 64         | 3.000 | 3/1         | 3500        | 6000        | 3.2                                     | 4              | 5.7             | 7.5  |
| <b>P4 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 120</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |             |             |   |                |                 |      |
| 75   | 86       | 92        | 2.1      | 0.99 | P422_0400 LM401U | 120        | 240        | 40.00 | 40/1        | 4500        | 8000        | 1.7                                     | 5              | 10              | 8.9  |
| 86   | 75       | 81        | 2.3      | 1.1  | P422_0350 LM401U | 120        | 240        | 35.00 | 35/1        | 4500        | 8000        | 1.7                                     | 5              | 11              | 8.9  |
| 94   | 68       | 74        | 2.6      | 1.2  | P422_0320 LM401U | 100        | 200        | 32.00 | 32/1        | 3700        | 6500        | 1.8                                     | 5              | 9.2             | 8.9  |
| 107  | 60       | 65        | 2.6      | 1.4  | P422_0280 LM401U | 120        | 240        | 28.00 | 28/1        | 4500        | 8000        | 1.7                                     | 5              | 10              | 8.9  |
| 120  | 53       | 58        | 2.7      | 1.6  | P422_0250 LM401U | 110        | 240        | 25.00 | 25/1        | 4000        | 7000        | 1.8                                     | 5              | 11              | 8.9  |
| 120  | 105      | 107       | 5.3      | 0.81 | P422_0250 LM402U | 120        | 240        | 25.00 | 25/1        | 4000        | 7000        | 3.1                                     | 5              | 11              | 11   |
| 150  | 43       | 46        | 3.0      | 2.0  | P422_0200 LM401U | 86         | 240        | 20.00 | 20/1        | 3700        | 6500        | 1.8                                     | 5              | 11              | 8.9  |
| 150  | 84       | 86        | 6.0      | 1.0  | P422_0200 LM402U | 120        | 240        | 20.00 | 20/1        | 3700        | 6500        | 3.1                                     | 5              | 11              | 11   |
| 188  | 34       | 37        | 3.4      | 2.5  | P422_0160 LM401U | 69         | 240        | 16.00 | 16/1        | 3700        | 6500        | 1.8                                     | 5              | 11              | 8.9  |
| 188  | 67       | 68        | 6.7      | 1.3  | P422_0160 LM402U | 120        | 240        | 16.00 | 16/1        | 3700        | 6500        | 3.2                                     | 5              | 11              | 11   |
| 250  | 26       | 28        | 6.7      | 1.9  | P422_0120 LM401U | 51         | 240        | 12.00 | 12/1        | 3500        | 6500        | 1.8                                     | 5              | 9.9             | 8.9  |
| 250  | 50       | 51        | 13       | 1.0  | P422_0120 LM402U | 100        | 240        | 12.00 | 12/1        | 3500        | 6500        | 3.2                                     | 5              | 9.9             | 11   |
| 300  | 43       | 44        | 1.6      | 1.2  | P421_0100 LM402U | 94         | 200        | 10.00 | 10/1        | 4000        | 7000        | 3.1                                     | 4              | 9.0             | 8.7  |
| 300  | 59       | 60        | 2.2      | 0.89 | P421_0100 LM403U | 100        | 200        | 10.00 | 10/1        | 4000        | 7000        | 4.4                                     | 4              | 9.0             | 10   |
| 375  | 34       | 35        | 1.6      | 2.0  | P421_0080 LM402U | 75         | 200        | 8.000 | 8/1         | 4000        | 7000        | 3.1                                     | 4              | 9.5             | 8.7  |
| 375  | 47       | 48        | 2.2      | 1.5  | P421_0080 LM403U | 100        | 200        | 8.000 | 8/1         | 4000        | 7000        | 4.4                                     | 4              | 9.5             | 10   |
| 429  | 30       | 31        | 1.7      | 2.5  | P421_0070 LM402U | 66         | 240        | 7.000 | 7/1         | 4000        | 7000        | 3.1                                     | 4              | 10              | 8.7  |
| 429  | 41       | 42        | 2.4      | 1.8  | P421_0070 LM403U | 87         | 240        | 7.000 | 7/1         | 4000        | 7000        | 4.4                                     | 4              | 10              | 10   |
| 600  | 21       | 22        | 2.6      | 3.5  | P421_0050 LM402U | 47         | 240        | 5.000 | 5/1         | 3700        | 6500        | 3.2                                     | 4              | 12              | 8.7  |
| 600  | 29       | 30        | 3.6      | 2.5  | P421_0050 LM403U | 62         | 240        | 5.000 | 5/1         | 3700        | 6500        | 4.5                                     | 4              | 12              | 10   |
| 600  | 46       | 49        | 5.6      | 1.6  | P421_0050 LM503U | 99         | 240        | 5.000 | 5/1         | 3700        | 6500        | 11                                      | 4              | 12              | 13   |
| 600  | 66       | 75        | 8.1      | 1.1  | P421_0050 LM505U | 120        | 240        | 5.000 | 5/1         | 3700        | 6500        | 17                                      | 4              | 12              | 18   |
| 750  | 17       | 17        | 3.4      | 4.3  | P421_0040 LM402U | 38         | 240        | 4.000 | 4/1         | 3300        | 6000        | 3.3                                     | 4              | 12              | 8.7  |
| 750  | 24       | 24        | 4.7      | 3.2  | P421_0040 LM403U | 50         | 240        | 4.000 | 4/1         | 3300        | 6000        | 4.6                                     | 4              | 12              | 10   |
| 750  | 37       | 39        | 7.3      | 2.0  | P421_0040 LM503U | 79         | 240        | 4.000 | 4/1         | 3300        | 6000        | 11                                      | 4              | 12              | 13   |
| 750  | 53       | 60        | 11       | 1.4  | P421_0040 LM505U | 120        | 240        | 4.000 | 4/1         | 3300        | 6000        | 17                                      | 4              | 12              | 18   |
| 1000   | 13       | 13        | 8.2      | 3.4  | P421_0030 LM402U | 28         | 240        | 3.000 | 3/1         | 3000        | 5500        | 3.7                                     | 4              | 13              | 8.7  |
| 1000   | 18       | 18        | 11       | 2.5  | P421_0030 LM403U | 37         | 240        | 3.000 | 3/1         | 3000        | 5500        | 5.0                                     | 4              | 13              | 10   |
| 1000   | 28       | 29        | 18       | 1.6  | P421_0030 LM503U | 59         | 240        | 3.000 | 3/1         | 3000        | 5500        | 11                                      | 4              | 13              | 13   |
| 1000   | 40       | 45        | 25       | 1.1  | P421_0030 LM505U | 93         | 240        | 3.000 | 3/1         | 3000        | 5500        | 17                                      | 4              | 13              | 18   |
| <b>P5 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 300</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |             |             |   |                |                 |      |
| 54   | 235      | 239       | 1.7      | 0.85 | P522_0560 LM402U | 250        | 500        | 56.00 | 56/1        | 4000        | 7000        | 3.1                                     | 4              | 25              | 13   |
| 60   | 209      | 214       | 1.7      | 1.0  | P522_0500 LM402U | 300        | 600        | 50.00 | 50/1        | 4000        | 7000        | 3.1                                     | 4              | 27              | 13   |
| 75   | 168      | 171       | 2.0      | 1.2  | P522_0400 LM402U | 300        | 600        | 40.00 | 40/1        | 4000        | 7000        | 3.1                                     | 4              | 26              | 13   |
| 75   | 230      | 235       | 2.7      | 0.88 | P522_0400 LM403U | 300        | 600        | 40.00 | 40/1        | 4000        | 7000        | 4.4                                     | 4              | 26              | 15   |
| 86   | 147      | 150       | 2.0      | 1.4  | P522_0350 LM402U | 300        | 600        | 35.00 | 35/1        | 4000        | 7000        | 3.1                                     | 4              | 28              | 13   |
| 86   | 201      | 206       | 2.8      | 1.0  | P522_0350 LM403U | 300        | 600        | 35.00 | 35/1        | 4000        | 7000        | 4.4                                     | 4              | 28              | 15   |
| 94   | 134      | 137       | 2.2      | 1.5  | P522_0320 LM402U | 250        | 500        | 32.00 | 32/1        | 3300        | 6000        | 3.3                                     | 4              | 25              | 13   |
| 94   | 184      | 188       | 3.1      | 1.1  | P522_0320 LM403U | 250        | 500        | 32.00 | 32/1        | 3300        | 6000        | 4.6                                     | 4              | 25              | 15   |
| 107  | 117      | 120       | 2.3      | 1.8  | P522_0280 LM402U | 260        | 600        | 28.00 | 28/1        | 4000        | 7000        | 3.1                                     | 4              | 27              | 13   |
| 107  | 161      | 165       | 3.1      | 1.3  | P522_0280 LM403U | 300        | 600        | 28.00 | 28/1        | 4000        | 7000        | 4.4                                     | 4              | 27              | 15   |

6.2 Selection tables 6 P planetary geared motors

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1max}$ | $n_{1max}$ | $J_1$              | $\Delta\phi_2$ | $C_2$   | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|------------|------------|--------------------|----------------|---------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | DB         | ZB         | [10 <sup>-4</sup>  | [arcmin]       | [Nm/    | [kg] |
|  |          |           |          |      |                  |            |            |       |             | [rpm]      | [rpm]      | kgm <sup>2</sup> ] |                | arcmin] |      |
| <b>P5 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 300</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |            |            |                    |                |         |      |
| 120  | 105      | 107       | 2.4      | 2.0  | P522_0250 LM402U | 230        | 600        | 25.00 | 25/1        | 3700       | 6500       | 3.2                | 4              | 28      | 13   |
| 120  | 144      | 147       | 3.3      | 1.5  | P522_0250 LM403U | 300        | 600        | 25.00 | 25/1        | 3700       | 6500       | 4.5                | 4              | 28      | 15   |
| 120  | 225      | 239       | 5.1      | 0.93 | P522_0250 LM503U | 300        | 600        | 25.00 | 25/1        | 3700       | 6500       | 11                 | 4              | 28      | 18   |
| 150  | 84       | 86        | 2.7      | 2.5  | P522_0200 LM402U | 180        | 600        | 20.00 | 20/1        | 3300       | 6000       | 3.3                | 4              | 28      | 13   |
| 150  | 115      | 118       | 3.7      | 1.8  | P522_0200 LM403U | 240        | 600        | 20.00 | 20/1        | 3300       | 6000       | 4.6                | 4              | 28      | 15   |
| 150  | 180      | 191       | 5.8      | 1.2  | P522_0200 LM503U | 300        | 600        | 20.00 | 20/1        | 3300       | 6000       | 11                 | 4              | 28      | 18   |
| 150  | 260      | 294       | 8.3      | 0.81 | P522_0200 LM505U | 300        | 600        | 20.00 | 20/1        | 3300       | 6000       | 17                 | 4              | 28      | 22   |
| 188  | 67       | 68        | 3.0      | 3.1  | P522_0160 LM402U | 150        | 600        | 16.00 | 16/1        | 3300       | 6000       | 3.4                | 4              | 28      | 13   |
| 188  | 92       | 94        | 4.1      | 2.3  | P522_0160 LM403U | 200        | 600        | 16.00 | 16/1        | 3300       | 6000       | 4.7                | 4              | 28      | 15   |
| 188  | 144      | 153       | 6.4      | 1.5  | P522_0160 LM503U | 300        | 600        | 16.00 | 16/1        | 3300       | 6000       | 11                 | 4              | 28      | 18   |
| 188  | 208      | 235       | 9.3      | 1.0  | P522_0160 LM505U | 300        | 600        | 16.00 | 16/1        | 3300       | 6000       | 17                 | 4              | 28      | 22   |
| 250  | 50       | 51        | 6.0      | 2.4  | P522_0120 LM402U | 110        | 460        | 12.00 | 12/1        | 3000       | 6000       | 3.4                | 4              | 27      | 13   |
| 250  | 69       | 71        | 8.3      | 1.7  | P522_0120 LM403U | 150        | 460        | 12.00 | 12/1        | 3000       | 6000       | 4.7                | 4              | 27      | 15   |
| 250  | 108      | 115       | 13       | 1.1  | P522_0120 LM503U | 200        | 460        | 12.00 | 12/1        | 3000       | 6000       | 11                 | 4              | 27      | 18   |
| 300  | 92       | 98        | 4.0      | 1.3  | P521_0100 LM503U | 200        | 500        | 10.00 | 10/1        | 3700       | 6500       | 11                 | 3              | 25      | 15   |
| 300  | 133      | 150       | 5.8      | 0.92 | P521_0100 LM505U | 250        | 500        | 10.00 | 10/1        | 3700       | 6500       | 17                 | 3              | 25      | 19   |
| 375  | 74       | 78        | 3.7      | 2.4  | P521_0080 LM503U | 160        | 500        | 8.000 | 8/1         | 3700       | 6500       | 11                 | 3              | 26      | 15   |
| 375  | 106      | 120       | 5.3      | 1.6  | P521_0080 LM505U | 250        | 500        | 8.000 | 8/1         | 3700       | 6500       | 17                 | 3              | 26      | 19   |
| 429  | 64       | 68        | 4.1      | 2.9  | P521_0070 LM503U | 140        | 600        | 7.000 | 7/1         | 3700       | 6500       | 11                 | 3              | 28      | 15   |
| 429  | 93       | 105       | 6.0      | 2.0  | P521_0070 LM505U | 220        | 600        | 7.000 | 7/1         | 3700       | 6500       | 17                 | 3              | 28      | 19   |
| 600  | 46       | 49        | 6.2      | 4.0  | P521_0050 LM503U | 99         | 430        | 5.000 | 5/1         | 3500       | 6000       | 11                 | 3              | 31      | 15   |
| 600  | 66       | 75        | 8.9      | 2.8  | P521_0050 LM505U | 160        | 430        | 5.000 | 5/1         | 3500       | 6000       | 17                 | 3              | 31      | 19   |
| 600  | 93       | 103       | 13       | 2.0  | P521_0050 LM704U | 200        | 600        | 5.000 | 5/1         | 3500       | 6000       | 37                 | 3              | 31      | 25   |
| 600  | 125      | 145       | 17       | 1.5  | P521_0050 LM706U | 300        | 600        | 5.000 | 5/1         | 3500       | 6000       | 54                 | 3              | 31      | 32   |
| 750  | 37       | 39        | 8.1      | 5.0  | P521_0040 LM503U | 79         | 350        | 4.000 | 4/1         | 3000       | 5000       | 11                 | 3              | 32      | 15   |
| 750  | 53       | 60        | 12       | 3.5  | P521_0040 LM505U | 120        | 350        | 4.000 | 4/1         | 3000       | 5000       | 18                 | 3              | 32      | 19   |
| 750  | 75       | 82        | 16       | 2.5  | P521_0040 LM704U | 160        | 600        | 4.000 | 4/1         | 3000       | 5000       | 38                 | 3              | 32      | 25   |
| 750  | 100      | 116       | 22       | 1.8  | P521_0040 LM706U | 240        | 600        | 4.000 | 4/1         | 3000       | 5000       | 55                 | 3              | 32      | 32   |
| 1000   | 28       | 29        | 20       | 3.8  | P521_0030 LM503U | 59         | 260        | 3.000 | 3/1         | 2500       | 4500       | 13                 | 3              | 36      | 15   |
| 1000   | 40       | 45        | 29       | 2.6  | P521_0030 LM505U | 93         | 260        | 3.000 | 3/1         | 2500       | 4500       | 20                 | 3              | 36      | 19   |
| 1000   | 56       | 62        | 41       | 1.9  | P521_0030 LM704U | 120        | 460        | 3.000 | 3/1         | 2500       | 4500       | 39                 | 3              | 36      | 25   |
| 1000   | 75       | 87        | 54       | 1.4  | P521_0030 LM706U | 180        | 460        | 3.000 | 3/1         | 2500       | 4500       | 57                 | 3              | 36      | 32   |
| <b>P7 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 700</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |            |            |                    |                |         |      |
| 60   | 450      | 478       | 2.1      | 0.98 | P722_0500 LM503U | 700        | 1400       | 50.00 | 50/1        | 3700       | 6500       | 11                 | 4              | 53      | 23   |
| 75   | 360      | 383       | 2.3      | 1.2  | P722_0400 LM503U | 700        | 1380       | 40.00 | 40/1        | 3700       | 6500       | 11                 | 4              | 52      | 23   |
| 75   | 521      | 588       | 3.4      | 0.85 | P722_0400 LM505U | 700        | 1380       | 40.00 | 40/1        | 3700       | 6500       | 17                 | 4              | 52      | 28   |
| 86   | 315      | 335       | 2.5      | 1.4  | P722_0350 LM503U | 680        | 1400       | 35.00 | 35/1        | 3700       | 6500       | 11                 | 4              | 53      | 23   |
| 86   | 456      | 514       | 3.6      | 0.97 | P722_0350 LM505U | 700        | 1400       | 35.00 | 35/1        | 3700       | 6500       | 17                 | 4              | 53      | 28   |
| 94   | 288      | 306       | 2.9      | 1.4  | P722_0320 LM503U | 500        | 1000       | 32.00 | 32/1        | 3000       | 5000       | 11                 | 4              | 52      | 23   |
| 94   | 416      | 470       | 4.1      | 0.96 | P722_0320 LM505U | 500        | 1000       | 32.00 | 32/1        | 3000       | 5000       | 18                 | 4              | 52      | 28   |
| 107  | 252      | 268       | 2.8      | 1.7  | P722_0280 LM503U | 540        | 1380       | 28.00 | 28/1        | 3700       | 6500       | 11                 | 4              | 53      | 23   |
| 107  | 364      | 412       | 4.0      | 1.2  | P722_0280 LM505U | 700        | 1380       | 28.00 | 28/1        | 3700       | 6500       | 17                 | 4              | 53      | 28   |
| 120  | 225      | 239       | 2.9      | 2.0  | P722_0250 LM503U | 480        | 1400       | 25.00 | 25/1        | 3500       | 6000       | 11                 | 4              | 54      | 23   |
| 120  | 325      | 367       | 4.3      | 1.4  | P722_0250 LM505U | 700        | 1400       | 25.00 | 25/1        | 3500       | 6000       | 17                 | 4              | 54      | 28   |
| 120  | 458      | 505       | 6.0      | 0.96 | P722_0250 LM704U | 700        | 1400       | 25.00 | 25/1        | 3500       | 6000       | 37                 | 4              | 54      | 34   |
| 150  | 180      | 191       | 3.3      | 2.4  | P722_0200 LM503U | 390        | 1400       | 20.00 | 20/1        | 3000       | 5000       | 11                 | 4              | 54      | 23   |
| 150  | 260      | 294       | 4.8      | 1.7  | P722_0200 LM505U | 610        | 1400       | 20.00 | 20/1        | 3000       | 5000       | 18                 | 4              | 54      | 28   |
| 150  | 366      | 404       | 6.7      | 1.2  | P722_0200 LM704U | 700        | 1400       | 20.00 | 20/1        | 3000       | 5000       | 37                 | 4              | 54      | 34   |
| 150  | 488      | 566       | 8.9      | 0.90 | P722_0200 LM706U | 700        | 1400       | 20.00 | 20/1        | 3000       | 5000       | 55                 | 4              | 54      | 41   |
| 188  | 144      | 153       | 3.7      | 3.1  | P722_0160 LM503U | 310        | 1340       | 16.00 | 16/1        | 3000       | 5000       | 12                 | 4              | 54      | 23   |
| 188  | 208      | 235       | 5.3      | 2.1  | P722_0160 LM505U | 490        | 1340       | 16.00 | 16/1        | 3000       | 5000       | 18                 | 4              | 54      | 28   |
| 188  | 293      | 323       | 7.5      | 1.5  | P722_0160 LM704U | 630        | 1380       | 16.00 | 16/1        | 3000       | 5000       | 38                 | 4              | 54      | 34   |
| 188  | 390      | 453       | 10       | 1.1  | P722_0160 LM706U | 700        | 1380       | 16.00 | 16/1        | 3000       | 5000       | 55                 | 4              | 54      | 41   |
| 250  | 108      | 115       | 6.7      | 2.6  | P722_0120 LM503U | 230        | 1000       | 12.00 | 12/1        | 2500       | 5000       | 12                 | 4              | 53      | 23   |
| 250  | 156      | 176       | 9.7      | 1.8  | P722_0120 LM505U | 370        | 1000       | 12.00 | 12/1        | 2500       | 5000       | 18                 | 4              | 53      | 28   |
| 250  | 220      | 242       | 14       | 1.3  | P722_0120 LM704U | 470        | 1040       | 12.00 | 12/1        | 2500       | 5000       | 38                 | 4              | 53      | 34   |
| 250  | 293      | 340       | 18       | 0.96 | P722_0120 LM706U | 500        | 1040       | 12.00 | 12/1        | 2500       | 5000       | 55                 | 4              | 53      | 41   |
| 300  | 187      | 206       | 4.6      | 1.4  | P721_0100 LM704U | 400        | 1000       | 10.00 | 10/1        | 3300       | 6000       | 37                 | 3              | 50      | 29   |
| 300  | 249      | 289       | 6.1      | 1.1  | P721_0100 LM706U | 500        | 1000       | 10.00 | 10/1        | 3300       | 6000       | 54                 | 3              | 50      | 36   |
| 375  | 150      | 165       | 4.5      | 2.3  | P721_0080 LM704U | 320        | 1000       | 8.000 | 8/1         | 3300       | 6000       | 37                 | 3              | 53      | 29   |
| 375  | 199      | 231       | 6.0      | 1.8  | P721_0080 LM706U | 480        | 1000       | 8.000 | 8/1         | 3300       | 6000       | 55                 | 3              | 53      | 36   |
| 429  | 131      | 144       | 4.8      | 2.9  | P721_0070 LM704U | 280        | 1250       | 7.000 | 7/1         | 3300       | 6000       | 37                 | 3              | 55      | 29   |
| 429  | 174      | 202       | 6.4      | 2.2  | P721_0070 LM706U | 420        | 1250       | 7.000 | 7/1         | 3300       | 6000       | 55                 | 3              | 55      | 36   |
| 600  | 93       | 103       | 7.2      | 4.1  | P721_0050 LM704U | 200        | 900        | 5.000 | 5/1         | 3000       | 5500       | 38                 | 3              | 58      | 29   |

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1max}$  | $n_{1max}$  | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|-------------|-------------|---|----------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | DB<br>[rpm] | ZB<br>[rpm] | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>P7 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 700</math> Nm)</b>  |          |           |          |      |                  |            |            |       |             |             |             |   |                |                 |      |
| 600   | 125      | 145       | 9.6      | 3.1  | P721_0050 LM706U | 300        | 900        | 5.000 | 5/1         | 3000        | 5500        | 56                                      | 3              | 58              | 36   |
| 750   | 100      | 116       | 13       | 3.9  | P721_0040 LM706U | 240        | 720        | 4.000 | 4/1         | 2500        | 4500        | 57                                      | 3              | 60              | 36   |
| 1000  | 56       | 62        | 21       | 4.4  | P721_0030 LM704U | 120        | 540        | 3.000 | 3/1         | 2200        | 3700        | 45                                      | 3              | 65              | 29   |
| 1000  | 75       | 87        | 28       | 3.3  | P721_0030 LM706U | 180        | 540        | 3.000 | 3/1         | 2200        | 3700        | 62                                      | 3              | 65              | 36   |
| <b>P8 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 1600</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |             |             |   |                |                 |      |
| 60  | 915      | 1010      | 2.0      | 1.1  | P822_0500 LM704U | 1600       | 3200       | 50.00 | 50/1        | 3300        | 6000        | 37                                      | 4              | 168             | 49   |
| 60  | 1219     | 1416      | 2.7      | 0.82 | P822_0500 LM706U | 1600       | 3200       | 50.00 | 50/1        | 3300        | 6000        | 54                                      | 4              | 168             | 56   |
| 75  | 732      | 808       | 2.8      | 1.1  | P822_0400 LM704U | 1560       | 3180       | 40.00 | 40/1        | 3300        | 6000        | 37                                      | 4              | 163             | 49   |
| 75  | 975      | 1132      | 3.8      | 0.82 | P822_0400 LM706U | 1600       | 3180       | 40.00 | 40/1        | 3300        | 6000        | 54                                      | 4              | 163             | 56   |
| 86  | 641      | 707       | 2.4      | 1.6  | P822_0350 LM704U | 1370       | 3200       | 35.00 | 35/1        | 3300        | 6000        | 38                                      | 4              | 170             | 49   |
| 86  | 854      | 991       | 3.2      | 1.2  | P822_0350 LM706U | 1600       | 3200       | 35.00 | 35/1        | 3300        | 6000        | 55                                      | 4              | 170             | 56   |
| 94  | 586      | 646       | 3.2      | 1.4  | P822_0320 LM704U | 1200       | 2400       | 32.00 | 32/1        | 2500        | 4500        | 40                                      | 4              | 159             | 49   |
| 94  | 780      | 906       | 4.2      | 1.0  | P822_0320 LM706U | 1200       | 2400       | 32.00 | 32/1        | 2500        | 4500        | 57                                      | 4              | 159             | 56   |
| 107   | 513      | 566       | 3.4      | 1.6  | P822_0280 LM704U | 1100       | 3180       | 28.00 | 28/1        | 3300        | 6000        | 38                                      | 4              | 166             | 49   |
| 107   | 683      | 793       | 4.5      | 1.2  | P822_0280 LM706U | 1600       | 3180       | 28.00 | 28/1        | 3300        | 6000        | 55                                      | 4              | 166             | 56   |
| 120   | 458      | 505       | 2.9      | 2.2  | P822_0250 LM704U | 980        | 3200       | 25.00 | 25/1        | 3000        | 5500        | 39                                      | 4              | 171             | 49   |
| 120   | 610      | 708       | 3.8      | 1.6  | P822_0250 LM706U | 1460       | 3200       | 25.00 | 25/1        | 3000        | 5500        | 56                                      | 4              | 171             | 56   |
| 150   | 366      | 404       | 3.2      | 2.7  | P822_0200 LM704U | 780        | 3200       | 20.00 | 20/1        | 2500        | 4500        | 40                                      | 4              | 172             | 49   |
| 150   | 488      | 566       | 4.3      | 2.1  | P822_0200 LM706U | 1170       | 3200       | 20.00 | 20/1        | 2500        | 4500        | 57                                      | 4              | 172             | 56   |
| 188   | 293      | 323       | 4.5      | 2.7  | P822_0160 LM704U | 630        | 2790       | 16.00 | 16/1        | 2500        | 4500        | 41                                      | 4              | 169             | 49   |
| 188   | 390      | 453       | 5.9      | 2.1  | P822_0160 LM706U | 930        | 2790       | 16.00 | 16/1        | 2500        | 4500        | 58                                      | 4              | 169             | 56   |
| 250   | 220      | 242       | 5.2      | 3.6  | P822_0120 LM704U | 470        | 2090       | 12.00 | 12/1        | 2200        | 4500        | 42                                      | 4              | 156             | 49   |
| 250   | 293      | 340       | 6.9      | 2.7  | P822_0120 LM706U | 700        | 2090       | 12.00 | 12/1        | 2200        | 4500        | 59                                      | 4              | 156             | 56   |

## 6.3 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 gear unit 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 <http://configurator.stoeber.de>.

Combination options and the dimensions of forced ventilated geared motors can be found at <http://cad.stoeber.de>.

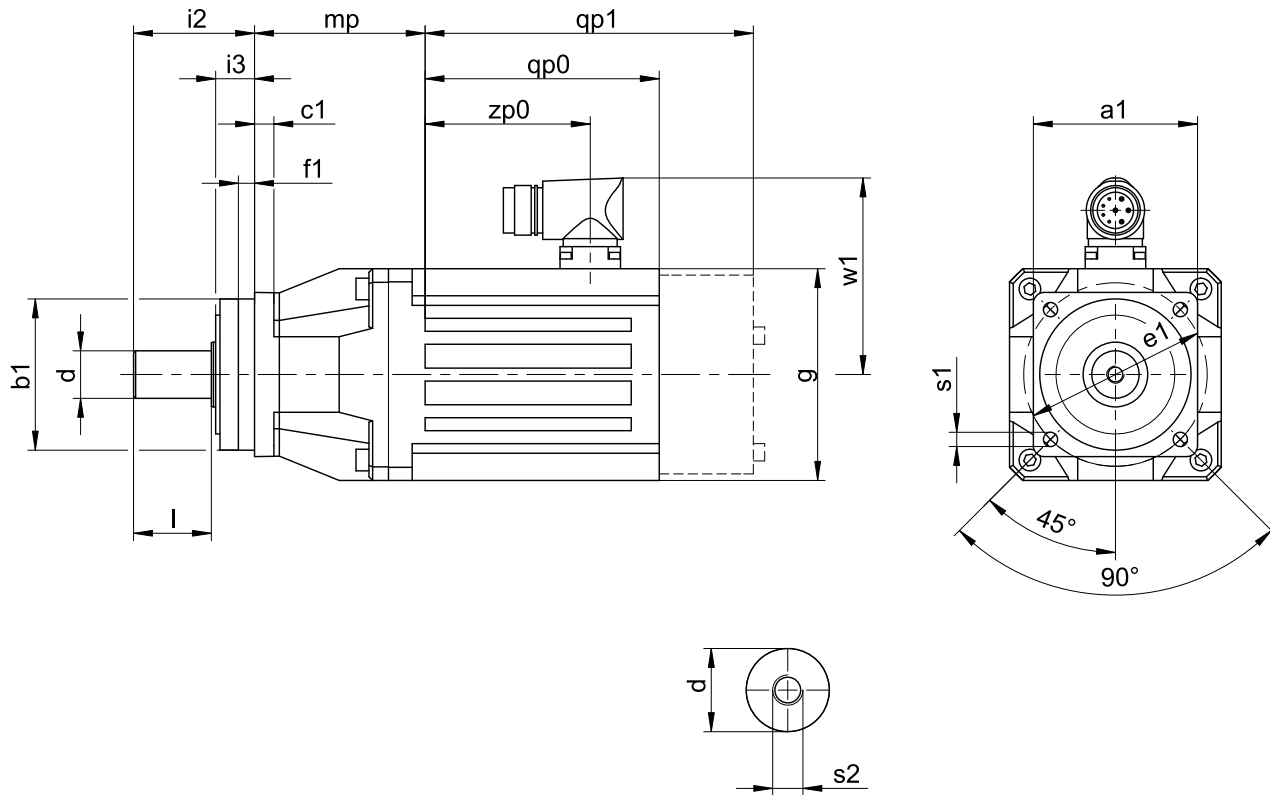
### Tolerances

| Solid shaft                          | Tolerance                              |
|--------------------------------------|--|
| Shaft $\varnothing$ fit $\leq 50$ mm | DIN 748-1, ISO k6                      |
| Shaft $\varnothing$ fit $> 50$ mm    | DIN 748-1, ISO m6                      |
| Feather keys                         | DIN 6885-1, high form A                |
| Balance quality                      | Q 2.5 (balanced 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  |

### 6.3.1 G shaft design (solid shaft without feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

#### Dimensions of gear units

| Type | □a1 | Øb1               | c1 | Ød               | Øe1 | f1   | i2  | i3 | l  | Øs1  | s2  |
|------|-----|-------------------|----|------------------|-----|------|-----|----|----|------|-----|
| P321 | 72  | 60 <sub>h6</sub>  | 7  | 16 <sub>k6</sub> | 75  | 7.5  | 48  | 18 | 28 | 5.5  | M5  |
| P421 | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 36 | 6.6  | M8  |
| P422 | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 36 | 6.6  | M8  |
| P521 | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 58 | 9.0  | M12 |
| P522 | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 58 | 9.0  | M12 |
| P721 | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 82 | 11.0 | M16 |
| P722 | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 82 | 11.0 | M16 |
| P822 | 190 | 160 <sub>h6</sub> | 15 | 55 <sub>k6</sub> | 215 | 10.0 | 112 | 27 | 82 | 13.5 | M20 |

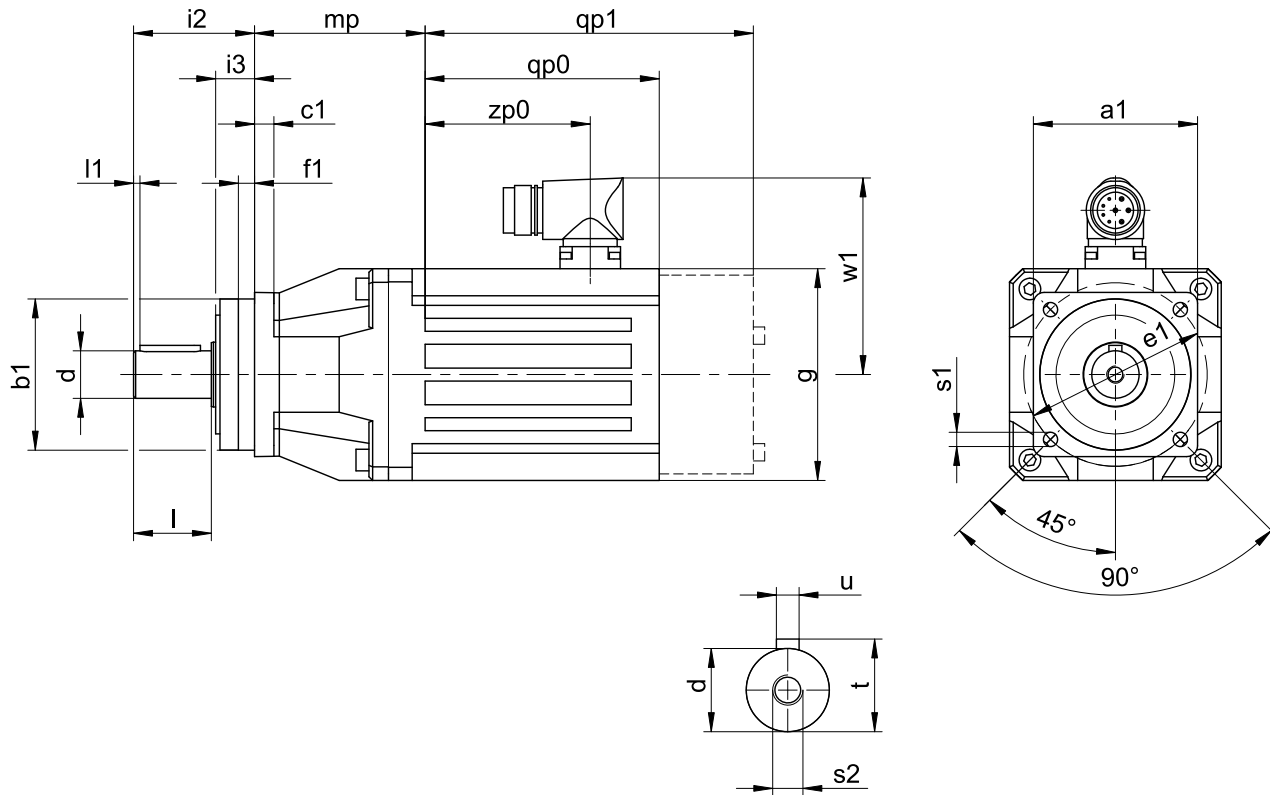
#### Dimensions of motors

| 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 mp | LM5 mp | LM7 mp |
|------|--------|--------|--------|
| P321 | 70.0   | -      | -      |
| P421 | 79.0   | 81.5   | -      |
| P422 | 127.5  | -      | -      |
| P521 | -      | 81.0   | 87.0   |
| P522 | 136.5  | 139.0  | -      |
| P721 | -      | -      | 98.0   |
| P722 | -      | 158.0  | 164.0  |
| P822 | -      | -      | 206.5  |

### 6.3.2 P shaft design (solid shaft with feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

#### Dimensions of gear units

| Type | □a1 | ∅b1               | c1 | ∅d               | ∅e1 | f1   | i2  | i3 | l  | l1 | ∅s1  | s2  | t    | u         |
|------|-----|-------------------|----|------------------|-----|------|-----|----|----|----|------|-----|------|-----------|
| P321 | 72  | 60 <sub>h6</sub>  | 7  | 16 <sub>k6</sub> | 75  | 7.5  | 48  | 18 | 28 | 2  | 5.5  | M5  | 18.0 | A5×5×22   |
| P421 | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 36 | 3  | 6.6  | M8  | 24.5 | A6×6×28   |
| P422 | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 36 | 3  | 6.6  | M8  | 24.5 | A6×6×28   |
| P521 | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 58 | 3  | 9.0  | M12 | 35.0 | A10×8×50  |
| P522 | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 58 | 3  | 9.0  | M12 | 35.0 | A10×8×50  |
| P721 | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 82 | 4  | 11.0 | M16 | 43.0 | A12×8×70  |
| P722 | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 82 | 4  | 11.0 | M16 | 43.0 | A12×8×70  |
| P822 | 190 | 160 <sub>h6</sub> | 15 | 55 <sub>k6</sub> | 215 | 10.0 | 112 | 27 | 82 | 6  | 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<br>mp | LM5<br>mp | LM7<br>mp |
|------|-----------|-----------|-----------|
| P321 | 70.0      | -         | -         |
| P421 | 79.0      | 81.5      | -         |
| P422 | 127.5     | -         | -         |
| P521 | -         | 81.0      | 87.0      |
| P522 | 136.5     | 139.0     | -         |
| P721 | -         | -         | 98.0      |
| P722 | -         | 158.0     | 164.0     |
| P822 | -         | -         | 206.5     |

## 6.4 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.

### Sample code

|   |   |   |   |   |   |   |      |        |
|---|---|---|---|---|---|---|------|--------|
| P | 4 | 2 | 1 | S | G | R | 0040 | LM403U |
|---|---|---|---|---|---|---|------|--------|

### Explanation

| Code   | Designation                 | Design                          |
|--------|-----------------------------|---------------------------------|
| P      | Type                        | Planetary gear unit             |
| 4      | Size                        | 4 (example)                     |
| 2      | Generation                  | Generation 2                    |
| 1      | Stages                      | Single-stage                    |
| 2      |                             | Two-stage                       |
| S      | Housing                     | Standard                        |
| G      | Shaft                       | Solid shaft without feather key |
| P      |                             | Solid shaft with feather key    |
| R      | Bearing                     | Standard bearing                |
| D      |                             | Axially reinforced bearing      |
| Z      |                             | Radially reinforced bearing     |
| 0040   | Transmission ratio (i x 10) | i = 4 (example)                 |
| LM403U | Motor                       | LM Lean motor                   |

In order to complete the type designation, also specify:

- 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 [▶ 6.6.3]
- The position of the plug connector, see the chapter [▶ 6.5.3]
- For reverse operation of the output shaft from  $\pm 20^\circ$  to  $\pm 90^\circ$  and horizontal installation, see the chapter [▶ 6.6.4]

## 6.5 Product description

### 6.5.1 Installation conditions

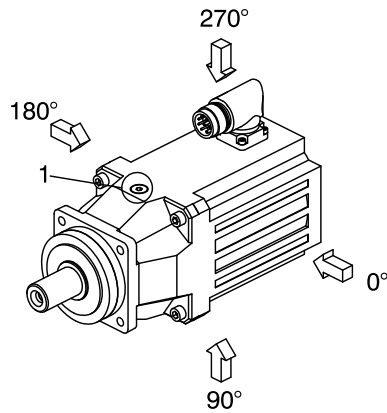
The specified torques and forces only apply when attaching gear units at the machine side using screws of quality 10.9. In addition, the gear unit housings must be adjusted at the pilot. The machine-side fit must be H7.

### 6.5.2 Lubricants

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

Lubricant filling quantities for gear units, document ID 441871, can be found online at <http://www.stober.de/en/download>. Enter the ID of the documentation in the Search... field.

### 6.5.3 Position of the plug connector



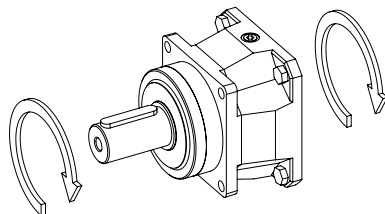
In the standard version, the plug connector is attached in the 270° position (relative to the oil drain plug (1) of the planetary gear unit). Indicate variations for your geared motor in the purchase order.

### 6.5.4 Other product features

| Feature  | Value                 |
|--|-----------------------|
| Max. permitted gear unit temperature (on the surface of the gear unit) | ≤ 90 °C               |
| Paint  | Black RAL 9005        |
| (ATEX) Directive 2014/34/EU (option)                                   | Not suitable          |
| <b>Protection class:<sup>1</sup></b>                                   |                       |
| Gear unit  | IP65                  |
| Motor  | IP56, optionally IP66 |

### 6.5.5 Direction of rotation

The input and output rotate in the same direction.



## 6.6 Project configuration

Project your drives using our SERVOSOFT designing software. You can receive SERVOSOFT for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

### 6.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point  $M_{2N}$  specified in the selection tables.

$$n_{1m^*} \leq \frac{n_{1maxDB}}{fB_T}$$

$$n_{1max^*} \leq \frac{n_{1maxZB}}{fB_T}$$

$$M_{2eff^*} \leq M_{2th}$$

<sup>1</sup> Observe the protection class of all the components.

$$M_{2acc^*} \leq M_{2acc}$$

$$M_{2NOT^*} \leq M_{2NOT}$$

$$M_{2eq^*} \leq M_{2N} \cdot \frac{S}{fB_{op} \cdot fB_t}$$

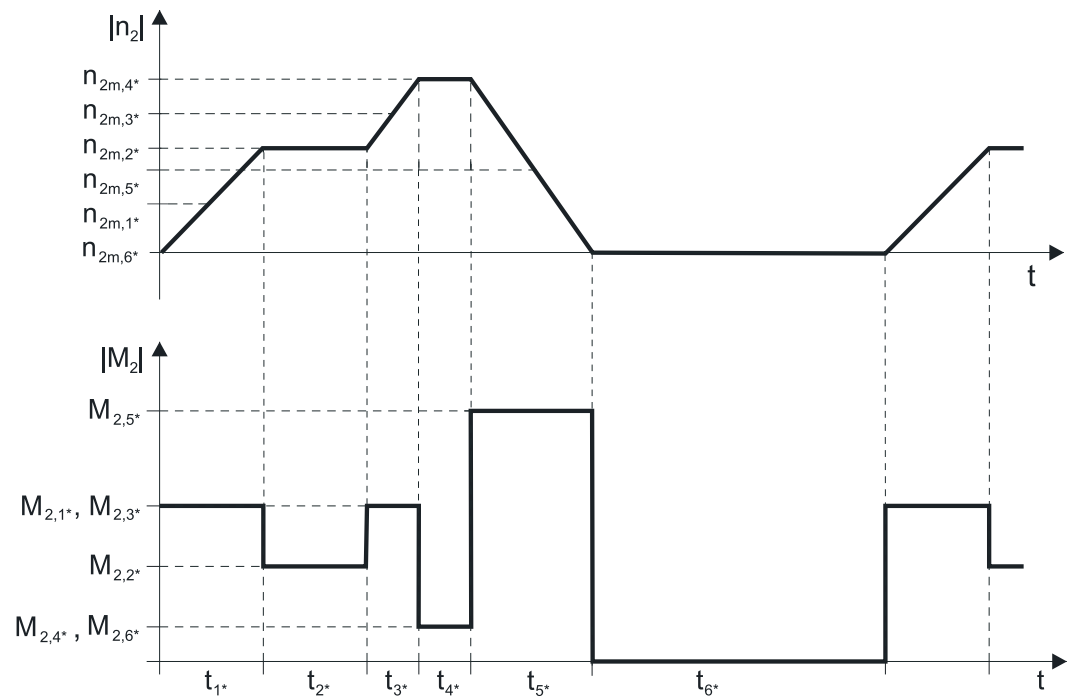
The values for  $n_{1maxDB}$ ,  $n_{1maxzB}$ ,  $M_{2acc}$ ,  $M_{2NOT}$ ,  $M_{2N}$  and  $S$  can be found in the selection tables.

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

Calculate the thermal limit torque  $M_{2th}$  for a duty cycle  $> 50\%$ .

#### 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 average input speed

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

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

If  $t_{1^*} + \dots + t_{5^*} \geq 10$  min, calculate  $n_{2m^*}$  without the rest phase  $t_{6^*}$ .

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

#### Calculation of the actual effective torque

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

#### Calculation of the actual equivalent torque

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

#### 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.)

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

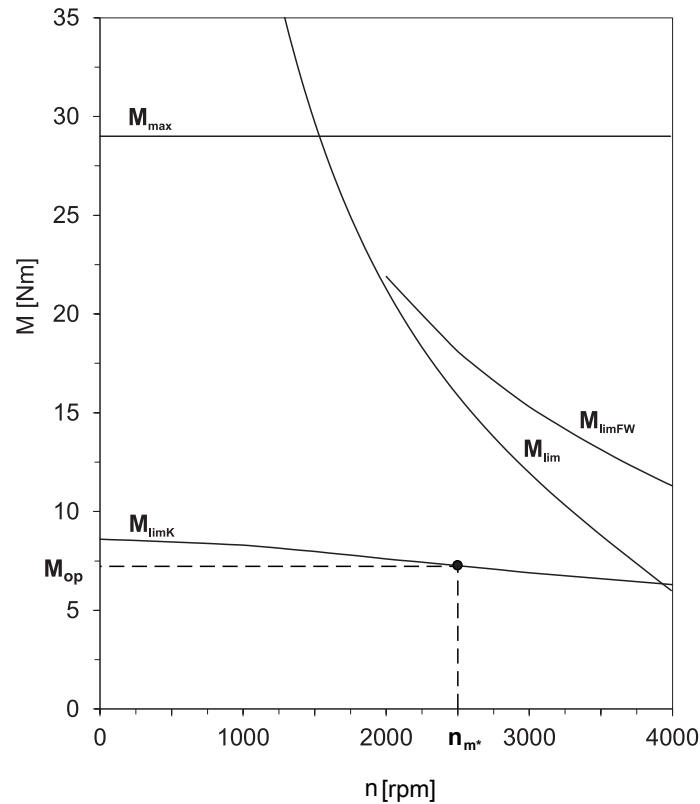


$$K_{\text{mot,th}} = 0,95 - \frac{a_{\text{th}}}{1000} \cdot fB_T \cdot \left( \frac{n_{1m^*}}{1000} \right)^3$$

The values for  $i$  and  $a_{\text{th}}$  can be found in the selection tables.

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  $M_{\text{op}}$  with the determined average input speed  $n_{1m^*}$  can be found in the motor curve of Chapter [ 2.3]. Note the size and nominal speed  $n_N$  of the motor. The figure below shows an example of reading the torque  $M_{\text{op}}$  of a motor with convection cooling at the operating point.



#### Operating factors

|                                 |                                |                                    |
|---------------------------------|--------------------------------|------------------------------------|
| <b>Operating mode</b>           |                                | <b><math>fB_{\text{op}}</math></b> |
| Uniform continuous operation    |                                | 1.00                               |
| Cyclic operation                |                                | 1.00                               |
| Reversing load cyclic operation |                                | 1.00                               |
| <b>Run time</b>                 |                                | <b><math>fB_t</math></b>           |
| Daily run time $\leq 8$ h       |                                | 1.00                               |
| Daily run time $\leq 16$ h      |                                | 1.15                               |
| Daily run time $\leq 24$ h      |                                | 1.20                               |
| <b>Temperature</b>              |                                | <b><math>fB_T</math></b>           |
| <b>Motor cooling</b>            | <b>Surrounding temperature</b> |                                    |
| Motor with convection cooling   | $\leq 20$ °C                   | 1.0                                |
|                                 | $\leq 30$ °C                   | 1.1                                |
|                                 | $\leq 40$ °C                   | 1.25                               |

#### Notes

- The maximum permitted gear unit 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 gear unit torques ( $M_{2\text{acc}}$ ,  $M_{2\text{NOT}}$ ) in the selection tables.
- The values specified in the selection tables for  $M_{2\text{acc}}$  refer to the gear units with a solid shaft design without feather key (G). We recommend this shaft design in general for cyclic operation.

### 6.6.2 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 ( $F_{2ax^N} = F_{2ax100}$ ;  $F_{2radN} = F_{2rad100}$ ;  $M_{2kN} = M_{2k100}$ )
- Only if radial forces on the gear unit are stabilized by its pilots (housing, flange shaft)

#### Permitted shaft loads for standard bearing R

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $F_{2rad,acc}$<br>[N] | $M_{2k100}$<br>[Nm] | $M_{2k,acc}$<br>[Nm] |
|------|---------------|---------------------|----------------------|-----------------------|---------------------|----------------------|
| P2   | 17.0          | 500                 | 1200                 | 1300                  | 34                  | 36                   |
| P3   | 21.0          | 1000                | 2500                 | 2500                  | 88                  | 88                   |
| P4   | 22.0          | 1500                | 4000                 | 4500                  | 160                 | 180                  |
| P5   | 23.0          | 2300                | 6500                 | 7000                  | 338                 | 364                  |
| P7   | 26.0          | 2900                | 8000                 | 9000                  | 536                 | 603                  |
| P8   | 28.0          | 4700                | 13000                | 18000                 | 897                 | 1242                 |
| P9   | 40.0          | 6000                | 18000                | 27000                 | 1665                | 2498                 |

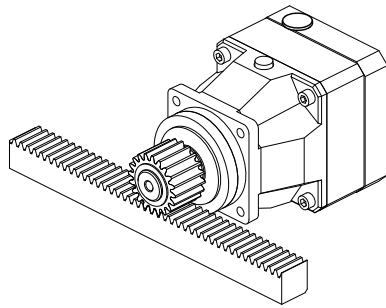


Fig. 1: Recommendation for bearing assignment R

#### Permitted shaft loads for axially reinforced bearing D

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $F_{2rad,acc}$<br>[N] | $M_{2k100}$<br>[Nm] | $M_{2k,acc}$<br>[Nm] |
|------|---------------|---------------------|----------------------|-----------------------|---------------------|----------------------|
| P3   | 24.0          | 1400                | 2750                 | 2750                  | 105                 | 105                  |
| P4   | 25.0          | 2250                | 4500                 | 5000                  | 194                 | 215                  |
| P5   | 29.0          | 3500                | 7000                 | 8000                  | 406                 | 464                  |
| P7   | 31.0          | 4500                | 9000                 | 10000                 | 648                 | 720                  |
| P8   | 35.0          | 7500                | 15000                | 18000                 | 1140                | 1368                 |
| P9   | 51.0          | 10000               | 20000                | 30000                 | 2070                | 3105                 |

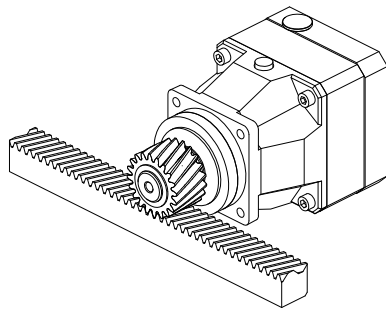


Fig. 2: Recommendation for bearing assignment D

**Permitted shaft loads for radially reinforced bearing Z**

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $F_{2rad,acc}$<br>[N] | $M_{2k100}$<br>[Nm] | $M_{2k,acc}$<br>[Nm] |
|------|---------------|---------------------|----------------------|-----------------------|---------------------|----------------------|
| P3   | 21.0          | 600                 | 3000                 | 3000                  | 105                 | 105                  |
| P4   | 22.0          | 1000                | 5000                 | 5000                  | 200                 | 200                  |
| P5   | 23.0          | 1600                | 8000                 | 8000                  | 416                 | 416                  |
| P7   | 26.0          | 2000                | 10000                | 10000                 | 670                 | 670                  |
| P8   | 28.0          | 3600                | 18000                | 18000                 | 1242                | 1242                 |
| P9   | 40.0          | 5000                | 27000                | 35000                 | 2500                | 3238                 |

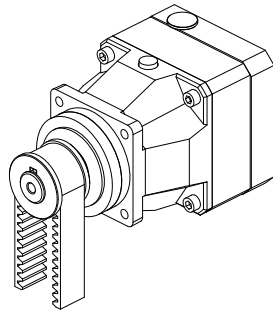


Fig. 3: Recommendation for bearing assignment Z

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

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

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

$$F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

$$M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

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

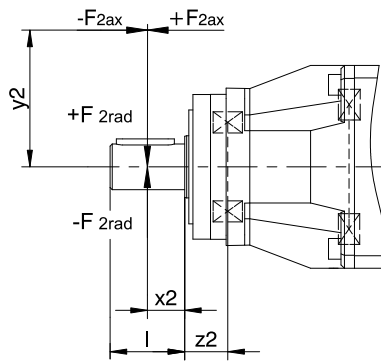


Fig. 4: Force application points

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:

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

$$F_{2rad,acc^*} \leq F_{2rad,acc}$$

$$F_{2ax^*} \leq F_{2axN}$$

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

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:

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

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

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

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

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

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

For different duty cycles:

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

### 6.6.3 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:

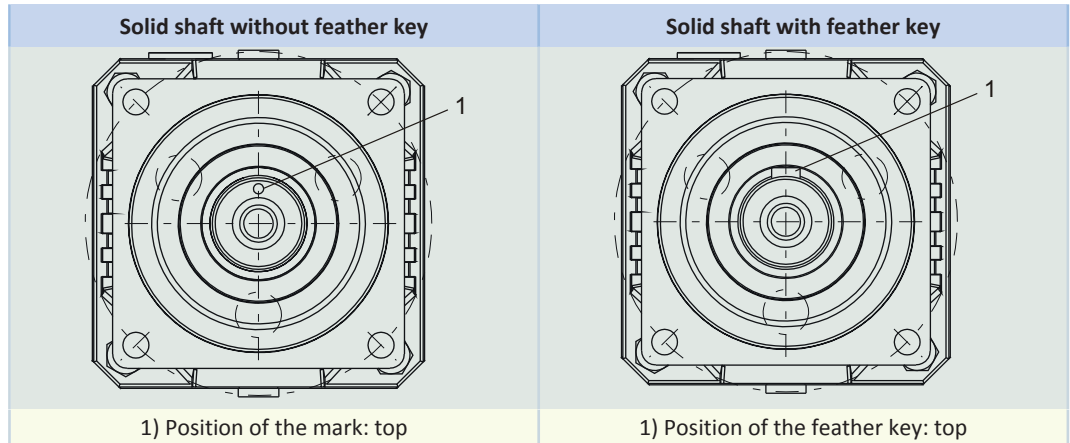
- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance to mineral oils and greases
- For use in the food, beverage and pharmaceutical industries

#### Leak-proofness

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

## 6.6.4 Reverse operation

To ensure lubrication of circulating geared parts during cyclic reverse operation from  $\pm 20^\circ$  to  $\pm 90^\circ$ , pay careful attention to the position of the output shaft if the gear unit is installed horizontally as shown in the images below. The images show the center position of reverse operation. Cyclic reverse operation  $\leq \pm 20^\circ$  on request.



### Notes

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

## 6.7 Additional documentation

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

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

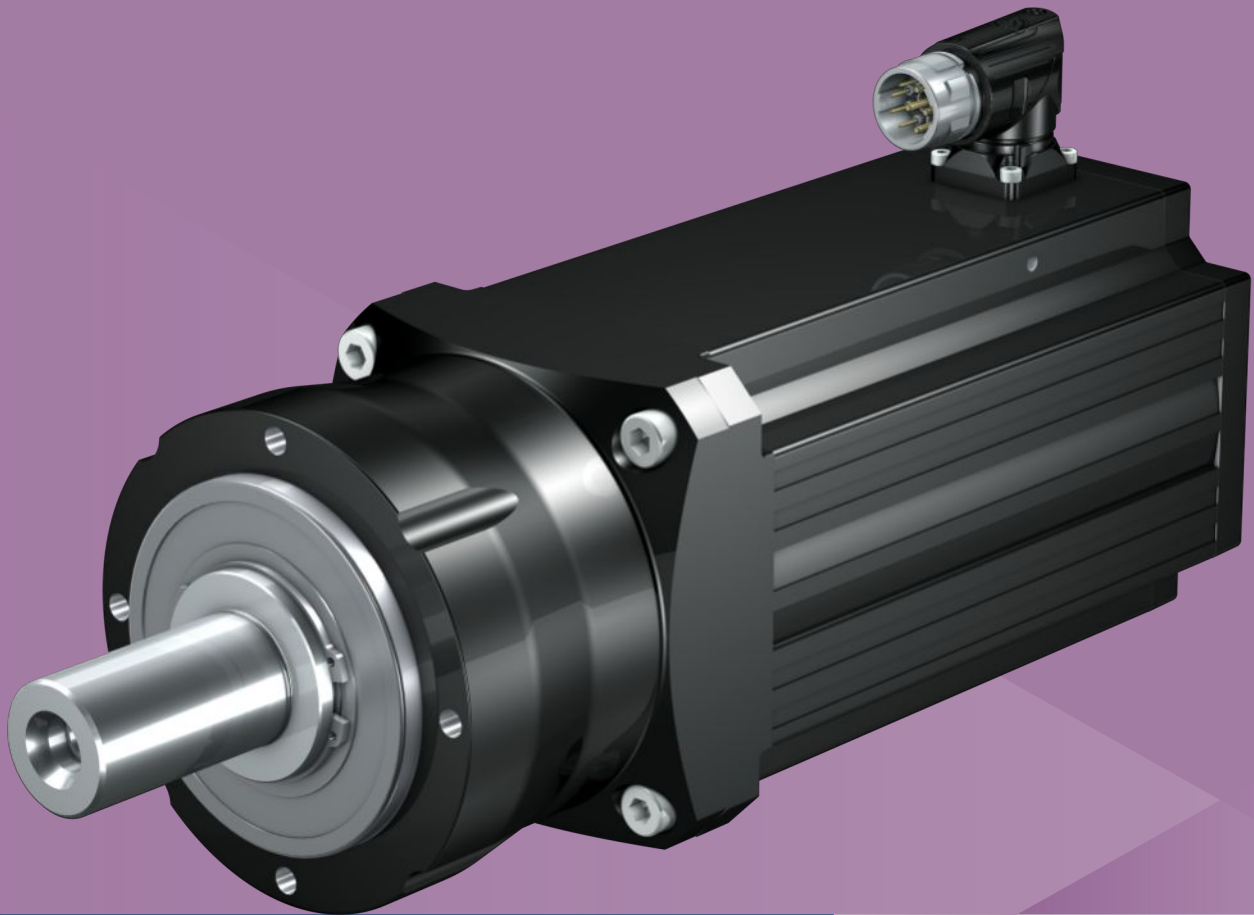
| Documentation  | ID        |
|--|-----------|
| Operating manual for P/PA/PE/PH/PHA/PHQ/PHQA/PHV/PHVA planetary gear units and planetary geared motors | 443029_en |
| Lubricant filling quantities for gear units  | 441871    |



# 7 PE planetary geared motors

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# 7

## Planetary geared motors

PE

### 7.1 Overview

Cost-efficient helical-gear 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 – 20        |
| $M_{2acc}$     | 13 – 310 Nm   |
| $\Delta\phi_2$ | 8 – 10 arcmin |
| $\eta_{get}$   | ≤ 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

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#).

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type              | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1max}$<br>DB | $n_{1max}$<br>ZB | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|-------------------|------------|------------|-------|-------------|------------------|------------------|---|----------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                   | [Nm]       | [Nm]       |       |             | [rpm]            | [rpm]            | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>PE3 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 55</math> Nm)</b>  |          |           |          |      |                   |            |            |       |             |                  |                  |   |                |                 |      |
| 188   | 34       | 37        | 8.6      | 0.88 | PE312_0160 LM401U | 55         | 75         | 16.00 | 16/1        | 3700             | 6000             | 1.7                                     | 10             | 4.2             | 6.6  |
| 250   | 26       | 28        | 9.9      | 1.2  | PE312_0120 LM401U | 51         | 75         | 12.00 | 12/1        | 3700             | 6000             | 1.8                                     | 10             | 4.2             | 6.6  |
| 429   | 15       | 17        | 3.0      | 1.2  | PE311_0070 LM401U | 31         | 75         | 7.000 | 7/1         | 4000             | 6000             | 1.7                                     | 8              | 3.8             | 6.0  |
| 600   | 11       | 12        | 4.4      | 1.7  | PE311_0050 LM401U | 22         | 75         | 5.000 | 5/1         | 3700             | 6000             | 1.7                                     | 8              | 4.1             | 6.0  |
| 600   | 21       | 22        | 8.7      | 0.85 | PE311_0050 LM402U | 40         | 75         | 5.000 | 5/1         | 3700             | 6000             | 3.1                                     | 8              | 4.1             | 7.7  |
| 750   | 8.7      | 9.4       | 6.1      | 2.0  | PE311_0040 LM401U | 17         | 75         | 4.000 | 4/1         | 3700             | 6000             | 1.7                                     | 8              | 4.2             | 6.0  |
| 750   | 17       | 17        | 12       | 1.0  | PE311_0040 LM402U | 38         | 75         | 4.000 | 4/1         | 3700             | 6000             | 3.1                                     | 8              | 4.2             | 7.7  |
| 1000  | 6.5      | 7.1       | 9.0      | 2.5  | PE311_0030 LM401U | 13         | 64         | 3.000 | 3/1         | 3500             | 6000             | 1.8                                     | 8              | 3.6             | 6.0  |
| 1000  | 13       | 13        | 18       | 1.3  | PE311_0030 LM402U | 28         | 64         | 3.000 | 3/1         | 3500             | 6000             | 3.1                                     | 8              | 3.6             | 7.7  |
| <b>PE4 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 120</math> Nm)</b> |          |           |          |      |                   |            |            |       |             |                  |                  |   |                |                 |      |
| 188   | 67       | 68        | 8.7      | 0.97 | PE412_0160 LM402U | 120        | 190        | 16.00 | 16/1        | 3400             | 6000             | 3.2                                     | 10             | 14              | 10   |
| 250   | 50       | 51        | 10       | 1.3  | PE412_0120 LM402U | 110        | 190        | 12.00 | 12/1        | 3400             | 5500             | 3.4                                     | 10             | 14              | 10   |
| 250   | 69       | 71        | 14       | 0.94 | PE412_0120 LM403U | 120        | 190        | 12.00 | 12/1        | 3400             | 5500             | 4.7                                     | 10             | 14              | 12   |
| 300   | 43       | 44        | 2.4      | 0.84 | PE411_0100 LM402U | 90         | 190        | 10.00 | 10/1        | 3600             | 6000             | 3.1                                     | 8              | 10              | 9.2  |
| 429   | 30       | 31        | 3.3      | 1.3  | PE411_0070 LM402U | 66         | 190        | 7.000 | 7/1         | 3600             | 6000             | 3.1                                     | 8              | 12              | 9.2  |
| 429   | 41       | 42        | 4.5      | 0.96 | PE411_0070 LM403U | 87         | 190        | 7.000 | 7/1         | 3600             | 6000             | 4.4                                     | 8              | 12              | 11   |
| 600   | 21       | 22        | 4.9      | 1.9  | PE411_0050 LM402U | 47         | 190        | 5.000 | 5/1         | 3400             | 6000             | 3.3                                     | 8              | 13              | 9.2  |
| 600   | 29       | 30        | 6.7      | 1.4  | PE411_0050 LM403U | 62         | 190        | 5.000 | 5/1         | 3400             | 6000             | 4.6                                     | 8              | 13              | 11   |
| 600   | 46       | 49        | 10       | 0.86 | PE411_0050 LM503U | 99         | 190        | 5.000 | 5/1         | 3400             | 6000             | 11                                      | 8              | 13              | 14   |
| 750   | 17       | 17        | 6.4      | 2.3  | PE411_0040 LM402U | 38         | 190        | 4.000 | 4/1         | 3400             | 6000             | 3.3                                     | 8              | 14              | 9.2  |
| 750   | 24       | 24        | 8.7      | 1.7  | PE411_0040 LM403U | 50         | 190        | 4.000 | 4/1         | 3400             | 6000             | 4.6                                     | 8              | 14              | 11   |
| 750   | 37       | 39        | 14       | 1.1  | PE411_0040 LM503U | 79         | 190        | 4.000 | 4/1         | 3400             | 6000             | 11                                      | 8              | 14              | 14   |
| 1000  | 13       | 13        | 10       | 2.8  | PE411_0030 LM402U | 28         | 180        | 3.000 | 3/1         | 3000             | 5500             | 3.5                                     | 8              | 13              | 9.2  |
| 1000  | 18       | 18        | 14       | 2.0  | PE411_0030 LM403U | 37         | 180        | 3.000 | 3/1         | 3000             | 5500             | 4.8                                     | 8              | 13              | 11   |
| 1000  | 28       | 29        | 21       | 1.3  | PE411_0030 LM503U | 59         | 180        | 3.000 | 3/1         | 3000             | 5500             | 11                                      | 8              | 13              | 14   |
| 1000  | 40       | 45        | 31       | 0.90 | PE411_0030 LM505U | 90         | 180        | 3.000 | 3/1         | 3000             | 5500             | 17                                      | 8              | 13              | 18   |
| <b>PE5 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 310</math> Nm)</b> |          |           |          |      |                   |            |            |       |             |                  |                  |   |                |                 |      |
| 150   | 180      | 191       | 7.6      | 0.89 | PE512_0200 LM503U | 310        | 480        | 20.00 | 20/1        | 2600             | 5000             | 11                                      | 10             | 35              | 19   |
| 188   | 144      | 153       | 8.4      | 1.1  | PE512_0160 LM503U | 310        | 480        | 16.00 | 16/1        | 2600             | 5000             | 11                                      | 10             | 35              | 19   |
| 200   | 135      | 143       | 11       | 0.96 | PE512_0150 LM503U | 250        | 480        | 15.00 | 15/1        | 2500             | 4500             | 12                                      | 10             | 33              | 19   |
| 250   | 108      | 115       | 9.8      | 1.5  | PE512_0120 LM503U | 230        | 480        | 12.00 | 12/1        | 2500             | 4500             | 12                                      | 10             | 35              | 19   |
| 250   | 156      | 176       | 14       | 1.0  | PE512_0120 LM505U | 310        | 480        | 12.00 | 12/1        | 2500             | 4500             | 18                                      | 10             | 35              | 24   |
| 300   | 92       | 98        | 5.7      | 0.95 | PE511_0100 LM503U | 200        | 400        | 10.00 | 10/1        | 3000             | 5000             | 10                                      | 8              | 27              | 17   |
| 429   | 64       | 68        | 7.3      | 1.6  | PE511_0070 LM503U | 140        | 400        | 7.000 | 7/1         | 2800             | 5000             | 11                                      | 8              | 31              | 17   |
| 429   | 93       | 105       | 11       | 1.1  | PE511_0070 LM505U | 220        | 400        | 7.000 | 7/1         | 2800             | 5000             | 17                                      | 8              | 31              | 21   |
| 600   | 46       | 49        | 11       | 2.2  | PE511_0050 LM503U | 99         | 390        | 5.000 | 5/1         | 2600             | 5000             | 11                                      | 8              | 34              | 17   |
| 600   | 66       | 75        | 16       | 1.6  | PE511_0050 LM505U | 160        | 390        | 5.000 | 5/1         | 2600             | 5000             | 17                                      | 8              | 34              | 21   |
| 600   | 93       | 103       | 22       | 1.1  | PE511_0050 LM704U | 200        | 400        | 5.000 | 5/1         | 2600             | 5000             | 37                                      | 8              | 34              | 27   |
| 600   | 125      | 145       | 30       | 0.83 | PE511_0050 LM706U | 250        | 400        | 5.000 | 5/1         | 2600             | 5000             | 54                                      | 8              | 34              | 34   |
| 750   | 37       | 39        | 14       | 2.8  | PE511_0040 LM503U | 79         | 310        | 4.000 | 4/1         | 2600             | 5000             | 11                                      | 8              | 35              | 17   |
| 750   | 53       | 60        | 21       | 1.9  | PE511_0040 LM505U | 120        | 310        | 4.000 | 4/1         | 2600             | 5000             | 17                                      | 8              | 35              | 21   |
| 750   | 75       | 82        | 29       | 1.4  | PE511_0040 LM704U | 160        | 400        | 4.000 | 4/1         | 2600             | 5000             | 37                                      | 8              | 35              | 27   |
| 750   | 100      | 116       | 39       | 1.0  | PE511_0040 LM706U | 240        | 400        | 4.000 | 4/1         | 2600             | 5000             | 54                                      | 8              | 35              | 34   |
| 1000  | 28       | 29        | 29       | 2.6  | PE511_0030 LM503U | 59         | 240        | 3.000 | 3/1         | 2500             | 4500             | 11                                      | 8              | 35              | 17   |
| 1000  | 40       | 45        | 42       | 1.8  | PE511_0030 LM505U | 93         | 240        | 3.000 | 3/1         | 2500             | 4500             | 17                                      | 8              | 35              | 21   |
| 1000  | 56       | 62        | 60       | 1.3  | PE511_0030 LM704U | 120        | 390        | 3.000 | 3/1         | 2500             | 4500             | 37                                      | 8              | 35              | 27   |
| 1000  | 75       | 87        | 79       | 0.96 | PE511_0030 LM706U | 180        | 390        | 3.000 | 3/1         | 2500             | 4500             | 54                                      | 8              | 35              | 34   |

## 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 gear unit 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 <http://configurator.stoeber.de>.

Combination options and the dimensions of forced ventilated geared motors can be found at <http://cad.stoeber.de>.

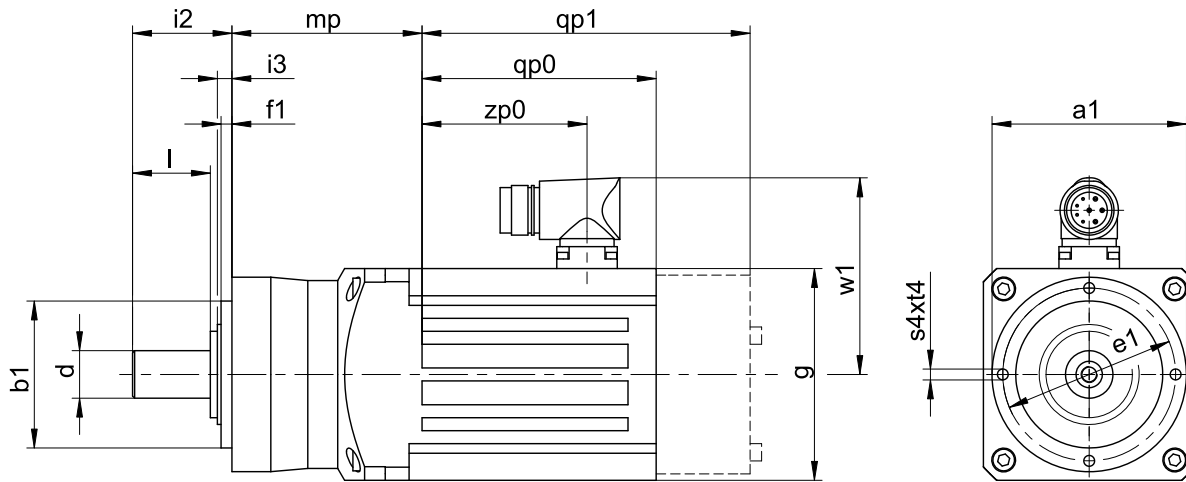
### Tolerances

| Solid shaft                          | Tolerance                              |
|--------------------------------------|--|
| Shaft $\varnothing$ fit $\leq$ 50 mm | DIN 748-1, ISO k6                      |
| Shaft $\varnothing$ fit $>$ 50 mm    | DIN 748-1, ISO m6                      |
| Feather keys                         | DIN 6885-1, high form A                |
| Balance quality                      | Q 2.5 (balanced 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.

#### Dimensions of gear units

| Type  | $\varnothing a1$ | $\varnothing b1$ | $\varnothing d$  | $\varnothing e1$ | f1 | i2 | i3  | l  | s2  | s4 | t4 |
|-------|------------------|------------------|------------------|------------------|----|----|-----|----|-----|----|----|
| PE311 | 70               | 52 <sub>h6</sub> | 16 <sub>k6</sub> | 62               | 5  | 36 | 6.0 | 28 | M5  | M5 | 10 |
| PE312 | 70               | 52 <sub>h6</sub> | 16 <sub>k6</sub> | 62               | 5  | 36 | 6.0 | 28 | M5  | M5 | 10 |
| PE411 | 90               | 68 <sub>h6</sub> | 22 <sub>k6</sub> | 80               | 5  | 46 | 6.5 | 36 | M8  | M6 | 13 |
| PE412 | 90               | 68 <sub>h6</sub> | 22 <sub>k6</sub> | 80               | 5  | 46 | 6.5 | 36 | M8  | M6 | 13 |
| PE511 | 120              | 90 <sub>h6</sub> | 32 <sub>k6</sub> | 108              | 6  | 70 | 8.0 | 58 | M12 | M8 | 16 |
| PE512 | 120              | 90 <sub>h6</sub> | 32 <sub>k6</sub> | 108              | 6  | 70 | 8.0 | 58 | M12 | M8 | 16 |

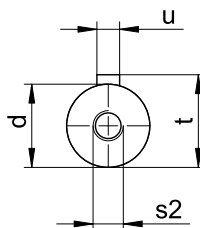
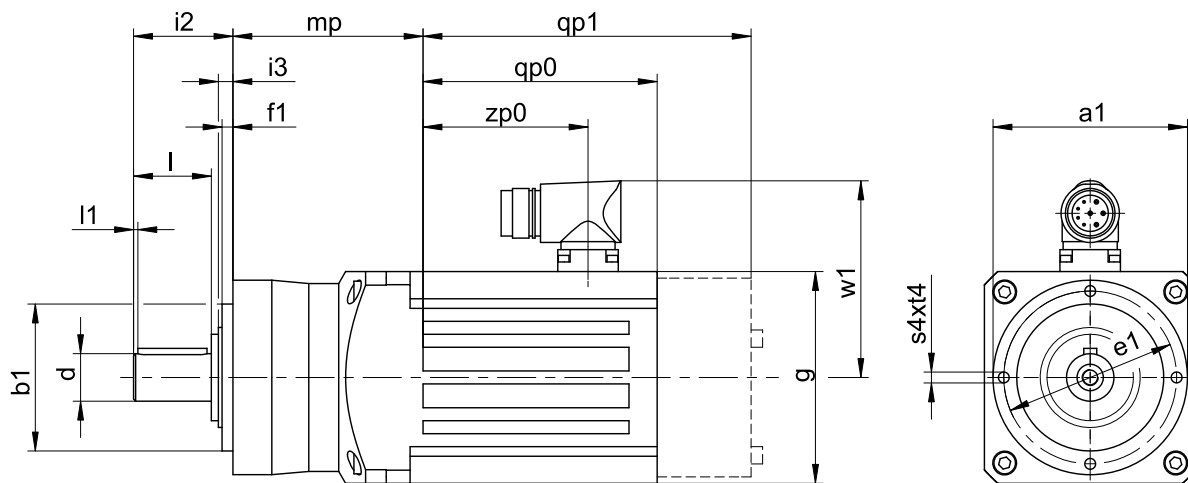
#### Dimensions of motors

| Type   | $\square g$ | 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<br>mp | LM5<br>mp | LM7<br>mp |
|-------|-----------|-----------|-----------|
| PE311 | 82.5      | -         | -         |
| PE312 | 115.0     | -         | -         |
| PE411 | 88.0      | 90.5      | -         |
| PE412 | 126.0     | -         | -         |
| PE511 | -         | 105.5     | 111.5     |
| PE512 | -         | 151.0     | -         |

### 7.3.2 P shaft design (solid shaft with feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

#### Dimensions of gear units

| Type  | Øa1 | Øb1              | Ød               | Øe1 | f1 | i2 | i3  | l  | l1 | s2  | s4 | t    | t4 | u        |
|-------|-----|------------------|------------------|-----|----|----|-----|----|----|-----|----|------|----|----------|
| PE311 | 70  | 52 <sub>h6</sub> | 16 <sub>k6</sub> | 62  | 5  | 36 | 6.0 | 28 | 2  | M5  | M5 | 18.0 | 10 | A5×5×22  |
| PE312 | 70  | 52 <sub>h6</sub> | 16 <sub>k6</sub> | 62  | 5  | 36 | 6.0 | 28 | 2  | M5  | M5 | 18.0 | 10 | A5×5×22  |
| PE411 | 90  | 68 <sub>h6</sub> | 22 <sub>k6</sub> | 80  | 5  | 46 | 6.5 | 36 | 2  | M8  | M6 | 24.5 | 13 | A6×6×32  |
| PE412 | 90  | 68 <sub>h6</sub> | 22 <sub>k6</sub> | 80  | 5  | 46 | 6.5 | 36 | 2  | M8  | M6 | 24.5 | 13 | A6×6×32  |
| PE511 | 120 | 90 <sub>h6</sub> | 32 <sub>k6</sub> | 108 | 6  | 70 | 8.0 | 58 | 4  | M12 | M8 | 35.0 | 16 | A10×8×50 |
| PE512 | 120 | 90 <sub>h6</sub> | 32 <sub>k6</sub> | 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<br>mp | LM5<br>mp | LM7<br>mp |
|-------|-----------|-----------|-----------|
| PE311 | 82.5      | -         | -         |
| PE312 | 115.0     | -         | -         |
| PE411 | 88.0      | 90.5      | -         |
| PE412 | 126.0     | -         | -         |
| PE511 | -         | 105.5     | 111.5     |
| PE512 | -         | 151.0     | -         |

## 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.

### Sample code

|    |   |   |   |   |   |   |      |        |
|----|---|---|---|---|---|---|------|--------|
| PE | 4 | 1 | 2 | S | G | R | 0120 | LM403U |
|----|---|---|---|---|---|---|------|--------|

### Explanation

| Code   | Designation                 | Design                          |
|--------|-----------------------------|---------------------------------|
| PE     | Type                        | Planetary gear unit             |
| 4      | Size                        | 4 (example)                     |
| 1      | Generation                  | Generation 1                    |
| 1      | Stages                      | Single-stage                    |
| 2      |                             | Two-stage                       |
| S      | Housing                     | Standard                        |
| G      | Shaft                       | Solid shaft without feather key |
| P      |                             | Solid shaft with feather key    |
| R      | Bearing                     | Standard bearing                |
| 0120   | Transmission ratio (i x 10) | i = 12 (example)                |
| LM403U | Motor                       | LM Lean motor                   |

In order to complete the type designation, also specify:

- A detailed type designation of the motor, see the chapter [▶ 2\]](#)

## 7.5 Product description

### 7.5.1 Installation conditions

The specified torques and forces only apply when attaching gear units at the machine side using screws of quality 10.9. In addition, the gear unit housings must be adjusted at the pilot. The machine-side fit must be H7.

### 7.5.2 Lubricants

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

Lubricant filling quantities for gear units, document ID 441871, can be found online at <http://www.stober.de/en/download>. Enter the ID of the documentation in the Search... field.

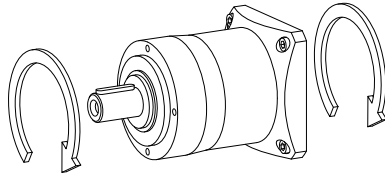
### 7.5.3 Other product features

| Feature  | Value                 |
|--|-----------------------|
| Max. permitted gear unit temperature (on the surface of the gear unit) | ≤ 80 °C               |
| Paint  | Black RAL 9005        |
| (ATEX) Directive 2014/34/EU (option)                                   | Not suitable          |
| <b>Protection class:<sup>1</sup></b>                                   |                       |
| Gear unit  | IP64                  |
| Motor  | IP56, optionally IP66 |

<sup>1</sup>Observe the protection class of all the components.

## 7.5.4 Direction of rotation

The input and output rotate in the same direction.



## 7.6 Project configuration

Project your drives using our SERVOfsoft designing software. You can receive SERVOfsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

### 7.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point  $M_{2N}$  specified in the selection tables.

$$n_{1m^*} \leq \frac{n_{1\max DB}}{fB_T}$$

$$n_{1\max^*} \leq \frac{n_{1\max ZB}}{fB_T}$$

$$M_{2\text{eff}^*} \leq M_{2\text{th}}$$

$$M_{2\text{acc}^*} \leq M_{2\text{acc}}$$

$$M_{2\text{NOT}^*} \leq M_{2\text{NOT}}$$

$$M_{2\text{eq}^*} \leq M_{2N} \cdot \frac{S}{fB_{\text{op}} \cdot fB_t}$$

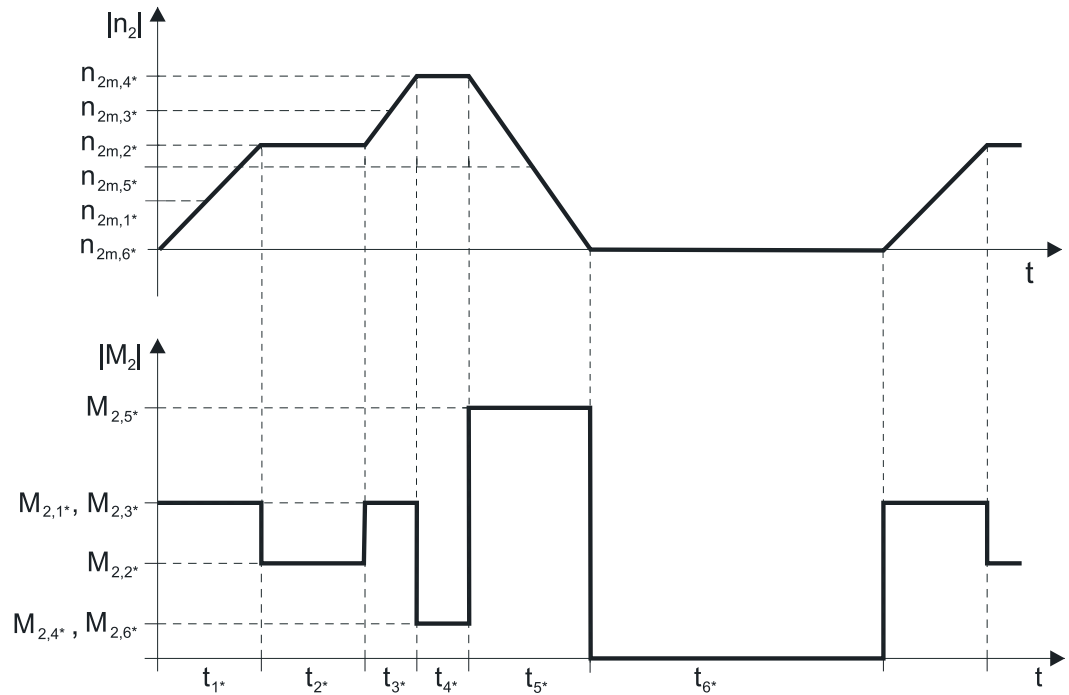
The values for  $n_{1\max DB}$ ,  $n_{1\max ZB}$ ,  $M_{2\text{acc}}$ ,  $M_{2\text{NOT}}$ ,  $M_{2N}$  and  $S$  can be found in the selection tables.

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

Calculate the thermal limit torque  $M_{2\text{th}}$  for a duty cycle > 50%.

**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 average input speed**

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

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

If  $t_{1^*} + \dots + t_{5^*} \geq 10$  min, calculate  $n_{2m^*}$  without the rest phase  $t_{6^*}$ .

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

**Calculation of the actual effective torque**

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

**Calculation of the actual equivalent torque**

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

**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.)

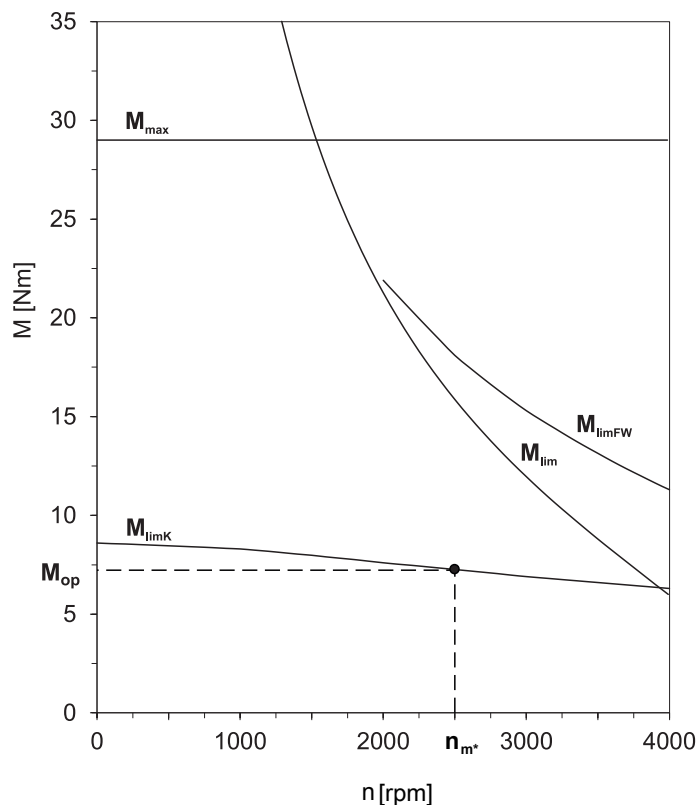
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

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

The values for  $i$  and  $a_{th}$  can be found in the selection tables.

The values for  $f_{B_T}$  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 curve of Chapter [▶ 2.3](#). Note the size and nominal speed  $n_N$  of the motor. The figure below shows an example of reading the torque  $M_{op}$  of a motor with convection cooling at the operating point.



**Operating factors**

| Operating mode                                 | Number of load changes/<br>hour | $fB_{op}$ |
|--|---------------------------------|-----------|
| Uniform continuous operation                   | –                               | 1.00      |
| Cyclic operation                               | –                               | 1.00      |
| Cyclic operation – reversing load <sup>2</sup> | ≤ 1000                          | 1.00      |
|  | 2000                            | 1.20      |
|  | 3000                            | 1.40      |
|  | 4000                            | 1.60      |
|  | ≥ 5000                          | 1.80      |

| Run time              | $fB_t$ |
|-----------------------|--------|
| Daily run time ≤ 8 h  | 1.00   |
| Daily run time ≤ 16 h | 1.15   |
| Daily run time ≤ 24 h | 1.20   |

| Temperature                   |                         | $fB_T$ |
|-------------------------------|-------------------------|--------|
| Motor cooling                 | Surrounding temperature |        |
| Motor with convection cooling | ≤ 20 °C                 | 1.0    |
|                               | ≤ 30 °C                 | 1.1    |
|                               | ≤ 40 °C                 | 1.25   |

**Notes**

- The maximum permitted gear unit 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 gear unit torques ( $M_{2acc}$ ,  $M_{2NOT}$ ) in the selection tables.
- The values specified in the selection tables for  $M_{2acc}$  refer to the gear units with a solid shaft design without feather key (G). We recommend this shaft design in general for cyclic operation.



## 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 gear unit are stabilized by its pilots (housing, flange shaft)

### Permitted shaft loads for standard bearing R

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $F_{2rad,acc}$<br>[N] | $M_{2k100}$<br>[Nm] | $M_{2k,acc}$<br>[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 <http://configurator.stoeber.de>.

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

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

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

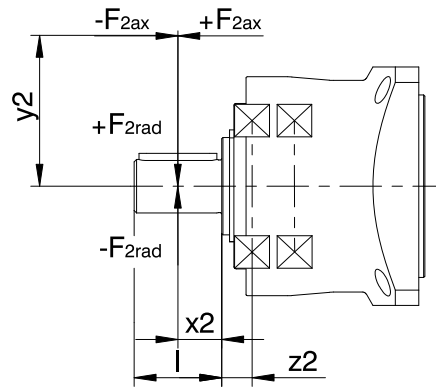


Fig. 1: Force application points

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:

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

$$F_{2rad,acc^*} \leq F_{2rad,acc}$$

$$F_{2ax^*} \leq F_{2axN}$$

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

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:

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

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

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

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

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

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

For different duty cycles:

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

### 7.6.3 Radial shaft seal rings

#### Leak-proofness

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

## 7.7 Additional documentation

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

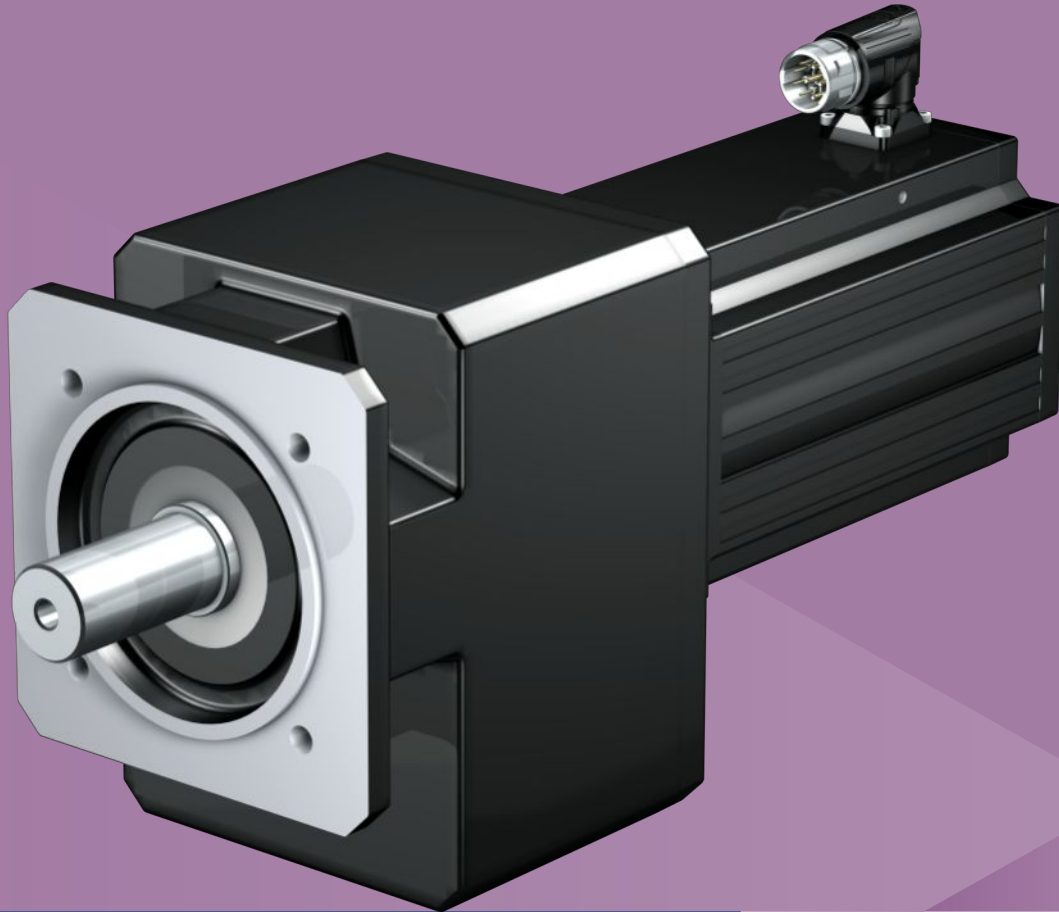
Enter the ID of the documentation in the Search... field.

| Documentation  | ID        |
|--|-----------|
| Operating manual for P/PA/PE/PH/PHA/PHQ/PHQA/PHV/PHVA planetary gear units and planetary geared motors | 443029_en |
| Lubricant filling quantities for gear units  | 441871    |

## 8 C helical geared motors

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## 8 Helical geared motors

C

### 8.1 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 – 178        |
| $M_{2acc}$     | 8.7 – 4140 Nm  |
| $\Delta\phi_2$ | 10 – 20 arcmin |
| $\eta_{get}$   | ≤ 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
- Weight specification for mounting position EL1, housing design N

For all other technical data, refer to <http://configurator.stoeber.de>.

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#).

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,3,4 | $n_{1maxDB}$<br>EL5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>C0 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 72</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 120   | 55       | 59        | 3.3      | 1.1  | C002_0250 LM401U | 72         | 120        | 24.97 | 899/36      | 4000                      | 4000                  | 6000         | 1.7                                     | 16                | 1.6             | 10   |
| 129   | 51       | 55        | 3.2      | 1.2  | C002_0230 LM401U | 65         | 120        | 23.21 | 325/14      | 4000                      | 4000                  | 6000         | 1.7                                     | 16                | 1.6             | 10   |
| 145   | 45       | 49        | 3.0      | 1.3  | C002_0210 LM401U | 72         | 120        | 20.71 | 145/7       | 4000                      | 4000                  | 6000         | 1.7                                     | 16                | 1.6             | 10   |
| 171   | 38       | 41        | 2.7      | 1.6  | C002_0175 LM401U | 65         | 120        | 17.53 | 3575/204    | 4000                      | 4000                  | 6000         | 1.8                                     | 16                | 1.6             | 10   |
| 192   | 34       | 37        | 2.6      | 1.8  | C002_0155 LM401U | 68         | 110        | 15.64 | 1595/102    | 4000                      | 4000                  | 6000         | 1.8                                     | 16                | 1.6             | 10   |
| 192   | 67       | 68        | 5.1      | 0.90 | C002_0155 LM402U | 72         | 120        | 15.64 | 1595/102    | 4000                      | 4000                  | 6000         | 3.1                                     | 16                | 1.6             | 12   |
| 213   | 31       | 33        | 2.5      | 2.0  | C002_0140 LM401U | 62         | 100        | 14.08 | 169/12      | 4000                      | 4000                  | 6000         | 1.8                                     | 16                | 1.6             | 10   |
| 213   | 60       | 61        | 4.8      | 1.0  | C002_0140 LM402U | 65         | 120        | 14.08 | 169/12      | 4000                      | 4000                  | 6000         | 3.2                                     | 16                | 1.6             | 12   |
| 239   | 27       | 30        | 2.3      | 2.2  | C002_0125 LM401U | 55         | 91         | 12.57 | 377/30      | 4000                      | 4000                  | 6000         | 1.8                                     | 16                | 1.6             | 10   |
| 239   | 54       | 55        | 4.6      | 1.1  | C002_0125 LM402U | 72         | 120        | 12.57 | 377/30      | 4000                      | 4000                  | 6000         | 3.2                                     | 16                | 1.6             | 12   |
| 260   | 25       | 27        | 2.3      | 2.3  | C002_0115 LM401U | 50         | 84         | 11.54 | 3185/276    | 3700                      | 3600                  | 6000         | 1.9                                     | 16                | 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                | 1.6             | 12   |
| 291   | 22       | 24        | 2.2      | 2.5  | C002_0105 LM401U | 45         | 75         | 10.30 | 1421/138    | 3700                      | 3600                  | 6000         | 1.9                                     | 16                | 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                | 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                | 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                | 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                | 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                | 1.6             | 14   |
| 364   | 18       | 19        | 2.2      | 2.7  | C002_0082 LM401U | 36         | 60         | 8.235 | 667/81      | 3700                      | 3600                  | 6000         | 1.9                                     | 16                | 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                | 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                | 1.6             | 14   |
| 389   | 17       | 18        | 2.5      | 2.5  | C002_0077 LM401U | 34         | 53         | 7.714 | 54/7        | 4000                      | 4000                  | 6000         | 1.8                                     | 20                | 1.3             | 10   |
| 389   | 33       | 34        | 5.0      | 1.3  | C002_0077 LM402U | 65         | 110        | 7.714 | 54/7        | 4000                      | 4000                  | 6000         | 3.1                                     | 20                | 1.3             | 12   |
| 389   | 45       | 46        | 6.8      | 0.95 | C002_0077 LM403U | 65         | 110        | 7.714 | 54/7        | 4000                      | 4000                  | 6000         | 4.4                                     | 20                | 1.3             | 14   |
| 476   | 14       | 15        | 2.4      | 2.7  | C002_0063 LM401U | 28         | 46         | 6.300 | 2035/323    | 4000                      | 4000                  | 6000         | 1.8                                     | 20                | 1.3             | 10   |
| 476   | 27       | 28        | 4.8      | 1.5  | C002_0063 LM402U | 59         | 110        | 6.300 | 2035/323    | 4000                      | 4000                  | 6000         | 3.2                                     | 20                | 1.3             | 12   |
| 476   | 37       | 38        | 6.6      | 1.1  | C002_0063 LM403U | 65         | 110        | 6.300 | 2035/323    | 4000                      | 4000                  | 6000         | 4.5                                     | 20                | 1.3             | 14   |
| 515   | 13       | 14        | 2.4      | 2.7  | C002_0058 LM401U | 25         | 42         | 5.824 | 99/17       | 4000                      | 4000                  | 6000         | 1.8                                     | 20                | 1.3             | 10   |
| 515   | 25       | 25        | 4.7      | 1.6  | C002_0058 LM402U | 55         | 110        | 5.824 | 99/17       | 4000                      | 4000                  | 6000         | 3.2                                     | 20                | 1.3             | 12   |
| 515   | 34       | 35        | 6.5      | 1.1  | C002_0058 LM403U | 65         | 110        | 5.824 | 99/17       | 4000                      | 4000                  | 6000         | 4.5                                     | 20                | 1.3             | 14   |
| 593   | 11       | 12        | 2.4      | 2.7  | C002_0051 LM401U | 22         | 37         | 5.063 | 481/95      | 4000                      | 4000                  | 6000         | 1.9                                     | 20                | 1.3             | 10   |
| 593   | 22       | 22        | 4.6      | 1.7  | C002_0051 LM402U | 48         | 110        | 5.063 | 481/95      | 4000                      | 4000                  | 6000         | 3.2                                     | 20                | 1.3             | 12   |
| 593   | 30       | 30        | 6.4      | 1.3  | C002_0051 LM403U | 63         | 110        | 5.063 | 481/95      | 4000                      | 4000                  | 6000         | 4.5                                     | 20                | 1.3             | 14   |
| 593   | 47       | 49        | 9.9      | 0.81 | C002_0051 LM503U | 65         | 110        | 5.063 | 481/95      | 4000                      | 4000                  | 6000         | 11                                      | 20                | 1.3             | 17   |
| 641   | 10       | 11        | 2.3      | 2.7  | C002_0047 LM401U | 20         | 34         | 4.680 | 117/25      | 4000                      | 4000                  | 6000         | 1.9                                     | 20                | 1.3             | 10   |
| 641   | 20       | 20        | 4.6      | 1.8  | C002_0047 LM402U | 44         | 110        | 4.680 | 117/25      | 4000                      | 4000                  | 6000         | 3.2                                     | 20                | 1.3             | 12   |
| 641   | 28       | 28        | 6.3      | 1.3  | C002_0047 LM403U | 58         | 110        | 4.680 | 117/25      | 4000                      | 4000                  | 6000         | 4.5                                     | 20                | 1.3             | 14   |
| 641   | 43       | 46        | 9.8      | 0.85 | C002_0047 LM503U | 65         | 110        | 4.680 | 117/25      | 4000                      | 4000                  | 6000         | 11                                      | 20                | 1.3             | 17   |
| 723   | 9.1      | 9.8       | 2.3      | 2.7  | C002_0041 LM401U | 18         | 30         | 4.149 | 1813/437    | 3700                      | 3600                  | 6000         | 1.9                                     | 20                | 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                | 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                | 1.3             | 14   |
| 723   | 38       | 41        | 9.6      | 0.92 | C002_0041 LM503U | 65         | 110        | 4.149 | 1813/437    | 3700                      | 3600                  | 6000         | 11                                      | 20                | 1.3             | 17   |
| 782   | 8.4      | 9.0       | 2.3      | 2.7  | C002_0038 LM401U | 17         | 28         | 3.835 | 441/115     | 3700                      | 3600                  | 6000         | 1.9                                     | 20                | 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                | 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                | 1.3             | 14   |
| 782   | 35       | 37        | 9.5      | 0.97 | C002_0038 LM503U | 65         | 110        | 3.835 | 441/115     | 3700                      | 3600                  | 6000         | 11                                      | 20                | 1.3             | 17   |
| 904   | 7.2      | 7.8       | 2.2      | 2.7  | C002_0033 LM401U | 15         | 24         | 3.318 | 1702/513    | 3700                      | 3600                  | 6000         | 2.0                                     | 20                | 1.3             | 10   |
| 904   | 14       | 14        | 4.3      | 2.3  | C002_0033 LM402U | 31         | 97         | 3.318 | 1702/513    | 3700                      | 3600                  | 6000         | 3.4                                     | 20                | 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                | 1.3             | 14   |
| 904   | 31       | 32        | 9.3      | 1.1  | C002_0033 LM503U | 62         | 97         | 3.318 | 1702/513    | 3700                      | 3600                  | 6000         | 11                                      | 20                | 1.3             | 17   |
| 978   | 6.7      | 7.2       | 2.2      | 2.7  | C002_0031 LM401U | 13         | 22         | 3.067 | 46/15       | 3700                      | 3600                  | 6000         | 2.0                                     | 20                | 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                | 1.3             | 12   |

8.2 Selection tables 8 C helical geared motors

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,3,4 | $n_{1maxDB}$<br>EL5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>C0 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 72</math> Nm)</b>  |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 978  | 18       | 18        | 5.8      | 1.8  | C002_0031 LM403U | 38         | 89         | 3.067 | 46/15       | 3700                      | 3600                  | 6000         | 4.7                                     | 20                | 1.3             | 14   |
| 978  | 28       | 30        | 9.1      | 1.1  | C002_0031 LM503U | 60         | 89         | 3.067 | 46/15       | 3700                      | 3600                  | 6000         | 11                                      | 20                | 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                | 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                | 1.3             | 14   |
| 1083   | 25       | 27        | 9.0      | 1.2  | C002_0028 LM503U | 55         | 81         | 2.769 | 36/13       | 3500                      | 3000                  | 6000         | 11                                      | 20                | 1.3             | 17   |
| 1083   | 37       | 42        | 13       | 0.83 | C002_0028 LM505U | 58         | 81         | 2.769 | 36/13       | 3500                      | 3000                  | 6000         | 17                                      | 20                | 1.3             | 21   |
| 1502   | 4.4      | 4.7       | 2.0      | 2.7  | C002_0020 LM401U | 8.7        | 15         | 1.997 | 1480/741    | 3500                      | 3000                  | 6000         | 2.4                                     | 20                | 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                | 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                | 1.3             | 14   |
| 1502   | 18       | 20        | 8.5      | 1.5  | C002_0020 LM503U | 39         | 58         | 1.997 | 1480/741    | 3500                      | 3000                  | 6000         | 11                                      | 20                | 1.3             | 17   |
| 1502   | 27       | 30        | 12       | 1.0  | C002_0020 LM505U | 46         | 58         | 1.997 | 1480/741    | 3500                      | 3000                  | 6000         | 17                                      | 20                | 1.3             | 21   |
| <b>C1 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 140</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 53   | 123      | 133       | 2.7      | 0.98 | C102_0560 LM401U | 140        | 240        | 56.36 | 620/11      | 4000                      | 3900                  | 6000         | 1.7                                     | 15                | 3.9             | 15   |
| 60   | 109      | 118       | 2.6      | 1.1  | C102_0500 LM401U | 140        | 240        | 49.94 | 899/18      | 4000                      | 3900                  | 6000         | 1.7                                     | 15                | 3.9             | 15   |
| 64   | 102      | 111       | 2.5      | 1.2  | C102_0470 LM401U | 140        | 240        | 46.91 | 516/11      | 4000                      | 3900                  | 6000         | 1.7                                     | 15                | 3.9             | 15   |
| 72   | 91       | 98        | 2.3      | 1.3  | C102_0420 LM401U | 140        | 230        | 41.57 | 1247/30     | 4000                      | 3900                  | 6000         | 1.7                                     | 15                | 3.9             | 15   |
| 86   | 77       | 83        | 2.2      | 1.6  | C102_0350 LM401U | 140        | 220        | 35.07 | 2700/77     | 4000                      | 3900                  | 6000         | 1.8                                     | 15                | 3.9             | 15   |
| 97   | 68       | 73        | 2.0      | 1.8  | C102_0310 LM401U | 140        | 190        | 31.07 | 435/14      | 4000                      | 3900                  | 6000         | 1.8                                     | 15                | 3.9             | 15   |
| 97   | 133      | 136       | 4.0      | 0.90 | C102_0310 LM402U | 140        | 240        | 31.07 | 435/14      | 4000                      | 3900                  | 6000         | 3.1                                     | 15                | 3.9             | 17   |
| 106  | 121      | 124       | 3.8      | 0.99 | C102_0280 LM402U | 140        | 240        | 28.36 | 312/11      | 4000                      | 3900                  | 6000         | 3.2                                     | 15                | 3.9             | 17   |
| 119  | 108      | 110       | 3.6      | 1.1  | C102_0250 LM402U | 140        | 240        | 25.13 | 377/15      | 4000                      | 3900                  | 6000         | 3.2                                     | 15                | 3.9             | 17   |
| 128  | 51       | 55        | 1.8      | 2.3  | C102_0240 LM401U | 100        | 170        | 23.52 | 1035/44     | 4000                      | 3900                  | 6000         | 1.9                                     | 15                | 3.9             | 15   |
| 128  | 101      | 103       | 3.5      | 1.2  | C102_0240 LM402U | 140        | 240        | 23.52 | 1035/44     | 4000                      | 3900                  | 6000         | 3.2                                     | 15                | 3.9             | 17   |
| 144  | 45       | 49        | 1.7      | 2.6  | C102_0210 LM401U | 91         | 150        | 20.84 | 667/32      | 4000                      | 3900                  | 6000         | 1.9                                     | 15                | 3.9             | 15   |
| 144  | 89       | 91        | 3.3      | 1.3  | C102_0210 LM402U | 140        | 240        | 20.84 | 667/32      | 4000                      | 3900                  | 6000         | 3.2                                     | 15                | 3.9             | 17   |
| 144  | 123      | 125       | 4.5      | 0.98 | C102_0210 LM403U | 140        | 240        | 20.84 | 667/32      | 4000                      | 3900                  | 6000         | 4.5                                     | 15                | 3.9             | 19   |
| 169  | 39       | 42        | 1.5      | 2.7  | C102_0175 LM401U | 78         | 130        | 17.73 | 195/11      | 3800                      | 3500                  | 6000         | 2.0                                     | 15                | 3.9             | 15   |
| 169  | 76       | 77        | 3.0      | 1.6  | C102_0175 LM402U | 140        | 240        | 17.73 | 195/11      | 3800                      | 3500                  | 6000         | 3.3                                     | 15                | 3.9             | 17   |
| 169  | 104      | 106       | 4.1      | 1.2  | C102_0175 LM403U | 140        | 240        | 17.73 | 195/11      | 3800                      | 3500                  | 6000         | 4.6                                     | 15                | 3.9             | 19   |
| 191  | 34       | 37        | 1.4      | 2.7  | C102_0155 LM401U | 69         | 110        | 15.71 | 377/24      | 3800                      | 3500                  | 6000         | 2.0                                     | 15                | 3.9             | 15   |
| 191  | 67       | 69        | 2.8      | 1.8  | C102_0155 LM402U | 140        | 240        | 15.71 | 377/24      | 3800                      | 3500                  | 6000         | 3.3                                     | 15                | 3.9             | 17   |
| 191  | 92       | 94        | 3.9      | 1.3  | C102_0155 LM403U | 140        | 240        | 15.71 | 377/24      | 3800                      | 3500                  | 6000         | 4.6                                     | 15                | 3.9             | 19   |
| 213  | 60       | 61        | 2.7      | 2.0  | C102_0140 LM402U | 130        | 240        | 14.06 | 2010/143    | 3800                      | 3500                  | 6000         | 3.4                                     | 15                | 3.9             | 17   |
| 213  | 83       | 84        | 3.7      | 1.5  | C102_0140 LM403U | 140        | 240        | 14.06 | 2010/143    | 3800                      | 3500                  | 6000         | 4.7                                     | 15                | 3.9             | 19   |
| 213  | 129      | 137       | 5.7      | 0.93 | C102_0140 LM503U | 140        | 240        | 14.06 | 2010/143    | 3800                      | 3500                  | 6000         | 11                                      | 15                | 3.9             | 21   |
| 241  | 53       | 54        | 2.5      | 2.2  | C102_0125 LM402U | 120        | 240        | 12.46 | 1943/156    | 3800                      | 3500                  | 6000         | 3.4                                     | 15                | 3.9             | 17   |
| 241  | 73       | 75        | 3.5      | 1.6  | C102_0125 LM403U | 140        | 240        | 12.46 | 1943/156    | 3800                      | 3500                  | 6000         | 4.7                                     | 15                | 3.9             | 19   |
| 241  | 115      | 122       | 5.4      | 1.0  | C102_0125 LM503U | 140        | 240        | 12.46 | 1943/156    | 3800                      | 3500                  | 6000         | 11                                      | 15                | 3.9             | 21   |
| 256  | 26       | 28        | 1.3      | 2.7  | C102_0115 LM401U | 51         | 85         | 11.72 | 1160/99     | 3600                      | 3100                  | 6000         | 2.2                                     | 15                | 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                | 3.9             | 17   |
| 256  | 69       | 70        | 3.4      | 1.7  | C102_0115 LM403U | 140        | 240        | 11.72 | 1160/99     | 3600                      | 3100                  | 6000         | 4.8                                     | 15                | 3.9             | 19   |
| 256  | 108      | 114       | 5.4      | 1.1  | C102_0115 LM503U | 140        | 240        | 11.72 | 1160/99     | 3600                      | 3100                  | 6000         | 11                                      | 15                | 3.9             | 21   |
| 289  | 23       | 24        | 1.3      | 2.7  | C102_0105 LM401U | 45         | 76         | 10.38 | 841/81      | 3600                      | 3100                  | 6000         | 2.2                                     | 15                | 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                | 3.9             | 17   |
| 289  | 61       | 62        | 3.4      | 1.8  | C102_0105 LM403U | 130        | 240        | 10.38 | 841/81      | 3600                      | 3100                  | 6000         | 4.9                                     | 15                | 3.9             | 19   |
| 289  | 95       | 101       | 5.3      | 1.2  | C102_0105 LM503U | 140        | 240        | 10.38 | 841/81      | 3600                      | 3100                  | 6000         | 11                                      | 15                | 3.9             | 21   |
| 322  | 40       | 41        | 2.4      | 2.7  | C102_0093 LM402U | 88         | 240        | 9.326 | 3180/341    | 3600                      | 3100                  | 6000         | 3.7                                     | 15                | 3.9             | 17   |
| 322  | 55       | 56        | 3.3      | 2.0  | C102_0093 LM403U | 120        | 240        | 9.326 | 3180/341    | 3600                      | 3100                  | 6000         | 5.0                                     | 15                | 3.9             | 19   |
| 322  | 86       | 91        | 5.2      | 1.3  | C102_0093 LM503U | 140        | 240        | 9.326 | 3180/341    | 3600                      | 3100                  | 6000         | 11                                      | 15                | 3.9             | 21   |
| 363  | 35       | 36        | 2.4      | 3.0  | C102_0083 LM402U | 78         | 240        | 8.263 | 1537/186    | 3600                      | 3100                  | 6000         | 3.7                                     | 15                | 3.9             | 17   |
| 363  | 49       | 50        | 3.2      | 2.1  | C102_0083 LM403U | 100        | 240        | 8.263 | 1537/186    | 3600                      | 3100                  | 6000         | 5.0                                     | 15                | 3.9             | 19   |
| 363  | 76       | 81        | 5.1      | 1.4  | C102_0083 LM503U | 140        | 240        | 8.263 | 1537/186    | 3600                      | 3100                  | 6000         | 11                                      | 15                | 3.9             | 21   |
| 363  | 110      | 124       | 7.3      | 0.95 | C102_0083 LM505U | 140        | 240        | 8.263 | 1537/186    | 3600                      | 3100                  | 6000         | 17                                      | 15                | 3.9             | 26   |
| 385  | 17       | 18        | 1.4      | 2.7  | C102_0078 LM401U | 34         | 57         | 7.796 | 3243/416    | 4000                      | 3900                  | 6000         | 1.9                                     | 18                | 3.1             | 15   |
| 385  | 33       | 34        | 2.8      | 2.6  | C102_0078 LM402U | 73         | 210        | 7.796 | 3243/416    | 4000                      | 3900                  | 6000         | 3.3                                     | 18                | 3.1             | 17   |
| 385  | 46       | 47        | 3.8      | 1.9  | C102_0078 LM403U | 97         | 210        | 7.796 | 3243/416    | 4000                      | 3900                  | 6000         | 4.6                                     | 18                | 3.1             | 19   |
| 385  | 72       | 76        | 5.9      | 1.2  | C102_0078 LM503U | 130        | 210        | 7.796 | 3243/416    | 4000                      | 3900                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 385  | 104      | 117       | 8.6      | 0.84 | C102_0078 LM505U | 130        | 210        | 7.796 | 3243/416    | 4000                      | 3900                  | 6000         | 17                                      | 18                | 3.1             | 26   |
| 473  | 14       | 15        | 1.4      | 2.7  | C102_0063 LM401U | 28         | 46         | 6.338 | 507/80      | 3800                      | 3500                  | 6000         | 2.1                                     | 18                | 3.1             | 15   |
| 473  | 27       | 28        | 2.7      | 3.0  | C102_0063 LM402U | 60         | 180        | 6.338 | 507/80      | 3800                      | 3500                  | 6000         | 3.4                                     | 18                | 3.1             | 17   |
| 473  | 37       | 38        | 3.7      | 2.2  | C102_0063 LM403U | 79         | 180        | 6.338 | 507/80      | 3800                      | 3500                  | 6000         | 4.7                                     | 18                | 3.1             | 19   |
| 473  | 58       | 62        | 5.7      | 1.4  | C102_0063 LM503U | 130        | 180        | 6.338 | 507/80      | 3800                      | 3500                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 473  | 84       | 95        | 8.3      | 0.96 | C102_0063 LM505U | 130        | 180        | 6.338 | 507/80      | 3800                      | 3500                  | 6000         | 17                                      | 18                | 3.1             | 26   |
| 511  | 13       | 14        | 1.3      | 2.7  | C102_0059 LM401U | 26         | 43         | 5.875 | 47/8        | 3800                      | 3500                  | 6000         | 2.1                                     | 18                | 3.1             | 15   |

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,3,4 | $n_{1maxEB}$<br>EL5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>C1 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 140</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 511  | 25       | 26        | 2.6      | 3.1  | C102_0059 LM402U | 55         | 170        | 5.875 | 47/8        | 3800                      | 3500                  | 6000         | 3.4                                     | 18                | 3.1             | 17   |
| 511  | 35       | 35        | 3.6      | 2.3  | C102_0059 LM403U | 73         | 170        | 5.875 | 47/8        | 3800                      | 3500                  | 6000         | 4.7                                     | 18                | 3.1             | 19   |
| 511  | 54       | 57        | 5.7      | 1.5  | C102_0059 LM503U | 120        | 170        | 5.875 | 47/8        | 3800                      | 3500                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 511  | 78       | 88        | 8.2      | 1.0  | C102_0059 LM505U | 130        | 170        | 5.875 | 47/8        | 3800                      | 3500                  | 6000         | 17                                      | 18                | 3.1             | 26   |
| 597  | 21       | 22        | 2.6      | 3.5  | C102_0050 LM402U | 47         | 150        | 5.025 | 201/40      | 3800                      | 3500                  | 6000         | 3.5                                     | 18                | 3.1             | 17   |
| 597  | 30       | 30        | 3.5      | 2.5  | C102_0050 LM403U | 63         | 150        | 5.025 | 201/40      | 3800                      | 3500                  | 6000         | 4.8                                     | 18                | 3.1             | 19   |
| 597  | 46       | 49        | 5.5      | 1.6  | C102_0050 LM503U | 99         | 150        | 5.025 | 201/40      | 3800                      | 3500                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 597  | 67       | 75        | 8.0      | 1.1  | C102_0050 LM505U | 120        | 150        | 5.025 | 201/40      | 3800                      | 3500                  | 6000         | 17                                      | 18                | 3.1             | 26   |
| 644  | 20       | 20        | 2.5      | 3.7  | C102_0047 LM402U | 44         | 140        | 4.658 | 3149/676    | 3800                      | 3500                  | 6000         | 3.6                                     | 18                | 3.1             | 17   |
| 644  | 27       | 28        | 3.5      | 2.7  | C102_0047 LM403U | 58         | 140        | 4.658 | 3149/676    | 3800                      | 3500                  | 6000         | 4.9                                     | 18                | 3.1             | 19   |
| 644  | 43       | 45        | 5.4      | 1.7  | C102_0047 LM503U | 92         | 140        | 4.658 | 3149/676    | 3800                      | 3500                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 644  | 62       | 70        | 7.9      | 1.2  | C102_0047 LM505U | 110        | 140        | 4.658 | 3149/676    | 3800                      | 3500                  | 6000         | 17                                      | 18                | 3.1             | 26   |
| 644  | 87       | 96        | 11       | 0.84 | C102_0047 LM704U | 130        | 220        | 4.658 | 3149/676    | 3800                      | 3500                  | 6000         | 37                                      | 18                | 3.1             | 32   |
| 716  | 9.1      | 9.9       | 1.3      | 2.7  | C102_0042 LM401U | 18         | 30         | 4.189 | 377/90      | 3600                      | 3100                  | 6000         | 2.4                                     | 18                | 3.1             | 15   |
| 716  | 18       | 18        | 2.5      | 3.9  | C102_0042 LM402U | 39         | 120        | 4.189 | 377/90      | 3600                      | 3100                  | 6000         | 3.7                                     | 18                | 3.1             | 17   |
| 716  | 25       | 25        | 3.4      | 2.9  | C102_0042 LM403U | 52         | 120        | 4.189 | 377/90      | 3600                      | 3100                  | 6000         | 5.0                                     | 18                | 3.1             | 19   |
| 716  | 39       | 41        | 5.3      | 1.8  | C102_0042 LM503U | 83         | 120        | 4.189 | 377/90      | 3600                      | 3100                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 716  | 56       | 63        | 7.7      | 1.3  | C102_0042 LM505U | 98         | 120        | 4.189 | 377/90      | 3600                      | 3100                  | 6000         | 17                                      | 18                | 3.1             | 26   |
| 716  | 78       | 86        | 11       | 0.90 | C102_0042 LM704U | 130        | 220        | 4.189 | 377/90      | 3600                      | 3100                  | 6000         | 37                                      | 18                | 3.1             | 32   |
| 773  | 8.5      | 9.2       | 1.3      | 2.7  | C102_0039 LM401U | 17         | 28         | 3.883 | 1363/351    | 3600                      | 3100                  | 6000         | 2.4                                     | 18                | 3.1             | 15   |
| 773  | 17       | 17        | 2.5      | 4.1  | C102_0039 LM402U | 37         | 110        | 3.883 | 1363/351    | 3600                      | 3100                  | 6000         | 3.7                                     | 18                | 3.1             | 17   |
| 773  | 23       | 23        | 3.4      | 3.0  | C102_0039 LM403U | 48         | 110        | 3.883 | 1363/351    | 3600                      | 3100                  | 6000         | 5.0                                     | 18                | 3.1             | 19   |
| 773  | 36       | 38        | 5.3      | 1.9  | C102_0039 LM503U | 77         | 110        | 3.883 | 1363/351    | 3600                      | 3100                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 773  | 52       | 58        | 7.6      | 1.3  | C102_0039 LM505U | 90         | 110        | 3.883 | 1363/351    | 3600                      | 3100                  | 6000         | 17                                      | 18                | 3.1             | 26   |
| 773  | 73       | 80        | 11       | 0.95 | C102_0039 LM704U | 130        | 220        | 3.883 | 1363/351    | 3600                      | 3100                  | 6000         | 37                                      | 18                | 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                | 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                | 3.1             | 19   |
| 900  | 31       | 33        | 5.2      | 2.1  | C102_0033 LM503U | 66         | 97         | 3.334 | 2067/620    | 3600                      | 3100                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 900  | 44       | 50        | 7.4      | 1.5  | C102_0033 LM505U | 78         | 97         | 3.334 | 2067/620    | 3600                      | 3100                  | 6000         | 18                                      | 18                | 3.1             | 26   |
| 900  | 62       | 69        | 10       | 1.0  | C102_0033 LM704U | 120        | 220        | 3.334 | 2067/620    | 3600                      | 3100                  | 6000         | 37                                      | 18                | 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                | 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                | 3.1             | 19   |
| 971  | 28       | 30        | 5.1      | 2.2  | C102_0031 LM503U | 61         | 90         | 3.091 | 2491/806    | 3600                      | 3100                  | 6000         | 11                                      | 18                | 3.1             | 21   |
| 971  | 41       | 46        | 7.3      | 1.5  | C102_0031 LM505U | 72         | 90         | 3.091 | 2491/806    | 3600                      | 3100                  | 6000         | 18                                      | 18                | 3.1             | 26   |
| 971  | 58       | 64        | 10       | 1.1  | C102_0031 LM704U | 120        | 220        | 3.091 | 2491/806    | 3600                      | 3100                  | 6000         | 37                                      | 18                | 3.1             | 32   |
| 971  | 77       | 89        | 14       | 0.83 | C102_0031 LM706U | 120        | 220        | 3.091 | 2491/806    | 3600                      | 3100                  | 6000         | 55                                      | 18                | 3.1             | 39   |
| 1162   | 48       | 53        | 10       | 1.2  | C102_0026 LM704U | 100        | 190        | 2.582 | 1911/740    | 3100                      | 2600                  | 5000         | 38                                      | 18                | 3.1             | 32   |
| 1162   | 64       | 75        | 13       | 0.93 | C102_0026 LM706U | 110        | 190        | 2.582 | 1911/740    | 3100                      | 2600                  | 5000         | 55                                      | 18                | 3.1             | 39   |
| 1253   | 45       | 49        | 9.9      | 1.3  | C102_0024 LM704U | 96         | 170        | 2.394 | 2303/962    | 3100                      | 2600                  | 5000         | 38                                      | 18                | 3.1             | 32   |
| 1253   | 60       | 69        | 13       | 0.98 | C102_0024 LM706U | 110        | 170        | 2.394 | 2303/962    | 3100                      | 2600                  | 5000         | 55                                      | 18                | 3.1             | 39   |
| 1378   | 13       | 13        | 3.1      | 4.0  | C102_0022 LM403U | 27         | 63         | 2.177 | 468/215     | 3100                      | 2600                  | 5000         | 6.1                                     | 18                | 3.1             | 19   |
| 1378   | 20       | 21        | 4.8      | 2.5  | C102_0022 LM503U | 43         | 63         | 2.177 | 468/215     | 3100                      | 2600                  | 5000         | 12                                      | 18                | 3.1             | 21   |
| 1378   | 29       | 33        | 6.9      | 1.8  | C102_0022 LM505U | 51         | 63         | 2.177 | 468/215     | 3100                      | 2600                  | 5000         | 19                                      | 18                | 3.1             | 26   |
| 1378   | 41       | 45        | 9.8      | 1.4  | C102_0022 LM704U | 87         | 160        | 2.177 | 468/215     | 3100                      | 2600                  | 5000         | 38                                      | 18                | 3.1             | 32   |
| 1378   | 54       | 63        | 13       | 1.0  | C102_0022 LM706U | 110        | 160        | 2.177 | 468/215     | 3100                      | 2600                  | 5000         | 56                                      | 18                | 3.1             | 39   |
| 1487   | 12       | 12        | 3.0      | 4.0  | C102_0020 LM403U | 25         | 59         | 2.018 | 1128/559    | 3100                      | 2600                  | 5000         | 6.2                                     | 18                | 3.1             | 19   |
| 1487   | 19       | 20        | 4.7      | 2.5  | C102_0020 LM503U | 40         | 59         | 2.018 | 1128/559    | 3100                      | 2600                  | 5000         | 12                                      | 18                | 3.1             | 21   |
| 1487   | 27       | 30        | 6.8      | 1.8  | C102_0020 LM505U | 47         | 59         | 2.018 | 1128/559    | 3100                      | 2600                  | 5000         | 19                                      | 18                | 3.1             | 26   |
| 1487   | 38       | 42        | 9.6      | 1.5  | C102_0020 LM704U | 81         | 150        | 2.018 | 1128/559    | 3100                      | 2600                  | 5000         | 38                                      | 18                | 3.1             | 32   |
| 1487   | 50       | 58        | 13       | 1.1  | C102_0020 LM706U | 100        | 150        | 2.018 | 1128/559    | 3100                      | 2600                  | 5000         | 56                                      | 18                | 3.1             | 39   |
| <b>C2 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 230</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 32   | 199      | 215       | 2.3      | 1.0  | C203_0920 LM401U | 230        | 400        | 92.40 | 29939/324   | 4000                      | 3900                  | 6000         | 1.7                                     | 14                | 8.3             | 24   |
| 37   | 173      | 187       | 2.1      | 1.2  | C203_0810 LM401U | 230        | 400        | 80.62 | 11609/144   | 4000                      | 3900                  | 6000         | 1.7                                     | 14                | 8.3             | 24   |
| 43   | 153      | 166       | 2.0      | 1.3  | C202_0700 LM401U | 230        | 310        | 70.32 | 7595/108    | 4000                      | 3900                  | 6000         | 1.7                                     | 14                | 8.3             | 19   |
| 49   | 134      | 145       | 2.0      | 1.4  | C202_0610 LM401U | 220        | 270        | 61.35 | 2945/48     | 4000                      | 3900                  | 6000         | 1.7                                     | 14                | 8.3             | 19   |
| 61   | 211      | 215       | 3.3      | 0.95 | C202_0490 LM402U | 230        | 400        | 49.23 | 1083/22     | 4000                      | 3900                  | 6000         | 3.1                                     | 14                | 8.3             | 21   |
| 64   | 200      | 204       | 3.2      | 1.0  | C202_0470 LM402U | 230        | 400        | 46.82 | 2107/45     | 4000                      | 3900                  | 6000         | 3.2                                     | 14                | 8.3             | 21   |
| 73   | 175      | 178       | 3.0      | 1.1  | C202_0410 LM402U | 230        | 400        | 40.85 | 817/20      | 4000                      | 3900                  | 6000         | 3.2                                     | 14                | 8.3             | 21   |
| 85   | 150      | 154       | 2.8      | 1.3  | C202_0350 LM402U | 230        | 400        | 35.18 | 1372/39     | 4000                      | 3900                  | 6000         | 3.2                                     | 14                | 8.3             | 21   |
| 85   | 207      | 211       | 3.8      | 0.97 | C202_0350 LM403U | 230        | 400        | 35.18 | 1372/39     | 4000                      | 3900                  | 6000         | 4.5                                     | 14                | 8.3             | 23   |
| 98   | 131      | 134       | 2.6      | 1.5  | C202_0310 LM402U | 230        | 400        | 30.69 | 399/13      | 4000                      | 3900                  | 6000         | 3.2                                     | 14                | 8.3             | 21   |
| 98   | 180      | 184       | 3.6      | 1.1  | C202_0310 LM403U | 230        | 400        | 30.69 | 399/13      | 4000                      | 3900                  | 6000         | 4.5                                     | 14                | 8.3             | 23   |
| 106  | 121      | 123       | 2.5      | 1.7  | C202_0280 LM402U | 230        | 400        | 28.24 | 4067/144    | 4000                      | 3900                  | 6000         | 3.3                                     | 14                | 8.3             | 21   |
| 106  | 166      | 170       | 3.4      | 1.2  | C202_0280 LM403U | 230        | 400        | 28.24 | 4067/144    | 4000                      | 3900                  | 6000         | 4.6                                     | 14                | 8.3             | 23   |



8.2 Selection tables 8 C helical geared motors

| n <sub>2N</sub>   | M <sub>2N</sub> | M <sub>2,0</sub> | a <sub>th</sub> | S    | Type             | M <sub>2acc</sub> | M <sub>2NOT</sub> | i     | i <sub>exakt</sub> | n <sub>1maxDB</sub><br>EL1,2,3,4 | n <sub>1maxDB</sub><br>EL5,6 | n <sub>1maxZB</sub> | J <sub>1</sub>                          | Δφ <sub>2</sub> | C <sub>2</sub>  | m    |
|---|-----------------|------------------|-----------------|------|------------------|-------------------|-------------------|-------|--------------------|----------------------------------|------------------------------|---------------------|---|-----------------|-----------------|------|
| [rpm]   | [Nm]            | [Nm]             |                 |      |                  | [Nm]              | [Nm]              |       |                    | [rpm]                            | [rpm]                        | [rpm]               | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]        | [Nm/<br>arcmin] | [kg] |
| C2 (n <sub>1N</sub> = 3000 rpm, M <sub>2acc,max</sub> = 230 Nm) |                 |                  |                 |      |                  |                   |                   |       |                    |                                  |                              |                     |   |                 |                 |      |
| 122   | 105             | 108              | 2.3             | 1.9  | C202_0250 LM402U | 230               | 400               | 24.64 | 1577/64            | 4000                             | 3900                         | 6000                | 3.3                                     | 14              | 8.3             | 21   |
| 122   | 145             | 148              | 3.2             | 1.4  | C202_0250 LM403U | 230               | 400               | 24.64 | 1577/64            | 4000                             | 3900                         | 6000                | 4.6                                     | 14              | 8.3             | 23   |
| 127   | 101             | 103              | 2.3             | 2.0  | C202_0240 LM402U | 220               | 400               | 23.59 | 637/27             | 4000                             | 3900                         | 6000                | 3.4                                     | 14              | 8.3             | 21   |
| 127   | 139             | 142              | 3.1             | 1.4  | C202_0240 LM403U | 230               | 400               | 23.59 | 637/27             | 4000                             | 3900                         | 6000                | 4.7                                     | 14              | 8.3             | 23   |
| 127   | 217             | 230              | 4.9             | 0.92 | C202_0240 LM503U | 230               | 400               | 23.59 | 637/27             | 4000                             | 3900                         | 6000                | 11                                      | 14              | 8.3             | 25   |
| 146   | 88              | 90               | 2.1             | 2.3  | C202_0210 LM402U | 190               | 400               | 20.58 | 247/12             | 4000                             | 3900                         | 6000                | 3.4                                     | 14              | 8.3             | 21   |
| 146   | 121             | 124              | 2.9             | 1.7  | C202_0210 LM403U | 230               | 400               | 20.58 | 247/12             | 4000                             | 3900                         | 6000                | 4.7                                     | 14              | 8.3             | 23   |
| 146   | 189             | 201              | 4.6             | 1.1  | C202_0210 LM503U | 230               | 400               | 20.58 | 247/12             | 4000                             | 3900                         | 6000                | 11                                      | 14              | 8.3             | 25   |
| 171   | 75              | 76               | 2.0             | 2.7  | C202_0175 LM402U | 160               | 400               | 17.52 | 3626/207           | 3700                             | 3500                         | 5500                | 3.6                                     | 14              | 8.3             | 21   |
| 171   | 103             | 105              | 2.7             | 1.9  | C202_0175 LM403U | 220               | 400               | 17.52 | 3626/207           | 3700                             | 3500                         | 5500                | 4.9                                     | 14              | 8.3             | 23   |
| 171   | 161             | 171              | 4.2             | 1.2  | C202_0175 LM503U | 230               | 400               | 17.52 | 3626/207           | 3700                             | 3500                         | 5500                | 11                                      | 14              | 8.3             | 25   |
| 196   | 65              | 67               | 1.8             | 3.1  | C202_0155 LM402U | 140               | 400               | 15.28 | 703/46             | 3700                             | 3500                         | 5500                | 3.7                                     | 14              | 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              | 8.3             | 23   |
| 196   | 141             | 149              | 4.0             | 1.4  | C202_0155 LM503U | 230               | 400               | 15.28 | 703/46             | 3700                             | 3500                         | 5500                | 11                                      | 14              | 8.3             | 25   |
| 196   | 203             | 229              | 5.7             | 0.99 | C202_0155 LM505U | 230               | 400               | 15.28 | 703/46             | 3700                             | 3500                         | 5500                | 17                                      | 14              | 8.3             | 30   |
| 213   | 60              | 62               | 1.8             | 3.3  | C202_0140 LM402U | 130               | 400               | 14.12 | 3430/243           | 3700                             | 3500                         | 5500                | 3.9                                     | 14              | 8.3             | 21   |
| 213   | 83              | 85               | 2.4             | 2.4  | C202_0140 LM403U | 180               | 400               | 14.12 | 3430/243           | 3700                             | 3500                         | 5500                | 5.2                                     | 14              | 8.3             | 23   |
| 213   | 130             | 138              | 3.8             | 1.5  | C202_0140 LM503U | 230               | 400               | 14.12 | 3430/243           | 3700                             | 3500                         | 5500                | 11                                      | 14              | 8.3             | 25   |
| 213   | 188             | 212              | 5.5             | 1.1  | C202_0140 LM505U | 230               | 400               | 14.12 | 3430/243           | 3700                             | 3500                         | 5500                | 18                                      | 14              | 8.3             | 30   |
| 244   | 53              | 54               | 1.7             | 3.7  | C202_0125 LM402U | 120               | 360               | 12.32 | 665/54             | 3700                             | 3500                         | 5500                | 3.9                                     | 14              | 8.3             | 21   |
| 244   | 72              | 74               | 2.3             | 2.7  | C202_0125 LM403U | 150               | 360               | 12.32 | 665/54             | 3700                             | 3500                         | 5500                | 5.2                                     | 14              | 8.3             | 23   |
| 244   | 113             | 120              | 3.6             | 1.7  | C202_0125 LM503U | 230               | 360               | 12.32 | 665/54             | 3700                             | 3500                         | 5500                | 11                                      | 14              | 8.3             | 25   |
| 244   | 164             | 185              | 5.2             | 1.2  | C202_0125 LM505U | 230               | 360               | 12.32 | 665/54             | 3700                             | 3500                         | 5500                | 18                                      | 14              | 8.3             | 30   |
| 255   | 50              | 51               | 1.7             | 3.8  | C202_0120 LM402U | 110               | 340               | 11.76 | 294/25             | 3500                             | 3100                         | 5000                | 4.1                                     | 14              | 8.3             | 21   |
| 255   | 69              | 71               | 2.3             | 2.8  | C202_0120 LM403U | 150               | 340               | 11.76 | 294/25             | 3500                             | 3100                         | 5000                | 5.4                                     | 14              | 8.3             | 23   |
| 255   | 108             | 115              | 3.6             | 1.8  | C202_0120 LM503U | 230               | 340               | 11.76 | 294/25             | 3500                             | 3100                         | 5000                | 11                                      | 14              | 8.3             | 25   |
| 255   | 156             | 176              | 5.2             | 1.2  | C202_0120 LM505U | 230               | 340               | 11.76 | 294/25             | 3500                             | 3100                         | 5000                | 18                                      | 14              | 8.3             | 30   |
| 292   | 44              | 45               | 1.6             | 4.2  | C202_0105 LM402U | 97                | 300               | 10.26 | 513/50             | 3500                             | 3100                         | 5000                | 4.2                                     | 14              | 8.3             | 21   |
| 292   | 60              | 62               | 2.3             | 3.1  | C202_0105 LM403U | 130               | 300               | 10.26 | 513/50             | 3500                             | 3100                         | 5000                | 5.5                                     | 14              | 8.3             | 23   |
| 292   | 94              | 100              | 3.5             | 2.0  | C202_0105 LM503U | 200               | 300               | 10.26 | 513/50             | 3500                             | 3100                         | 5000                | 12                                      | 14              | 8.3             | 25   |
| 292   | 136             | 154              | 5.1             | 1.4  | C202_0105 LM505U | 230               | 300               | 10.26 | 513/50             | 3500                             | 3100                         | 5000                | 18                                      | 14              | 8.3             | 30   |
| 292   | 192             | 212              | 7.2             | 0.96 | C202_0105 LM704U | 230               | 400               | 10.26 | 513/50             | 3500                             | 3100                         | 5000                | 38                                      | 14              | 8.3             | 36   |
| 320   | 175             | 194              | 7.0             | 1.0  | C202_0094 LM704U | 230               | 400               | 9.387 | 2450/261           | 3500                             | 3100                         | 5000                | 38                                      | 14              | 8.3             | 36   |
| 366   | 153             | 169              | 6.9             | 1.1  | C202_0082 LM704U | 230               | 400               | 8.190 | 475/58             | 3500                             | 3100                         | 5000                | 38                                      | 14              | 8.3             | 36   |
| 385   | 33              | 34               | 2.0             | 4.0  | C202_0078 LM402U | 73                | 220               | 7.800 | 39/5               | 4000                             | 3900                         | 6000                | 3.5                                     | 17              | 6.0             | 21   |
| 385   | 46              | 47               | 2.7             | 2.9  | C202_0078 LM403U | 97                | 220               | 7.800 | 39/5               | 4000                             | 3900                         | 6000                | 4.8                                     | 17              | 6.0             | 23   |
| 385   | 72              | 76               | 4.3             | 1.8  | C202_0078 LM503U | 150               | 220               | 7.800 | 39/5               | 4000                             | 3900                         | 6000                | 11                                      | 17              | 6.0             | 25   |
| 385   | 104             | 117              | 6.2             | 1.3  | C202_0078 LM505U | 170               | 220               | 7.800 | 39/5               | 4000                             | 3900                         | 6000                | 17                                      | 17              | 6.0             | 30   |
| 385   | 146             | 161              | 8.7             | 0.91 | C202_0078 LM704U | 200               | 350               | 7.800 | 39/5               | 4000                             | 3900                         | 6000                | 37                                      | 17              | 6.0             | 36   |
| 477   | 27              | 27               | 1.9             | 4.6  | C202_0063 LM402U | 59                | 180               | 6.295 | 3330/529           | 3700                             | 3500                         | 5500                | 3.8                                     | 17              | 6.0             | 21   |
| 477   | 37              | 38               | 2.6             | 3.3  | C202_0063 LM403U | 78                | 180               | 6.295 | 3330/529           | 3700                             | 3500                         | 5500                | 5.1                                     | 17              | 6.0             | 23   |
| 477   | 58              | 61               | 4.1             | 2.1  | C202_0063 LM503U | 120               | 180               | 6.295 | 3330/529           | 3700                             | 3500                         | 5500                | 11                                      | 17              | 6.0             | 25   |
| 477   | 84              | 94               | 6.0             | 1.5  | C202_0063 LM505U | 150               | 180               | 6.295 | 3330/529           | 3700                             | 3500                         | 5500                | 18                                      | 17              | 6.0             | 30   |
| 477   | 118             | 130              | 8.4             | 1.0  | C202_0063 LM704U | 200               | 350               | 6.295 | 3330/529           | 3700                             | 3500                         | 5500                | 37                                      | 17              | 6.0             | 36   |
| 518   | 25              | 25               | 1.9             | 4.8  | C202_0058 LM402U | 54                | 170               | 5.791 | 666/115            | 3700                             | 3500                         | 5500                | 3.8                                     | 17              | 6.0             | 21   |
| 518   | 34              | 35               | 2.6             | 3.5  | C202_0058 LM403U | 72                | 170               | 5.791 | 666/115            | 3700                             | 3500                         | 5500                | 5.1                                     | 17              | 6.0             | 23   |
| 518   | 53              | 57               | 4.1             | 2.2  | C202_0058 LM503U | 110               | 170               | 5.791 | 666/115            | 3700                             | 3500                         | 5500                | 11                                      | 17              | 6.0             | 25   |
| 518   | 77              | 87               | 5.9             | 1.6  | C202_0058 LM505U | 130               | 170               | 5.791 | 666/115            | 3700                             | 3500                         | 5500                | 18                                      | 17              | 6.0             | 30   |
| 518   | 108             | 119              | 8.3             | 1.1  | C202_0058 LM704U | 200               | 350               | 5.791 | 666/115            | 3700                             | 3500                         | 5500                | 37                                      | 17              | 6.0             | 36   |
| 518   | 144             | 167              | 11              | 0.83 | C202_0058 LM706U | 200               | 350               | 5.791 | 666/115            | 3700                             | 3500                         | 5500                | 55                                      | 17              | 6.0             | 43   |
| 591   | 30              | 30               | 2.5             | 3.8  | C202_0051 LM403U | 63                | 150               | 5.072 | 350/69             | 3700                             | 3500                         | 5500                | 5.4                                     | 17              | 6.0             | 23   |
| 591   | 47              | 50               | 4.0             | 2.5  | C202_0051 LM503U | 100               | 150               | 5.072 | 350/69             | 3700                             | 3500                         | 5500                | 11                                      | 17              | 6.0             | 25   |
| 591   | 67              | 76               | 5.7             | 1.7  | C202_0051 LM505U | 120               | 150               | 5.072 | 350/69             | 3700                             | 3500                         | 5500                | 18                                      | 17              | 6.0             | 30   |
| 591   | 95              | 105              | 8.1             | 1.2  | C202_0051 LM704U | 200               | 350               | 5.072 | 350/69             | 3700                             | 3500                         | 5500                | 38                                      | 17              | 6.0             | 36   |
| 591   | 126             | 147              | 11              | 0.91 | C202_0051 LM706U | 200               | 350               | 5.072 | 350/69             | 3700                             | 3500                         | 5500                | 55                                      | 17              | 6.0             | 43   |
| 643   | 27              | 28               | 2.5             | 4.0  | C202_0047 LM403U | 58                | 140               | 4.667 | 14/3               | 3700                             | 3500                         | 5500                | 5.4                                     | 17              | 6.0             | 23   |
| 643   | 43              | 46               | 3.9             | 2.5  | C202_0047 LM503U | 92                | 140               | 4.667 | 14/3               | 3700                             | 3500                         | 5500                | 11                                      | 17              | 6.0             | 25   |
| 643   | 62              | 70               | 5.7             | 1.8  | C202_0047 LM505U | 110               | 140               | 4.667 | 14/3               | 3700                             | 3500                         | 5500                | 18                                      | 17              | 6.0             | 30   |
| 643   | 87              | 96               | 8.0             | 1.3  | C202_0047 LM704U | 190               | 340               | 4.667 | 14/3               | 3700                             | 3500                         | 5500                | 38                                      | 17              | 6.0             | 36   |
| 643   | 116             | 135              | 11              | 0.96 | C202_0047 LM706U | 200               | 340               | 4.667 | 14/3               | 3700                             | 3500                         | 5500                | 55                                      | 17              | 6.0             | 43   |
| 710   | 25              | 25               | 2.5             | 4.0  | C202_0042 LM403U | 53                | 120               | 4.226 | 486/115            | 3500                             | 3100                         | 5000                | 5.8                                     | 17              | 6.0             | 23   |
| 710   | 39              | 41               | 3.9             | 2.5  | C202_0042 LM503U | 84                | 120               | 4.226 | 486/115            | 3500                             | 3100                         | 5000                | 12                                      | 17              | 6.0             | 25   |
| 710   | 56              | 63               | 5.6             | 1.8  | C202_0042 LM505U | 98                | 120               | 4.226 | 486/115            | 3500                             | 3100                         | 5000                | 18                                      | 17              | 6.0             | 30   |
| 710   | 79              | 87               | 7.8             | 1.4  | C202_0042 LM704U | 170               | 310               | 4.226 | 486/115            | 3500                             | 3100                         | 5000                | 38                                      | 17              | 6.0             | 36   |



| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,3,4 | $n_{1maxEB}$<br>EL5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>C2 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 230</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 710  | 105      | 122       | 10       | 1.0  | C202_0042 LM706U | 200        | 310        | 4.226 | 486/115     | 3500                      | 3100                  | 5000         | 55                                      | 17                | 6.0             | 43   |
| 772  | 23       | 23        | 2.4      | 4.0  | C202_0039 LM403U | 48         | 110        | 3.888 | 486/125     | 3500                      | 3100                  | 5000         | 5.8                                     | 17                | 6.0             | 23   |
| 772  | 36       | 38        | 3.8      | 2.5  | C202_0039 LM503U | 77         | 110        | 3.888 | 486/125     | 3500                      | 3100                  | 5000         | 12                                      | 17                | 6.0             | 25   |
| 772  | 52       | 58        | 5.5      | 1.8  | C202_0039 LM505U | 91         | 110        | 3.888 | 486/125     | 3500                      | 3100                  | 5000         | 18                                      | 17                | 6.0             | 30   |
| 772  | 73       | 80        | 7.7      | 1.4  | C202_0039 LM704U | 160        | 280        | 3.888 | 486/125     | 3500                      | 3100                  | 5000         | 38                                      | 17                | 6.0             | 36   |
| 772  | 97       | 112       | 10       | 1.1  | C202_0039 LM706U | 200        | 280        | 3.888 | 486/125     | 3500                      | 3100                  | 5000         | 55                                      | 17                | 6.0             | 43   |
| 889  | 63       | 70        | 7.6      | 1.6  | C202_0034 LM704U | 130        | 250        | 3.373 | 2250/667    | 3500                      | 3100                  | 5000         | 38                                      | 17                | 6.0             | 36   |
| 889  | 84       | 98        | 10       | 1.2  | C202_0034 LM706U | 190        | 250        | 3.373 | 2250/667    | 3500                      | 3100                  | 5000         | 56                                      | 17                | 6.0             | 43   |
| 967  | 58       | 64        | 7.4      | 1.7  | C202_0031 LM704U | 120        | 230        | 3.103 | 90/29       | 3500                      | 3100                  | 5000         | 39                                      | 17                | 6.0             | 36   |
| 967  | 77       | 90        | 9.9      | 1.3  | C202_0031 LM706U | 180        | 230        | 3.103 | 90/29       | 3500                      | 3100                  | 5000         | 56                                      | 17                | 6.0             | 43   |
| 1115   | 50       | 55        | 7.3      | 1.8  | C202_0027 LM704U | 110        | 200        | 2.690 | 495/184     | 3000                      | 2600                  | 4500         | 39                                      | 17                | 6.0             | 36   |
| 1115   | 67       | 78        | 9.7      | 1.4  | C202_0027 LM706U | 160        | 200        | 2.690 | 495/184     | 3000                      | 2600                  | 4500         | 57                                      | 17                | 6.0             | 43   |
| 1212   | 46       | 51        | 7.2      | 1.9  | C202_0025 LM704U | 99         | 180        | 2.475 | 99/40       | 3000                      | 2600                  | 4500         | 39                                      | 17                | 6.0             | 36   |
| 1212   | 62       | 72        | 9.6      | 1.5  | C202_0025 LM706U | 140        | 180        | 2.475 | 99/40       | 3000                      | 2600                  | 4500         | 57                                      | 17                | 6.0             | 43   |
| 1374   | 41       | 45        | 7.0      | 2.1  | C202_0022 LM704U | 87         | 160        | 2.184 | 2160/989    | 3000                      | 2600                  | 4500         | 40                                      | 17                | 6.0             | 36   |
| 1374   | 54       | 63        | 9.4      | 1.6  | C202_0022 LM706U | 130        | 160        | 2.184 | 2160/989    | 3000                      | 2600                  | 4500         | 58                                      | 17                | 6.0             | 43   |
| 1493   | 38       | 41        | 6.9      | 2.2  | C202_0020 LM704U | 80         | 150        | 2.009 | 432/215     | 3000                      | 2600                  | 4500         | 40                                      | 17                | 6.0             | 36   |
| 1493   | 50       | 58        | 9.2      | 1.7  | C202_0020 LM706U | 120        | 150        | 2.009 | 432/215     | 3000                      | 2600                  | 4500         | 58                                      | 17                | 6.0             | 43   |
| <b>C3 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 400</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 22   | 295      | 319       | 1.7      | 1.2  | C303_1370 LM401U | 350        | 700        | 137.2 | 59267/432   | 3800                      | 3500                  | 5500         | 1.7                                     | 13                | 8.7             | 29   |
| 27   | 236      | 255       | 1.5      | 1.5  | C303_1100 LM401U | 350        | 700        | 109.6 | 94705/864   | 3800                      | 3500                  | 5500         | 1.8                                     | 13                | 8.7             | 29   |
| 33   | 198      | 214       | 1.4      | 1.8  | C303_0920 LM401U | 350        | 590        | 91.93 | 39715/432   | 3800                      | 3500                  | 5500         | 1.8                                     | 13                | 8.7             | 29   |
| 37   | 175      | 189       | 1.3      | 2.0  | C303_0810 LM401U | 350        | 520        | 81.47 | 1222/15     | 3800                      | 3500                  | 5500         | 1.8                                     | 13                | 8.7             | 29   |
| 37   | 343      | 350       | 2.6      | 1.0  | C303_0810 LM402U | 400        | 520        | 81.47 | 1222/15     | 3800                      | 3500                  | 5500         | 3.1                                     | 13                | 8.7             | 30   |
| 86   | 322      | 342       | 3.7      | 1.1  | C302_0350 LM503U | 350        | 700        | 35.03 | 1261/36     | 3800                      | 3500                  | 5500         | 11                                      | 13                | 8.7             | 31   |
| 97   | 285      | 303       | 3.5      | 1.2  | C302_0310 LM503U | 400        | 700        | 31.04 | 776/25      | 3800                      | 3500                  | 5500         | 11                                      | 13                | 8.7             | 31   |
| 107  | 257      | 273       | 3.3      | 1.4  | C302_0280 LM503U | 350        | 700        | 27.99 | 2015/72     | 3800                      | 3500                  | 5500         | 11                                      | 13                | 8.7             | 31   |
| 121  | 228      | 242       | 3.1      | 1.5  | C302_0250 LM503U | 400        | 670        | 24.80 | 124/5       | 3800                      | 3500                  | 5500         | 11                                      | 13                | 8.7             | 31   |
| 121  | 330      | 372       | 4.5      | 1.1  | C302_0250 LM505U | 400        | 670        | 24.80 | 124/5       | 3800                      | 3500                  | 5500         | 17                                      | 13                | 8.7             | 35   |
| 128  | 216      | 229       | 3.1      | 1.6  | C302_0230 LM503U | 350        | 680        | 23.47 | 845/36      | 3800                      | 3500                  | 5500         | 11                                      | 13                | 8.7             | 31   |
| 144  | 191      | 203       | 2.9      | 1.8  | C302_0210 LM503U | 400        | 610        | 20.80 | 104/5       | 3800                      | 3500                  | 5500         | 11                                      | 13                | 8.7             | 31   |
| 144  | 276      | 312       | 4.2      | 1.3  | C302_0210 LM505U | 400        | 610        | 20.80 | 104/5       | 3800                      | 3500                  | 5500         | 17                                      | 13                | 8.7             | 35   |
| 193  | 291      | 321       | 5.4      | 1.1  | C302_0155 LM704U | 400        | 700        | 15.54 | 544/35      | 3500                      | 3100                  | 5000         | 38                                      | 13                | 8.7             | 41   |
| 214  | 262      | 289       | 5.3      | 1.2  | C302_0140 LM704U | 350        | 700        | 13.99 | 2015/144    | 3500                      | 3100                  | 5000         | 38                                      | 13                | 8.7             | 41   |
| 242  | 232      | 256       | 5.2      | 1.3  | C302_0125 LM704U | 400        | 700        | 12.40 | 62/5        | 3500                      | 3100                  | 5000         | 38                                      | 13                | 8.7             | 41   |
| 242  | 309      | 358       | 6.9      | 0.99 | C302_0125 LM706U | 400        | 700        | 12.40 | 62/5        | 3500                      | 3100                  | 5000         | 55                                      | 13                | 8.7             | 48   |
| 258  | 217      | 239       | 5.1      | 1.4  | C302_0115 LM704U | 350        | 700        | 11.61 | 325/28      | 3200                      | 2800                  | 4500         | 38                                      | 13                | 8.7             | 41   |
| 258  | 289      | 336       | 6.8      | 1.0  | C302_0115 LM706U | 350        | 700        | 11.61 | 325/28      | 3200                      | 2800                  | 4500         | 56                                      | 13                | 8.7             | 48   |
| 292  | 192      | 212       | 5.0      | 1.5  | C302_0105 LM704U | 400        | 700        | 10.29 | 72/7        | 3200                      | 2800                  | 4500         | 38                                      | 13                | 8.7             | 41   |
| 292  | 256      | 297       | 6.7      | 1.1  | C302_0105 LM706U | 400        | 700        | 10.29 | 72/7        | 3200                      | 2800                  | 4500         | 56                                      | 13                | 8.7             | 48   |
| 322  | 174      | 192       | 4.9      | 1.6  | C302_0093 LM704U | 350        | 680        | 9.310 | 3575/384    | 3200                      | 2800                  | 4500         | 39                                      | 13                | 8.7             | 41   |
| 322  | 232      | 269       | 6.6      | 1.2  | C302_0093 LM706U | 350        | 680        | 9.310 | 3575/384    | 3200                      | 2800                  | 4500         | 56                                      | 13                | 8.7             | 48   |
| 364  | 154      | 170       | 4.8      | 1.7  | C302_0083 LM704U | 330        | 600        | 8.250 | 33/4        | 3200                      | 2800                  | 4500         | 39                                      | 13                | 8.7             | 41   |
| 364  | 205      | 238       | 6.4      | 1.3  | C302_0083 LM706U | 400        | 600        | 8.250 | 33/4        | 3200                      | 2800                  | 4500         | 56                                      | 13                | 8.7             | 48   |
| 383  | 72       | 77        | 2.9      | 2.5  | C302_0078 LM503U | 150        | 230        | 7.841 | 494/63      | 3800                      | 3500                  | 5500         | 11                                      | 16                | 7.1             | 31   |
| 383  | 104      | 118       | 4.1      | 1.8  | C302_0078 LM505U | 180        | 230        | 7.841 | 494/63      | 3800                      | 3500                  | 5500         | 18                                      | 16                | 7.1             | 35   |
| 383  | 147      | 162       | 5.8      | 1.5  | C302_0078 LM704U | 310        | 470        | 7.841 | 494/63      | 3800                      | 3500                  | 5500         | 37                                      | 16                | 7.1             | 41   |
| 383  | 195      | 227       | 7.7      | 1.1  | C302_0078 LM706U | 330        | 470        | 7.841 | 494/63      | 3800                      | 3500                  | 5500         | 55                                      | 16                | 7.1             | 48   |
| 475  | 118      | 130       | 5.6      | 1.7  | C302_0063 LM704U | 250        | 430        | 6.314 | 221/35      | 3500                      | 3100                  | 5000         | 38                                      | 16                | 7.1             | 41   |
| 475  | 157      | 183       | 7.4      | 1.3  | C302_0063 LM706U | 330        | 430        | 6.314 | 221/35      | 3500                      | 3100                  | 5000         | 55                                      | 16                | 7.1             | 48   |
| 512  | 110      | 121       | 5.5      | 1.8  | C302_0059 LM704U | 230        | 400        | 5.859 | 2584/441    | 3500                      | 3100                  | 5000         | 38                                      | 16                | 7.1             | 41   |
| 512  | 146      | 169       | 7.4      | 1.3  | C302_0059 LM706U | 320        | 400        | 5.859 | 2584/441    | 3500                      | 3100                  | 5000         | 55                                      | 16                | 7.1             | 48   |
| 595  | 94       | 104       | 5.4      | 2.0  | C302_0050 LM704U | 200        | 370        | 5.038 | 403/80      | 3500                      | 3100                  | 5000         | 38                                      | 16                | 7.1             | 41   |
| 595  | 125      | 146       | 7.2      | 1.5  | C302_0050 LM706U | 290        | 370        | 5.038 | 403/80      | 3500                      | 3100                  | 5000         | 56                                      | 16                | 7.1             | 48   |
| 642  | 87       | 96        | 5.3      | 2.1  | C302_0047 LM704U | 190        | 340        | 4.675 | 589/126     | 3500                      | 3100                  | 5000         | 38                                      | 16                | 7.1             | 41   |
| 642  | 116      | 135       | 7.1      | 1.6  | C302_0047 LM706U | 270        | 340        | 4.675 | 589/126     | 3500                      | 3100                  | 5000         | 56                                      | 16                | 7.1             | 48   |
| 718  | 78       | 86        | 5.2      | 2.3  | C302_0042 LM704U | 170        | 300        | 4.179 | 117/28      | 3200                      | 2800                  | 4500         | 39                                      | 16                | 7.1             | 41   |
| 718  | 104      | 121       | 7.0      | 1.7  | C302_0042 LM706U | 240        | 300        | 4.179 | 117/28      | 3200                      | 2800                  | 4500         | 56                                      | 16                | 7.1             | 48   |
| 774  | 72       | 80        | 5.2      | 2.4  | C302_0039 LM704U | 150        | 280        | 3.878 | 190/49      | 3200                      | 2800                  | 4500         | 39                                      | 16                | 7.1             | 41   |
| 774  | 97       | 112       | 6.9      | 1.8  | C302_0039 LM706U | 230        | 280        | 3.878 | 190/49      | 3200                      | 2800                  | 4500         | 56                                      | 16                | 7.1             | 48   |
| 895  | 63       | 69        | 5.0      | 2.6  | C302_0034 LM704U | 130        | 240        | 3.352 | 429/128     | 3200                      | 2800                  | 4500         | 40                                      | 16                | 7.1             | 41   |
| 895  | 83       | 97        | 6.7      | 2.0  | C302_0034 LM706U | 200        | 240        | 3.352 | 429/128     | 3200                      | 2800                  | 4500         | 57                                      | 16                | 7.1             | 48   |
| 965  | 58       | 64        | 5.0      | 2.7  | C302_0031 LM704U | 120        | 230        | 3.110 | 1045/336    | 3200                      | 2800                  | 4500         | 40                                      | 16                | 7.1             | 41   |
| 965  | 77       | 90        | 6.6      | 2.1  | C302_0031 LM706U | 180        | 230        | 3.110 | 1045/336    | 3200                      | 2800                  | 4500         | 57                                      | 16                | 7.1             | 48   |

8.2 Selection tables 8 C helical geared motors

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S   | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,3,4 | $n_{1maxDB}$<br>EL5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|-----|------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |     |                  | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>C4 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 600</math> Nm)</b>  |          |           |          |     |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 53  | 516      | 548       | 3.3      | 1.1 | C402_0560 LM503U | 550        | 1040       | 56.10 | 9425/168    | 3500                      | 3200                  | 5000         | 11                                      | 12                | 22              | 41   |
| 60  | 462      | 490       | 3.1      | 1.2 | C402_0500 LM503U | 600        | 930        | 50.19 | 1305/26     | 3500                      | 3200                  | 5000         | 11                                      | 12                | 22              | 41   |
| 64  | 429      | 456       | 3.0      | 1.3 | C402_0470 LM503U | 550        | 930        | 46.67 | 140/3       | 3500                      | 3200                  | 5000         | 11                                      | 12                | 22              | 41   |
| 72  | 384      | 408       | 2.8      | 1.4 | C402_0420 LM503U | 600        | 840        | 41.75 | 7056/169    | 3500                      | 3200                  | 5000         | 11                                      | 12                | 22              | 41   |
| 86  | 320      | 340       | 2.6      | 1.7 | C402_0350 LM503U | 550        | 790        | 34.82 | 975/28      | 3500                      | 3200                  | 5000         | 11                                      | 12                | 22              | 41   |
| 86  | 463      | 523       | 3.7      | 1.2 | C402_0350 LM505U | 550        | 790        | 34.82 | 975/28      | 3500                      | 3200                  | 5000         | 18                                      | 12                | 22              | 45   |
| 96  | 286      | 304       | 2.4      | 1.9 | C402_0310 LM503U | 570        | 710        | 31.15 | 405/13      | 3500                      | 3200                  | 5000         | 11                                      | 12                | 22              | 41   |
| 96  | 414      | 467       | 3.5      | 1.3 | C402_0310 LM505U | 570        | 710        | 31.15 | 405/13      | 3500                      | 3200                  | 5000         | 18                                      | 12                | 22              | 45   |
| 120   | 466      | 514       | 4.4      | 1.2 | C402_0250 LM704U | 600        | 1100       | 24.92 | 324/13      | 3500                      | 3200                  | 5000         | 38                                      | 12                | 22              | 51   |
| 128   | 437      | 482       | 4.3      | 1.3 | C402_0230 LM704U | 550        | 1100       | 23.36 | 1495/64     | 3500                      | 3200                  | 5000         | 38                                      | 12                | 22              | 51   |
| 144   | 391      | 431       | 4.0      | 1.4 | C402_0210 LM704U | 600        | 1100       | 20.90 | 4347/208    | 3500                      | 3200                  | 5000         | 38                                      | 12                | 22              | 51   |
| 170   | 329      | 363       | 3.7      | 1.7 | C402_0175 LM704U | 550        | 1100       | 17.60 | 845/48      | 3300                      | 2800                  | 4500         | 39                                      | 12                | 22              | 51   |
| 170   | 438      | 509       | 4.9      | 1.3 | C402_0175 LM706U | 550        | 1100       | 17.60 | 845/48      | 3300                      | 2800                  | 4500         | 56                                      | 12                | 22              | 58   |
| 190   | 294      | 325       | 3.5      | 1.9 | C402_0160 LM704U | 600        | 1070       | 15.75 | 63/4        | 3300                      | 2800                  | 4500         | 39                                      | 12                | 22              | 51   |
| 190   | 392      | 455       | 4.7      | 1.4 | C402_0160 LM706U | 600        | 1070       | 15.75 | 63/4        | 3300                      | 2800                  | 4500         | 56                                      | 12                | 22              | 58   |
| 214   | 262      | 289       | 3.4      | 2.0 | C402_0140 LM704U | 550        | 1020       | 13.99 | 2015/144    | 3300                      | 2800                  | 4500         | 40                                      | 12                | 22              | 51   |
| 214   | 348      | 404       | 4.5      | 1.5 | C402_0140 LM706U | 550        | 1020       | 13.99 | 2015/144    | 3300                      | 2800                  | 4500         | 57                                      | 12                | 22              | 58   |
| 240   | 234      | 258       | 3.4      | 2.2 | C402_0125 LM704U | 500        | 910        | 12.52 | 651/52      | 3300                      | 2800                  | 4500         | 40                                      | 12                | 22              | 51   |
| 240   | 312      | 362       | 4.5      | 1.6 | C402_0125 LM706U | 600        | 910        | 12.52 | 651/52      | 3300                      | 2800                  | 4500         | 57                                      | 12                | 22              | 58   |
| 258   | 217      | 240       | 3.3      | 2.3 | C402_0115 LM704U | 460        | 850        | 11.64 | 1885/162    | 2900                      | 2500                  | 4000         | 41                                      | 12                | 22              | 51   |
| 258   | 290      | 336       | 4.4      | 1.7 | C402_0115 LM706U | 550        | 850        | 11.64 | 1885/162    | 2900                      | 2500                  | 4000         | 58                                      | 12                | 22              | 58   |
| 288   | 195      | 215       | 3.2      | 2.5 | C402_0105 LM704U | 420        | 760        | 10.41 | 406/39      | 2900                      | 2500                  | 4000         | 41                                      | 12                | 22              | 51   |
| 288   | 259      | 301       | 4.3      | 1.9 | C402_0105 LM706U | 600        | 760        | 10.41 | 406/39      | 2900                      | 2500                  | 4000         | 58                                      | 12                | 22              | 58   |
| 384   | 146      | 161       | 4.3      | 2.2 | C402_0078 LM704U | 310        | 450        | 7.816 | 2001/256    | 3500                      | 3200                  | 5000         | 39                                      | 15                | 17              | 51   |
| 384   | 195      | 226       | 5.7      | 1.6 | C402_0078 LM706U | 360        | 450        | 7.816 | 2001/256    | 3500                      | 3200                  | 5000         | 56                                      | 15                | 17              | 58   |
| 509   | 110      | 121       | 4.1      | 2.6 | C402_0059 LM704U | 240        | 400        | 5.891 | 377/64      | 3300                      | 2800                  | 4500         | 40                                      | 15                | 17              | 51   |
| 509   | 147      | 170       | 5.5      | 2.0 | C402_0059 LM706U | 320        | 400        | 5.891 | 377/64      | 3300                      | 2800                  | 4500         | 57                                      | 15                | 17              | 58   |
| 641   | 88       | 97        | 4.0      | 3.0 | C402_0047 LM704U | 190        | 340        | 4.682 | 899/192     | 3300                      | 2800                  | 4500         | 41                                      | 15                | 17              | 51   |
| 641   | 117      | 135       | 5.3      | 2.3 | C402_0047 LM706U | 270        | 340        | 4.682 | 899/192     | 3300                      | 2800                  | 4500         | 58                                      | 15                | 17              | 58   |
| 770   | 73       | 80        | 3.8      | 3.1 | C402_0039 LM704U | 160        | 280        | 3.894 | 841/216     | 2900                      | 2500                  | 4000         | 42                                      | 15                | 17              | 51   |
| 770   | 97       | 113       | 5.1      | 2.3 | C402_0039 LM706U | 230        | 280        | 3.894 | 841/216     | 2900                      | 2500                  | 4000         | 60                                      | 15                | 17              | 58   |
| <b>C5 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 920</math> Nm)</b>  |          |           |          |     |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 37  | 730      | 776       | 2.8      | 1.1 | C503_0810 LM503U | 920        | 1330       | 80.60 | 19343/240   | 3400                      | 3000                  | 4500         | 11                                      | 12                | 23              | 56   |
| 43  | 643      | 683       | 2.7      | 1.2 | C502_0700 LM503U | 850        | 1210       | 69.97 | 10075/144   | 3400                      | 3000                  | 4500         | 11                                      | 12                | 23              | 52   |
| 48  | 574      | 610       | 2.8      | 1.2 | C502_0620 LM503U | 860        | 1080       | 62.43 | 4495/72     | 3400                      | 3000                  | 4500         | 11                                      | 12                | 23              | 52   |
| 54  | 513      | 545       | 2.4      | 1.6 | C502_0560 LM503U | 850        | 1120       | 55.83 | 335/6       | 3400                      | 3000                  | 4500         | 11                                      | 12                | 23              | 52   |
| 54  | 742      | 838       | 3.5      | 1.1 | C502_0560 LM505U | 850        | 1120       | 55.83 | 335/6       | 3400                      | 3000                  | 4500         | 17                                      | 12                | 23              | 57   |
| 60  | 458      | 487       | 2.3      | 1.7 | C502_0500 LM503U | 800        | 1000       | 49.82 | 1943/39     | 3400                      | 3000                  | 4500         | 11                                      | 12                | 23              | 52   |
| 60  | 662      | 748       | 3.3      | 1.2 | C502_0500 LM505U | 800        | 1000       | 49.82 | 1943/39     | 3400                      | 3000                  | 4500         | 17                                      | 12                | 23              | 57   |
| 72  | 779      | 860       | 4.2      | 1.0 | C502_0420 LM704U | 920        | 1600       | 41.69 | 667/16      | 3400                      | 3000                  | 4500         | 37                                      | 12                | 23              | 63   |
| 86  | 654      | 722       | 3.9      | 1.2 | C502_0350 LM704U | 850        | 1600       | 35.00 | 35/1        | 3400                      | 3000                  | 4500         | 38                                      | 12                | 23              | 63   |
| 96  | 584      | 644       | 3.7      | 1.4 | C502_0310 LM704U | 920        | 1520       | 31.23 | 406/13      | 3400                      | 3000                  | 4500         | 38                                      | 12                | 23              | 63   |
| 96  | 778      | 903       | 4.9      | 1.0 | C502_0310 LM706U | 920        | 1520       | 31.23 | 406/13      | 3400                      | 3000                  | 4500         | 55                                      | 12                | 23              | 70   |
| 107   | 525      | 579       | 3.5      | 1.5 | C502_0280 LM704U | 850        | 1600       | 28.10 | 5395/192    | 3400                      | 3000                  | 4500         | 39                                      | 12                | 23              | 63   |
| 107   | 700      | 812       | 4.6      | 1.1 | C502_0280 LM706U | 850        | 1600       | 28.10 | 5395/192    | 3400                      | 3000                  | 4500         | 56                                      | 12                | 23              | 70   |
| 120   | 469      | 517       | 3.3      | 1.7 | C502_0250 LM704U | 920        | 1440       | 25.07 | 2407/96     | 3400                      | 3000                  | 4500         | 39                                      | 12                | 23              | 63   |
| 120   | 624      | 725       | 4.4      | 1.3 | C502_0250 LM706U | 920        | 1440       | 25.07 | 2407/96     | 3400                      | 3000                  | 4500         | 56                                      | 12                | 23              | 70   |
| 128   | 437      | 482       | 3.2      | 1.8 | C502_0230 LM704U | 850        | 1490       | 23.36 | 1495/64     | 3400                      | 3000                  | 4500         | 39                                      | 12                | 23              | 63   |
| 128   | 582      | 675       | 4.2      | 1.4 | C502_0230 LM706U | 850        | 1490       | 23.36 | 1495/64     | 3400                      | 3000                  | 4500         | 57                                      | 12                | 23              | 70   |
| 144   | 390      | 430       | 3.0      | 2.1 | C502_0210 LM704U | 830        | 1330       | 20.84 | 667/32      | 3400                      | 3000                  | 4500         | 40                                      | 12                | 23              | 63   |
| 144   | 519      | 603       | 4.0      | 1.5 | C502_0210 LM706U | 920        | 1330       | 20.84 | 667/32      | 3400                      | 3000                  | 4500         | 57                                      | 12                | 23              | 70   |
| 215   | 260      | 287       | 2.4      | 3.1 | C502_0140 LM704U | 560        | 1010       | 13.93 | 195/14      | 3100                      | 2700                  | 4000         | 43                                      | 12                | 23              | 63   |
| 215   | 347      | 403       | 3.3      | 2.3 | C502_0140 LM706U | 810        | 1010       | 13.93 | 195/14      | 3100                      | 2700                  | 4000         | 60                                      | 12                | 23              | 70   |
| 241   | 232      | 256       | 2.4      | 3.1 | C502_0125 LM704U | 500        | 900        | 12.43 | 87/7        | 3100                      | 2700                  | 4000         | 43                                      | 12                | 23              | 63   |
| 241   | 309      | 359       | 3.2      | 2.3 | C502_0125 LM706U | 720        | 900        | 12.43 | 87/7        | 3100                      | 2700                  | 4000         | 60                                      | 12                | 23              | 70   |
| 386   | 145      | 160       | 3.0      | 2.7 | C502_0078 LM704U | 310        | 500        | 7.763 | 621/80      | 3400                      | 3000                  | 4500         | 40                                      | 14                | 21              | 63   |
| 386   | 193      | 224       | 4.0      | 2.1 | C502_0078 LM706U | 400        | 500        | 7.763 | 621/80      | 3400                      | 3000                  | 4500         | 58                                      | 14                | 21              | 70   |
| 648   | 87       | 95        | 2.7      | 3.1 | C502_0046 LM704U | 180        | 340        | 4.629 | 162/35      | 3100                      | 2700                  | 4000         | 45                                      | 14                | 21              | 63   |
| 648   | 115      | 134       | 3.7      | 2.3 | C502_0046 LM706U | 270        | 340        | 4.629 | 162/35      | 3100                      | 2700                  | 4000         | 62                                      | 14                | 21              | 70   |
| <b>C6 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 1650</math> Nm)</b> |          |           |          |     |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 22  | 1222     | 1298      | 2.4      | 1.1 | C613_1350 LM503U | 1380       | 1720       | 134.8 | 15776/117   | 3200                      | 2900                  | 4000         | 11                                      | 10                | 74              | 76   |
| 28  | 961      | 1021      | 2.2      | 1.3 | C613_1060 LM503U | 1280       | 1600       | 106.1 | 3712/35     | 3200                      | 2900                  | 4000         | 11                                      | 10                | 74              | 76   |
| 39  | 1415     | 1561      | 3.3      | 1.0 | C613_0770 LM704U | 1650       | 2560       | 76.80 | 8601/112    | 3200                      | 2900                  | 4000         | 37                                      | 10                | 74              | 86   |
| 40  | 687      | 730       | 2.6      | 1.3 | C613_0760 LM503U | 910        | 1140       | 75.81 | 5307/70     | 3200                      | 2900                  | 4000         | 11                                      | 10                | 74              | 76   |

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,3,4 | $n_{1maxDB}$<br>EL5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>C6 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 1650</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 47  | 1169     | 1290      | 3.2      | 1.2  | C613_0630 LM704U | 1650       | 2290       | 63.46 | 48739/768   | 3200                      | 2900                  | 4000         | 37                                      | 10                | 74              | 86   |
| 54  | 1030     | 1137      | 3.2      | 1.3  | C612_0550 LM704U | 1380       | 2240       | 55.11 | 496/9       | 3200                      | 2900                  | 4000         | 38                                      | 10                | 74              | 78   |
| 61  | 908      | 1002      | 3.0      | 1.4  | C613_0490 LM704U | 1550       | 1940       | 49.28 | 31537/640   | 3200                      | 2900                  | 4000         | 38                                      | 10                | 74              | 86   |
| 61  | 1209     | 1404      | 4.0      | 1.1  | C613_0490 LM706U | 1550       | 1940       | 49.28 | 31537/640   | 3200                      | 2900                  | 4000         | 55                                      | 10                | 74              | 94   |
| 66  | 847      | 935       | 2.9      | 1.5  | C612_0450 LM704U | 1380       | 2010       | 45.33 | 136/3       | 3200                      | 2900                  | 4000         | 39                                      | 10                | 74              | 78   |
| 66  | 1129     | 1310      | 3.9      | 1.2  | C612_0450 LM706U | 1380       | 2010       | 45.33 | 136/3       | 3200                      | 2900                  | 4000         | 56                                      | 10                | 74              | 85   |
| 76  | 736      | 812       | 2.9      | 1.7  | C612_0390 LM704U | 1280       | 1600       | 39.40 | 1891/48     | 3200                      | 2900                  | 4000         | 38                                      | 10                | 74              | 78   |
| 76  | 981      | 1139      | 3.8      | 1.2  | C612_0390 LM706U | 1280       | 1600       | 39.40 | 1891/48     | 3200                      | 2900                  | 4000         | 55                                      | 10                | 74              | 85   |
| 86  | 652      | 719       | 2.5      | 2.0  | C612_0350 LM704U | 1380       | 1720       | 34.87 | 1360/39     | 3200                      | 2900                  | 4000         | 40                                      | 10                | 74              | 78   |
| 86  | 868      | 1008      | 3.4      | 1.5  | C612_0350 LM706U | 1380       | 1720       | 34.87 | 1360/39     | 3200                      | 2900                  | 4000         | 57                                      | 10                | 74              | 85   |
| 93  | 606      | 668       | 2.2      | 1.9  | C612_0320 LM704U | 1150       | 1430       | 32.41 | 1037/32     | 3200                      | 2900                  | 4000         | 39                                      | 10                | 74              | 78   |
| 93  | 807      | 937       | 2.9      | 1.4  | C612_0320 LM706U | 1150       | 1430       | 32.41 | 1037/32     | 3200                      | 2900                  | 4000         | 56                                      | 10                | 74              | 85   |
| 109   | 513      | 566       | 2.3      | 2.5  | C612_0270 LM704U | 1100       | 1600       | 27.43 | 192/7       | 3200                      | 2900                  | 4000         | 42                                      | 10                | 74              | 78   |
| 109   | 683      | 793       | 3.0      | 1.9  | C612_0270 LM706U | 1280       | 1600       | 27.43 | 192/7       | 3200                      | 2900                  | 4000         | 59                                      | 10                | 74              | 85   |
| 120   | 466      | 514       | 2.1      | 2.1  | C612_0250 LM704U | 980        | 1230       | 24.93 | 5185/208    | 3200                      | 2900                  | 4000         | 40                                      | 10                | 74              | 78   |
| 120   | 621      | 721       | 2.8      | 1.6  | C612_0250 LM706U | 980        | 1230       | 24.93 | 5185/208    | 3200                      | 2900                  | 4000         | 57                                      | 10                | 74              | 85   |
| 153   | 366      | 404       | 2.0      | 2.5  | C612_0195 LM704U | 780        | 1140       | 19.61 | 549/28      | 3200                      | 2900                  | 4000         | 42                                      | 10                | 74              | 78   |
| 153   | 488      | 567       | 2.7      | 1.9  | C612_0195 LM706U | 910        | 1140       | 19.61 | 549/28      | 3200                      | 2900                  | 4000         | 59                                      | 10                | 74              | 85   |
| <b>C7 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 2760</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 23  | 2439     | 2690      | 3.4      | 0.81 | C713_1320 LM704U | 2760       | 3710       | 132.4 | 33887/256   | 3100                      | 2900                  | 3600         | 37                                      | 10                | 122             | 126  |
| 30  | 1826     | 2015      | 3.1      | 1.0  | C713_0990 LM704U | 2530       | 3170       | 99.14 | 6345/64     | 3100                      | 2900                  | 3600         | 37                                      | 10                | 122             | 126  |
| 37  | 1492     | 1646      | 3.0      | 1.2  | C713_0810 LM704U | 2260       | 2820       | 80.97 | 20727/256   | 3100                      | 2900                  | 3600         | 38                                      | 10                | 122             | 126  |
| 43  | 1300     | 1434      | 2.5      | 1.5  | C712_0700 LM704U | 2120       | 2650       | 69.55 | 765/11      | 3100                      | 2900                  | 3600         | 39                                      | 10                | 122             | 113  |
| 43  | 1732     | 2010      | 3.3      | 1.2  | C712_0700 LM706U | 2120       | 2650       | 69.55 | 765/11      | 3100                      | 2900                  | 3600         | 56                                      | 10                | 122             | 120  |
| 53  | 1062     | 1172      | 2.3      | 1.8  | C712_0570 LM704U | 1910       | 2390       | 56.82 | 625/11      | 3100                      | 2900                  | 3600         | 40                                      | 10                | 122             | 113  |
| 53  | 1415     | 1642      | 3.0      | 1.4  | C712_0570 LM706U | 1910       | 2390       | 56.82 | 625/11      | 3100                      | 2900                  | 3600         | 57                                      | 10                | 122             | 120  |
| 73  | 767      | 846       | 1.8      | 1.8  | C712_0410 LM704U | 1380       | 1730       | 41.02 | 2625/64     | 3100                      | 2900                  | 3600         | 40                                      | 10                | 122             | 113  |
| 73  | 1021     | 1186      | 2.4      | 1.4  | C712_0410 LM706U | 1380       | 1730       | 41.02 | 2625/64     | 3100                      | 2900                  | 3600         | 57                                      | 10                | 122             | 120  |
| 86  | 655      | 723       | 1.8      | 2.4  | C712_0350 LM704U | 1400       | 1960       | 35.07 | 2700/77     | 3100                      | 2900                  | 3600         | 44                                      | 10                | 122             | 113  |
| 86  | 873      | 1014      | 2.4      | 1.8  | C712_0350 LM706U | 1570       | 1960       | 35.07 | 2700/77     | 3100                      | 2900                  | 3600         | 61                                      | 10                | 122             | 120  |
| 119   | 473      | 522       | 1.4      | 2.4  | C712_0250 LM704U | 1010       | 1410       | 25.31 | 405/16      | 3100                      | 2900                  | 3600         | 44                                      | 10                | 122             | 113  |
| 119   | 630      | 732       | 1.8      | 1.8  | C712_0250 LM706U | 1130       | 1410       | 25.31 | 405/16      | 3100                      | 2900                  | 3600         | 62                                      | 10                | 122             | 120  |
| <b>C8 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 4140</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 17  | 3286     | 3625      | 2.6      | 0.97 | C813_1780 LM704U | 4140       | 5250       | 178.4 | 6956/39     | 2900                      | 2700                  | 3400         | 38                                      | 10                | 204             | 185  |
| 22  | 2549     | 2813      | 2.4      | 1.2  | C813_1380 LM704U | 3720       | 4650       | 138.4 | 2491/18     | 2900                      | 2700                  | 3400         | 38                                      | 10                | 204             | 185  |
| 28  | 1982     | 2186      | 2.3      | 1.4  | C813_1080 LM704U | 3370       | 4210       | 107.6 | 4841/45     | 2900                      | 2700                  | 3400         | 39                                      | 10                | 204             | 185  |
| 28  | 2640     | 3065      | 3.0      | 1.1  | C813_1080 LM706U | 3370       | 4210       | 107.6 | 4841/45     | 2900                      | 2700                  | 3400         | 56                                      | 10                | 204             | 193  |
| 33  | 1673     | 1846      | 2.2      | 1.6  | C813_0910 LM704U | 2860       | 3570       | 90.82 | 18800/207   | 2900                      | 2700                  | 3400         | 39                                      | 10                | 204             | 185  |
| 33  | 2229     | 2587      | 2.9      | 1.2  | C813_0910 LM706U | 2860       | 3570       | 90.82 | 18800/207   | 2900                      | 2700                  | 3400         | 56                                      | 10                | 204             | 193  |
| 38  | 1462     | 1613      | 2.6      | 1.4  | C813_0790 LM704U | 2490       | 3110       | 79.34 | 285619/3600 | 2900                      | 2700                  | 3400         | 39                                      | 10                | 204             | 185  |
| 38  | 1947     | 2260      | 3.5      | 1.1  | C813_0790 LM706U | 2490       | 3110       | 79.34 | 285619/3600 | 2900                      | 2700                  | 3400         | 56                                      | 10                | 204             | 193  |



## 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 gear unit 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 <http://configurator.stoeber.de>.

Combination options and the dimensions of forced ventilated geared motors can be found at <http://cad.stoeber.de>.

### 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 $\varnothing$ fit $\leq$ 50 mm | DIN 748-1, ISO k6       |
| Shaft $\varnothing$ fit $>$ 50 mm    | DIN 748-1, ISO m6       |
| Feather keys                         | DIN 6885-1, high form A |

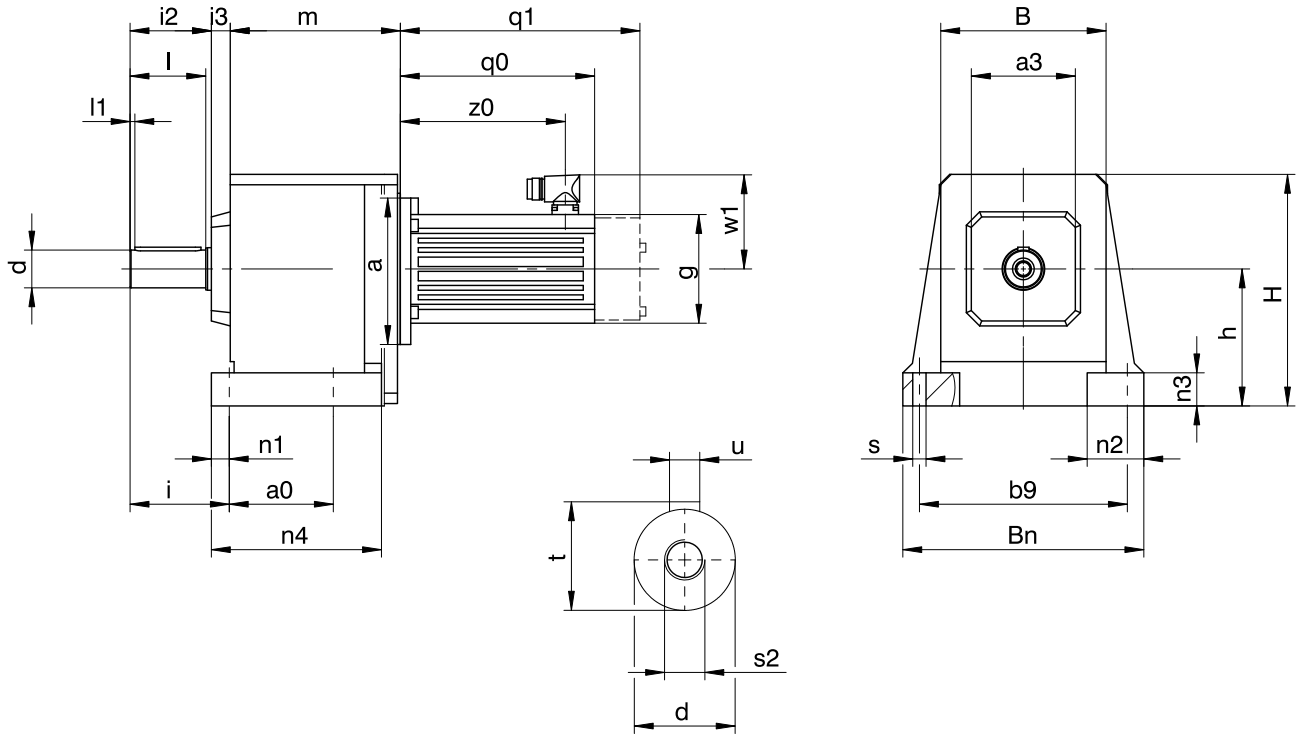
  

| Flange             | Pilot tolerance |
|--------------------|-----------------|
| Up to 300 mm       | ISO j6          |
| Starting at 350 mm | ISO h6          |

### 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  |

### 8.3.1 Solid shaft design with feather key, N housing design (base)



$q_0$  Applies to motors without brake.

$q_1$  Applies to motors with brake.

**Options:** C0 – C5 also available with solid shaft without feather key; on request starting at C6.

#### Dimensions of gear units

| Type | $a_0$ | $a_3$ | $b_9$ | $B$ | $B_n$ | $\varnothing d$  | $h$ | $H$ | $i$ | $i_2$ | $i_3$ | $l$ | $l_1$ | $n_1$ | $n_2$ | $n_3$ | $n_4$ | $\varnothing s$ | $s_2$ | $t$  | $u$        |
|------|-------|-------|-------|-----|-------|------------------|-----|-----|-----|-------|-------|-----|-------|-------|-------|-------|-------|-----------------|-------|------|------------|
| C0   | 62    | 60    | 110   | 92  | 132   | 20 <sub>k6</sub> | 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 <sub>k6</sub> | 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 <sub>k6</sub> | 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 <sub>k6</sub> | 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 <sub>k6</sub> | 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 <sub>k6</sub> | 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 <sub>k6</sub> | 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 <sub>m6</sub> | 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 <sub>m6</sub> | 290 | 450 | 190 | 148   | 70    | 140 | 5     | 29    | 95    | 55    | 360.0 | 22              | M20   | 74.5 | A20×12×125 |

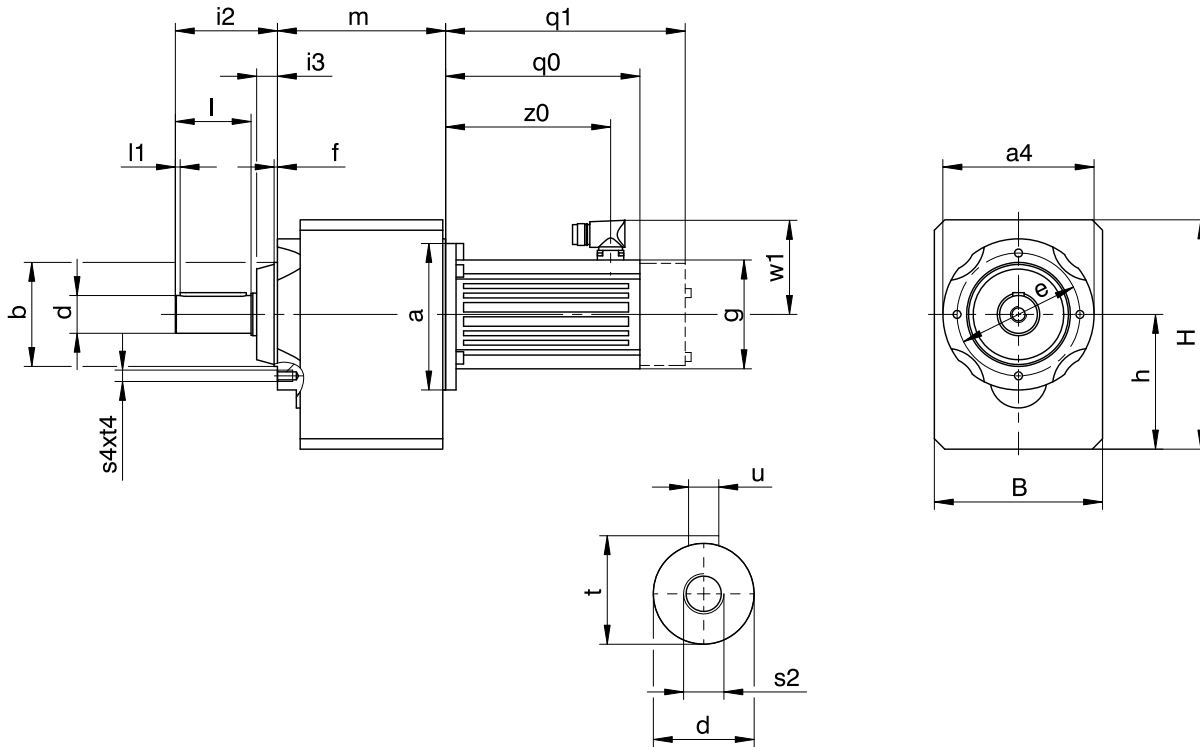
## Dimensions of motors

| 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 |

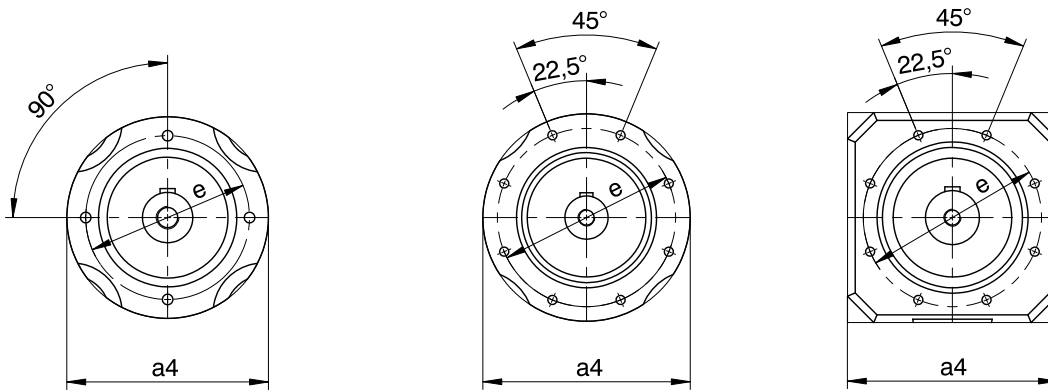
### 8.3.2 Solid shaft design with feather key, G housing design (pitch circle diameter)



C0-C4

C5

C6-C8



q0 Applies to motors without brake.

q1 Applies to motors with brake.

Options: C0 – C5 also available with solid shaft without feather key; on request starting at C6.

#### Dimensions of gear units

| Type | a4   | Øb                | B   | Ød               | Øe  | f   | h     | H     | i2  | i3 | l   | l1 | s2  | s4  | t    | t4 | u          |
|------|------|-------------------|-----|------------------|-----|-----|-------|-------|-----|----|-----|----|-----|-----|------|----|------------|
| C0   | Ø87  | 55 <sub>j6</sub>  | 97  | 20 <sub>j6</sub> | 75  | 3.0 | 79.0  | 141.0 | 58  | 14 | 40  | 3  | M6  | M6  | 22.5 | 10 | A6×6×32    |
| C1   | Ø120 | 80 <sub>j6</sub>  | 130 | 25 <sub>j6</sub> | 100 | 3.0 | 100.0 | 175.0 | 71  | 17 | 50  | 5  | M10 | M6  | 28.0 | 13 | A8×7×40    |
| C2   | Ø140 | 95 <sub>j6</sub>  | 142 | 30 <sub>j6</sub> | 115 | 3.0 | 112.0 | 192.0 | 87  | 22 | 60  | 5  | M10 | M8  | 33.0 | 13 | A8×7×50    |
| C3   | Ø140 | 95 <sub>j6</sub>  | 154 | 30 <sub>j6</sub> | 115 | 3.0 | 127.0 | 212.0 | 87  | 22 | 60  | 5  | M10 | M8  | 33.0 | 13 | A8×7×50    |
| C4   | Ø160 | 110 <sub>j6</sub> | 178 | 40 <sub>j6</sub> | 130 | 3.5 | 142.5 | 242.5 | 108 | 22 | 80  | 5  | M16 | M10 | 43.0 | 16 | A12×8×70   |
| C5   | Ø192 | 130 <sub>j6</sub> | 195 | 40 <sub>j6</sub> | 165 | 3.5 | 166.0 | 286.0 | 109 | 23 | 80  | 5  | M16 | M10 | 43.0 | 16 | A12×8×70   |
| C6   | □180 | 140 <sub>j6</sub> | 225 | 50 <sub>j6</sub> | 165 | 5.0 | 195.0 | 310.0 | 136 | 30 | 100 | 5  | M16 | M10 | 53.5 | 16 | A14×9×90   |
| C7   | □195 | 155 <sub>j6</sub> | 265 | 60 <sub>m6</sub> | 185 | 8.0 | 231.0 | 371.0 | 164 | 37 | 120 | 5  | M20 | M12 | 64.0 | 19 | A18×11×100 |
| C8   | □226 | 185 <sub>j6</sub> | 310 | 70 <sub>m6</sub> | 215 | 5.0 | 285.0 | 445.0 | 185 | 37 | 140 | 5  | M20 | M12 | 74.5 | 19 | A20×12×125 |



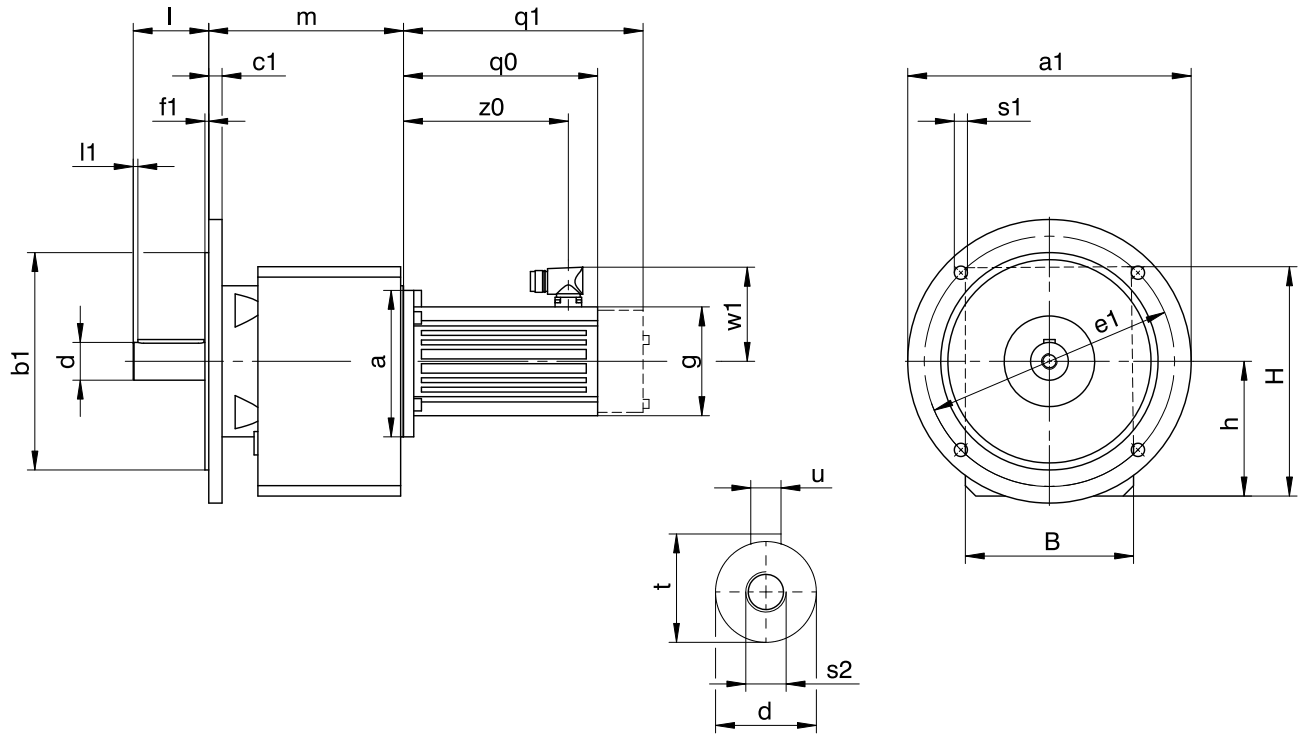
## Dimensions of motors

| 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 |

### 8.3.3 Solid shaft design with feather key, F housing design (round flange)



$q0$  Applies to motors without brake.

$q1$  Applies to motors with brake.

**Options:** C0 – C5 also available with solid shaft without feather key; on request starting at C6.

#### Dimensions of gear units

| Type | $\varnothing a1$ | $\varnothing b1$  | B   | $c1$ | $\varnothing d$  | $\varnothing e1$ | $f1$ | h     | H     | l   | l1 | $\varnothing s1$ | s2  | t    | u          |
|------|------------------|-------------------|-----|------|------------------|------------------|------|-------|-------|-----|----|------------------|-----|------|------------|
| C0   | 160              | 110 <sub>j6</sub> | 97  | 10   | 20 <sub>j6</sub> | 130              | 3.0  | 79.0  | 141.0 | 40  | 3  | 9                | M6  | 22.5 | A6×6×32    |
| C1   | 200              | 130 <sub>j6</sub> | 130 | 12   | 25 <sub>j6</sub> | 165              | 3.5  | 100.0 | 175.0 | 50  | 5  | 11               | M10 | 28.0 | A8×7×40    |
| C2   | 200              | 130 <sub>j6</sub> | 142 | 12   | 30 <sub>j6</sub> | 165              | 3.5  | 112.0 | 192.0 | 60  | 5  | 11               | M10 | 33.0 | A8×7×50    |
| C3   | 250              | 180 <sub>j6</sub> | 154 | 12   | 30 <sub>j6</sub> | 215              | 4.0  | 127.0 | 212.0 | 60  | 5  | 14               | M10 | 33.0 | A8×7×50    |
| C4   | 250              | 180 <sub>j6</sub> | 178 | 14   | 40 <sub>j6</sub> | 215              | 4.0  | 142.5 | 242.5 | 80  | 5  | 14               | M16 | 43.0 | A12×8×70   |
| C5   | 300              | 230 <sub>j6</sub> | 195 | 16   | 40 <sub>j6</sub> | 265              | 4.0  | 166.0 | 286.0 | 80  | 5  | 14               | M16 | 43.0 | A12×8×70   |
| C6   | 300              | 230 <sub>j6</sub> | 225 | 17   | 50 <sub>j6</sub> | 265              | 4.0  | 195.0 | 310.0 | 100 | 5  | 14               | M16 | 53.5 | A14×9×90   |
| C7   | 350              | 250 <sub>h6</sub> | 265 | 18   | 60 <sub>m6</sub> | 300              | 5.0  | 231.0 | 371.0 | 120 | 5  | 18               | M20 | 64.0 | A18×11×100 |
| C8   | 400              | 300 <sub>h6</sub> | 310 | 20   | 70 <sub>m6</sub> | 350              | 5.0  | 285.0 | 445.0 | 140 | 5  | 18               | M20 | 74.5 | A20×12×125 |

#### Dimensions of additional round flanges

| Type | $\varnothing a1$ | $\varnothing b1$  | $c1$ | $\varnothing e1$ | $f1$ | $\varnothing s1$ |
|------|------------------|-------------------|------|------------------|------|------------------|
| C0   | 120              | 80 <sub>j6</sub>  | 10   | 100              | 3.0  | 7                |
| C0   | 140              | 95 <sub>j6</sub>  | 10   | 115              | 3.0  | 9                |
| C1   | 140              | 95 <sub>j6</sub>  | 8    | 115              | 3.5  | 9                |
| C1   | 160              | 110 <sub>j6</sub> | 10   | 130              | 3.5  | 9                |
| C2   | 160              | 110 <sub>j6</sub> | 10   | 130              | 3.5  | 9                |
| C2   | 250              | 180 <sub>j6</sub> | 12   | 215              | 4.0  | 14               |
| C3   | 160              | 110 <sub>j6</sub> | 10   | 130              | 3.5  | 9                |
| C3   | 200              | 130 <sub>j6</sub> | 12   | 165              | 3.5  | 11               |
| C4   | 200              | 130 <sub>j6</sub> | 14   | 165              | 3.5  | 11               |
| C4   | 300              | 230 <sub>j6</sub> | 14   | 265              | 4.0  | 14               |
| C5   | 250              | 180 <sub>j6</sub> | 14   | 215              | 4.0  | 14               |
| C8   | 350              | 250 <sub>h6</sub> | 18   | 300              | 5.0  | 18               |
| C8   | 450              | 350 <sub>h6</sub> | 20   | 400              | 5.0  | 18               |

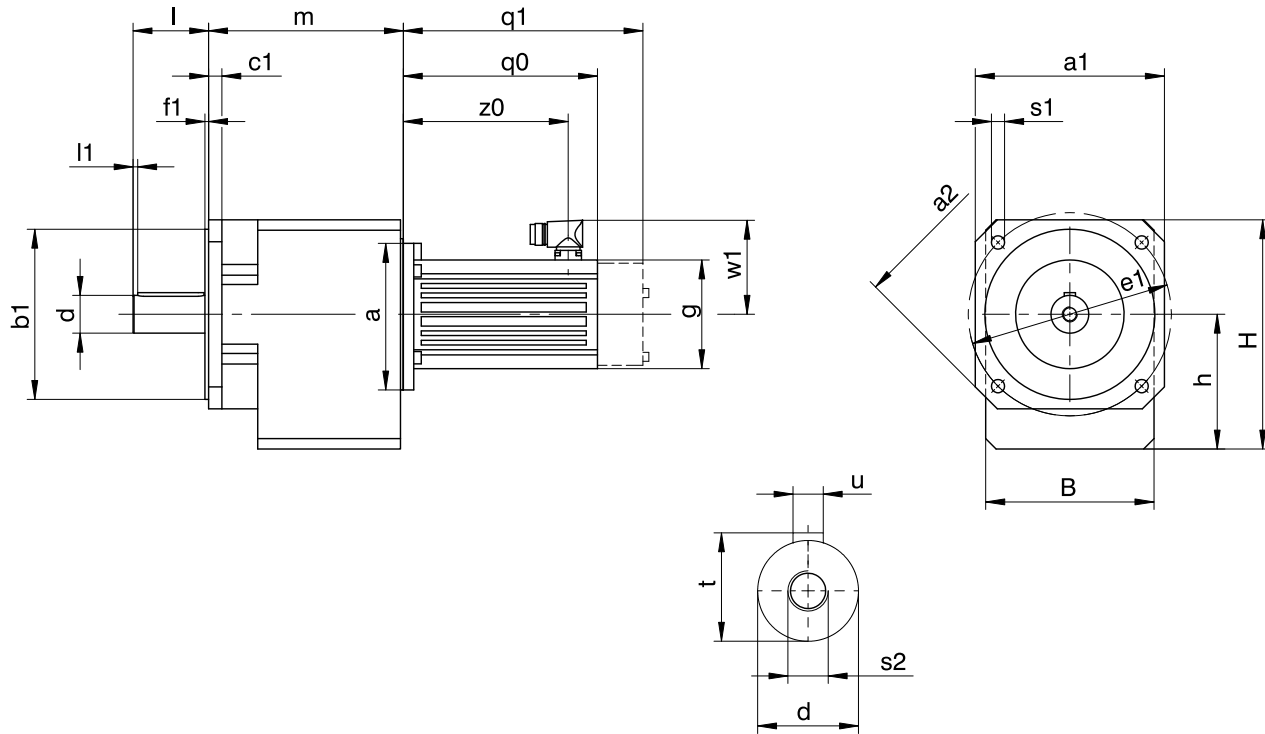
## Dimensions of motors

| 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 |

### 8.3.4 Solid shaft design with feather key, Q housing design (square flange)



$q0$  Applies to motors without brake.

$q1$  Applies to motors with brake.

**Options:** C0 – C5 also available with solid shaft without feather key; on request starting at C6.

#### Dimensions of gear units

| Type | $\square a1$ | $\square a2$ | $\varnothing b1$  | B   | c1 | $\varnothing d$  | $\varnothing e1$ | f1  | h     | H     | l  | l1 | $\varnothing s1$ | s2  | t    | u        |
|------|--------------|--------------|-------------------|-----|----|------------------|------------------|-----|-------|-------|----|----|------------------|-----|------|----------|
| C0   | 124          | 160          | 110 <sub>f6</sub> | 97  | 9  | 20 <sub>k6</sub> | 130              | 3.0 | 79.0  | 141.0 | 40 | 3  | 9                | M6  | 22.5 | A6×6×32  |
| C1   | 145          | 192          | 130 <sub>f6</sub> | 130 | 11 | 25 <sub>k6</sub> | 165              | 3.5 | 100.0 | 175.0 | 50 | 5  | 11               | M10 | 28.0 | A8×7×40  |
| C2   | 145          | 192          | 130 <sub>f6</sub> | 142 | 11 | 30 <sub>k6</sub> | 165              | 3.5 | 112.0 | 192.0 | 60 | 5  | 11               | M10 | 33.0 | A8×7×50  |
| C3   | 200          | 250          | 180 <sub>f6</sub> | 154 | 14 | 30 <sub>k6</sub> | 215              | 4.0 | 127.0 | 212.0 | 60 | 5  | 14               | M10 | 33.0 | A8×7×50  |
| C4   | 200          | 250          | 180 <sub>f6</sub> | 178 | 14 | 40 <sub>k6</sub> | 215              | 4.0 | 142.5 | 242.5 | 80 | 5  | 14               | M16 | 43.0 | A12×8×70 |

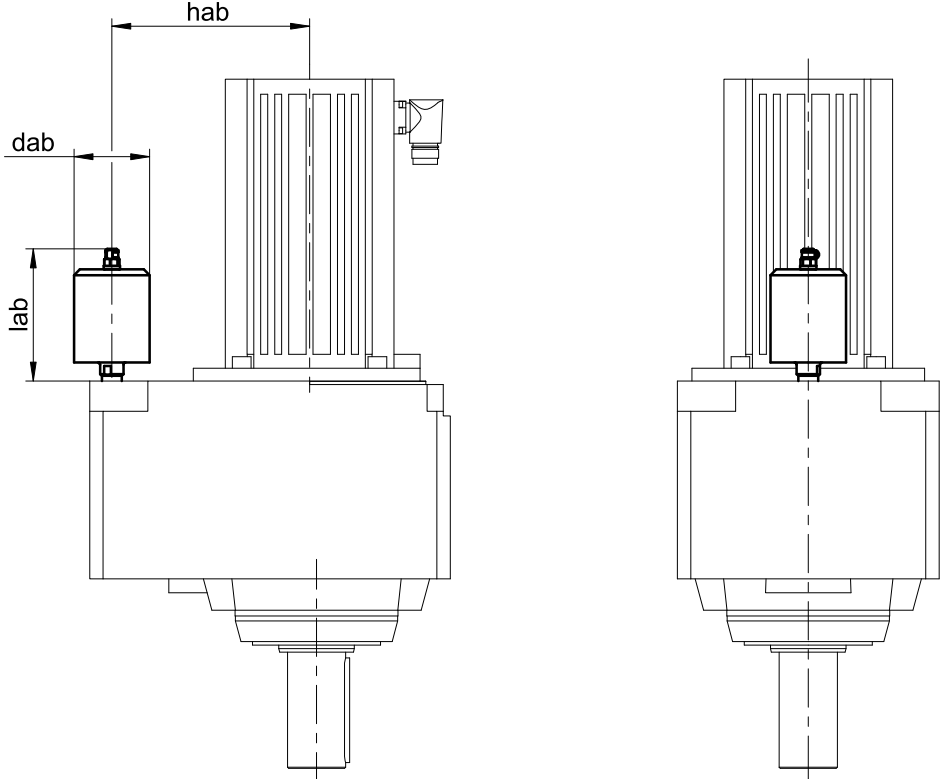
#### Dimensions of motors

| Type   | $\square g$ | $q0$  | $q1$  | $w1$ | $z0$ |
|--------|-------------|-------|-------|------|------|
| 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 | $\square 98$      | 114 | $\square 115$     | 118 | –             | –   |
| C102 | $\square 98$      | 137 | $\square 115$     | 141 | $\square 145$ | 143 |
| C202 | $\varnothing 140$ | 155 | $\square 115$     | 159 | $\square 145$ | 161 |
| C203 | $\varnothing 140$ | 192 | –                 | –   | –             | –   |
| C302 | –                 | –   | $\varnothing 160$ | 178 | $\square 145$ | 180 |
| C303 | $\varnothing 140$ | 211 | –                 | –   | –             | –   |
| C402 | –                 | –   | $\varnothing 160$ | 206 | $\square 145$ | 208 |

### 8.3.5 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 [8.6.4](#)

## 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.

### Sample code

|   |   |   |   |   |      |        |
|---|---|---|---|---|------|--------|
| C | 2 | 0 | 2 | N | 0280 | LM403U |
|---|---|---|---|---|------|--------|

### Explanation

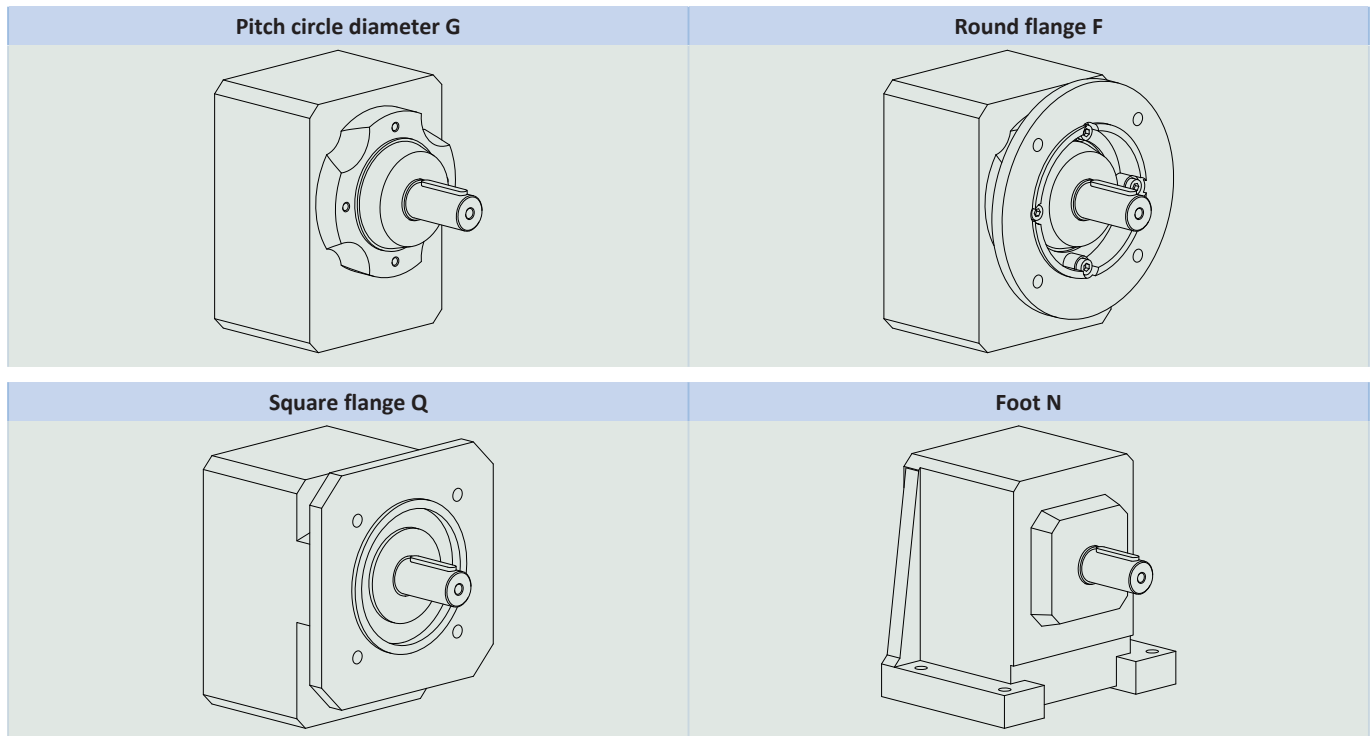
| Code   | Designation                         | Design                |
|--------|-------------------------------------|-----------------------|
| C      | Type                                | Helical gear unit     |
| 2      | Size                                | 2 (example)           |
| 0      | 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         |

### In order to complete the type designation, also specify:

- A detailed type designation of the motor, see the chapter [\[ 2 \]](#)
- The mounting position, see the chapter [\[ 8.5.4 \]](#)
- The position of the plug connector, see the chapter [\[ 8.5.6 \]](#)
- Oil expansion tank (recommended for gear units in mounting position EL5), see the chapter [\[ 8.6.4 \]](#)
- Standard or reinforced output bearing

## 8.5 Product description

### 8.5.1 Housing design



|    | G | F | Q | N |
|----|---|---|---|---|
| C0 | ✓ | ✓ | ✓ | ✓ |
| C1 | ✓ | ✓ | ✓ | ✓ |
| C2 | ✓ | ✓ | ✓ | ✓ |
| C3 | ✓ | ✓ | ✓ | ✓ |
| C4 | ✓ | ✓ | ✓ | ✓ |
| C5 | ✓ | ✓ | – | ✓ |
| C6 | ✓ | ✓ | – | ✓ |
| C7 | ✓ | ✓ | – | ✓ |
| C8 | ✓ | ✓ | – | ✓ |
| C9 | ✓ | ✓ | – | ✓ |

### 8.5.2 Shaft design

Gear units in sizes C0 – C9 come standard with a solid shaft with feather key.

Gear units in sizes C0 – C5 can be ordered with the option of a solid shaft without feather key. Only upon request starting at size C6.

### 8.5.3 Installation conditions

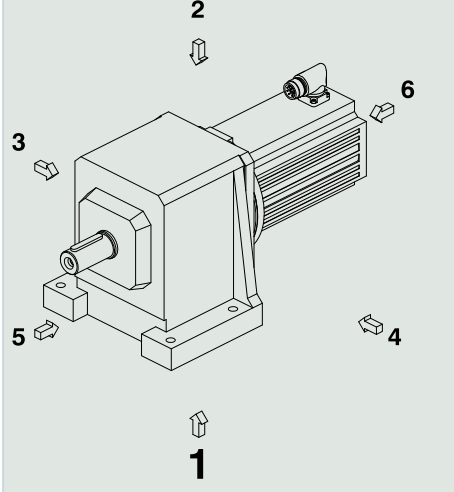
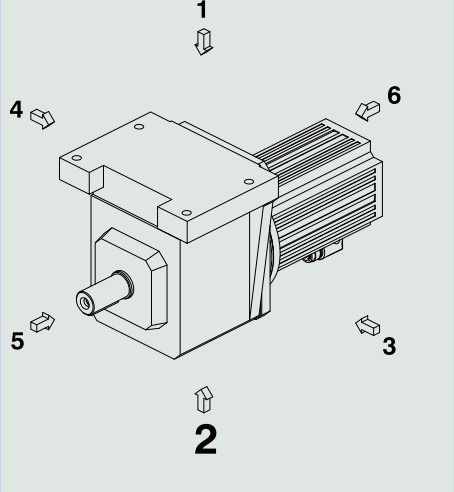
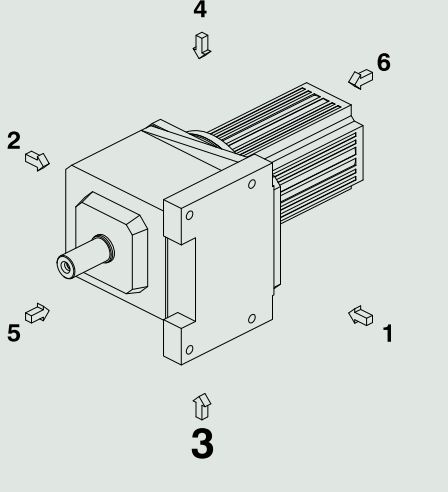
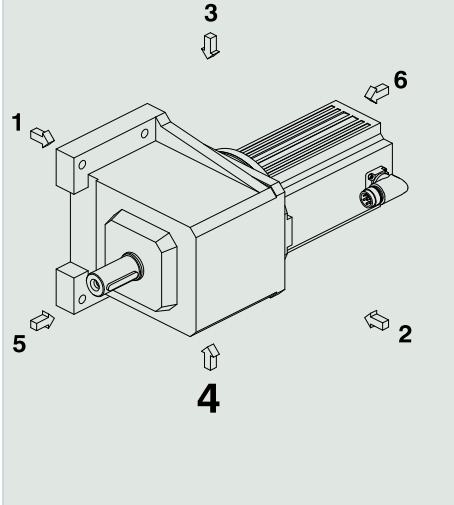
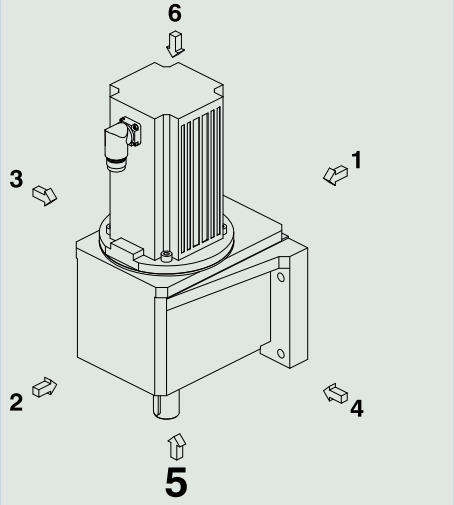
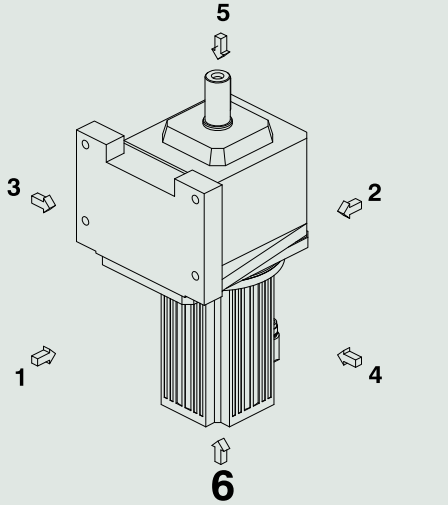
#### Fastening the gear units on the machine side using the pitch circle diameter

The specified torques and forces only apply when fastening gear units at the machine side using screws of quality 10.9. In addition, the gear unit housings must be adjusted at the pilot. The machine-side fit must be H7.

### 8.5.4 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gear unit sides. The mounting position is defined by the gear side facing downwards.

| <b>EL1</b><br><b>IMB3, IMB5, IMB14, IMB34, IMB35</b>                                | <b>EL2</b><br><b>IMB8</b>  | <b>EL3</b><br><b>IMB7</b>   |
|---|--|---|
|    |    |    |
| <b>EL4</b><br><b>IMB6</b>   | <b>EL5</b><br><b>IMV1, IMV5, IMV18</b>   | <b>EL6</b><br><b>IMV3, IMV6, IMV19</b>  |
|  |  |  |

Since the lubricant filling volume of the gear unit depends on the mounting position, the mounting position must be specified when ordering.

### 8.5.5 Lubricants

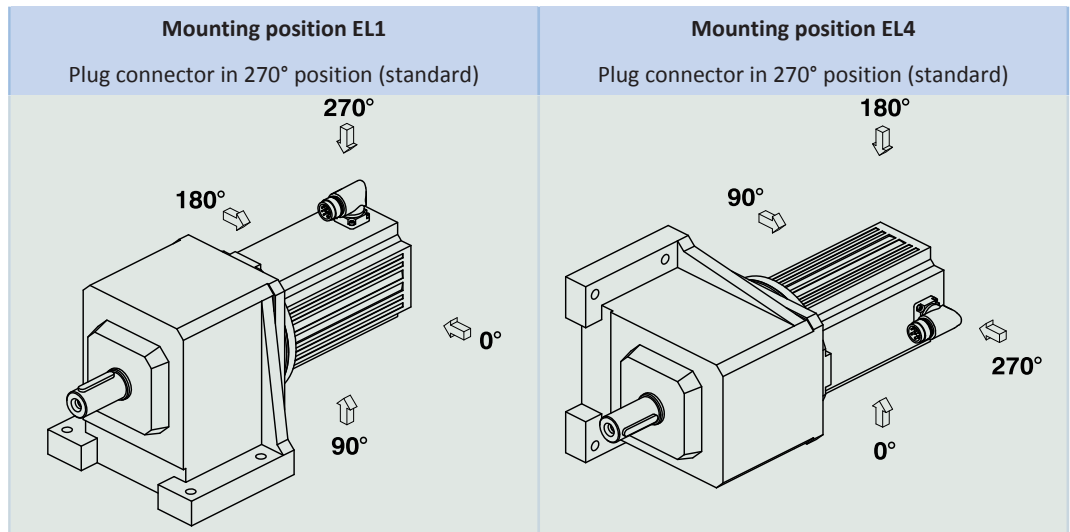
STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

Lubricant filling quantities for gear units, document ID 441871, can be found online at <http://www.stober.de/en/download>. Enter the ID of the documentation in the Search... field.



## 8.5.6 Position of the plug connector



Indicate variations for your geared motor in the purchase order.

Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

## 8.5.7 Other product features

| Feature  | Value                 |
|--|-----------------------|
| Max. permitted gear unit temperature (on the surface of the gear unit) | ≤ 80 °C               |
| Paint  | Black RAL 9005        |
| (ATEX) Directive 2014/34/EU (option)                                   | Not suitable          |
| <b>Protection class:<sup>1</sup></b>                                   |                       |
| Gear unit  | IP65                  |
| Motor  | IP56, optionally IP66 |

## 8.5.8 Maintenance

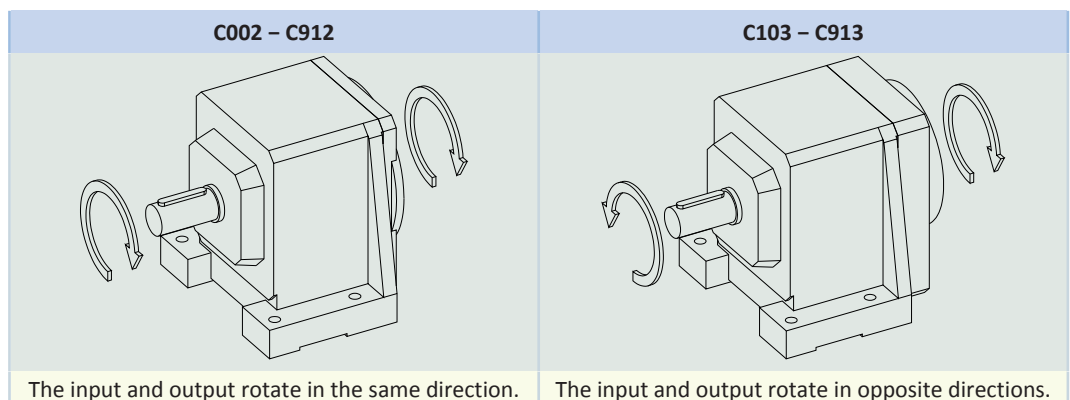
The instructions for maintenance can be found in the operating manual, ID 443027\_en, at <http://www.stoeber.de/en/download>. Enter the ID of the documentation in the Search... field.

### Ventilation

Air release valves are fitted as a standard feature and independently of installation position for gear unit sizes C6 to C9.

For the position and dimensions of the air release valve, refer to the 3D model at <http://cad.stoeber.de>.

## 8.5.9 Direction of rotation



The pictures show mounting position EL1.

<sup>1</sup>Observe the protection class of all the components.

## 8.6 Project configuration

Project your drives using our SERVOnsoft designing software. You can receive SERVOnsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

### 8.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point  $M_{2N}$  specified in the selection tables.

**For mounting positions EL1, EL2, EL3, EL4:**

$$n_{1m^*} \leq \frac{n_{1\max DBEL1,2,3,4}}{fB_T}$$

**For mounting positions EL5, EL6:**

$$n_{1m^*} \leq \frac{n_{1\max DBEL5,6}}{fB_T}$$

**For all mounting positions:**

$$n_{1\max^*} \leq \frac{n_{1\max ZB}}{fB_T}$$

$$M_{2\text{eff}^*} \leq M_{2\text{th}}$$

$$M_{2\text{acc}^*} \leq M_{2\text{acc}}$$

$$M_{2\text{NOT}^*} \leq M_{2\text{NOT}}$$

$$M_{2\text{eq}^*} \leq M_{2N} \cdot \frac{S}{fB_{\text{op}} \cdot fB_t}$$

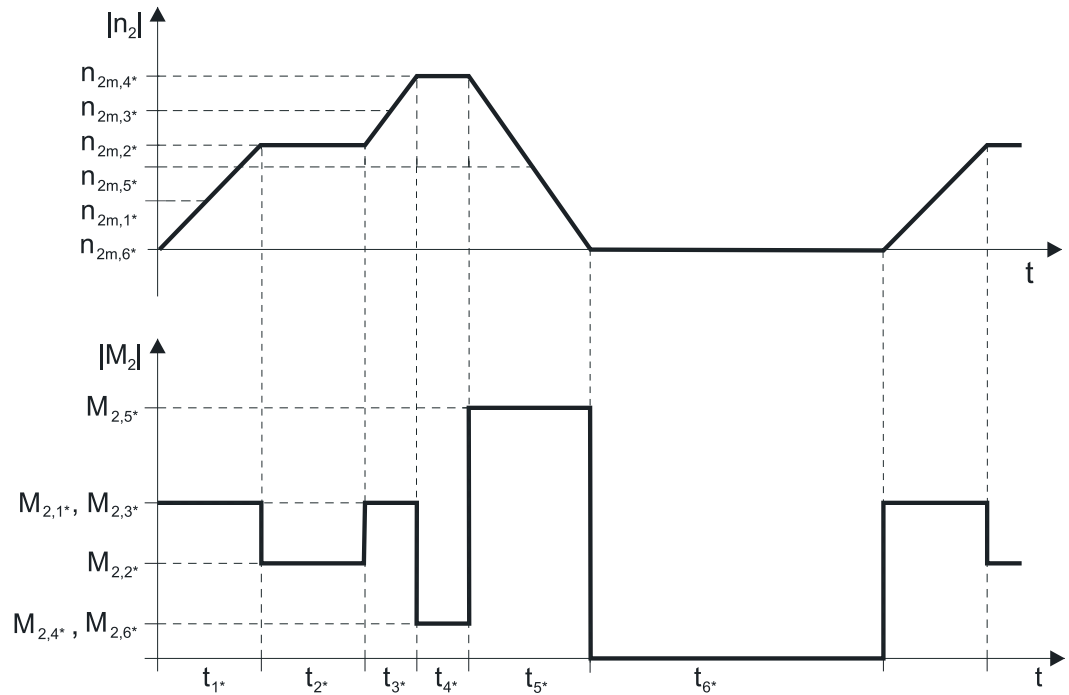
Refer to the selection table for the values for  $n_{1\max DBEL1,2,3,4}$  and  $n_{1\max DBEL5,6}$ ,  $n_{1\max ZB}$ ,  $M_{2\text{acc}}$ ,  $M_{2\text{NOT}}$ ,  $M_{2N}$  and  $S$ .

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

Calculate the thermal limit torque  $M_{2\text{th}}$  for a duty cycle > 50%.

**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 average input speed**

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

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

If  $t_{1*} + \dots + t_{5*} \geq 10$  min, calculate  $n_{2m*}$  without the rest phase  $t_{6*}$ .

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

**Calculation of the actual effective torque**

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

**Calculation of the actual equivalent torque**

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

**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.)

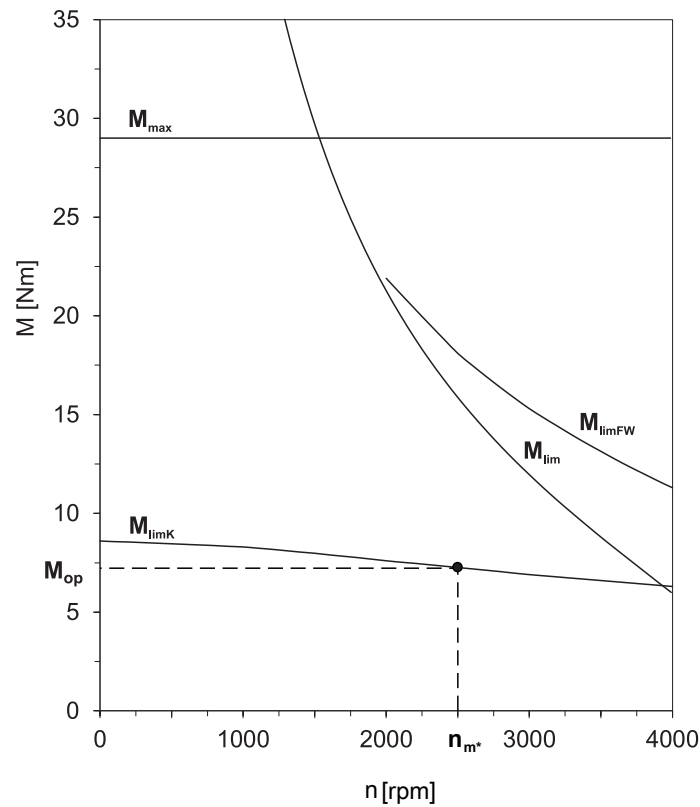
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

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

The values for  $i$  and  $a_{th}$  can be found in the selection tables.

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 curve of Chapter [▶ 2.3](#). Note the size and nominal speed  $n_N$  of the motor. The figure below shows an example of reading the torque  $M_{op}$  of a motor with convection cooling 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 run time $\leq 8$ h       |                         | 1.00       |
| Daily run time $\leq 16$ h      |                         | 1.15       |
| Daily run time $\leq 24$ h      |                         | 1.20       |
| Temperature                     |                         | $fB_T$     |
| Motor cooling                   | Surrounding temperature |            |
| Motor with convection cooling   | $\leq 20$ °C            | 1.0        |
|                                 | $\leq 30$ °C            | 1.1        |
|                                 | $\leq 40$ °C            | 1.25       |

**Notes**

- The maximum permitted gear unit 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 gear unit 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  $n_{2m^*} \leq 20$  rpm ( $F_{2axN} = F_{2ax20}$ ;  $F_{2radN} = F_{2rad20}$ ;  $M_{2kN} = M_{2k20}$ )
- Only if radial forces on the gear unit are stabilized by its pilots for the pitch circle diameter and flange housing design

### Permitted shaft loads

| Type | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| C0   | 20.0          | 500                | 1900                | 80                 |
| C1   | 30.0          | 850                | 3400                | 190                |
| C2   | 30.0          | 1050               | 4200                | 260                |
| C3   | 30.0          | 1400               | 5650                | 350                |
| C4   | 35.0          | 2400               | 9700                | 750                |
| C5   | 42.0          | 3000               | 11000               | 900                |
| C6   | 40.0          | 4000               | 16000               | 1500               |
| C7   | 45.0          | 5500               | 22000               | 2400               |
| C8   | 50.0          | 7500               | 30000               | 3700               |
| C9   | 55.0          | 9500               | 37000               | 5200               |

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

The following applies to output speeds  $n_{2m^*} > 20$  rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}}$$

The values for  $F_{2ax20}$ ,  $F_{2rad20}$  and  $M_{2k20}$  can be found in the table "Permitted shaft loads" in this chapter.

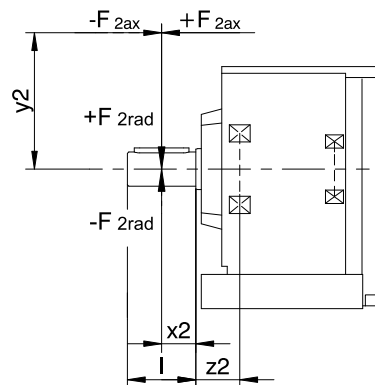


Fig. 1: Force application points

The specified values for  $F_{2rad20}$  are based on application of force at the middle 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:

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

$$F_{2rad^*} \leq F_{2radN}$$

$$F_{2ax^*} \leq F_{2axN}$$

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.

### 8.6.3 Radial shaft seal rings

#### Leak-proofness

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

### 8.6.4 Oil expansion tank

The gear units have a higher fill level in mounting position EL5. The oil expansion tank prevents oil from escaping out of the gear unit.

#### Notes

- We recommend using an oil expansion tank in mounting position EL5 (additional cost) for fast running gear units 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 [[8.3.5](#)]

## 8.7 Additional documentation

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

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

| Documentation   | ID        |
|---|-----------|
| Operating manual for C/F/K/S gear units and gear motors | 443027_en |
| Lubricant filling quantities for gear units             | 441871    |

## 9 F offset helical geared motors

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9

## Offset helical geared motors

F

### 9.1 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 – 274     |
| $M_{2acc}$     | 19 – 1100 Nm  |
| $\Delta\phi_2$ | 5 – 11 arcmin |
| $\eta_{get}$   | ≤ 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 G

For all other technical data, refer to <http://configurator.stoeber.de>.

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#).

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br><small>EL1,2,3,4</small> | $n_{1maxDB}$<br><small>EL5,6</small> | $n_{1maxZB}$ | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|--|--------------------------------------|--------------|---|----------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                                    | [rpm]                                | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>F1 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 120</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |  |                                      |              |   |                |                 |      |
| 65   | 101      | 109       | 2.5      | 1.2  | F102_0460 LM401U | 120        | 240        | 46.43 | 325/7       | 4000                                     | 4000                                 | 6000         | 1.8                                     | 11/6           | 7.7             | 16   |
| 86   | 76       | 83        | 2.4      | 1.4  | F102_0350 LM401U | 120        | 240        | 35.05 | 3575/102    | 4000                                     | 4000                                 | 6000         | 1.8                                     | 11/6           | 7.7             | 16   |
| 107  | 61       | 66        | 2.3      | 1.7  | F102_0280 LM401U | 120        | 200        | 28.17 | 169/6       | 4000                                     | 4000                                 | 6000         | 1.9                                     | 11/6           | 7.7             | 16   |
| 130  | 50       | 54        | 2.2      | 1.9  | F102_0230 LM401U | 100        | 170        | 23.08 | 3185/138    | 3700                                     | 3600                                 | 6000         | 1.9                                     | 11/6           | 7.7             | 16   |
| 130  | 99       | 101       | 4.3      | 0.97 | F102_0230 LM402U | 120        | 240        | 23.08 | 3185/138    | 3700                                     | 3600                                 | 6000         | 3.3                                     | 11/6           | 7.7             | 17   |
| 163  | 40       | 44        | 2.1      | 2.2  | F102_0185 LM401U | 81         | 130        | 18.46 | 1495/81     | 3700                                     | 3600                                 | 6000         | 2.0                                     | 11/6           | 7.7             | 16   |
| 163  | 79       | 81        | 4.2      | 1.1  | F102_0185 LM402U | 120        | 240        | 18.46 | 1495/81     | 3700                                     | 3600                                 | 6000         | 3.3                                     | 11/6           | 7.7             | 17   |
| 163  | 108      | 111       | 5.7      | 0.82 | F102_0185 LM403U | 120        | 240        | 18.46 | 1495/81     | 3700                                     | 3600                                 | 6000         | 4.6                                     | 11/6           | 7.7             | 19   |
| 221  | 30       | 32        | 2.0      | 2.7  | F102_0135 LM401U | 59         | 99         | 13.59 | 231/17      | 4000                                     | 4000                                 | 6000         | 1.9                                     | 11/8           | 6.5             | 16   |
| 221  | 58       | 59        | 4.0      | 1.4  | F102_0135 LM402U | 110        | 200        | 13.59 | 231/17      | 4000                                     | 4000                                 | 6000         | 3.2                                     | 11/8           | 6.5             | 17   |
| 221  | 80       | 82        | 5.4      | 1.0  | F102_0135 LM403U | 110        | 200        | 13.59 | 231/17      | 4000                                     | 4000                                 | 6000         | 4.5                                     | 11/8           | 6.5             | 19   |
| 275  | 24       | 26        | 1.9      | 2.7  | F102_0110 LM401U | 48         | 79         | 10.92 | 273/25      | 4000                                     | 4000                                 | 6000         | 2.0                                     | 11/8           | 6.5             | 16   |
| 275  | 47       | 48        | 3.8      | 1.6  | F102_0110 LM402U | 100        | 200        | 10.92 | 273/25      | 4000                                     | 4000                                 | 6000         | 3.3                                     | 11/8           | 6.5             | 17   |
| 275  | 64       | 66        | 5.2      | 1.2  | F102_0110 LM403U | 110        | 200        | 10.92 | 273/25      | 4000                                     | 4000                                 | 6000         | 4.6                                     | 11/8           | 6.5             | 19   |
| 335  | 20       | 21        | 1.9      | 2.7  | F102_0089 LM401U | 39         | 65         | 8.948 | 1029/115    | 3700                                     | 3600                                 | 6000         | 2.1                                     | 11/8           | 6.5             | 16   |
| 335  | 38       | 39        | 3.7      | 1.8  | F102_0089 LM402U | 84         | 200        | 8.948 | 1029/115    | 3700                                     | 3600                                 | 6000         | 3.4                                     | 11/8           | 6.5             | 17   |
| 335  | 53       | 54        | 5.1      | 1.3  | F102_0089 LM403U | 110        | 200        | 8.948 | 1029/115    | 3700                                     | 3600                                 | 6000         | 4.7                                     | 11/8           | 6.5             | 19   |
| 335  | 82       | 87        | 7.9      | 0.84 | F102_0089 LM503U | 110        | 200        | 8.948 | 1029/115    | 3700                                     | 3600                                 | 6000         | 11                                      | 11/8           | 6.5             | 22   |
| 419  | 16       | 17        | 1.8      | 2.7  | F102_0072 LM401U | 31         | 52         | 7.156 | 322/45      | 3700                                     | 3600                                 | 6000         | 2.3                                     | 11/8           | 6.5             | 16   |
| 419  | 31       | 31        | 3.6      | 2.1  | F102_0072 LM402U | 67         | 200        | 7.156 | 322/45      | 3700                                     | 3600                                 | 6000         | 3.6                                     | 11/8           | 6.5             | 17   |
| 419  | 42       | 43        | 4.9      | 1.5  | F102_0072 LM403U | 89         | 200        | 7.156 | 322/45      | 3700                                     | 3600                                 | 6000         | 4.9                                     | 11/8           | 6.5             | 19   |
| 419  | 66       | 70        | 7.6      | 0.98 | F102_0072 LM503U | 110        | 200        | 7.156 | 322/45      | 3700                                     | 3600                                 | 6000         | 11                                      | 11/8           | 6.5             | 22   |
| 464  | 28       | 28        | 3.5      | 2.3  | F102_0065 LM402U | 61         | 190        | 6.462 | 84/13       | 3500                                     | 3000                                 | 6000         | 3.8                                     | 11/8           | 6.5             | 17   |
| 464  | 38       | 39        | 4.8      | 1.6  | F102_0065 LM403U | 80         | 190        | 6.462 | 84/13       | 3500                                     | 3000                                 | 6000         | 5.1                                     | 11/8           | 6.5             | 19   |
| 464  | 59       | 63        | 7.5      | 1.0  | F102_0065 LM503U | 110        | 190        | 6.462 | 84/13       | 3500                                     | 3000                                 | 6000         | 11                                      | 11/8           | 6.5             | 22   |
| 696  | 9.4      | 10        | 1.7      | 2.7  | F102_0043 LM401U | 19         | 31         | 4.308 | 56/13       | 3500                                     | 3000                                 | 6000         | 3.2                                     | 11/8           | 6.5             | 16   |
| 696  | 18       | 19        | 3.3      | 3.0  | F102_0043 LM402U | 41         | 130        | 4.308 | 56/13       | 3500                                     | 3000                                 | 6000         | 4.5                                     | 11/8           | 6.5             | 17   |
| 696  | 25       | 26        | 4.5      | 2.2  | F102_0043 LM403U | 54         | 130        | 4.308 | 56/13       | 3500                                     | 3000                                 | 6000         | 5.8                                     | 11/8           | 6.5             | 19   |
| 696  | 40       | 42        | 7.0      | 1.4  | F102_0043 LM503U | 85         | 130        | 4.308 | 56/13       | 3500                                     | 3000                                 | 6000         | 12                                      | 11/8           | 6.5             | 22   |
| 696  | 57       | 65        | 10       | 0.95 | F102_0043 LM505U | 100        | 130        | 4.308 | 56/13       | 3500                                     | 3000                                 | 6000         | 18                                      | 11/8           | 6.5             | 26   |
| <b>F2 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 270</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |  |                                      |              |   |                |                 |      |
| 27   | 246      | 266       | 2.1      | 0.98 | F202_1130 LM401U | 270        | 480        | 112.7 | 1240/11     | 4000                                     | 3900                                 | 6000         | 1.7                                     | 11/6           | 18              | 24   |
| 32   | 205      | 221       | 1.9      | 1.2  | F202_0940 LM401U | 270        | 480        | 93.82 | 1032/11     | 4000                                     | 3900                                 | 6000         | 1.7                                     | 11/6           | 18              | 24   |
| 43   | 153      | 165       | 1.7      | 1.6  | F202_0700 LM401U | 270        | 430        | 70.13 | 5400/77     | 4000                                     | 3900                                 | 6000         | 1.8                                     | 11/6           | 18              | 24   |
| 53   | 243      | 248       | 3.0      | 0.99 | F202_0570 LM402U | 270        | 480        | 56.73 | 624/11      | 4000                                     | 3900                                 | 6000         | 3.2                                     | 11/6           | 18              | 25   |
| 64   | 103      | 111       | 1.4      | 2.3  | F202_0470 LM401U | 210        | 340        | 47.05 | 1035/22     | 4000                                     | 3900                                 | 6000         | 1.9                                     | 11/6           | 18              | 24   |
| 64   | 201      | 205       | 2.7      | 1.2  | F202_0470 LM402U | 270        | 480        | 47.05 | 1035/22     | 4000                                     | 3900                                 | 6000         | 3.2                                     | 11/6           | 18              | 25   |
| 85   | 77       | 84        | 1.3      | 2.7  | F202_0350 LM401U | 160        | 260        | 35.46 | 390/11      | 3800                                     | 3500                                 | 6000         | 2.0                                     | 11/6           | 18              | 24   |
| 85   | 152      | 155       | 2.6      | 1.4  | F202_0350 LM402U | 270        | 480        | 35.46 | 390/11      | 3800                                     | 3500                                 | 6000         | 3.4                                     | 11/6           | 18              | 25   |
| 85   | 208      | 213       | 3.5      | 1.0  | F202_0350 LM403U | 270        | 480        | 35.46 | 390/11      | 3800                                     | 3500                                 | 6000         | 4.7                                     | 11/6           | 18              | 27   |
| 107  | 120      | 123       | 2.5      | 1.7  | F202_0280 LM402U | 260        | 480        | 28.11 | 4020/143    | 3800                                     | 3500                                 | 6000         | 3.5                                     | 11/6           | 18              | 25   |
| 107  | 165      | 169       | 3.4      | 1.2  | F202_0280 LM403U | 270        | 480        | 28.11 | 4020/143    | 3800                                     | 3500                                 | 6000         | 4.8                                     | 11/6           | 18              | 27   |
| 128  | 51       | 55        | 1.2      | 2.7  | F202_0230 LM401U | 100        | 170        | 23.43 | 2320/99     | 3600                                     | 3100                                 | 6000         | 2.3                                     | 11/6           | 18              | 24   |
| 128  | 100      | 102       | 2.4      | 1.9  | F202_0230 LM402U | 220        | 480        | 23.43 | 2320/99     | 3600                                     | 3100                                 | 6000         | 3.7                                     | 11/6           | 18              | 25   |
| 128  | 138      | 141       | 3.3      | 1.4  | F202_0230 LM403U | 270        | 480        | 23.43 | 2320/99     | 3600                                     | 3100                                 | 6000         | 5.0                                     | 11/6           | 18              | 27   |
| 128  | 215      | 229       | 5.1      | 0.88 | F202_0230 LM503U | 270        | 480        | 23.43 | 2320/99     | 3600                                     | 3100                                 | 6000         | 11                                      | 11/6           | 18              | 30   |
| 161  | 80       | 81        | 2.3      | 2.2  | F202_0185 LM402U | 180        | 480        | 18.65 | 6360/341    | 3600                                     | 3100                                 | 6000         | 3.9                                     | 11/6           | 18              | 25   |
| 161  | 110      | 112       | 3.2      | 1.6  | F202_0185 LM403U | 230        | 480        | 18.65 | 6360/341    | 3600                                     | 3100                                 | 6000         | 5.2                                     | 11/6           | 18              | 27   |
| 161  | 172      | 182       | 5.0      | 1.0  | F202_0185 LM503U | 270        | 480        | 18.65 | 6360/341    | 3600                                     | 3100                                 | 6000         | 11                                      | 11/6           | 18              | 30   |
| 220  | 30       | 32        | 1.1      | 2.7  | F202_0135 LM401U | 60         | 99         | 13.63 | 109/8       | 3800                                     | 3500                                 | 6000         | 2.3                                     | 11/8           | 16              | 24   |
| 220  | 58       | 59        | 2.2      | 2.7  | F202_0135 LM402U | 130        | 400        | 13.63 | 109/8       | 3800                                     | 3500                                 | 6000         | 3.7                                     | 11/8           | 16              | 25   |
| 220  | 80       | 82        | 3.0      | 2.0  | F202_0135 LM403U | 170        | 400        | 13.63 | 109/8       | 3800                                     | 3500                                 | 6000         | 5.0                                     | 11/8           | 16              | 27   |

9.2 Selection tables 9 F offset helical geared motors

| $n_{2N}$   | $M_{2N}$ | $M_{2.0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br><small>EL1,2,3,4</small> | $n_{1maxDB}$<br><small>EL5,6</small> | $n_{1maxZB}$ | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|--|--------------------------------------|--------------|---|----------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                                    | [rpm]                                | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>F2 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 270</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |  |                                      |              |   |                |                 |      |
| 220  | 125      | 133       | 4.7      | 1.3  | F202_0135 LM503U | 210        | 400        | 13.63 | 109/8       | 3800                                     | 3500                                 | 6000         | 11                                      | 11/8           | 16              | 30   |
| 220  | 181      | 204       | 6.8      | 0.88 | F202_0135 LM505U | 210        | 400        | 13.63 | 109/8       | 3800                                     | 3500                                 | 6000         | 17                                      | 11/8           | 16              | 34   |
| 278  | 46       | 47        | 2.1      | 3.2  | F202_0110 LM402U | 100        | 310        | 10.80 | 7303/676    | 3800                                     | 3500                                 | 6000         | 4.0                                     | 11/8           | 16              | 25   |
| 278  | 64       | 65        | 2.9      | 2.3  | F202_0110 LM403U | 130        | 310        | 10.80 | 7303/676    | 3800                                     | 3500                                 | 6000         | 5.3                                     | 11/8           | 16              | 27   |
| 278  | 99       | 106       | 4.5      | 1.5  | F202_0110 LM503U | 210        | 310        | 10.80 | 7303/676    | 3800                                     | 3500                                 | 6000         | 11                                      | 11/8           | 16              | 30   |
| 278  | 144      | 162       | 6.5      | 1.0  | F202_0110 LM505U | 210        | 310        | 10.80 | 7303/676    | 3800                                     | 3500                                 | 6000         | 18                                      | 11/8           | 16              | 34   |
| 333  | 20       | 21        | 1.0      | 2.7  | F202_0090 LM401U | 39         | 66         | 9.006 | 3161/351    | 3600                                     | 3100                                 | 6000         | 3.0                                     | 11/8           | 16              | 24   |
| 333  | 39       | 39        | 2.0      | 3.6  | F202_0090 LM402U | 85         | 260        | 9.006 | 3161/351    | 3600                                     | 3100                                 | 6000         | 4.3                                     | 11/8           | 16              | 25   |
| 333  | 53       | 54        | 2.8      | 2.6  | F202_0090 LM403U | 110        | 260        | 9.006 | 3161/351    | 3600                                     | 3100                                 | 6000         | 5.6                                     | 11/8           | 16              | 27   |
| 333  | 83       | 88        | 4.4      | 1.7  | F202_0090 LM503U | 180        | 260        | 9.006 | 3161/351    | 3600                                     | 3100                                 | 6000         | 12                                      | 11/8           | 16              | 30   |
| 333  | 120      | 135       | 6.3      | 1.2  | F202_0090 LM505U | 210        | 260        | 9.006 | 3161/351    | 3600                                     | 3100                                 | 6000         | 18                                      | 11/8           | 16              | 34   |
| 333  | 168      | 186       | 8.9      | 0.82 | F202_0090 LM704U | 210        | 400        | 9.006 | 3161/351    | 3600                                     | 3100                                 | 6000         | 38                                      | 11/8           | 16              | 40   |
| 419  | 31       | 31        | 2.0      | 4.2  | F202_0072 LM402U | 67         | 210        | 7.167 | 5777/806    | 3600                                     | 3100                                 | 6000         | 4.9                                     | 11/8           | 16              | 25   |
| 419  | 42       | 43        | 2.7      | 3.0  | F202_0072 LM403U | 89         | 210        | 7.167 | 5777/806    | 3600                                     | 3100                                 | 6000         | 6.2                                     | 11/8           | 16              | 27   |
| 419  | 66       | 70        | 4.2      | 1.9  | F202_0072 LM503U | 140        | 210        | 7.167 | 5777/806    | 3600                                     | 3100                                 | 6000         | 12                                      | 11/8           | 16              | 30   |
| 419  | 95       | 108       | 6.1      | 1.3  | F202_0072 LM505U | 170        | 210        | 7.167 | 5777/806    | 3600                                     | 3100                                 | 6000         | 19                                      | 11/8           | 16              | 34   |
| 419  | 134      | 148       | 8.6      | 0.96 | F202_0072 LM704U | 210        | 400        | 7.167 | 5777/806    | 3600                                     | 3100                                 | 6000         | 38                                      | 11/8           | 16              | 40   |
| 540  | 104      | 114       | 8.2      | 1.1  | F202_0056 LM704U | 210        | 400        | 5.552 | 5341/962    | 3100                                     | 2600                                 | 5000         | 39                                      | 11/8           | 16              | 40   |
| 540  | 138      | 160       | 11       | 0.85 | F202_0056 LM706U | 210        | 400        | 5.552 | 5341/962    | 3100                                     | 2600                                 | 5000         | 57                                      | 11/8           | 16              | 47   |
| 641  | 28       | 28        | 2.5      | 4.0  | F202_0047 LM403U | 58         | 140        | 4.680 | 2616/559    | 3100                                     | 2600                                 | 5000         | 8.4                                     | 11/8           | 16              | 27   |
| 641  | 43       | 46        | 3.9      | 2.5  | F202_0047 LM503U | 92         | 140        | 4.680 | 2616/559    | 3100                                     | 2600                                 | 5000         | 14                                      | 11/8           | 16              | 30   |
| 641  | 62       | 70        | 5.7      | 1.8  | F202_0047 LM505U | 110        | 140        | 4.680 | 2616/559    | 3100                                     | 2600                                 | 5000         | 21                                      | 11/8           | 16              | 34   |
| 641  | 87       | 97        | 8.0      | 1.3  | F202_0047 LM704U | 190        | 340        | 4.680 | 2616/559    | 3100                                     | 2600                                 | 5000         | 41                                      | 11/8           | 16              | 40   |
| 641  | 117      | 135       | 11       | 0.96 | F202_0047 LM706U | 210        | 340        | 4.680 | 2616/559    | 3100                                     | 2600                                 | 5000         | 58                                      | 11/8           | 16              | 47   |
| <b>F3 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 450</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |  |                                      |              |   |                |                 |      |
| 16   | 398      | 429       | 1.8      | 1.0  | F303_1850 LM401U | 450        | 800        | 184.8 | 29939/162   | 4000                                     | 3900                                 | 6000         | 1.7                                     | 11/7           | 22              | 36   |
| 21   | 307      | 332       | 1.6      | 1.3  | F302_1410 LM401U | 450        | 620        | 140.6 | 7595/54     | 4000                                     | 3900                                 | 6000         | 1.7                                     | 11/6           | 22              | 31   |
| 32   | 401      | 409       | 2.5      | 1.0  | F302_0940 LM402U | 450        | 800        | 93.64 | 4214/45     | 4000                                     | 3900                                 | 6000         | 3.2                                     | 11/6           | 22              | 33   |
| 43   | 301      | 307       | 2.2      | 1.3  | F302_0700 LM402U | 450        | 800        | 70.36 | 2744/39     | 4000                                     | 3900                                 | 6000         | 3.3                                     | 11/6           | 22              | 33   |
| 43   | 414      | 422       | 3.0      | 0.97 | F302_0700 LM403U | 450        | 800        | 70.36 | 2744/39     | 4000                                     | 3900                                 | 6000         | 4.6                                     | 11/6           | 22              | 35   |
| 53   | 242      | 247       | 1.9      | 1.7  | F302_0560 LM402U | 450        | 800        | 56.49 | 4067/72     | 4000                                     | 3900                                 | 6000         | 3.4                                     | 11/6           | 22              | 33   |
| 53   | 332      | 339       | 2.7      | 1.2  | F302_0560 LM403U | 450        | 800        | 56.49 | 4067/72     | 4000                                     | 3900                                 | 6000         | 4.7                                     | 11/6           | 22              | 35   |
| 64   | 202      | 206       | 1.8      | 2.0  | F302_0470 LM402U | 440        | 800        | 47.19 | 1274/27     | 4000                                     | 3900                                 | 6000         | 3.5                                     | 11/6           | 22              | 33   |
| 64   | 277      | 283       | 2.4      | 1.4  | F302_0470 LM403U | 450        | 800        | 47.19 | 1274/27     | 4000                                     | 3900                                 | 6000         | 4.8                                     | 11/6           | 22              | 35   |
| 86   | 150      | 153       | 1.7      | 2.4  | F302_0350 LM402U | 330        | 800        | 35.03 | 7252/207    | 3700                                     | 3500                                 | 5500         | 3.8                                     | 11/6           | 22              | 33   |
| 86   | 206      | 210       | 2.3      | 1.8  | F302_0350 LM403U | 440        | 800        | 35.03 | 7252/207    | 3700                                     | 3500                                 | 5500         | 5.1                                     | 11/6           | 22              | 35   |
| 86   | 322      | 342       | 3.6      | 1.1  | F302_0350 LM503U | 450        | 800        | 35.03 | 7252/207    | 3700                                     | 3500                                 | 5500         | 11                                      | 11/6           | 22              | 38   |
| 106  | 121      | 123       | 1.6      | 2.8  | F302_0280 LM402U | 270        | 800        | 28.23 | 6860/243    | 3700                                     | 3500                                 | 5500         | 4.0                                     | 11/6           | 22              | 33   |
| 106  | 166      | 170       | 2.2      | 2.0  | F302_0280 LM403U | 350        | 800        | 28.23 | 6860/243    | 3700                                     | 3500                                 | 5500         | 5.3                                     | 11/6           | 22              | 35   |
| 106  | 260      | 276       | 3.5      | 1.3  | F302_0280 LM503U | 450        | 800        | 28.23 | 6860/243    | 3700                                     | 3500                                 | 5500         | 11                                      | 11/6           | 22              | 38   |
| 106  | 375      | 424       | 5.0      | 0.90 | F302_0280 LM505U | 450        | 800        | 28.23 | 6860/243    | 3700                                     | 3500                                 | 5500         | 18                                      | 11/6           | 22              | 42   |
| 128  | 101      | 103       | 1.6      | 3.2  | F302_0240 LM402U | 220        | 680        | 23.52 | 588/25      | 3500                                     | 3100                                 | 5000         | 4.4                                     | 11/6           | 22              | 33   |
| 128  | 138      | 141       | 2.2      | 2.3  | F302_0240 LM403U | 290        | 680        | 23.52 | 588/25      | 3500                                     | 3100                                 | 5000         | 5.7                                     | 11/6           | 22              | 35   |
| 128  | 216      | 230       | 3.4      | 1.5  | F302_0240 LM503U | 450        | 680        | 23.52 | 588/25      | 3500                                     | 3100                                 | 5000         | 12                                      | 11/6           | 22              | 38   |
| 128  | 313      | 353       | 4.9      | 1.0  | F302_0240 LM505U | 450        | 680        | 23.52 | 588/25      | 3500                                     | 3100                                 | 5000         | 18                                      | 11/6           | 22              | 42   |
| 160  | 351      | 387       | 6.6      | 0.84 | F302_0190 LM704U | 450        | 800        | 18.77 | 4900/261    | 3500                                     | 3100                                 | 5000         | 38                                      | 11/6           | 22              | 48   |
| 224  | 57       | 58        | 1.4      | 4.6  | F302_0135 LM402U | 130        | 390        | 13.38 | 7696/575    | 3700                                     | 3500                                 | 5500         | 4.3                                     | 11/8           | 20              | 33   |
| 224  | 79       | 80        | 2.0      | 3.3  | F302_0135 LM403U | 170        | 390        | 13.38 | 7696/575    | 3700                                     | 3500                                 | 5500         | 5.6                                     | 11/8           | 20              | 35   |
| 224  | 123      | 131       | 3.1      | 2.1  | F302_0135 LM503U | 260        | 390        | 13.38 | 7696/575    | 3700                                     | 3500                                 | 5500         | 12                                      | 11/8           | 20              | 38   |
| 224  | 178      | 201       | 4.4      | 1.5  | F302_0135 LM505U | 310        | 390        | 13.38 | 7696/575    | 3700                                     | 3500                                 | 5500         | 18                                      | 11/8           | 20              | 42   |
| 224  | 250      | 276       | 6.2      | 1.1  | F302_0135 LM704U | 350        | 650        | 13.38 | 7696/575    | 3700                                     | 3500                                 | 5500         | 38                                      | 11/8           | 20              | 48   |
| 278  | 63       | 65        | 1.9      | 3.9  | F302_0110 LM403U | 130        | 310        | 10.79 | 1456/135    | 3700                                     | 3500                                 | 5500         | 6.2                                     | 11/8           | 20              | 35   |
| 278  | 99       | 105       | 3.0      | 2.5  | F302_0110 LM503U | 210        | 310        | 10.79 | 1456/135    | 3700                                     | 3500                                 | 5500         | 12                                      | 11/8           | 20              | 38   |
| 278  | 143      | 162       | 4.3      | 1.7  | F302_0110 LM505U | 250        | 310        | 10.79 | 1456/135    | 3700                                     | 3500                                 | 5500         | 19                                      | 11/8           | 20              | 42   |
| 278  | 202      | 222       | 6.0      | 1.2  | F302_0110 LM704U | 350        | 650        | 10.79 | 1456/135    | 3700                                     | 3500                                 | 5500         | 38                                      | 11/8           | 20              | 48   |
| 278  | 269      | 312       | 8.0      | 0.91 | F302_0110 LM706U | 350        | 650        | 10.79 | 1456/135    | 3700                                     | 3500                                 | 5500         | 56                                      | 11/8           | 20              | 55   |
| 334  | 53       | 54        | 1.8      | 4.0  | F302_0090 LM403U | 110        | 260        | 8.986 | 5616/625    | 3500                                     | 3100                                 | 5000         | 6.9                                     | 11/8           | 20              | 35   |
| 334  | 83       | 88        | 2.9      | 2.5  | F302_0090 LM503U | 180        | 260        | 8.986 | 5616/625    | 3500                                     | 3100                                 | 5000         | 13                                      | 11/8           | 20              | 38   |
| 334  | 119      | 135       | 4.2      | 1.8  | F302_0090 LM505U | 210        | 260        | 8.986 | 5616/625    | 3500                                     | 3100                                 | 5000         | 19                                      | 11/8           | 20              | 42   |
| 334  | 168      | 185       | 5.8      | 1.4  | F302_0090 LM704U | 350        | 650        | 8.986 | 5616/625    | 3500                                     | 3100                                 | 5000         | 39                                      | 11/8           | 20              | 48   |
| 334  | 224      | 260       | 7.8      | 1.0  | F302_0090 LM706U | 350        | 650        | 8.986 | 5616/625    | 3500                                     | 3100                                 | 5000         | 56                                      | 11/8           | 20              | 55   |
| 418  | 134      | 148       | 5.6      | 1.6  | F302_0072 LM704U | 290        | 520        | 7.172 | 208/29      | 3500                                     | 3100                                 | 5000         | 40                                      | 11/8           | 20              | 48   |
| 418  | 179      | 207       | 7.5      | 1.2  | F302_0072 LM706U | 350        | 520        | 7.172 | 208/29      | 3500                                     | 3100                                 | 5000         | 58                                      | 11/8           | 20              | 55   |
| 524  | 107      | 118       | 5.4      | 1.9  | F302_0057 LM704U | 230        | 420        | 5.720 | 143/25      | 3000                                     | 2600                                 | 4500         | 42                                      | 11/8           | 20              | 48   |

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,3,4 | $n_{1maxDB}$<br>EL5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>F3 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 450</math> Nm)</b>  |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 524   | 142      | 165       | 7.2      | 1.4  | F302_0057 LM706U | 330        | 420        | 5.720 | 143/25      | 3000                      | 2600                  | 4500         | 60                                      | 11/8              | 20              | 55   |
| 646   | 87       | 96        | 5.2      | 2.1  | F302_0046 LM704U | 190        | 340        | 4.644 | 4992/1075   | 3000                      | 2600                  | 4500         | 45                                      | 11/8              | 20              | 48   |
| 646   | 116      | 134       | 7.0      | 1.6  | F302_0046 LM706U | 270        | 340        | 4.644 | 4992/1075   | 3000                      | 2600                  | 4500         | 62                                      | 11/8              | 20              | 55   |
| <b>F4 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 700</math> Nm)</b>  |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 11  | 590      | 637       | 1.3      | 1.2  | F403_2740 LM401U | 700        | 1400       | 274.4 | 59267/216   | 3800                      | 3500                  | 5500         | 1.7                                     | 10/6              | 39              | 44   |
| 14  | 472      | 509       | 1.2      | 1.5  | F403_2190 LM401U | 700        | 1400       | 219.2 | 94705/432   | 3800                      | 3500                  | 5500         | 1.8                                     | 10/6              | 39              | 44   |
| 16  | 395      | 427       | 1.1      | 1.8  | F403_1840 LM401U | 700        | 1180       | 183.9 | 39715/216   | 3800                      | 3500                  | 5500         | 1.8                                     | 10/6              | 39              | 44   |
| 43  | 644      | 684       | 2.9      | 1.1  | F402_0700 LM503U | 700        | 1400       | 70.06 | 1261/18     | 3800                      | 3500                  | 5500         | 11                                      | 10/5              | 39              | 46   |
| 54  | 515      | 547       | 2.6      | 1.4  | F402_0560 LM503U | 700        | 1400       | 55.97 | 2015/36     | 3800                      | 3500                  | 5500         | 11                                      | 10/5              | 39              | 46   |
| 64  | 432      | 459       | 2.5      | 1.5  | F402_0470 LM503U | 700        | 1370       | 46.94 | 845/18      | 3800                      | 3500                  | 5500         | 11                                      | 10/5              | 39              | 46   |
| 107   | 523      | 577       | 4.6      | 1.1  | F402_0280 LM704U | 700        | 1400       | 27.99 | 2015/72     | 3500                      | 3100                  | 5000         | 38                                      | 10/5              | 39              | 56   |
| 129   | 434      | 479       | 4.5      | 1.2  | F402_0230 LM704U | 700        | 1400       | 23.21 | 325/14      | 3200                      | 2800                  | 4500         | 39                                      | 10/5              | 39              | 56   |
| 129   | 578      | 671       | 6.0      | 0.90 | F402_0230 LM706U | 700        | 1400       | 23.21 | 325/14      | 3200                      | 2800                  | 4500         | 56                                      | 10/5              | 39              | 63   |
| 161   | 348      | 384       | 4.3      | 1.4  | F402_0185 LM704U | 700        | 1350       | 18.62 | 3575/192    | 3200                      | 2800                  | 4500         | 40                                      | 10/5              | 39              | 56   |
| 161   | 464      | 538       | 5.8      | 1.0  | F402_0185 LM706U | 700        | 1350       | 18.62 | 3575/192    | 3200                      | 2800                  | 4500         | 57                                      | 10/5              | 39              | 63   |
| 221   | 254      | 280       | 4.1      | 1.7  | F402_0135 LM704U | 540        | 930        | 13.57 | 5984/441    | 3500                      | 3100                  | 5000         | 39                                      | 10/7              | 39              | 56   |
| 221   | 338      | 392       | 5.5      | 1.3  | F402_0135 LM706U | 550        | 930        | 13.57 | 5984/441    | 3500                      | 3100                  | 5000         | 56                                      | 10/7              | 39              | 63   |
| 277   | 202      | 223       | 3.9      | 2.0  | F402_0110 LM704U | 430        | 790        | 10.83 | 682/63      | 3500                      | 3100                  | 5000         | 40                                      | 10/7              | 39              | 56   |
| 277   | 270      | 313       | 5.3      | 1.5  | F402_0110 LM706U | 550        | 790        | 10.83 | 682/63      | 3500                      | 3100                  | 5000         | 57                                      | 10/7              | 39              | 63   |
| 334   | 168      | 185       | 3.8      | 2.3  | F402_0090 LM704U | 360        | 650        | 8.980 | 440/49      | 3200                      | 2800                  | 4500         | 41                                      | 10/7              | 39              | 56   |
| 334   | 224      | 260       | 5.1      | 1.7  | F402_0090 LM706U | 520        | 650        | 8.980 | 440/49      | 3200                      | 2800                  | 4500         | 59                                      | 10/7              | 39              | 63   |
| 417   | 135      | 149       | 3.7      | 2.6  | F402_0072 LM704U | 290        | 520        | 7.202 | 605/84      | 3200                      | 2800                  | 4500         | 43                                      | 10/7              | 39              | 56   |
| 417   | 179      | 208       | 4.9      | 2.0  | F402_0072 LM706U | 420        | 520        | 7.202 | 605/84      | 3200                      | 2800                  | 4500         | 61                                      | 10/7              | 39              | 63   |
| <b>F6 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 1100</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 27  | 1032     | 1096      | 2.7      | 1.1  | F602_1120 LM503U | 1100       | 2000       | 112.2 | 9425/84     | 3500                      | 3200                  | 5000         | 11                                      | 10/5              | 77              | 73   |
| 32  | 858      | 912       | 2.4      | 1.3  | F602_0930 LM503U | 1100       | 1870       | 93.33 | 280/3       | 3500                      | 3200                  | 5000         | 11                                      | 10/5              | 77              | 73   |
| 43  | 640      | 680       | 2.1      | 1.7  | F602_0700 LM503U | 1100       | 1590       | 69.64 | 975/14      | 3500                      | 3200                  | 5000         | 11                                      | 10/5              | 77              | 73   |
| 43  | 925      | 1045      | 3.0      | 1.2  | F602_0700 LM505U | 1100       | 1590       | 69.64 | 975/14      | 3500                      | 3200                  | 5000         | 18                                      | 10/5              | 77              | 77   |
| 64  | 873      | 963       | 3.5      | 1.3  | F602_0470 LM704U | 1100       | 2000       | 46.72 | 1495/32     | 3500                      | 3200                  | 5000         | 38                                      | 10/5              | 77              | 83   |
| 85  | 658      | 726       | 3.3      | 1.5  | F602_0350 LM704U | 1100       | 2000       | 35.21 | 845/24      | 3300                      | 2800                  | 4500         | 39                                      | 10/5              | 77              | 83   |
| 85  | 877      | 1018      | 4.4      | 1.1  | F602_0350 LM706U | 1100       | 2000       | 35.21 | 845/24      | 3300                      | 2800                  | 4500         | 57                                      | 10/5              | 77              | 90   |
| 107   | 523      | 577       | 3.2      | 1.8  | F602_0280 LM704U | 1100       | 2000       | 27.99 | 2015/72     | 3300                      | 2800                  | 4500         | 41                                      | 10/5              | 77              | 83   |
| 107   | 697      | 809       | 4.3      | 1.3  | F602_0280 LM706U | 1100       | 2000       | 27.99 | 2015/72     | 3300                      | 2800                  | 4500         | 58                                      | 10/5              | 77              | 90   |
| 129   | 435      | 480       | 3.1      | 2.0  | F602_0230 LM704U | 930        | 1690       | 23.27 | 1885/81     | 2900                      | 2500                  | 4000         | 42                                      | 10/5              | 77              | 83   |
| 129   | 579      | 673       | 4.1      | 1.5  | F602_0230 LM706U | 1100       | 1690       | 23.27 | 1885/81     | 2900                      | 2500                  | 4000         | 59                                      | 10/5              | 77              | 90   |
| 220   | 254      | 281       | 2.8      | 2.9  | F602_0135 LM704U | 540        | 920        | 13.61 | 871/64      | 3300                      | 2800                  | 4500         | 42                                      | 10/7              | 73              | 83   |
| 220   | 339      | 393       | 3.8      | 2.2  | F602_0135 LM706U | 740        | 920        | 13.61 | 871/64      | 3300                      | 2800                  | 4500         | 59                                      | 10/7              | 73              | 90   |
| 277   | 202      | 223       | 2.7      | 3.1  | F602_0110 LM704U | 430        | 790        | 10.82 | 2077/192    | 3300                      | 2800                  | 4500         | 44                                      | 10/7              | 73              | 83   |
| 277   | 269      | 313       | 3.6      | 2.3  | F602_0110 LM706U | 630        | 790        | 10.82 | 2077/192    | 3300                      | 2800                  | 4500         | 62                                      | 10/7              | 73              | 90   |
| 334   | 168      | 185       | 2.6      | 3.1  | F602_0090 LM704U | 360        | 650        | 8.995 | 1943/216    | 2900                      | 2500                  | 4000         | 47                                      | 10/7              | 73              | 83   |
| 334   | 224      | 260       | 3.5      | 2.3  | F602_0090 LM706U | 520        | 650        | 8.995 | 1943/216    | 2900                      | 2500                  | 4000         | 65                                      | 10/7              | 73              | 90   |



## 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 gear unit 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 <http://configurator.stoeber.de>.

Combination options and the dimensions of forced ventilated geared motors can be found at <http://cad.stoeber.de>.

### 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 $\varnothing$ fit $\leq$ 50 mm | DIN 748-1, ISO k6       |
| Shaft $\varnothing$ fit $>$ 50 mm    | DIN 748-1, ISO m6       |
| Feather keys                         | DIN 6885-1, high form A |

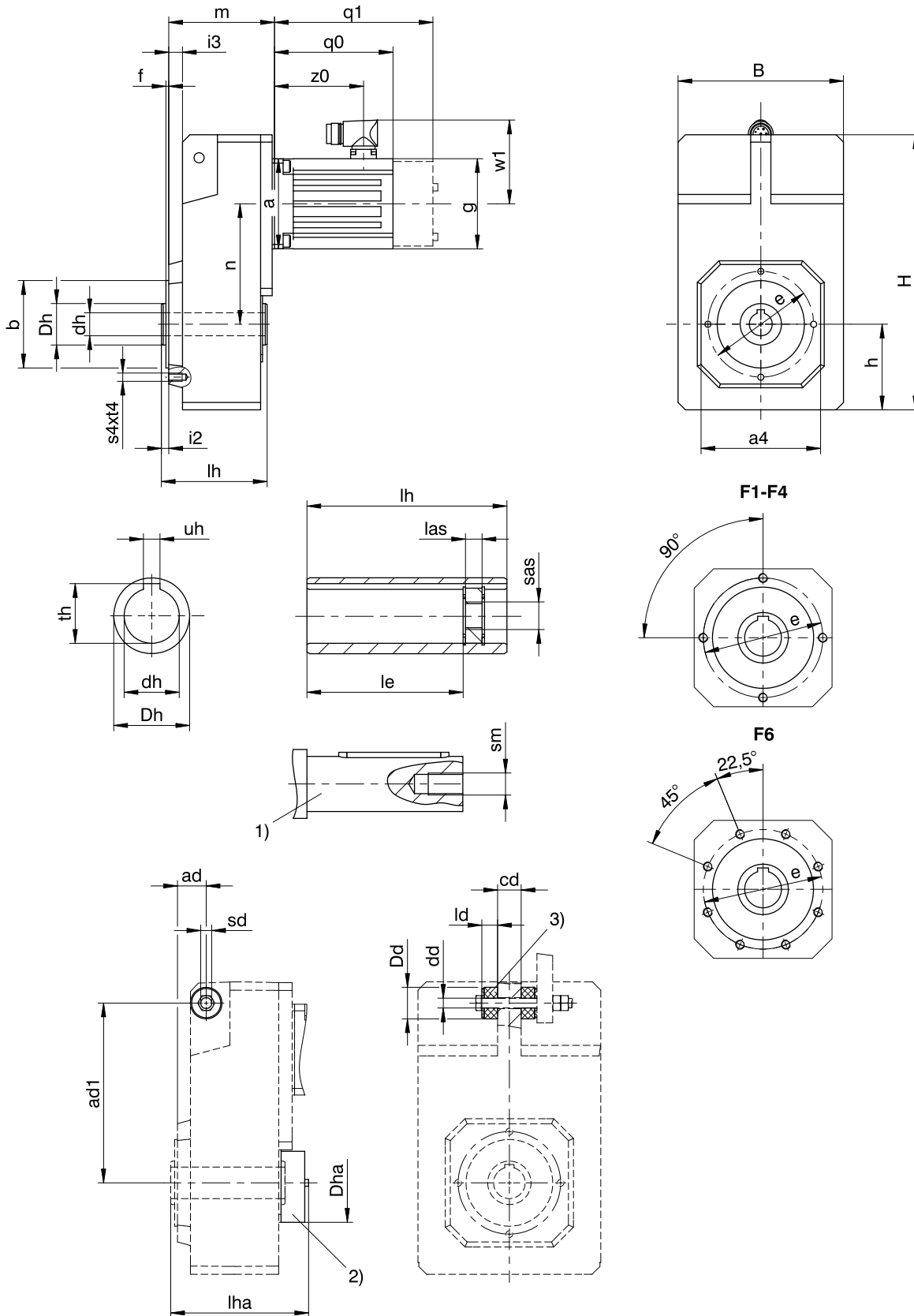
| Hollow shaft          | Tolerance |
|-----------------------|-----------|
| Hollow shaft hole fit | ISO H7    |

| 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 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 $\varnothing dh$ and the length of the feather key must be at least 2 x $\varnothing dh$ . | 2) | Cover (optional)              |
| 3) | Rubber buffer for torque arm bracket (optional). Dimension $\varnothing Dd$ = outer $\varnothing$ of the rubber buffer when not tensioned.        |    |                               |

Dimensions of gear units

| 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 | 29.5 | 150 | 70 <sub>j6</sub>  | 145 | 20 | 11.0 <sup>+0.5</sup> | 20 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| F2   | 130 | 33.0 | 181 | 95 <sub>j6</sub>  | 180 | 22 | 11.0 <sup>+0.5</sup> | 25 <sup>H7</sup> | 30  | 45  | 82   | 115 | 3.0 | 93  | 299.0 | 8.0  | 15.0 | 15 | 92  | 115 | 12  | 130.5 | M8  | M10 | M10 | M12 | 13 | 28.3 | 8 <sup>JS9</sup>  |
| F3   | 150 | 38.5 | 205 | 110 <sub>j6</sub> | 206 | 30 | 14.0 <sup>+0.5</sup> | 30 <sup>H7</sup> | 37  | 50  | 88   | 130 | 3.5 | 106 | 335.5 | 8.5  | 16.5 | 20 | 103 | 130 | 12  | 155.5 | M10 | M12 | M10 | M12 | 16 | 33.3 | 8 <sup>JS9</sup>  |
| F4   | 150 | 38.5 | 228 | 110 <sub>j6</sub> | 230 | 30 | 14.0 <sup>+0.5</sup> | 40 <sup>H7</sup> | 37  | 55  | 100  | 130 | 3.5 | 116 | 370.0 | 8.5  | 16.5 | 20 | 114 | 145 | 12  | 174.5 | M10 | M12 | M16 | M20 | 16 | 43.3 | 12 <sup>JS9</sup> |
| F6   | 180 | 44.5 | 270 | 130 <sub>j6</sub> | 265 | 35 | 22.0 <sup>+0.5</sup> | 50 <sup>H7</sup> | 60  | 70  | 115  | 165 | 3.5 | 137 | 433.0 | 10.5 | 20.5 | 30 | 143 | 180 | 12  | 192.5 | M10 | M20 | M16 | M20 | 16 | 53.8 | 14 <sup>JS9</sup> |

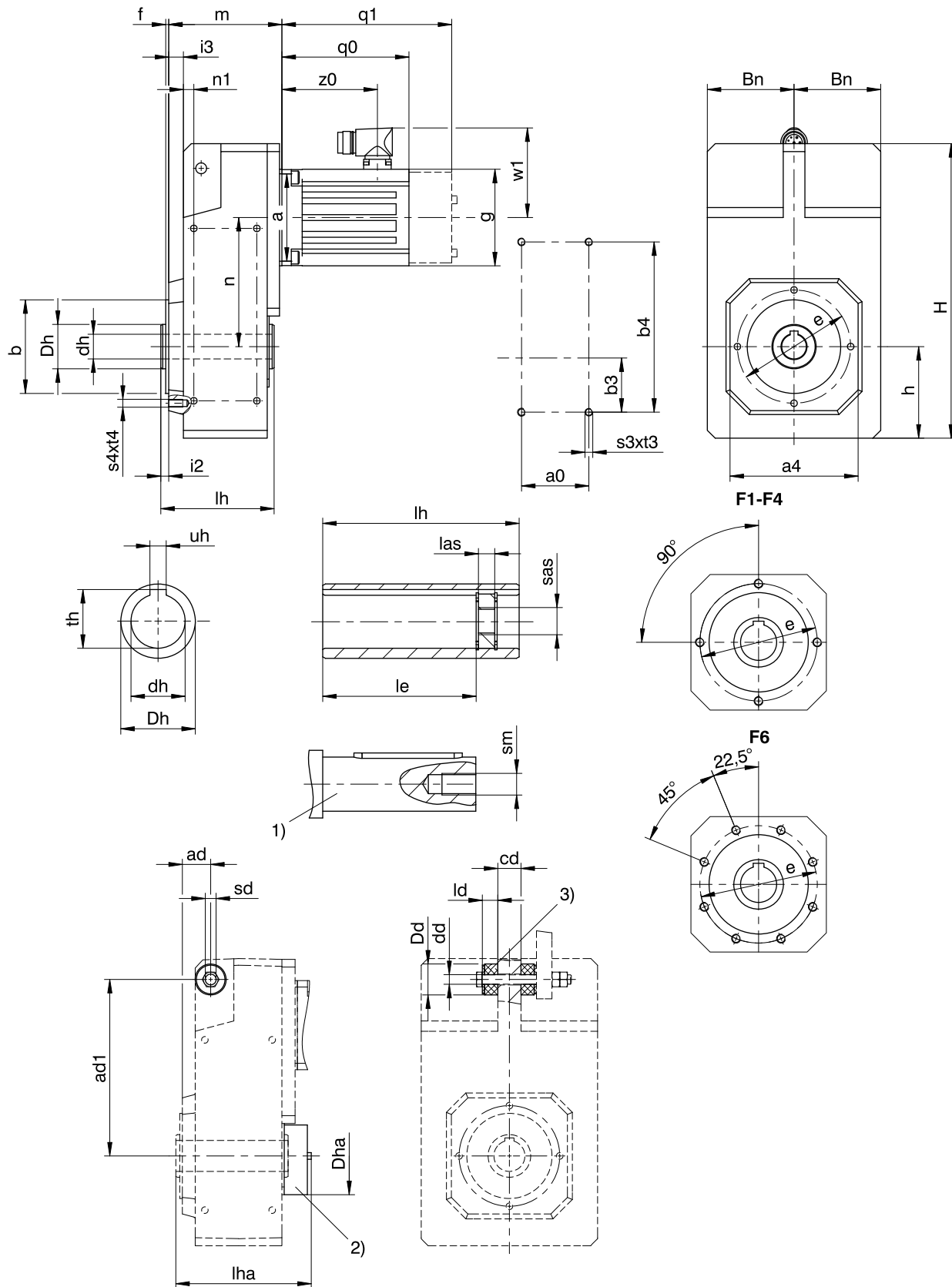
Dimensions of motors

| 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 |

### 9.3.2 A shaft design (hollow shaft), GN housing design (pitch circle diameter + side fastening)



- |    |   |    |                               |
|----|---|----|-------------------------------|
| 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 $\varnothing dh$ and the length of the feather key must be at least 2 x $\varnothing dh$ . | 2) | Cover (optional)              |
| 3) | Rubber buffer for torque arm bracket (optional). Dimension $\varnothing Dd$ = outer $\varnothing$ of the rubber buffer when not tensioned.        |    |                               |



## Dimensions of gear units

| Type | a0  | □a4 | ad   | ad1 | Øb                | b3 | b4  | Bn  | cd | Ødd                  | Ødh              | ØDd | ØDh | ØDha | Øe  | f   | h   | H     |
|------|-----|-----|------|-----|-------------------|----|-----|-----|----|----------------------|------------------|-----|-----|------|-----|-----|-----|-------|
| F1   | 50  | 100 | 29.5 | 150 | 70 <sub>js</sub>  | 40 | 140 | 71  | 20 | 11.0 <sup>+0.5</sup> | 20 <sup>H7</sup> | 30  | 35  | 70   | 85  | 2.5 | 74  | 238.0 |
| F2   | 64  | 130 | 33.0 | 181 | 95 <sub>js</sub>  | 55 | 175 | 88  | 22 | 11.0 <sup>+0.5</sup> | 25 <sup>H7</sup> | 30  | 45  | 82   | 115 | 3.0 | 93  | 299.0 |
| F3   | 72  | 150 | 38.5 | 205 | 110 <sub>js</sub> | 60 | 200 | 102 | 30 | 14.0 <sup>+0.5</sup> | 30 <sup>H7</sup> | 37  | 50  | 88   | 130 | 3.5 | 106 | 335.5 |
| F4   | 87  | 150 | 38.5 | 228 | 110 <sub>js</sub> | 70 | 220 | 114 | 30 | 14.0 <sup>+0.5</sup> | 40 <sup>H7</sup> | 37  | 55  | 100  | 130 | 3.5 | 116 | 370.0 |
| F6   | 108 | 180 | 44.5 | 270 | 130 <sub>js</sub> | 85 | 270 | 131 | 35 | 22.0 <sup>+0.5</sup> | 50 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| F2   | 8.0  | 15.0 | 15 | 92  | 115 | 12  | 130.5 | 10.5 | M8  | M8  | M10 | M10 | M12 | 13 | 13 | 28.3 | 8 <sup>JS9</sup>  |
| F3   | 8.5  | 16.5 | 20 | 103 | 130 | 12  | 155.5 | 12.5 | M10 | M10 | M12 | M10 | M12 | 16 | 16 | 33.3 | 8 <sup>JS9</sup>  |
| F4   | 8.5  | 16.5 | 20 | 114 | 145 | 12  | 174.5 | 12.5 | M10 | M10 | M12 | M16 | M20 | 16 | 16 | 43.3 | 12 <sup>JS9</sup> |
| F6   | 10.5 | 20.5 | 30 | 143 | 180 | 12  | 192.5 | 15.5 | M12 | M10 | M20 | M16 | M20 | 19 | 16 | 53.8 | 14 <sup>JS9</sup> |

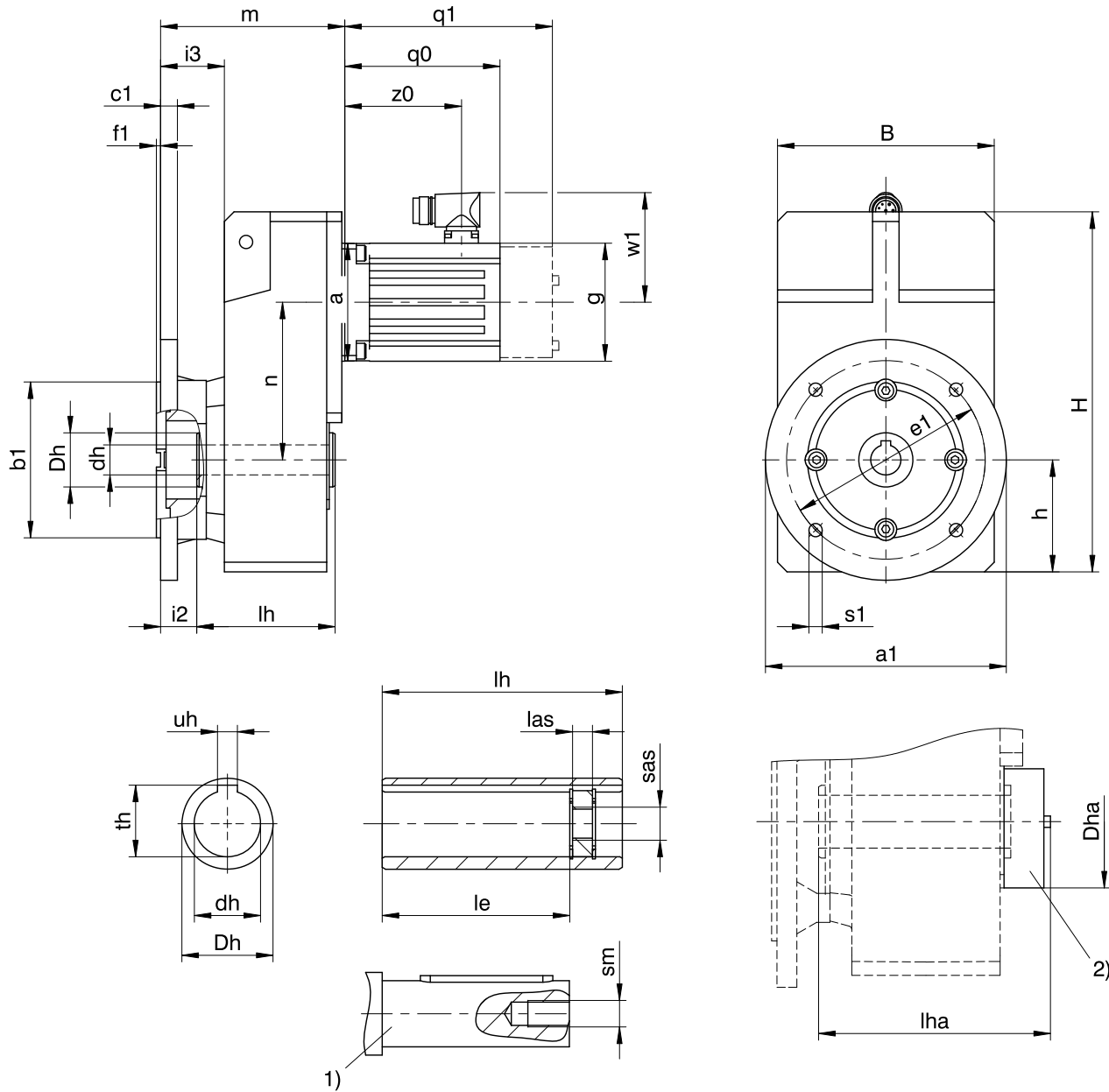
## Dimensions of motors

| 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 |

### 9.3.3 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  $2.2 \times \varnothing dh$  and the length of the feather key must be at least  $2 \times \varnothing dh$ .

2) Cover (optional)

## Dimensions of gear units

| Type | Øa1 | Øb1               | B   | c1 | Ødh              | ØDh | ØDha | Øe1 | f1  | h   | H     | i2   | i3   | le  | lh  | las | lha   | Øs1 | sm  | sas | th   | uh                |
|------|-----|-------------------|-----|----|------------------|-----|------|-----|-----|-----|-------|------|------|-----|-----|-----|-------|-----|-----|-----|------|-------------------|
| F1   | 160 | 110 <sub>js</sub> | 145 | 10 | 20 <sup>H7</sup> | 35  | 70   | 130 | 3.5 | 74  | 238.0 | 25.5 | 44.5 | 73  | 95  | 12  | 112   | 9   | M6  | M8  | 22.8 | 6 <sup>JS9</sup>  |
| F2   | 200 | 130 <sub>js</sub> | 180 | 14 | 25 <sup>H7</sup> | 45  | 82   | 165 | 3.5 | 93  | 299.0 | 30.0 | 53.0 | 92  | 115 | 12  | 130.5 | 11  | M10 | M12 | 28.3 | 8 <sup>JS9</sup>  |
| F3   | 250 | 180 <sub>js</sub> | 206 | 15 | 30 <sup>H7</sup> | 50  | 88   | 215 | 4.0 | 106 | 335.5 | 31.5 | 56.5 | 103 | 130 | 12  | 155.5 | 14  | M10 | M12 | 33.3 | 8 <sup>JS9</sup>  |
| F4   | 250 | 180 <sub>js</sub> | 230 | 15 | 40 <sup>H7</sup> | 55  | 100  | 215 | 4.0 | 116 | 370.0 | 31.5 | 56.5 | 114 | 145 | 12  | 174.5 | 14  | M16 | M20 | 43.3 | 12 <sup>JS9</sup> |
| F6   | 300 | 230 <sub>js</sub> | 265 | 17 | 50 <sup>H7</sup> | 70  | 115  | 265 | 4.0 | 137 | 433.0 | 29.5 | 60.5 | 143 | 180 | 12  | 192.5 | 14  | M16 | M20 | 53.8 | 14 <sup>JS9</sup> |

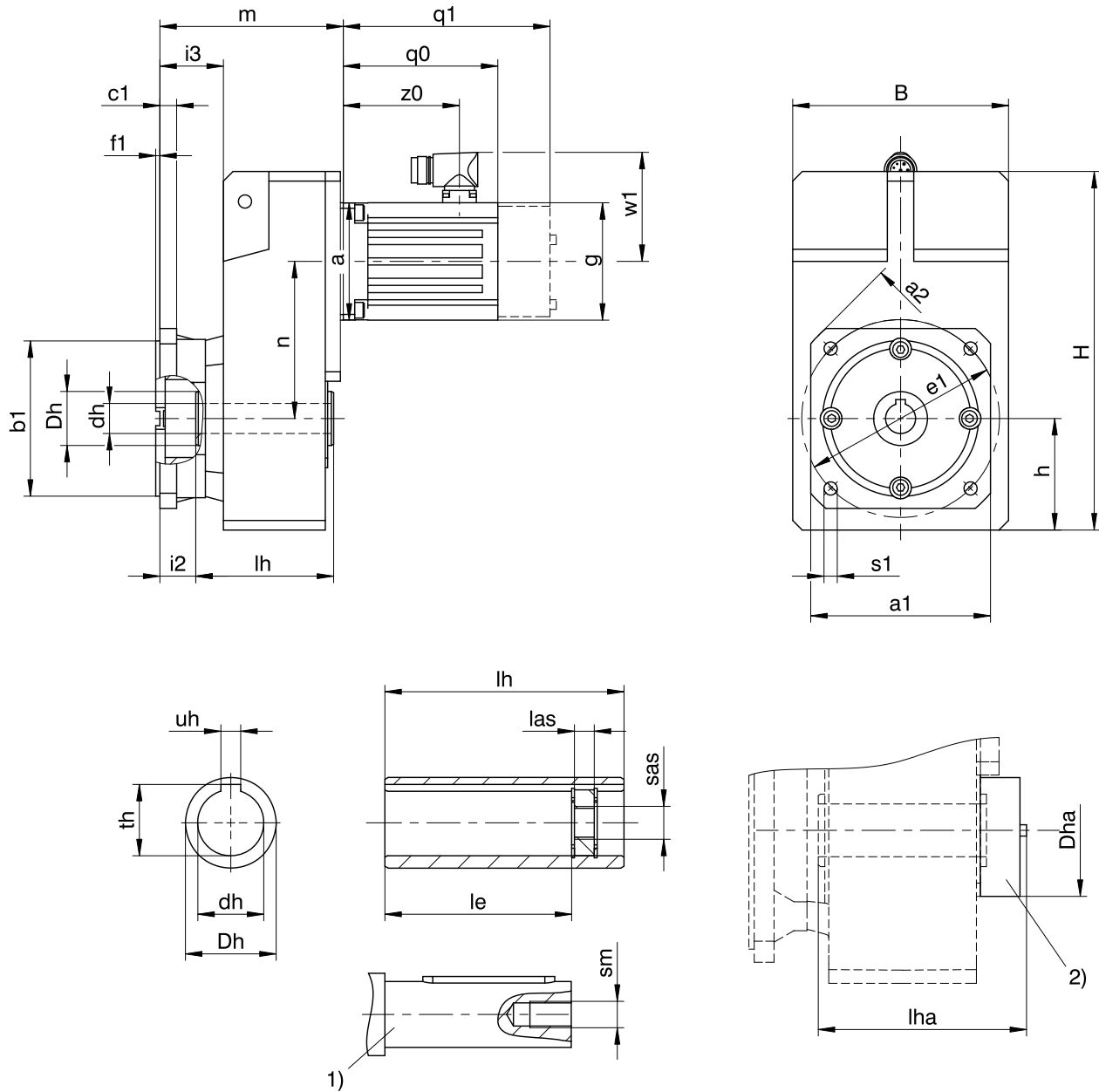
## Dimensions of motors

| 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 | Ø140 | 169.5 | 149.5 | □115 | 173.5 | 149.5 | □145 | 175.5 | 149.5 |
| F303 | Ø140 | 206.5 | 149.5 | –    | –     | –     | –    | –     | –     |
| F402 | –    | –     | –     | Ø160 | 188.5 | 169.0 | □145 | 190.5 | 169.0 |
| F403 | Ø140 | 221.5 | 169.0 | –    | –     | –     | –    | –     | –     |
| F602 | –    | –     | –     | Ø160 | 219.5 | 196.0 | □145 | 221.5 | 196.0 |

### 9.3.4 A shaft design (hollow shaft), Q housing design (square 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  $\varnothing dh$  and the length of the feather key must be at least 2 x  $\varnothing dh$ .

2) Cover (optional)

## Dimensions of gear units

| 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 <sub>f6</sub> | 145 | 10 | 20 <sup>H7</sup> | 35  | 70   | 130 | 3.5 | 74  | 238.0 | 25.5 | 44.5 | 73  | 95  | 12  | 112   | 9   | M6  | M8  | 22.8 | 6 <sup>JS9</sup>  |
| F2   | 150 | 195 | 130 <sub>f6</sub> | 180 | 14 | 25 <sup>H7</sup> | 45  | 82   | 165 | 3.5 | 93  | 299.0 | 30.0 | 53.0 | 92  | 115 | 12  | 130.5 | 11  | M10 | M12 | 28.3 | 8 <sup>JS9</sup>  |
| F3   | 200 | 260 | 180 <sub>f6</sub> | 206 | 15 | 30 <sup>H7</sup> | 50  | 88   | 215 | 4.0 | 106 | 335.5 | 31.5 | 56.5 | 103 | 130 | 12  | 155.5 | 14  | M10 | M12 | 33.3 | 8 <sup>JS9</sup>  |
| F4   | 200 | 260 | 180 <sub>f6</sub> | 230 | 15 | 40 <sup>H7</sup> | 55  | 100  | 215 | 4.0 | 116 | 370.0 | 31.5 | 56.5 | 114 | 145 | 12  | 174.5 | 14  | M16 | M20 | 43.3 | 12 <sup>JS9</sup> |
| F6   | 250 | 325 | 230 <sub>f6</sub> | 265 | 17 | 50 <sup>H7</sup> | 70  | 115  | 265 | 4.0 | 137 | 433.0 | 29.5 | 60.5 | 143 | 180 | 12  | 192.5 | 14  | M16 | M20 | 53.8 | 14 <sup>JS9</sup> |

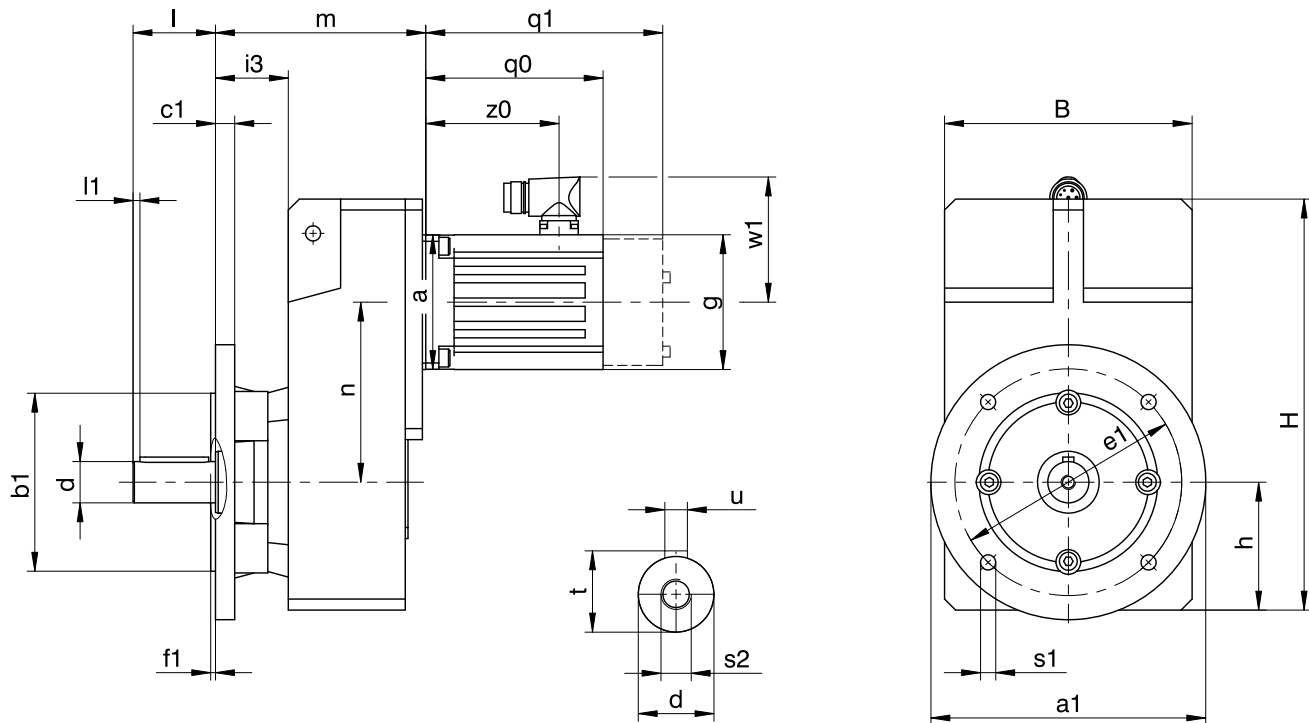
## Dimensions of motors

| 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 |

### 9.3.5 V shaft design (solid shaft), F housing design (round flange)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

#### Dimensions of gear units

| Type | Øa1 | Øb1               | B   | c1 | Ød               | Øe1 | f1  | h   | H     | i3   | l   | l1 | Øs1 | s2  | t    | u        |
|------|-----|-------------------|-----|----|------------------|-----|-----|-----|-------|------|-----|----|-----|-----|------|----------|
| F1   | 160 | 110 <sub>j6</sub> | 145 | 10 | 25 <sub>k6</sub> | 130 | 3.5 | 74  | 238.0 | 44.5 | 50  | 5  | 9   | M10 | 28.0 | A8×7×40  |
| F2   | 200 | 130 <sub>j6</sub> | 180 | 14 | 30 <sub>k6</sub> | 165 | 3.5 | 93  | 299.0 | 53.0 | 60  | 5  | 11  | M10 | 33.0 | A8×7×50  |
| F3   | 250 | 180 <sub>j6</sub> | 206 | 15 | 35 <sub>k6</sub> | 215 | 4.0 | 106 | 335.5 | 56.5 | 70  | 5  | 14  | M12 | 38.0 | A10×8×60 |
| F4   | 250 | 180 <sub>j6</sub> | 230 | 15 | 40 <sub>k6</sub> | 215 | 4.0 | 116 | 370.0 | 56.5 | 80  | 5  | 14  | M16 | 43.0 | A12×8×70 |
| F6   | 300 | 230 <sub>j6</sub> | 265 | 17 | 50 <sub>k6</sub> | 265 | 4.0 | 137 | 433.0 | 60.5 | 100 | 5  | 14  | M16 | 53.5 | A14×9×90 |

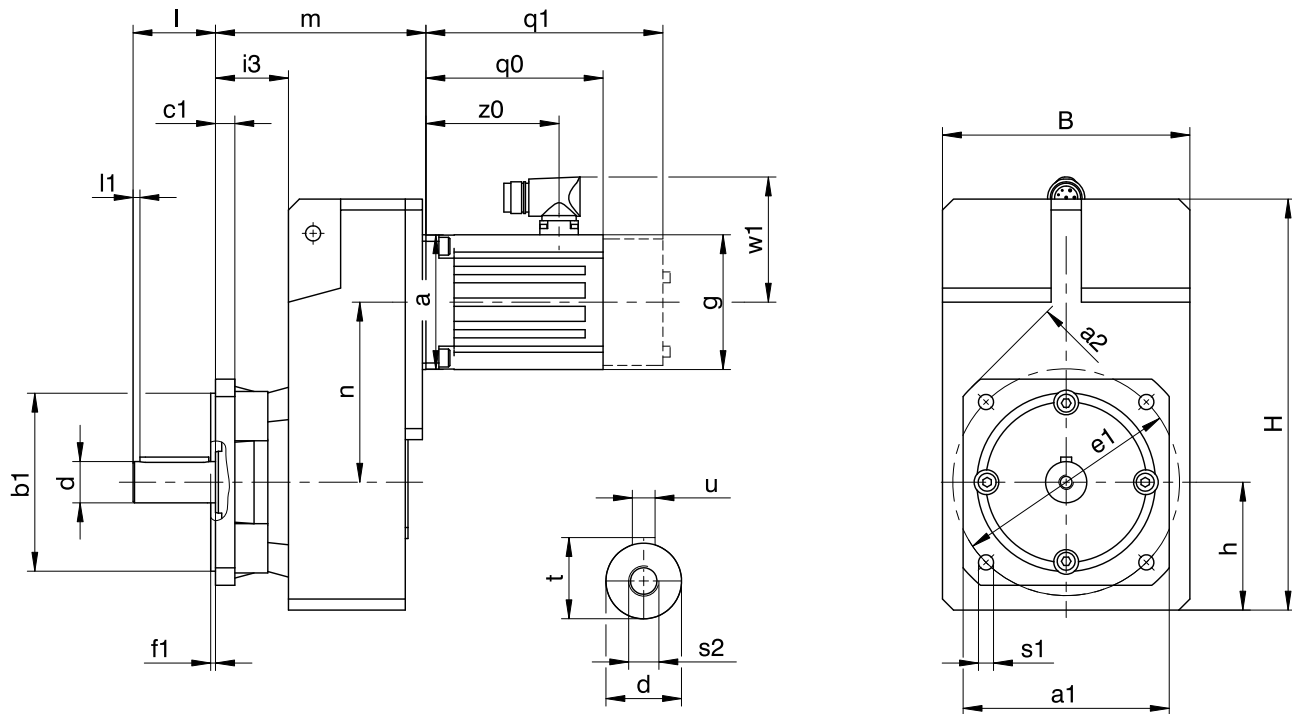
#### Dimensions of motors

| 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 | Ø140 | 169.5 | 149.5 | □115 | 173.5 | 149.5 | □145 | 175.5 | 149.5 |
| F303 | Ø140 | 206.5 | 149.5 | -    | -     | -     | -    | -     | -     |
| F402 | -    | -     | -     | Ø160 | 188.5 | 169.0 | □145 | 190.5 | 169.0 |
| F403 | Ø140 | 221.5 | 169.0 | -    | -     | -     | -    | -     | -     |
| F602 | -    | -     | -     | Ø160 | 219.5 | 196.0 | □145 | 221.5 | 196.0 |

### 9.3.6 V shaft design (solid shaft), Q housing design (square flange)



q0 Applies to motors without brake.

q1 Applies to motors with brake.

#### Dimensions of gear units

| Type | □a1 | □a2 | ∅b1               | c1 | B   | ∅d               | ∅e1 | f1  | h   | H     | i3   | l   | l1 | ∅s1 | s2  | t    | u        |
|------|-----|-----|-------------------|----|-----|------------------|-----|-----|-----|-------|------|-----|----|-----|-----|------|----------|
| F1   | 125 | 160 | 110 <sub>f6</sub> | 10 | 145 | 25 <sub>f6</sub> | 130 | 3.5 | 74  | 238.0 | 44.5 | 50  | 5  | 9   | M10 | 28.0 | A8×7×40  |
| F2   | 150 | 195 | 130 <sub>f6</sub> | 14 | 180 | 30 <sub>f6</sub> | 165 | 3.5 | 93  | 299.0 | 53.0 | 60  | 5  | 11  | M10 | 33.0 | A8×7×50  |
| F3   | 200 | 260 | 180 <sub>f6</sub> | 15 | 206 | 35 <sub>f6</sub> | 215 | 4.0 | 106 | 335.5 | 56.5 | 70  | 5  | 14  | M12 | 38.0 | A10×8×60 |
| F4   | 200 | 260 | 180 <sub>f6</sub> | 15 | 230 | 40 <sub>f6</sub> | 215 | 4.0 | 116 | 370.0 | 56.5 | 80  | 5  | 14  | M16 | 43.0 | A12×8×70 |
| F6   | 250 | 325 | 230 <sub>f6</sub> | 17 | 265 | 50 <sub>f6</sub> | 265 | 4.0 | 137 | 433.0 | 60.5 | 100 | 5  | 14  | M16 | 53.5 | A14×9×90 |

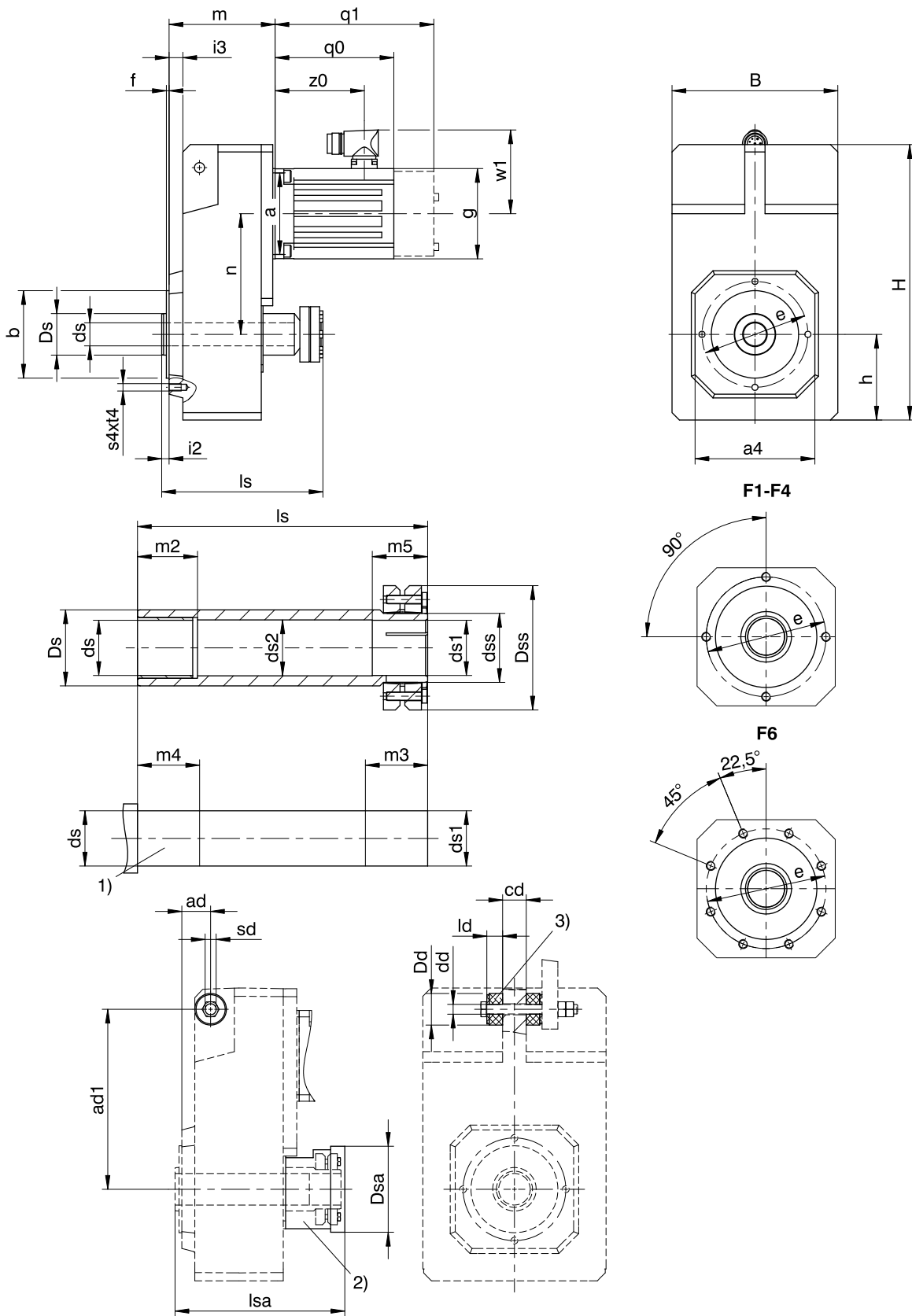
#### Dimensions of motors

| 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 |

### 9.3.7 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 $l_s$ must meet or exceed the specified value.   | 2) | Cover (optional)              |
| 3) | Rubber buffer for torque arm bracket (optional). Dimension $\varnothing D_d$ = outer $\varnothing$ of the rubber buffer when not tensioned. |    |                               |



Dimensions of gear units

| 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 | 29.5 | 150 | 70 <sub>j6</sub>  | 145 | 20 | 11.0 <sup>+0.5</sup> | 20 <sub>h9</sub> | 20 <sub>h9</sub> <sup>H7</sup> | 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 | 33.0 | 181 | 95 <sub>j6</sub>  | 180 | 22 | 11.0 <sup>+0.5</sup> | 25 <sub>h9</sub> | 25 <sub>h9</sub> <sup>H7</sup> | 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 | 38.5 | 205 | 110 <sub>j6</sub> | 206 | 30 | 14.0 <sup>+0.5</sup> | 30 <sub>h9</sub> | 30 <sub>h9</sub> <sup>H7</sup> | 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 | 38.5 | 228 | 110 <sub>j6</sub> | 230 | 30 | 14.0 <sup>+0.5</sup> | 40 <sub>h9</sub> | 40 <sub>h9</sub> <sup>H7</sup> | 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 <sub>j6</sub> | 265 | 35 | 22.0 <sup>+0.5</sup> | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 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 |

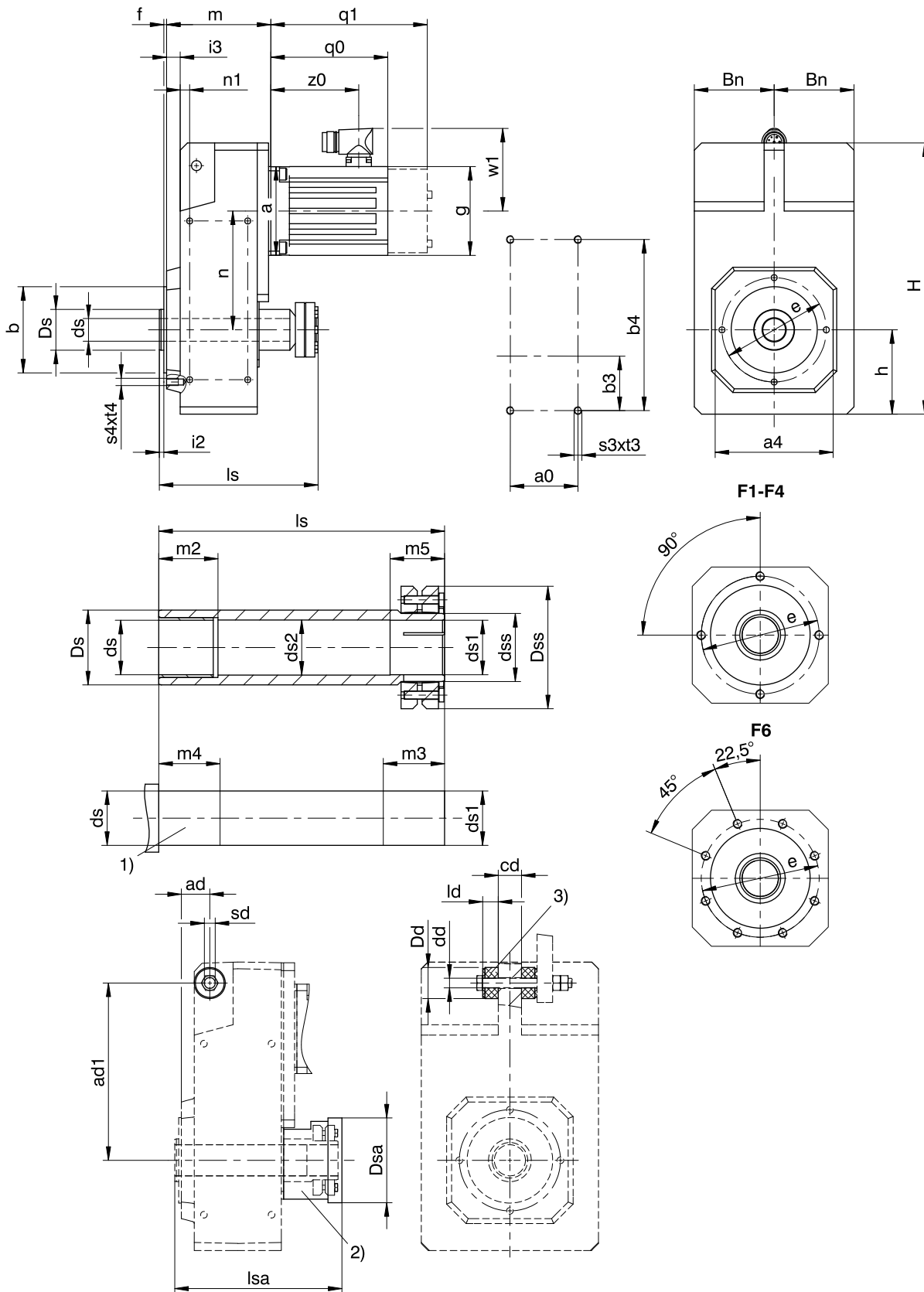
Dimensions of motors

| 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 |

### 9.3.8 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  $l_s$  must meet or exceed the specified value.
- 2) Cover (optional)
- 3) Rubber buffer for torque arm bracket (optional). Dimension  $\varnothing D_d$  = outer  $\varnothing$  of the rubber buffer when not tensioned.

## Dimensions of gear units

| Type | a0  | □a4 | ad   | ad1 | Øb               | b3 | b4  | Bn  | cd | Ødd                  | Øds              | Øds1                           | Øds2 | Ødss | ØDd | ØDs | ØDsa | ØDss |
|------|-----|-----|------|-----|------------------|----|-----|-----|----|----------------------|------------------|--------------------------------|------|------|-----|-----|------|------|
| F1   | 50  | 100 | 29.5 | 150 | 70 <sub>f</sub>  | 40 | 140 | 71  | 20 | 11.0 <sup>+0.5</sup> | 20 <sub>h9</sub> | 20 <sub>h9</sub> <sup>H7</sup> | 20.5 | 24   | 30  | 35  | 63   | 50   |
| F2   | 64  | 130 | 33.0 | 181 | 95 <sub>f</sub>  | 55 | 175 | 88  | 22 | 11.0 <sup>+0.5</sup> | 25 <sub>h9</sub> | 25 <sub>h9</sub> <sup>H7</sup> | 25.5 | 30   | 30  | 45  | 73   | 60   |
| F3   | 72  | 150 | 38.5 | 205 | 110 <sub>f</sub> | 60 | 200 | 102 | 30 | 14.0 <sup>+0.5</sup> | 30 <sub>h9</sub> | 30 <sub>h9</sub> <sup>H7</sup> | 30.5 | 36   | 37  | 50  | 83   | 72   |
| F4   | 87  | 150 | 38.5 | 228 | 110 <sub>f</sub> | 70 | 220 | 114 | 30 | 14.0 <sup>+0.5</sup> | 40 <sub>h9</sub> | 40 <sub>h9</sub> <sup>H7</sup> | 40.5 | 50   | 37  | 55  | 108  | 90   |
| F6   | 108 | 180 | 44.5 | 270 | 130 <sub>f</sub> | 85 | 270 | 131 | 35 | 22.0 <sup>+0.5</sup> | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 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 |

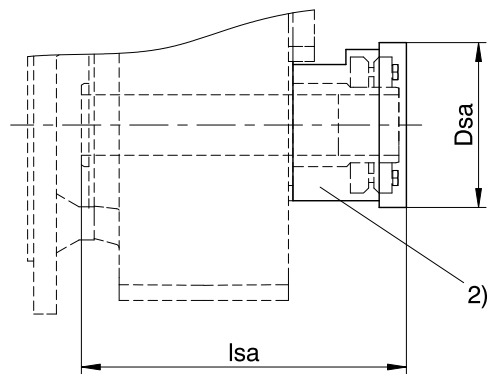
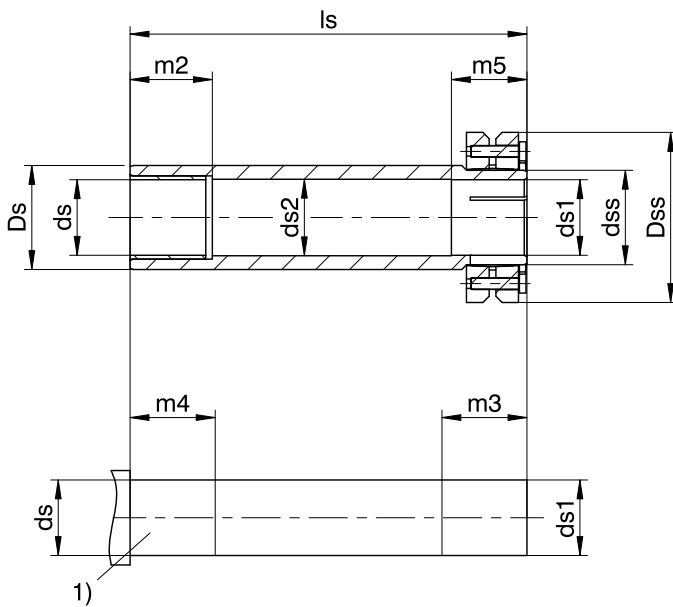
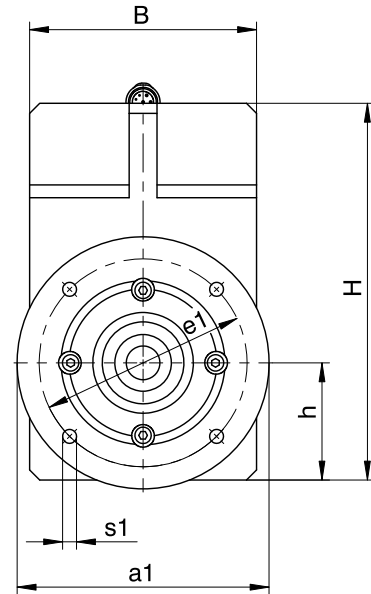
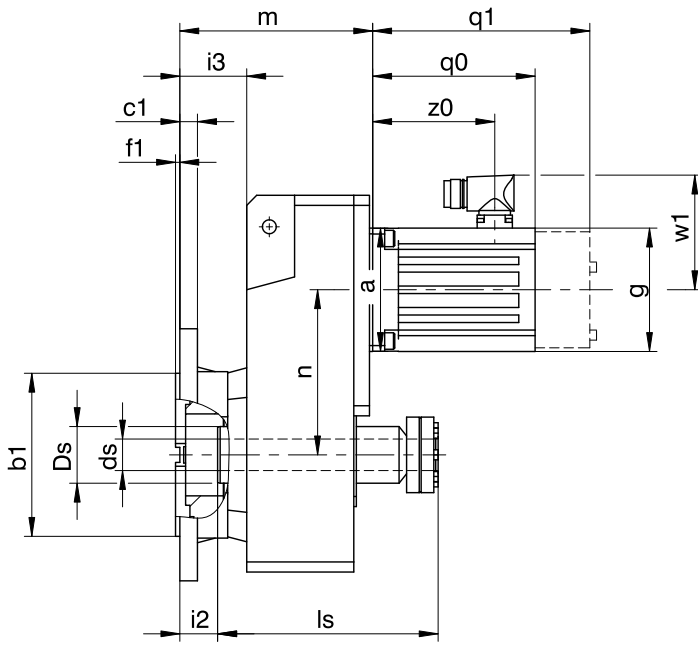
## Dimensions of motors

| 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 |

### 9.3.9 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 gear units

| Type | Øa1 | Øb1               | B   | c1 | Øds              | Øds1                           | Øds2 | Ødss | ØDs | ØDsa | ØDss | Øe1 | f1  | h   | H     | i2   | i3   | ls  | lsa | m2 | m3 | m4 | m5 | Øs1 |
|------|-----|-------------------|-----|----|------------------|--------------------------------|------|------|-----|------|------|-----|-----|-----|-------|------|------|-----|-----|----|----|----|----|-----|
| F1   | 160 | 110 <sub>f6</sub> | 145 | 10 | 20 <sub>h9</sub> | 20 <sub>h9</sub> <sup>H7</sup> | 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 <sub>f6</sub> | 180 | 14 | 25 <sub>h9</sub> | 25 <sub>h9</sub> <sup>H7</sup> | 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 <sub>f6</sub> | 206 | 15 | 30 <sub>h9</sub> | 30 <sub>h9</sub> <sup>H7</sup> | 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 <sub>f6</sub> | 230 | 15 | 40 <sub>h9</sub> | 40 <sub>h9</sub> <sup>H7</sup> | 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 <sub>f6</sub> | 265 | 17 | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 70  | 128  | 106  | 265 | 4.0 | 137 | 433.0 | 29.5 | 60.5 | 248 | 251 | 40 | 47 | 45 | 42 | 14  |

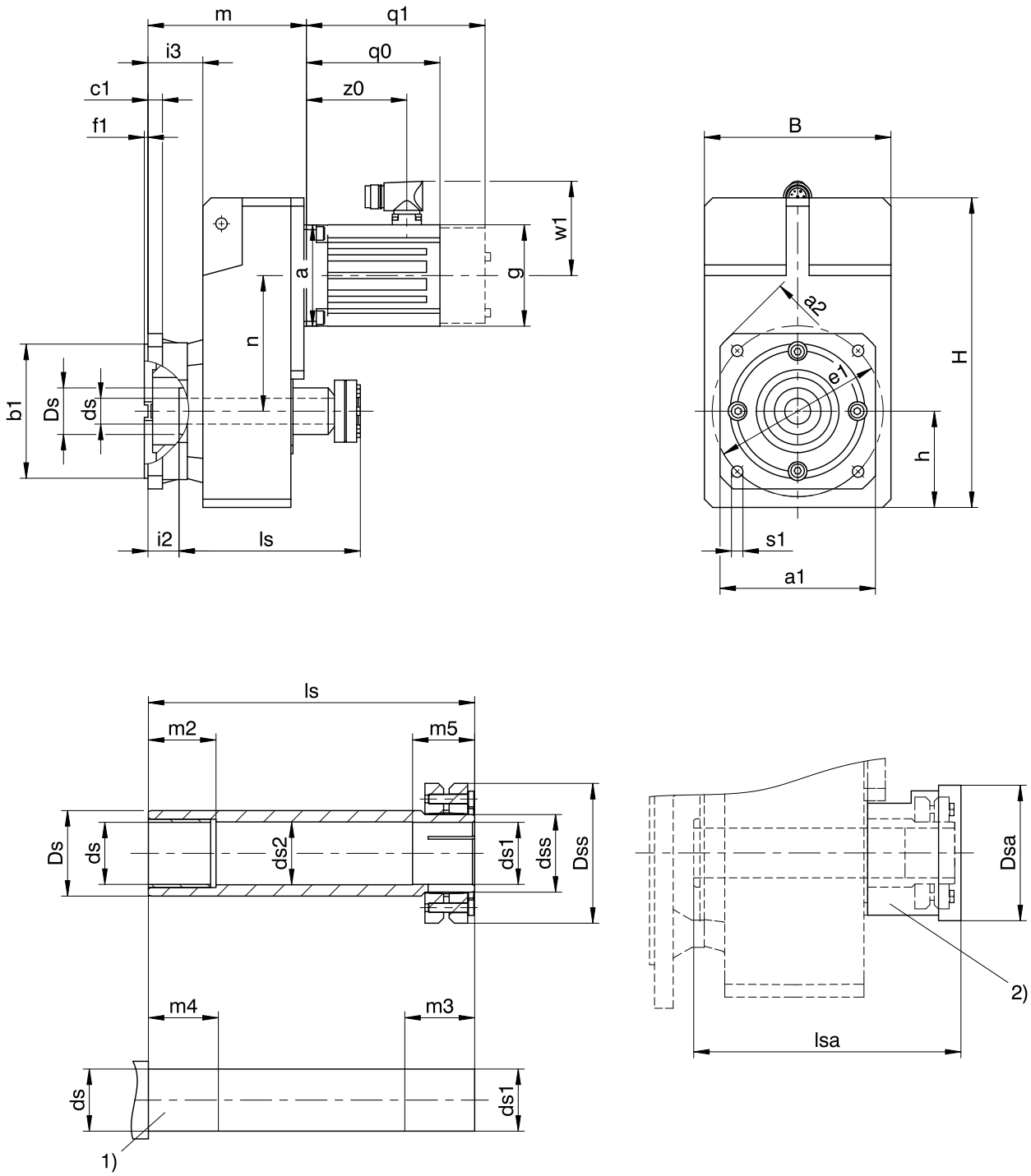
## Dimensions of motors

| 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 | Ø140 | 169.5 | 149.5 | □115 | 173.5 | 149.5 | □145 | 175.5 | 149.5 |
| F303 | Ø140 | 206.5 | 149.5 | –    | –     | –     | –    | –     | –     |
| F402 | –    | –     | –     | Ø160 | 188.5 | 169.0 | □145 | 190.5 | 169.0 |
| F403 | Ø140 | 221.5 | 169.0 | –    | –     | –     | –    | –     | –     |
| F602 | –    | –     | –     | Ø160 | 219.5 | 196.0 | □145 | 221.5 | 196.0 |

### 9.3.10 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  $l_s$  must meet or exceed the specified value.

2) Cover (optional)

## Dimensions of gear units

| 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 <sub>f6</sub> | 145 | 10 | 20 <sub>H9</sub> | 20 <sub>H7</sub> | 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 <sub>f6</sub> | 180 | 14 | 25 <sub>H9</sub> | 25 <sub>H7</sub> | 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 <sub>f6</sub> | 206 | 15 | 30 <sub>H9</sub> | 30 <sub>H7</sub> | 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 <sub>f6</sub> | 230 | 15 | 40 <sub>H9</sub> | 40 <sub>H7</sub> | 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 <sub>f6</sub> | 265 | 17 | 50 <sub>H9</sub> | 50 <sub>H7</sub> | 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 |

## 9.4 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.

### Sample code

|   |   |   |   |   |   |      |        |
|---|---|---|---|---|---|------|--------|
| F | 2 | 0 | 2 | A | G | 0280 | LM403U |
|---|---|---|---|---|---|------|--------|

### Explanation

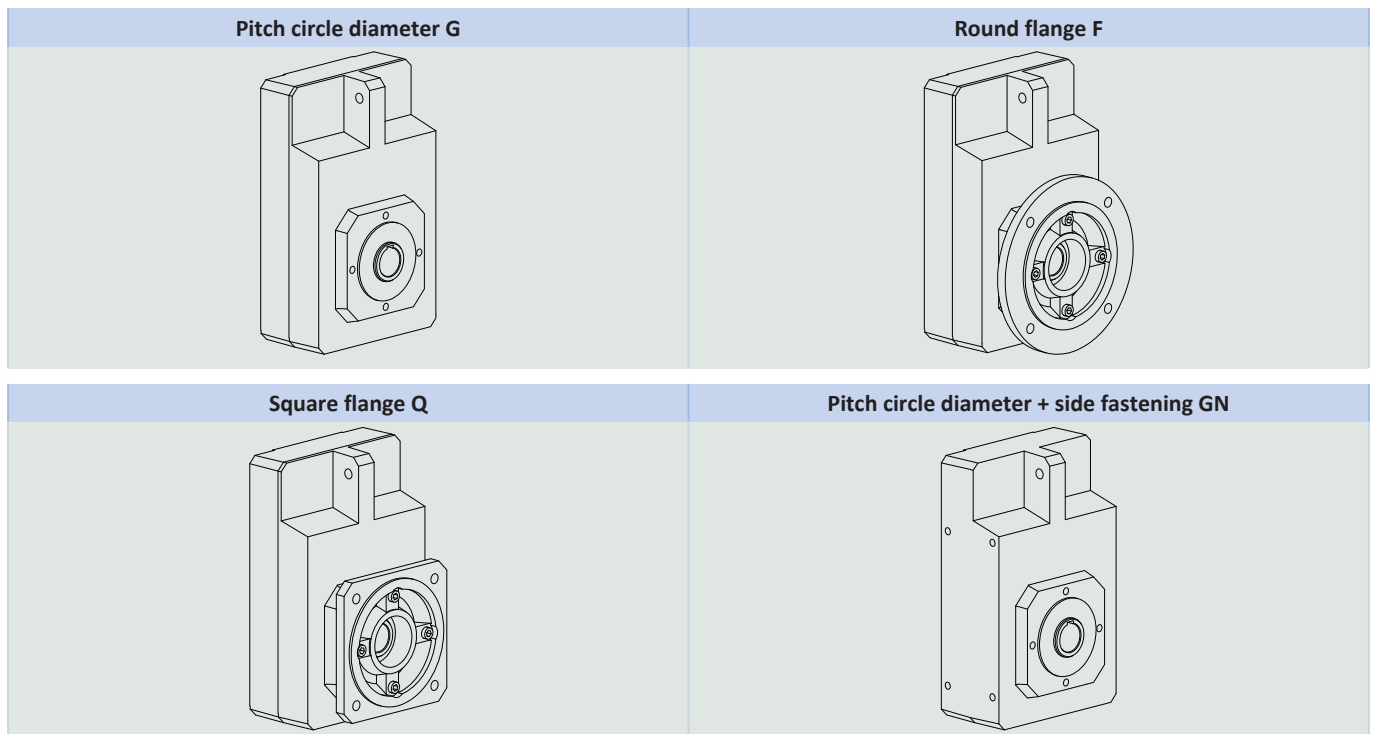
| Code   | Designation                         | Design                                 |
|--------|-------------------------------------|--|
| F      | Type                                | Offset helical gear unit               |
| 2      | Size                                | 2 (example)                            |
| 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                          |

In order to complete the type designation, also specify:

- A detailed type designation of the motor, see the chapter [\[ 2 \]](#)
- The mounting position, see the chapter [\[ 9.5.4 \]](#)
- The position of the plug connector, see the chapter [\[ 9.5.6 \]](#)

## 9.5 Product description

### 9.5.1 Housing design





|    | G | F | Q | GN |
|----|---|---|---|----|
| F1 | ✓ | ✓ | ✓ | ✓  |
| F2 | ✓ | ✓ | ✓ | ✓  |
| F3 | ✓ | ✓ | ✓ | ✓  |
| F4 | ✓ | ✓ | ✓ | ✓  |
| F6 | ✓ | ✓ | ✓ | ✓  |

## 9.5.2 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 | –   |

## 9.5.3 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 gear unit hollow shaft when attaching the gear unit.

Maximum deviation  $\leq 0.03$  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  $p \geq 325$  N/mm<sup>2</sup>.

Possible materials:

- C45E +QT
- 42CrMo4

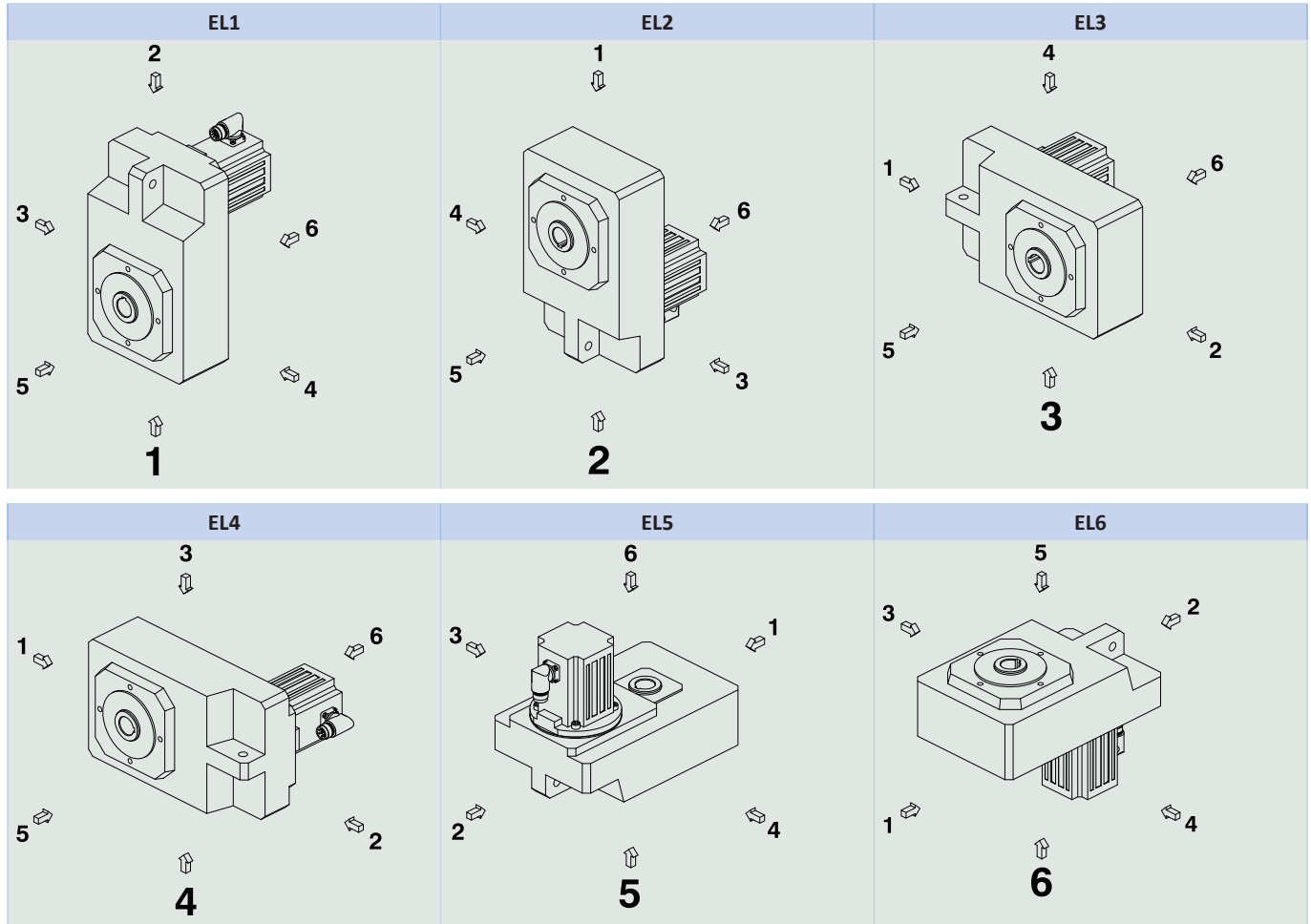
### Fastening the gear units on the machine side using the pitch circle diameter

The specified torques and forces only apply when fastening gear units at the machine side using screws of quality 10.9. In addition, the gear unit housings must be adjusted at the pilot. The machine-side fit must be H7.

### 9.5.4 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gear unit sides. The mounting position is defined by the gear side facing downwards.



Since the lubricant filling volume of the gear unit depends on the mounting position, the mounting position must be specified when ordering.

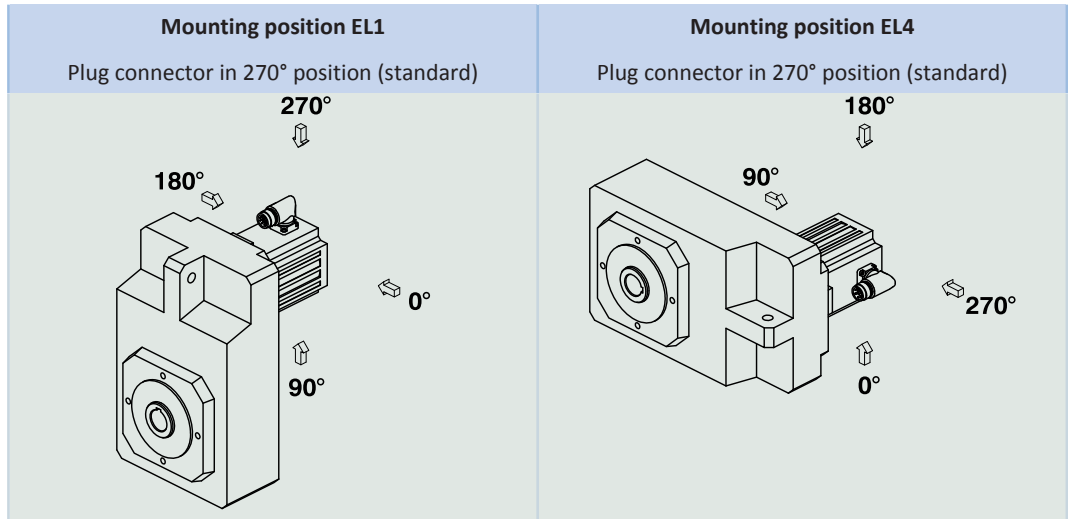
### 9.5.5 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

Lubricant filling quantities for gear units, document ID 441871, can be found online at <http://www.stober.de/en/download>. Enter the ID of the documentation in the Search... field.

### 9.5.6 Position of the plug connector



Indicate variations for your geared motor in the purchase order.

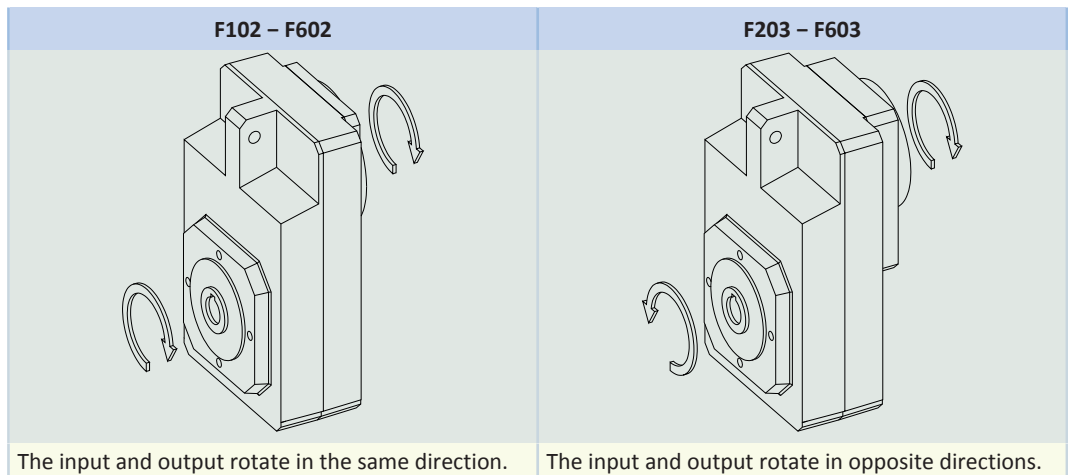
Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

### 9.5.7 Other product features

| Feature  | Value                 |
|--|-----------------------|
| Max. permitted gear unit temperature (on the surface of the gear unit) | ≤ 80 °C               |
| Paint  | Black RAL 9005        |
| (ATEX) Directive 2014/34/EU (option)                                   | Not suitable          |
| <b>Protection class:<sup>1</sup></b>                                   |                       |
| Gear unit  | IP65                  |
| Motor  | IP56, optionally IP66 |

### 9.5.8 Direction of rotation

Solid shaft (V), hollow shaft with keyway (A), hollow shaft with shrink ring (S)



The pictures show mounting position EL1.

## 9.6 Project configuration

Project your drives using our SERVOfsoft designing software. You can receive SERVOfsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

<sup>1</sup> Observe the protection class of all the components.

### 9.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point  $M_{2N}$  specified in the selection tables.

**For mounting positions EL1, EL2, EL3, EL4:**

$$n_{1m^*} \leq \frac{n_{1maxDBEL1,2,3,4}}{fB_T}$$

**For mounting positions EL5, EL6:**

$$n_{1m^*} \leq \frac{n_{1maxDBEL5,6}}{fB_T}$$

**For all mounting positions:**

$$n_{1max^*} \leq \frac{n_{1maxZB}}{fB_T}$$

$$M_{2eff^*} \leq M_{2th}$$

$$M_{2acc^*} \leq M_{2acc}$$

$$M_{2NOT^*} \leq M_{2NOT}$$

$$M_{2eq^*} \leq M_{2N} \cdot \frac{S}{fB_{op} \cdot fB_t}$$

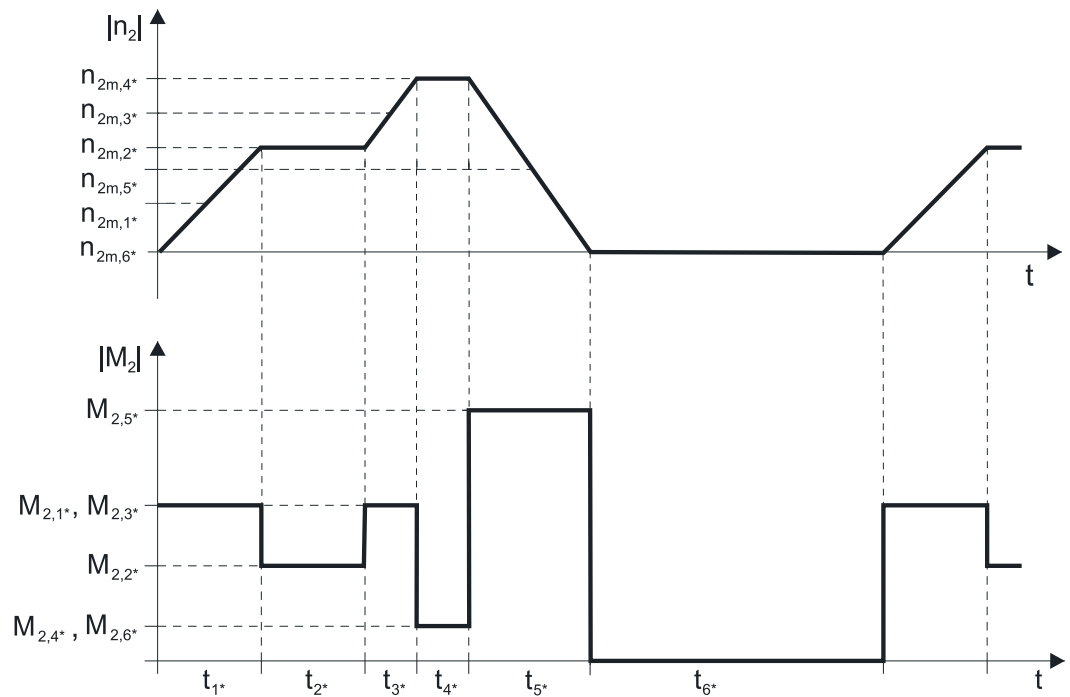
Refer to the selection table for the values for  $n_{1maxDBEL1,2,3,4}$  and  $n_{1maxDBEL5,6}$ ,  $n_{1maxZB}$ ,  $M_{2acc}$ ,  $M_{2NOT}$ ,  $M_{2N}$  and  $S$ .

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

Calculate the thermal limit torque  $M_{2th}$  for a duty cycle > 50%.

**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 average input speed**

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

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

If  $t_{1^*} + \dots + t_{5^*} \geq 10$  min, calculate  $n_{2m^*}$  without the rest phase  $t_{6^*}$ .

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

**Calculation of the actual effective torque**

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

**Calculation of the actual equivalent torque**

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

**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.)

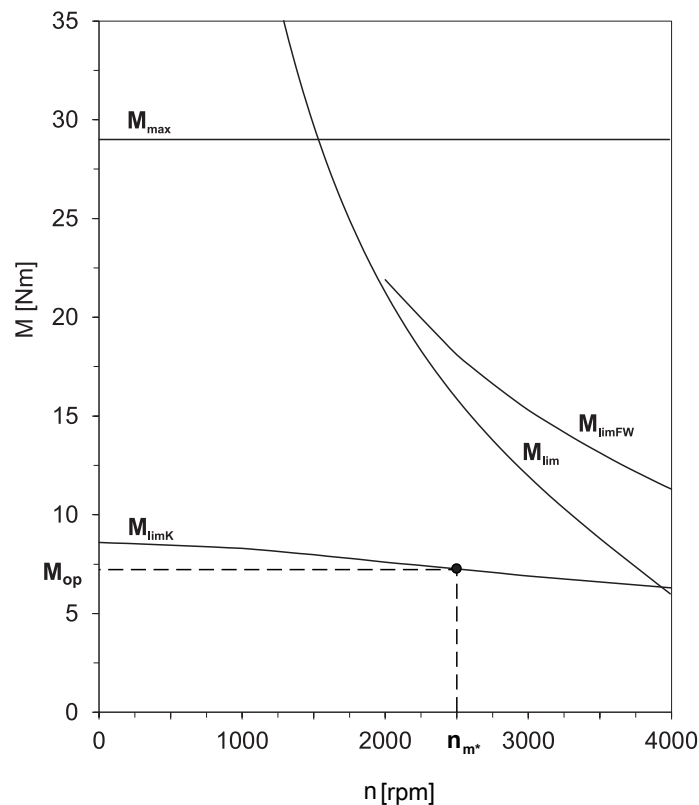
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

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

The values for  $i$  and  $a_{th}$  can be found in the selection tables.

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 curve of Chapter [▶ 2.3](#). Note the size and nominal speed  $n_N$  of the motor. The figure below shows an example of reading the torque  $M_{op}$  of a motor with convection cooling 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 run time $\leq 8$ h       |                         | 1.00       |
| Daily run time $\leq 16$ h      |                         | 1.15       |
| Daily run time $\leq 24$ h      |                         | 1.20       |
| Temperature                     |                         | $fB_T$     |
| Motor cooling                   | Surrounding temperature |            |
| Motor with convection cooling   | $\leq 20$ °C            | 1.0        |
|                                 | $\leq 30$ °C            | 1.1        |
|                                 | $\leq 40$ °C            | 1.25       |

**Notes**

- The maximum permitted gear unit 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 gear unit 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 gear unit are stabilized by its pilots for the pitch circle diameter and flange housing design

### 9.6.2.1 V shaft design

**Permitted shaft loads for V shaft design (solid shaft)**

| Type | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| F1   | 35.0          | 1100               | 4200                | 260                |
| F2   | 41.0          | 1400               | 5400                | 400                |
| F3   | 43.0          | 1900               | 7500                | 600                |
| F4   | 44.0          | 2350               | 9250                | 800                |
| F6   | 44.0          | 3100               | 12500               | 1200               |

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

The following applies to output speeds  $n_{2m^*} > 20$  rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}}$$

The values for  $F_{2ax20}$ ,  $F_{2rad20}$  and  $M_{2k20}$  can be found in the table "Permitted shaft loads" in this chapter.

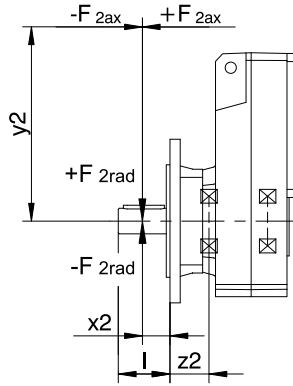


Fig. 1: Force application points for solid shaft

The specified values for  $F_{2rad20}$  are based on application of force at the middle 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:

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

$$F_{2rad^*} \leq F_{2radN}$$

$$F_{2ax^*} \leq F_{2axN}$$

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.

### 9.6.2.2 A and S shaft design

Permitted shaft loads for A shaft design (hollow shaft with keyway)

| Type | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| F1   | 30.0          | 900                | 4200                | 175                |
| F2   | 33.0          | 1200               | 5400                | 250                |
| F3   | 33.0          | 1350               | 7500                | 375                |
| F4   | 39.0          | 1900               | 9250                | 550                |
| F6   | 45.0          | 2200               | 12500               | 800                |

Permitted shaft loads for S shaft design (hollow shaft with shrink ring)

| Type | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| F1   | 30.0          | 900                | 4200                | 175                |
| F2   | 33.0          | 1200               | 5400                | 250                |
| F3   | 33.0          | 1350               | 7500                | 375                |
| F4   | 39.0          | 1900               | 9250                | 550                |
| F6   | 45.0          | 2200               | 12500               | 800                |

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

The following applies to output speeds  $n_{2m^*} > 20$  rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}}$$

The values for  $F_{2ax20}$ ,  $F_{2rad20}$  and  $M_{2k20}$  can be found in the table "Permitted shaft loads" in this chapter.

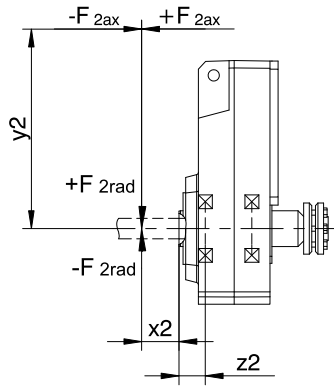


Fig. 2: Force application points for hollow shaft

You can determine the permitted radial forces from the permitted breakdown torque  $M_{2kN}$ . The actual radial forces may not exceed the permitted radial forces. The permitted radial forces are in relation to the end of the hollow shaft ( $x_2 = 0$ ).

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

$$F_{2ax*} \leq F_{2axN}$$

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.

### 9.6.3 Radial shaft seal rings

#### Leak-proofness

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

## 9.7 Additional documentation

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

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

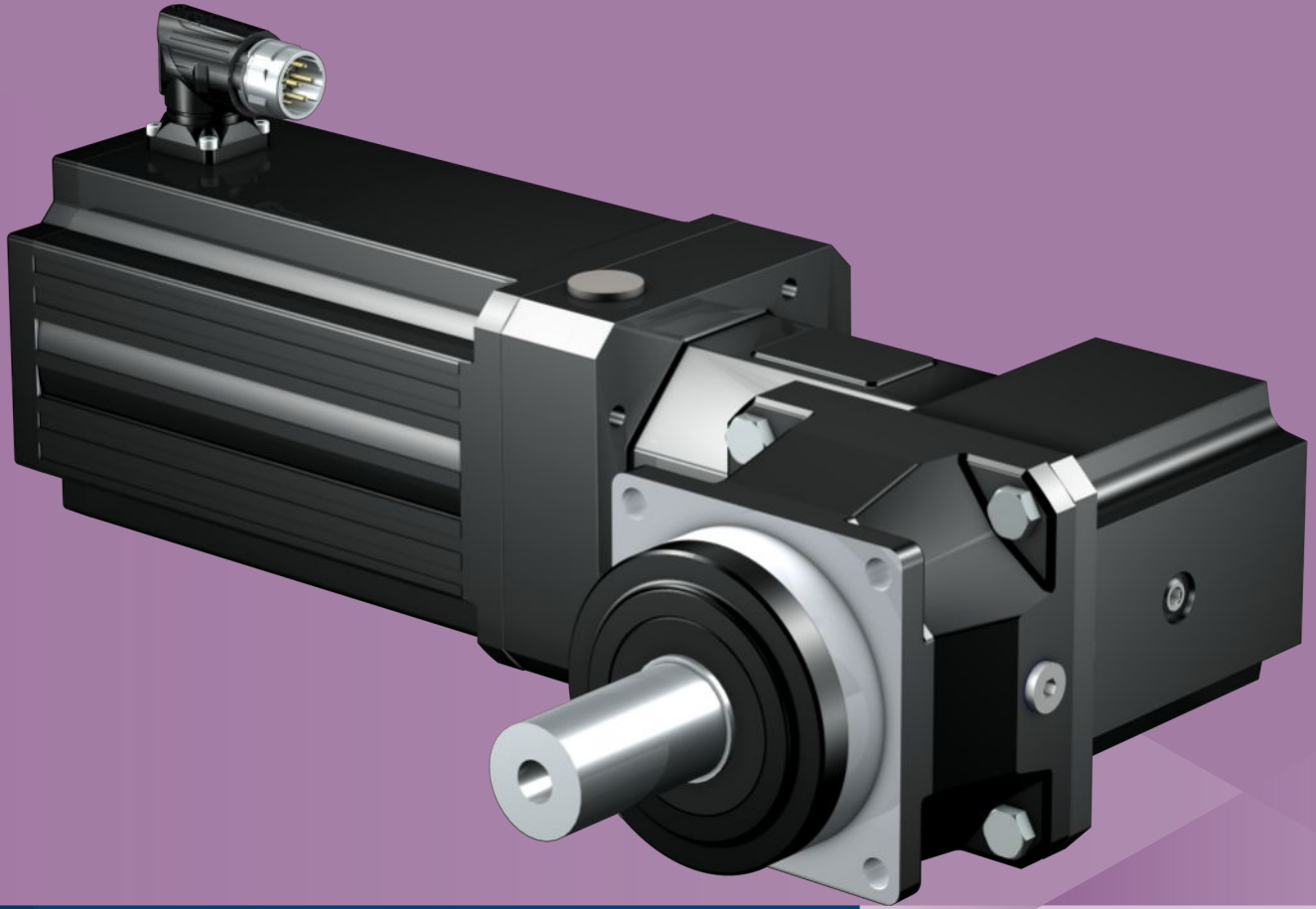
| Documentation   | ID        |
|---|-----------|
| Operating manual for C/F/K/S gear units and gear motors | 443027_en |
| Lubricant filling quantities for gear units             | 441871    |



# 10 PKX right-angle planetary geared motors

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10

## Right-angle planetary geared motors

PKX

### 10.1 Overview

Helical-gear 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 – 3000 Nm   |
| $\Delta\phi_2$ | 4 – 8.5 arcmin |
| $\eta_{get}$   | ≤ 96 %         |

## 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

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#).

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type                            | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br><small>EL1,2,5,6</small> | $n_{1maxDB}$<br><small>EL3,4</small> | $n_{1maxZB}$ | $J_1$                                | $\Delta\varphi_2$ | $C_2$       | m    |
|--|----------|-----------|----------|------|---------------------------------|------------|------------|-------|-------------|--|--------------------------------------|--------------|--------------------------------------|-------------------|-------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                                 | [Nm]       | [Nm]       |       |             | [rpm]                                    | [rpm]                                | [rpm]        | [10 <sup>-4</sup> kgm <sup>2</sup> ] | [arcmin]          | [Nm/arcmin] | [kg] |
| <b>P2KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 22</math> Nm)</b>  |          |           |          |      |                                 |            |            |       |             |  |                                      |              |                                      |                   |             |      |
| 375  | 17       | 19        | 61       | 0.93 | P221_0040 KX301VF0020 MF LM401U | 22         | 44         | 8.000 | 8/1         | 3500                                     | 3000                                 | 5500         | 2.5                                  | 8.5               | 1.5         | 7.7  |
| 429  | 15       | 16        | 103      | 0.93 | P221_0070 KX301VF0010 MF LM401U | 22         | 44         | 7.000 | 7/1         | 3000                                     | 2500                                 | 4500         | 2.7                                  | 7.5               | 1.7         | 7.7  |
| 600  | 11       | 12        | 74       | 1.3  | P221_0050 KX301VF0010 MF LM401U | 22         | 44         | 5.000 | 5/1         | 3000                                     | 2500                                 | 4500         | 2.7                                  | 8                 | 1.6         | 7.7  |
| 750  | 8.6      | 9.3       | 59       | 1.6  | P221_0040 KX301VF0010 MF LM401U | 17         | 44         | 4.000 | 4/1         | 3000                                     | 2500                                 | 4500         | 2.7                                  | 8.5               | 1.5         | 7.7  |
| 750  | 17       | 17        | 116      | 0.83 | P221_0040 KX301VF0010 MF LM402U | 22         | 44         | 4.000 | 4/1         | 3000                                     | 2500                                 | 4500         | 4.1                                  | 8.5               | 1.5         | 9.4  |
| <b>P3KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 63</math> Nm)</b>  |          |           |          |      |                                 |            |            |       |             |  |                                      |              |                                      |                   |             |      |
| 143  | 45       | 49        | 42       | 1.0  | P321_0070 KX301VF0030 MF LM401U | 60         | 130        | 21.00 | 21/1        | 3500                                     | 3500                                 | 6000         | 2.4                                  | 5.5               | 3.7         | 8.4  |
| 188  | 34       | 37        | 49       | 1.2  | P321_0080 KX301VF0020 MF LM401U | 50         | 100        | 16.00 | 16/1        | 3500                                     | 3000                                 | 5500         | 2.5                                  | 5.5               | 3.7         | 8.4  |
| 200  | 32       | 35        | 32       | 1.3  | P321_0050 KX301VF0030 MF LM401U | 63         | 130        | 15.00 | 15/1        | 3500                                     | 3500                                 | 6000         | 2.4                                  | 6                 | 3.6         | 8.4  |
| 214  | 30       | 33        | 38       | 1.5  | P321_0070 KX301VF0020 MF LM401U | 60         | 130        | 14.00 | 14/1        | 3500                                     | 3000                                 | 5500         | 2.5                                  | 5.5               | 3.7         | 8.4  |
| 250  | 26       | 28        | 32       | 1.3  | P321_0040 KX301VF0030 MF LM401U | 50         | 100        | 12.00 | 12/1        | 3500                                     | 3500                                 | 6000         | 2.4                                  | 6.5               | 3.2         | 8.4  |
| 300  | 21       | 23        | 29       | 2.0  | P321_0050 KX301VF0020 MF LM401U | 43         | 130        | 10.00 | 10/1        | 3500                                     | 3000                                 | 5500         | 2.5                                  | 6                 | 3.6         | 8.4  |
| 300  | 42       | 43        | 57       | 1.0  | P321_0050 KX301VF0020 MF LM402U | 63         | 130        | 10.00 | 10/1        | 3500                                     | 3000                                 | 5500         | 3.8                                  | 6                 | 3.6         | 10   |
| 375  | 17       | 19        | 29       | 2.0  | P321_0040 KX301VF0020 MF LM401U | 34         | 100        | 8.000 | 8/1         | 3500                                     | 3000                                 | 5500         | 2.5                                  | 6.5               | 3.2         | 8.4  |
| 375  | 34       | 34        | 57       | 1.0  | P321_0040 KX301VF0020 MF LM402U | 50         | 100        | 8.000 | 8/1         | 3500                                     | 3000                                 | 5500         | 3.8                                  | 6.5               | 3.2         | 10   |
| 429  | 15       | 16        | 37       | 2.6  | P321_0070 KX301VF0010 MF LM401U | 30         | 130        | 7.000 | 7/1         | 3000                                     | 2500                                 | 4500         | 2.7                                  | 5.5               | 3.7         | 8.4  |
| 429  | 29       | 30        | 72       | 1.3  | P321_0070 KX301VF0010 MF LM402U | 60         | 130        | 7.000 | 7/1         | 3000                                     | 2500                                 | 4500         | 4.1                                  | 5.5               | 3.7         | 10   |
| 429  | 41       | 41        | 99       | 0.97 | P321_0070 KX301VF0010 MF LM403U | 60         | 130        | 7.000 | 7/1         | 3000                                     | 2500                                 | 4500         | 5.4                                  | 5.5               | 3.7         | 12   |
| 500  | 13       | 14        | 29       | 2.0  | P321_0030 KX301VF0020 MF LM401U | 26         | 77         | 6.000 | 6/1         | 3500                                     | 3000                                 | 5500         | 2.5                                  | 7.5               | 2.5         | 8.4  |
| 500  | 25       | 26        | 57       | 1.0  | P321_0030 KX301VF0020 MF LM402U | 38         | 77         | 6.000 | 6/1         | 3500                                     | 3000                                 | 5500         | 3.9                                  | 7.5               | 2.5         | 10   |
| 600  | 11       | 12        | 26       | 3.7  | P321_0050 KX301VF0010 MF LM401U | 22         | 110        | 5.000 | 5/1         | 3000                                     | 2500                                 | 4500         | 2.8                                  | 6                 | 3.6         | 8.4  |
| 600  | 21       | 21        | 51       | 1.9  | P321_0050 KX301VF0010 MF LM402U | 46         | 110        | 5.000 | 5/1         | 3000                                     | 2500                                 | 4500         | 4.1                                  | 6                 | 3.6         | 10   |
| 600  | 29       | 30        | 71       | 1.4  | P321_0050 KX301VF0010 MF LM403U | 61         | 110        | 5.000 | 5/1         | 3000                                     | 2500                                 | 4500         | 5.4                                  | 6                 | 3.6         | 12   |
| 750  | 8.6      | 9.3       | 24       | 3.9  | P321_0040 KX301VF0010 MF LM401U | 17         | 91         | 4.000 | 4/1         | 3000                                     | 2500                                 | 4500         | 2.8                                  | 6.5               | 3.2         | 8.4  |
| 750  | 17       | 17        | 48       | 2.0  | P321_0040 KX301VF0010 MF LM402U | 37         | 91         | 4.000 | 4/1         | 3000                                     | 2500                                 | 4500         | 4.1                                  | 6.5               | 3.2         | 10   |
| 750  | 23       | 24        | 66       | 1.5  | P321_0040 KX301VF0010 MF LM403U | 49         | 91         | 4.000 | 4/1         | 3000                                     | 2500                                 | 4500         | 5.4                                  | 6.5               | 3.2         | 12   |
| 1000   | 6.4      | 7.0       | 24       | 3.9  | P321_0030 KX301VF0010 MF LM401U | 13         | 68         | 3.000 | 3/1         | 3000                                     | 2500                                 | 4500         | 2.9                                  | 7.5               | 2.5         | 8.4  |
| 1000   | 13       | 13        | 48       | 2.0  | P321_0030 KX301VF0010 MF LM402U | 28         | 68         | 3.000 | 3/1         | 3000                                     | 2500                                 | 4500         | 4.2                                  | 7.5               | 2.5         | 10   |
| 1000   | 17       | 18        | 66       | 1.5  | P321_0030 KX301VF0010 MF LM403U | 37         | 68         | 3.000 | 3/1         | 3000                                     | 2500                                 | 4500         | 5.5                                  | 7.5               | 2.5         | 12   |
| <b>P4KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 120</math> Nm)</b> |          |           |          |      |                                 |            |            |       |             |  |                                      |              |                                      |                   |             |      |
| 60   | 105      | 114       | 71       | 0.81 | P422_0250 KX301VF0020 MF LM401U | 120        | 240        | 50.00 | 50/1        | 3500                                     | 3000                                 | 5500         | 2.5                                  | 5.5               | 10          | 11   |
| 75   | 84       | 91        | 57       | 1.0  | P422_0200 KX301VF0020 MF LM401U | 120        | 240        | 40.00 | 40/1        | 3500                                     | 3000                                 | 5500         | 2.5                                  | 5.5               | 10          | 11   |
| 86   | 74       | 80        | 83       | 1.2  | P422_0350 KX301VF0010 MF LM401U | 120        | 240        | 35.00 | 35/1        | 3000                                     | 2500                                 | 4500         | 2.7                                  | 5.5               | 10          | 11   |
| 94   | 67       | 73        | 45       | 1.3  | P422_0160 KX301VF0020 MF LM401U | 120        | 240        | 32.00 | 32/1        | 3500                                     | 3000                                 | 5500         | 2.5                                  | 5.5               | 9.7         | 11   |
| 100  | 64       | 70        | 51       | 0.93 | P421_0100 KX401VF0030 MF LM401U | 100        | 200        | 30.00 | 30/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 5                 | 8.3         | 11   |
| 125  | 52       | 56        | 31       | 1.6  | P421_0080 KX401VF0030 MF LM401U | 100        | 200        | 24.00 | 24/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 5.5               | 8.3         | 11   |
| 143  | 45       | 49        | 25       | 1.9  | P421_0070 KX401VF0030 MF LM401U | 90         | 240        | 21.00 | 21/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 5.5               | 8.4         | 11   |
| 143  | 88       | 90        | 49       | 0.96 | P421_0070 KX401VF0030 MF LM402U | 110        | 240        | 21.00 | 21/1        | 3000                                     | 3000                                 | 5500         | 4.5                                  | 5.5               | 8.4         | 13   |
| 150  | 43       | 46        | 46       | 1.4  | P421_0100 KX401VF0020 MF LM401U | 86         | 200        | 20.00 | 20/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 5                 | 8.3         | 11   |
| 188  | 34       | 37        | 28       | 2.3  | P421_0080 KX401VF0020 MF LM401U | 69         | 200        | 16.00 | 16/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 5.5               | 8.3         | 11   |
| 188  | 67       | 69        | 54       | 1.2  | P421_0080 KX401VF0020 MF LM402U | 100        | 200        | 16.00 | 16/1        | 2500                                     | 2500                                 | 5000         | 4.7                                  | 5.5               | 8.3         | 13   |
| 188  | 93       | 95        | 74       | 0.86 | P421_0080 KX401VF0020 MF LM403U | 100        | 200        | 16.00 | 16/1        | 2500                                     | 2500                                 | 5000         | 5.9                                  | 5.5               | 8.3         | 14   |
| 200  | 32       | 35        | 18       | 2.6  | P421_0050 KX401VF0030 MF LM401U | 65         | 240        | 15.00 | 15/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 6                 | 8.0         | 11   |
| 200  | 63       | 64        | 35       | 1.3  | P421_0050 KX401VF0030 MF LM402U | 120        | 240        | 15.00 | 15/1        | 3000                                     | 3000                                 | 5500         | 4.5                                  | 6                 | 8.0         | 13   |
| 200  | 87       | 89        | 49       | 0.98 | P421_0050 KX401VF0030 MF LM403U | 120        | 240        | 15.00 | 15/1        | 3000                                     | 3000                                 | 5500         | 5.8                                  | 6                 | 8.0         | 14   |
| 214  | 30       | 33        | 23       | 2.8  | P421_0070 KX401VF0020 MF LM401U | 60         | 240        | 14.00 | 14/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 5.5               | 8.4         | 11   |
| 214  | 59       | 60        | 45       | 1.4  | P421_0070 KX401VF0020 MF LM402U | 110        | 240        | 14.00 | 14/1        | 2500                                     | 2500                                 | 5000         | 4.7                                  | 5.5               | 8.4         | 13   |
| 214  | 81       | 83        | 61       | 1.0  | P421_0070 KX401VF0020 MF LM403U | 110        | 240        | 14.00 | 14/1        | 2500                                     | 2500                                 | 5000         | 6.0                                  | 5.5               | 8.4         | 14   |
| 250  | 26       | 28        | 18       | 2.6  | P421_0040 KX401VF0030 MF LM401U | 52         | 210        | 12.00 | 12/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 6.5               | 6.9         | 11   |
| 250  | 51       | 52        | 35       | 1.3  | P421_0040 KX401VF0030 MF LM402U | 97         | 210        | 12.00 | 12/1        | 3000                                     | 3000                                 | 5500         | 4.5                                  | 6.5               | 6.9         | 13   |
| 250  | 69       | 71        | 49       | 0.98 | P421_0040 KX401VF0030 MF LM403U | 97         | 210        | 12.00 | 12/1        | 3000                                     | 3000                                 | 5500         | 5.8                                  | 6.5               | 6.9         | 14   |
| 300  | 21       | 23        | 16       | 3.9  | P421_0050 KX401VF0020 MF LM401U | 43         | 240        | 10.00 | 10/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 6                 | 8.0         | 11   |
| 300  | 42       | 43        | 32       | 2.0  | P421_0050 KX401VF0020 MF LM402U | 93         | 240        | 10.00 | 10/1        | 2500                                     | 2500                                 | 5000         | 4.7                                  | 6                 | 8.0         | 13   |
| 300  | 58       | 59        | 44       | 1.5  | P421_0050 KX401VF0020 MF LM403U | 120        | 240        | 10.00 | 10/1        | 2500                                     | 2500                                 | 5000         | 6.0                                  | 6                 | 8.0         | 14   |
| 300  | 91       | 96        | 69       | 0.94 | P421_0050 KX401VF0020 MF LM503U | 120        | 240        | 10.00 | 10/1        | 2500                                     | 2500                                 | 5000         | 12                                   | 6                 | 8.0         | 17   |

10.2 Selection tables 10 PKX right-angle planetary geared motors

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type                            | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br><small>EL1,2,5,6</small> | $n_{1maxDB}$<br><small>EL3,4</small> | $n_{1maxZB}$ | $J_1$                                | $\Delta\varphi_2$ | $C_2$       | m    |
|--|----------|-----------|----------|------|---------------------------------|------------|------------|-------|-------------|--|--------------------------------------|--------------|--------------------------------------|-------------------|-------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                                 | [Nm]       | [Nm]       |       |             | [rpm]                                    | [rpm]                                | [rpm]        | [10 <sup>-4</sup> kgm <sup>2</sup> ] | [arcmin]          | [Nm/arcmin] | [kg] |
| <b>P4KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 120</math> Nm)</b> |          |           |          |      |                                 |            |            |       |             |  |                                      |              |                                      |                   |             |      |
| 375  | 17       | 19        | 16       | 3.9  | P421_0040 KX401VF0020 MF LM401U | 34         | 210        | 8.000 | 8/1         | 2500                                     | 2500                                 | 5000         | 3.4                                  | 6.5               | 6.9         | 11   |
| 375  | 34       | 34        | 32       | 2.0  | P421_0040 KX401VF0020 MF LM402U | 74         | 210        | 8.000 | 8/1         | 2500                                     | 2500                                 | 5000         | 4.7                                  | 6.5               | 6.9         | 13   |
| 375  | 46       | 47        | 44       | 1.5  | P421_0040 KX401VF0020 MF LM403U | 97         | 210        | 8.000 | 8/1         | 2500                                     | 2500                                 | 5000         | 6.0                                  | 6.5               | 6.9         | 14   |
| 375  | 72       | 77        | 69       | 0.94 | P421_0040 KX401VF0020 MF LM503U | 97         | 210        | 8.000 | 8/1         | 2500                                     | 2500                                 | 5000         | 12                                   | 6.5               | 6.9         | 17   |
| 429  | 15       | 16        | 22       | 4.9  | P421_0070 KX401VF0010 MF LM401U | 30         | 240        | 7.000 | 7/1         | 2500                                     | 2000                                 | 4000         | 4.1                                  | 5.5               | 8.4         | 11   |
| 429  | 29       | 30        | 43       | 2.5  | P421_0070 KX401VF0010 MF LM402U | 65         | 240        | 7.000 | 7/1         | 2500                                     | 2000                                 | 4000         | 5.4                                  | 5.5               | 8.4         | 13   |
| 429  | 41       | 41        | 59       | 1.8  | P421_0070 KX401VF0010 MF LM403U | 86         | 240        | 7.000 | 7/1         | 2500                                     | 2000                                 | 4000         | 6.7                                  | 5.5               | 8.4         | 14   |
| 429  | 63       | 67        | 92       | 1.2  | P421_0070 KX401VF0010 MF LM503U | 110        | 240        | 7.000 | 7/1         | 2500                                     | 2000                                 | 4000         | 13                                   | 5.5               | 8.4         | 17   |
| 429  | 92       | 103       | 133      | 0.81 | P421_0070 KX401VF0010 MF LM505U | 110        | 240        | 7.000 | 7/1         | 2500                                     | 2000                                 | 4000         | 19                                   | 5.5               | 8.4         | 22   |
| 500  | 13       | 14        | 17       | 3.9  | P421_0030 KX401VF0020 MF LM401U | 26         | 150        | 6.000 | 6/1         | 2500                                     | 2500                                 | 5000         | 3.5                                  | 7.5               | 5.2         | 11   |
| 500  | 25       | 26        | 32       | 2.0  | P421_0030 KX401VF0020 MF LM402U | 56         | 150        | 6.000 | 6/1         | 2500                                     | 2500                                 | 5000         | 4.8                                  | 7.5               | 5.2         | 13   |
| 500  | 35       | 35        | 45       | 1.4  | P421_0030 KX401VF0020 MF LM403U | 73         | 150        | 6.000 | 6/1         | 2500                                     | 2500                                 | 5000         | 6.1                                  | 7.5               | 5.2         | 14   |
| 500  | 54       | 58        | 70       | 0.92 | P421_0030 KX401VF0020 MF LM503U | 73         | 150        | 6.000 | 6/1         | 2500                                     | 2500                                 | 5000         | 12                                   | 7.5               | 5.2         | 17   |
| 600  | 21       | 21        | 31       | 3.5  | P421_0050 KX401VF0010 MF LM402U | 46         | 240        | 5.000 | 5/1         | 2500                                     | 2000                                 | 4000         | 5.6                                  | 6                 | 8.0         | 13   |
| 600  | 29       | 30        | 42       | 2.6  | P421_0050 KX401VF0010 MF LM403U | 61         | 240        | 5.000 | 5/1         | 2500                                     | 2000                                 | 4000         | 6.9                                  | 6                 | 8.0         | 14   |
| 600  | 45       | 48        | 66       | 1.6  | P421_0050 KX401VF0010 MF LM503U | 97         | 240        | 5.000 | 5/1         | 2500                                     | 2000                                 | 4000         | 13                                   | 6                 | 8.0         | 17   |
| 600  | 65       | 74        | 95       | 1.1  | P421_0050 KX401VF0010 MF LM505U | 120        | 240        | 5.000 | 5/1         | 2500                                     | 2000                                 | 4000         | 19                                   | 6                 | 8.0         | 22   |
| 600  | 92       | 102       | 134      | 0.81 | P421_0050 KX401VF0010 MF LM704U | 120        | 240        | 5.000 | 5/1         | 2500                                     | 2000                                 | 4000         | 39                                   | 6                 | 8.0         | 28   |
| 750  | 17       | 17        | 27       | 4.0  | P421_0040 KX401VF0010 MF LM402U | 37         | 210        | 4.000 | 4/1         | 2500                                     | 2000                                 | 4000         | 5.7                                  | 6.5               | 6.9         | 13   |
| 750  | 23       | 24        | 37       | 2.9  | P421_0040 KX401VF0010 MF LM403U | 49         | 210        | 4.000 | 4/1         | 2500                                     | 2000                                 | 4000         | 7.0                                  | 6.5               | 6.9         | 14   |
| 750  | 36       | 38        | 58       | 1.9  | P421_0040 KX401VF0010 MF LM503U | 78         | 210        | 4.000 | 4/1         | 2500                                     | 2000                                 | 4000         | 13                                   | 6.5               | 6.9         | 17   |
| 750  | 52       | 59        | 83       | 1.3  | P421_0040 KX401VF0010 MF LM505U | 97         | 210        | 4.000 | 4/1         | 2500                                     | 2000                                 | 4000         | 19                                   | 6.5               | 6.9         | 22   |
| 750  | 74       | 81        | 117      | 0.92 | P421_0040 KX401VF0010 MF LM704U | 97         | 210        | 4.000 | 4/1         | 2500                                     | 2000                                 | 4000         | 39                                   | 6.5               | 6.9         | 28   |
| 1000   | 13       | 13        | 31       | 3.5  | P421_0030 KX401VF0010 MF LM402U | 28         | 150        | 3.000 | 3/1         | 2500                                     | 2000                                 | 4000         | 6.1                                  | 7.5               | 5.2         | 13   |
| 1000   | 17       | 18        | 43       | 2.5  | P421_0030 KX401VF0010 MF LM403U | 37         | 150        | 3.000 | 3/1         | 2500                                     | 2000                                 | 4000         | 7.4                                  | 7.5               | 5.2         | 14   |
| 1000   | 27       | 29        | 67       | 1.6  | P421_0030 KX401VF0010 MF LM503U | 58         | 150        | 3.000 | 3/1         | 2500                                     | 2000                                 | 4000         | 13                                   | 7.5               | 5.2         | 17   |
| 1000   | 39       | 44        | 97       | 1.1  | P421_0030 KX401VF0010 MF LM505U | 73         | 150        | 3.000 | 3/1         | 2500                                     | 2000                                 | 4000         | 20                                   | 7.5               | 5.2         | 22   |
| <b>P5KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 300</math> Nm)</b> |          |           |          |      |                                 |            |            |       |             |  |                                      |              |                                      |                   |             |      |
| 25   | 253      | 273       | 57       | 0.83 | P522_0400 KX401VF0030 MF LM401U | 300        | 600        | 120.0 | 120/1       | 3000                                     | 3000                                 | 5500         | 3.1                                  | 4.5               | 26          | 16   |
| 29   | 221      | 239       | 50       | 0.95 | P522_0350 KX401VF0030 MF LM401U | 300        | 600        | 105.0 | 105/1       | 3000                                     | 3000                                 | 5500         | 3.1                                  | 4.5               | 27          | 16   |
| 30   | 211      | 227       | 64       | 1.0  | P522_0500 KX401VF0020 MF LM401U | 300        | 600        | 100.0 | 100/1       | 2500                                     | 2500                                 | 5000         | 3.3                                  | 4                 | 27          | 16   |
| 36   | 177      | 191       | 40       | 1.2  | P522_0280 KX401VF0030 MF LM401U | 300        | 600        | 84.00 | 84/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 4.5               | 26          | 16   |
| 38   | 168      | 182       | 51       | 1.2  | P522_0400 KX401VF0020 MF LM401U | 300        | 600        | 80.00 | 80/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 4.5               | 26          | 16   |
| 40   | 158      | 171       | 36       | 1.3  | P522_0250 KX401VF0030 MF LM401U | 300        | 600        | 75.00 | 75/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 4.5               | 27          | 16   |
| 43   | 147      | 159       | 45       | 1.4  | P522_0350 KX401VF0020 MF LM401U | 300        | 600        | 70.00 | 70/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 4.5               | 27          | 16   |
| 47   | 135      | 146       | 43       | 1.5  | P522_0320 KX401VF0020 MF LM401U | 250        | 500        | 64.00 | 64/1        | 2500                                     | 2500                                 | 5000         | 3.4                                  | 4.5               | 25          | 16   |
| 50   | 126      | 136       | 29       | 1.7  | P522_0200 KX401VF0030 MF LM401U | 250        | 600        | 60.00 | 60/1        | 3000                                     | 3000                                 | 5500         | 3.1                                  | 4.5               | 26          | 16   |
| 50   | 248      | 253       | 56       | 0.85 | P522_0200 KX401VF0030 MF LM402U | 300        | 600        | 60.00 | 60/1        | 3000                                     | 3000                                 | 5500         | 4.5                                  | 4.5               | 26          | 17   |
| 54   | 118      | 127       | 36       | 1.8  | P522_0280 KX401VF0020 MF LM401U | 240        | 600        | 56.00 | 56/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 4.5               | 26          | 16   |
| 54   | 231      | 236       | 71       | 0.91 | P522_0280 KX401VF0020 MF LM402U | 300        | 600        | 56.00 | 56/1        | 2500                                     | 2500                                 | 5000         | 4.7                                  | 4.5               | 26          | 17   |
| 60   | 105      | 114       | 32       | 2.0  | P522_0250 KX401VF0020 MF LM401U | 210        | 600        | 50.00 | 50/1        | 2500                                     | 2500                                 | 5000         | 3.3                                  | 4.5               | 27          | 16   |
| 60   | 206      | 211       | 63       | 1.0  | P522_0250 KX401VF0020 MF LM402U | 300        | 600        | 50.00 | 50/1        | 2500                                     | 2500                                 | 5000         | 4.7                                  | 4.5               | 27          | 17   |
| 75   | 84       | 91        | 26       | 2.5  | P522_0200 KX401VF0020 MF LM401U | 170        | 600        | 40.00 | 40/1        | 2500                                     | 2500                                 | 5000         | 3.4                                  | 4.5               | 26          | 16   |
| 75   | 165      | 168       | 50       | 1.3  | P522_0200 KX401VF0020 MF LM402U | 300        | 600        | 40.00 | 40/1        | 2500                                     | 2500                                 | 5000         | 4.7                                  | 4.5               | 26          | 17   |
| 75   | 227      | 232       | 69       | 0.93 | P522_0200 KX401VF0020 MF LM403U | 300        | 600        | 40.00 | 40/1        | 2500                                     | 2500                                 | 5000         | 6.0                                  | 4.5               | 26          | 19   |
| 86   | 74       | 80        | 38       | 2.9  | P522_0350 KX401VF0010 MF LM401U | 150        | 600        | 35.00 | 35/1        | 2500                                     | 2000                                 | 4000         | 4.1                                  | 4.5               | 27          | 16   |
| 86   | 144      | 147       | 74       | 1.5  | P522_0350 KX401VF0010 MF LM402U | 300        | 600        | 35.00 | 35/1        | 2500                                     | 2000                                 | 4000         | 5.5                                  | 4.5               | 27          | 17   |
| 86   | 198      | 203       | 102      | 1.1  | P522_0350 KX401VF0010 MF LM403U | 300        | 600        | 35.00 | 35/1        | 2500                                     | 2000                                 | 4000         | 6.8                                  | 4.5               | 27          | 19   |
| 94   | 67       | 73        | 21       | 3.1  | P522_0160 KX401VF0020 MF LM401U | 140        | 600        | 32.00 | 32/1        | 2500                                     | 2500                                 | 5000         | 3.4                                  | 4.5               | 25          | 16   |
| 94   | 132      | 135       | 40       | 1.6  | P522_0160 KX401VF0020 MF LM402U | 290        | 600        | 32.00 | 32/1        | 2500                                     | 2500                                 | 5000         | 4.7                                  | 4.5               | 25          | 17   |
| 94   | 181      | 185       | 56       | 1.2  | P522_0160 KX401VF0020 MF LM403U | 300        | 600        | 32.00 | 32/1        | 2500                                     | 2500                                 | 5000         | 6.0                                  | 4.5               | 25          | 19   |
| 100  | 64       | 70        | 24       | 2.2  | P521_0100 KX501VF0030 MF LM401U | 130        | 500        | 30.00 | 30/1        | 3000                                     | 3000                                 | 5000         | 6.5                                  | 4                 | 23          | 17   |
| 100  | 126      | 129       | 48       | 1.1  | P521_0100 KX501VF0030 MF LM402U | 250        | 500        | 30.00 | 30/1        | 3000                                     | 3000                                 | 5000         | 7.8                                  | 4                 | 23          | 19   |
| 100  | 174      | 177       | 65       | 0.81 | P521_0100 KX501VF0030 MF LM403U | 250        | 500        | 30.00 | 30/1        | 3000                                     | 3000                                 | 5000         | 9.1                                  | 4                 | 23          | 20   |
| 125  | 52       | 56        | 14       | 3.9  | P521_0080 KX501VF0030 MF LM401U | 100        | 500        | 24.00 | 24/1        | 3000                                     | 3000                                 | 5000         | 6.5                                  | 4.5               | 22          | 17   |
| 125  | 101      | 103       | 27       | 2.0  | P521_0080 KX501VF0030 MF LM402U | 220        | 500        | 24.00 | 24/1        | 3000                                     | 3000                                 | 5000         | 7.8                                  | 4.5               | 22          | 19   |
| 125  | 139      | 142       | 37       | 1.4  | P521_0080 KX501VF0030 MF LM403U | 250        | 500        | 24.00 | 24/1        | 3000                                     | 3000                                 | 5000         | 9.1                                  | 4.5               | 22          | 20   |
| 125  | 217      | 231       | 57       | 0.92 | P521_0080 KX501VF0030 MF LM503U | 250        | 500        | 24.00 | 24/1        | 3000                                     | 3000                                 | 5000         | 15                                   | 4.5               | 22          | 23   |
| 143  | 45       | 49        | 11       | 4.7  | P521_0070 KX501VF0030 MF LM401U | 90         | 600        | 21.00 | 21/1        | 3000                                     | 3000                                 | 5000         | 6.5                                  | 4.5               | 23          | 17   |
| 143  | 88       | 90        | 22       | 2.4  | P521_0070 KX501VF0030 MF LM402U | 190        | 600        | 21.00 | 21/1        | 3000                                     | 3000                                 | 5000         | 7.8                                  | 4.5               | 23          | 19   |
| 143  | 122      | 124       | 30       | 1.7  | P521_0070 KX501VF0030 MF LM403U | 260        | 600        | 21.00 | 21/1        | 3000                                     | 3000                                 | 5000         | 9.1                                  | 4.5               | 23          | 20   |
| 143  | 190      | 202       | 48       | 1.1  | P521_0070 KX501VF0030 MF LM503U | 270        | 600        | 21.00 | 21/1        | 3000                                     | 3000                                 | 5000         | 15                                   | 4.5               | 23          | 23   |
| 150  | 43       | 46        | 22       | 3.3  | P521_0100 KX501VF0020 MF LM401U | 86         | 500        | 20.00 | 20/1        | 2500                                     | 2500                                 | 4500         | 7.0                                  | 4                 | 23          | 17   |
| 150  | 84       | 86        | 43       | 1.7  | P521_0100 KX501VF0020 MF LM402U | 190        | 500        | 20.00 | 20/1        | 2500                                     | 2500                                 | 4500         | 8.3                                  | 4                 | 23          | 19   |

| $n_{2N}$   | $M_{2N}$ | $M_{2.0}$ | $a_{th}$ | S    | Type                            | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,5,6<br>[rpm] | $n_{1maxDB}$<br>EL3,4<br>[rpm] | $n_{1maxZB}$<br>[rpm] | $J_1$<br>[10 <sup>-4</sup> kgm <sup>2</sup> ] | $\Delta\varphi_2$<br>[arcmin] | $C_2$<br>[Nm/arcmin] | m<br>[kg] |
|--|----------|-----------|----------|------|---------------------------------|------------|------------|-------|-------------|------------------------------------|--------------------------------|-----------------------|---|-------------------------------|----------------------|-----------|
| <b>P5KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 300</math> Nm)</b> |          |           |          |      |                                 |            |            |       |             |                                    |                                |                       |   |                               |                      |           |
| 150  | 116      | 118       | 59       | 1.2  | P521_0100 KX501VF0020 MF LM403U | 250        | 500        | 20.00 | 20/1        | 2500                               | 2500                           | 4500                  | 9.6   | 4                             | 23                   | 20        |
| 188  | 67       | 69        | 24       | 3.0  | P521_0080 KX501VF0020 MF LM402U | 150        | 500        | 16.00 | 16/1        | 2500                               | 2500                           | 4500                  | 8.3   | 4.5                           | 22                   | 19        |
| 188  | 93       | 95        | 33       | 2.2  | P521_0080 KX501VF0020 MF LM403U | 200        | 500        | 16.00 | 16/1        | 2500                               | 2500                           | 4500                  | 9.6   | 4.5                           | 22                   | 20        |
| 188  | 145      | 154       | 52       | 1.4  | P521_0080 KX501VF0020 MF LM503U | 250        | 500        | 16.00 | 16/1        | 2500                               | 2500                           | 4500                  | 16  | 4.5                           | 22                   | 23        |
| 188  | 209      | 236       | 75       | 0.96 | P521_0080 KX501VF0020 MF LM505U | 250        | 500        | 16.00 | 16/1        | 2500                               | 2500                           | 4500                  | 22  | 4.5                           | 22                   | 28        |
| 200  | 63       | 64        | 16       | 3.3  | P521_0050 KX501VF0030 MF LM402U | 140        | 600        | 15.00 | 15/1        | 3000                               | 3000                           | 5000                  | 7.9   | 5                             | 20                   | 19        |
| 200  | 87       | 89        | 22       | 2.4  | P521_0050 KX501VF0030 MF LM403U | 180        | 600        | 15.00 | 15/1        | 3000                               | 3000                           | 5000                  | 9.2   | 5                             | 20                   | 20        |
| 200  | 136      | 144       | 34       | 1.5  | P521_0050 KX501VF0030 MF LM503U | 290        | 600        | 15.00 | 15/1        | 3000                               | 3000                           | 5000                  | 15  | 5                             | 20                   | 23        |
| 200  | 196      | 222       | 49       | 1.1  | P521_0050 KX501VF0030 MF LM505U | 300        | 600        | 15.00 | 15/1        | 3000                               | 3000                           | 5000                  | 22  | 5                             | 20                   | 28        |
| 214  | 59       | 60        | 20       | 3.6  | P521_0070 KX501VF0020 MF LM402U | 130        | 600        | 14.00 | 14/1        | 2500                               | 2500                           | 4500                  | 8.4   | 4.5                           | 23                   | 19        |
| 214  | 81       | 83        | 28       | 2.6  | P521_0070 KX501VF0020 MF LM403U | 170        | 600        | 14.00 | 14/1        | 2500                               | 2500                           | 4500                  | 9.7   | 4.5                           | 23                   | 20        |
| 214  | 127      | 135       | 43       | 1.7  | P521_0070 KX501VF0020 MF LM503U | 270        | 600        | 14.00 | 14/1        | 2500                               | 2500                           | 4500                  | 16  | 4.5                           | 23                   | 23        |
| 214  | 183      | 207       | 62       | 1.1  | P521_0070 KX501VF0020 MF LM505U | 270        | 600        | 14.00 | 14/1        | 2500                               | 2500                           | 4500                  | 22  | 4.5                           | 23                   | 28        |
| 250  | 51       | 52        | 16       | 3.4  | P521_0040 KX501VF0030 MF LM402U | 110        | 520        | 12.00 | 12/1        | 3000                               | 3000                           | 5000                  | 7.9   | 5.5                           | 17                   | 19        |
| 250  | 69       | 71        | 22       | 2.4  | P521_0040 KX501VF0030 MF LM403U | 150        | 520        | 12.00 | 12/1        | 3000                               | 3000                           | 5000                  | 9.2   | 5.5                           | 17                   | 20        |
| 250  | 109      | 115       | 34       | 1.6  | P521_0040 KX501VF0030 MF LM503U | 230        | 520        | 12.00 | 12/1        | 3000                               | 3000                           | 5000                  | 15  | 5.5                           | 17                   | 23        |
| 250  | 157      | 177       | 49       | 1.1  | P521_0040 KX501VF0030 MF LM505U | 240        | 520        | 12.00 | 12/1        | 3000                               | 3000                           | 5000                  | 22  | 5.5                           | 17                   | 28        |
| 300  | 42       | 43        | 14       | 5.0  | P521_0050 KX501VF0020 MF LM402U | 93         | 600        | 10.00 | 10/1        | 2500                               | 2500                           | 4500                  | 8.4   | 5                             | 20                   | 19        |
| 300  | 58       | 59        | 20       | 3.6  | P521_0050 KX501VF0020 MF LM403U | 120        | 600        | 10.00 | 10/1        | 2500                               | 2500                           | 4500                  | 9.7   | 5                             | 20                   | 20        |
| 300  | 91       | 96        | 31       | 2.3  | P521_0050 KX501VF0020 MF LM503U | 190        | 600        | 10.00 | 10/1        | 2500                               | 2500                           | 4500                  | 16  | 5                             | 20                   | 23        |
| 300  | 131      | 148       | 44       | 1.6  | P521_0050 KX501VF0020 MF LM505U | 300        | 600        | 10.00 | 10/1        | 2500                               | 2500                           | 4500                  | 22  | 5                             | 20                   | 28        |
| 300  | 184      | 203       | 63       | 1.1  | P521_0050 KX501VF0020 MF LM704U | 300        | 600        | 10.00 | 10/1        | 2500                               | 2500                           | 4500                  | 42  | 5                             | 20                   | 34        |
| 300  | 245      | 285       | 83       | 0.86 | P521_0050 KX501VF0020 MF LM706U | 300        | 600        | 10.00 | 10/1        | 2500                               | 2500                           | 4500                  | 59  | 5                             | 20                   | 41        |
| 375  | 46       | 47        | 20       | 3.7  | P521_0040 KX501VF0020 MF LM403U | 98         | 520        | 8.000 | 8/1         | 2500                               | 2500                           | 4500                  | 9.8   | 5.5                           | 17                   | 20        |
| 375  | 72       | 77        | 31       | 2.3  | P521_0040 KX501VF0020 MF LM503U | 160        | 520        | 8.000 | 8/1         | 2500                               | 2500                           | 4500                  | 16  | 5.5                           | 17                   | 23        |
| 375  | 105      | 118       | 44       | 1.6  | P521_0040 KX501VF0020 MF LM505U | 240        | 520        | 8.000 | 8/1         | 2500                               | 2500                           | 4500                  | 22  | 5.5                           | 17                   | 28        |
| 375  | 147      | 163       | 62       | 1.2  | P521_0040 KX501VF0020 MF LM704U | 240        | 520        | 8.000 | 8/1         | 2500                               | 2500                           | 4500                  | 42  | 5.5                           | 17                   | 34        |
| 375  | 196      | 228       | 83       | 0.86 | P521_0040 KX501VF0020 MF LM706U | 240        | 520        | 8.000 | 8/1         | 2500                               | 2500                           | 4500                  | 59  | 5.5                           | 17                   | 41        |
| 429  | 41       | 41        | 27       | 4.5  | P521_0070 KX501VF0010 MF LM403U | 86         | 600        | 7.000 | 7/1         | 2500                               | 2000                           | 3500                  | 12  | 4.5                           | 23                   | 20        |
| 429  | 63       | 67        | 41       | 2.9  | P521_0070 KX501VF0010 MF LM503U | 140        | 600        | 7.000 | 7/1         | 2500                               | 2000                           | 3500                  | 18  | 4.5                           | 23                   | 23        |
| 429  | 92       | 103       | 60       | 2.0  | P521_0070 KX501VF0010 MF LM505U | 210        | 600        | 7.000 | 7/1         | 2500                               | 2000                           | 3500                  | 24  | 4.5                           | 23                   | 28        |
| 429  | 129      | 142       | 84       | 1.4  | P521_0070 KX501VF0010 MF LM704U | 270        | 600        | 7.000 | 7/1         | 2500                               | 2000                           | 3500                  | 44  | 4.5                           | 23                   | 34        |
| 429  | 172      | 199       | 112      | 1.1  | P521_0070 KX501VF0010 MF LM706U | 270        | 600        | 7.000 | 7/1         | 2500                               | 2000                           | 3500                  | 62  | 4.5                           | 23                   | 41        |
| 500  | 25       | 26        | 15       | 4.7  | P521_0030 KX501VF0020 MF LM402U | 56         | 390        | 6.000 | 6/1         | 2500                               | 2500                           | 4500                  | 9.0   | 6.5                           | 14                   | 19        |
| 500  | 35       | 35        | 21       | 3.5  | P521_0030 KX501VF0020 MF LM403U | 74         | 390        | 6.000 | 6/1         | 2500                               | 2500                           | 4500                  | 10  | 6.5                           | 14                   | 20        |
| 500  | 54       | 58        | 32       | 2.2  | P521_0030 KX501VF0020 MF LM503U | 120        | 390        | 6.000 | 6/1         | 2500                               | 2500                           | 4500                  | 16  | 6.5                           | 14                   | 23        |
| 500  | 79       | 89        | 47       | 1.5  | P521_0030 KX501VF0020 MF LM505U | 180        | 390        | 6.000 | 6/1         | 2500                               | 2500                           | 4500                  | 23  | 6.5                           | 14                   | 28        |
| 500  | 110      | 122       | 66       | 1.1  | P521_0030 KX501VF0020 MF LM704U | 180        | 390        | 6.000 | 6/1         | 2500                               | 2500                           | 4500                  | 42  | 6.5                           | 14                   | 34        |
| 500  | 147      | 171       | 88       | 0.82 | P521_0030 KX501VF0020 MF LM706U | 180        | 390        | 6.000 | 6/1         | 2500                               | 2500                           | 4500                  | 60  | 6.5                           | 14                   | 41        |
| 600  | 45       | 48        | 30       | 4.1  | P521_0050 KX501VF0010 MF LM503U | 97         | 600        | 5.000 | 5/1         | 2500                               | 2000                           | 3500                  | 18  | 5                             | 20                   | 23        |
| 600  | 65       | 74        | 43       | 2.8  | P521_0050 KX501VF0010 MF LM505U | 150        | 600        | 5.000 | 5/1         | 2500                               | 2000                           | 3500                  | 25  | 5                             | 20                   | 28        |
| 600  | 92       | 102       | 60       | 2.0  | P521_0050 KX501VF0010 MF LM704U | 200        | 600        | 5.000 | 5/1         | 2500                               | 2000                           | 3500                  | 45  | 5                             | 20                   | 34        |
| 600  | 123      | 142       | 80       | 1.5  | P521_0050 KX501VF0010 MF LM706U | 290        | 600        | 5.000 | 5/1         | 2500                               | 2000                           | 3500                  | 62  | 5                             | 20                   | 41        |
| 750  | 36       | 38        | 26       | 4.7  | P521_0040 KX501VF0010 MF LM503U | 78         | 520        | 4.000 | 4/1         | 2500                               | 2000                           | 3500                  | 19  | 5.5                           | 17                   | 23        |
| 750  | 52       | 59        | 37       | 3.2  | P521_0040 KX501VF0010 MF LM505U | 120        | 520        | 4.000 | 4/1         | 2500                               | 2000                           | 3500                  | 25  | 5.5                           | 17                   | 28        |
| 750  | 74       | 81        | 52       | 2.3  | P521_0040 KX501VF0010 MF LM704U | 160        | 520        | 4.000 | 4/1         | 2500                               | 2000                           | 3500                  | 45  | 5.5                           | 17                   | 34        |
| 750  | 98       | 114       | 69       | 1.7  | P521_0040 KX501VF0010 MF LM706U | 230        | 520        | 4.000 | 4/1         | 2500                               | 2000                           | 3500                  | 62  | 5.5                           | 17                   | 41        |
| 1000   | 27       | 29        | 31       | 3.9  | P521_0030 KX501VF0010 MF LM503U | 58         | 390        | 3.000 | 3/1         | 2500                               | 2000                           | 3500                  | 21  | 6.5                           | 14                   | 23        |
| 1000   | 39       | 44        | 45       | 2.7  | P521_0030 KX501VF0010 MF LM505U | 92         | 390        | 3.000 | 3/1         | 2500                               | 2000                           | 3500                  | 27  | 6.5                           | 14                   | 28        |
| 1000   | 55       | 61        | 63       | 1.9  | P521_0030 KX501VF0010 MF LM704U | 120        | 390        | 3.000 | 3/1         | 2500                               | 2000                           | 3500                  | 47  | 6.5                           | 14                   | 34        |
| 1000   | 74       | 85        | 84       | 1.4  | P521_0030 KX501VF0010 MF LM706U | 180        | 390        | 3.000 | 3/1         | 2500                               | 2000                           | 3500                  | 64  | 6.5                           | 14                   | 41        |
| <b>P7KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 700</math> Nm)</b> |          |           |          |      |                                 |            |            |       |             |                                    |                                |                       |   |                               |                      |           |
| 14   | 442      | 478       | 53       | 1.0  | P722_0700 KX501VF0030 MF LM401U | 650        | 1250       | 210.0 | 210/1       | 3000                               | 3000                           | 5000                  | 6.5   | 4                             | 52                   | 26        |
| 20   | 316      | 341       | 38       | 1.4  | P722_0500 KX501VF0030 MF LM401U | 630        | 1400       | 150.0 | 150/1       | 3000                               | 3000                           | 5000                  | 6.5   | 4                             | 52                   | 26        |
| 21   | 295      | 318       | 48       | 1.5  | P722_0700 KX501VF0020 MF LM401U | 590        | 1250       | 140.0 | 140/1       | 2500                               | 2500                           | 4500                  | 7.0   | 4                             | 52                   | 26        |
| 25   | 253      | 273       | 30       | 1.7  | P722_0400 KX501VF0030 MF LM401U | 510        | 1380       | 120.0 | 120/1       | 3000                               | 3000                           | 5000                  | 6.5   | 4.5                           | 51                   | 26        |
| 25   | 495      | 505       | 59       | 0.89 | P722_0400 KX501VF0030 MF LM402U | 700        | 1380       | 120.0 | 120/1       | 3000                               | 3000                           | 5000                  | 7.8   | 4.5                           | 51                   | 27        |
| 29   | 221      | 239       | 26       | 2.0  | P722_0350 KX501VF0030 MF LM401U | 440        | 1400       | 105.0 | 105/1       | 3000                               | 3000                           | 5000                  | 6.5   | 4.5                           | 52                   | 26        |
| 29   | 433      | 442       | 52       | 1.0  | P722_0350 KX501VF0030 MF LM402U | 700        | 1400       | 105.0 | 105/1       | 3000                               | 3000                           | 5000                  | 7.8   | 4.5                           | 52                   | 27        |
| 30   | 211      | 227       | 34       | 2.1  | P722_0500 KX501VF0020 MF LM401U | 420        | 1400       | 100.0 | 100/1       | 2500                               | 2500                           | 4500                  | 7.0   | 4                             | 52                   | 26        |
| 30   | 413      | 421       | 67       | 1.1  | P722_0500 KX501VF0020 MF LM402U | 700        | 1400       | 100.0 | 100/1       | 2500                               | 2500                           | 4500                  | 8.3   | 4                             | 52                   | 27        |
| 36   | 177      | 191       | 21       | 2.5  | P722_0280 KX501VF0030 MF LM401U | 350        | 1380       | 84.00 | 84/1        | 3000                               | 3000                           | 5000                  | 6.5   | 4.5                           | 51                   | 26        |
| 36   | 347      | 354       | 41       | 1.3  | P722_0280 KX501VF0030 MF LM402U | 700        | 1380       | 84.00 | 84/1        | 3000                               | 3000                           | 5000                  | 7.8   | 4.5                           | 51                   | 27        |
| 36   | 476      | 487       | 57       | 0.92 | P722_0280 KX501VF0030 MF LM403U | 700        | 1380       | 84.00 | 84/1        | 3000                               | 3000                           | 5000                  | 9.1   | 4.5                           | 51                   | 29        |



10.2 Selection tables 10 PKX right-angle planetary geared motors

| n <sub>2N</sub>  | M <sub>2N</sub> | M <sub>2,0</sub> | a <sub>th</sub> | S    | Type                            | M <sub>2acc</sub> | M <sub>2NOT</sub> | i     | i <sub>exakt</sub> | n <sub>1maxDB</sub><br><small>EL1,2,5,6</small> | n <sub>1maxDB</sub><br><small>EL3,4</small> | n <sub>1maxZB</sub> | J <sub>1</sub>                          | Δφ <sub>2</sub> | C <sub>2</sub>  | m    |
|--|-----------------|------------------|-----------------|------|---------------------------------|-------------------|-------------------|-------|--------------------|---|---|---------------------|---|-----------------|-----------------|------|
| [rpm]  | [Nm]            | [Nm]             |                 |      |                                 | [Nm]              | [Nm]              |       |                    | [rpm]   | [rpm]                                       | [rpm]               | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]        | [Nm/<br>arcmin] | [kg] |
| <b>P7KX (n<sub>1N</sub> = 3000 rpm, M<sub>2acc,max</sub> = 700 Nm)</b> |                 |                  |                 |      |                                 |                   |                   |       |                    |   |   |                     |   |                 |                 |      |
| 38   | 168             | 182              | 27              | 2.6  | P722_0400 KX501VF0020 MF LM401U | 340               | 1380              | 80.00 | 80/1               | 2500  | 2500  | 4500                | 7.0                                     | 4.5             | 51              | 26   |
| 38   | 330             | 337              | 54              | 1.3  | P722_0400 KX501VF0020 MF LM402U | 700               | 1380              | 80.00 | 80/1               | 2500  | 2500  | 4500                | 8.3                                     | 4.5             | 51              | 27   |
| 38   | 454             | 463              | 74              | 0.97 | P722_0400 KX501VF0020 MF LM403U | 700               | 1380              | 80.00 | 80/1               | 2500  | 2500  | 4500                | 9.6                                     | 4.5             | 51              | 29   |
| 40   | 158             | 171              | 19              | 2.8  | P722_0250 KX501VF0030 MF LM401U | 320               | 1400              | 75.00 | 75/1               | 3000  | 3000  | 5000                | 6.5                                     | 4.5             | 52              | 26   |
| 40   | 309             | 316              | 37              | 1.4  | P722_0250 KX501VF0030 MF LM402U | 680               | 1400              | 75.00 | 75/1               | 3000  | 3000  | 5000                | 7.9                                     | 4.5             | 52              | 27   |
| 40   | 425             | 434              | 51              | 1.0  | P722_0250 KX501VF0030 MF LM403U | 700               | 1400              | 75.00 | 75/1               | 3000  | 3000  | 5000                | 9.2                                     | 4.5             | 52              | 29   |
| 43   | 147             | 159              | 24              | 3.0  | P722_0350 KX501VF0020 MF LM401U | 300               | 1400              | 70.00 | 70/1               | 2500  | 2500  | 4500                | 7.0                                     | 4.5             | 52              | 26   |
| 43   | 289             | 295              | 47              | 1.5  | P722_0350 KX501VF0020 MF LM402U | 640               | 1400              | 70.00 | 70/1               | 2500  | 2500  | 4500                | 8.4                                     | 4.5             | 52              | 27   |
| 43   | 397             | 405              | 64              | 1.1  | P722_0350 KX501VF0020 MF LM403U | 700               | 1400              | 70.00 | 70/1               | 2500  | 2500  | 4500                | 9.7                                     | 4.5             | 52              | 29   |
| 47   | 135             | 146              | 24              | 3.0  | P722_0320 KX501VF0020 MF LM401U | 270               | 1000              | 64.00 | 64/1               | 2500  | 2500  | 4500                | 7.2                                     | 4.5             | 51              | 26   |
| 47   | 264             | 269              | 47              | 1.5  | P722_0320 KX501VF0020 MF LM402U | 500               | 1000              | 64.00 | 64/1               | 2500  | 2500  | 4500                | 8.5                                     | 4.5             | 51              | 27   |
| 47   | 363             | 371              | 65              | 1.1  | P722_0320 KX501VF0020 MF LM403U | 500               | 1000              | 64.00 | 64/1               | 2500  | 2500  | 4500                | 9.8                                     | 4.5             | 51              | 29   |
| 50   | 126             | 136              | 15              | 3.5  | P722_0200 KX501VF0030 MF LM401U | 250               | 1400              | 60.00 | 60/1               | 3000  | 3000  | 5000                | 6.6                                     | 4.5             | 51              | 26   |
| 50   | 248             | 253              | 30              | 1.8  | P722_0200 KX501VF0030 MF LM402U | 540               | 1400              | 60.00 | 60/1               | 3000  | 3000  | 5000                | 7.9                                     | 4.5             | 51              | 27   |
| 50   | 340             | 348              | 41              | 1.3  | P722_0200 KX501VF0030 MF LM403U | 700               | 1400              | 60.00 | 60/1               | 3000  | 3000  | 5000                | 9.2                                     | 4.5             | 51              | 29   |
| 50   | 532             | 565              | 64              | 0.83 | P722_0200 KX501VF0030 MF LM503U | 700               | 1400              | 60.00 | 60/1               | 3000  | 3000  | 5000                | 15                                      | 4.5             | 51              | 32   |
| 54   | 118             | 127              | 19              | 3.7  | P722_0280 KX501VF0020 MF LM401U | 240               | 1380              | 56.00 | 56/1               | 2500  | 2500  | 4500                | 7.0                                     | 4.5             | 51              | 26   |
| 54   | 231             | 236              | 37              | 1.9  | P722_0280 KX501VF0020 MF LM402U | 510               | 1380              | 56.00 | 56/1               | 2500  | 2500  | 4500                | 8.4                                     | 4.5             | 51              | 27   |
| 54   | 318             | 324              | 51              | 1.4  | P722_0280 KX501VF0020 MF LM403U | 670               | 1380              | 56.00 | 56/1               | 2500  | 2500  | 4500                | 9.7                                     | 4.5             | 51              | 29   |
| 54   | 497             | 528              | 81              | 0.89 | P722_0280 KX501VF0020 MF LM503U | 700               | 1380              | 56.00 | 56/1               | 2500  | 2500  | 4500                | 16                                      | 4.5             | 51              | 32   |
| 60   | 105             | 114              | 17              | 4.2  | P722_0250 KX501VF0020 MF LM401U | 210               | 1400              | 50.00 | 50/1               | 2500  | 2500  | 4500                | 7.1                                     | 4.5             | 52              | 26   |
| 60   | 206             | 211              | 33              | 2.1  | P722_0250 KX501VF0020 MF LM402U | 450               | 1400              | 50.00 | 50/1               | 2500  | 2500  | 4500                | 8.4                                     | 4.5             | 52              | 27   |
| 60   | 284             | 290              | 46              | 1.6  | P722_0250 KX501VF0020 MF LM403U | 600               | 1400              | 50.00 | 50/1               | 2500  | 2500  | 4500                | 9.7                                     | 4.5             | 52              | 29   |
| 60   | 444             | 471              | 72              | 0.99 | P722_0250 KX501VF0020 MF LM503U | 700               | 1400              | 50.00 | 50/1               | 2500  | 2500  | 4500                | 16                                      | 4.5             | 52              | 32   |
| 75   | 165             | 168              | 27              | 2.7  | P722_0200 KX501VF0020 MF LM402U | 360               | 1400              | 40.00 | 40/1               | 2500  | 2500  | 4500                | 8.5                                     | 4.5             | 51              | 27   |
| 75   | 227             | 232              | 37              | 1.9  | P722_0200 KX501VF0020 MF LM403U | 480               | 1400              | 40.00 | 40/1               | 2500  | 2500  | 4500                | 9.8                                     | 4.5             | 51              | 29   |
| 75   | 355             | 377              | 58              | 1.2  | P722_0200 KX501VF0020 MF LM503U | 700               | 1400              | 40.00 | 40/1               | 2500  | 2500  | 4500                | 16                                      | 4.5             | 51              | 32   |
| 75   | 513             | 579              | 83              | 0.86 | P722_0200 KX501VF0020 MF LM505U | 700               | 1400              | 40.00 | 40/1               | 2500  | 2500  | 4500                | 22                                      | 4.5             | 51              | 36   |
| 86   | 144             | 147              | 39              | 3.0  | P722_0350 KX501VF0010 MF LM402U | 320               | 1400              | 35.00 | 35/1               | 2500  | 2000  | 3500                | 11                                      | 4.5             | 52              | 27   |
| 86   | 198             | 203              | 54              | 2.2  | P722_0350 KX501VF0010 MF LM403U | 420               | 1400              | 35.00 | 35/1               | 2500  | 2000  | 3500                | 12                                      | 4.5             | 52              | 29   |
| 86   | 310             | 330              | 85              | 1.4  | P722_0350 KX501VF0010 MF LM503U | 670               | 1400              | 35.00 | 35/1               | 2500  | 2000  | 3500                | 18                                      | 4.5             | 52              | 32   |
| 86   | 449             | 507              | 122             | 0.98 | P722_0350 KX501VF0010 MF LM505U | 700               | 1400              | 35.00 | 35/1               | 2500  | 2000  | 3500                | 25                                      | 4.5             | 52              | 36   |
| 94   | 132             | 135              | 21              | 3.3  | P722_0160 KX501VF0020 MF LM402U | 290               | 1380              | 32.00 | 32/1               | 2500  | 2500  | 4500                | 8.6                                     | 4.5             | 49              | 27   |
| 94   | 181             | 185              | 29              | 2.4  | P722_0160 KX501VF0020 MF LM403U | 380               | 1380              | 32.00 | 32/1               | 2500  | 2500  | 4500                | 9.9                                     | 4.5             | 49              | 29   |
| 94   | 284             | 302              | 46              | 1.6  | P722_0160 KX501VF0020 MF LM503U | 610               | 1380              | 32.00 | 32/1               | 2500  | 2500  | 4500                | 16                                      | 4.5             | 49              | 32   |
| 94   | 410             | 463              | 66              | 1.1  | P722_0160 KX501VF0020 MF LM505U | 700               | 1380              | 32.00 | 32/1               | 2500  | 2500  | 4500                | 22                                      | 4.5             | 49              | 36   |
| 100  | 272             | 289              | 143             | 1.1  | P721_0100 KX701VF0030 MF LM503U | 500               | 1000              | 30.00 | 30/1               | 2100  | 2100  | 4000                | 23                                      | 4               | 47              | 34   |
| 125  | 217             | 231              | 86              | 1.8  | P721_0080 KX701VF0030 MF LM503U | 470               | 1000              | 24.00 | 24/1               | 2100  | 2100  | 4000                | 23                                      | 4.5             | 49              | 34   |
| 125  | 314             | 355              | 124             | 1.3  | P721_0080 KX701VF0030 MF LM505U | 500               | 1000              | 24.00 | 24/1               | 2100  | 2100  | 4000                | 29                                      | 4.5             | 49              | 38   |
| 125  | 442             | 488              | 175             | 0.91 | P721_0080 KX701VF0030 MF LM704U | 500               | 1000              | 24.00 | 24/1               | 2100  | 2100  | 4000                | 49                                      | 4.5             | 49              | 44   |
| 143  | 190             | 202              | 68              | 2.3  | P721_0070 KX701VF0030 MF LM503U | 410               | 1250              | 21.00 | 21/1               | 2100  | 2100  | 4000                | 23                                      | 4.5             | 49              | 34   |
| 143  | 275             | 310              | 99              | 1.6  | P721_0070 KX701VF0030 MF LM505U | 640               | 1250              | 21.00 | 21/1               | 2100  | 2100  | 4000                | 29                                      | 4.5             | 49              | 38   |
| 143  | 387             | 427              | 139             | 1.1  | P721_0070 KX701VF0030 MF LM704U | 650               | 1250              | 21.00 | 21/1               | 2100  | 2100  | 4000                | 49                                      | 4.5             | 49              | 44   |
| 143  | 515             | 598              | 185             | 0.85 | P721_0070 KX701VF0030 MF LM706U | 650               | 1250              | 21.00 | 21/1               | 2100  | 2100  | 4000                | 66                                      | 4.5             | 49              | 51   |
| 150  | 181             | 192              | 129             | 1.7  | P721_0100 KX701VF0020 MF LM503U | 390               | 1000              | 20.00 | 20/1               | 1800  | 1800  | 3500                | 25                                      | 4               | 47              | 34   |
| 150  | 262             | 296              | 187             | 1.1  | P721_0100 KX701VF0020 MF LM505U | 500               | 1000              | 20.00 | 20/1               | 1800  | 1800  | 3500                | 32                                      | 4               | 47              | 38   |
| 150  | 368             | 406              | 263             | 0.82 | P721_0100 KX701VF0020 MF LM704U | 500               | 1000              | 20.00 | 20/1               | 1800  | 1800  | 3500                | 51                                      | 4               | 47              | 44   |
| 188  | 145             | 154              | 78              | 2.8  | P721_0080 KX701VF0020 MF LM503U | 310               | 1000              | 16.00 | 16/1               | 1800  | 1800  | 3500                | 25                                      | 4.5             | 49              | 34   |
| 188  | 209             | 236              | 112             | 1.9  | P721_0080 KX701VF0020 MF LM505U | 490               | 1000              | 16.00 | 16/1               | 1800  | 1800  | 3500                | 32                                      | 4.5             | 49              | 38   |
| 188  | 295             | 325              | 158             | 1.4  | P721_0080 KX701VF0020 MF LM704U | 500               | 1000              | 16.00 | 16/1               | 1800  | 1800  | 3500                | 51                                      | 4.5             | 49              | 44   |
| 188  | 392             | 456              | 210             | 1.0  | P721_0080 KX701VF0020 MF LM706U | 500               | 1000              | 16.00 | 16/1               | 1800  | 1800  | 3500                | 69                                      | 4.5             | 49              | 51   |
| 200  | 136             | 144              | 51              | 3.1  | P721_0050 KX701VF0030 MF LM503U | 290               | 1290              | 15.00 | 15/1               | 2100  | 2100  | 4000                | 23                                      | 5               | 46              | 34   |
| 200  | 196             | 222              | 73              | 2.2  | P721_0050 KX701VF0030 MF LM505U | 460               | 1290              | 15.00 | 15/1               | 2100  | 2100  | 4000                | 29                                      | 5               | 46              | 38   |
| 200  | 276             | 305              | 103             | 1.5  | P721_0050 KX701VF0030 MF LM704U | 590               | 1290              | 15.00 | 15/1               | 2100  | 2100  | 4000                | 49                                      | 5               | 46              | 44   |
| 200  | 368             | 427              | 137             | 1.2  | P721_0050 KX701VF0030 MF LM706U | 610               | 1290              | 15.00 | 15/1               | 2100  | 2100  | 4000                | 66                                      | 5               | 46              | 51   |
| 214  | 127             | 135              | 62              | 3.5  | P721_0070 KX701VF0020 MF LM503U | 270               | 1250              | 14.00 | 14/1               | 1800  | 1800  | 3500                | 25                                      | 4.5             | 49              | 34   |
| 214  | 183             | 207              | 89              | 2.4  | P721_0070 KX701VF0020 MF LM505U | 430               | 1250              | 14.00 | 14/1               | 1800  | 1800  | 3500                | 32                                      | 4.5             | 49              | 38   |
| 214  | 258             | 284              | 125             | 1.7  | P721_0070 KX701VF0020 MF LM704U | 550               | 1250              | 14.00 | 14/1               | 1800  | 1800  | 3500                | 51                                      | 4.5             | 49              | 44   |
| 214  | 343             | 399              | 167             | 1.3  | P721_0070 KX701VF0020 MF LM706U | 650               | 1250              | 14.00 | 14/1               | 1800  | 1800  | 3500                | 69                                      | 4.5             | 49              | 51   |
| 250  | 109             | 115              | 51              | 3.1  | P721_0040 KX701VF0030 MF LM503U | 230               | 1030              | 12.00 | 12/1               | 2100  | 2100  | 4000                | 23                                      | 5.5             | 43              | 34   |
| 250  | 157             | 177              | 73              | 2.2  | P721_0040 KX701VF0030 MF LM505U | 370               | 1030              | 12.00 | 12/1               | 2100  | 2100  | 4000                | 30                                      | 5.5             | 43              | 38   |
| 250  | 221             | 244              | 103             | 1.5  | P721_0040 KX701VF0030 MF LM704U | 470               | 1030              | 12.00 | 12/1               | 2100  | 2100  | 4000                | 49                                      | 5.5             | 43              | 44   |
| 250  | 294             | 342              | 137             | 1.2  | P721_0040 KX701VF0030 MF LM706U | 490               | 1030              | 12.00 | 12/1               | 2100  | 2100  | 4000                | 67                                      | 5.5             | 43              | 51   |
| 300  | 91              | 96               | 46              | 4.7  | P721_0050 KX701VF0020 MF LM503U | 190               | 1290              | 10.00 | 10/1               | 1800  | 1800  | 3500                | 26                                      | 5               | 46              | 34   |

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type                            | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,5,6 | $n_{1maxDB}$<br>EL3,4 | $n_{1maxZB}$ | $J_1$                                | $\Delta\varphi_2$ | $C_2$       | m    |
|---|----------|-----------|----------|------|---------------------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|--------------------------------------|-------------------|-------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                                 | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup> kgm <sup>2</sup> ] | [arcmin]          | [Nm/arcmin] | [kg] |
| <b>P7KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 700</math> Nm)</b>  |          |           |          |      |                                 |            |            |       |             |                           |                       |              |                                      |                   |             |      |
| 300   | 131      | 148       | 66       | 3.2  | P721_0050 KX701VF0020 MF LM505U | 310        | 1290       | 10.00 | 10/1        | 1800                      | 1800                  | 3500         | 32                                   | 5                 | 46          | 38   |
| 300   | 184      | 203       | 93       | 2.3  | P721_0050 KX701VF0020 MF LM704U | 390        | 1290       | 10.00 | 10/1        | 1800                      | 1800                  | 3500         | 52                                   | 5                 | 46          | 44   |
| 300   | 245      | 285       | 124      | 1.7  | P721_0050 KX701VF0020 MF LM706U | 590        | 1290       | 10.00 | 10/1        | 1800                      | 1800                  | 3500         | 69                                   | 5                 | 46          | 51   |
| 375   | 72       | 77        | 46       | 4.7  | P721_0040 KX701VF0020 MF LM503U | 160        | 1030       | 8.000 | 8/1         | 1800                      | 1800                  | 3500         | 26                                   | 5.5               | 43          | 34   |
| 375   | 105      | 118       | 66       | 3.2  | P721_0040 KX701VF0020 MF LM505U | 250        | 1030       | 8.000 | 8/1         | 1800                      | 1800                  | 3500         | 32                                   | 5.5               | 43          | 38   |
| 375   | 147      | 163       | 93       | 2.3  | P721_0040 KX701VF0020 MF LM704U | 310        | 1030       | 8.000 | 8/1         | 1800                      | 1800                  | 3500         | 52                                   | 5.5               | 43          | 44   |
| 375   | 196      | 228       | 124      | 1.7  | P721_0040 KX701VF0020 MF LM706U | 470        | 1030       | 8.000 | 8/1         | 1800                      | 1800                  | 3500         | 69                                   | 5.5               | 43          | 51   |
| 429   | 92       | 103       | 86       | 4.2  | P721_0070 KX701VF0010 MF LM505U | 210        | 1250       | 7.000 | 7/1         | 1800                      | 1600                  | 3000         | 43                                   | 4.5               | 49          | 38   |
| 429   | 129      | 142       | 121      | 3.0  | P721_0070 KX701VF0010 MF LM704U | 280        | 1250       | 7.000 | 7/1         | 1800                      | 1600                  | 3000         | 62                                   | 4.5               | 49          | 44   |
| 429   | 172      | 199       | 161      | 2.2  | P721_0070 KX701VF0010 MF LM706U | 410        | 1250       | 7.000 | 7/1         | 1800                      | 1600                  | 3000         | 80                                   | 4.5               | 49          | 51   |
| 500   | 54       | 58        | 46       | 4.7  | P721_0030 KX701VF0020 MF LM503U | 120        | 770        | 6.000 | 6/1         | 1800                      | 1800                  | 3500         | 27                                   | 6.5               | 37          | 34   |
| 500   | 79       | 89        | 66       | 3.2  | P721_0030 KX701VF0020 MF LM505U | 180        | 770        | 6.000 | 6/1         | 1800                      | 1800                  | 3500         | 34                                   | 6.5               | 37          | 38   |
| 500   | 110      | 122       | 93       | 2.3  | P721_0030 KX701VF0020 MF LM704U | 240        | 770        | 6.000 | 6/1         | 1800                      | 1800                  | 3500         | 53                                   | 6.5               | 37          | 44   |
| 500   | 147      | 171       | 124      | 1.7  | P721_0030 KX701VF0020 MF LM706U | 350        | 770        | 6.000 | 6/1         | 1800                      | 1800                  | 3500         | 71                                   | 6.5               | 37          | 51   |
| 600   | 92       | 102       | 86       | 4.2  | P721_0050 KX701VF0010 MF LM704U | 200        | 1130       | 5.000 | 5/1         | 1800                      | 1600                  | 3000         | 63                                   | 5                 | 46          | 44   |
| 600   | 123      | 142       | 115      | 3.1  | P721_0050 KX701VF0010 MF LM706U | 290        | 1130       | 5.000 | 5/1         | 1800                      | 1600                  | 3000         | 81                                   | 5                 | 46          | 51   |
| 750   | 74       | 81        | 78       | 4.6  | P721_0040 KX701VF0010 MF LM704U | 160        | 910        | 4.000 | 4/1         | 1800                      | 1600                  | 3000         | 65                                   | 5.5               | 43          | 44   |
| 750   | 98       | 114       | 104      | 3.5  | P721_0040 KX701VF0010 MF LM706U | 230        | 910        | 4.000 | 4/1         | 1800                      | 1600                  | 3000         | 82                                   | 5.5               | 43          | 51   |
| 1000  | 55       | 61        | 81       | 4.4  | P721_0030 KX701VF0010 MF LM704U | 120        | 680        | 3.000 | 3/1         | 1800                      | 1600                  | 3000         | 70                                   | 6.5               | 37          | 44   |
| 1000  | 74       | 85        | 108      | 3.3  | P721_0030 KX701VF0010 MF LM706U | 180        | 680        | 3.000 | 3/1         | 1800                      | 1600                  | 3000         | 87                                   | 6.5               | 37          | 51   |
| <b>P8KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 1600</math> Nm)</b> |          |           |          |      |                                 |            |            |       |             |                           |                       |              |                                      |                   |             |      |
| 21  | 1242     | 1319      | 266      | 0.81 | P822_0700 KX701VF0020 MF LM503U | 1400       | 2800       | 140.0 | 140/1       | 1800                      | 1800                  | 3500         | 25                                   | 4                 | 164         | 54   |
| 29  | 931      | 989       | 147      | 1.1  | P822_0350 KX701VF0030 MF LM503U | 1600       | 3200       | 105.0 | 105/1       | 2100                      | 2100                  | 4000         | 23                                   | 4.5               | 168         | 54   |
| 30  | 887      | 942       | 190      | 1.1  | P822_0500 KX701VF0020 MF LM503U | 1600       | 3200       | 100.0 | 100/1       | 1800                      | 1800                  | 3500         | 25                                   | 4                 | 167         | 54   |
| 36  | 745      | 792       | 147      | 1.1  | P822_0280 KX701VF0030 MF LM503U | 1600       | 3180       | 84.00 | 84/1        | 2100                      | 2100                  | 4000         | 23                                   | 4.5               | 163         | 54   |
| 38  | 710      | 754       | 190      | 1.1  | P822_0400 KX701VF0020 MF LM503U | 1520       | 3180       | 80.00 | 80/1        | 1800                      | 1800                  | 3500         | 25                                   | 4.5               | 161         | 54   |
| 40  | 665      | 707       | 105      | 1.5  | P822_0250 KX701VF0030 MF LM503U | 1430       | 3200       | 75.00 | 75/1        | 2100                      | 2100                  | 4000         | 23                                   | 4.5               | 166         | 54   |
| 40  | 961      | 1086      | 152      | 1.0  | P822_0250 KX701VF0030 MF LM505U | 1600       | 3200       | 75.00 | 75/1        | 2100                      | 2100                  | 4000         | 29                                   | 4.5               | 166         | 58   |
| 43  | 621      | 660       | 133      | 1.6  | P822_0350 KX701VF0020 MF LM503U | 1330       | 3200       | 70.00 | 70/1        | 1800                      | 1800                  | 3500         | 25                                   | 4.5               | 168         | 54   |
| 43  | 897      | 1013      | 192      | 1.1  | P822_0350 KX701VF0020 MF LM505U | 1600       | 3200       | 70.00 | 70/1        | 1800                      | 1800                  | 3500         | 32                                   | 4.5               | 168         | 58   |
| 47  | 568      | 603       | 152      | 1.4  | P822_0320 KX701VF0020 MF LM503U | 1200       | 2400       | 64.00 | 64/1        | 1800                      | 1800                  | 3500         | 26                                   | 4.5               | 157         | 54   |
| 47  | 820      | 926       | 220      | 0.98 | P822_0320 KX701VF0020 MF LM505U | 1200       | 2400       | 64.00 | 64/1        | 1800                      | 1800                  | 3500         | 32                                   | 4.5               | 157         | 58   |
| 50  | 532      | 565       | 84       | 1.9  | P822_0200 KX701VF0030 MF LM503U | 1140       | 3200       | 60.00 | 60/1        | 2100                      | 2100                  | 4000         | 23                                   | 4.5               | 164         | 54   |
| 50  | 769      | 869       | 121      | 1.3  | P822_0200 KX701VF0030 MF LM505U | 1600       | 3200       | 60.00 | 60/1        | 2100                      | 2100                  | 4000         | 30                                   | 4.5               | 164         | 58   |
| 50  | 1082     | 1194      | 171      | 0.92 | P822_0200 KX701VF0030 MF LM704U | 1600       | 3200       | 60.00 | 60/1        | 2100                      | 2100                  | 4000         | 49                                   | 4.5               | 164         | 64   |
| 54  | 497      | 528       | 133      | 1.6  | P822_0280 KX701VF0020 MF LM503U | 1070       | 3180       | 56.00 | 56/1        | 1800                      | 1800                  | 3500         | 25                                   | 4.5               | 163         | 54   |
| 54  | 718      | 811       | 192      | 1.1  | P822_0280 KX701VF0020 MF LM505U | 1600       | 3180       | 56.00 | 56/1        | 1800                      | 1800                  | 3500         | 32                                   | 4.5               | 163         | 58   |
| 60  | 444      | 471       | 95       | 2.3  | P822_0250 KX701VF0020 MF LM503U | 950        | 3200       | 50.00 | 50/1        | 1800                      | 1800                  | 3500         | 26                                   | 4.5               | 166         | 54   |
| 60  | 641      | 724       | 137      | 1.6  | P822_0250 KX701VF0020 MF LM505U | 1500       | 3200       | 50.00 | 50/1        | 1800                      | 1800                  | 3500         | 32                                   | 4.5               | 166         | 58   |
| 60  | 902      | 995       | 193      | 1.1  | P822_0250 KX701VF0020 MF LM704U | 1600       | 3200       | 50.00 | 50/1        | 1800                      | 1800                  | 3500         | 52                                   | 4.5               | 166         | 64   |
| 60  | 1201     | 1394      | 257      | 0.83 | P822_0250 KX701VF0020 MF LM706U | 1600       | 3200       | 50.00 | 50/1        | 1800                      | 1800                  | 3500         | 69                                   | 4.5               | 166         | 71   |
| 75  | 355      | 377       | 76       | 2.8  | P822_0200 KX701VF0020 MF LM503U | 760        | 3200       | 40.00 | 40/1        | 1800                      | 1800                  | 3500         | 26                                   | 4.5               | 164         | 54   |
| 75  | 513      | 579       | 110      | 2.0  | P822_0200 KX701VF0020 MF LM505U | 1200       | 3200       | 40.00 | 40/1        | 1800                      | 1800                  | 3500         | 32                                   | 4.5               | 164         | 58   |
| 75  | 721      | 796       | 154      | 1.4  | P822_0200 KX701VF0020 MF LM704U | 1540       | 3200       | 40.00 | 40/1        | 1800                      | 1800                  | 3500         | 52                                   | 4.5               | 164         | 64   |
| 75  | 961      | 1115      | 206      | 1.0  | P822_0200 KX701VF0020 MF LM706U | 1600       | 3200       | 40.00 | 40/1        | 1800                      | 1800                  | 3500         | 69                                   | 4.5               | 164         | 71   |
| 86  | 310      | 330       | 112      | 3.2  | P822_0350 KX701VF0010 MF LM503U | 670        | 3200       | 35.00 | 35/1        | 1800                      | 1600                  | 3000         | 36                                   | 4.5               | 168         | 54   |
| 86  | 449      | 507       | 162      | 2.2  | P822_0350 KX701VF0010 MF LM505U | 1050       | 3200       | 35.00 | 35/1        | 1800                      | 1600                  | 3000         | 43                                   | 4.5               | 168         | 58   |
| 86  | 631      | 696       | 227      | 1.6  | P822_0350 KX701VF0010 MF LM704U | 1350       | 3200       | 35.00 | 35/1        | 1800                      | 1600                  | 3000         | 62                                   | 4.5               | 168         | 64   |
| 86  | 841      | 976       | 303      | 1.2  | P822_0350 KX701VF0010 MF LM706U | 1600       | 3200       | 35.00 | 35/1        | 1800                      | 1600                  | 3000         | 80                                   | 4.5               | 168         | 71   |
| 94  | 284      | 302       | 76       | 2.8  | P822_0160 KX701VF0020 MF LM503U | 610        | 3180       | 32.00 | 32/1        | 1800                      | 1800                  | 3500         | 26                                   | 4.5               | 158         | 54   |
| 94  | 410      | 463       | 110      | 2.0  | P822_0160 KX701VF0020 MF LM505U | 960        | 3180       | 32.00 | 32/1        | 1800                      | 1800                  | 3500         | 32                                   | 4.5               | 158         | 58   |
| 94  | 577      | 637       | 154      | 1.4  | P822_0160 KX701VF0020 MF LM704U | 1230       | 3180       | 32.00 | 32/1        | 1800                      | 1800                  | 3500         | 52                                   | 4.5               | 158         | 64   |
| 94  | 769      | 892       | 206      | 1.0  | P822_0160 KX701VF0020 MF LM706U | 1600       | 3180       | 32.00 | 32/1        | 1800                      | 1800                  | 3500         | 70                                   | 4.5               | 158         | 71   |
| 100   | 552      | 609       | 135      | 1.3  | P821_0100 KX801VF0030 MF LM704U | 1180       | 2400       | 30.00 | 30/1        | 1300                      | 1300                  | 3000         | 80                                   | 4                 | 139         | 68   |
| 100   | 736      | 854       | 180      | 0.95 | P821_0100 KX801VF0030 MF LM706U | 1200       | 2400       | 30.00 | 30/1        | 1300                      | 1300                  | 3000         | 97                                   | 4                 | 139         | 75   |
| 125   | 442      | 488       | 95       | 1.8  | P821_0080 KX801VF0030 MF LM704U | 940        | 2400       | 24.00 | 24/1        | 1300                      | 1300                  | 3000         | 80                                   | 4.5               | 142         | 68   |
| 125   | 589      | 683       | 126      | 1.4  | P821_0080 KX801VF0030 MF LM706U | 1200       | 2400       | 24.00 | 24/1        | 1300                      | 1300                  | 3000         | 97                                   | 4.5               | 142         | 75   |
| 143   | 387      | 427       | 66       | 2.6  | P821_0070 KX801VF0030 MF LM704U | 830        | 2800       | 21.00 | 21/1        | 1300                      | 1300                  | 3000         | 80                                   | 4.5               | 142         | 68   |
| 143   | 515      | 598       | 88       | 1.9  | P821_0070 KX801VF0030 MF LM706U | 1230       | 2800       | 21.00 | 21/1        | 1300                      | 1300                  | 3000         | 98                                   | 4.5               | 142         | 75   |
| 200   | 276      | 305       | 56       | 3.1  | P821_0050 KX801VF0030 MF LM704U | 590        | 2580       | 15.00 | 15/1        | 1300                      | 1300                  | 3000         | 81                                   | 5                 | 128         | 68   |
| 200   | 368      | 427       | 74       | 2.3  | P821_0050 KX801VF0030 MF LM706U | 880        | 2580       | 15.00 | 15/1        | 1300                      | 1300                  | 3000         | 98                                   | 5                 | 128         | 75   |
| 250   | 221      | 244       | 56       | 3.1  | P821_0040 KX801VF0030 MF LM704U | 470        | 2060       | 12.00 | 12/1        | 1300                      | 1300                  | 3000         | 82                                   | 5.5               | 111         | 68   |
| 250   | 294      | 342       | 74       | 2.3  | P821_0040 KX801VF0030 MF LM706U | 700        | 2060       | 12.00 | 12/1        | 1300                      | 1300                  | 3000         | 99                                   | 5.5               | 111         | 75   |

10.2 Selection tables 10 PKX right-angle planetary geared motors

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type                            | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2,5,6 | $n_{1maxDB}$<br>EL3,4 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|---------------------------------|------------|------------|-------|-------------|---------------------------|-----------------------|--------------|---|-------------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                                 | [Nm]       | [Nm]       |       |             | [rpm]                     | [rpm]                 | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>P9KX (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 3000</math> Nm)</b> |          |           |          |      |                                 |            |            |       |             |                           |                       |              |   |                   |                 |      |
| 25  | 2164     | 2387      | 185      | 0.92 | P922_0400 KX801VF0030 MF LM704U | 3000       | 5530       | 120.0 | 120/1       | 1300                      | 1300                  | 3000         | 80                                      | 4.5               | 324             | 103  |
| 29  | 1893     | 2089      | 162      | 1.1  | P922_0350 KX801VF0030 MF LM704U | 3000       | 6000       | 105.0 | 105/1       | 1300                      | 1300                  | 3000         | 80                                      | 4.5               | 327             | 103  |
| 36  | 1515     | 1671      | 130      | 1.3  | P922_0280 KX801VF0030 MF LM704U | 3000       | 5530       | 84.00 | 84/1        | 1300                      | 1300                  | 3000         | 80                                      | 4.5               | 326             | 103  |
| 36  | 2018     | 2342      | 173      | 0.99 | P922_0280 KX801VF0030 MF LM706U | 3000       | 5530       | 84.00 | 84/1        | 1300                      | 1300                  | 3000         | 98                                      | 4.5               | 326             | 110  |
| 40  | 1352     | 1492      | 116      | 1.5  | P922_0250 KX801VF0030 MF LM704U | 2890       | 6000       | 75.00 | 75/1        | 1300                      | 1300                  | 3000         | 81                                      | 4.5               | 324             | 103  |
| 40  | 1802     | 2091      | 154      | 1.1  | P922_0250 KX801VF0030 MF LM706U | 3000       | 6000       | 75.00 | 75/1        | 1300                      | 1300                  | 3000         | 98                                      | 4.5               | 324             | 110  |
| 50  | 1082     | 1194      | 93       | 1.8  | P922_0200 KX801VF0030 MF LM704U | 2310       | 6000       | 60.00 | 60/1        | 1300                      | 1300                  | 3000         | 81                                      | 4.5               | 319             | 103  |
| 50  | 1441     | 1673      | 123      | 1.4  | P922_0200 KX801VF0030 MF LM706U | 3000       | 6000       | 60.00 | 60/1        | 1300                      | 1300                  | 3000         | 99                                      | 4.5               | 319             | 110  |



## 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 gear unit 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 <http://configurator.stoeber.de>.

Combination options and the dimensions of forced ventilated geared motors can be found at <http://cad.stoeber.de>.

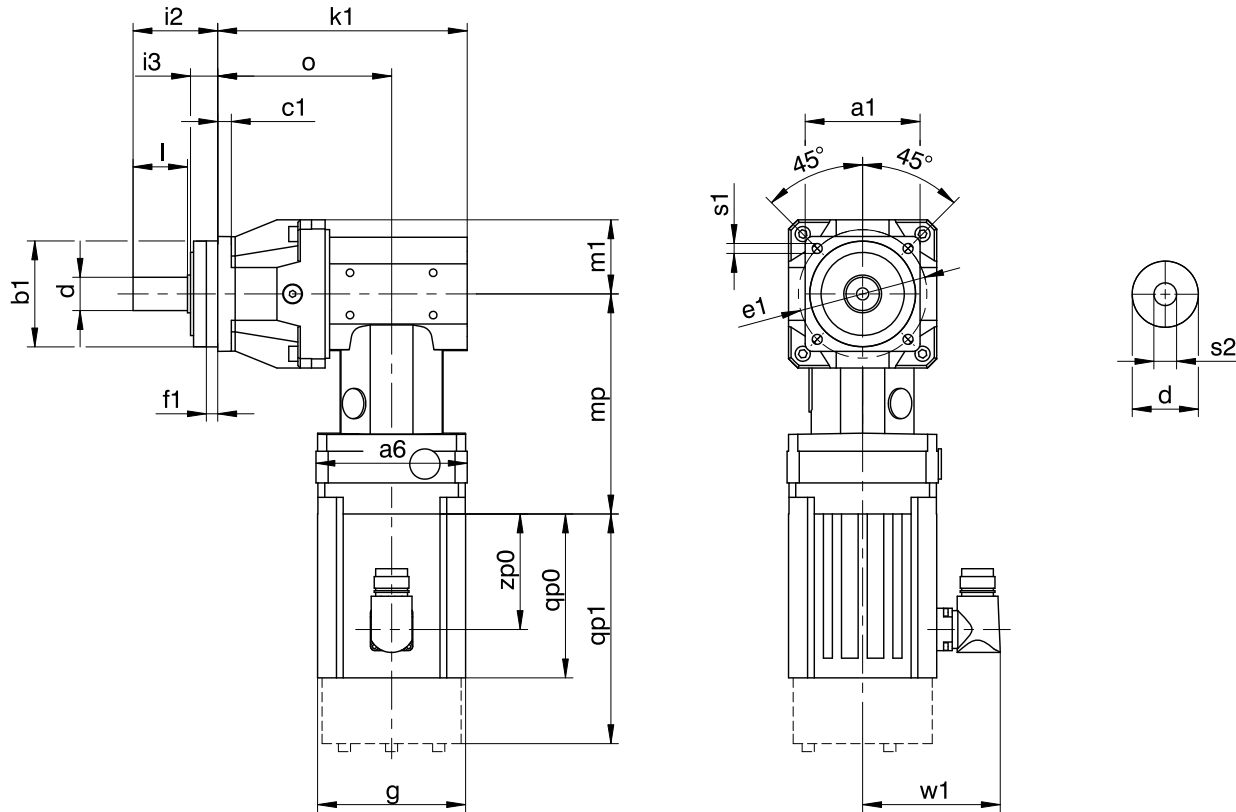
### Tolerances

| Solid shaft                          | Tolerance                              |
|--------------------------------------|--|
| Shaft $\varnothing$ fit $\leq 50$ mm | DIN 748-1, ISO k6                      |
| Shaft $\varnothing$ fit $> 50$ mm    | DIN 748-1, ISO m6                      |
| Feather keys                         | DIN 6885-1, high form A                |
| Balance quality                      | Q 2.5 (balanced 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  |

### 10.3.1 G shaft design (solid shaft without feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

#### Dimensions of gear units

| Type        | □a1 | ∅b1               | c1 | ∅d               | ∅e1 | f1   | i2  | i3 | k1    | l   | m1    | o     | ∅s1  | s2  |
|-------------|-----|-------------------|----|------------------|-----|------|-----|----|-------|-----|-------|-------|------|-----|
| P221_KX301_ | 55  | 50 <sub>h6</sub>  | 6  | 12 <sub>k6</sub> | 63  | 7.0  | 36  | 12 | 124.0 | 22  | 31.0  | 84.0  | 5.5  | M4  |
| P321_KX301_ | 72  | 60 <sub>h6</sub>  | 7  | 16 <sub>k6</sub> | 75  | 7.5  | 48  | 18 | 136.0 | 28  | 36.0  | 96.0  | 5.5  | M5  |
| P421_KX401_ | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 163.0 | 36  | 49.0  | 113.0 | 6.6  | M8  |
| P422_KX301_ | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 193.5 | 36  | 49.0  | 153.5 | 6.6  | M8  |
| P521_KX501_ | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 188.0 | 58  | 57.0  | 129.0 | 9.0  | M12 |
| P522_KX401_ | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 220.5 | 58  | 57.0  | 170.5 | 9.0  | M12 |
| P721_KX701_ | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 231.0 | 82  | 72.0  | 157.0 | 11.0 | M16 |
| P722_KX501_ | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 265.0 | 82  | 72.0  | 206.0 | 11.0 | M16 |
| P821_KX801_ | 190 | 160 <sub>h6</sub> | 15 | 55 <sub>k6</sub> | 215 | 10.0 | 112 | 27 | 305.0 | 82  | 95.0  | 213.0 | 13.5 | M20 |
| P822_KX701_ | 190 | 160 <sub>h6</sub> | 15 | 55 <sub>k6</sub> | 215 | 10.0 | 112 | 27 | 339.5 | 82  | 95.0  | 265.5 | 13.5 | M20 |
| P922_KX801_ | 212 | 180 <sub>h6</sub> | 17 | 75 <sub>k6</sub> | 250 | 10.0 | 143 | 34 | 432.0 | 105 | 112.5 | 340.0 | 17.5 | M20 |

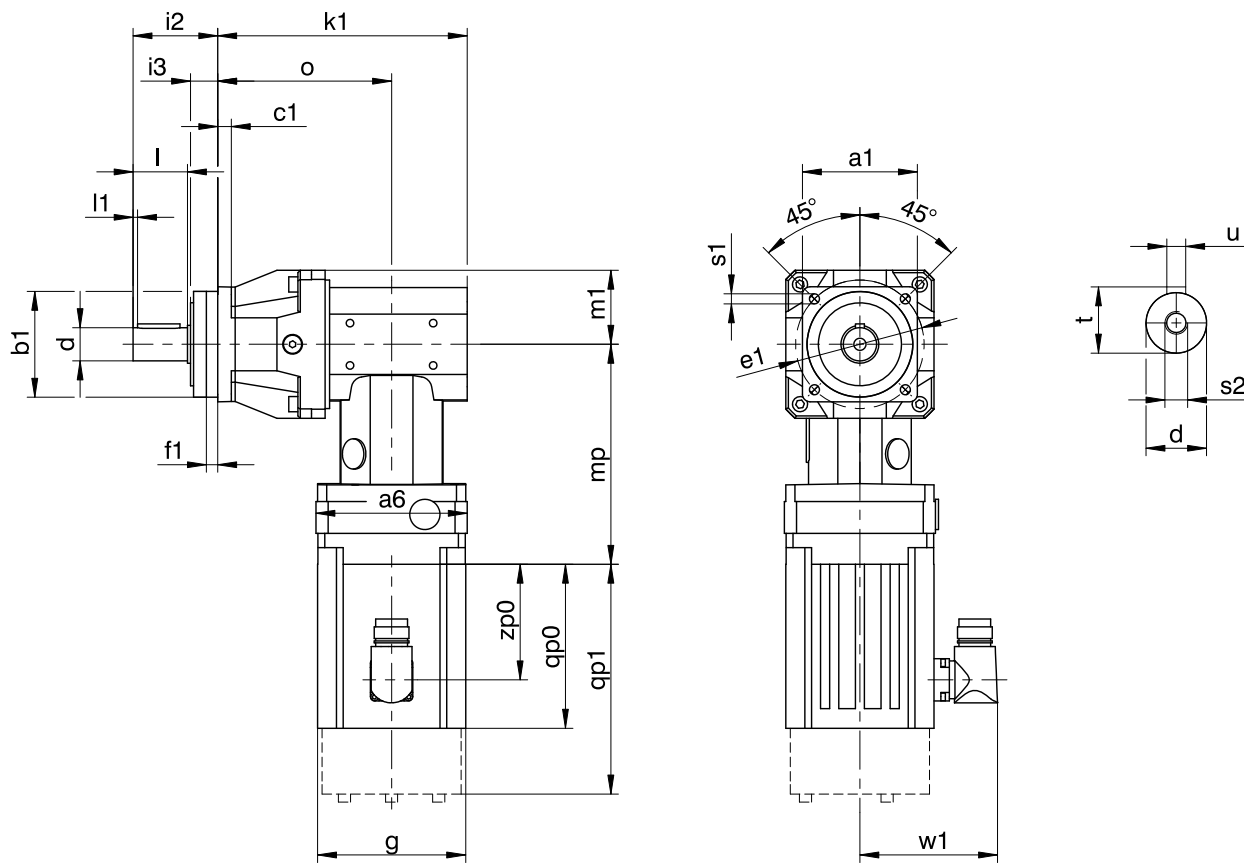
## Dimensions of motors

| 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    |
| P221_KX301_ | 100 | 134.0 | –   | –     | –   | –     |
| P321_KX301_ | 100 | 134.0 | –   | –     | –   | –     |
| P421_KX401_ | 100 | 145.5 | 115 | 150.0 | 140 | 153.0 |
| P422_KX301_ | 100 | 134.0 | –   | –     | –   | –     |
| P521_KX501_ | 115 | 176.5 | 115 | 172.0 | 140 | 183.0 |
| P522_KX401_ | 100 | 145.5 | –   | –     | –   | –     |
| P721_KX701_ | –   | –     | 145 | 214.5 | 145 | 217.5 |
| P722_KX501_ | 115 | 176.5 | 115 | 172.0 | –   | –     |
| P821_KX801_ | –   | –     | –   | –     | 190 | 263.0 |
| P822_KX701_ | –   | –     | 145 | 214.5 | 145 | 217.5 |
| P922_KX801_ | –   | –     | –   | –     | 190 | 263.0 |

### 10.3.2 P shaft design (solid shaft with feather key)



qp0 Applies to motors without brake.

qp1 Applies to motors with brake.

#### Dimensions of gear units

| Type        | □a1 | ∅b1               | c1 | ∅d               | ∅e1 | f1   | i2  | i3 | k1    | l   | l1 | m1    | o     | ∅s1  | s2  | t    | u         |
|-------------|-----|-------------------|----|------------------|-----|------|-----|----|-------|-----|----|-------|-------|------|-----|------|-----------|
| P221_KX301_ | 55  | 50 <sub>h6</sub>  | 6  | 12 <sub>k6</sub> | 63  | 7.0  | 36  | 12 | 124.0 | 22  | 2  | 31.0  | 84.0  | 5.5  | M4  | 13.5 | A4×4×18   |
| P321_KX301_ | 72  | 60 <sub>h6</sub>  | 7  | 16 <sub>k6</sub> | 75  | 7.5  | 48  | 18 | 136.0 | 28  | 2  | 36.0  | 96.0  | 5.5  | M5  | 18.0 | A5×5×22   |
| P421_KX401_ | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 163.0 | 36  | 3  | 49.0  | 113.0 | 6.6  | M8  | 24.5 | A6×6×28   |
| P422_KX301_ | 76  | 70 <sub>h6</sub>  | 9  | 22 <sub>k6</sub> | 85  | 7.5  | 56  | 18 | 193.5 | 36  | 3  | 49.0  | 153.5 | 6.6  | M8  | 24.5 | A6×6×28   |
| P521_KX501_ | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 188.0 | 58  | 3  | 57.0  | 129.0 | 9.0  | M12 | 35.0 | A10×8×50  |
| P522_KX401_ | 101 | 90 <sub>h6</sub>  | 10 | 32 <sub>k6</sub> | 120 | 15.0 | 88  | 28 | 220.5 | 58  | 3  | 57.0  | 170.5 | 9.0  | M12 | 35.0 | A10×8×50  |
| P721_KX701_ | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 231.0 | 82  | 4  | 72.0  | 157.0 | 11.0 | M16 | 43.0 | A12×8×70  |
| P722_KX501_ | 144 | 130 <sub>h6</sub> | 15 | 40 <sub>k6</sub> | 165 | 3.5  | 112 | 27 | 265.0 | 82  | 4  | 72.0  | 206.0 | 11.0 | M16 | 43.0 | A12×8×70  |
| P821_KX801_ | 190 | 160 <sub>h6</sub> | 15 | 55 <sub>k6</sub> | 215 | 10.0 | 112 | 27 | 305.0 | 82  | 6  | 95.0  | 213.0 | 13.5 | M20 | 59.0 | A16×10×70 |
| P822_KX701_ | 190 | 160 <sub>h6</sub> | 15 | 55 <sub>k6</sub> | 215 | 10.0 | 112 | 27 | 339.5 | 82  | 6  | 95.0  | 265.5 | 13.5 | M20 | 59.0 | A16×10×70 |
| P922_KX801_ | 212 | 180 <sub>h6</sub> | 17 | 75 <sub>k6</sub> | 250 | 10.0 | 143 | 34 | 432.0 | 105 | 7  | 112.5 | 340.0 | 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    |
| P221_KX301_ | 100 | 134.0 | –   | –     | –   | –     |
| P321_KX301_ | 100 | 134.0 | –   | –     | –   | –     |
| P421_KX401_ | 100 | 145.5 | 115 | 150.0 | 140 | 153.0 |
| P422_KX301_ | 100 | 134.0 | –   | –     | –   | –     |
| P521_KX501_ | 115 | 176.5 | 115 | 172.0 | 140 | 183.0 |
| P522_KX401_ | 100 | 145.5 | –   | –     | –   | –     |
| P721_KX701_ | –   | –     | 145 | 214.5 | 145 | 217.5 |
| P722_KX501_ | 115 | 176.5 | 115 | 172.0 | –   | –     |
| P821_KX801_ | –   | –     | –   | –     | 190 | 263.0 |
| P822_KX701_ | –   | –     | 145 | 214.5 | 145 | 217.5 |
| P922_KX801_ | –   | –     | –   | –     | 190 | 263.0 |

## 10.4 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.

### Sample code

|   |   |   |   |   |   |   |      |         |      |    |        |
|---|---|---|---|---|---|---|------|---------|------|----|--------|
| P | 7 | 2 | 1 | S | G | R | 0050 | KX701VF | 0030 | MF | LM704U |
|---|---|---|---|---|---|---|------|---------|------|----|--------|

### Explanation

| Code        | Designation                                       | Design                                 |
|-------------|---|--|
| P           | Type  | Planetary gear unit                    |
| 7           | Size  | 7 (example)                            |
| 2           | Generation  | Generation 2                           |
| 1           | Stages  | Single-stage                           |
| 2           |   | Two-stage                              |
| S           | Housing   | Standard                               |
| G           | Shaft   | Solid shaft without feather key        |
| P           |   | Solid shaft with feather key           |
| R           | Bearing   | Standard bearing                       |
| D           |   | Axially reinforced bearing             |
| Z           |   | Radially reinforced bearing            |
| 0050        | Transmission ratio of output<br>( $i \times 10$ ) | $i = 5$ (example)                      |
| KX701<br>VF | Input   | KX7 right-angle geared motor (example) |
| 0030        | Transmission ratio of input<br>( $i \times 10$ )  | $i = 3$ (example)                      |
| MF          | Attachment to motor                               | MF motor adapter                       |
| LM704U      | Motor   | LM Lean motor                          |

### In order to complete the type designation, also specify:

- A detailed type designation of the motor, see the chapter [\[ 2 \]](#)
- The mounting position, see the chapter [\[ 10.5.2 \]](#)
- Radial shaft seal rings at the output made of NBR or FKM, see the chapter [\[ 10.6.3 \]](#)
- The position of the plug connector, see the chapter [\[ 10.5.4 \]](#)
- For reverse operation of the output shaft from  $\pm 20^\circ$  to  $\pm 90^\circ$  and horizontal installation, see the chapter [\[ 10.6.4 \]](#)

## 10.5 Product description

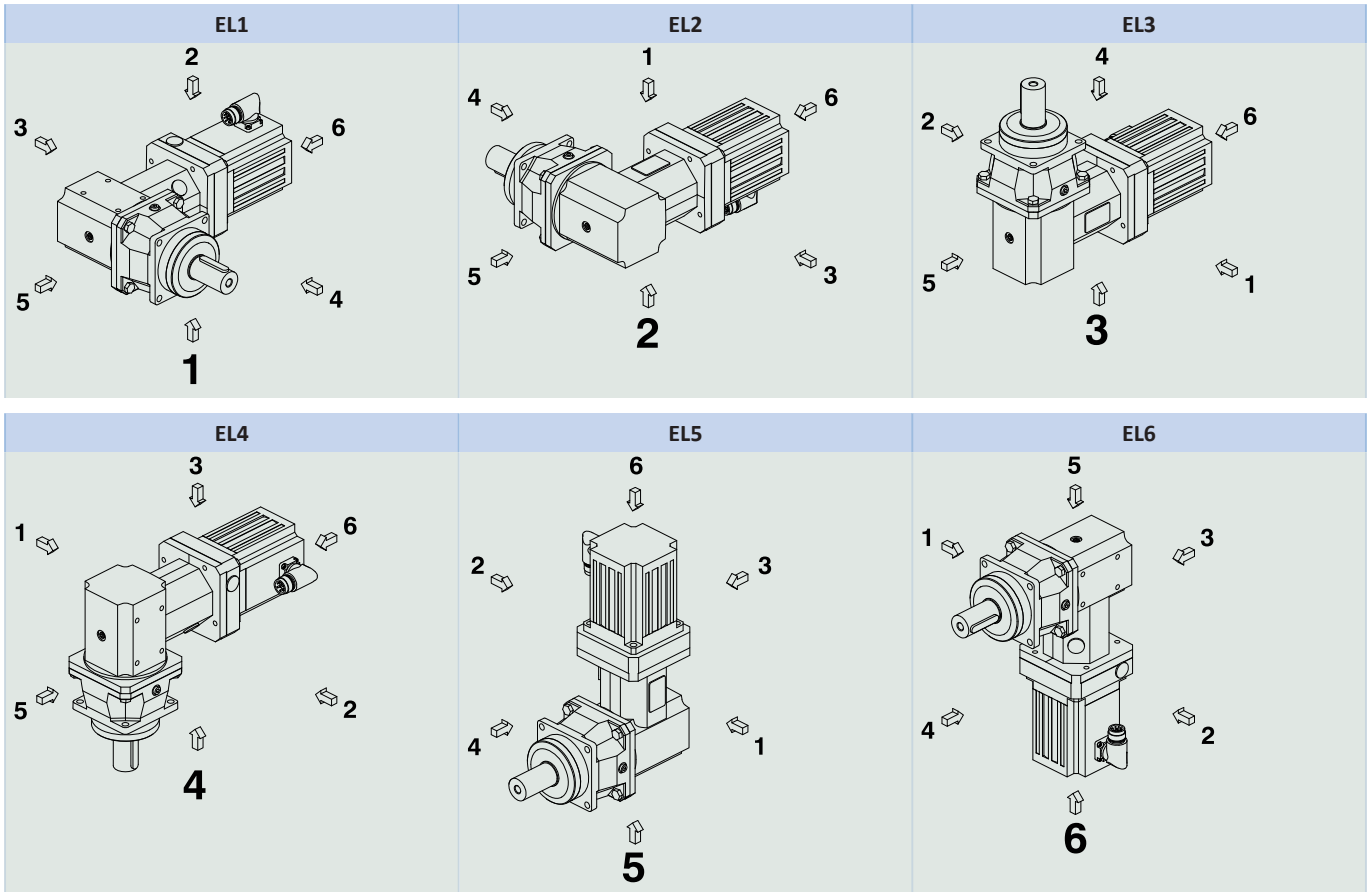
### 10.5.1 Installation conditions

The specified torques and forces only apply when attaching gear units at the machine side using screws of quality 10.9. In addition, the gear unit housings must be adjusted at the pilot. The machine-side fit must be H7.

### 10.5.2 Mounting positions

The following table shows the standard mounting positions.

The numbers identify the gear unit sides. The mounting position is defined by the gear side facing downwards.



Since the lubricant filling volume of the gear unit depends on the mounting position, the mounting position must be specified when ordering.

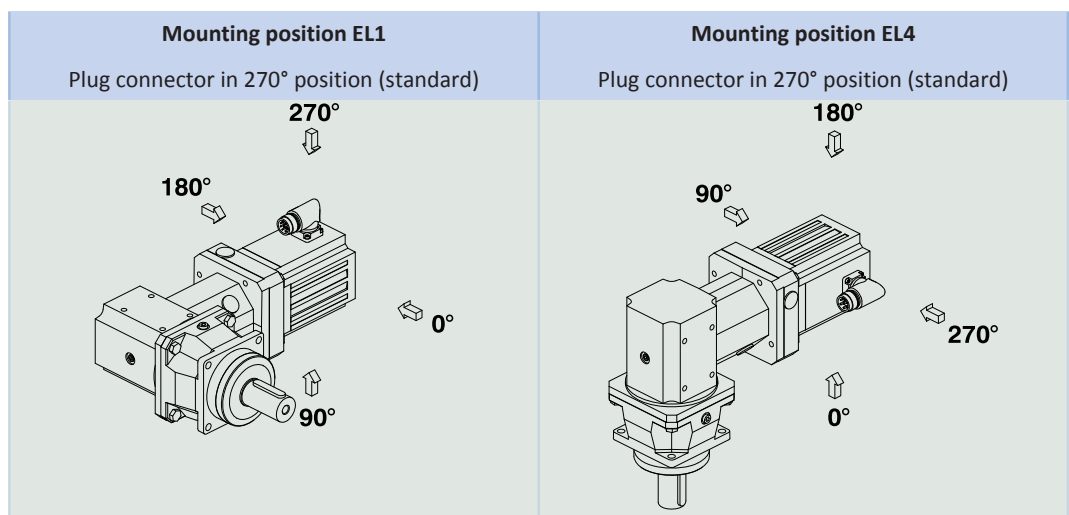
### 10.5.3 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

Lubricant filling quantities for gear units, document ID 441871, can be found online at <http://www.stoerber.de/en/download>. Enter the ID of the documentation in the Search... field.

### 10.5.4 Position of the plug connector



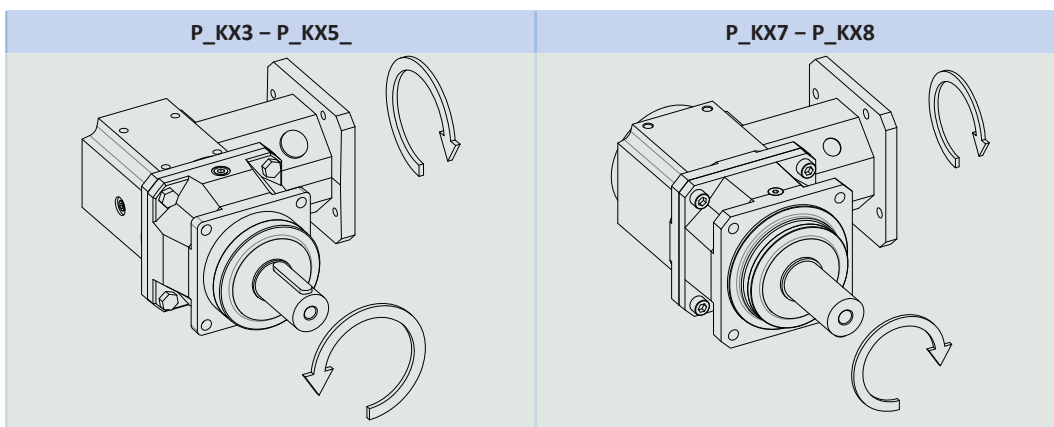
Indicate variations for your geared motor in the purchase order.

Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

### 10.5.5 Other product features

| Feature  | Value                 |
|--|-----------------------|
| Max. permitted gear unit temperature (on the surface of the gear unit) | ≤ 90 °C               |
| Paint  | Black RAL 9005        |
| (ATEX) Directive 2014/34/EU (option)                                   | Not suitable          |
| <b>Protection class:<sup>1</sup></b>                                   |                       |
| Gear unit  | IP65                  |
| Motor  | IP56, optionally IP66 |

### 10.5.6 Direction of rotation



The pictures show mounting position EL1.

## 10.6 Project configuration

Project your drives using our SERVOfsoft designing software. You can receive SERVOfsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

### 10.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point  $M_{2N}$  specified in the selection tables.

**For mounting positions EL1, EL2, EL5, EL6:**

$$n_{1m^*} \leq \frac{n_{1maxDBEL1,2,5,6}}{fB_T}$$

**For mounting positions EL3, EL4:**

$$n_{1m^*} \leq \frac{n_{1maxDBEL3,4}}{fB_T}$$

$$n_{1max^*} \leq \frac{n_{1maxZB}}{fB_T}$$

$$M_{2eff^*} \leq M_{2th}$$

$$M_{2acc^*} \leq M_{2acc}$$

$$M_{2NOT^*} \leq M_{2NOT}$$

$$M_{2eq^*} \leq M_{2N} \cdot \frac{S}{fB_{op} \cdot fB_t}$$

<sup>1</sup> Observe the protection class of all the components.



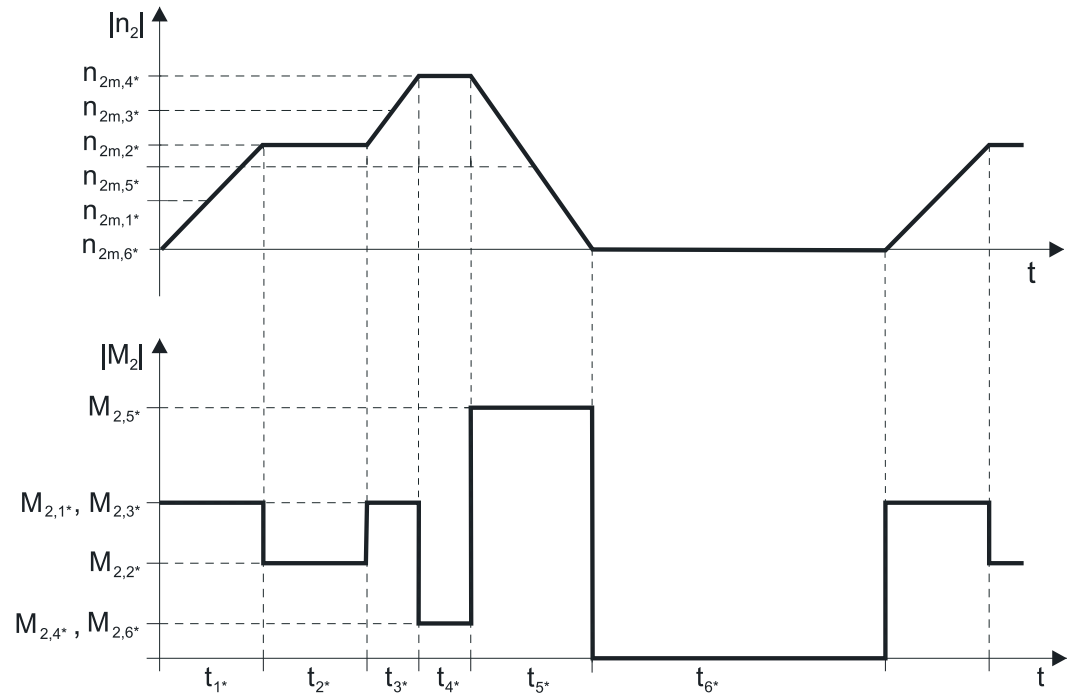
The values for  $n_{1\max\text{DBEL}1,2,5,6}$ ,  $n_{1\max\text{DBEL}3,4}$ ,  $n_{1\max\text{ZB}}$ ,  $M_{2\text{acc}}$ ,  $M_{2\text{NOT}}$ ,  $M_{2\text{N}}$  and  $S$  can be found in the selection tables.

The values for  $f_{B_T}$ ,  $f_{B_{op}}$  and  $f_{B_t}$  can be found in the corresponding tables in this chapter.

Calculate the thermal limit torque  $M_{2\text{th}}$  for a duty cycle  $> 50\%$ .

#### 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 average input speed

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

$$n_{2m^*} = \frac{|n_{2m,1}^*| \cdot t_1^* + \dots + |n_{2m,n}^*| \cdot t_n^*}{t_1^* + \dots + t_n^*}$$

If  $t_1^* + \dots + t_5^* \geq 10 \text{ min}$ , calculate  $n_{2m^*}$  without the rest phase  $t_6^*$ .

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

#### Calculation of the actual effective torque

$$M_{2\text{eff}^*} = \sqrt{\frac{t_1^* \cdot M_{2,1}^{*2} + \dots + t_n^* \cdot M_{2,n}^{*2}}{t_1^* + \dots + t_n^*}}$$

#### Calculation of the actual equivalent torque

$$M_{2\text{eq}^*} = \sqrt[3]{\frac{|n_{2m,1}^*| \cdot t_1^* \cdot M_{2,1}^{*3} + \dots + |n_{2m,n}^*| \cdot t_n^* \cdot M_{2,n}^{*3}}{|n_{2m,1}^*| \cdot t_1^* + \dots + |n_{2m,n}^*| \cdot t_n^*}}$$

#### Calculation of the thermal limit torque

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

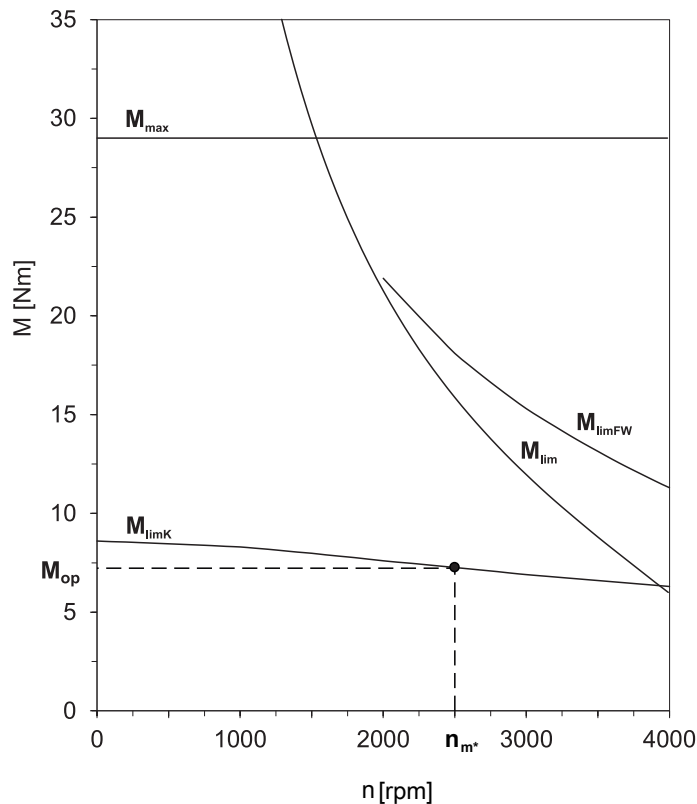
$$M_{2\text{th}} = M_{op} \cdot i \cdot K_{\text{mot,th}}$$

$$K_{\text{mot,th}} = 0,9 - \frac{a_{\text{th}}}{1000} \cdot \text{athEL} \cdot f_{B_T} \cdot \left(\frac{n_{1m^*}}{1000}\right)^3$$

The values for  $i$  and  $a_{\text{th}}$  can be found in the selection tables.

The values for  $f_{B_T}$  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 curve of Chapter [ 2.3]. Note the size and nominal speed  $n_N$  of the motor. The figure below shows an example of reading the torque  $M_{op}$  of a motor with convection cooling 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 run time $\leq 8$ h  |  | 1.00   |
| Daily run time $\leq 16$ h |  | 1.15   |
| Daily run time $\leq 24$ h |  | 1.20   |

| Temperature                   |                         | $fB_T$ |
|-------------------------------|-------------------------|--------|
| Motor cooling                 | Surrounding temperature |        |
| Motor with convection cooling | $\leq 20$ °C            | 1.0    |
|                               | $\leq 30$ °C            | 1.1    |
|                               | $\leq 40$ °C            | 1.25   |

**Notes**

- The maximum permitted gear unit 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 gear unit torques ( $M_{2acc}$ ,  $M_{2NO_T}$ ) in the selection tables.
- The values specified in the selection tables for  $M_{2acc}$  refer to the gear units with a solid shaft design without feather key (G). We recommend this shaft design in general for cyclic operation.

### 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  $n_{2m^*} \leq 100$  rpm ( $F_{2ax^N} = F_{2ax100}$ ;  $F_{2radN} = F_{2rad100}$ ;  $M_{2kN} = M_{2k100}$ )
- Only if radial forces on the gear unit are stabilized by its pilots (housing, flange shaft)

#### Permitted shaft loads for standard bearing R

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $F_{2rad,acc}$<br>[N] | $M_{2k100}$<br>[Nm] | $M_{2k,acc}$<br>[Nm] |
|------|---------------|---------------------|----------------------|-----------------------|---------------------|----------------------|
| P2   | 17.0          | 500                 | 1200                 | 1300                  | 34                  | 36                   |
| P3   | 21.0          | 1000                | 2500                 | 2500                  | 88                  | 88                   |
| P4   | 22.0          | 1500                | 4000                 | 4500                  | 160                 | 180                  |
| P5   | 23.0          | 2300                | 6500                 | 7000                  | 338                 | 364                  |
| P7   | 26.0          | 2900                | 8000                 | 9000                  | 536                 | 603                  |
| P8   | 28.0          | 4700                | 13000                | 18000                 | 897                 | 1242                 |
| P9   | 40.0          | 6000                | 18000                | 27000                 | 1665                | 2498                 |

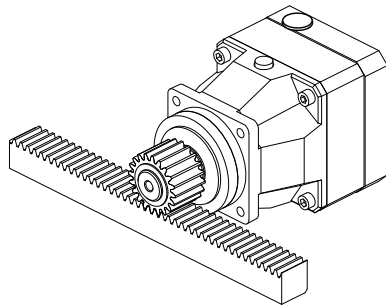


Fig. 1: Recommendation for bearing assignment R

#### Permitted shaft loads for axially reinforced bearing D

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $F_{2rad,acc}$<br>[N] | $M_{2k100}$<br>[Nm] | $M_{2k,acc}$<br>[Nm] |
|------|---------------|---------------------|----------------------|-----------------------|---------------------|----------------------|
| P3   | 24.0          | 1400                | 2750                 | 2750                  | 105                 | 105                  |
| P4   | 25.0          | 2250                | 4500                 | 5000                  | 194                 | 215                  |
| P5   | 29.0          | 3500                | 7000                 | 8000                  | 406                 | 464                  |
| P7   | 31.0          | 4500                | 9000                 | 10000                 | 648                 | 720                  |
| P8   | 35.0          | 7500                | 15000                | 18000                 | 1140                | 1368                 |
| P9   | 51.0          | 10000               | 20000                | 30000                 | 2070                | 3105                 |

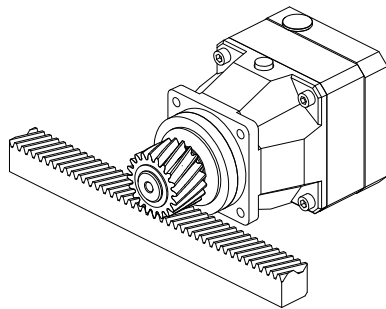


Fig. 2: Recommendation for bearing assignment D

Permitted shaft loads for radially reinforced bearing Z

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $F_{2rad,acc}$<br>[N] | $M_{2k100}$<br>[Nm] | $M_{2k,acc}$<br>[Nm] |
|------|---------------|---------------------|----------------------|-----------------------|---------------------|----------------------|
| P3   | 21.0          | 600                 | 3000                 | 3000                  | 105                 | 105                  |
| P4   | 22.0          | 1000                | 5000                 | 5000                  | 200                 | 200                  |
| P5   | 23.0          | 1600                | 8000                 | 8000                  | 416                 | 416                  |
| P7   | 26.0          | 2000                | 10000                | 10000                 | 670                 | 670                  |
| P8   | 28.0          | 3600                | 18000                | 18000                 | 1242                | 1242                 |
| P9   | 40.0          | 5000                | 27000                | 35000                 | 2500                | 3238                 |

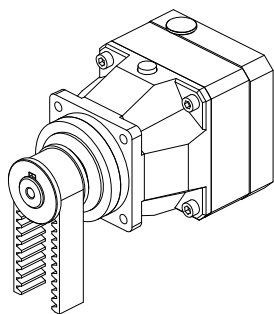


Fig. 3: Recommendation for bearing assignment Z

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

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

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

$$F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

$$M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

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

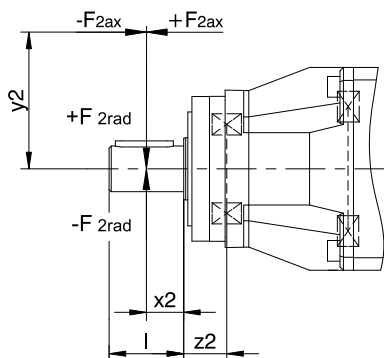


Fig. 4: Force application points

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:

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

$$F_{2rad,acc^*} \leq F_{2rad,acc}$$

$$F_{2ax^*} \leq F_{2axN}$$

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

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:

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

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

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

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

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

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

For different duty cycles:

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

### 10.6.3 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:

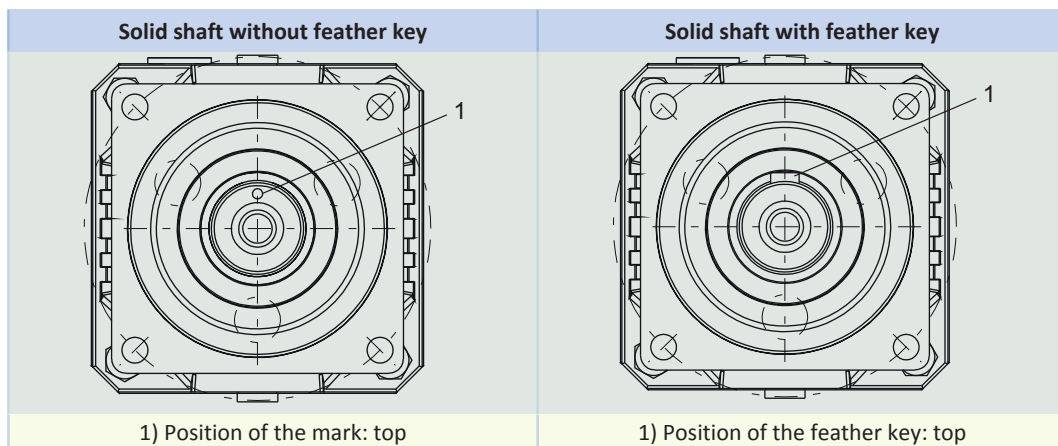
- Excellent temperature resistance
- High chemical stability
- Very good resistance to aging
- Excellent resistance to mineral oils and greases
- For use in the food, beverage and pharmaceutical industries

#### Leak-proofness

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

### 10.6.4 Reverse operation

To ensure lubrication of circulating geared parts during cyclic reverse operation from  $\pm 20^\circ$  to  $\pm 90^\circ$ , pay careful attention to the position of the output shaft if the gear unit is installed horizontally as shown in the images below. The images show the center position of reverse operation. Cyclic reverse operation  $\leq \pm 20^\circ$  on request.



**Notes**

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

## 10.7 Additional documentation

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

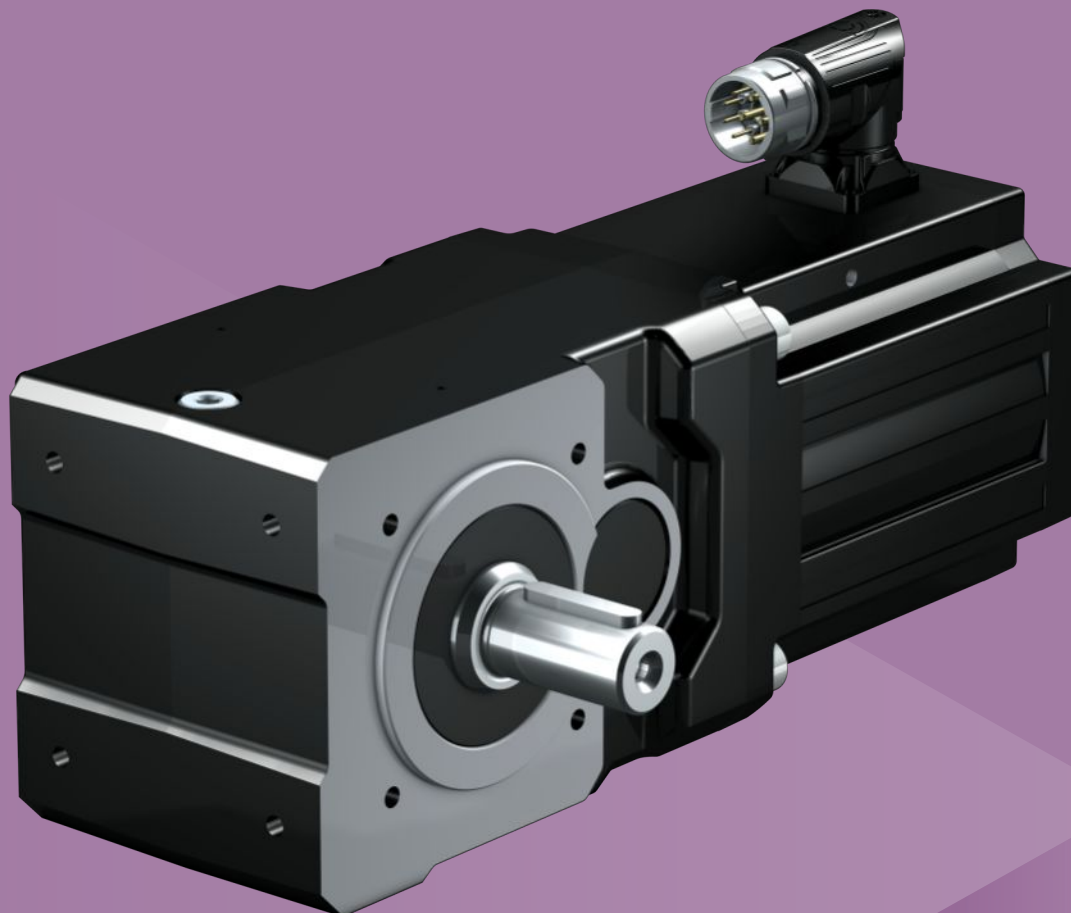
Enter the ID of the documentation in the Search... field.

| Documentation  | ID        |
|--|-----------|
| Operating manual for KL/KS/PHK/PHKX/PHQK/PK/PKX right-angle gear units and right-angle geared motors | 443004_en |
| Lubricant filling quantities for gear units  | 441871    |

# 11 KL helical bevel geared motors

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# 11 Helical bevel geared motors

KL

## 11.1 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 |
| $\eta_{get}$   | ≤ 97 %         |



## 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

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#).

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type              | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1max}$<br>DB | $n_{1max}$<br>ZB | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|-------------------|------------|------------|-------|-------------|------------------|------------------|---|----------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                   | [Nm]       | [Nm]       |       |             | [rpm]            | [rpm]            | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>KL2 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 60</math> Nm)</b> |          |           |          |      |                   |            |            |       |             |                  |                  |   |                |                 |      |
| 188  | 35       | 38        | 22       | 1.4  | KL202_0160 LM401U | 60         | 120        | 16.00 | 16/1        | 4000             | 6000             | 1.8                                     | 16             | 4.0             | 12   |
| 375  | 17       | 19        | 36       | 1.4  | KL202_0080 LM401U | 35         | 58         | 8.000 | 8/1         | 4000             | 6000             | 1.8                                     | 20             | 2.4             | 12   |
| 375  | 34       | 35        | 45       | 1.2  | KL202_0080 LM402U | 60         | 120        | 8.000 | 8/1         | 3500             | 5000             | 3.3                                     | 16             | 4.0             | 14   |
| 375  | 47       | 48        | 62       | 0.84 | KL202_0080 LM403U | 60         | 120        | 8.000 | 8/1         | 3500             | 5000             | 4.6                                     | 16             | 4.0             | 15   |
| 750  | 17       | 17        | 54       | 1.6  | KL202_0040 LM402U | 38         | 110        | 4.000 | 4/1         | 3500             | 5000             | 3.5                                     | 20             | 2.4             | 14   |
| 750  | 24       | 24        | 74       | 1.2  | KL202_0040 LM403U | 50         | 110        | 4.000 | 4/1         | 3500             | 5000             | 4.8                                     | 20             | 2.4             | 15   |

## 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 gear unit 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 <http://configurator.stoeber.de>.

Combination options and the dimensions of forced ventilated geared motors can be found at <http://cad.stoeber.de>.

### 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 $\varnothing$ fit $\leq 50$ mm | DIN 748-1, ISO k6       |
| Shaft $\varnothing$ fit $> 50$ mm    | DIN 748-1, ISO m6       |
| Feather keys                         | DIN 6885-1, high form A |

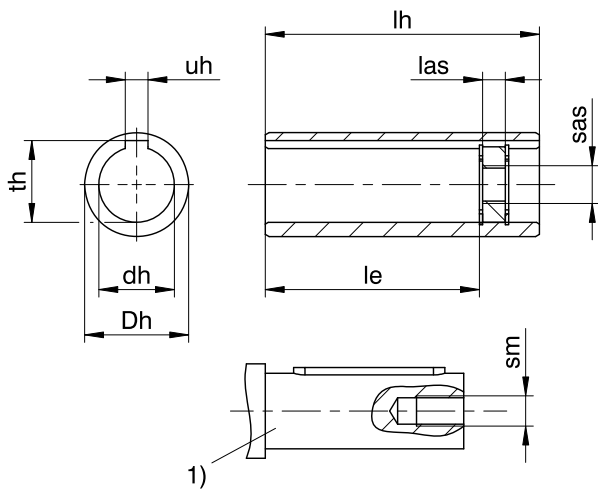
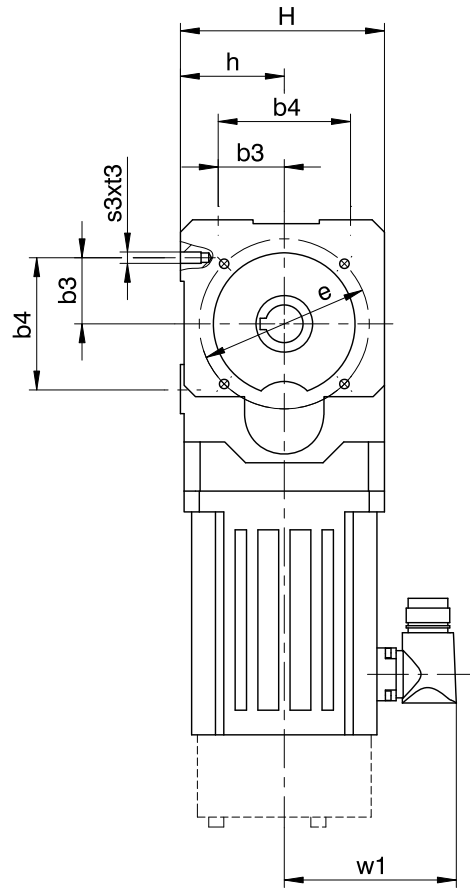
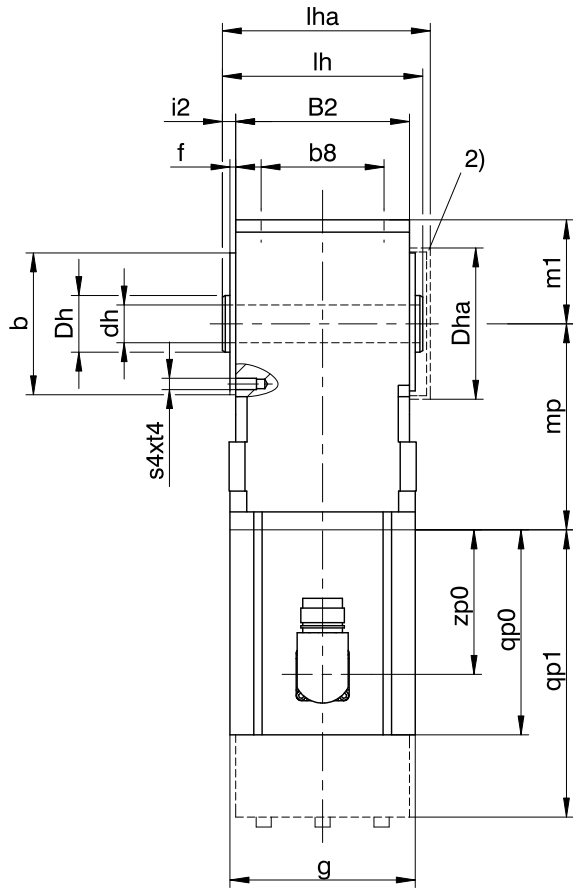
### Centering holes in solid shafts in accordance with DIN 332-2, DR shape

| 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    |

| Flange             | Pilot tolerance |
|--------------------|-----------------|
| Up to 300 mm       | ISO j6          |
| Starting at 350 mm | ISO h6          |

### 11.3.1 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  $\varnothing dh$  and the length of the feather key must be at least 2 x  $\varnothing dh$ .

2) Cover (optional)

## Dimensions of gear units

| 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 <sub>6</sub> | 35 | 70 | 65 | 92 | 20 <sup>H7</sup> | 30 | 80  | 90 | 3 | 55 | 108 | 7  | 79.5 | 106 | 12  | 110 | 55 | M6 | M6 | M6 | M8  | 13 | 13 | 22.8 | 6 <sup>JS9</sup> |

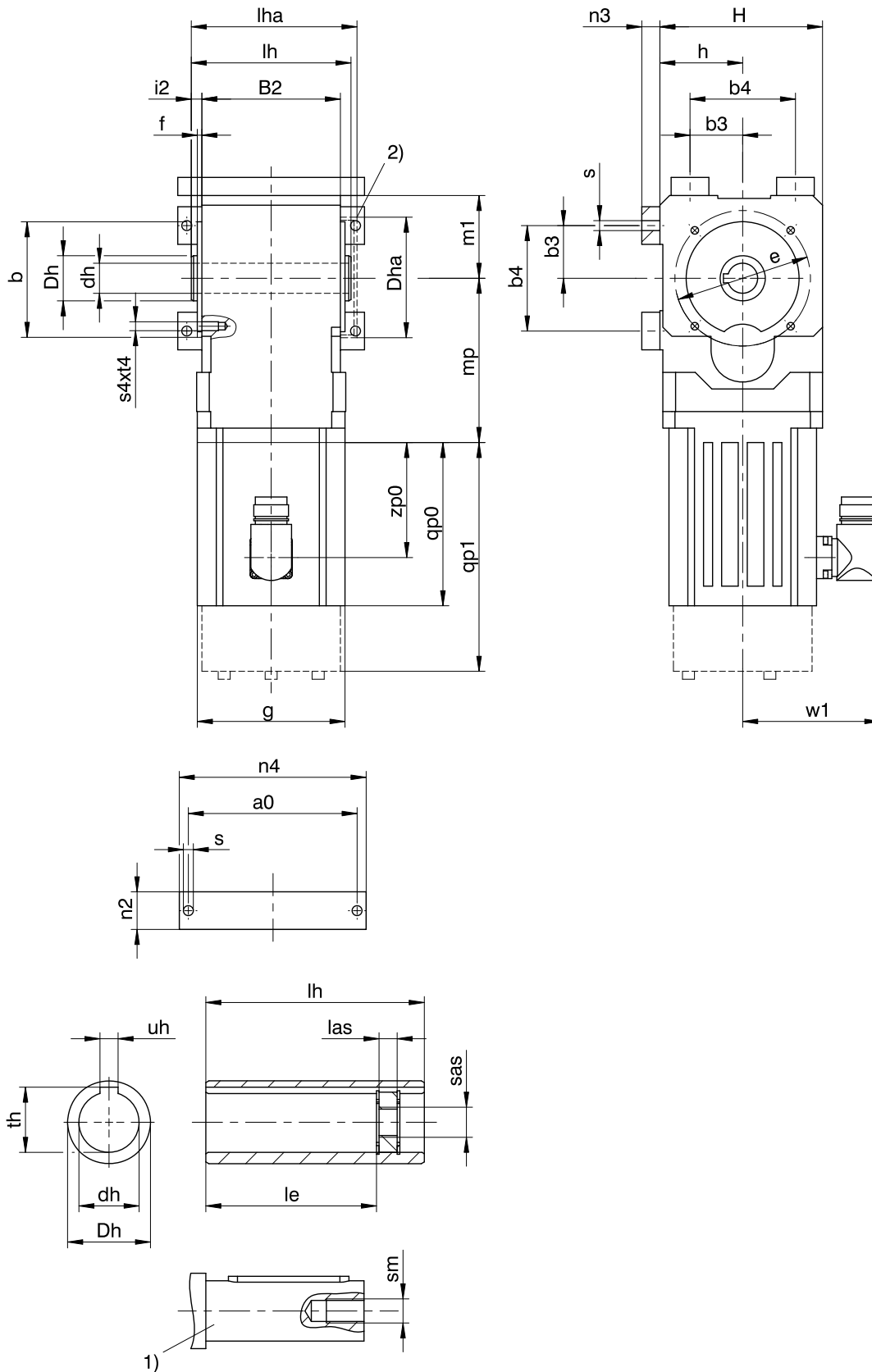
## Dimensions of motors

| 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<br>mp |
|-------|-----------|
| KL202 | 109       |

### 11.3.2 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  $\varnothing dh$  and the length of the feather key must be at least 2 x  $\varnothing dh$ .

2) Cover (optional)

Dimensions of gear units

| Type | a0  | Øb               | b3 | b4 | B2 | Ødh              | Dh | Dha | Øe | f | h  | H   | i2 | le   | lh  | las | lha | m1 | n2 | n3 | n4  | Øs  | s4 | sm | sas | t4 | th   | uh              |
|------|-----|------------------|----|----|----|------------------|----|-----|----|---|----|-----|----|------|-----|-----|-----|----|----|----|-----|-----|----|----|-----|----|------|-----------------|
| KL2  | 112 | 75 <sub>js</sub> | 35 | 70 | 92 | 20 <sup>H7</sup> | 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 <sup>h9</sup> |

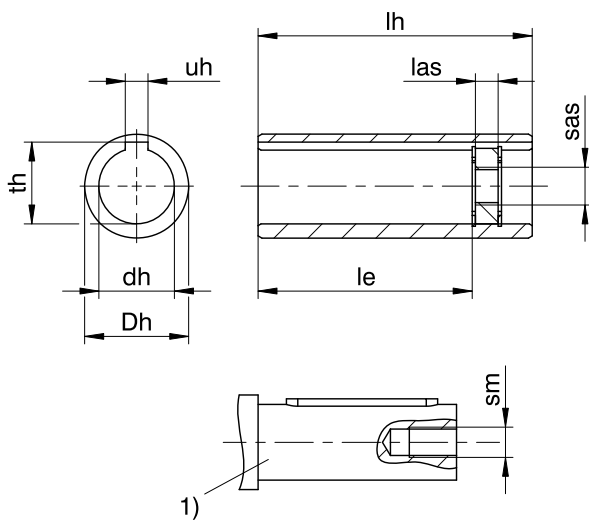
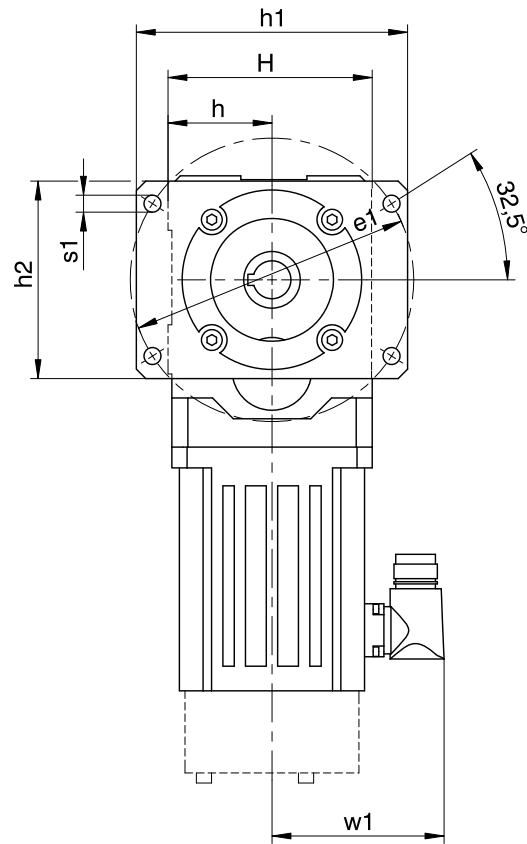
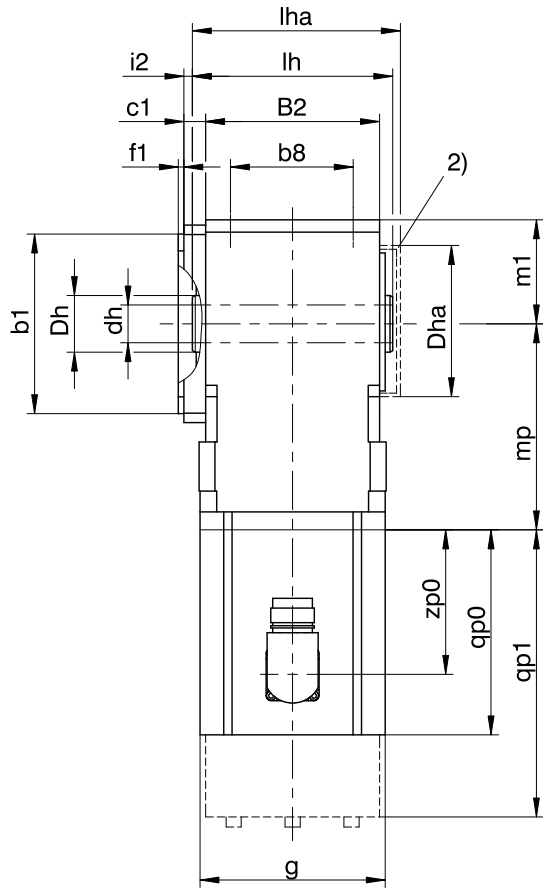
Dimensions of motors

| 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<br>mp |
|-------|-----------|
| KL202 | 109       |

### 11.3.3 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  $2.2 \times \varnothing dh$  and the length of the feather key must be at least  $2 \times \varnothing dh$ .

2) Cover (optional)

## Dimensions of gear units

| Type | Øb1             | b8 | B2 | c1   | Ødh              | Dh | Dha | Øe1 | f1 | h  | h1    | h2    | H   | i2  | le   | lh  | las | lha | m1 | Øs1 | sm | sas | th   | uh              |
|------|-----------------|----|----|------|------------------|----|-----|-----|----|----|-------|-------|-----|-----|------|-----|-----|-----|----|-----|----|-----|------|-----------------|
| KL2  | 95 <sub>6</sub> | 65 | 92 | 11.5 | 20 <sup>H7</sup> | 30 | 80  | 150 | 3  | 55 | 143.5 | 104.5 | 108 | 4.5 | 79.5 | 106 | 12  | 110 | 55 | 9   | M6 | M8  | 22.8 | 6 <sup>h9</sup> |

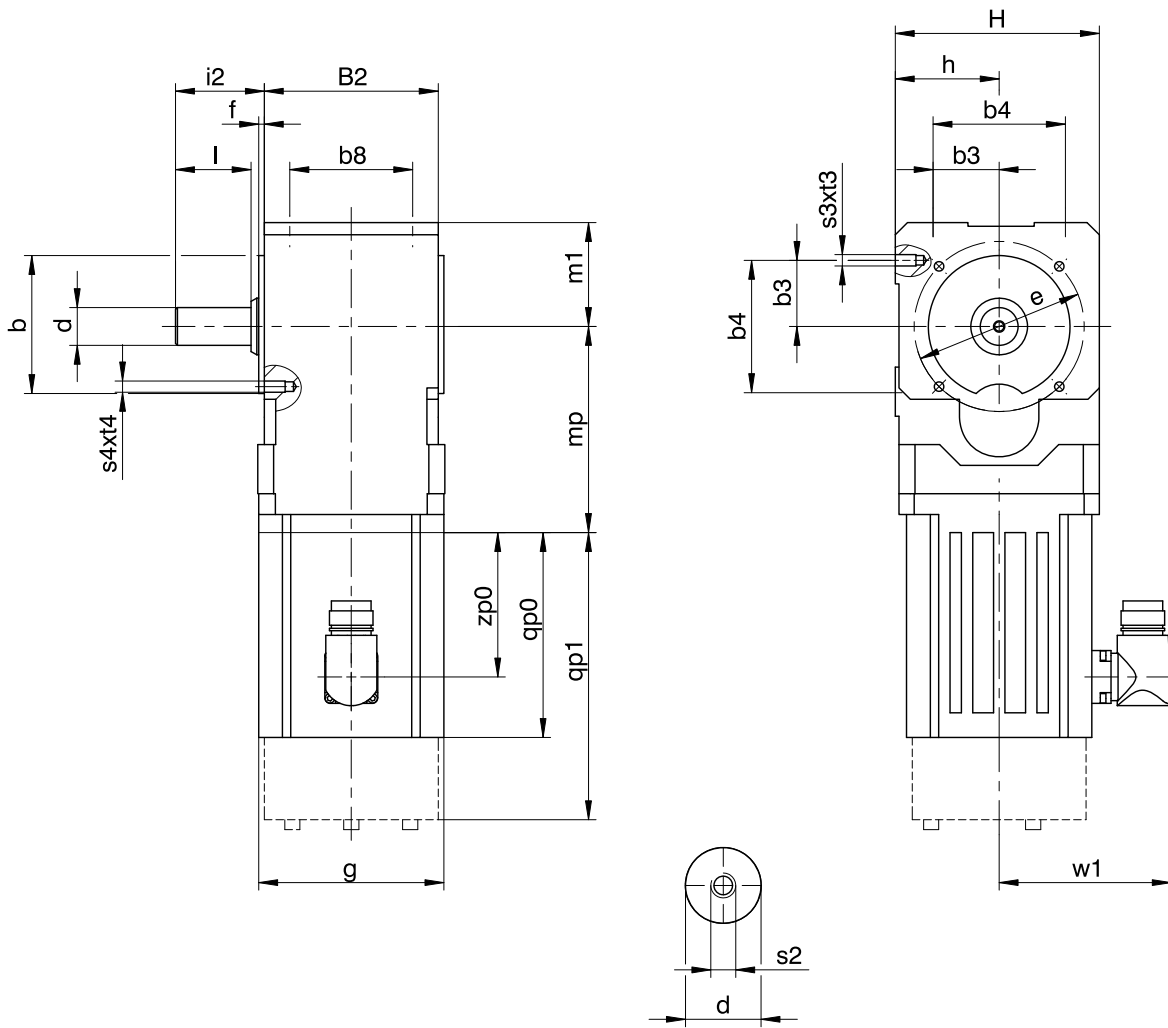
## Dimensions of motors

| 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<br>mp |
|-------|-----------|
| KL202 | 109       |

### 11.3.4 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 gear units

| Type | $\varnothing b$  | b3 | b4 | b8 | B2 | $\varnothing d$  | $\varnothing e$ | f | h  | H   | i2 | l  | m1 | s2 | s3 | s4 | t3 | t4 |
|------|------------------|----|----|----|----|------------------|-----------------|---|----|-----|----|----|----|----|----|----|----|----|
| KL2  | 75 <sub>h6</sub> | 35 | 70 | 65 | 92 | 20 <sub>k6</sub> | 90              | 3 | 55 | 108 | 47 | 40 | 55 | M6 | M6 | M6 | 13 | 13 |

#### Dimensions of motors

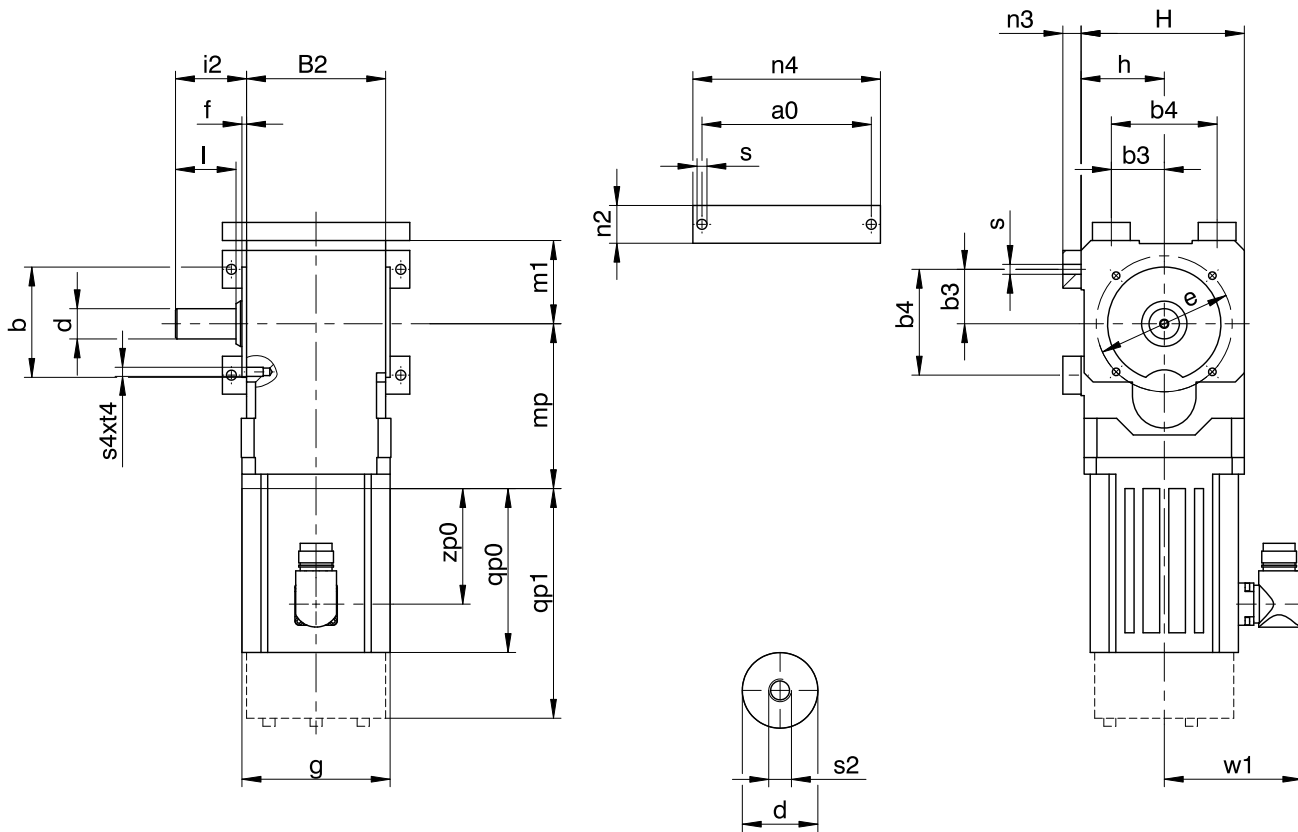
| Type   | $\square g$ | qp0   | qp1 | w1 | zp0   |
|--------|-------------|-------|-----|----|-------|
| LM401U | 98          | 108.5 | 152 | 91 | 76.5  |
| LM402U | 98          | 147.5 | 191 | 91 | 115.5 |
| LM403U | 98          | 178.5 | 222 | 91 | 146.5 |

#### Dimensions of geared motors

| Type  | LM4 |
|-------|-----|
|       | mp  |
| KL202 | 109 |



### 11.3.5 G shaft design (solid shaft without feather key), NG housing design (base + pitch circle diameter)



$q_{p0}$  Applies to motors without brake.

$q_{p1}$  Applies to motors with brake.

#### Dimensions of gear units

| Type | $a_0$ | $\varnothing b$  | $b_3$ | $b_4$ | $B_2$ | $\varnothing d$ | $\varnothing e$ | $f$ | $h$ | $H$ | $i_2$ | $l$ | $m_1$ | $n_2$ | $n_3$ | $n_4$ | $\varnothing s$ | $s_2$ | $s_4$ | $t_4$ |
|------|-------|------------------|-------|-------|-------|-----------------|-----------------|-----|-----|-----|-------|-----|-------|-------|-------|-------|-----------------|-------|-------|-------|
| KL2  | 112   | $75_{\varphi_6}$ | 35    | 70    | 92    | $20_{k_6}$      | 90              | 3   | 55  | 108 | 47    | 40  | 55    | 25    | 12    | 124   | 6.6             | M6    | M6    | 13    |

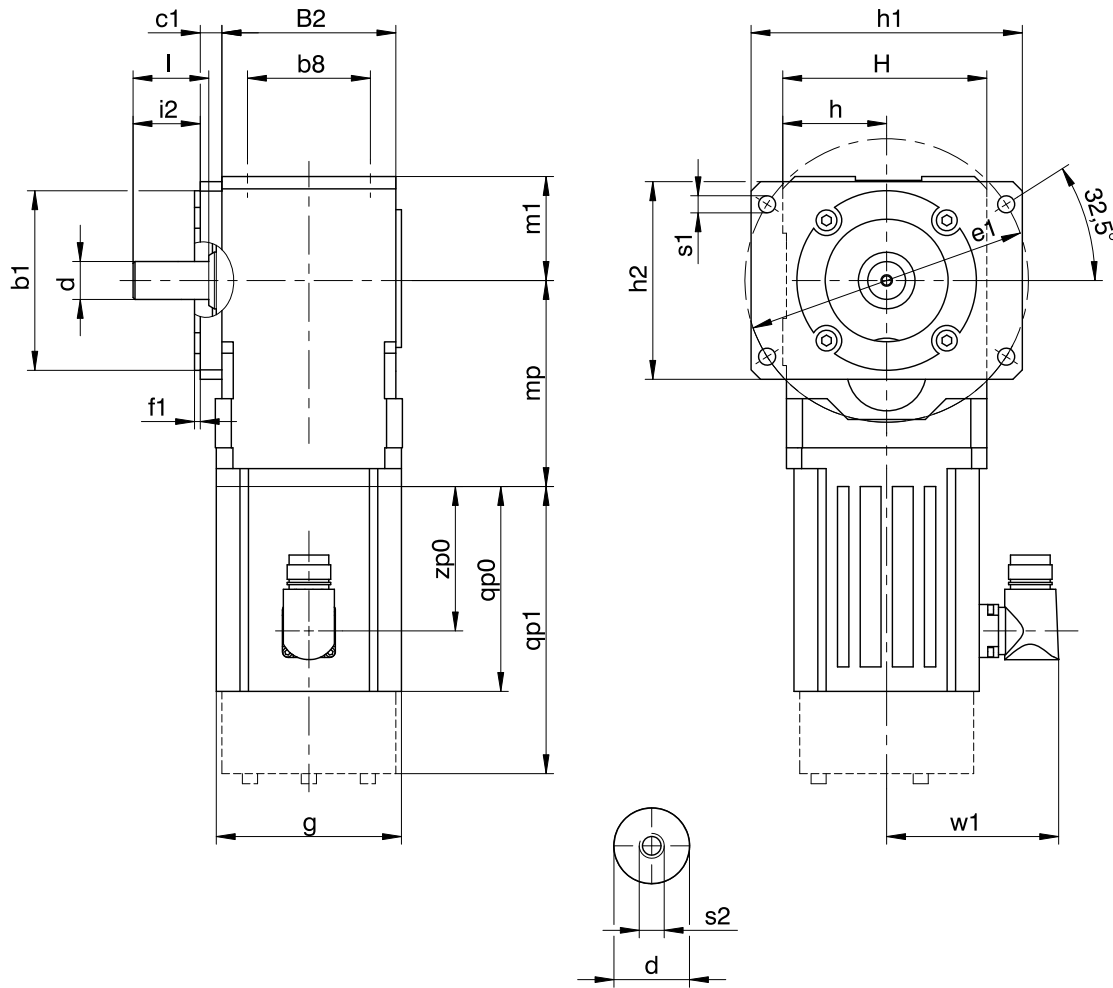
#### Dimensions of motors

| Type   | $\square g$ | $q_{p0}$ | $q_{p1}$ | $w_1$ | $z_{p0}$ |
|--------|-------------|----------|----------|-------|----------|
| 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  |

### 11.3.6 G shaft design (solid shaft without feather key), F housing design (flange)



$q_{p0}$  Applies to motors without brake.

$q_{p1}$  Applies to motors with brake.

#### Dimensions of gear units

| Type | $\varnothing b1$ | $b8$ | $B2$ | $c1$ | $\varnothing d$ | $\varnothing e1$ | $f1$ | $h$ | $h1$  | $h2$  | $H$ | $i2$ | $l$ | $m1$ | $\varnothing s1$ | $s2$ |
|------|------------------|------|------|------|-----------------|------------------|------|-----|-------|-------|-----|------|-----|------|------------------|------|
| KL2  | $95_{\pm 0.05}$  | 65   | 92   | 11.5 | $20_{\pm 0.06}$ | 150              | 3    | 55  | 143.5 | 104.5 | 108 | 35.5 | 40  | 55   | 9                | M6   |

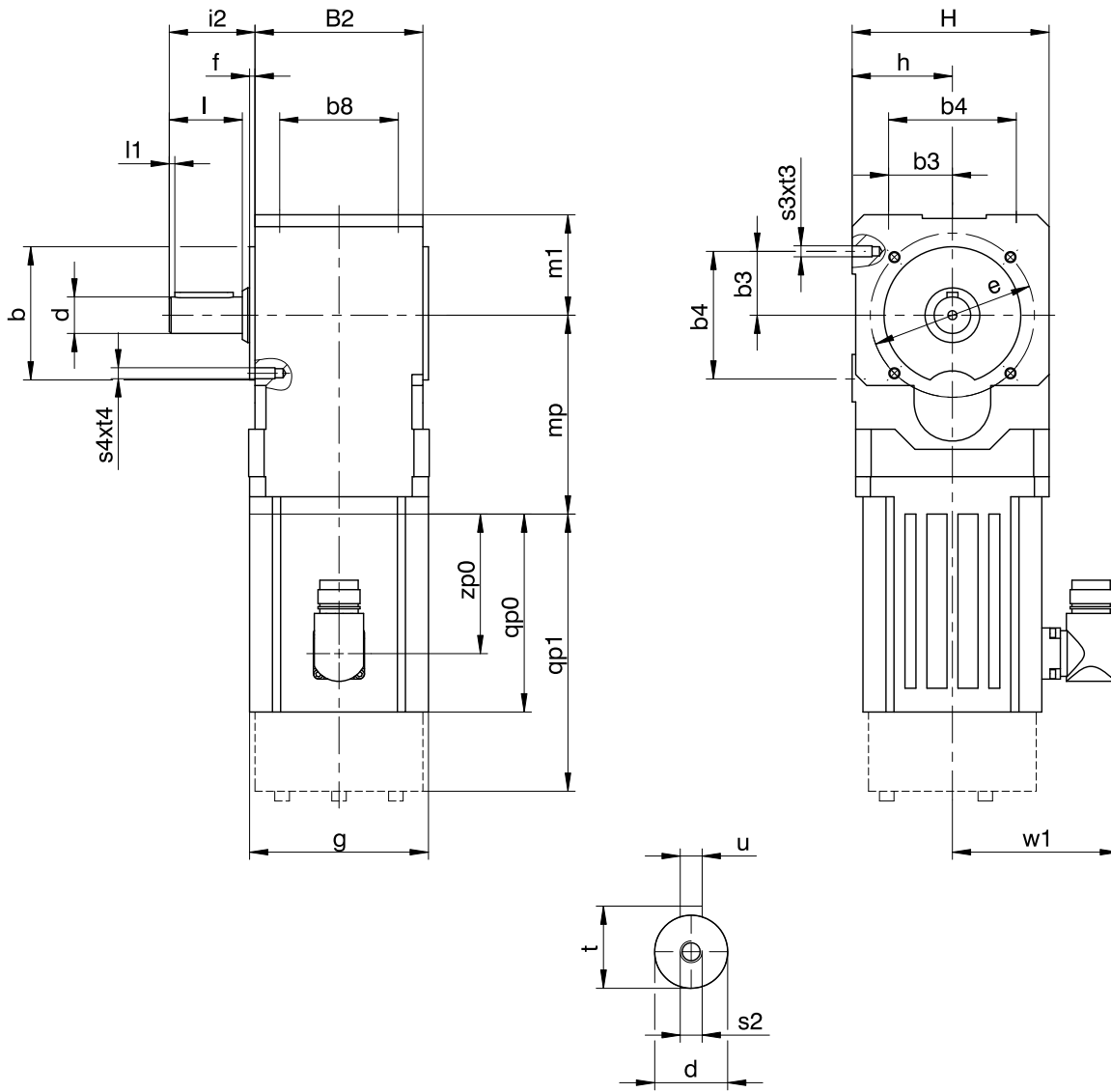
#### Dimensions of motors

| Type   | $\square g$ | $q_{p0}$ | $q_{p1}$ | $w1$ | $z_{p0}$ |
|--------|-------------|----------|----------|------|----------|
| 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<br>mp |
|-------|-----------|
| KL202 | 109       |

### 11.3.7 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 gear units

| Type | ∅b              | b3 | b4 | b8 | B2 | ∅d              | ∅e | f | h  | H   | i2 | l  | l1 | m1 | s2 | s3 | s4 | t    | t3 | t4 | u       |
|------|-----------------|----|----|----|----|-----------------|----|---|----|-----|----|----|----|----|----|----|----|------|----|----|---------|
| KL2  | 75 <sub>6</sub> | 35 | 70 | 65 | 92 | 20 <sub>6</sub> | 90 | 3 | 55 | 108 | 47 | 40 | 3  | 55 | M6 | M6 | M6 | 22.5 | 13 | 13 | A6×6×32 |

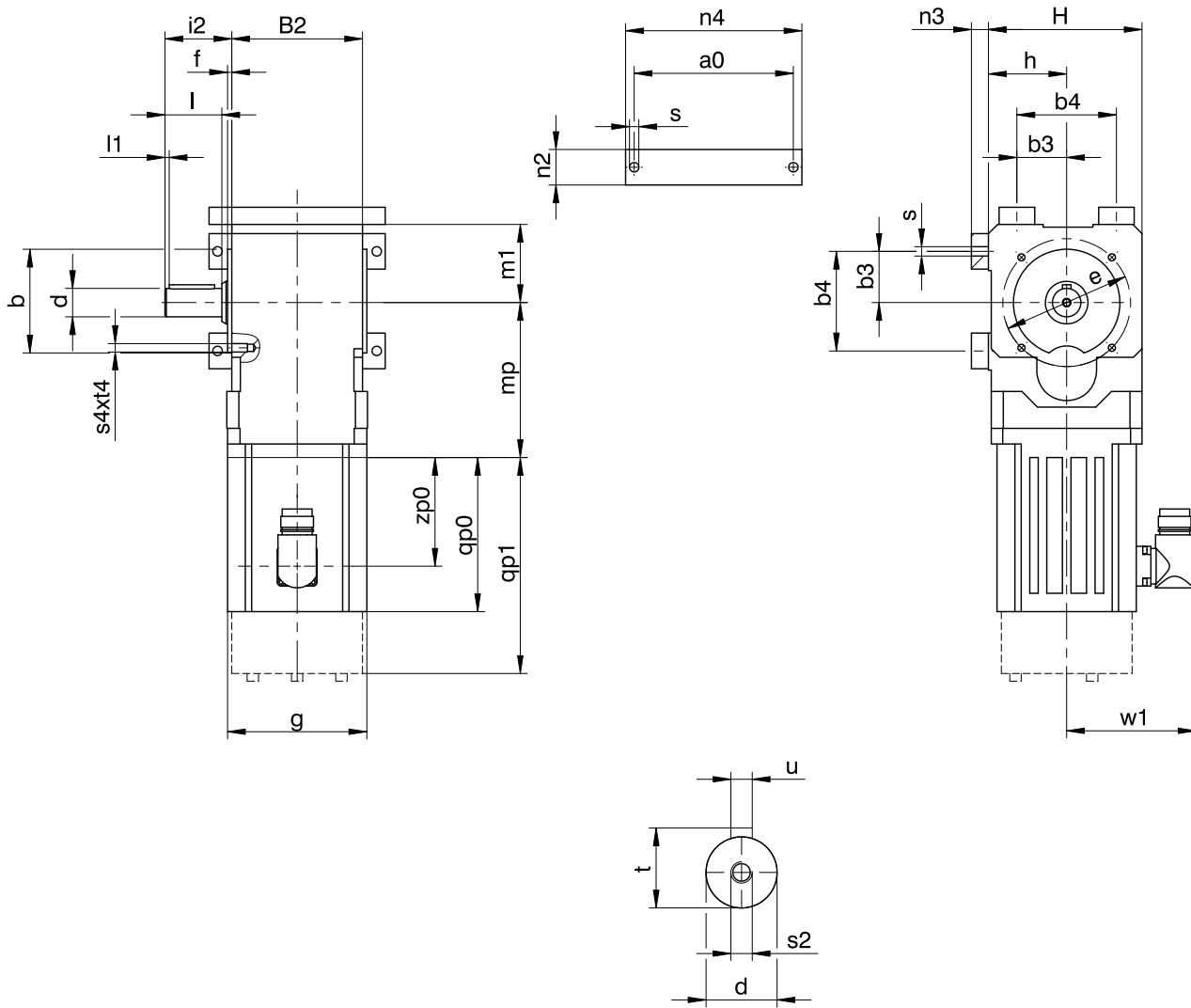
#### Dimensions of motors

| 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 |

### 11.3.8 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 gear units

| Type | a0  | Øb               | b3 | b4 | B2 | Ød               | Øe | f | h  | H   | i2 | l  | l1 | m1 | n2 | n3 | n4  | Øs  | s2 | s4 | t    | t4 | u       |
|------|-----|------------------|----|----|----|------------------|----|---|----|-----|----|----|----|----|----|----|-----|-----|----|----|------|----|---------|
| KL2  | 112 | 75 <sub>js</sub> | 35 | 70 | 92 | 20 <sub>kg</sub> | 90 | 3 | 55 | 108 | 47 | 40 | 3  | 55 | 25 | 12 | 124 | 6.6 | M6 | M6 | 22.5 | 13 | A6×6×32 |

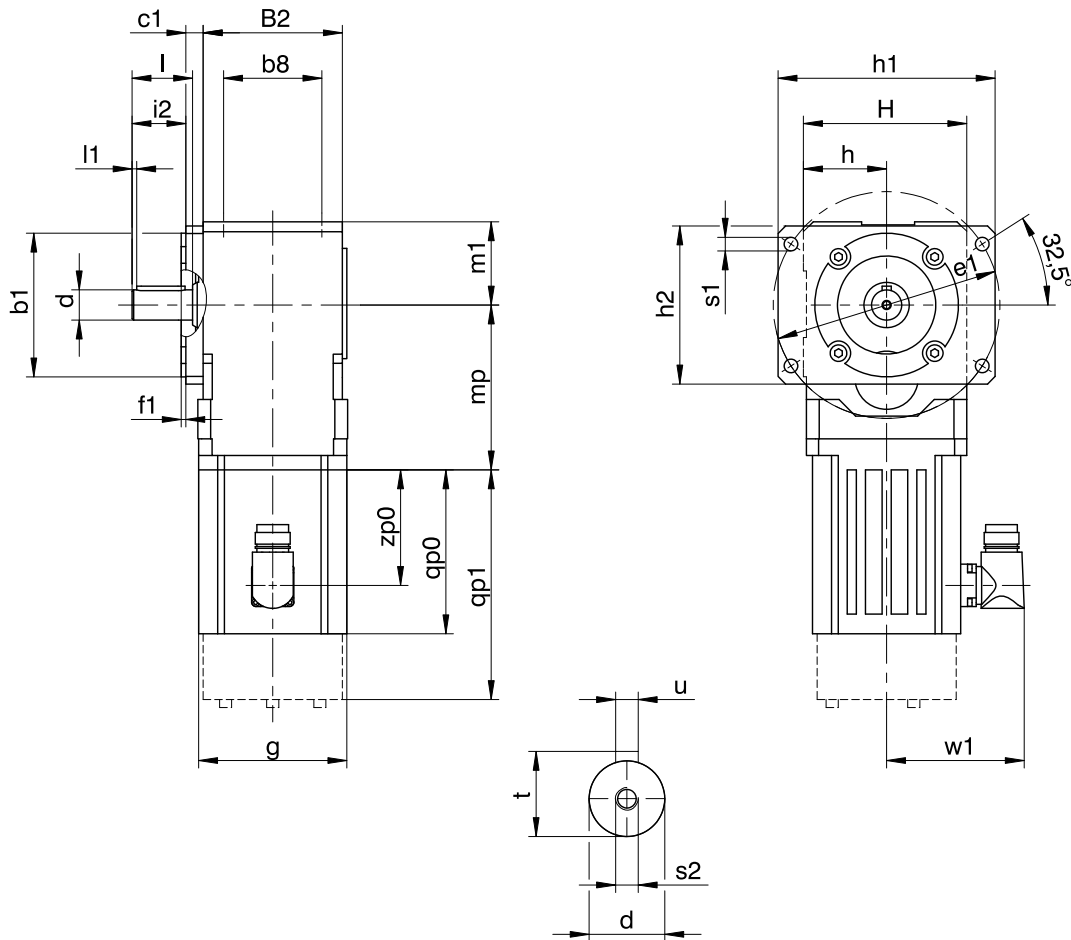
#### Dimensions of motors

| 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 |

### 11.3.9 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 gear units

| Type | ∅b1              | b8 | B2 | c1   | ∅d               | ∅e1 | f1 | h  | h1    | h2    | H   | i2   | l  | l1 | m1 | ∅s1 | s2 | t    | u       |
|------|------------------|----|----|------|------------------|-----|----|----|-------|-------|-----|------|----|----|----|-----|----|------|---------|
| KL2  | 95 <sub>f6</sub> | 65 | 92 | 11.5 | 20 <sub>k6</sub> | 150 | 3  | 55 | 143.5 | 104.5 | 108 | 35.5 | 40 | 3  | 55 | 9   | M6 | 22.5 | A6×6×32 |

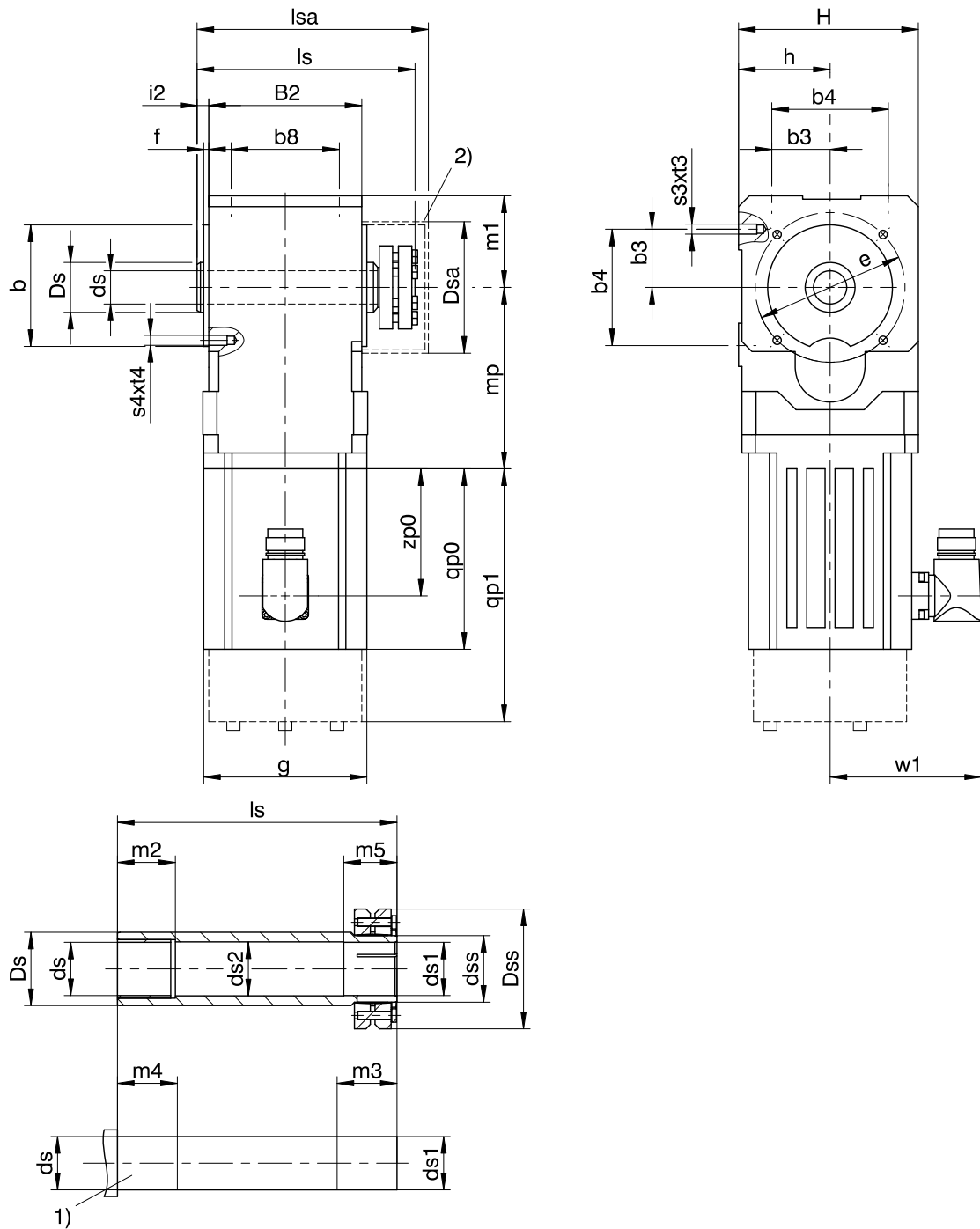
#### Dimensions of motors

| 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 |

### 11.3.10 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 gear units

| 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 <sub>p</sub> | 35 | 70 | 65 | 92 | 20 <sup>H7</sup> | 20 <sub>h6</sub> <sup>H7</sup> | 21.5 | 24   | 30  | 79   | 50   | 90 | 3 | 55 | 108 | 7  | 131 | 139 | 55 | 22 | 27 | 31 | 26 | M6 | M6 | 13 | 13 |

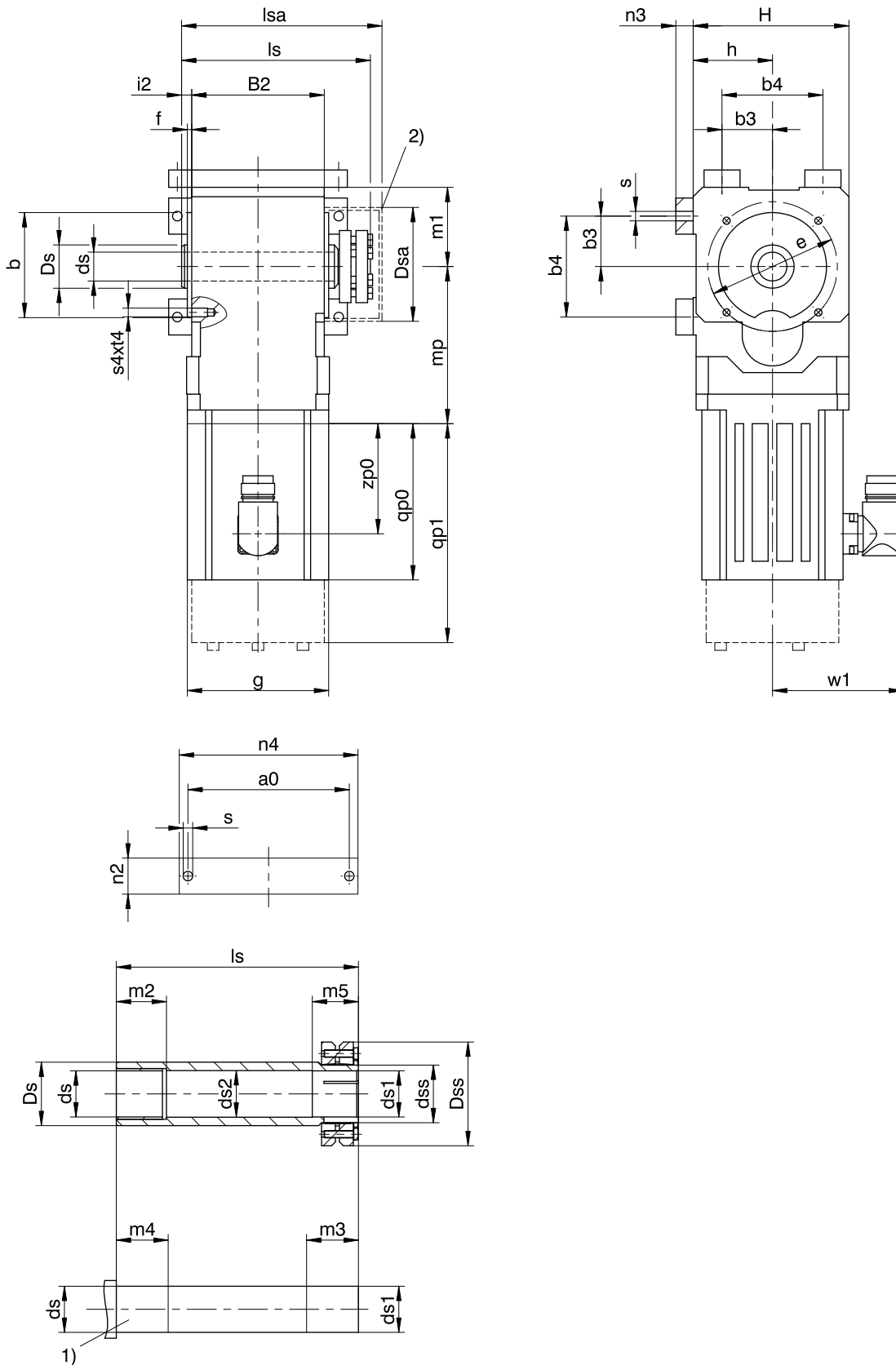
#### Dimensions of motors

| 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<br>mp |
|-------|-----------|
| KL202 | 109       |

### 11.3.11 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  $l_s$  must meet or exceed the specified value.

2) Cover (optional)



Dimensions of gear units

| Type | a0  | Øb              | b3 | b4 | B2 | Øds              | Øds1                           | Øds2 | Ødss | ØDs | ØDsa | ØDss | Øe | f | h  | H   | i2 | ls  | lsa | m1 | m2 | m3 | m4 | m5 | n2 | n3 | n4  | Øs  | s4 | t4 |
|------|-----|-----------------|----|----|----|------------------|--------------------------------|------|------|-----|------|------|----|---|----|-----|----|-----|-----|----|----|----|----|----|----|----|-----|-----|----|----|
| KL2  | 112 | 75 <sub>p</sub> | 35 | 70 | 92 | 20 <sup>H7</sup> | 20 <sub>h6</sub> <sup>H7</sup> | 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 |

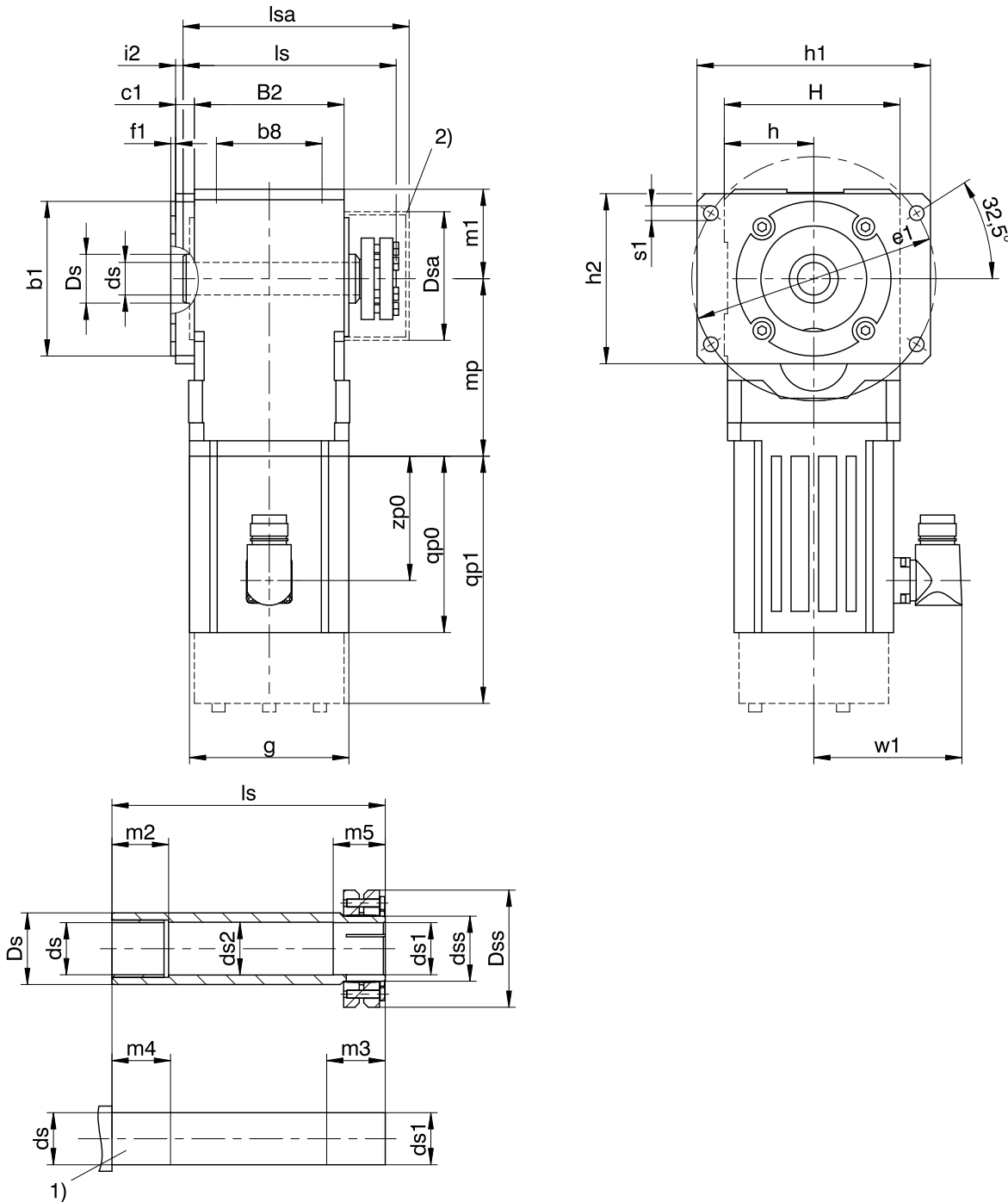
Dimensions of motors

| 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<br>mp |
|-------|-----------|
| KL202 | 109       |

### 11.3.12 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  $l_s$  must meet or exceed the specified value.

2) Cover (optional)

#### Dimensions of gear units

| Type | $\varnothing b_1$ | b8 | B2 | c1   | $\varnothing ds$ | $\varnothing ds_1$             | $\varnothing ds_2$ | $\varnothing ds_s$ | $\varnothing D_s$ | $\varnothing D_{sa}$ | $\varnothing D_{ss}$ | $\varnothing e_1$ | f1 | h  | h1    | h2    | H   | i2  | ls  | lsa | m1 | m2 | m3 | m4 | m5 | $\varnothing s_1$ |
|------|-------------------|----|----|------|------------------|--------------------------------|--------------------|--------------------|-------------------|----------------------|----------------------|-------------------|----|----|-------|-------|-----|-----|-----|-----|----|----|----|----|----|-------------------|
| KL2  | 95 <sub>j6</sub>  | 65 | 92 | 11.5 | 20 <sup>H7</sup> | 20 <sub>j6</sub> <sup>H7</sup> | 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   | $\square g$ | 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<br>mp |
|-------|-----------|
| KL202 | 109       |

## 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.

### Sample code

|    |   |   |   |   |   |      |        |
|----|---|---|---|---|---|------|--------|
| KL | 2 | 0 | 2 | P | G | 0080 | LM401U |
|----|---|---|---|---|---|------|--------|

### Explanation

| Code   | Designation                 | Design                          |
|--------|-----------------------------|---------------------------------|
| KL     | Type                        | Helical bevel gear unit         |
| 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    |
| 0080   | Transmission ratio (i x 10) | i = 8 (example)                 |
| LM401U | Motor                       | LM Lean motor                   |

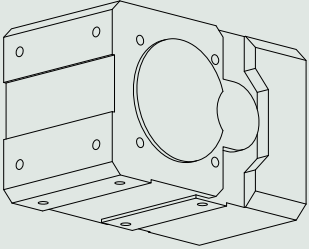
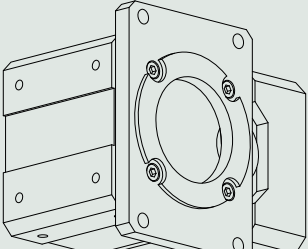
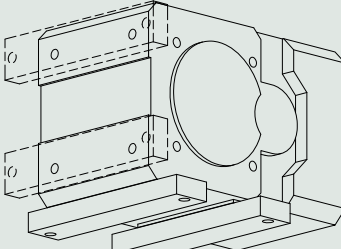
### In order to complete the type designation, also specify:

- A detailed type designation of the motor, see the chapter [\[ 2 \]](#)
- Attachment of solid shaft: gear unit 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 gear unit side 3 or 4
- Attachment of baseboards: gear unit side 1 or 5
- Attachment of flange: gear unit side 3 or 4
- Pitch circle diameter: gear unit side 3 or 4
- The position of the plug connector, see the chapter [\[ 11.5.6 \]](#)

An explanation of the gear unit sides can be found in the chapter [\[ 11.5.4 \]](#).

## 11.5 Product description

### 11.5.1 Housing design

|     | Pitch circle diameter G   | Flange F  | Foot + pitch circle diameter NG   |
|-----|---|---|---|
|     |  |  |  |
|     | <b>G</b>  | <b>F</b>  | <b>NG</b>   |
| KL1 | ✓   | ✓   | ✓   |
| KL2 | ✓   | ✓   | ✓   |

## 11.5.2 Combinatorial shaft/housing design

| Shaft design                    | Housing design |    |    |     |
|---------------------------------|----------------|----|----|-----|
|                                 | Code           | G  | F  | NG  |
| Hollow shaft with keyway        | A              | AG | AF | ANG |
| Hollow shaft with shrink ring   | S              | SG | SF | SNG |
| Solid shaft without feather key | G              | GG | GF | GNG |
| Solid shaft with feather key    | P              | PG | PF | PNG |

## 11.5.3 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 gear unit hollow shaft when attaching the gear unit.

Maximum deviation  $\leq 0.03$  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  $p \geq 325$  N/mm<sup>2</sup>.

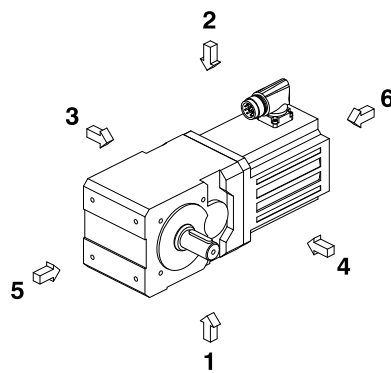
Possible materials:

- C45E +QT
- 42CrMo4

### Fastening the gear units on the machine side using the pitch circle diameter

The specified torques and forces only apply when fastening gear units at the machine side using screws of quality 10.9. In addition, the gear unit housings must be adjusted at the pilot. The machine-side fit must be H7.

## 11.5.4 Gear unit sides



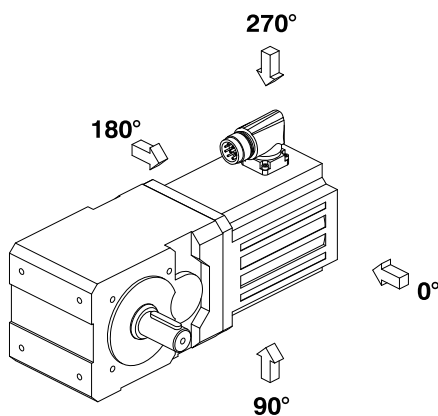
The numbers identify the gear unit sides.

## 11.5.5 Lubricants

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

Lubricant filling quantities for gear units, document ID 441871, can be found online at <http://www.stober.de/en/download>. Enter the ID of the documentation in the Search... field.

### 11.5.6 Position of the plug connector



In the standard version, the plug connector is attached in the 270° position.

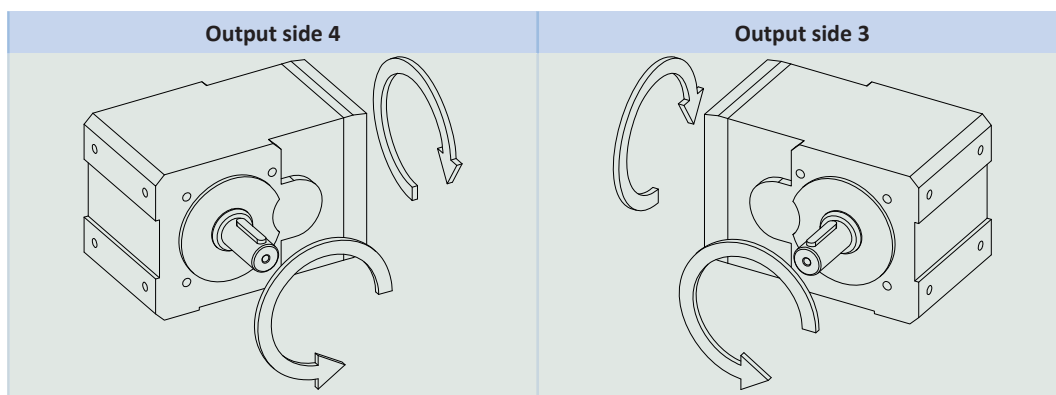
Indicate variations for your geared motor in the purchase order.

### 11.5.7 Other product features

| Feature  | Value                 |
|--|-----------------------|
| Max. permitted gear unit temperature (on the surface of the gear unit) | ≤ 80 °C               |
| Paint  | Black RAL 9005        |
| (ATEX) Directive 2014/34/EU (option)                                   | Not suitable          |
| <b>Protection class:<sup>1</sup></b>                                   |                       |
| Gear unit  | IP65                  |
| Motor  | IP56, optionally IP66 |

### 11.5.8 Direction of rotation

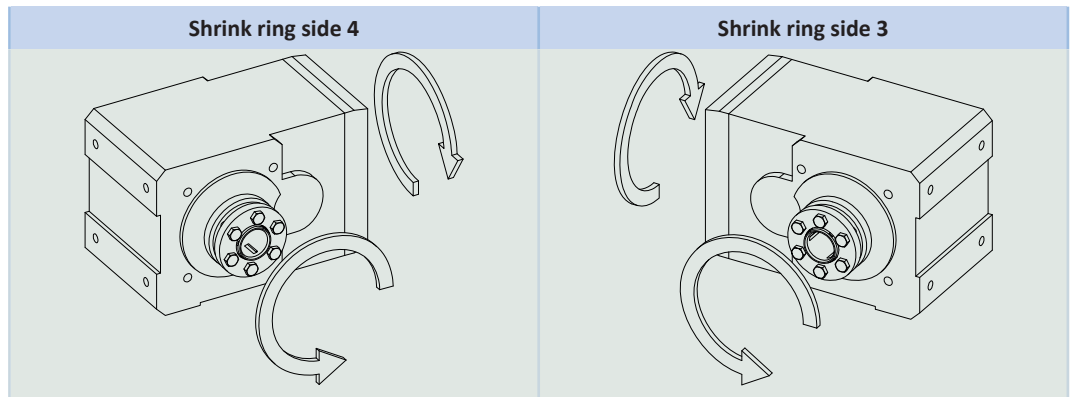
Solid shaft (P and G), solid shaft on both sides (P and G), hollow shaft with keyway (A)



The specified directions of rotation also apply to gear units with hollow shaft (A) if the insertion side of the machine shaft corresponds to the side of the solid shaft that is shown.

The pictures show mounting position EL1.

## Hollow shaft with shrink ring (S)



The pictures show mounting position EL1.

## 11.6 Project configuration

Project your drives using our SERVOnsoft designing software. You can receive SERVOnsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

### 11.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point  $M_{2N}$  specified in the selection tables.

$$n_{1m^*} \leq \frac{n_{1\max DB}}{fB_T}$$

$$n_{1\max^*} \leq \frac{n_{1\max ZB}}{fB_T}$$

$$M_{2\text{eff}^*} \leq M_{2\text{th}}$$

$$M_{2\text{acc}^*} \leq M_{2\text{acc}}$$

$$M_{2\text{NOT}^*} \leq M_{2\text{NOT}}$$

$$M_{2\text{eq}^*} \leq M_{2N} \cdot \frac{S}{fB_{\text{op}} \cdot fB_t}$$

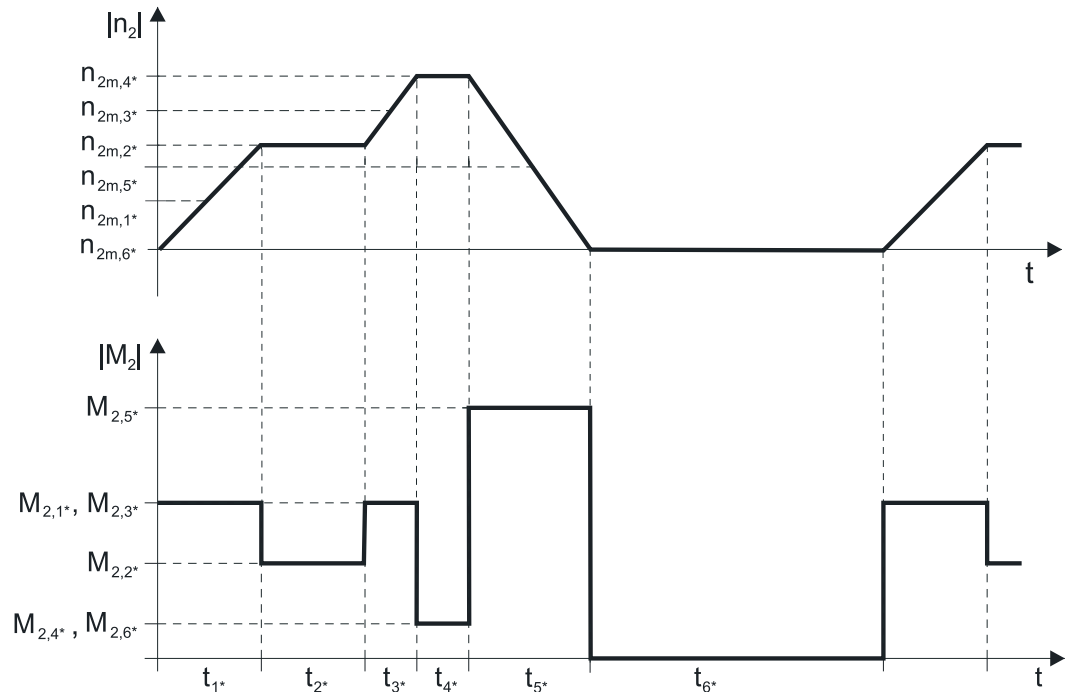
The values for  $n_{1\max DB}$ ,  $n_{1\max ZB}$ ,  $M_{2\text{acc}}$ ,  $M_{2\text{NOT}}$ ,  $M_{2N}$  and  $S$  can be found in the selection tables.

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

Calculate the thermal limit torque  $M_{2\text{th}}$  for a duty cycle > 50%.

**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 average input speed**

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

$$n_{2m}^* = \frac{|n_{2m,1}^*| \cdot t_1^* + \dots + |n_{2m,n}^*| \cdot t_n^*}{t_1^* + \dots + t_n^*}$$

If  $t_1^* + \dots + t_5^* \geq 10$  min, calculate  $n_{2m}^*$  without the rest phase  $t_6^*$ .

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

**Calculation of the actual effective torque**

$$M_{2eff}^* = \sqrt{\frac{t_1^* \cdot M_{2,1}^{*2} + \dots + t_n^* \cdot M_{2,n}^{*2}}{t_1^* + \dots + t_n^*}}$$

**Calculation of the actual equivalent torque**

$$M_{2eq}^* = \sqrt[3]{\frac{|n_{2m,1}^*| \cdot t_1^* \cdot |M_{2,1}^*|^3 + \dots + |n_{2m,n}^*| \cdot t_n^* \cdot |M_{2,n}^*|^3}{|n_{2m,1}^*| \cdot t_1^* + \dots + |n_{2m,n}^*| \cdot t_n^*}}$$

**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.)

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

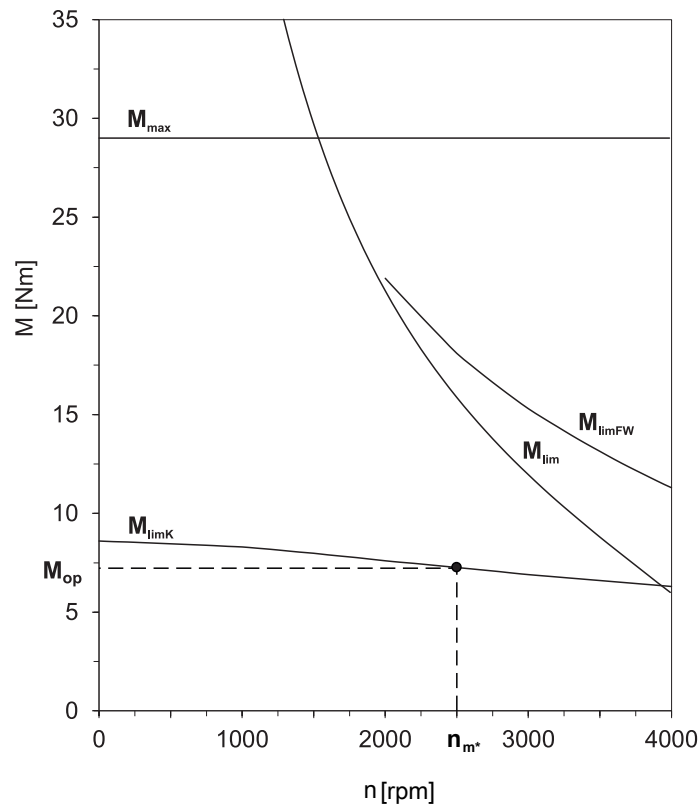
$$K_{mot,th} = 0,9 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left( \frac{n_{1m}^*}{1000} \right)^2$$

The values for  $i$  and  $a_{th}$  can be found in the selection tables.

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 curve of Chapter [▶ 2.3](#). Note the size and nominal speed  $n_N$  of the motor. The figure below shows an example of reading the torque  $M_{op}$  of a motor with convection cooling at the operating point.





| Operating mode                  |                         | $fB_{op}$ |
|---------------------------------|-------------------------|-----------|
| Uniform continuous operation    |                         | 1.00      |
| Cyclic operation                |                         | 1.25      |
| Reversing load cyclic operation |                         | 1.40      |
| Run time                        |                         | $fB_t$    |
| Daily run time $\leq 8$ h       |                         | 1.00      |
| Daily run time $\leq 16$ h      |                         | 1.15      |
| Daily run time $\leq 24$ h      |                         | 1.20      |
| Temperature                     |                         | $fB_T$    |
| Motor cooling                   | Surrounding temperature |           |
| Motor with convection cooling   | $\leq 20$ °C            | 1.0       |
|                                 | $\leq 30$ °C            | 1.1       |
|                                 | $\leq 40$ °C            | 1.25      |

**Notes**

- The maximum permitted gear unit 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 gear unit 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 gear unit are stabilized by its pilots (housing, flange shaft)

### 11.6.2.1 G and P shaft designs

Permitted shaft loads for G and P shaft designs (solid shaft)

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $M_{2k100}$<br>[Nm] |
|------|---------------|---------------------|----------------------|---------------------|
| KL1  | 20.0          | 380                 | 1900                 | 68                  |
| KL2  | 22.0          | 560                 | 2800                 | 118                 |

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

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

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

$$F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

$$M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m^*}}{100 \text{ rpm}}}}$$

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

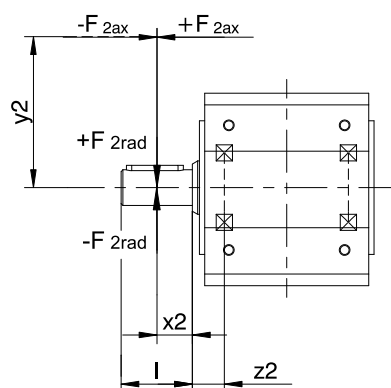


Fig. 1: Force application points for solid shaft

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:

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

$$F_{2rad^*} \leq F_{2radN}$$

$$F_{2ax^*} \leq F_{2axN}$$

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.

### 11.6.2.2 A and S shaft design

Permitted shaft loads for A shaft design (hollow shaft with keyway)

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $M_{2k100}$<br>[Nm] |
|------|---------------|---------------------|----------------------|---------------------|
| KL1  | 18.5          | 250                 | 1250                 | 43                  |
| KL2  | 22.0          | 560                 | 2800                 | 118                 |

Permitted shaft loads for S shaft design (hollow shaft with shrink ring)

| Type | $z_2$<br>[mm] | $F_{2ax100}$<br>[N] | $F_{2rad100}$<br>[N] | $M_{2k100}$<br>[Nm] |
|------|---------------|---------------------|----------------------|---------------------|
| KL1  | 18.5          | 250                 | 1250                 | 43                  |
| KL2  | 22.0          | 560                 | 2800                 | 118                 |

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

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

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

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

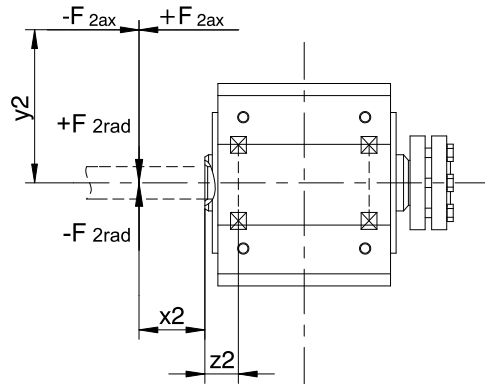


Fig. 2: Force application points for hollow shaft

You can determine the permitted radial forces from the permitted breakdown torque  $M_{2kN}$ . The actual radial forces may not exceed the permitted radial forces. The permitted radial forces are in relation to the end of the hollow shaft ( $x_2 = 0$ ).

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

$$F_{2ax^*} \leq F_{2axN}$$

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.

### 11.6.3 Radial shaft seal rings

#### Leak-proofness

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

## 11.7 Additional documentation

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

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

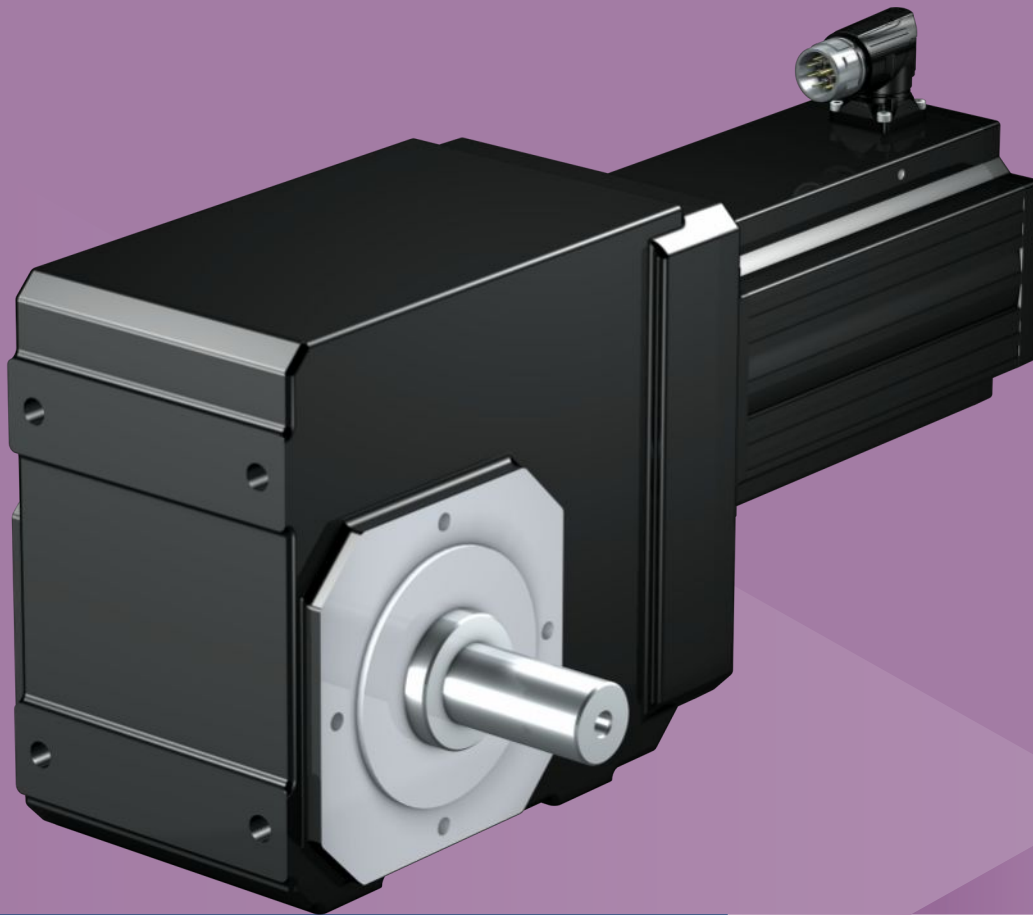
| Documentation  | ID        |
|--|-----------|
| Operating manual for KL/KS/PHK/PHKX/PHQK/PK/PKX right-angle gear units and right-angle geared motors | 443004_en |
| Lubricant filling quantities for gear units  | 441871    |



# 12 K helical bevel geared motors

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# 12

## Helical bevel geared motors

# K

### 12.1 Overview

Highly rigid helical-gear 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 – 6821 Nm    |
| $\Delta\phi_2$ | 1.5 – 12 arcmin |
| $\eta_{get}$   | ≤ 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
- Weight specification for mounting position EL1, housing design G

For all other technical data, refer to <http://configurator.stoeber.de>.

An explanation of the formula symbols can be found in the Chapter [▶ 14.1](#).

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$   | $n_{1maxDB}$       | $n_{1maxZB}$ | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|----------------|--------------------|--------------|---|----------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | EL1,2<br>[rpm] | EL3,4,5,6<br>[rpm] | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>K1 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 140</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                |                    |              |   |                |                 |      |
| 64   | 102      | 111       | 13       | 0.99 | K102_0470 LM401U | 120        | 200        | 46.92 | 2299/49     | 4000           | 4000               | 6000         | 1.7                                     | 12/6           | 6.8             | 14   |
| 85   | 77       | 83        | 11       | 1.4  | K102_0350 LM401U | 140        | 190        | 35.11 | 3686/105    | 4000           | 4000               | 6000         | 1.7                                     | 12/6           | 6.8             | 14   |
| 89   | 74       | 79        | 16       | 0.99 | K102_0340 LM401U | 88         | 150        | 33.71 | 4719/140    | 4000           | 4000               | 6000         | 1.7                                     | 12/6           | 6.8             | 14   |
| 107  | 61       | 66        | 11       | 1.6  | K102_0280 LM401U | 120        | 170        | 28.05 | 589/21      | 4000           | 4000               | 6000         | 1.7                                     | 12/6           | 6.8             | 14   |
| 107  | 120      | 122       | 22       | 0.83 | K102_0280 LM402U | 140        | 240        | 28.05 | 589/21      | 4000           | 4000               | 6000         | 3.1                                     | 12/6           | 6.8             | 16   |
| 119  | 55       | 59        | 12       | 1.7  | K102_0250 LM401U | 110        | 140        | 25.22 | 1261/50     | 4000           | 4000               | 6000         | 1.7                                     | 12/6           | 6.8             | 14   |
| 119  | 108      | 110       | 23       | 0.89 | K102_0250 LM402U | 120        | 190        | 25.22 | 1261/50     | 4000           | 4000               | 6000         | 3.1                                     | 12/6           | 6.8             | 16   |
| 129  | 51       | 55        | 12       | 1.8  | K102_0230 LM401U | 100        | 160        | 23.27 | 1140/49     | 4000           | 4000               | 6000         | 1.8                                     | 12/6           | 6.8             | 14   |
| 129  | 100      | 102       | 23       | 0.93 | K102_0230 LM402U | 140        | 240        | 23.27 | 1140/49     | 4000           | 4000               | 6000         | 3.1                                     | 12/6           | 6.8             | 16   |
| 149  | 44       | 47        | 12       | 2.0  | K102_0200 LM401U | 88         | 120        | 20.15 | 403/20      | 4000           | 4000               | 6000         | 1.7                                     | 12/6           | 6.8             | 14   |
| 149  | 86       | 88        | 23       | 1.0  | K102_0200 LM402U | 130        | 220        | 20.15 | 403/20      | 4000           | 4000               | 6000         | 3.1                                     | 12/6           | 6.8             | 16   |
| 171  | 38       | 41        | 12       | 2.2  | K102_0175 LM401U | 77         | 130        | 17.56 | 2090/119    | 4000           | 3800               | 5500         | 1.8                                     | 12/6           | 6.8             | 14   |
| 171  | 75       | 77        | 23       | 1.1  | K102_0175 LM402U | 140        | 240        | 17.56 | 2090/119    | 4000           | 3800               | 5500         | 3.1                                     | 12/6           | 6.8             | 16   |
| 171  | 103      | 105       | 32       | 0.82 | K102_0175 LM403U | 140        | 240        | 17.56 | 2090/119    | 4000           | 3800               | 5500         | 4.4                                     | 12/6           | 6.8             | 17   |
| 179  | 36       | 39        | 12       | 2.3  | K102_0165 LM401U | 73         | 110        | 16.71 | 117/7       | 4000           | 4000               | 6000         | 1.8                                     | 12/6           | 6.8             | 14   |
| 179  | 71       | 73        | 23       | 1.2  | K102_0165 LM402U | 130        | 220        | 16.71 | 117/7       | 4000           | 4000               | 6000         | 3.1                                     | 12/6           | 6.8             | 16   |
| 179  | 98       | 100       | 32       | 0.85 | K102_0165 LM403U | 130        | 220        | 16.71 | 117/7       | 4000           | 4000               | 6000         | 4.4                                     | 12/6           | 6.8             | 17   |
| 213  | 31       | 33        | 12       | 2.6  | K102_0140 LM401U | 62         | 100        | 14.11 | 494/35      | 4000           | 3800               | 5500         | 1.9                                     | 12/6           | 6.8             | 14   |
| 213  | 60       | 62        | 24       | 1.3  | K102_0140 LM402U | 130        | 240        | 14.11 | 494/35      | 4000           | 3800               | 5500         | 3.2                                     | 12/6           | 6.8             | 16   |
| 213  | 83       | 85        | 33       | 0.95 | K102_0140 LM403U | 140        | 240        | 14.11 | 494/35      | 4000           | 3800               | 5500         | 4.5                                     | 12/6           | 6.8             | 17   |
| 238  | 28       | 30        | 12       | 2.7  | K102_0125 LM401U | 55         | 92         | 12.62 | 429/34      | 4000           | 3800               | 5500         | 1.8                                     | 12/6           | 6.8             | 14   |
| 238  | 54       | 55        | 24       | 1.4  | K102_0125 LM402U | 120        | 220        | 12.62 | 429/34      | 4000           | 3800               | 5500         | 3.2                                     | 12/6           | 6.8             | 16   |
| 238  | 74       | 76        | 33       | 1.0  | K102_0125 LM403U | 130        | 220        | 12.62 | 429/34      | 4000           | 3800               | 5500         | 4.5                                     | 12/6           | 6.8             | 17   |
| 259  | 25       | 27        | 12       | 2.7  | K102_0115 LM401U | 51         | 84         | 11.57 | 266/23      | 3600           | 3300               | 5000         | 1.9                                     | 12/6           | 6.8             | 14   |
| 259  | 49       | 50        | 24       | 1.5  | K102_0115 LM402U | 110        | 240        | 11.57 | 266/23      | 3600           | 3300               | 5000         | 3.3                                     | 12/6           | 6.8             | 16   |
| 259  | 68       | 69        | 33       | 1.1  | K102_0115 LM403U | 140        | 240        | 11.57 | 266/23      | 3600           | 3300               | 5000         | 4.5                                     | 12/6           | 6.8             | 17   |
| 296  | 22       | 24        | 12       | 2.7  | K102_0100 LM401U | 44         | 74         | 10.14 | 507/50      | 4000           | 3800               | 5500         | 1.9                                     | 12/6           | 6.8             | 14   |
| 296  | 43       | 44        | 24       | 1.6  | K102_0100 LM402U | 95         | 220        | 10.14 | 507/50      | 4000           | 3800               | 5500         | 3.2                                     | 12/6           | 6.8             | 16   |
| 296  | 60       | 61        | 33       | 1.2  | K102_0100 LM403U | 130        | 220        | 10.14 | 507/50      | 4000           | 3800               | 5500         | 4.5                                     | 12/6           | 6.8             | 17   |
| 324  | 20       | 22        | 13       | 2.7  | K102_0092 LM401U | 40         | 67         | 9.249 | 1748/189    | 3600           | 3300               | 5000         | 2.0                                     | 12/6           | 6.8             | 14   |
| 324  | 40       | 40        | 25       | 1.7  | K102_0092 LM402U | 87         | 240        | 9.249 | 1748/189    | 3600           | 3300               | 5000         | 3.3                                     | 12/6           | 6.8             | 16   |
| 324  | 54       | 56        | 34       | 1.3  | K102_0092 LM403U | 120        | 240        | 9.249 | 1748/189    | 3600           | 3300               | 5000         | 4.6                                     | 12/6           | 6.8             | 17   |
| 324  | 85       | 90        | 53       | 0.80 | K102_0092 LM503U | 130        | 240        | 9.249 | 1748/189    | 3600           | 3300               | 5000         | 11                                      | 12/6           | 6.8             | 20   |
| 361  | 18       | 20        | 13       | 2.7  | K102_0083 LM401U | 36         | 60         | 8.309 | 1911/230    | 3600           | 3300               | 5000         | 2.0                                     | 12/6           | 6.8             | 14   |
| 361  | 36       | 36        | 25       | 1.9  | K102_0083 LM402U | 78         | 220        | 8.309 | 1911/230    | 3600           | 3300               | 5000         | 3.3                                     | 12/6           | 6.8             | 16   |
| 361  | 49       | 50        | 34       | 1.4  | K102_0083 LM403U | 100        | 220        | 8.309 | 1911/230    | 3600           | 3300               | 5000         | 4.6                                     | 12/6           | 6.8             | 17   |
| 361  | 76       | 81        | 53       | 0.86 | K102_0083 LM503U | 120        | 220        | 8.309 | 1911/230    | 3600           | 3300               | 5000         | 11                                      | 12/6           | 6.8             | 20   |
| 452  | 15       | 16        | 13       | 2.7  | K102_0066 LM401U | 29         | 48         | 6.644 | 299/45      | 3600           | 3300               | 5000         | 2.1                                     | 12/6           | 6.8             | 14   |
| 452  | 28       | 29        | 25       | 2.2  | K102_0066 LM402U | 63         | 190        | 6.644 | 299/45      | 3600           | 3300               | 5000         | 3.4                                     | 12/6           | 6.8             | 16   |
| 452  | 39       | 40        | 35       | 1.6  | K102_0066 LM403U | 83         | 190        | 6.644 | 299/45      | 3600           | 3300               | 5000         | 4.7                                     | 12/6           | 6.8             | 17   |
| 452  | 61       | 65        | 54       | 1.0  | K102_0066 LM503U | 120        | 190        | 6.644 | 299/45      | 3600           | 3300               | 5000         | 11                                      | 12/6           | 6.8             | 20   |
| 500  | 26       | 26        | 25       | 2.3  | K102_0060 LM402U | 56         | 170        | 6.000 | 6/1         | 3300           | 2800               | 4500         | 3.5                                     | 12/6           | 6.8             | 16   |
| 500  | 35       | 36        | 35       | 1.7  | K102_0060 LM403U | 75         | 170        | 6.000 | 6/1         | 3300           | 2800               | 4500         | 4.8                                     | 12/6           | 6.8             | 17   |
| 500  | 55       | 59        | 55       | 1.1  | K102_0060 LM503U | 110        | 170        | 6.000 | 6/1         | 3300           | 2800               | 4500         | 11                                      | 12/6           | 6.8             | 20   |
| 539  | 12       | 13        | 13       | 2.7  | K102_0056 LM401U | 24         | 41         | 5.568 | 1520/273    | 3300           | 2800               | 4500         | 2.3                                     | 12/6           | 6.8             | 14   |
| 539  | 24       | 24        | 26       | 2.4  | K102_0056 LM402U | 52         | 160        | 5.568 | 1520/273    | 3300           | 2800               | 4500         | 3.7                                     | 12/6           | 6.8             | 16   |
| 539  | 33       | 33        | 35       | 1.8  | K102_0056 LM403U | 69         | 160        | 5.568 | 1520/273    | 3300           | 2800               | 4500         | 5.0                                     | 12/6           | 6.8             | 17   |
| 539  | 51       | 54        | 55       | 1.1  | K102_0056 LM503U | 110        | 160        | 5.568 | 1520/273    | 3300           | 2800               | 4500         | 11                                      | 12/6           | 6.8             | 20   |
| 750  | 8.7      | 9.4       | 13       | 2.7  | K102_0040 LM401U | 17         | 29         | 4.000 | 4/1         | 3300           | 2800               | 4500         | 2.5                                     | 12/6           | 6.8             | 14   |
| 750  | 17       | 17        | 26       | 3.0  | K102_0040 LM402U | 38         | 120        | 4.000 | 4/1         | 3300           | 2800               | 4500         | 3.9                                     | 12/6           | 6.8             | 16   |
| 750  | 24       | 24        | 36       | 2.2  | K102_0040 LM403U | 50         | 120        | 4.000 | 4/1         | 3300           | 2800               | 4500         | 5.2                                     | 12/6           | 6.8             | 17   |

12.2 Selection tables 12 K helical bevel geared motors

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$   | $n_{1maxDB}$       | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|----------------|--------------------|--------------|---|-------------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | EL1,2<br>[rpm] | EL3,4,5,6<br>[rpm] | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>K1 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 140</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                |                    |              |   |                   |                 |      |
| 750  | 37       | 39        | 57       | 1.4  | K102_0040 LM503U | 79         | 120        | 4.000 | 4/1         | 3300           | 2800               | 4500         | 11                                      | 12/6              | 6.8             | 20   |
| 750  | 53       | 60        | 82       | 0.97 | K102_0040 LM505U | 93         | 120        | 4.000 | 4/1         | 3300           | 2800               | 4500         | 18                                      | 12/6              | 6.8             | 25   |
| <b>K2 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 220</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                |                    |              |   |                   |                 |      |
| 33   | 195      | 211       | 8.3      | 1.0  | K203_0910 LM401U | 220        | 390        | 90.79 | 46483/512   | 4000           | 3900               | 5500         | 1.7                                     | 10/6/2.5          | 11              | 25   |
| 38   | 171      | 185       | 8.0      | 1.2  | K203_0800 LM401U | 220        | 390        | 79.62 | 26273/330   | 4000           | 3900               | 5500         | 1.7                                     | 10/6/2.5          | 11              | 25   |
| 44   | 147      | 159       | 7.7      | 1.4  | K203_0680 LM401U | 220        | 390        | 68.42 | 26273/384   | 4000           | 3900               | 5500         | 1.7                                     | 10/6/2.5          | 11              | 25   |
| 45   | 142      | 153       | 7.7      | 1.4  | K203_0660 LM401U | 220        | 390        | 66.03 | 46483/704   | 4000           | 3900               | 5500         | 1.7                                     | 10/6/2.5          | 11              | 25   |
| 54   | 121      | 131       | 9.4      | 1.3  | K202_0560 LM401U | 190        | 280        | 55.54 | 1333/24     | 4000           | 3900               | 5500         | 1.7                                     | 10/5/1.5          | 11              | 22   |
| 55   | 117      | 126       | 7.3      | 1.7  | K203_0540 LM401U | 220        | 350        | 54.25 | 135407/2496 | 4000           | 3900               | 5500         | 1.8                                     | 10/6/2.5          | 11              | 25   |
| 60   | 107      | 116       | 7.1      | 1.9  | K203_0500 LM401U | 210        | 320        | 49.76 | 26273/528   | 4000           | 3900               | 5500         | 1.7                                     | 10/6/2.5          | 11              | 25   |
| 60   | 210      | 214       | 14       | 0.95 | K203_0500 LM402U | 220        | 320        | 49.76 | 26273/528   | 4000           | 3900               | 5500         | 3.1                                     | 10/6/2.5          | 11              | 26   |
| 65   | 101      | 109       | 7.1      | 2.0  | K202_0460 LM401U | 200        | 260        | 46.23 | 1849/40     | 4000           | 3900               | 5500         | 1.7                                     | 10/5/1.5          | 11              | 22   |
| 65   | 198      | 202       | 14       | 1.0  | K202_0460 LM402U | 220        | 400        | 46.23 | 1849/40     | 4000           | 3900               | 5500         | 3.1                                     | 10/5/1.5          | 11              | 23   |
| 66   | 97       | 105       | 7.0      | 2.1  | K203_0450 LM401U | 190        | 290        | 45.22 | 58609/1296  | 4000           | 3900               | 5500         | 1.8                                     | 10/6/2.5          | 11              | 25   |
| 66   | 191      | 195       | 14       | 1.0  | K203_0450 LM402U | 220        | 290        | 45.22 | 58609/1296  | 4000           | 3900               | 5500         | 3.1                                     | 10/6/2.5          | 11              | 26   |
| 74   | 88       | 95        | 12       | 1.3  | K202_0400 LM401U | 140        | 200        | 40.39 | 1333/33     | 4000           | 3900               | 5500         | 1.7                                     | 10/5/1.5          | 11              | 22   |
| 76   | 85       | 92        | 6.8      | 2.3  | K203_0390 LM401U | 170        | 250        | 39.45 | 135407/3432 | 4000           | 3900               | 5500         | 1.8                                     | 10/6/2.5          | 11              | 25   |
| 76   | 166      | 170       | 13       | 1.2  | K203_0390 LM402U | 200        | 250        | 39.45 | 135407/3432 | 4000           | 3900               | 5500         | 3.1                                     | 10/6/2.5          | 11              | 26   |
| 87   | 75       | 81        | 7.0      | 2.3  | K202_0350 LM401U | 150        | 210        | 34.55 | 1935/56     | 4000           | 3900               | 5500         | 1.8                                     | 10/5/1.5          | 11              | 22   |
| 87   | 148      | 151       | 14       | 1.3  | K202_0350 LM402U | 220        | 400        | 34.55 | 1935/56     | 4000           | 3900               | 5500         | 3.1                                     | 10/5/1.5          | 11              | 23   |
| 87   | 203      | 207       | 19       | 0.93 | K202_0350 LM403U | 220        | 400        | 34.55 | 1935/56     | 4000           | 3900               | 5500         | 4.4                                     | 10/5/1.5          | 11              | 25   |
| 89   | 73       | 79        | 8.5      | 2.0  | K202_0340 LM401U | 150        | 190        | 33.62 | 1849/55     | 4000           | 3900               | 5500         | 1.8                                     | 10/5/1.5          | 11              | 22   |
| 89   | 144      | 147       | 17       | 1.1  | K202_0340 LM402U | 180        | 310        | 33.62 | 1849/55     | 4000           | 3900               | 5500         | 3.1                                     | 10/5/1.5          | 11              | 23   |
| 107  | 120      | 122       | 14       | 1.5  | K202_0280 LM402U | 220        | 400        | 27.95 | 559/20      | 4000           | 3900               | 5500         | 3.2                                     | 10/5/1.5          | 11              | 23   |
| 107  | 164      | 168       | 19       | 1.1  | K202_0280 LM403U | 220        | 400        | 27.95 | 559/20      | 4000           | 3900               | 5500         | 4.5                                     | 10/5/1.5          | 11              | 25   |
| 119  | 55       | 59        | 7.2      | 2.3  | K202_0250 LM401U | 110        | 160        | 25.13 | 1935/77     | 4000           | 3900               | 5500         | 1.8                                     | 10/5/1.5          | 11              | 22   |
| 119  | 107      | 110       | 14       | 1.6  | K202_0250 LM402U | 220        | 400        | 25.13 | 1935/77     | 4000           | 3900               | 5500         | 3.1                                     | 10/5/1.5          | 11              | 23   |
| 119  | 148      | 151       | 19       | 1.2  | K202_0250 LM403U | 220        | 400        | 25.13 | 1935/77     | 4000           | 3900               | 5500         | 4.4                                     | 10/5/1.5          | 11              | 25   |
| 129  | 51       | 55        | 7.2      | 2.7  | K202_0230 LM401U | 100        | 170        | 23.18 | 2967/128    | 4000           | 3900               | 5500         | 1.9                                     | 10/5/1.5          | 11              | 22   |
| 129  | 99       | 101       | 14       | 1.7  | K202_0230 LM402U | 220        | 400        | 23.18 | 2967/128    | 4000           | 3900               | 5500         | 3.2                                     | 10/5/1.5          | 11              | 23   |
| 129  | 136      | 139       | 19       | 1.2  | K202_0230 LM403U | 220        | 400        | 23.18 | 2967/128    | 4000           | 3900               | 5500         | 4.5                                     | 10/5/1.5          | 11              | 25   |
| 148  | 87       | 89        | 14       | 1.8  | K202_0200 LM402U | 190        | 400        | 20.33 | 1118/55     | 4000           | 3900               | 5500         | 3.2                                     | 10/5/1.5          | 11              | 23   |
| 148  | 119      | 122       | 20       | 1.3  | K202_0200 LM403U | 220        | 400        | 20.33 | 1118/55     | 4000           | 3900               | 5500         | 4.5                                     | 10/5/1.5          | 11              | 25   |
| 148  | 187      | 199       | 31       | 0.85 | K202_0200 LM503U | 220        | 400        | 20.33 | 1118/55     | 4000           | 3900               | 5500         | 11                                      | 10/5/1.5          | 11              | 28   |
| 172  | 38       | 41        | 7.4      | 2.7  | K202_0175 LM401U | 76         | 130        | 17.47 | 559/32      | 3900           | 3500               | 5000         | 2.0                                     | 10/5/1.5          | 11              | 22   |
| 172  | 75       | 76        | 14       | 2.0  | K202_0175 LM402U | 160        | 400        | 17.47 | 559/32      | 3900           | 3500               | 5000         | 3.4                                     | 10/5/1.5          | 11              | 23   |
| 172  | 103      | 105       | 20       | 1.5  | K202_0175 LM403U | 220        | 400        | 17.47 | 559/32      | 3900           | 3500               | 5000         | 4.7                                     | 10/5/1.5          | 11              | 25   |
| 172  | 161      | 171       | 31       | 0.94 | K202_0175 LM503U | 220        | 400        | 17.47 | 559/32      | 3900           | 3500               | 5000         | 11                                      | 10/5/1.5          | 11              | 28   |
| 178  | 37       | 40        | 7.4      | 2.7  | K202_0170 LM401U | 74         | 120        | 16.86 | 2967/176    | 4000           | 3900               | 5500         | 1.9                                     | 10/5/1.5          | 11              | 22   |
| 178  | 72       | 74        | 15       | 2.1  | K202_0170 LM402U | 160        | 400        | 16.86 | 2967/176    | 4000           | 3900               | 5500         | 3.3                                     | 10/5/1.5          | 11              | 23   |
| 178  | 99       | 101       | 20       | 1.5  | K202_0170 LM403U | 210        | 400        | 16.86 | 2967/176    | 4000           | 3900               | 5500         | 4.6                                     | 10/5/1.5          | 11              | 25   |
| 178  | 155      | 165       | 31       | 0.96 | K202_0170 LM503U | 220        | 400        | 16.86 | 2967/176    | 4000           | 3900               | 5500         | 11                                      | 10/5/1.5          | 11              | 28   |
| 217  | 59       | 60        | 15       | 2.4  | K202_0140 LM402U | 130        | 400        | 13.85 | 2881/208    | 3900           | 3500               | 5000         | 3.5                                     | 10/5/1.5          | 11              | 23   |
| 217  | 81       | 83        | 20       | 1.7  | K202_0140 LM403U | 170        | 400        | 13.85 | 2881/208    | 3900           | 3500               | 5000         | 4.8                                     | 10/5/1.5          | 11              | 25   |
| 217  | 127      | 135       | 32       | 1.1  | K202_0140 LM503U | 220        | 400        | 13.85 | 2881/208    | 3900           | 3500               | 5000         | 11                                      | 10/5/1.5          | 11              | 28   |
| 236  | 28       | 30        | 7.6      | 2.7  | K202_0125 LM401U | 56         | 92         | 12.71 | 559/44      | 3900           | 3500               | 5000         | 2.1                                     | 10/5/1.5          | 11              | 22   |
| 236  | 54       | 55        | 15       | 2.5  | K202_0125 LM402U | 120        | 370        | 12.71 | 559/44      | 3900           | 3500               | 5000         | 3.4                                     | 10/5/1.5          | 11              | 23   |
| 236  | 75       | 76        | 20       | 1.8  | K202_0125 LM403U | 160        | 370        | 12.71 | 559/44      | 3900           | 3500               | 5000         | 4.7                                     | 10/5/1.5          | 11              | 25   |
| 236  | 117      | 124       | 32       | 1.2  | K202_0125 LM503U | 220        | 370        | 12.71 | 559/44      | 3900           | 3500               | 5000         | 11                                      | 10/5/1.5          | 11              | 28   |
| 236  | 169      | 191       | 46       | 0.80 | K202_0125 LM505U | 220        | 370        | 12.71 | 559/44      | 3900           | 3500               | 5000         | 17                                      | 10/5/1.5          | 11              | 32   |
| 260  | 25       | 27        | 7.7      | 2.7  | K202_0115 LM401U | 51         | 84         | 11.55 | 1247/108    | 3500           | 3100               | 4500         | 2.3                                     | 10/5/1.5          | 11              | 22   |
| 260  | 49       | 50        | 15       | 2.7  | K202_0115 LM402U | 110        | 340        | 11.55 | 1247/108    | 3500           | 3100               | 4500         | 3.7                                     | 10/5/1.5          | 11              | 23   |
| 260  | 68       | 69        | 21       | 1.9  | K202_0115 LM403U | 140        | 340        | 11.55 | 1247/108    | 3500           | 3100               | 4500         | 5.0                                     | 10/5/1.5          | 11              | 25   |
| 260  | 106      | 113       | 32       | 1.2  | K202_0115 LM503U | 220        | 340        | 11.55 | 1247/108    | 3500           | 3100               | 4500         | 11                                      | 10/5/1.5          | 11              | 28   |
| 260  | 153      | 173       | 47       | 0.86 | K202_0115 LM505U | 220        | 340        | 11.55 | 1247/108    | 3500           | 3100               | 4500         | 17                                      | 10/5/1.5          | 11              | 32   |
| 298  | 43       | 44        | 15       | 2.9  | K202_0100 LM402U | 95         | 290        | 10.07 | 2881/286    | 3900           | 3500               | 5000         | 3.6                                     | 10/5/1.5          | 11              | 23   |
| 298  | 59       | 60        | 21       | 2.1  | K202_0100 LM403U | 130        | 290        | 10.07 | 2881/286    | 3900           | 3500               | 5000         | 4.9                                     | 10/5/1.5          | 11              | 25   |
| 298  | 93       | 98        | 33       | 1.4  | K202_0100 LM503U | 200        | 290        | 10.07 | 2881/286    | 3900           | 3500               | 5000         | 11                                      | 10/5/1.5          | 11              | 28   |
| 298  | 134      | 151       | 47       | 0.94 | K202_0100 LM505U | 220        | 290        | 10.07 | 2881/286    | 3900           | 3500               | 5000         | 17                                      | 10/5/1.5          | 11              | 32   |
| 326  | 39       | 40        | 15       | 3.1  | K202_0092 LM402U | 86         | 270        | 9.190 | 2279/248    | 3500           | 3100               | 4500         | 3.9                                     | 10/5/1.5          | 11              | 23   |
| 326  | 54       | 55        | 21       | 2.3  | K202_0092 LM403U | 110        | 270        | 9.190 | 2279/248    | 3500           | 3100               | 4500         | 5.2                                     | 10/5/1.5          | 11              | 25   |
| 326  | 85       | 90        | 33       | 1.4  | K202_0092 LM503U | 180        | 270        | 9.190 | 2279/248    | 3500           | 3100               | 4500         | 11                                      | 10/5/1.5          | 11              | 28   |
| 326  | 122      | 138       | 47       | 1.0  | K202_0092 LM505U | 210        | 270        | 9.190 | 2279/248    | 3500           | 3100               | 4500         | 18                                      | 10/5/1.5          | 11              | 32   |
| 357  | 18       | 20        | 7.9      | 2.7  | K202_0084 LM401U | 37         | 61         | 8.397 | 2494/297    | 3500           | 3100               | 4500         | 2.4                                     | 10/5/1.5          | 11              | 22   |



| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2 | $n_{1maxDB}$<br>EL3,4,5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|-----------------------|---------------------------|--------------|---|-------------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                 | [rpm]                     | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>K2 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 220</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                       |                           |              |   |                   |                 |      |
| 357  | 36       | 37        | 15       | 3.3  | K202_0084 LM402U | 79         | 240        | 8.397 | 2494/297    | 3500                  | 3100                      | 4500         | 3.8                                     | 10/5/1.5          | 11              | 23   |
| 357  | 49       | 50        | 21       | 2.4  | K202_0084 LM403U | 100        | 240        | 8.397 | 2494/297    | 3500                  | 3100                      | 4500         | 5.1                                     | 10/5/1.5          | 11              | 25   |
| 357  | 77       | 82        | 33       | 1.5  | K202_0084 LM503U | 170        | 240        | 8.397 | 2494/297    | 3500                  | 3100                      | 4500         | 11                                      | 10/5/1.5          | 11              | 28   |
| 357  | 112      | 126       | 48       | 1.1  | K202_0084 LM505U | 200        | 240        | 8.397 | 2494/297    | 3500                  | 3100                      | 4500         | 18                                      | 10/5/1.5          | 11              | 32   |
| 421  | 133      | 147       | 68       | 0.84 | K202_0071 LM704U | 210        | 400        | 7.118 | 2107/296    | 3000                  | 2600                      | 4000         | 38                                      | 10/5/1.5          | 11              | 38   |
| 449  | 29       | 29        | 16       | 3.8  | K202_0067 LM402U | 63         | 190        | 6.683 | 2279/341    | 3500                  | 3100                      | 4500         | 4.1                                     | 10/5/1.5          | 11              | 23   |
| 449  | 39       | 40        | 22       | 2.8  | K202_0067 LM403U | 83         | 190        | 6.683 | 2279/341    | 3500                  | 3100                      | 4500         | 5.4                                     | 10/5/1.5          | 11              | 25   |
| 449  | 61       | 65        | 34       | 1.8  | K202_0067 LM503U | 130        | 190        | 6.683 | 2279/341    | 3500                  | 3100                      | 4500         | 11                                      | 10/5/1.5          | 11              | 28   |
| 449  | 89       | 100       | 49       | 1.2  | K202_0067 LM505U | 160        | 190        | 6.683 | 2279/341    | 3500                  | 3100                      | 4500         | 18                                      | 10/5/1.5          | 11              | 32   |
| 449  | 125      | 138       | 69       | 0.88 | K202_0067 LM704U | 210        | 400        | 6.683 | 2279/341    | 3500                  | 3100                      | 4500         | 38                                      | 10/5/1.5          | 11              | 38   |
| 500  | 26       | 26        | 16       | 4.1  | K202_0060 LM402U | 56         | 170        | 6.000 | 6/1         | 3000                  | 2600                      | 4000         | 4.7                                     | 10/5/1.5          | 11              | 23   |
| 500  | 35       | 36        | 22       | 3.0  | K202_0060 LM403U | 75         | 170        | 6.000 | 6/1         | 3000                  | 2600                      | 4000         | 6.0                                     | 10/5/1.5          | 11              | 25   |
| 500  | 55       | 59        | 34       | 1.9  | K202_0060 LM503U | 120        | 170        | 6.000 | 6/1         | 3000                  | 2600                      | 4000         | 12                                      | 10/5/1.5          | 11              | 28   |
| 500  | 80       | 90        | 49       | 1.3  | K202_0060 LM505U | 140        | 170        | 6.000 | 6/1         | 3000                  | 2600                      | 4000         | 18                                      | 10/5/1.5          | 11              | 32   |
| 500  | 112      | 124       | 69       | 0.94 | K202_0060 LM704U | 200        | 400        | 6.000 | 6/1         | 3000                  | 2600                      | 4000         | 38                                      | 10/5/1.5          | 11              | 38   |
| 579  | 97       | 107       | 70       | 1.0  | K202_0052 LM704U | 190        | 380        | 5.177 | 2107/407    | 3000                  | 2600                      | 4000         | 38                                      | 10/5/1.5          | 11              | 38   |
| 687  | 26       | 26        | 22       | 3.7  | K202_0044 LM403U | 54         | 130        | 4.364 | 48/11       | 3000                  | 2600                      | 4000         | 6.4                                     | 10/5/1.5          | 11              | 25   |
| 687  | 40       | 43        | 35       | 2.4  | K202_0044 LM503U | 86         | 130        | 4.364 | 48/11       | 3000                  | 2600                      | 4000         | 12                                      | 10/5/1.5          | 11              | 28   |
| 687  | 58       | 65        | 51       | 1.6  | K202_0044 LM505U | 100        | 130        | 4.364 | 48/11       | 3000                  | 2600                      | 4000         | 19                                      | 10/5/1.5          | 11              | 32   |
| 687  | 82       | 90        | 71       | 1.2  | K202_0044 LM704U | 170        | 320        | 4.364 | 48/11       | 3000                  | 2600                      | 4000         | 39                                      | 10/5/1.5          | 11              | 38   |
| 687  | 109      | 126       | 95       | 0.88 | K202_0044 LM706U | 180        | 320        | 4.364 | 48/11       | 3000                  | 2600                      | 4000         | 56                                      | 10/5/1.5          | 11              | 45   |
| 750  | 75       | 82        | 72       | 1.2  | K202_0040 LM704U | 160        | 290        | 4.000 | 4/1         | 3000                  | 2600                      | 4000         | 39                                      | 10/5/1.5          | 11              | 38   |
| 750  | 100      | 116       | 95       | 0.93 | K202_0040 LM706U | 170        | 290        | 4.000 | 4/1         | 3000                  | 2600                      | 4000         | 56                                      | 10/5/1.5          | 11              | 45   |
| <b>K3 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 390</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                       |                           |              |   |                   |                 |      |
| 22   | 293      | 316       | 5.8      | 1.2  | K303_1360 LM401U | 380        | 690        | 136.0 | 14147/104   | 3800                  | 3500                      | 5000         | 1.7                                     | 10/5/2.5          | 16              | 32   |
| 27   | 235      | 254       | 5.5      | 1.5  | K303_1090 LM401U | 380        | 690        | 109.2 | 167743/1536 | 3800                  | 3500                      | 5000         | 1.7                                     | 10/5/2.5          | 16              | 32   |
| 33   | 196      | 212       | 5.2      | 1.8  | K303_0910 LM401U | 380        | 590        | 91.23 | 26273/288   | 3800                  | 3500                      | 5000         | 1.7                                     | 10/5/2.5          | 16              | 32   |
| 38   | 171      | 185       | 6.2      | 1.7  | K303_0790 LM401U | 340        | 510        | 79.42 | 167743/2112 | 3800                  | 3500                      | 5000         | 1.7                                     | 10/5/2.5          | 16              | 32   |
| 38   | 335      | 342       | 12       | 0.85 | K303_0790 LM402U | 380        | 510        | 79.42 | 167743/2112 | 3800                  | 3500                      | 5000         | 3.1                                     | 10/5/2.5          | 16              | 33   |
| 43   | 152      | 164       | 8.2      | 1.4  | K302_0690 LM401U | 250        | 310        | 69.43 | 6665/96     | 3800                  | 3500                      | 5000         | 1.7                                     | 10/4/1.5          | 16              | 27   |
| 44   | 146      | 157       | 5.0      | 2.3  | K303_0680 LM401U | 290        | 430        | 67.73 | 74777/1104  | 3800                  | 3500                      | 5000         | 1.8                                     | 10/5/2.5          | 16              | 32   |
| 44   | 286      | 291       | 9.7      | 1.2  | K303_0680 LM402U | 350        | 430        | 67.73 | 74777/1104  | 3800                  | 3500                      | 5000         | 3.1                                     | 10/5/2.5          | 16              | 33   |
| 45   | 143      | 154       | 6.3      | 1.9  | K303_0660 LM401U | 290        | 430        | 66.35 | 26273/396   | 3800                  | 3500                      | 5000         | 1.8                                     | 10/5/2.5          | 16              | 32   |
| 45   | 280      | 285       | 12       | 0.96 | K303_0660 LM402U | 340        | 430        | 66.35 | 26273/396   | 3800                  | 3500                      | 5000         | 3.1                                     | 10/5/2.5          | 16              | 33   |
| 54   | 238      | 243       | 12       | 1.1  | K302_0560 LM402U | 320        | 530        | 55.71 | 2451/44     | 3800                  | 3500                      | 5000         | 3.1                                     | 10/4/1.5          | 16              | 28   |
| 55   | 117      | 127       | 5.1      | 2.4  | K303_0550 LM401U | 240        | 350        | 54.58 | 70735/1296  | 3800                  | 3500                      | 5000         | 1.8                                     | 10/5/2.5          | 16              | 32   |
| 55   | 230      | 235       | 9.9      | 1.2  | K303_0550 LM402U | 280        | 350        | 54.58 | 70735/1296  | 3800                  | 3500                      | 5000         | 3.1                                     | 10/5/2.5          | 16              | 33   |
| 59   | 110      | 119       | 10       | 1.4  | K302_0500 LM401U | 180        | 220        | 50.49 | 6665/132    | 3800                  | 3500                      | 5000         | 1.8                                     | 10/4/1.5          | 16              | 27   |
| 61   | 106      | 114       | 6.3      | 2.3  | K303_0490 LM401U | 210        | 320        | 49.26 | 74777/1518  | 3800                  | 3500                      | 5000         | 1.8                                     | 10/5/2.5          | 16              | 32   |
| 61   | 208      | 212       | 12       | 1.2  | K303_0490 LM402U | 250        | 320        | 49.26 | 74777/1518  | 3800                  | 3500                      | 5000         | 3.1                                     | 10/5/2.5          | 16              | 33   |
| 65   | 198      | 202       | 8.9      | 1.7  | K302_0460 LM402U | 390        | 690        | 46.23 | 1849/40     | 3800                  | 3500                      | 5000         | 3.2                                     | 10/4/1.5          | 16              | 28   |
| 65   | 272      | 278       | 12       | 1.3  | K302_0460 LM403U | 390        | 690        | 46.23 | 1849/40     | 3800                  | 3500                      | 5000         | 4.5                                     | 10/4/1.5          | 16              | 30   |
| 74   | 173      | 177       | 15       | 1.1  | K302_0410 LM402U | 230        | 390        | 40.51 | 4902/121    | 3800                  | 3500                      | 5000         | 3.1                                     | 10/4/1.5          | 16              | 28   |
| 77   | 355      | 377       | 18       | 0.97 | K303_0390 LM503U | 380        | 690        | 39.19 | 34916/891   | 3800                  | 3500                      | 5000         | 11                                      | 10/5/2.5          | 16              | 38   |
| 84   | 325      | 345       | 18       | 1.0  | K303_0360 LM503U | 380        | 630        | 35.83 | 215/6       | 3800                  | 3500                      | 5000         | 11                                      | 10/5/2.5          | 16              | 38   |
| 86   | 149      | 152       | 8.6      | 2.2  | K302_0350 LM402U | 330        | 700        | 34.73 | 903/26      | 3800                  | 3500                      | 5000         | 3.3                                     | 10/4/1.5          | 16              | 28   |
| 86   | 204      | 209       | 12       | 1.6  | K302_0350 LM403U | 390        | 700        | 34.73 | 903/26      | 3800                  | 3500                      | 5000         | 4.6                                     | 10/4/1.5          | 16              | 30   |
| 86   | 319      | 339       | 18       | 1.0  | K302_0350 LM503U | 390        | 700        | 34.73 | 903/26      | 3800                  | 3500                      | 5000         | 11                                      | 10/4/1.5          | 16              | 33   |
| 89   | 144      | 147       | 11       | 1.7  | K302_0340 LM402U | 300        | 500        | 33.62 | 1849/55     | 3800                  | 3500                      | 5000         | 3.2                                     | 10/4/1.5          | 16              | 28   |
| 89   | 198      | 202       | 16       | 1.3  | K302_0340 LM403U | 300        | 500        | 33.62 | 1849/55     | 3800                  | 3500                      | 5000         | 4.5                                     | 10/4/1.5          | 16              | 30   |
| 92   | 296      | 314       | 18       | 1.1  | K303_0330 LM503U | 380        | 580        | 32.65 | 44892/1375  | 3800                  | 3500                      | 5000         | 11                                      | 10/5/2.5          | 16              | 38   |
| 108  | 119      | 122       | 8.8      | 2.6  | K302_0280 LM402U | 260        | 700        | 27.88 | 3569/128    | 3800                  | 3500                      | 5000         | 3.4                                     | 10/4/1.5          | 16              | 28   |
| 108  | 164      | 167       | 12       | 1.9  | K302_0280 LM403U | 350        | 700        | 27.88 | 3569/128    | 3800                  | 3500                      | 5000         | 4.7                                     | 10/4/1.5          | 16              | 30   |
| 108  | 256      | 272       | 19       | 1.2  | K302_0280 LM503U | 390        | 700        | 27.88 | 3569/128    | 3800                  | 3500                      | 5000         | 11                                      | 10/4/1.5          | 16              | 33   |
| 119  | 108      | 110       | 8.8      | 2.8  | K302_0250 LM402U | 240        | 600        | 25.26 | 3612/143    | 3800                  | 3500                      | 5000         | 3.3                                     | 10/4/1.5          | 16              | 28   |
| 119  | 148      | 152       | 12       | 2.0  | K302_0250 LM403U | 310        | 600        | 25.26 | 3612/143    | 3800                  | 3500                      | 5000         | 4.6                                     | 10/4/1.5          | 16              | 30   |
| 119  | 232      | 247       | 19       | 1.3  | K302_0250 LM503U | 390        | 600        | 25.26 | 3612/143    | 3800                  | 3500                      | 5000         | 11                                      | 10/4/1.5          | 16              | 33   |
| 119  | 336      | 379       | 27       | 0.89 | K302_0250 LM505U | 390        | 600        | 25.26 | 3612/143    | 3800                  | 3500                      | 5000         | 17                                      | 10/4/1.5          | 16              | 37   |
| 129  | 100      | 102       | 8.9      | 2.9  | K302_0230 LM402U | 220        | 640        | 23.29 | 559/24      | 3800                  | 3500                      | 5000         | 3.5                                     | 10/4/1.5          | 16              | 28   |
| 129  | 137      | 140       | 12       | 2.1  | K302_0230 LM403U | 290        | 640        | 23.29 | 559/24      | 3800                  | 3500                      | 5000         | 4.8                                     | 10/4/1.5          | 16              | 30   |
| 129  | 214      | 228       | 19       | 1.4  | K302_0230 LM503U | 390        | 640        | 23.29 | 559/24      | 3800                  | 3500                      | 5000         | 11                                      | 10/4/1.5          | 16              | 33   |
| 129  | 310      | 350       | 28       | 0.94 | K302_0230 LM505U | 390        | 640        | 23.29 | 559/24      | 3800                  | 3500                      | 5000         | 17                                      | 10/4/1.5          | 16              | 37   |
| 148  | 87       | 89        | 9.0      | 3.2  | K302_0200 LM402U | 190        | 510        | 20.28 | 3569/176    | 3800                  | 3500                      | 5000         | 3.4                                     | 10/4/1.5          | 16              | 28   |
| 148  | 119      | 122       | 12       | 2.3  | K302_0200 LM403U | 250        | 510        | 20.28 | 3569/176    | 3800                  | 3500                      | 5000         | 4.7                                     | 10/4/1.5          | 16              | 30   |

12.2 Selection tables 12 K helical bevel geared motors

| $n_{2N}$   | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2 | $n_{1maxDB}$<br>EL3,4,5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\phi_2$ | $C_2$           | m    |
|--|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|-----------------------|---------------------------|--------------|---|----------------|-----------------|------|
| [rpm]  | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                 | [rpm]                     | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]       | [Nm/<br>arcmin] | [kg] |
| <b>K3 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 390</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                       |                           |              |   |                |                 |      |
| 148  | 186      | 198       | 19       | 1.5  | K302_0200 LM503U | 390        | 510        | 20.28 | 3569/176    | 3800                  | 3500                      | 5000         | 11                                      | 10/4/1.5       | 16              | 33   |
| 148  | 269      | 304       | 28       | 1.0  | K302_0200 LM505U | 390        | 510        | 20.28 | 3569/176    | 3800                  | 3500                      | 5000         | 17                                      | 10/4/1.5       | 16              | 37   |
| 173  | 74       | 75        | 9.1      | 3.6  | K302_0175 LM402U | 160        | 500        | 17.29 | 1591/92     | 3500                  | 3100                      | 5000         | 3.8                                     | 10/4/1.5       | 16              | 28   |
| 173  | 102      | 104       | 13       | 2.6  | K302_0175 LM403U | 220        | 500        | 17.29 | 1591/92     | 3500                  | 3100                      | 5000         | 5.1                                     | 10/4/1.5       | 16              | 30   |
| 173  | 159      | 169       | 20       | 1.7  | K302_0175 LM503U | 340        | 500        | 17.29 | 1591/92     | 3500                  | 3100                      | 5000         | 11                                      | 10/4/1.5       | 16              | 33   |
| 173  | 230      | 259       | 28       | 1.1  | K302_0175 LM505U | 390        | 500        | 17.29 | 1591/92     | 3500                  | 3100                      | 5000         | 18                                      | 10/4/1.5       | 16              | 37   |
| 173  | 323      | 357       | 40       | 0.82 | K302_0175 LM704U | 390        | 700        | 17.29 | 1591/92     | 3500                  | 3100                      | 5000         | 37                                      | 10/4/1.5       | 16              | 43   |
| 177  | 72       | 74        | 9.1      | 3.6  | K302_0170 LM402U | 160        | 470        | 16.94 | 559/33      | 3800                  | 3500                      | 5000         | 3.6                                     | 10/4/1.5       | 16              | 28   |
| 177  | 100      | 102       | 13       | 2.6  | K302_0170 LM403U | 210        | 470        | 16.94 | 559/33      | 3800                  | 3500                      | 5000         | 4.8                                     | 10/4/1.5       | 16              | 30   |
| 177  | 156      | 165       | 20       | 1.7  | K302_0170 LM503U | 330        | 470        | 16.94 | 559/33      | 3800                  | 3500                      | 5000         | 11                                      | 10/4/1.5       | 16              | 33   |
| 177  | 225      | 254       | 28       | 1.2  | K302_0170 LM505U | 380        | 470        | 16.94 | 559/33      | 3800                  | 3500                      | 5000         | 17                                      | 10/4/1.5       | 16              | 37   |
| 177  | 317      | 349       | 40       | 0.83 | K302_0170 LM704U | 390        | 700        | 16.94 | 559/33      | 3800                  | 3500                      | 5000         | 37                                      | 10/4/1.5       | 16              | 43   |
| 215  | 60       | 61        | 9.3      | 4.1  | K302_0140 LM402U | 130        | 410        | 13.94 | 1505/108    | 3500                  | 3100                      | 5000         | 4.0                                     | 10/4/1.5       | 16              | 28   |
| 215  | 82       | 84        | 13       | 3.0  | K302_0140 LM403U | 170        | 410        | 13.94 | 1505/108    | 3500                  | 3100                      | 5000         | 5.3                                     | 10/4/1.5       | 16              | 30   |
| 215  | 128      | 136       | 20       | 1.9  | K302_0140 LM503U | 280        | 410        | 13.94 | 1505/108    | 3500                  | 3100                      | 5000         | 11                                      | 10/4/1.5       | 16              | 33   |
| 215  | 185      | 209       | 29       | 1.3  | K302_0140 LM505U | 320        | 410        | 13.94 | 1505/108    | 3500                  | 3100                      | 5000         | 18                                      | 10/4/1.5       | 16              | 37   |
| 215  | 260      | 287       | 41       | 0.94 | K302_0140 LM704U | 390        | 700        | 13.94 | 1505/108    | 3500                  | 3100                      | 5000         | 37                                      | 10/4/1.5       | 16              | 43   |
| 239  | 54       | 55        | 9.4      | 4.4  | K302_0125 LM402U | 120        | 370        | 12.58 | 3182/253    | 3500                  | 3100                      | 5000         | 3.9                                     | 10/4/1.5       | 16              | 28   |
| 239  | 74       | 76        | 13       | 3.2  | K302_0125 LM403U | 160        | 370        | 12.58 | 3182/253    | 3500                  | 3100                      | 5000         | 5.2                                     | 10/4/1.5       | 16              | 30   |
| 239  | 116      | 123       | 20       | 2.0  | K302_0125 LM503U | 250        | 370        | 12.58 | 3182/253    | 3500                  | 3100                      | 5000         | 11                                      | 10/4/1.5       | 16              | 33   |
| 239  | 167      | 189       | 29       | 1.4  | K302_0125 LM505U | 290        | 370        | 12.58 | 3182/253    | 3500                  | 3100                      | 5000         | 18                                      | 10/4/1.5       | 16              | 37   |
| 239  | 235      | 259       | 41       | 1.0  | K302_0125 LM704U | 390        | 700        | 12.58 | 3182/253    | 3500                  | 3100                      | 5000         | 37                                      | 10/4/1.5       | 16              | 43   |
| 258  | 50       | 51        | 9.4      | 4.6  | K302_0115 LM402U | 110        | 340        | 11.61 | 1161/100    | 3200                  | 2800                      | 4200         | 4.4                                     | 10/4/1.5       | 16              | 28   |
| 258  | 68       | 70        | 13       | 3.4  | K302_0115 LM403U | 140        | 340        | 11.61 | 1161/100    | 3200                  | 2800                      | 4200         | 5.7                                     | 10/4/1.5       | 16              | 30   |
| 258  | 107      | 113       | 20       | 2.2  | K302_0115 LM503U | 230        | 340        | 11.61 | 1161/100    | 3200                  | 2800                      | 4200         | 12                                      | 10/4/1.5       | 16              | 33   |
| 258  | 154      | 174       | 29       | 1.5  | K302_0115 LM505U | 270        | 340        | 11.61 | 1161/100    | 3200                  | 2800                      | 4200         | 18                                      | 10/4/1.5       | 16              | 37   |
| 258  | 217      | 239       | 41       | 1.1  | K302_0115 LM704U | 390        | 700        | 11.61 | 1161/100    | 3200                  | 2800                      | 4200         | 38                                      | 10/4/1.5       | 16              | 43   |
| 296  | 60       | 61        | 13       | 3.7  | K302_0100 LM403U | 130        | 290        | 10.14 | 3010/297    | 3500                  | 3100                      | 5000         | 5.5                                     | 10/4/1.5       | 16              | 30   |
| 296  | 93       | 99        | 20       | 2.4  | K302_0100 LM503U | 200        | 290        | 10.14 | 3010/297    | 3500                  | 3100                      | 5000         | 12                                      | 10/4/1.5       | 16              | 33   |
| 296  | 135      | 152       | 30       | 1.6  | K302_0100 LM505U | 240        | 290        | 10.14 | 3010/297    | 3500                  | 3100                      | 5000         | 18                                      | 10/4/1.5       | 16              | 37   |
| 296  | 189      | 209       | 42       | 1.2  | K302_0100 LM704U | 390        | 700        | 10.14 | 3010/297    | 3500                  | 3100                      | 5000         | 38                                      | 10/4/1.5       | 16              | 43   |
| 296  | 252      | 293       | 55       | 0.87 | K302_0100 LM706U | 390        | 700        | 10.14 | 3010/297    | 3500                  | 3100                      | 5000         | 55                                      | 10/4/1.5       | 16              | 50   |
| 324  | 173      | 191       | 42       | 1.2  | K302_0093 LM704U | 370        | 670        | 9.267 | 1075/116    | 3200                  | 2800                      | 4200         | 38                                      | 10/4/1.5       | 16              | 43   |
| 324  | 231      | 268       | 56       | 0.93 | K302_0093 LM706U | 390        | 670        | 9.267 | 1075/116    | 3200                  | 2800                      | 4200         | 56                                      | 10/4/1.5       | 16              | 50   |
| 355  | 50       | 51        | 13       | 4.0  | K302_0084 LM403U | 110        | 250        | 8.444 | 2322/275    | 3200                  | 2800                      | 4200         | 5.9                                     | 10/4/1.5       | 16              | 30   |
| 355  | 78       | 82        | 21       | 2.5  | K302_0084 LM503U | 170        | 250        | 8.444 | 2322/275    | 3200                  | 2800                      | 4200         | 12                                      | 10/4/1.5       | 16              | 33   |
| 355  | 112      | 127       | 30       | 1.8  | K302_0084 LM505U | 200        | 250        | 8.444 | 2322/275    | 3200                  | 2800                      | 4200         | 18                                      | 10/4/1.5       | 16              | 37   |
| 355  | 158      | 174       | 42       | 1.3  | K302_0084 LM704U | 340        | 610        | 8.444 | 2322/275    | 3200                  | 2800                      | 4200         | 38                                      | 10/4/1.5       | 16              | 43   |
| 355  | 210      | 244       | 56       | 0.99 | K302_0084 LM706U | 390        | 610        | 8.444 | 2322/275    | 3200                  | 2800                      | 4200         | 55                                      | 10/4/1.5       | 16              | 50   |
| 406  | 138      | 152       | 43       | 1.4  | K302_0074 LM704U | 300        | 540        | 7.391 | 473/64      | 2700                  | 2300                      | 3800         | 39                                      | 10/4/1.5       | 16              | 43   |
| 406  | 184      | 214       | 57       | 1.1  | K302_0074 LM706U | 380        | 540        | 7.391 | 473/64      | 2700                  | 2300                      | 3800         | 56                                      | 10/4/1.5       | 16              | 50   |
| 445  | 126      | 139       | 43       | 1.5  | K302_0067 LM704U | 270        | 490        | 6.740 | 2150/319    | 3200                  | 2800                      | 4200         | 39                                      | 10/4/1.5       | 16              | 43   |
| 445  | 168      | 195       | 57       | 1.1  | K302_0067 LM706U | 360        | 490        | 6.740 | 2150/319    | 3200                  | 2800                      | 4200         | 56                                      | 10/4/1.5       | 16              | 50   |
| 500  | 112      | 124       | 43       | 1.7  | K302_0060 LM704U | 240        | 440        | 6.000 | 6/1         | 2700                  | 2300                      | 3800         | 40                                      | 10/4/1.5       | 16              | 43   |
| 500  | 149      | 173       | 58       | 1.2  | K302_0060 LM706U | 350        | 440        | 6.000 | 6/1         | 2700                  | 2300                      | 3800         | 57                                      | 10/4/1.5       | 16              | 50   |
| 558  | 100      | 111       | 44       | 1.8  | K302_0054 LM704U | 210        | 390        | 5.375 | 43/8        | 2700                  | 2300                      | 3800         | 40                                      | 10/4/1.5       | 16              | 43   |
| 558  | 134      | 155       | 58       | 1.3  | K302_0054 LM706U | 310        | 390        | 5.375 | 43/8        | 2700                  | 2300                      | 3800         | 57                                      | 10/4/1.5       | 16              | 50   |
| 687  | 82       | 90        | 45       | 2.0  | K302_0044 LM704U | 170        | 320        | 4.364 | 48/11       | 2700                  | 2300                      | 3800         | 41                                      | 10/4/1.5       | 16              | 43   |
| 687  | 109      | 126       | 59       | 1.5  | K302_0044 LM706U | 250        | 320        | 4.364 | 48/11       | 2700                  | 2300                      | 3800         | 58                                      | 10/4/1.5       | 16              | 50   |
| 750  | 75       | 82        | 45       | 2.2  | K302_0040 LM704U | 160        | 290        | 4.000 | 4/1         | 2700                  | 2300                      | 3800         | 41                                      | 10/4/1.5       | 16              | 43   |
| 750  | 100      | 116       | 60       | 1.6  | K302_0040 LM706U | 230        | 290        | 4.000 | 4/1         | 2700                  | 2300                      | 3800         | 59                                      | 10/4/1.5       | 16              | 50   |
| <b>K4 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 600</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                       |                           |              |   |                |                 |      |
| 14   | 469      | 507       | 5.9      | 0.90 | K403_2180 LM401U | 510        | 850        | 218.2 | 38399/176   | 3600                  | 3300                      | 5000         | 1.7                                     | 10/5/2.5       | 31              | 44   |
| 17   | 390      | 421       | 4.8      | 1.3  | K403_1810 LM401U | 590        | 980        | 181.4 | 14147/78    | 3600                  | 3300                      | 5000         | 1.7                                     | 10/5/2.5       | 31              | 44   |
| 22   | 293      | 316       | 4.8      | 1.6  | K403_1360 LM401U | 590        | 810        | 136.1 | 196037/1440 | 3600                  | 3300                      | 5000         | 1.7                                     | 10/5/2.5       | 31              | 44   |
| 22   | 574      | 586       | 9.4      | 0.81 | K403_1360 LM402U | 590        | 810        | 136.1 | 196037/1440 | 3600                  | 3300                      | 5000         | 3.1                                     | 10/5/2.5       | 31              | 46   |
| 28   | 234      | 253       | 4.7      | 1.9  | K403_1090 LM401U | 470        | 700        | 108.8 | 62651/576   | 3600                  | 3300                      | 5000         | 1.8                                     | 10/5/2.5       | 31              | 44   |
| 28   | 459      | 468       | 9.3      | 0.96 | K403_1090 LM402U | 560        | 700        | 108.8 | 62651/576   | 3600                  | 3300                      | 5000         | 3.1                                     | 10/5/2.5       | 31              | 46   |
| 33   | 196      | 212       | 4.8      | 2.1  | K403_0910 LM401U | 390        | 590        | 91.23 | 26273/288   | 3600                  | 3300                      | 5000         | 1.8                                     | 10/5/2.5       | 31              | 44   |
| 33   | 385      | 392       | 9.3      | 1.1  | K403_0910 LM402U | 470        | 590        | 91.23 | 26273/288   | 3600                  | 3300                      | 5000         | 3.1                                     | 10/5/2.5       | 31              | 46   |
| 38   | 170      | 184       | 6.0      | 1.9  | K403_0790 LM401U | 340        | 510        | 79.11 | 62651/792   | 3600                  | 3300                      | 5000         | 1.8                                     | 10/5/2.5       | 31              | 44   |
| 38   | 334      | 340       | 12       | 0.96 | K403_0790 LM402U | 410        | 510        | 79.11 | 62651/792   | 3600                  | 3300                      | 5000         | 3.1                                     | 10/5/2.5       | 31              | 46   |
| 45   | 143      | 154       | 6.0      | 2.1  | K403_0660 LM401U | 290        | 430        | 66.35 | 26273/396   | 3600                  | 3300                      | 5000         | 1.8                                     | 10/5/2.5       | 31              | 44   |
| 45   | 280      | 285       | 12       | 1.1  | K403_0660 LM402U | 340        | 430        | 66.35 | 26273/396   | 3600                  | 3300                      | 5000         | 3.1                                     | 10/5/2.5       | 31              | 46   |

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$ | $n_{1maxDB}$<br>EL1,2 | $n_{1maxDB}$<br>EL3,4,5,6 | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|------------------|------------|------------|-------|-------------|-----------------------|---------------------------|--------------|---|-------------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |             | [rpm]                 | [rpm]                     | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>K4 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 600</math> Nm)</b>  |          |           |          |      |                  |            |            |       |             |                       |                           |              |   |                   |                 |      |
| 56  | 487      | 517       | 13       | 1.1  | K403_0540 LM503U | 590        | 950        | 53.69 | 38657/720   | 3600                  | 3300                      | 5000         | 11                                      | 10/5/2.5          | 31              | 50   |
| 61  | 444      | 471       | 13       | 1.2  | K403_0490 LM503U | 590        | 870        | 48.94 | 169592/3465 | 3600                  | 3300                      | 5000         | 11                                      | 10/5/2.5          | 31              | 50   |
| 65  | 426      | 452       | 13       | 1.3  | K402_0460 LM503U | 600        | 980        | 46.31 | 602/13      | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 67  | 404      | 429       | 13       | 1.3  | K403_0450 LM503U | 590        | 790        | 44.54 | 1247/28     | 3600                  | 3300                      | 5000         | 11                                      | 10/5/2.5          | 31              | 50   |
| 77  | 354      | 376       | 13       | 1.4  | K403_0390 LM503U | 550        | 690        | 39.05 | 38657/990   | 3600                  | 3300                      | 5000         | 11                                      | 10/5/2.5          | 31              | 50   |
| 84  | 324      | 344       | 13       | 1.6  | K403_0360 LM503U | 510        | 630        | 35.72 | 13717/384   | 3600                  | 3300                      | 5000         | 11                                      | 10/5/2.5          | 31              | 50   |
| 86  | 320      | 340       | 13       | 1.6  | K402_0350 LM503U | 600        | 810        | 34.76 | 4171/120    | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 86  | 462      | 522       | 19       | 1.1  | K402_0350 LM505U | 600        | 810        | 34.76 | 4171/120    | 3600                  | 3300                      | 5000         | 17                                      | 10/4/1.5          | 31              | 51   |
| 89  | 310      | 329       | 17       | 1.3  | K402_0340 LM503U | 470        | 710        | 33.68 | 4816/143    | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 93  | 294      | 312       | 14       | 1.6  | K402_0320 LM503U | 460        | 570        | 32.39 | 2494/77     | 3600                  | 3300                      | 5000         | 11                                      | 10/5/2.5          | 31              | 50   |
| 108   | 255      | 271       | 14       | 1.8  | K402_0280 LM503U | 550        | 750        | 27.77 | 1333/48     | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 108   | 369      | 417       | 20       | 1.3  | K402_0280 LM505U | 600        | 750        | 27.77 | 1333/48     | 3600                  | 3300                      | 5000         | 17                                      | 10/4/1.5          | 31              | 51   |
| 108   | 519      | 573       | 28       | 0.89 | K402_0280 LM704U | 600        | 1100       | 27.77 | 1333/48     | 3600                  | 3300                      | 5000         | 37                                      | 10/4/1.5          | 31              | 57   |
| 119   | 232      | 247       | 14       | 1.9  | K402_0250 LM503U | 470        | 590        | 25.28 | 4171/165    | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 119   | 336      | 379       | 20       | 1.3  | K402_0250 LM505U | 470        | 590        | 25.28 | 4171/165    | 3600                  | 3300                      | 5000         | 17                                      | 10/4/1.5          | 31              | 51   |
| 119   | 473      | 521       | 28       | 0.95 | K402_0250 LM704U | 600        | 1000       | 25.28 | 4171/165    | 3600                  | 3300                      | 5000         | 37                                      | 10/4/1.5          | 31              | 57   |
| 129   | 214      | 228       | 14       | 2.0  | K402_0230 LM503U | 460        | 680        | 23.29 | 559/24      | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 129   | 310      | 350       | 20       | 1.4  | K402_0230 LM505U | 540        | 680        | 23.29 | 559/24      | 3600                  | 3300                      | 5000         | 18                                      | 10/4/1.5          | 31              | 51   |
| 129   | 435      | 480       | 28       | 1.0  | K402_0230 LM704U | 600        | 1100       | 23.29 | 559/24      | 3600                  | 3300                      | 5000         | 37                                      | 10/4/1.5          | 31              | 57   |
| 149   | 186      | 197       | 14       | 2.2  | K402_0200 LM503U | 400        | 540        | 20.20 | 1333/66     | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 149   | 268      | 303       | 20       | 1.6  | K402_0200 LM505U | 430        | 540        | 20.20 | 1333/66     | 3600                  | 3300                      | 5000         | 17                                      | 10/4/1.5          | 31              | 51   |
| 149   | 378      | 417       | 29       | 1.1  | K402_0200 LM704U | 600        | 1100       | 20.20 | 1333/66     | 3600                  | 3300                      | 5000         | 37                                      | 10/4/1.5          | 31              | 57   |
| 149   | 503      | 584       | 38       | 0.83 | K402_0200 LM706U | 600        | 1100       | 20.20 | 1333/66     | 3600                  | 3300                      | 5000         | 55                                      | 10/4/1.5          | 31              | 64   |
| 172   | 325      | 359       | 29       | 1.2  | K402_0175 LM704U | 600        | 1100       | 17.41 | 731/42      | 3400                  | 3000                      | 4500         | 38                                      | 10/4/1.5          | 31              | 57   |
| 172   | 433      | 503       | 39       | 0.91 | K402_0175 LM706U | 600        | 1100       | 17.41 | 731/42      | 3400                  | 3000                      | 4500         | 55                                      | 10/4/1.5          | 31              | 64   |
| 177   | 156      | 165       | 14       | 2.5  | K402_0170 LM503U | 330        | 490        | 16.94 | 559/33      | 3600                  | 3300                      | 5000         | 11                                      | 10/4/1.5          | 31              | 46   |
| 177   | 225      | 254       | 21       | 1.7  | K402_0170 LM505U | 390        | 490        | 16.94 | 559/33      | 3600                  | 3300                      | 5000         | 18                                      | 10/4/1.5          | 31              | 51   |
| 177   | 317      | 349       | 29       | 1.2  | K402_0170 LM704U | 600        | 1010       | 16.94 | 559/33      | 3600                  | 3300                      | 5000         | 37                                      | 10/4/1.5          | 31              | 57   |
| 177   | 422      | 490       | 39       | 0.93 | K402_0170 LM706U | 600        | 1010       | 16.94 | 559/33      | 3600                  | 3300                      | 5000         | 55                                      | 10/4/1.5          | 31              | 64   |
| 216   | 260      | 286       | 29       | 1.4  | K402_0140 LM704U | 550        | 1010       | 13.89 | 1333/96     | 3400                  | 3000                      | 4500         | 38                                      | 10/4/1.5          | 31              | 57   |
| 216   | 346      | 401       | 39       | 1.1  | K402_0140 LM706U | 600        | 1010       | 13.89 | 1333/96     | 3400                  | 3000                      | 4500         | 56                                      | 10/4/1.5          | 31              | 64   |
| 237   | 237      | 261       | 30       | 1.5  | K402_0125 LM704U | 510        | 870        | 12.66 | 2924/231    | 3400                  | 3000                      | 4500         | 38                                      | 10/4/1.5          | 31              | 57   |
| 237   | 315      | 366       | 40       | 1.1  | K402_0125 LM706U | 600        | 870        | 12.66 | 2924/231    | 3400                  | 3000                      | 4500         | 55                                      | 10/4/1.5          | 31              | 64   |
| 260   | 215      | 238       | 30       | 1.6  | K402_0115 LM704U | 460        | 840        | 11.52 | 645/56      | 3000                  | 2600                      | 4000         | 39                                      | 10/4/1.5          | 31              | 57   |
| 260   | 287      | 333       | 40       | 1.2  | K402_0115 LM706U | 600        | 840        | 11.52 | 645/56      | 3000                  | 2600                      | 4000         | 56                                      | 10/4/1.5          | 31              | 64   |
| 297   | 189      | 208       | 30       | 1.8  | K402_0100 LM704U | 400        | 730        | 10.10 | 1333/132    | 3400                  | 3000                      | 4500         | 39                                      | 10/4/1.5          | 31              | 57   |
| 297   | 251      | 292       | 40       | 1.3  | K402_0100 LM706U | 590        | 730        | 10.10 | 1333/132    | 3400                  | 3000                      | 4500         | 56                                      | 10/4/1.5          | 31              | 64   |
| 325   | 173      | 191       | 30       | 1.9  | K402_0092 LM704U | 370        | 670        | 9.238 | 2365/256    | 3000                  | 2600                      | 4000         | 40                                      | 10/4/1.5          | 31              | 57   |
| 325   | 230      | 267       | 41       | 1.4  | K402_0092 LM706U | 540        | 670        | 9.238 | 2365/256    | 3000                  | 2600                      | 4000         | 57                                      | 10/4/1.5          | 31              | 64   |
| 358   | 157      | 173       | 31       | 2.0  | K402_0084 LM704U | 330        | 610        | 8.377 | 645/77      | 3000                  | 2600                      | 4000         | 39                                      | 10/4/1.5          | 31              | 57   |
| 358   | 209      | 242       | 41       | 1.5  | K402_0084 LM706U | 490        | 610        | 8.377 | 645/77      | 3000                  | 2600                      | 4000         | 57                                      | 10/4/1.5          | 31              | 64   |
| 446   | 126      | 139       | 31       | 2.3  | K402_0067 LM704U | 270        | 490        | 6.719 | 215/32      | 3000                  | 2600                      | 4000         | 41                                      | 10/4/1.5          | 31              | 57   |
| 446   | 167      | 194       | 42       | 1.7  | K402_0067 LM706U | 390        | 490        | 6.719 | 215/32      | 3000                  | 2600                      | 4000         | 58                                      | 10/4/1.5          | 31              | 64   |
| <b>K5 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 1000</math> Nm)</b> |          |           |          |      |                  |            |            |       |             |                       |                           |              |   |                   |                 |      |
| 32  | 840      | 892       | 15       | 1.1  | K514_0940 LM503U | 1000       | 1620       | 94.15 | 338923/3600 | 3400                  | 3000                      | 4500         | 11                                      | 10/6/3            | 50              | 57   |
| 35  | 759      | 806       | 15       | 1.2  | K514_0850 LM503U | 1000       | 1470       | 85.03 | 76531/900   | 3400                  | 3000                      | 4500         | 11                                      | 10/6/3            | 50              | 57   |
| 39  | 703      | 747       | 15       | 1.3  | K513_0780 LM503U | 1000       | 1410       | 77.59 | 26071/336   | 3400                  | 3000                      | 4500         | 11                                      | 10/5/2            | 50              | 52   |
| 43  | 635      | 675       | 16       | 1.3  | K513_0700 LM503U | 980        | 1280       | 70.08 | 841/12      | 3400                  | 3000                      | 4500         | 11                                      | 10/5/2            | 50              | 52   |
| 46  | 585      | 621       | 14       | 1.5  | K513_0650 LM503U | 1000       | 1270       | 64.54 | 12586/195   | 3400                  | 3000                      | 4500         | 11                                      | 10/5/2            | 50              | 52   |
| 46  | 845      | 955       | 20       | 1.1  | K513_0650 LM505U | 1000       | 1270       | 64.54 | 12586/195   | 3400                  | 3000                      | 4500         | 17                                      | 10/5/2            | 50              | 57   |
| 51  | 528      | 561       | 14       | 1.7  | K513_0580 LM503U | 920        | 1150       | 58.30 | 11368/195   | 3400                  | 3000                      | 4500         | 11                                      | 10/5/2            | 50              | 52   |
| 51  | 764      | 862       | 20       | 1.2  | K513_0580 LM505U | 920        | 1150       | 58.30 | 11368/195   | 3400                  | 3000                      | 4500         | 17                                      | 10/5/2            | 50              | 57   |
| 62  | 436      | 464       | 13       | 2.0  | K513_0480 LM503U | 870        | 1080       | 48.16 | 2697/56     | 3400                  | 3000                      | 4500         | 11                                      | 10/5/2            | 50              | 52   |
| 62  | 631      | 712       | 19       | 1.4  | K513_0480 LM505U | 870        | 1080       | 48.16 | 2697/56     | 3400                  | 3000                      | 4500         | 18                                      | 10/5/2            | 50              | 57   |
| 62  | 887      | 979       | 26       | 1.0  | K513_0480 LM704U | 1000       | 1800       | 48.16 | 2697/56     | 3400                  | 3000                      | 4500         | 37                                      | 10/5/2            | 50              | 62   |
| 69  | 394      | 419       | 12       | 2.0  | K513_0440 LM503U | 780        | 980        | 43.50 | 87/2        | 3400                  | 3000                      | 4500         | 11                                      | 10/5/2            | 50              | 52   |
| 69  | 570      | 643       | 18       | 1.4  | K513_0440 LM505U | 780        | 980        | 43.50 | 87/2        | 3400                  | 3000                      | 4500         | 18                                      | 10/5/2            | 50              | 57   |
| 69  | 801      | 884       | 25       | 1.1  | K513_0440 LM704U | 1000       | 1800       | 43.50 | 87/2        | 3400                  | 3000                      | 4500         | 37                                      | 10/5/2            | 50              | 62   |
| 78  | 710      | 783       | 24       | 1.3  | K513_0390 LM704U | 1000       | 1800       | 38.53 | 2697/70     | 3400                  | 3000                      | 4500         | 38                                      | 10/5/2            | 50              | 62   |
| 86  | 641      | 707       | 24       | 1.4  | K513_0350 LM704U | 1000       | 1780       | 34.80 | 174/5       | 3400                  | 3000                      | 4500         | 38                                      | 10/5/2            | 50              | 62   |
| 86  | 854      | 991       | 32       | 1.1  | K513_0350 LM706U | 1000       | 1780       | 34.80 | 174/5       | 3400                  | 3000                      | 4500         | 55                                      | 10/5/2            | 50              | 70   |
| 93  | 595      | 657       | 23       | 1.5  | K513_0320 LM704U | 1000       | 1800       | 32.31 | 20677/640   | 3400                  | 3000                      | 4500         | 38                                      | 10/5/2            | 50              | 62   |
| 93  | 793      | 920       | 31       | 1.1  | K513_0320 LM706U | 1000       | 1800       | 32.31 | 20677/640   | 3400                  | 3000                      | 4500         | 56                                      | 10/5/2            | 50              | 70   |
| 103   | 538      | 593       | 23       | 1.6  | K513_0290 LM704U | 1000       | 1660       | 29.18 | 4669/160    | 3400                  | 3000                      | 4500         | 38                                      | 10/5/2            | 50              | 62   |

12.2 Selection tables 12 K helical bevel geared motors

| n <sub>2N</sub>   | M <sub>2N</sub> | M <sub>2,0</sub> | a <sub>th</sub> | S    | Type             | M <sub>2acc</sub> | M <sub>2NOT</sub> | i     | i <sub>exakt</sub> | n <sub>1maxDB</sub> | n <sub>1maxDB</sub> | n <sub>1maxZB</sub> | J <sub>1</sub>                          | Δφ <sub>2</sub> | C <sub>2</sub>  | m    |
|---|-----------------|------------------|-----------------|------|------------------|-------------------|-------------------|-------|--------------------|---------------------|---------------------|---------------------|---|-----------------|-----------------|------|
| [rpm]   | [Nm]            | [Nm]             |                 |      |                  | [Nm]              | [Nm]              |       |                    | EL1,2<br>[rpm]      | EL3,4,5,6<br>[rpm]  | [rpm]               | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]        | [Nm/<br>arcmin] | [kg] |
| <b>K5 (n<sub>1N</sub> = 3000 rpm, M<sub>2acc,max</sub> = 1000 Nm)</b> |                 |                  |                 |      |                  |                   |                   |       |                    |                     |                     |                     |   |                 |                 |      |
| 103   | 716             | 831              | 31              | 1.2  | K513_0290 LM706U | 1000              | 1660              | 29.18 | 4669/160           | 3400                | 3000                | 4500                | 56                                      | 10/5/2          | 50              | 70   |
| 123   | 449             | 495              | 23              | 1.8  | K513_0240 LM704U | 960               | 1620              | 24.35 | 11687/480          | 2800                | 2500                | 4000                | 39                                      | 10/5/2          | 50              | 62   |
| 123   | 598             | 694              | 31              | 1.4  | K513_0240 LM706U | 1000              | 1620              | 24.35 | 11687/480          | 2800                | 2500                | 4000                | 57                                      | 10/5/2          | 50              | 70   |
| 136   | 405             | 447              | 23              | 2.0  | K513_0220 LM704U | 870               | 1470              | 21.99 | 2639/120           | 2800                | 2500                | 4000                | 40                                      | 10/5/2          | 50              | 62   |
| 136   | 540             | 627              | 31              | 1.5  | K513_0220 LM706U | 1000              | 1470              | 21.99 | 2639/120           | 2800                | 2500                | 4000                | 57                                      | 10/5/2          | 50              | 70   |
| 155   | 357             | 393              | 24              | 2.1  | K513_0195 LM704U | 760               | 1390              | 19.35 | 27869/1440         | 2800                | 2500                | 4000                | 40                                      | 10/5/2          | 50              | 62   |
| 155   | 475             | 551              | 31              | 1.6  | K513_0195 LM706U | 1000              | 1390              | 19.35 | 27869/1440         | 2800                | 2500                | 4000                | 58                                      | 10/5/2          | 50              | 70   |
| 172   | 322             | 355              | 24              | 2.3  | K513_0175 LM704U | 690               | 1250              | 17.48 | 6293/360           | 2800                | 2500                | 4000                | 41                                      | 10/5/2          | 50              | 62   |
| 172   | 429             | 498              | 31              | 1.7  | K513_0175 LM706U | 1000              | 1250              | 17.48 | 6293/360           | 2800                | 2500                | 4000                | 58                                      | 10/5/2          | 50              | 70   |
| 186   | 296             | 327              | 24              | 2.4  | K513_0160 LM704U | 630               | 1150              | 16.09 | 26071/1620         | 2300                | 2200                | 3600                | 42                                      | 10/5/2          | 50              | 62   |
| 186   | 395             | 458              | 32              | 1.8  | K513_0160 LM706U | 920               | 1150              | 16.09 | 26071/1620         | 2300                | 2200                | 3600                | 59                                      | 10/5/2          | 50              | 70   |
| 206   | 268             | 295              | 24              | 2.6  | K513_0145 LM704U | 570               | 1040              | 14.54 | 5887/405           | 2300                | 2200                | 3600                | 42                                      | 10/5/2          | 50              | 62   |
| 206   | 357             | 414              | 32              | 1.9  | K513_0145 LM706U | 830               | 1040              | 14.54 | 5887/405           | 2300                | 2200                | 3600                | 59                                      | 10/5/2          | 50              | 70   |
| <b>K6 (n<sub>1N</sub> = 3000 rpm, M<sub>2acc,max</sub> = 1600 Nm)</b> |                 |                  |                 |      |                  |                   |                   |       |                    |                     |                     |                     |   |                 |                 |      |
| 18  | 1487            | 1580             | 13              | 0.97 | K614_1670 LM503U | 1600              | 2070              | 166.7 | 86681/520          | 3100                | 2800                | 4000                | 11                                      | 10/6/3          | 83              | 77   |
| 20  | 1322            | 1404             | 12              | 1.1  | K614_1480 LM503U | 1600              | 2170              | 148.2 | 4551637/30720      | 3100                | 2800                | 4000                | 11                                      | 10/6/3          | 83              | 77   |
| 22  | 1194            | 1268             | 12              | 1.2  | K614_1340 LM503U | 1570              | 1960              | 133.8 | 1027789/7680       | 3100                | 2800                | 4000                | 11                                      | 10/6/3          | 83              | 77   |
| 24  | 1099            | 1167             | 11              | 1.3  | K614_1230 LM503U | 1600              | 2000              | 123.2 | 1261297/10240      | 3100                | 2800                | 4000                | 11                                      | 10/6/3          | 83              | 77   |
| 27  | 992             | 1054             | 12              | 1.3  | K614_1110 LM503U | 1450              | 1810              | 111.3 | 284809/2560        | 3100                | 2800                | 4000                | 11                                      | 10/6/3          | 83              | 77   |
| 31  | 865             | 919              | 15              | 1.2  | K613_0950 LM503U | 1290              | 1630              | 95.41 | 293105/3072        | 3100                | 2800                | 4000                | 11                                      | 10/5/2          | 83              | 74   |
| 35  | 781             | 830              | 16              | 1.2  | K613_0860 LM503U | 1170              | 1470              | 86.18 | 66185/768          | 3100                | 2800                | 4000                | 11                                      | 10/5/2          | 83              | 74   |
| 39  | 690             | 733              | 10              | 1.7  | K613_0760 LM503U | 1200              | 1500              | 76.14 | 126697/1664        | 3100                | 2800                | 4000                | 11                                      | 10/5/2          | 83              | 74   |
| 39  | 997             | 1126             | 15              | 1.2  | K613_0760 LM505U | 1200              | 1500              | 76.14 | 126697/1664        | 3100                | 2800                | 4000                | 18                                      | 10/5/2          | 83              | 78   |
| 39  | 1403            | 1548             | 21              | 1.0  | K613_0760 LM704U | 1600              | 2900              | 76.14 | 126697/1664        | 3100                | 2800                | 4000                | 37                                      | 10/5/2          | 83              | 84   |
| 44  | 623             | 662              | 11              | 1.7  | K613_0690 LM503U | 1080              | 1360              | 68.77 | 28609/416          | 3100                | 2800                | 4000                | 11                                      | 10/5/2          | 83              | 74   |
| 44  | 901             | 1017             | 16              | 1.2  | K613_0690 LM505U | 1080              | 1360              | 68.77 | 28609/416          | 3100                | 2800                | 4000                | 18                                      | 10/5/2          | 83              | 78   |
| 44  | 1267            | 1398             | 22              | 1.0  | K613_0690 LM704U | 1580              | 2630              | 68.77 | 28609/416          | 3100                | 2800                | 4000                | 37                                      | 10/5/2          | 83              | 84   |
| 47  | 1174            | 1295             | 19              | 1.2  | K613_0640 LM704U | 1600              | 2900              | 63.71 | 130479/2048        | 3100                | 2800                | 4000                | 38                                      | 10/5/2          | 83              | 84   |
| 52  | 1060            | 1170             | 19              | 1.4  | K613_0580 LM704U | 1600              | 2800              | 57.55 | 29463/512          | 3100                | 2800                | 4000                | 38                                      | 10/5/2          | 83              | 84   |
| 63  | 879             | 970              | 19              | 1.5  | K613_0480 LM704U | 1600              | 2290              | 47.73 | 39711/832          | 3100                | 2800                | 4000                | 38                                      | 10/5/2          | 83              | 84   |
| 63  | 1171            | 1360             | 25              | 1.2  | K613_0480 LM706U | 1600              | 2290              | 47.73 | 39711/832          | 3100                | 2800                | 4000                | 56                                      | 10/5/2          | 83              | 91   |
| 70  | 794             | 876              | 19              | 1.7  | K613_0430 LM704U | 1600              | 2070              | 43.11 | 8967/208           | 3100                | 2800                | 4000                | 38                                      | 10/5/2          | 83              | 84   |
| 70  | 1058            | 1228             | 25              | 1.2  | K613_0430 LM706U | 1600              | 2070              | 43.11 | 8967/208           | 3100                | 2800                | 4000                | 56                                      | 10/5/2          | 83              | 91   |
| 78  | 706             | 779              | 19              | 1.8  | K613_0380 LM704U | 1510              | 2170              | 38.32 | 156953/4096        | 3100                | 2800                | 4000                | 39                                      | 10/5/2          | 83              | 84   |
| 78  | 940             | 1092             | 26              | 1.3  | K613_0380 LM706U | 1600              | 2170              | 38.32 | 156953/4096        | 3100                | 2800                | 4000                | 56                                      | 10/5/2          | 83              | 91   |
| 87  | 638             | 703              | 19              | 1.9  | K613_0350 LM704U | 1360              | 1960              | 34.61 | 35441/1024         | 3100                | 2800                | 4000                | 39                                      | 10/5/2          | 83              | 84   |
| 87  | 849             | 986              | 26              | 1.4  | K613_0350 LM706U | 1570              | 1960              | 34.61 | 35441/1024         | 3100                | 2800                | 4000                | 57                                      | 10/5/2          | 83              | 91   |
| 94  | 587             | 647              | 19              | 2.0  | K613_0320 LM704U | 1250              | 2000              | 31.86 | 130479/4096        | 3100                | 2800                | 4000                | 40                                      | 10/5/2          | 83              | 84   |
| 94  | 782             | 908              | 26              | 1.5  | K613_0320 LM706U | 1600              | 2000              | 31.86 | 130479/4096        | 3100                | 2800                | 4000                | 57                                      | 10/5/2          | 83              | 91   |
| 104   | 530             | 585              | 19              | 2.2  | K613_0290 LM704U | 1130              | 1810              | 28.77 | 29463/1024         | 3100                | 2800                | 4000                | 40                                      | 10/5/2          | 83              | 84   |
| 104   | 706             | 820              | 26              | 1.6  | K613_0290 LM706U | 1450              | 1810              | 28.77 | 29463/1024         | 3100                | 2800                | 4000                | 58                                      | 10/5/2          | 83              | 91   |
| 158   | 350             | 386              | 20              | 2.9  | K613_0190 LM704U | 750               | 1360              | 18.99 | 17019/896          | 2600                | 2300                | 3600                | 44                                      | 10/5/2          | 83              | 84   |
| 158   | 466             | 541              | 26              | 2.1  | K613_0190 LM706U | 1090              | 1360              | 18.99 | 17019/896          | 2600                | 2300                | 3600                | 61                                      | 10/5/2          | 83              | 91   |
| 175   | 316             | 349              | 20              | 3.1  | K613_0170 LM704U | 680               | 1230              | 17.16 | 549/32             | 2600                | 2300                | 3600                | 45                                      | 10/5/2          | 83              | 84   |
| 175   | 421             | 489              | 26              | 2.3  | K613_0170 LM706U | 980               | 1230              | 17.16 | 549/32             | 2600                | 2300                | 3600                | 62                                      | 10/5/2          | 83              | 91   |
| <b>K7 (n<sub>1N</sub> = 3000 rpm, M<sub>2acc,max</sub> = 2600 Nm)</b> |                 |                  |                 |      |                  |                   |                   |       |                    |                     |                     |                     |   |                 |                 |      |
| 16  | 1721            | 1828             | 11              | 1.1  | K714_1930 LM503U | 1940              | 2420              | 192.9 | 320943/1664        | 2900                | 2600                | 3800                | 11                                      | 10/6/3          | 126             | 110  |
| 17  | 1554            | 1651             | 12              | 1.1  | K714_1740 LM503U | 1750              | 2190              | 174.2 | 72471/416          | 2900                | 2600                | 3800                | 11                                      | 10/6/3          | 126             | 110  |
| 20  | 1353            | 1438             | 11              | 1.3  | K714_1520 LM503U | 1800              | 2250              | 151.7 | 24273/160          | 2900                | 2600                | 3800                | 11                                      | 10/6/3          | 126             | 110  |
| 22  | 1222            | 1298             | 12              | 1.3  | K714_1370 LM503U | 1630              | 2030              | 137.0 | 5481/40            | 2900                | 2600                | 3800                | 11                                      | 10/6/3          | 126             | 110  |
| 24  | 2303            | 2541             | 16              | 1.0  | K714_1270 LM704U | 2600              | 4530              | 127.0 | 520149/4096        | 2900                | 2600                | 3800                | 37                                      | 10/6/3          | 126             | 121  |
| 26  | 2080            | 2295             | 15              | 1.2  | K714_1150 LM704U | 2600              | 4090              | 114.7 | 117453/1024        | 2900                | 2600                | 3800                | 37                                      | 10/6/3          | 126             | 121  |
| 30  | 1788            | 1973             | 14              | 1.3  | K714_0990 LM704U | 2600              | 3820              | 98.60 | 1009701/10240      | 2900                | 2600                | 3800                | 38                                      | 10/6/3          | 126             | 121  |
| 30  | 1815            | 2003             | 19              | 1.0  | K713_0990 LM704U | 2220              | 3330              | 98.54 | 100905/1024        | 2900                | 2600                | 3800                | 38                                      | 10/5/2          | 126             | 112  |
| 34  | 1615            | 1782             | 15              | 1.4  | K714_0890 LM704U | 2600              | 3450              | 89.06 | 227997/2560        | 2900                | 2600                | 3800                | 38                                      | 10/6/3          | 126             | 121  |
| 34  | 2151            | 2497             | 20              | 1.1  | K714_0890 LM706U | 2600              | 3450              | 89.06 | 227997/2560        | 2900                | 2600                | 3800                | 55                                      | 10/6/3          | 126             | 128  |
| 34  | 1640            | 1809             | 20              | 1.0  | K713_0890 LM704U | 2010              | 3010              | 89.00 | 22785/256          | 2900                | 2600                | 3800                | 38                                      | 10/5/2          | 126             | 112  |
| 38  | 1452            | 1602             | 14              | 1.7  | K713_0790 LM704U | 2520              | 3150              | 78.83 | 20181/256          | 2900                | 2600                | 3800                | 38                                      | 10/5/2          | 126             | 112  |
| 38  | 1935            | 2246             | 18              | 1.2  | K713_0790 LM706U | 2520              | 3150              | 78.83 | 20181/256          | 2900                | 2600                | 3800                | 56                                      | 10/5/2          | 126             | 119  |
| 42  | 1312            | 1447             | 15              | 1.7  | K713_0710 LM704U | 2280              | 2850              | 71.20 | 4557/64            | 2900                | 2600                | 3800                | 38                                      | 10/5/2          | 126             | 112  |
| 42  | 1747            | 2028             | 20              | 1.2  | K713_0710 LM706U | 2280              | 2850              | 71.20 | 4557/64            | 2900                | 2600                | 3800                | 56                                      | 10/5/2          | 126             | 119  |
| 46  | 1195            | 1318             | 13              | 1.9  | K713_0650 LM704U | 2260              | 2830              | 64.85 | 33201/512          | 2900                | 2600                | 3800                | 39                                      | 10/5/2          | 126             | 112  |
| 46  | 1591            | 1847             | 17              | 1.4  | K713_0650 LM706U | 2260              | 2830              | 64.85 | 33201/512          | 2900                | 2600                | 3800                | 56                                      | 10/5/2          | 126             | 119  |
| 51  | 1079            | 1190             | 13              | 1.9  | K713_0590 LM704U | 2040              | 2560              | 58.57 | 7497/128           | 2900                | 2600                | 3800                | 39                                      | 10/5/2          | 126             | 112  |

| $n_{2N}$  | $M_{2N}$ | $M_{2,0}$ | $a_{th}$ | S    | Type             | $M_{2acc}$ | $M_{2NOT}$ | i     | $i_{exakt}$   | $n_{1maxDB}$   | $n_{1maxDB}$       | $n_{1maxZB}$ | $J_1$                                   | $\Delta\varphi_2$ | $C_2$           | m    |
|---|----------|-----------|----------|------|------------------|------------|------------|-------|---------------|----------------|--------------------|--------------|---|-------------------|-----------------|------|
| [rpm]   | [Nm]     | [Nm]      |          |      |                  | [Nm]       | [Nm]       |       |               | EL1,2<br>[rpm] | EL3,4,5,6<br>[rpm] | [rpm]        | [10 <sup>-4</sup><br>kgm <sup>2</sup> ] | [arcmin]          | [Nm/<br>arcmin] | [kg] |
| <b>K7 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 2600</math> Nm)</b> |          |           |          |      |                  |            |            |       |               |                |                    |              |   |                   |                 |      |
| 51  | 1437     | 1669      | 17       | 1.4  | K713_0590 LM706U | 2040       | 2560       | 58.57 | 7497/128      | 2900           | 2600               | 3800         | 56                                      | 10/5/2            | 126             | 119  |
| 60  | 919      | 1014      | 13       | 2.1  | K713_0500 LM704U | 1940       | 2420       | 49.88 | 166005/3328   | 2900           | 2600               | 3800         | 40                                      | 10/5/2            | 126             | 112  |
| 60  | 1224     | 1421      | 17       | 1.6  | K713_0500 LM706U | 1940       | 2420       | 49.88 | 166005/3328   | 2900           | 2600               | 3800         | 58                                      | 10/5/2            | 126             | 119  |
| 67  | 830      | 916       | 13       | 2.1  | K713_0450 LM704U | 1750       | 2190       | 45.05 | 37485/832     | 2900           | 2600               | 3800         | 40                                      | 10/5/2            | 126             | 112  |
| 67  | 1106     | 1284      | 17       | 1.6  | K713_0450 LM706U | 1750       | 2190       | 45.05 | 37485/832     | 2900           | 2600               | 3800         | 58                                      | 10/5/2            | 126             | 119  |
| 76  | 723      | 797       | 13       | 2.5  | K713_0390 LM704U | 1540       | 2250       | 39.23 | 2511/64       | 2900           | 2600               | 3800         | 42                                      | 10/5/2            | 126             | 112  |
| 76  | 963      | 1118      | 17       | 1.9  | K713_0390 LM706U | 1800       | 2250       | 39.23 | 2511/64       | 2900           | 2600               | 3800         | 60                                      | 10/5/2            | 126             | 119  |
| 85  | 653      | 720       | 13       | 2.5  | K713_0350 LM704U | 1390       | 2030       | 35.44 | 567/16        | 2900           | 2600               | 3800         | 42                                      | 10/5/2            | 126             | 112  |
| 85  | 870      | 1010      | 17       | 1.9  | K713_0350 LM706U | 1630       | 2030       | 35.44 | 567/16        | 2900           | 2600               | 3800         | 60                                      | 10/5/2            | 126             | 119  |
| <b>K8 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 4650</math> Nm)</b> |          |           |          |      |                  |            |            |       |               |                |                    |              |   |                   |                 |      |
| 13  | 4196     | 4629      | 14       | 0.81 | K814_2310 LM704U | 4650       | 6390       | 231.4 | 1999333/8640  | 2800           | 2500               | 3600         | 37                                      | 10/6/3            | 196             | 179  |
| 16  | 3479     | 3839      | 13       | 1.0  | K814_1920 LM704U | 4650       | 6040       | 191.9 | 85963/448     | 2800           | 2500               | 3600         | 38                                      | 10/6/3            | 196             | 179  |
| 17  | 3143     | 3467      | 14       | 1.0  | K814_1730 LM704U | 4370       | 5460       | 173.3 | 2773/16       | 2800           | 2500               | 3600         | 38                                      | 10/6/3            | 196             | 179  |
| 19  | 2842     | 3135      | 13       | 1.2  | K814_1570 LM704U | 4300       | 5380       | 156.7 | 601741/3840   | 2800           | 2500               | 3600         | 38                                      | 10/6/3            | 196             | 179  |
| 21  | 2567     | 2832      | 14       | 1.2  | K814_1420 LM704U | 3890       | 4860       | 141.5 | 135877/960    | 2800           | 2500               | 3600         | 38                                      | 10/6/3            | 196             | 179  |
| 24  | 2300     | 2538      | 12       | 1.4  | K814_1270 LM704U | 3930       | 4910       | 126.9 | 1461371/11520 | 2800           | 2500               | 3600         | 38                                      | 10/6/3            | 196             | 179  |
| 24  | 3064     | 3557      | 17       | 1.1  | K814_1270 LM706U | 3930       | 4910       | 126.9 | 1461371/11520 | 2800           | 2500               | 3600         | 55                                      | 10/6/3            | 196             | 186  |
| 26  | 2078     | 2292      | 13       | 1.4  | K814_1150 LM704U | 3550       | 4440       | 114.6 | 329987/2880   | 2800           | 2500               | 3600         | 38                                      | 10/6/3            | 196             | 179  |
| 26  | 2768     | 3213      | 18       | 1.1  | K814_1150 LM706U | 3550       | 4440       | 114.6 | 329987/2880   | 2800           | 2500               | 3600         | 55                                      | 10/6/3            | 196             | 186  |
| 31  | 1790     | 1975      | 12       | 1.6  | K813_0970 LM704U | 2920       | 3650       | 97.17 | 31093/320     | 2800           | 2500               | 3600         | 39                                      | 10/5/2            | 196             | 166  |
| 31  | 2385     | 2768      | 16       | 1.2  | K813_0970 LM706U | 2920       | 3650       | 97.17 | 31093/320     | 2800           | 2500               | 3600         | 56                                      | 10/5/2            | 196             | 173  |
| 34  | 1617     | 1784      | 13       | 1.6  | K813_0880 LM704U | 2640       | 3300       | 87.76 | 7021/80       | 2800           | 2500               | 3600         | 39                                      | 10/5/2            | 196             | 166  |
| 34  | 2154     | 2500      | 17       | 1.2  | K813_0880 LM706U | 2640       | 3300       | 87.76 | 7021/80       | 2800           | 2500               | 3600         | 57                                      | 10/5/2            | 196             | 173  |
| 38  | 1462     | 1613      | 8.9      | 1.8  | K813_0790 LM704U | 2630       | 3290       | 79.38 | 45725/576     | 2800           | 2500               | 3600         | 40                                      | 10/5/2            | 196             | 166  |
| 38  | 1948     | 2262      | 12       | 1.4  | K813_0790 LM706U | 2630       | 3290       | 79.38 | 45725/576     | 2800           | 2500               | 3600         | 58                                      | 10/5/2            | 196             | 173  |
| 42  | 1321     | 1457      | 9.6      | 1.8  | K813_0720 LM704U | 2380       | 2970       | 71.70 | 10325/144     | 2800           | 2500               | 3600         | 40                                      | 10/5/2            | 196             | 166  |
| 42  | 1760     | 2043      | 13       | 1.4  | K813_0720 LM706U | 2380       | 2970       | 71.70 | 10325/144     | 2800           | 2500               | 3600         | 58                                      | 10/5/2            | 196             | 173  |
| 61  | 903      | 996       | 7.9      | 2.4  | K813_0490 LM704U | 1930       | 2690       | 48.99 | 5487/112      | 2800           | 2500               | 3600         | 45                                      | 10/5/2            | 196             | 166  |
| 61  | 1202     | 1396      | 11       | 1.8  | K813_0490 LM706U | 2160       | 2690       | 48.99 | 5487/112      | 2800           | 2500               | 3600         | 63                                      | 10/5/2            | 196             | 173  |
| 68  | 815      | 899       | 8.0      | 2.4  | K813_0440 LM704U | 1740       | 2430       | 44.25 | 177/4         | 2800           | 2500               | 3600         | 46                                      | 10/5/2            | 196             | 166  |
| 68  | 1086     | 1261      | 11       | 1.8  | K813_0440 LM706U | 1950       | 2430       | 44.25 | 177/4         | 2800           | 2500               | 3600         | 63                                      | 10/5/2            | 196             | 173  |
| <b>K9 (<math>n_{1N} = 3000</math> rpm, <math>M_{2acc,max} = 6820</math> Nm)</b> |          |           |          |      |                  |            |            |       |               |                |                    |              |   |                   |                 |      |
| 10  | 5327     | 5877      | 12       | 0.85 | K914_2940 LM704U | 6820       | 8530       | 293.8 | 977647/3328   | 2600           | 2500               | 3400         | 38                                      | 10/5              | 379             | 293  |
| 12  | 4479     | 4942      | 12       | 0.97 | K914_2470 LM704U | 5730       | 7170       | 247.0 | 3288449/13312 | 2600           | 2500               | 3400         | 38                                      | 10/5              | 379             | 293  |
| 16  | 3476     | 3834      | 12       | 1.2  | K914_1920 LM704U | 5070       | 6340       | 191.7 | 4710481/24576 | 2600           | 2500               | 3400         | 38                                      | 10/5              | 379             | 293  |
| 20  | 2702     | 2981      | 12       | 1.4  | K914_1490 LM704U | 4600       | 5750       | 149.0 | 9154331/61440 | 2600           | 2500               | 3400         | 39                                      | 10/5              | 379             | 293  |
| 20  | 3599     | 4178      | 16       | 1.1  | K914_1490 LM706U | 4600       | 5750       | 149.0 | 9154331/61440 | 2600           | 2500               | 3400         | 56                                      | 10/5              | 379             | 300  |
| 24  | 2281     | 2516      | 12       | 1.6  | K914_1260 LM704U | 3900       | 4870       | 125.8 | 2221925/17664 | 2600           | 2500               | 3400         | 40                                      | 10/5              | 379             | 293  |
| 24  | 3038     | 3527      | 15       | 1.2  | K914_1260 LM706U | 3900       | 4870       | 125.8 | 2221925/17664 | 2600           | 2500               | 3400         | 57                                      | 10/5              | 379             | 300  |
| 32  | 1700     | 1876      | 14       | 1.7  | K914_0940 LM704U | 2910       | 3630       | 93.78 | 4177219/44544 | 2600           | 2500               | 3400         | 41                                      | 10/5              | 379             | 293  |
| 32  | 2265     | 2630      | 18       | 1.3  | K914_0940 LM706U | 2910       | 3630       | 93.78 | 4177219/44544 | 2600           | 2500               | 3400         | 58                                      | 10/5              | 379             | 300  |





## 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 gear unit 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 <http://configurator.stoeber.de>.

Combination options and the dimensions of forced ventilated geared motors can be found at <http://cad.stoeber.de>.

### 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 $\varnothing$ fit $\leq$ 50 mm | DIN 748-1, ISO k6       |
| Shaft $\varnothing$ fit $>$ 50 mm    | DIN 748-1, ISO m6       |
| Feather keys                         | DIN 6885-1, high form A |

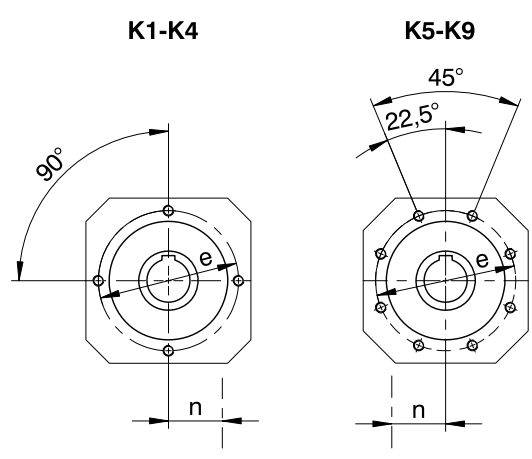
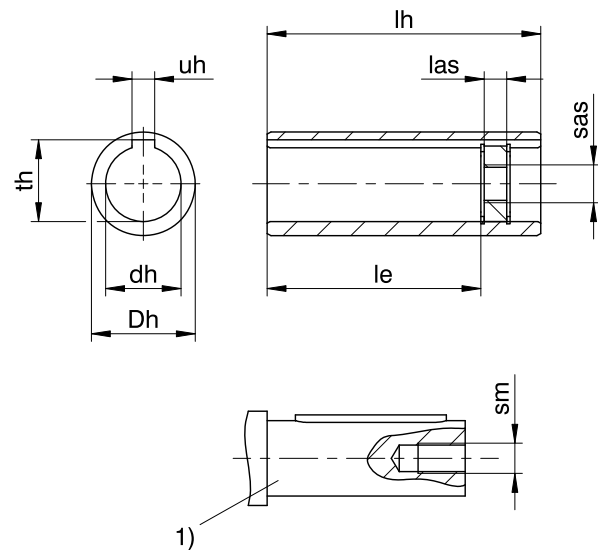
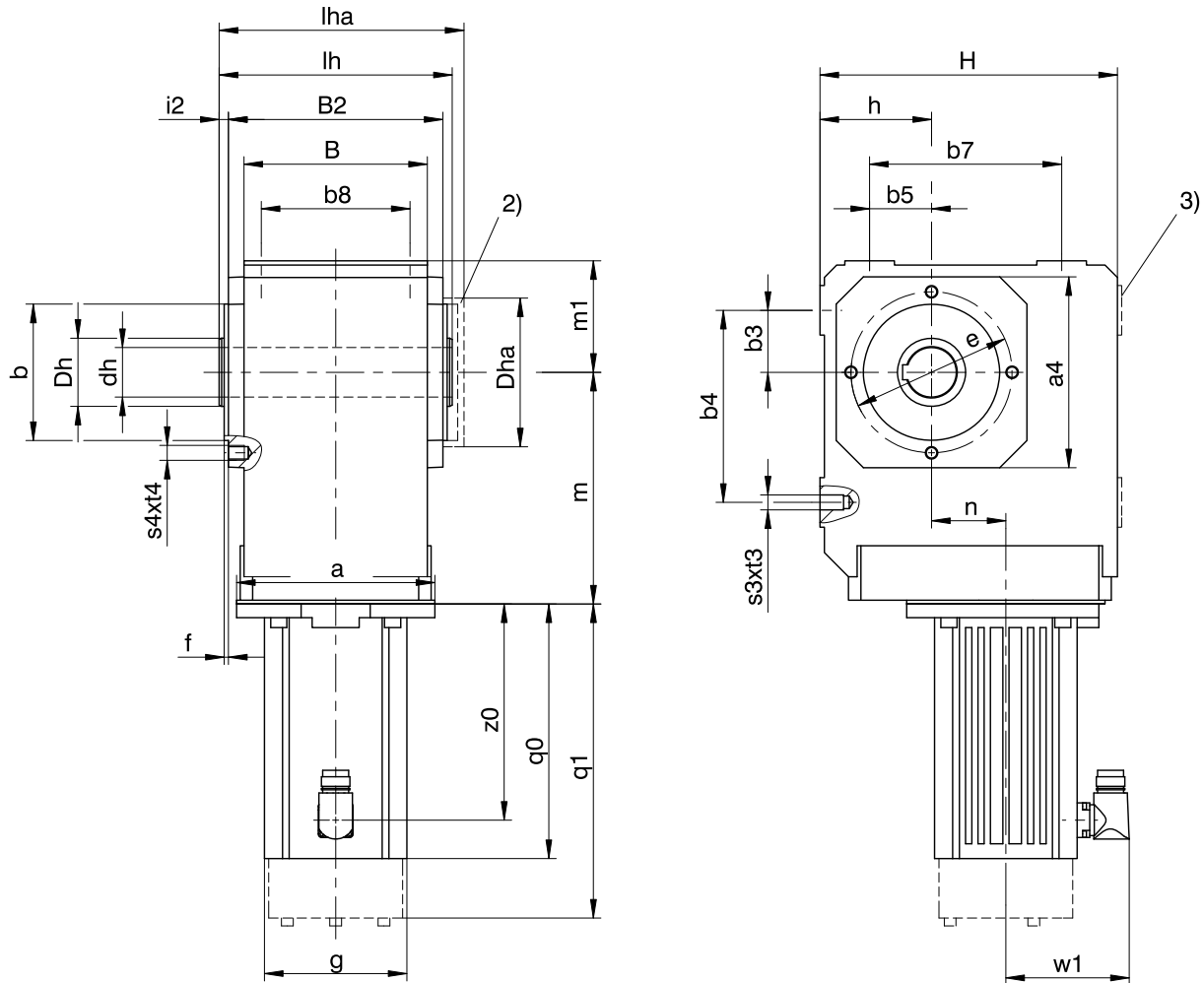
| Hollow shaft          | Tolerance   |
|-----------------------|---|
| Hollow shaft hole fit | ISO H7  |
| Feather keys          | DIN 6885-1, high form<br>S1/K1 $\varnothing$ 30: DIN 6885-3, low form |

| 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  |

### 12.3.1 A shaft design (hollow shaft), G housing design (pitch circle diameter)



- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- 2) Cover (optional)
- q1 Applies to motors with brake.
- 1) The length of the machine shaft must be at least 2.2 x  $\varnothing dh$  and the length of the feather key must be at least 2 x  $\varnothing dh$ .
- 3) Only for K1 (other sizes on request)



Dimensions of gear units

| 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 <sub>js</sub>  | 30 | 90  | 30  | 90  | 70  | 90  | 106 | 20 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K1   | 105 | 75 <sub>js</sub>  | 30 | 90  | 30  | 90  | 70  | 90  | 106 | 25 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K1   | 105 | 75 <sub>js</sub>  | 30 | 90  | 30  | 90  | 70  | 90  | 106 | 30 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K2   | 116 | 82 <sub>js</sub>  | 35 | 115 | 35  | 115 | 90  | 115 | 134 | 30 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K3   | 132 | 95 <sub>js</sub>  | 40 | 130 | 40  | 130 | 105 | 130 | 146 | 35 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K4   | 152 | 110 <sub>js</sub> | 50 | 155 | 50  | 155 | 120 | 148 | 173 | 40 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K5   | 145 | 110 <sub>js</sub> | 40 | 140 | 100 | 140 | 125 | 160 | 185 | 50 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K6   | 180 | 140 <sub>js</sub> | 50 | 160 | 110 | 160 | 130 | 168 | 200 | 50 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K7   | 195 | 155 <sub>js</sub> | 55 | 180 | 125 | 180 | 145 | 190 | 226 | 60 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K8   | 226 | 185 <sub>js</sub> | 75 | 240 | 165 | 240 | 185 | 235 | 282 | 70 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K9   | 280 | 230 <sub>js</sub> | 95 | 280 | 185 | 280 | 225 | 285 | 330 | 90 <sup>H7</sup> | 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 <sup>JS9</sup> |

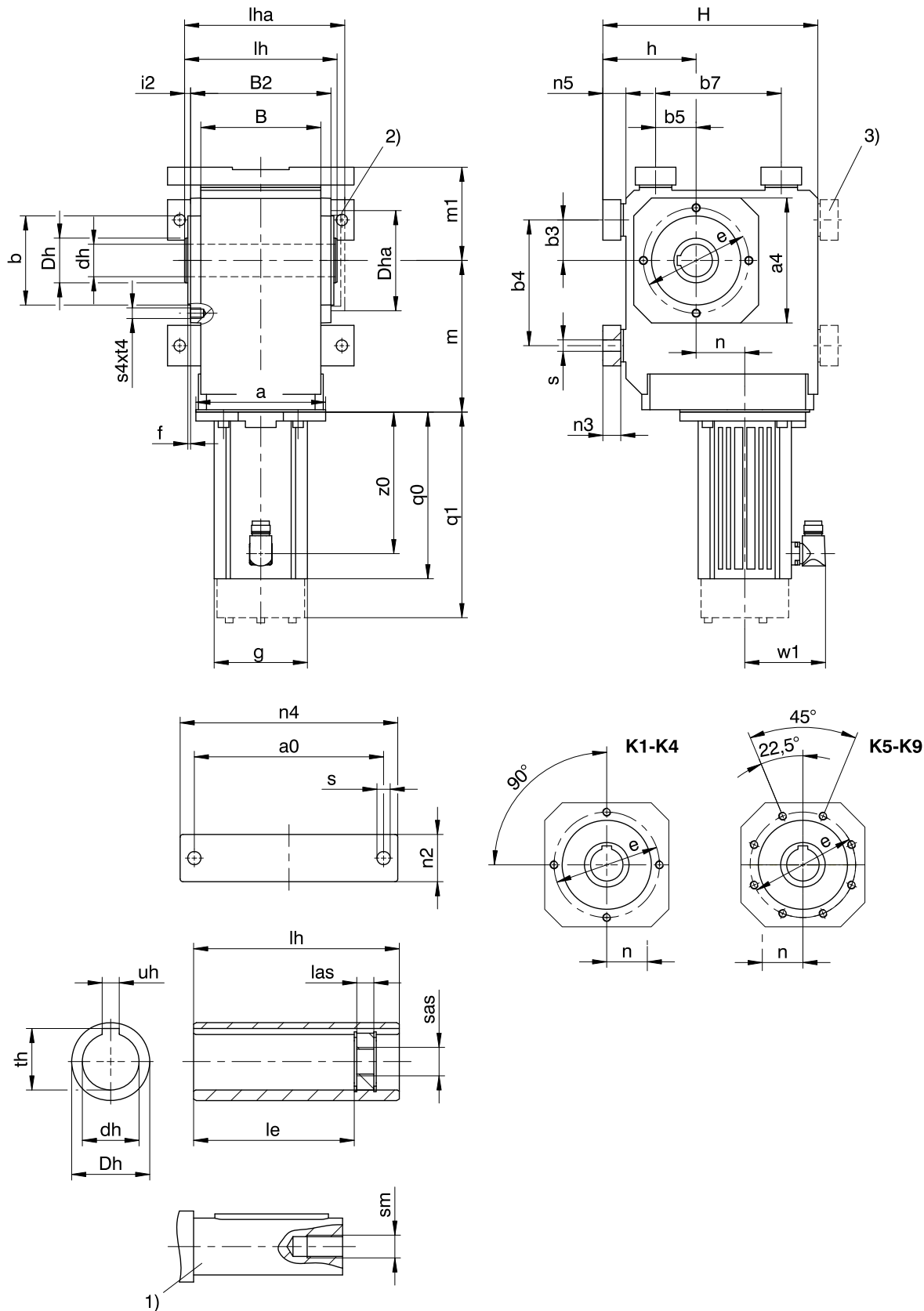
Dimensions of motors

| 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 |

### 12.3.2 A shaft design (hollow shaft), NG housing design (base + pitch circle diameter)



- |       |  |       |   |
|-------|--|-------|---|
| $q_0$ | Applies to motors without brake.                       | $q_1$ | Applies to motors with brake.   |
| $x$   | Applies to encoders using an optical measuring method. | 1)    | The length of the machine shaft must be at least $2.2 \times \varnothing d_h$ and the length of the feather key must be at least $2 \times \varnothing d_h$ . |
| 2)    | Cover (optional)                                       | 3)    | Only for K1 (other sizes on request)  |

Dimensions of gear units

| 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 <sub>f6</sub>  | 30 | 90  | 30  | 90  | 90  | 106 | 20 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K1   | 115 | 105 | 75 <sub>f6</sub>  | 30 | 90  | 30  | 90  | 90  | 106 | 25 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K1   | 115 | 105 | 75 <sub>f6</sub>  | 30 | 90  | 30  | 90  | 90  | 106 | 30 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K2   | 155 | 116 | 82 <sub>f6</sub>  | 35 | 115 | 35  | 115 | 115 | 134 | 30 <sup>H7</sup> | 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 <sup>JS9</sup>  |
| K3   | 170 | 132 | 95 <sub>f6</sub>  | 40 | 130 | 40  | 130 | 130 | 146 | 35 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K4   | 200 | 152 | 110 <sub>f6</sub> | 50 | 155 | 50  | 155 | 148 | 173 | 40 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K5   | 200 | 145 | 110 <sub>f6</sub> | 40 | 140 | 100 | 140 | 160 | 185 | 50 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K6   | 210 | 180 | 140 <sub>f6</sub> | 50 | 160 | 110 | 160 | 168 | 200 | 50 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K7   | 241 | 195 | 155 <sub>f6</sub> | 55 | 180 | 125 | 180 | 190 | 226 | 60 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K8   | 300 | 226 | 185 <sub>f6</sub> | 75 | 240 | 165 | 240 | 235 | 282 | 70 <sup>H7</sup> | 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 <sup>JS9</sup> |
| K9   | 360 | 280 | 230 <sub>f6</sub> | 95 | 280 | 185 | 280 | 285 | 330 | 90 <sup>H7</sup> | 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 <sup>JS9</sup> |

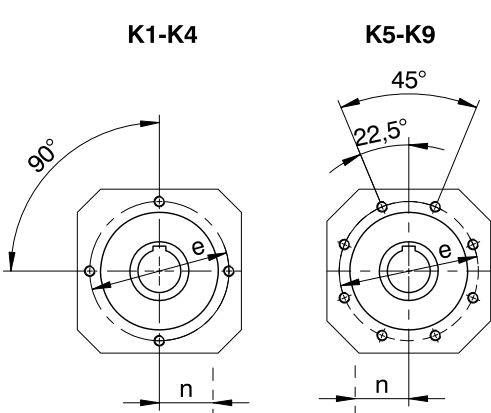
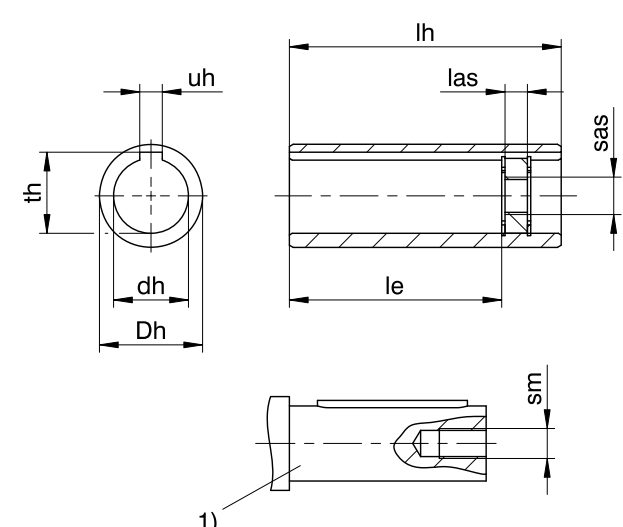
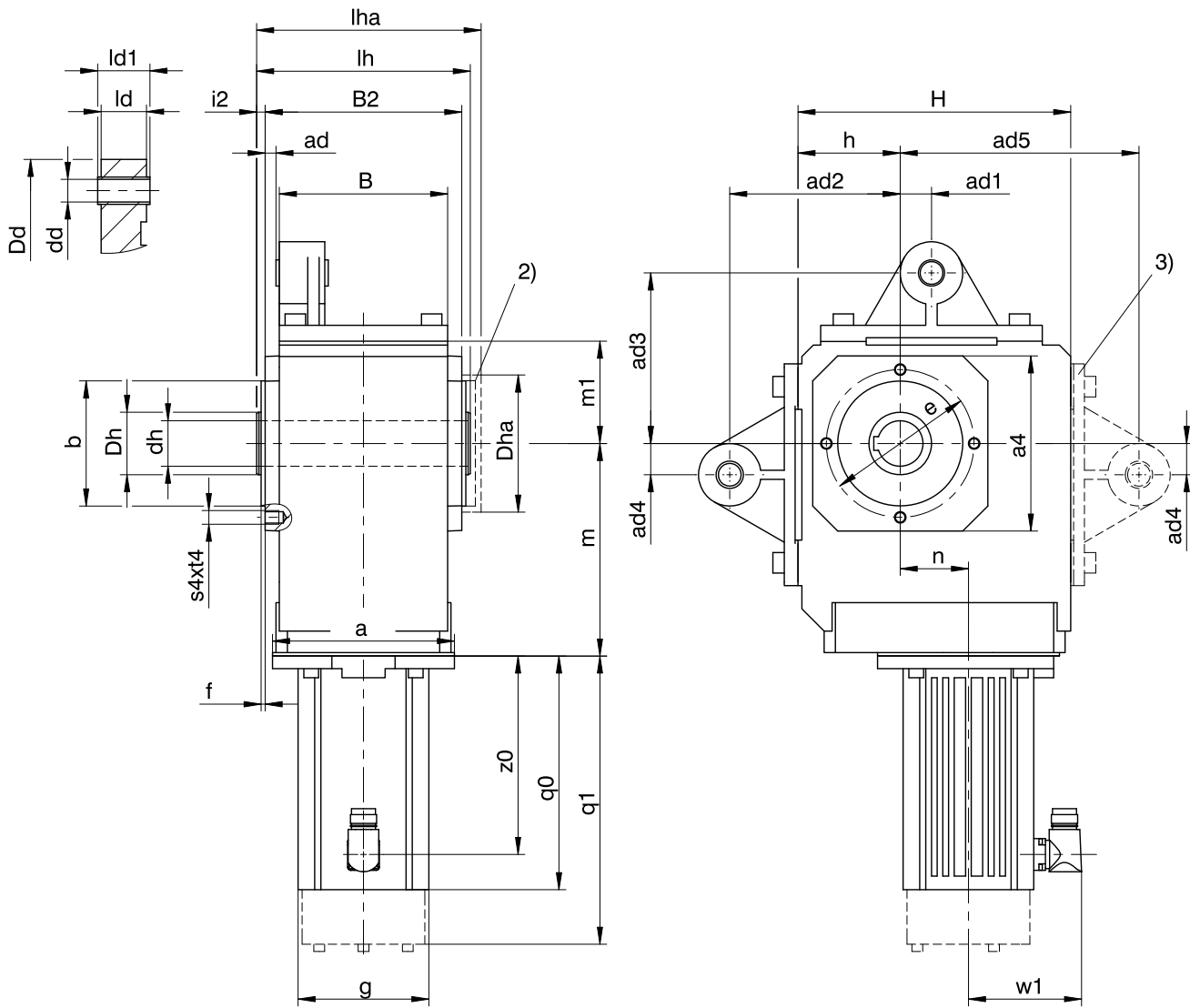
Dimensions of motors

| 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 |

### 12.3.3 A shaft design (hollow shaft), GD housing design (pitch circle diameter + torque arm bracket)



- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- 2) Cover (optional)
- q1 Applies to motors with brake.
- 1) The length of the machine shaft must be at least 2.2 x  $\varnothing dh$  and the length of the feather key must be at least 2 x  $\varnothing dh$ .
- 3) Only for K1 (other sizes on request)

- If you brace the gear units without the factory-adjusted torque arms provided for this purpose, the dimensions for ad2 and ad3 must meet the specified value.

## Dimensions of gear units

| Type | □a4 | ad   | ad1  | ad2 | ad3 | ad4  | ad5 | Øb               | B   | B2  | Ødd              | Ødh              | ØDd | ØDh | Dha  | Øe  | f   |
|------|-----|------|------|-----|-----|------|-----|------------------|-----|-----|------------------|------------------|-----|-----|------|-----|-----|
| K1   | 105 | 6.0  | 15.0 | 90  | 90  | 15.0 | 130 | 75 <sub>6</sub>  | 90  | 106 | 12 <sup>H9</sup> | 20 <sup>H7</sup> | 43  | 40  | □105 | 90  | 3.0 |
| K1   | 105 | 6.0  | 15.0 | 90  | 90  | 15.0 | 130 | 75 <sub>6</sub>  | 90  | 106 | 12 <sup>H9</sup> | 25 <sup>H7</sup> | 43  | 40  | □105 | 90  | 3.0 |
| K1   | 105 | 6.0  | 15.0 | 90  | 90  | 15.0 | 130 | 75 <sub>6</sub>  | 90  | 106 | 12 <sup>H9</sup> | 30 <sup>H7</sup> | 43  | 40  | □105 | 90  | 3.0 |
| K2   | 116 | 6.5  | 22.5 | 100 | 100 | 22.5 | -   | 82 <sub>6</sub>  | 115 | 134 | 16 <sup>H9</sup> | 30 <sup>H7</sup> | 45  | 45  | □116 | 100 | 3.0 |
| K3   | 132 | 5.0  | 25.0 | 120 | 120 | 25.0 | -   | 95 <sub>6</sub>  | 130 | 146 | 16 <sup>H9</sup> | 35 <sup>H7</sup> | 45  | 50  | □132 | 115 | 3.0 |
| K4   | 152 | 9.5  | 27.5 | 150 | 150 | 27.5 | -   | 110 <sub>6</sub> | 148 | 173 | 20 <sup>H9</sup> | 40 <sup>H7</sup> | 55  | 55  | □152 | 130 | 3.5 |
| K5   | 145 | 9.5  | 30.0 | 250 | 190 | 30.0 | -   | 110 <sub>6</sub> | 160 | 185 | 20 <sup>H9</sup> | 50 <sup>H7</sup> | 58  | 65  | □145 | 130 | 3.5 |
| K6   | 180 | 13.0 | 30.0 | 250 | 180 | 30.0 | -   | 140 <sub>6</sub> | 168 | 200 | 20 <sup>H9</sup> | 50 <sup>H7</sup> | 58  | 70  | Ø183 | 165 | 3.5 |
| K7   | 195 | 15.0 | 35.0 | 300 | 213 | 35.0 | -   | 155 <sub>6</sub> | 190 | 226 | 20 <sup>H9</sup> | 60 <sup>H7</sup> | 68  | 85  | Ø205 | 185 | 3.5 |
| K8   | 226 | 17.0 | 45.0 | 350 | 230 | 45.0 | -   | 185 <sub>6</sub> | 235 | 282 | 24 <sup>H9</sup> | 70 <sup>H7</sup> | 72  | 100 | Ø184 | 215 | 4.0 |
| K9   | 280 | 16.0 | 45.0 | 450 | 315 | 45.0 | -   | 230 <sub>6</sub> | 285 | 330 | 24 <sup>H9</sup> | 90 <sup>H7</sup> | 75  | 120 | Ø230 | 265 | 5.0 |

## Dimensions of gear units

| 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 <sup>JS9</sup>  |
| K1   | 60  | 160 | 7.0  | 24  | 28  | 98.0  | 120 | 12  | 127.0 | 60  | M8  | M10 | M12 | 13 | 28.3 | 8 <sup>JS9</sup>  |
| K1   | 60  | 160 | 7.0  | 24  | 28  | 93.5  | 120 | 12  | 127.0 | 60  | M8  | M10 | M12 | 13 | 32.0 | 8 <sup>JS9</sup>  |
| K2   | 65  | 190 | 7.0  | 32  | 38  | 121.5 | 148 | 12  | 156.0 | 65  | M8  | M10 | M12 | 13 | 33.3 | 8 <sup>JS9</sup>  |
| K3   | 75  | 213 | 7.0  | 32  | 38  | 125.0 | 160 | 12  | 168.0 | 75  | M8  | M12 | M16 | 13 | 38.3 | 10 <sup>JS9</sup> |
| K4   | 90  | 240 | 7.5  | 40  | 46  | 157.0 | 188 | 12  | 197.5 | 90  | M10 | M16 | M20 | 16 | 43.3 | 12 <sup>JS9</sup> |
| K5   | 160 | 260 | 7.5  | 40  | 46  | 164.0 | 200 | 12  | 209.5 | 100 | M10 | M16 | M20 | 16 | 53.8 | 14 <sup>JS9</sup> |
| K6   | 190 | 310 | 7.5  | 40  | 46  | 179.0 | 215 | 12  | 224.5 | 120 | M10 | M16 | M20 | 16 | 53.8 | 14 <sup>JS9</sup> |
| K7   | 212 | 342 | 8.0  | 64  | 70  | 214.0 | 242 | 12  | 252.0 | 125 | M12 | M20 | M24 | 19 | 64.4 | 18 <sup>JS9</sup> |
| K8   | 265 | 410 | 9.0  | 102 | 115 | 263.0 | 300 | 20  | 311.0 | 145 | M12 | M20 | M24 | 19 | 74.9 | 20 <sup>JS9</sup> |
| K9   | 315 | 495 | 10.0 | 102 | 115 | 302.0 | 350 | 26  | 361.0 | 180 | M16 | M24 | M30 | 26 | 95.4 | 25 <sup>JS9</sup> |

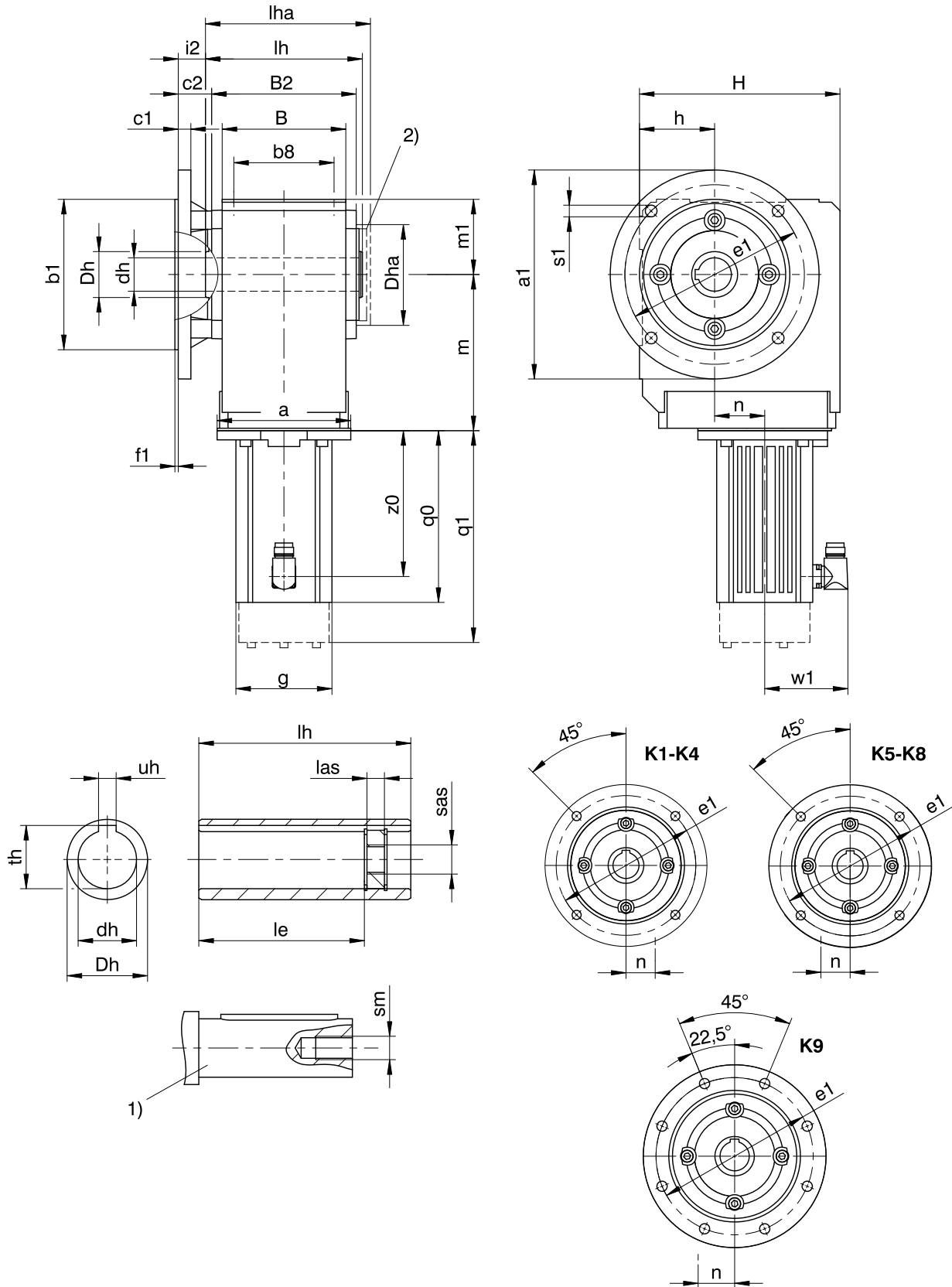
## Dimensions of motors

| 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 |

### 12.3.4 A shaft design (hollow shaft), F housing design (round flange)



q0 Applies to motors without brake.

x Applies to encoders using an optical measuring method.

2) Cover (optional)

q1 Applies to motors with brake.

1) The length of the machine shaft must be at least  $2.2 \times \varnothing d_h$  and the length of the feather key must be at least  $2 \times \varnothing d_h$ .

Dimensions of gear units

| Type | Øa1 | Øb1               | b8  | B   | B2  | c1 | c2   | Ødh              | ØDh | Dha  | Øe1 | f1  | h   | H   | i2   | le    | lh  | las | lha   | m1  | Øs1 | sm  | sas | th   | uh                |
|------|-----|-------------------|-----|-----|-----|----|------|------------------|-----|------|-----|-----|-----|-----|------|-------|-----|-----|-------|-----|-----|-----|-----|------|-------------------|
| K1   | 160 | 110 <sub>js</sub> | 70  | 90  | 106 | 10 | 32.0 | 20 <sup>H7</sup> | 40  | □105 | 130 | 3.5 | 60  | 160 | 25.0 | 98.0  | 120 | 12  | 127.0 | 60  | 9   | M6  | M8  | 22.8 | 6 <sup>JS9</sup>  |
| K1   | 160 | 110 <sub>js</sub> | 70  | 90  | 106 | 10 | 32.0 | 25 <sup>H7</sup> | 40  | □105 | 130 | 3.5 | 60  | 160 | 25.0 | 98.0  | 120 | 12  | 127.0 | 60  | 9   | M10 | M12 | 28.3 | 8 <sup>JS9</sup>  |
| K1   | 160 | 110 <sub>js</sub> | 70  | 90  | 106 | 10 | 32.0 | 30 <sup>H7</sup> | 40  | □105 | 130 | 3.5 | 60  | 160 | 25.0 | 93.5  | 120 | 12  | 127.0 | 60  | 9   | M10 | M12 | 32.0 | 8 <sup>JS9</sup>  |
| K2   | 200 | 130 <sub>js</sub> | 90  | 115 | 134 | 12 | 32.0 | 30 <sup>H7</sup> | 45  | □116 | 165 | 3.5 | 65  | 190 | 25.0 | 121.5 | 148 | 12  | 156.0 | 65  | 11  | M10 | M12 | 33.3 | 8 <sup>JS9</sup>  |
| K3   | 200 | 130 <sub>js</sub> | 105 | 130 | 146 | 14 | 38.0 | 35 <sup>H7</sup> | 50  | □132 | 165 | 3.5 | 75  | 213 | 31.0 | 125.0 | 160 | 12  | 168.0 | 75  | 11  | M12 | M16 | 38.3 | 10 <sup>JS9</sup> |
| K4   | 250 | 180 <sub>js</sub> | 120 | 148 | 173 | 15 | 40.0 | 40 <sup>H7</sup> | 55  | □152 | 215 | 4.0 | 90  | 240 | 32.5 | 157.0 | 188 | 12  | 197.5 | 90  | 14  | M16 | M20 | 43.3 | 12 <sup>JS9</sup> |
| K5   | 250 | 180 <sub>js</sub> | 125 | 160 | 185 | 15 | 39.5 | 50 <sup>H7</sup> | 65  | □145 | 215 | 4.0 | 160 | 260 | 32.0 | 164.0 | 200 | 12  | 209.5 | 100 | 14  | M16 | M20 | 53.8 | 14 <sup>JS9</sup> |
| K6   | 300 | 230 <sub>js</sub> | 130 | 168 | 200 | 17 | 36.0 | 50 <sup>H7</sup> | 70  | Ø183 | 265 | 4.0 | 190 | 310 | 28.5 | 179.0 | 215 | 12  | 224.5 | 120 | 14  | M16 | M20 | 53.8 | 14 <sup>JS9</sup> |
| K7   | 350 | 250 <sub>h6</sub> | 145 | 190 | 226 | 18 | 44.0 | 60 <sup>H7</sup> | 85  | Ø205 | 300 | 5.0 | 212 | 342 | 36.0 | 214.0 | 242 | 12  | 252.0 | 125 | 18  | M20 | M24 | 64.4 | 18 <sup>JS9</sup> |
| K8   | 400 | 300 <sub>h6</sub> | 185 | 235 | 282 | 20 | 45.0 | 70 <sup>H7</sup> | 100 | Ø184 | 350 | 5.0 | 265 | 410 | 36.0 | 263.0 | 300 | 20  | 311.0 | 145 | 18  | M20 | M24 | 74.9 | 20 <sup>JS9</sup> |
| K9   | 450 | 350 <sub>h6</sub> | 225 | 285 | 330 | 23 | 50.0 | 90 <sup>H7</sup> | 120 | Ø230 | 400 | 5.0 | 315 | 495 | 40.0 | 302.0 | 350 | 26  | 361.0 | 180 | 18  | M24 | M30 | 95.4 | 25 <sup>JS9</sup> |

Dimensions of additional round flanges

| Type | Øa1 | Øb1               | c1 | Øe1 | f1  | Øs1 |
|------|-----|-------------------|----|-----|-----|-----|
| K1   | 140 | 95 <sub>js</sub>  | 10 | 115 | 3.0 | 9   |
| K2   | 160 | 110 <sub>js</sub> | 12 | 130 | 3.5 | 9   |
| K3   | 160 | 110 <sub>js</sub> | 14 | 130 | 3.5 | 9   |
| K3   | 250 | 180 <sub>js</sub> | 14 | 215 | 4.0 | 14  |
| K8   | 350 | 250 <sub>h6</sub> | 18 | 300 | 5.0 | 18  |
| K8   | 450 | 350 <sub>h6</sub> | 20 | 400 | 5.0 | 18  |

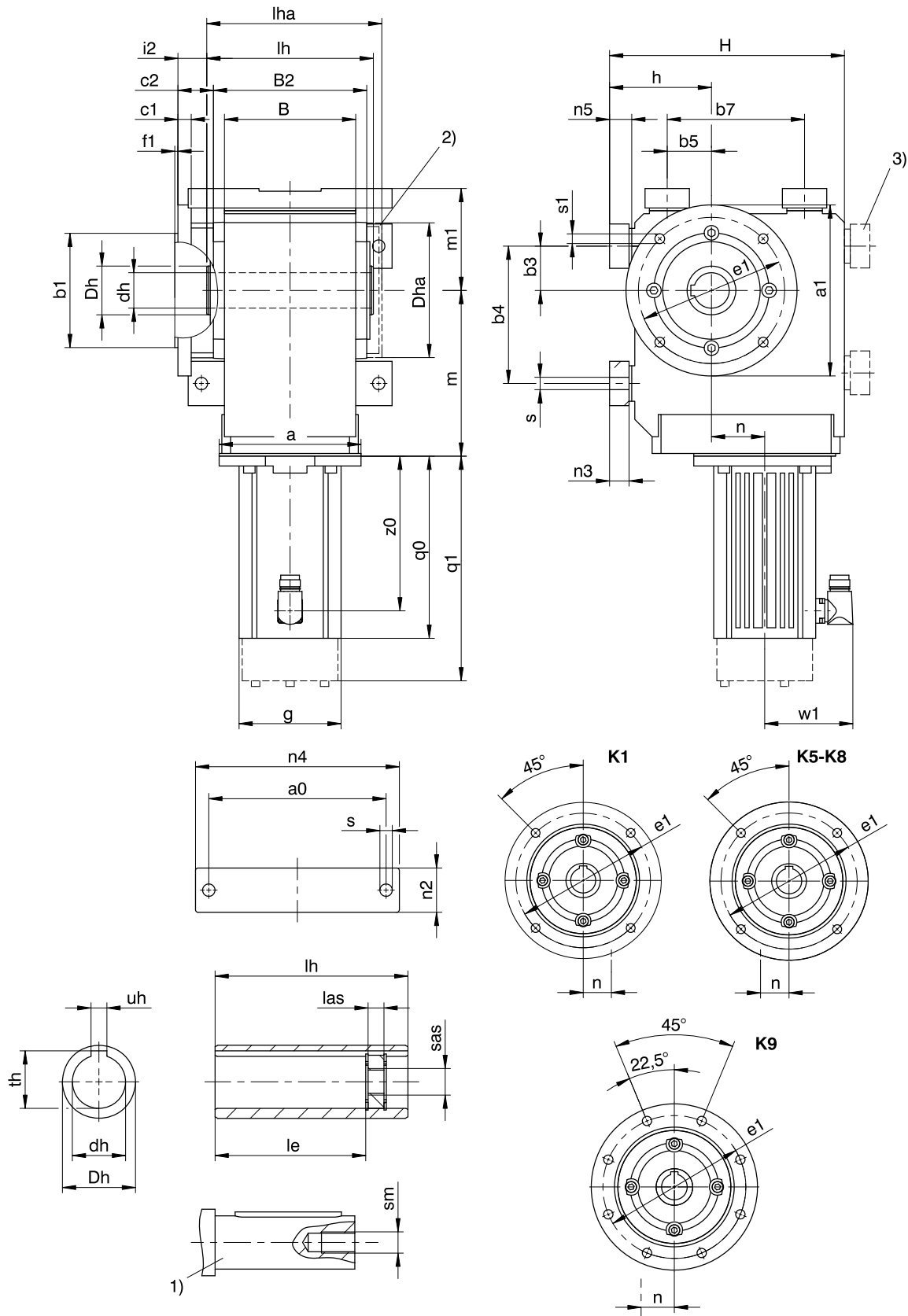
Dimensions of motors

| 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 |

### 12.3.5 A shaft design (hollow shaft), NF housing design (base + round flange)



- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- 2) Cover (optional)
- q1 Applies to motors with brake.
- 1) The length of the machine shaft must be at least  $2.2 \times \varnothing d_h$  and the length of the feather key must be at least  $2 \times \varnothing d_h$ .
- 3) Only for K1 (other sizes on request)



## Dimensions of gear units

| Type | a0  | Øa1 | Øb1               | b3 | b4  | b5  | b7  | B   | B2  | c1 | c2   | Ødh              | ØDh | Dha  | Øe1 | f1  | h   |
|------|-----|-----|-------------------|----|-----|-----|-----|-----|-----|----|------|------------------|-----|------|-----|-----|-----|
| K1   | 115 | 160 | 110 <sub>je</sub> | 30 | 90  | 30  | 90  | 90  | 106 | 10 | 32.0 | 20 <sup>H7</sup> | 40  | □105 | 130 | 3.5 | 75  |
| K1   | 115 | 160 | 110 <sub>je</sub> | 30 | 90  | 30  | 90  | 90  | 106 | 10 | 32.0 | 25 <sup>H7</sup> | 40  | □105 | 130 | 3.5 | 75  |
| K1   | 115 | 160 | 110 <sub>je</sub> | 30 | 90  | 30  | 90  | 90  | 106 | 10 | 32.0 | 30 <sup>H7</sup> | 40  | □105 | 130 | 3.5 | 75  |
| K3   | 170 | 160 | 110 <sub>je</sub> | 40 | 130 | 40  | 130 | 130 | 146 | 14 | 38.0 | 35 <sup>H7</sup> | 50  | □132 | 130 | 3.5 | 98  |
| K5   | 200 | 250 | 180 <sub>je</sub> | 40 | 140 | 100 | 140 | 160 | 185 | 15 | 39.5 | 50 <sup>H7</sup> | 65  | □145 | 215 | 4.0 | 190 |
| K6   | 210 | 300 | 230 <sub>je</sub> | 50 | 160 | 110 | 160 | 168 | 200 | 17 | 36.0 | 50 <sup>H7</sup> | 70  | Ø183 | 265 | 4.0 | 220 |
| K7   | 241 | 350 | 250 <sub>he</sub> | 55 | 180 | 125 | 180 | 190 | 226 | 18 | 44.0 | 60 <sup>H7</sup> | 85  | Ø205 | 300 | 5.0 | 250 |
| K8   | 300 | 400 | 300 <sub>he</sub> | 75 | 240 | 165 | 240 | 235 | 282 | 20 | 45.0 | 70 <sup>H7</sup> | 100 | Ø184 | 350 | 5.0 | 310 |
| K9   | 360 | 450 | 350 <sub>he</sub> | 95 | 280 | 185 | 280 | 285 | 330 | 23 | 50.0 | 90 <sup>H7</sup> | 120 | Ø230 | 400 | 5.0 | 365 |

## Dimensions of gear units

| 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 <sup>JS9</sup>  |
| K1   | 175 | 25.0 | 98.0  | 120 | 12  | 127.0 | 75  | 30 | 13 | 140 | 15 | 9.0  | 9   | M10 | M12 | 28.3 | 8 <sup>JS9</sup>  |
| K1   | 175 | 25.0 | 93.5  | 120 | 12  | 127.0 | 75  | 30 | 13 | 140 | 15 | 9.0  | 9   | M10 | M12 | 32.0 | 8 <sup>JS9</sup>  |
| K3   | 236 | 31.0 | 125.0 | 160 | 12  | 168.0 | 98  | 45 | 20 | 200 | 23 | 11.0 | 9   | M12 | M16 | 38.3 | 10 <sup>JS9</sup> |
| K5   | 290 | 32.0 | 164.0 | 200 | 12  | 209.5 | 130 | 60 | 27 | 240 | 30 | 18.0 | 14  | M16 | M20 | 53.8 | 14 <sup>JS9</sup> |
| K6   | 340 | 28.5 | 179.0 | 215 | 12  | 224.5 | 150 | 65 | 27 | 250 | 30 | 18.5 | 14  | M16 | M20 | 53.8 | 14 <sup>JS9</sup> |
| K7   | 380 | 36.0 | 214.0 | 242 | 12  | 252.0 | 163 | 70 | 35 | 290 | 38 | 23.0 | 18  | M20 | M24 | 64.4 | 18 <sup>JS9</sup> |
| K8   | 455 | 36.0 | 263.0 | 300 | 20  | 311.0 | 190 | 85 | 41 | 360 | 45 | 27.0 | 18  | M20 | M24 | 74.9 | 20 <sup>JS9</sup> |
| K9   | 545 | 40.0 | 302.0 | 350 | 26  | 361.0 | 230 | 95 | 46 | 430 | 50 | 31.0 | 18  | M24 | M30 | 95.4 | 25 <sup>JS9</sup> |

## Dimensions of additional round flanges

| Type | Øa1 | Øb1               | c1 | Øe1 | f1 | Øs1 |
|------|-----|-------------------|----|-----|----|-----|
| K1   | 140 | 95 <sub>je</sub>  | 10 | 115 | 3  | 9   |
| K8   | 350 | 250 <sub>he</sub> | 18 | 300 | 5  | 18  |
| K8   | 450 | 350 <sub>he</sub> | 20 | 400 | 5  | 18  |

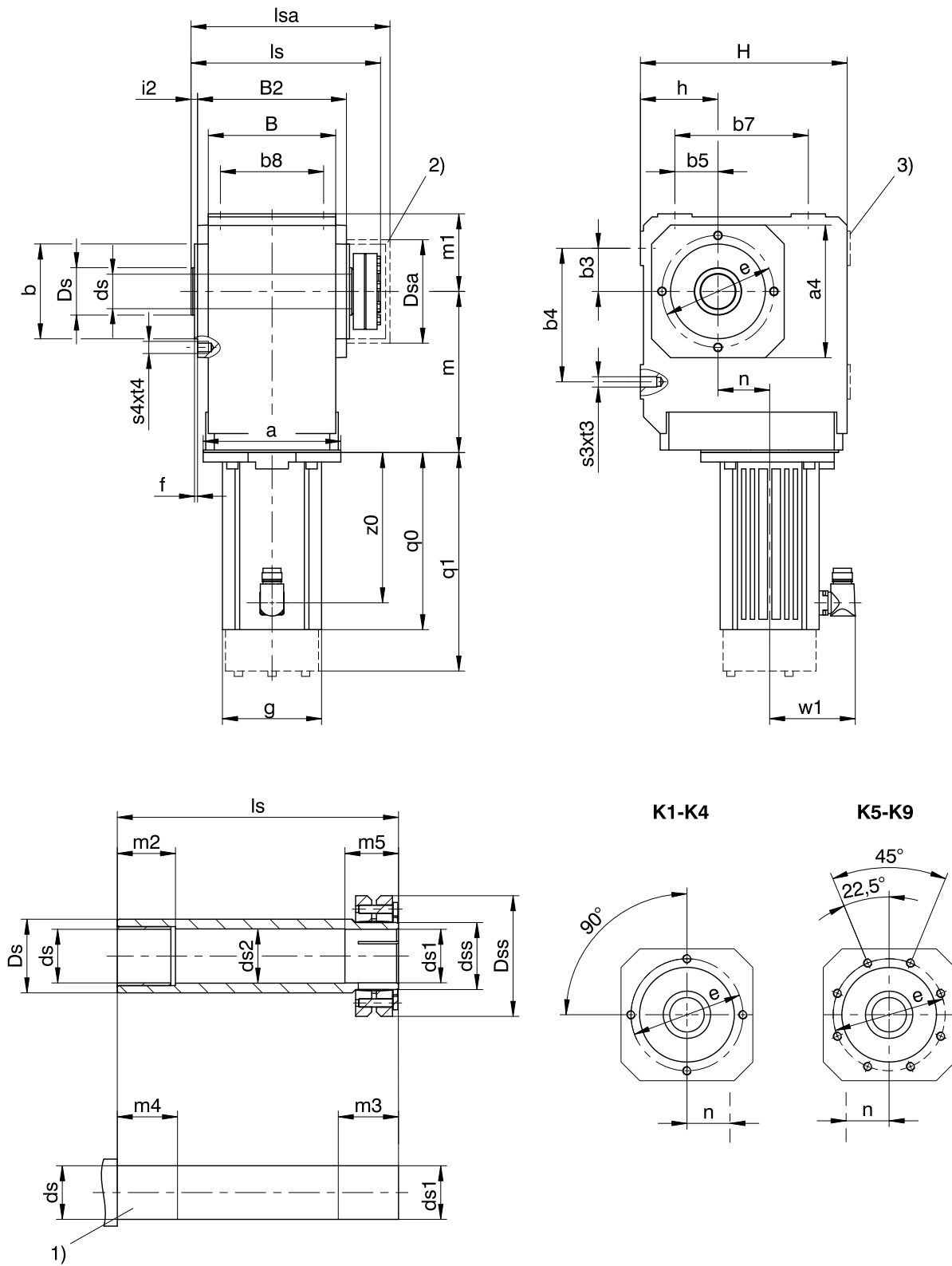
## Dimensions of motors

| 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 | –    | –   | –    |
| K302 | Ø140 | 163 | 52.5 | □115 | 167 | 52.5 | □145 | 169 | 52.5 |
| K303 | Ø140 | 200 | 52.5 | Ø160 | 210 | 16.0 | –    | –   | –    |
| 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 |

### 12.3.6 S shaft design (hollow shaft with shrink disk), G housing design (pitch circle diameter)



- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- 2) Cover (optional)

- q1 Applies to motors with brake.
- 1) Machine shaft: The dimension  $l_s$  must meet or exceed the specified value.
- 3) Only for K1 (other sizes on request)

Dimensions of gear units

| 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 <sub>f6</sub>  | 30 | 90  | 30  | 90  | 70  | 90  | 106 | 25 <sub>h9</sub> | 25 <sub>h7</sub> | 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 <sub>f6</sub>  | 35 | 115 | 35  | 115 | 90  | 115 | 134 | 30 <sub>h9</sub> | 30 <sub>h7</sub> | 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 <sub>f6</sub>  | 40 | 130 | 40  | 130 | 105 | 130 | 146 | 35 <sub>h9</sub> | 35 <sub>h7</sub> | 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 <sub>f6</sub> | 50 | 155 | 50  | 155 | 120 | 148 | 173 | 40 <sub>h9</sub> | 40 <sub>h7</sub> | 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 <sub>f6</sub> | 40 | 140 | 100 | 140 | 125 | 160 | 185 | 50 <sub>h9</sub> | 50 <sub>h7</sub> | 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 <sub>f6</sub> | 50 | 160 | 110 | 160 | 130 | 168 | 200 | 50 <sub>h9</sub> | 50 <sub>h7</sub> | 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 <sub>h6</sub> | 55 | 180 | 125 | 180 | 145 | 190 | 226 | 60 <sub>h6</sub> | 60 <sub>h7</sub> | 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 <sub>h6</sub> | 75 | 240 | 165 | 240 | 185 | 235 | 282 | 70 <sub>h6</sub> | 70 <sub>h7</sub> | 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 <sub>h6</sub> | 95 | 280 | 185 | 280 | 225 | 285 | 330 | 90 <sub>h6</sub> | 90 <sub>h7</sub> | 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 |

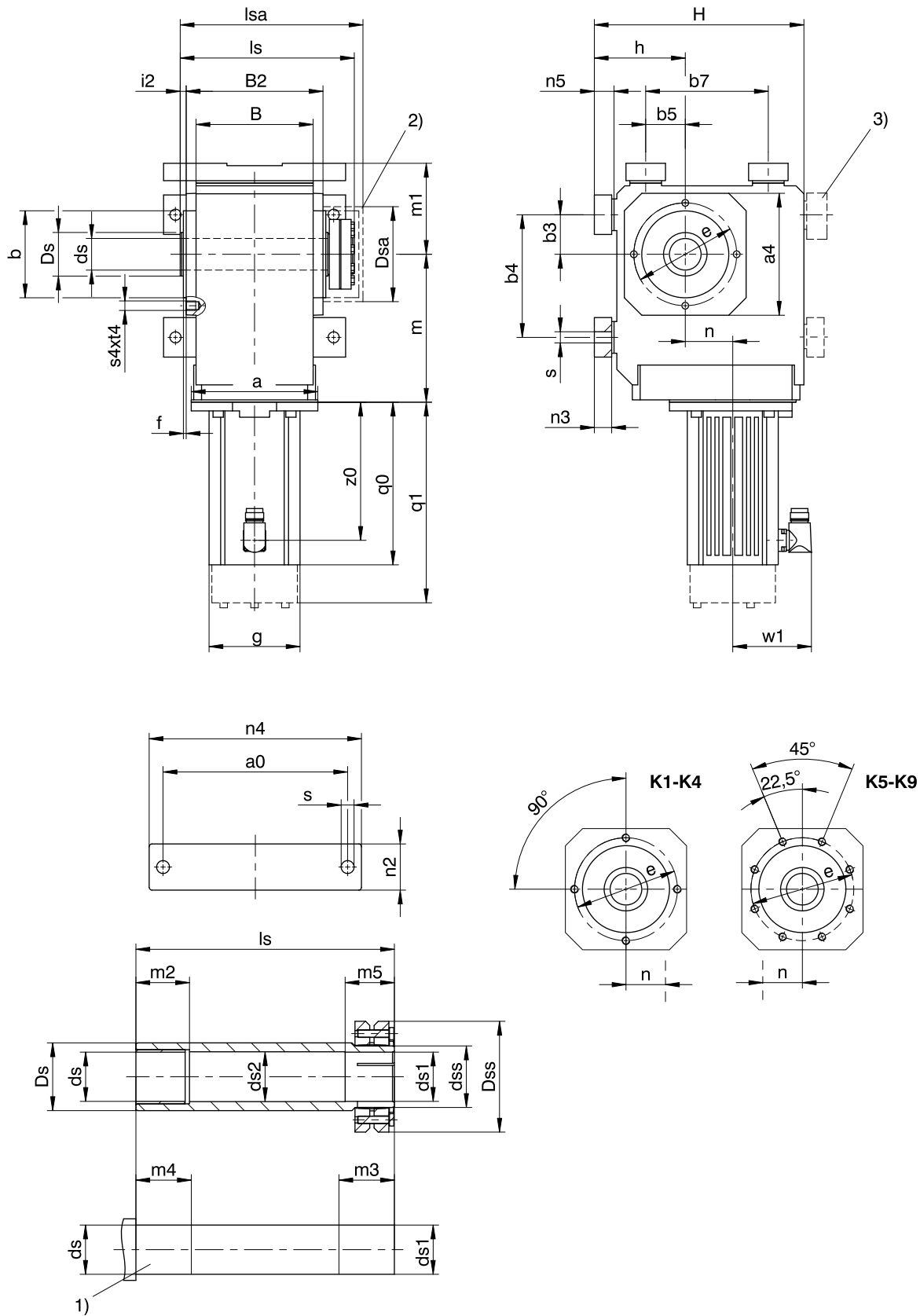
Dimensions of motors

| 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 |

### 12.3.7 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.  |
| x  | Applies to encoders using an optical measuring method. | 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 gear units

| Type | a0  | a4  | Øb                | b3 | b4  | b5  | b7  | B   | B2  | Øds              | Øds1                           | Øds2 | Ødss | ØDs | ØDsa  |
|------|-----|-----|-------------------|----|-----|-----|-----|-----|-----|------------------|--------------------------------|------|------|-----|-------|
| K1   | 115 | 105 | 75 <sub>j6</sub>  | 30 | 90  | 30  | 90  | 90  | 106 | 25 <sub>h9</sub> | 25 <sub>h9</sub> <sup>H7</sup> | 25.5 | 30   | 40  | 80    |
| K2   | 155 | 116 | 82 <sub>j6</sub>  | 35 | 115 | 35  | 115 | 115 | 134 | 30 <sub>h9</sub> | 30 <sub>h9</sub> <sup>H7</sup> | 30.5 | 36   | 45  | 88    |
| K3   | 170 | 132 | 95 <sub>j6</sub>  | 40 | 130 | 40  | 130 | 130 | 146 | 35 <sub>h9</sub> | 35 <sub>h9</sub> <sup>H7</sup> | 35.5 | 44   | 50  | 101   |
| K4   | 200 | 152 | 110 <sub>j6</sub> | 50 | 155 | 50  | 155 | 148 | 173 | 40 <sub>h9</sub> | 40 <sub>h9</sub> <sup>H7</sup> | 40.5 | 50   | 55  | 114   |
| K5   | 200 | 145 | 110 <sub>j6</sub> | 40 | 140 | 100 | 140 | 160 | 185 | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 65  | 116   |
| K6   | 210 | 180 | 140 <sub>j6</sub> | 50 | 160 | 110 | 160 | 168 | 200 | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 70  | 128   |
| K7   | 241 | 195 | 155 <sub>j6</sub> | 55 | 180 | 125 | 180 | 190 | 226 | 60 <sub>h6</sub> | 60 <sub>h6</sub> <sup>H7</sup> | 62.0 | 75   | 85  | 161.5 |
| K8   | 300 | 226 | 185 <sub>j6</sub> | 75 | 240 | 165 | 240 | 235 | 282 | 70 <sub>h6</sub> | 70 <sub>h6</sub> <sup>H7</sup> | 72.0 | 90   | 100 | 193   |
| K9   | 360 | 280 | 230 <sub>j6</sub> | 95 | 280 | 185 | 280 | 285 | 330 | 90 <sub>h6</sub> | 90 <sub>h6</sub> <sup>H7</sup> | 92.0 | 120  | 120 | 244   |

## Dimensions of gear units

| Type | ØDss | Øe  | f   | h   | H   | i2   | ls  | lsa | m1  | m2 | m3 | m4 | m5 | n2 | n3 | n4  | n5 | Øs   | 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 |

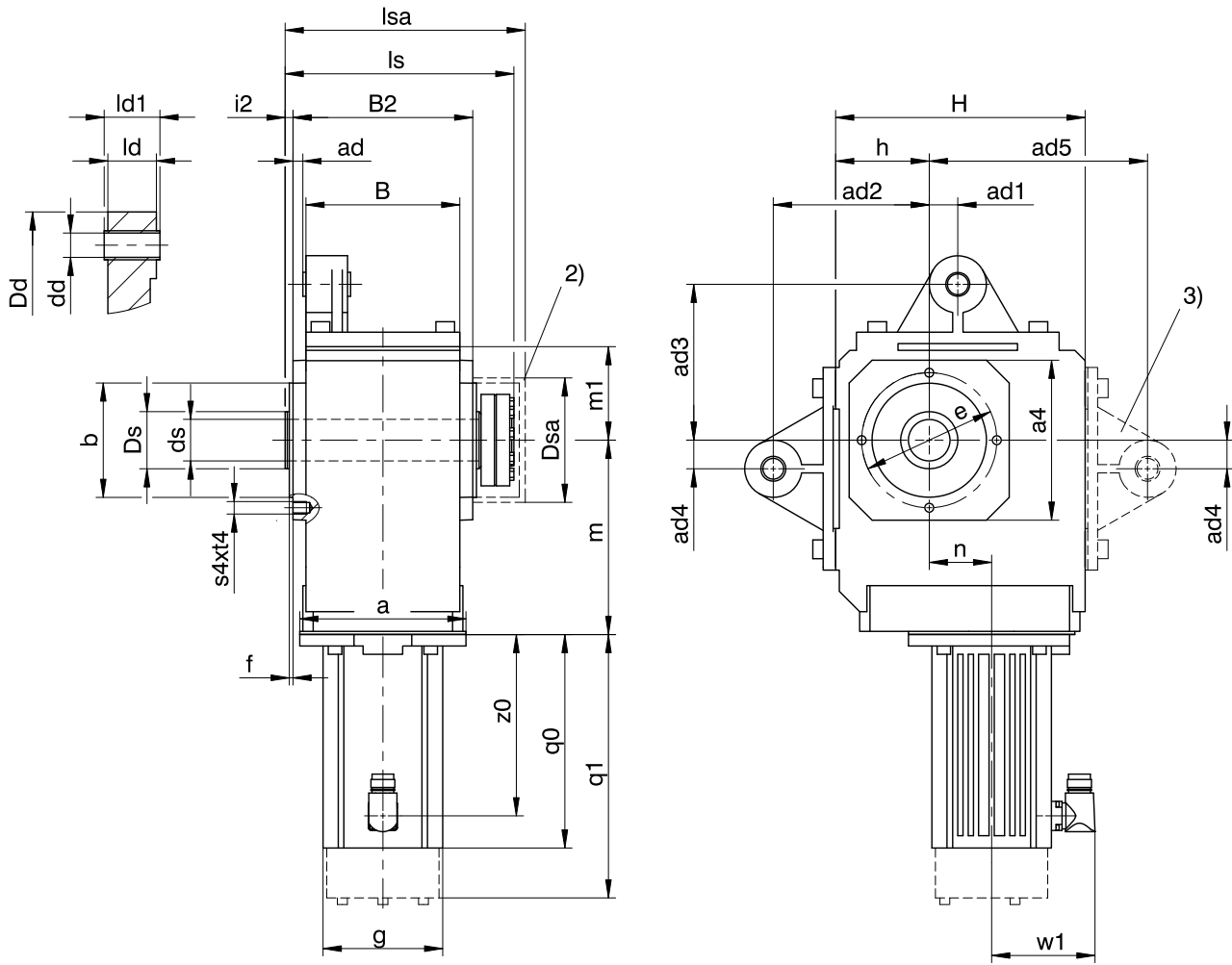
## Dimensions of motors

| 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 | 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 |

### 12.3.8 S shaft design (hollow shaft with shrink disk), GD housing design (pitch circle diameter + torque arm bracket)



K1-K4

K5-K9

- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- 2) Cover (optional)
- If you brace the gear units without the factory-adjusted torque arms provided for this purpose, the dimensions for  $ad_2$  and  $ad_3$  must meet the specified value.
- q1 Applies to motors with brake.
- 1) Machine shaft: The dimension  $l_s$  must meet or exceed the specified value.
- 3) Only for K1 (other sizes on request)

## Dimensions of gear units

| Type | □a4 | ad   | ad1  | ad2 | ad3 | ad4  | ad5 | Øb                | B   | B2  | Ødd              | Øds              | Øds1                           | Øds2 | Ødss | ØDd | ØDs | ØDsa  |
|------|-----|------|------|-----|-----|------|-----|-------------------|-----|-----|------------------|------------------|--------------------------------|------|------|-----|-----|-------|
| K1   | 105 | 6.0  | 15.0 | 90  | 90  | 15.0 | 130 | 75 <sub>f6</sub>  | 90  | 106 | 12 <sup>H9</sup> | 25 <sub>h9</sub> | 25 <sub>h9</sub> <sup>H7</sup> | 25.5 | 30   | 43  | 40  | 80    |
| K2   | 116 | 6.5  | 22.5 | 100 | 100 | 22.5 | –   | 82 <sub>f6</sub>  | 115 | 134 | 16 <sup>H9</sup> | 30 <sub>h9</sub> | 30 <sub>h9</sub> <sup>H7</sup> | 30.5 | 36   | 45  | 45  | 88    |
| K3   | 132 | 5.0  | 25.0 | 120 | 120 | 25.0 | –   | 95 <sub>f6</sub>  | 130 | 146 | 16 <sup>H9</sup> | 35 <sub>h9</sub> | 35 <sub>h9</sub> <sup>H7</sup> | 35.5 | 44   | 45  | 50  | 101   |
| K4   | 152 | 9.5  | 27.5 | 150 | 150 | 27.5 | –   | 110 <sub>f6</sub> | 148 | 173 | 20 <sup>H9</sup> | 40 <sub>h9</sub> | 40 <sub>h9</sub> <sup>H7</sup> | 40.5 | 50   | 55  | 55  | 114   |
| K5   | 145 | 9.5  | 30.0 | 250 | 190 | 30.0 | –   | 110 <sub>f6</sub> | 160 | 185 | 20 <sup>H9</sup> | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 58  | 65  | 116   |
| K6   | 180 | 13.0 | 30.0 | 250 | 180 | 30.0 | –   | 140 <sub>f6</sub> | 168 | 200 | 20 <sup>H9</sup> | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 58  | 70  | 128   |
| K7   | 195 | 15.0 | 35.0 | 300 | 213 | 35.0 | –   | 155 <sub>h6</sub> | 190 | 226 | 20 <sup>H9</sup> | 60 <sub>h6</sub> | 60 <sub>h6</sub> <sup>H7</sup> | 62.0 | 75   | 68  | 85  | 161.5 |
| K8   | 226 | 17.0 | 45.0 | 350 | 230 | 45.0 | –   | 185 <sub>h6</sub> | 235 | 282 | 24 <sup>H9</sup> | 70 <sub>h6</sub> | 70 <sub>h6</sub> <sup>H7</sup> | 72.0 | 90   | 72  | 100 | 193   |
| K9   | 280 | 16.0 | 45.0 | 450 | 315 | 45.0 | –   | 230 <sub>h6</sub> | 285 | 330 | 24 <sup>H9</sup> | 90 <sub>h6</sub> | 90 <sub>h6</sub> <sup>H7</sup> | 92.0 | 120  | 75  | 120 | 244   |

## Dimensions of gear units

| Type | ØDss | Øe  | 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 |

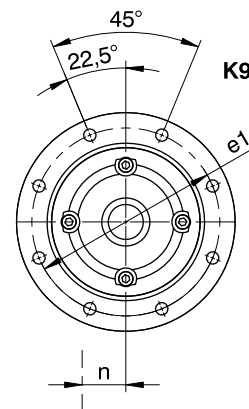
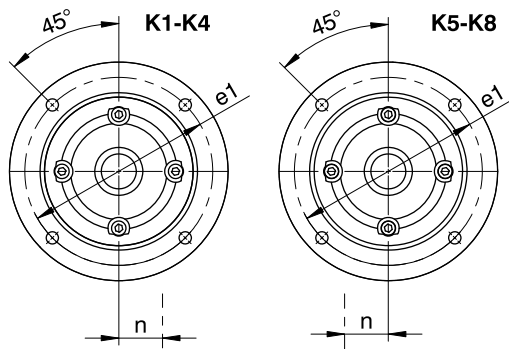
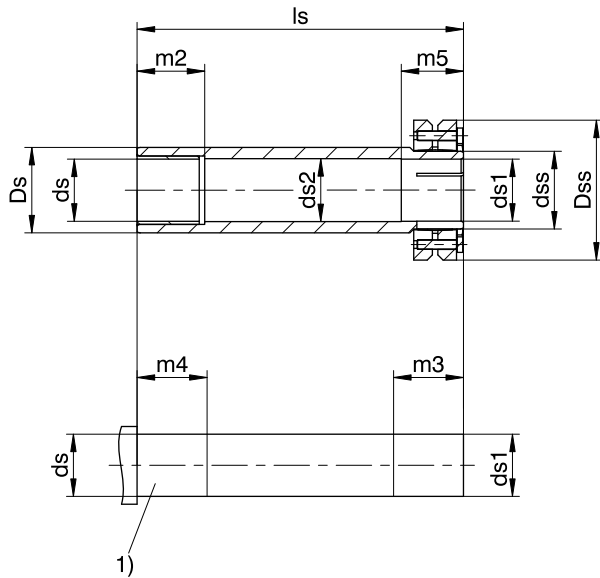
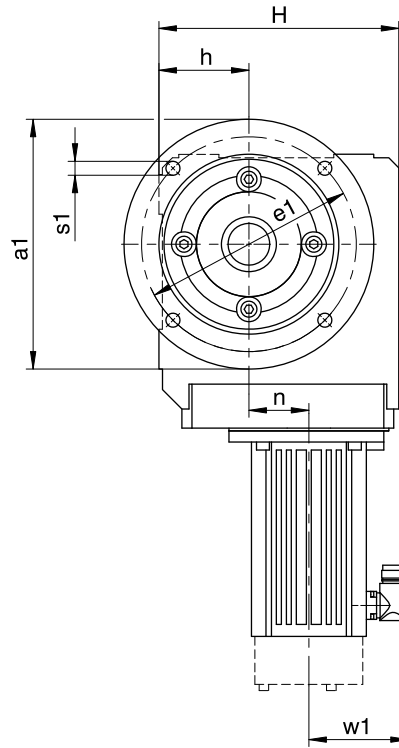
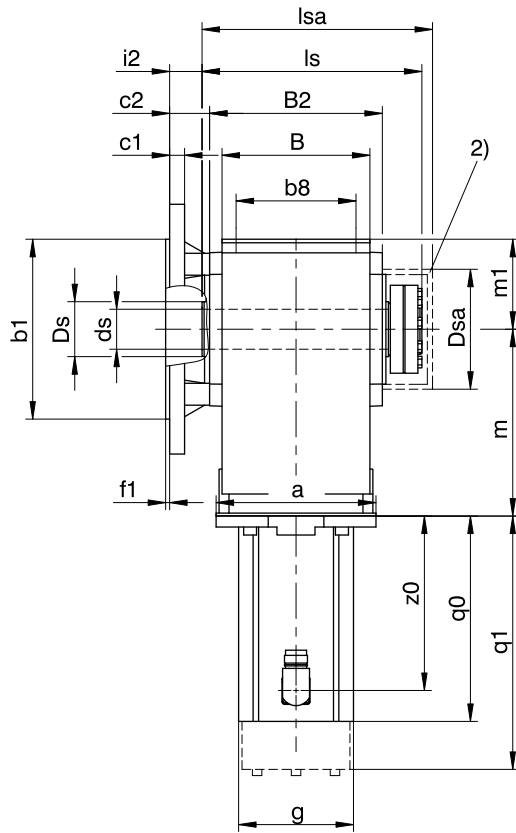
## Dimensions of motors

| 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 | 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 |

### 12.3.9 S shaft design (hollow shaft with shrink disk), F housing design (round flange)



- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- 2) Cover (optional)
- q1 Applies to motors with brake.
- 1) Machine shaft: The dimension  $l_s$  must meet or exceed the specified value.



## Dimensions of gear units

| 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 <sub>js</sub> | 70  | 90  | 106 | 10 | 32.0 | 25 <sub>h9</sub> | 25 <sub>h9</sub> <sup>H7</sup> | 25.5 | 30   | 40  | 80    | 60   | 130 | 3.5 | 60  | 160 | 25.0 | 149 | 163 | 60  | 20 | 34 | 25 | 29 | 9   |
| K2   | 200 | 130 <sub>js</sub> | 90  | 115 | 134 | 12 | 32.0 | 30 <sub>h9</sub> | 30 <sub>h9</sub> <sup>H7</sup> | 30.5 | 36   | 45  | 88    | 72   | 165 | 3.5 | 65  | 190 | 25.0 | 178 | 193 | 65  | 25 | 39 | 30 | 34 | 11  |
| K3   | 200 | 130 <sub>js</sub> | 105 | 130 | 146 | 14 | 38.0 | 35 <sub>h9</sub> | 35 <sub>h9</sub> <sup>H7</sup> | 35.5 | 44   | 50  | 101   | 80   | 165 | 3.5 | 75  | 213 | 31.0 | 190 | 206 | 75  | 30 | 39 | 35 | 34 | 11  |
| K4   | 250 | 180 <sub>js</sub> | 120 | 148 | 173 | 15 | 40.0 | 40 <sub>h9</sub> | 40 <sub>h9</sub> <sup>H7</sup> | 40.5 | 50   | 55  | 114   | 88   | 215 | 4.0 | 90  | 240 | 32.5 | 220 | 243 | 90  | 40 | 39 | 45 | 34 | 14  |
| K5   | 250 | 180 <sub>js</sub> | 125 | 160 | 185 | 15 | 39.5 | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 65  | 116   | 106  | 215 | 4.0 | 160 | 260 | 32.0 | 237 | 254 | 100 | 40 | 44 | 45 | 39 | 14  |
| K6   | 300 | 230 <sub>js</sub> | 130 | 168 | 200 | 17 | 36.0 | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 70  | 128   | 106  | 265 | 4.0 | 190 | 310 | 28.5 | 254 | 276 | 120 | 40 | 45 | 45 | 40 | 14  |
| K7   | 350 | 250 <sub>h6</sub> | 145 | 190 | 226 | 18 | 44.0 | 60 <sub>h6</sub> | 60 <sub>h6</sub> <sup>H7</sup> | 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 <sub>h6</sub> | 185 | 235 | 282 | 20 | 45.0 | 70 <sub>h6</sub> | 70 <sub>h6</sub> <sup>H7</sup> | 72.0 | 90   | 100 | 193   | 155  | 350 | 5.0 | 265 | 410 | 36.0 | 352 | 378 | 145 | 50 | 60 | 60 | 50 | 18  |
| K9   | 450 | 350 <sub>h6</sub> | 225 | 285 | 330 | 23 | 50.0 | 90 <sub>h6</sub> | 90 <sub>h6</sub> <sup>H7</sup> | 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 <sub>js</sub>  | 10 | 115 | 3.0 | 9   |
| K2   | 160 | 110 <sub>js</sub> | 12 | 130 | 3.5 | 9   |
| K3   | 160 | 110 <sub>js</sub> | 14 | 130 | 3.5 | 9   |
| K3   | 250 | 180 <sub>js</sub> | 14 | 215 | 4.0 | 14  |
| K8   | 350 | 250 <sub>h6</sub> | 18 | 300 | 5.0 | 18  |
| K8   | 450 | 350 <sub>h6</sub> | 20 | 400 | 5.0 | 18  |

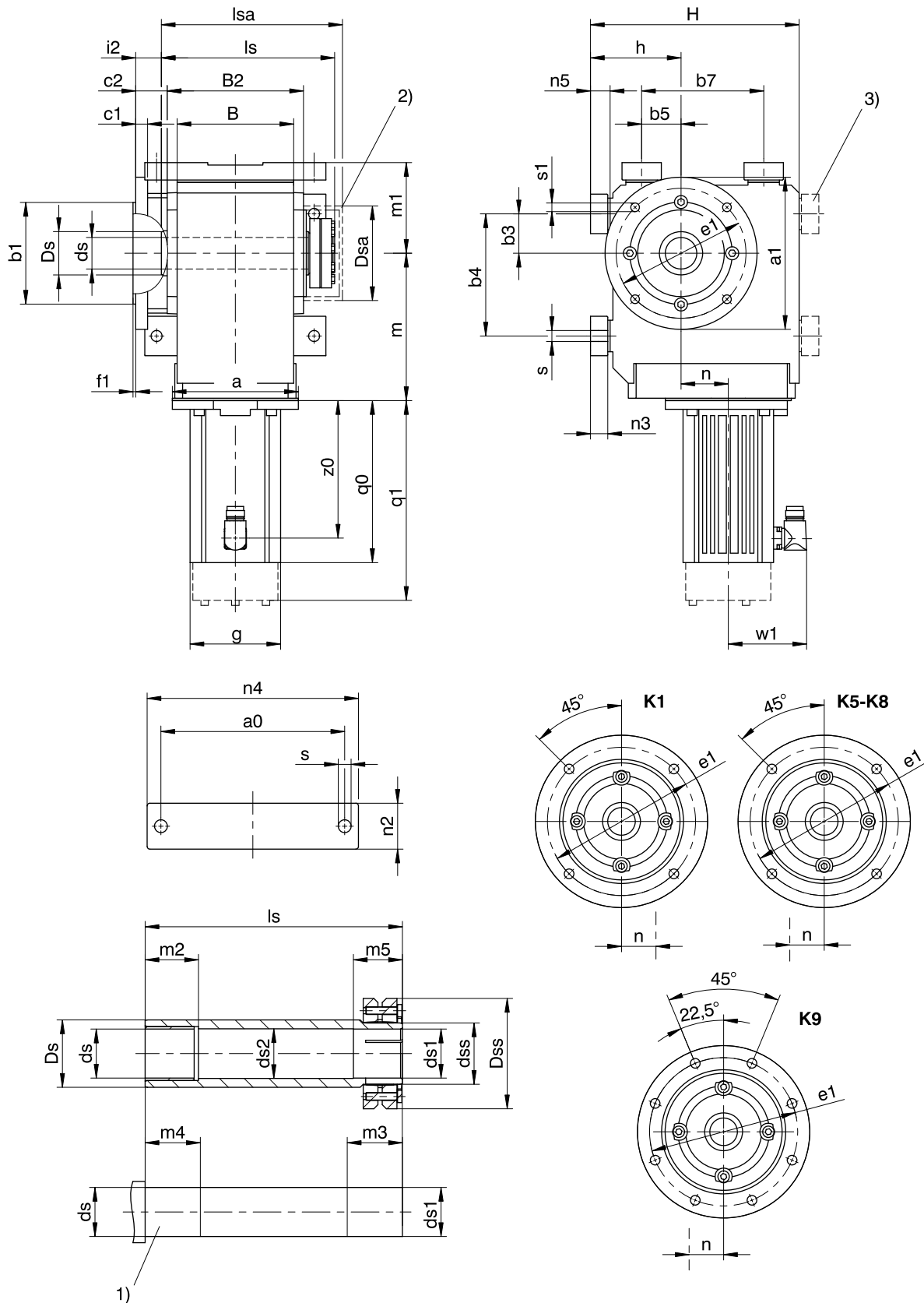
## Dimensions of motors

| 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 |

### 12.3.10 S shaft design (hollow shaft with shrink disk), NF housing design (base + round flange)



- |       |  |       |   |
|-------|--|-------|---|
| $q_0$ | Applies to motors without brake.                       | $q_1$ | Applies to motors with brake.   |
| x     | Applies to encoders using an optical measuring method. | 1)    | Machine shaft: The dimension $l_s$ must meet or exceed the specified value. |
| 2)    | Cover (optional)                                       | 3)    | Only for K1 (other sizes on request)  |

## Dimensions of gear units

| Type | a0  | Øa1 | Øb1               | b3 | b4  | b5  | b7  | B   | B2  | c1 | c2   | Øds              | Øds1                           | Øds2 | Ødss | ØDs | ØDsa  | ØDss |
|------|-----|-----|-------------------|----|-----|-----|-----|-----|-----|----|------|------------------|--------------------------------|------|------|-----|-------|------|
| K1   | 115 | 160 | 110 <sub>f6</sub> | 30 | 90  | 30  | 90  | 90  | 106 | 10 | 32.0 | 25 <sub>h9</sub> | 25 <sub>h9</sub> <sup>H7</sup> | 25.5 | 30   | 40  | 80.0  | 60   |
| K3   | 170 | 160 | 110 <sub>f6</sub> | 40 | 130 | 40  | 130 | 130 | 146 | 14 | 38.0 | 35 <sub>h9</sub> | 35 <sub>h9</sub> <sup>H7</sup> | 35.5 | 44   | 50  | 101.0 | 80   |
| K5   | 200 | 250 | 180 <sub>f6</sub> | 40 | 140 | 100 | 140 | 160 | 185 | 15 | 39.5 | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 65  | 116.0 | 106  |
| K6   | 210 | 300 | 230 <sub>f6</sub> | 50 | 160 | 110 | 160 | 168 | 200 | 17 | 36.0 | 50 <sub>h9</sub> | 50 <sub>h9</sub> <sup>H7</sup> | 50.5 | 62   | 70  | 128.0 | 106  |
| K7   | 241 | 350 | 250 <sub>h6</sub> | 55 | 180 | 125 | 180 | 190 | 226 | 18 | 44.0 | 60 <sub>h6</sub> | 60 <sub>h6</sub> <sup>H7</sup> | 62.0 | 75   | 85  | 161.5 | 138  |
| K8   | 300 | 400 | 300 <sub>h6</sub> | 75 | 240 | 165 | 240 | 235 | 282 | 20 | 45.0 | 70 <sub>h6</sub> | 70 <sub>h6</sub> <sup>H7</sup> | 72.0 | 90   | 100 | 193.0 | 155  |
| K9   | 360 | 450 | 350 <sub>h6</sub> | 95 | 280 | 185 | 280 | 285 | 330 | 23 | 50.0 | 90 <sub>h6</sub> | 90 <sub>h6</sub> <sup>H7</sup> | 92.0 | 120  | 120 | 244.0 | 200  |

## Dimensions of gear units

| Type | Øe1 | f1  | h   | H   | i2   | ls  | lsa | m1  | m2 | m3 | m4 | m5 | n2 | n3 | n4  | n5 | Øs   | Øs1 |
|------|-----|-----|-----|-----|------|-----|-----|-----|----|----|----|----|----|----|-----|----|------|-----|
| K1   | 130 | 3.5 | 75  | 175 | 25.0 | 149 | 163 | 75  | 20 | 34 | 25 | 29 | 30 | 13 | 140 | 15 | 9.0  | 9   |
| K3   | 130 | 3.5 | 98  | 236 | 31.0 | 190 | 206 | 98  | 30 | 39 | 35 | 34 | 45 | 20 | 200 | 23 | 11.0 | 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 | Øa1 | Øb1               | c1 | Øe1 | f1 | Øs1 |
|------|-----|-------------------|----|-----|----|-----|
| K1   | 140 | 95 <sub>f6</sub>  | 10 | 115 | 3  | 9   |
| K8   | 350 | 250 <sub>h6</sub> | 18 | 300 | 5  | 18  |
| K8   | 450 | 350 <sub>h6</sub> | 20 | 400 | 5  | 18  |

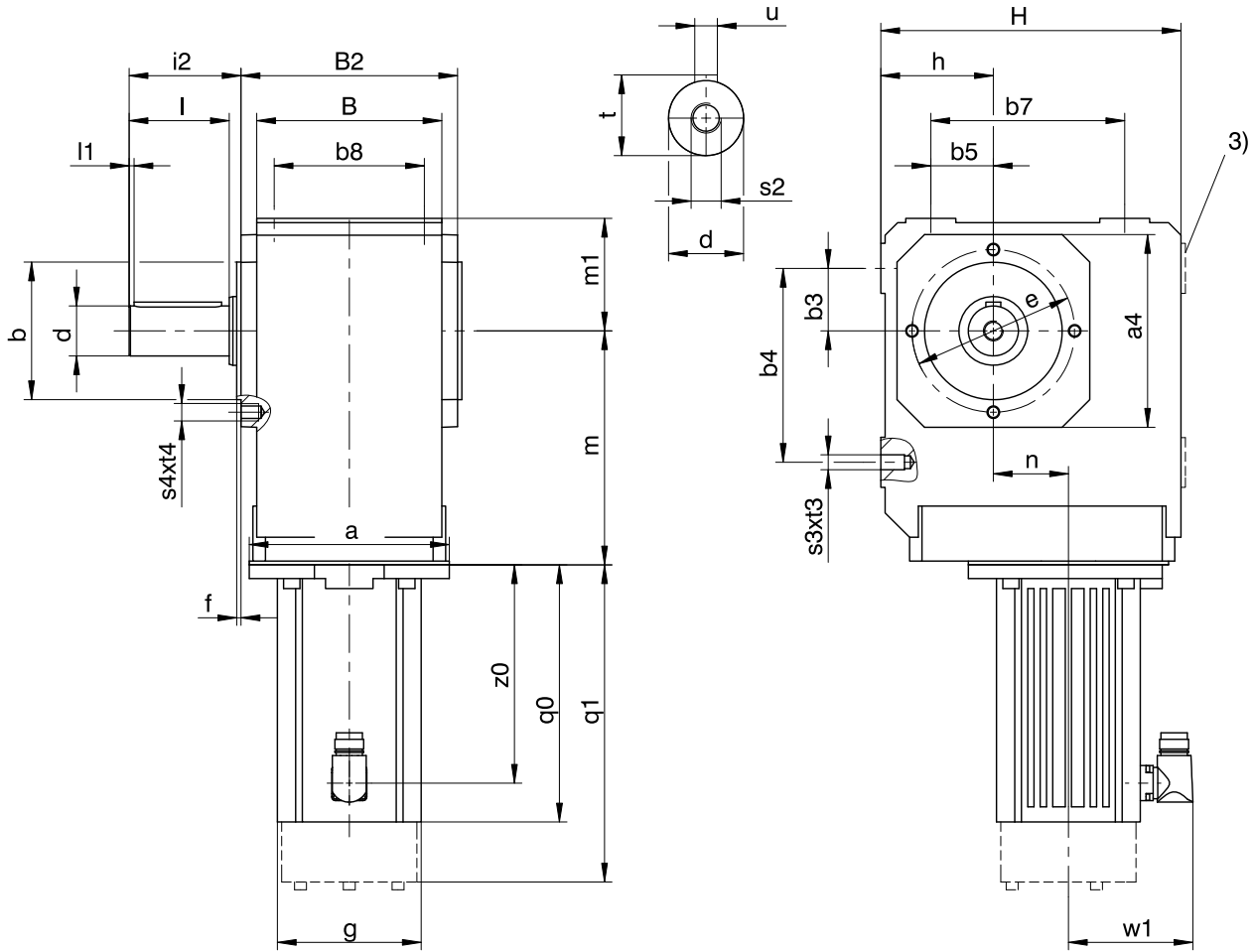
## Dimensions of motors

| 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

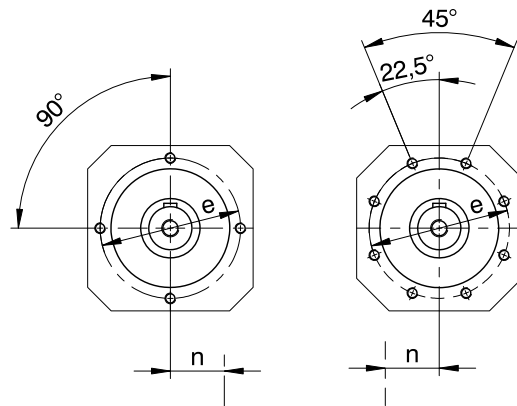
| Type | LM4  |     |      | LM5  |     |      | LM7  |     |      |
|------|------|-----|------|------|-----|------|------|-----|------|
|      | a    | m   | n    | a    | m   | n    | a    | m   | n    |
| K102 | □98  | 124 | 36.0 | □115 | 128 | 36.0 | –    | –   | –    |
| K302 | Ø140 | 163 | 52.5 | □115 | 167 | 52.5 | □145 | 169 | 52.5 |
| K303 | Ø140 | 200 | 52.5 | Ø160 | 210 | 16.0 | –    | –   | –    |
| 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 |

### 12.3.11 A shaft design (solid shaft), G housing design (pitch circle diameter)



K1-K4

K5-K9



- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- K1 – K4: solid shaft without feather key available, on request starting at K5.

- q1 Applies to motors with brake.
- 3) Only for K1 (other sizes on request)
- K1 – K9: Solid shaft on both sides available.

## Dimensions of gear units

| 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 <sub>g6</sub>  | 30 | 90  | 30  | 90  | 70  | 90  | 106 | 25 <sub>h6</sub> | 90  | 3.0 | 60  | 160 | 62.0  | 50  | 4  | 60  | M10 | M8  | M8  | 28.0 | 13 | 13 | A8×7×40    |
| K2   | 116 | 82 <sub>g6</sub>  | 35 | 115 | 35  | 115 | 90  | 115 | 134 | 30 <sub>h6</sub> | 100 | 3.0 | 65  | 190 | 68.0  | 60  | 4  | 65  | M10 | M10 | M8  | 33.0 | 16 | 13 | A8×7×50    |
| K3   | 132 | 95 <sub>g6</sub>  | 40 | 130 | 40  | 130 | 105 | 130 | 146 | 30 <sub>h6</sub> | 115 | 3.0 | 75  | 213 | 69.0  | 60  | 4  | 75  | M10 | M10 | M8  | 33.0 | 16 | 13 | A8×7×50    |
| K4   | 152 | 110 <sub>g6</sub> | 50 | 155 | 50  | 155 | 120 | 148 | 173 | 40 <sub>h6</sub> | 130 | 3.5 | 90  | 240 | 89.5  | 80  | 4  | 90  | M16 | M12 | M10 | 43.0 | 19 | 16 | A12×8×70   |
| K5   | 145 | 110 <sub>g6</sub> | 40 | 140 | 100 | 140 | 125 | 160 | 185 | 45 <sub>h6</sub> | 130 | 3.5 | 160 | 260 | 129.5 | 90  | 4  | 100 | M16 | M16 | M10 | 48.5 | 26 | 16 | A14×9×80   |
| K6   | 180 | 140 <sub>g6</sub> | 50 | 160 | 110 | 160 | 130 | 168 | 200 | 50 <sub>h6</sub> | 165 | 3.5 | 190 | 310 | 136.0 | 100 | 4  | 120 | M16 | M16 | M10 | 53.5 | 26 | 16 | A14×9×90   |
| K7   | 195 | 155 <sub>g6</sub> | 55 | 180 | 125 | 180 | 145 | 190 | 226 | 60 <sub>h6</sub> | 185 | 3.5 | 212 | 342 | 164.0 | 120 | 4  | 125 | M20 | M20 | M12 | 64.0 | 33 | 19 | A18×11×110 |
| K8   | 226 | 185 <sub>g6</sub> | 75 | 240 | 165 | 240 | 185 | 235 | 282 | 70 <sub>h6</sub> | 215 | 4.0 | 265 | 410 | 185.0 | 140 | 5  | 145 | M20 | M24 | M12 | 74.5 | 38 | 19 | A20×12×125 |
| K9   | 280 | 230 <sub>g6</sub> | 95 | 280 | 185 | 280 | 225 | 285 | 330 | 90 <sub>h6</sub> | 265 | 5.0 | 315 | 495 | 220.0 | 170 | 8  | 180 | M24 | M30 | M16 | 95.0 | 48 | 26 | A25×14×140 |

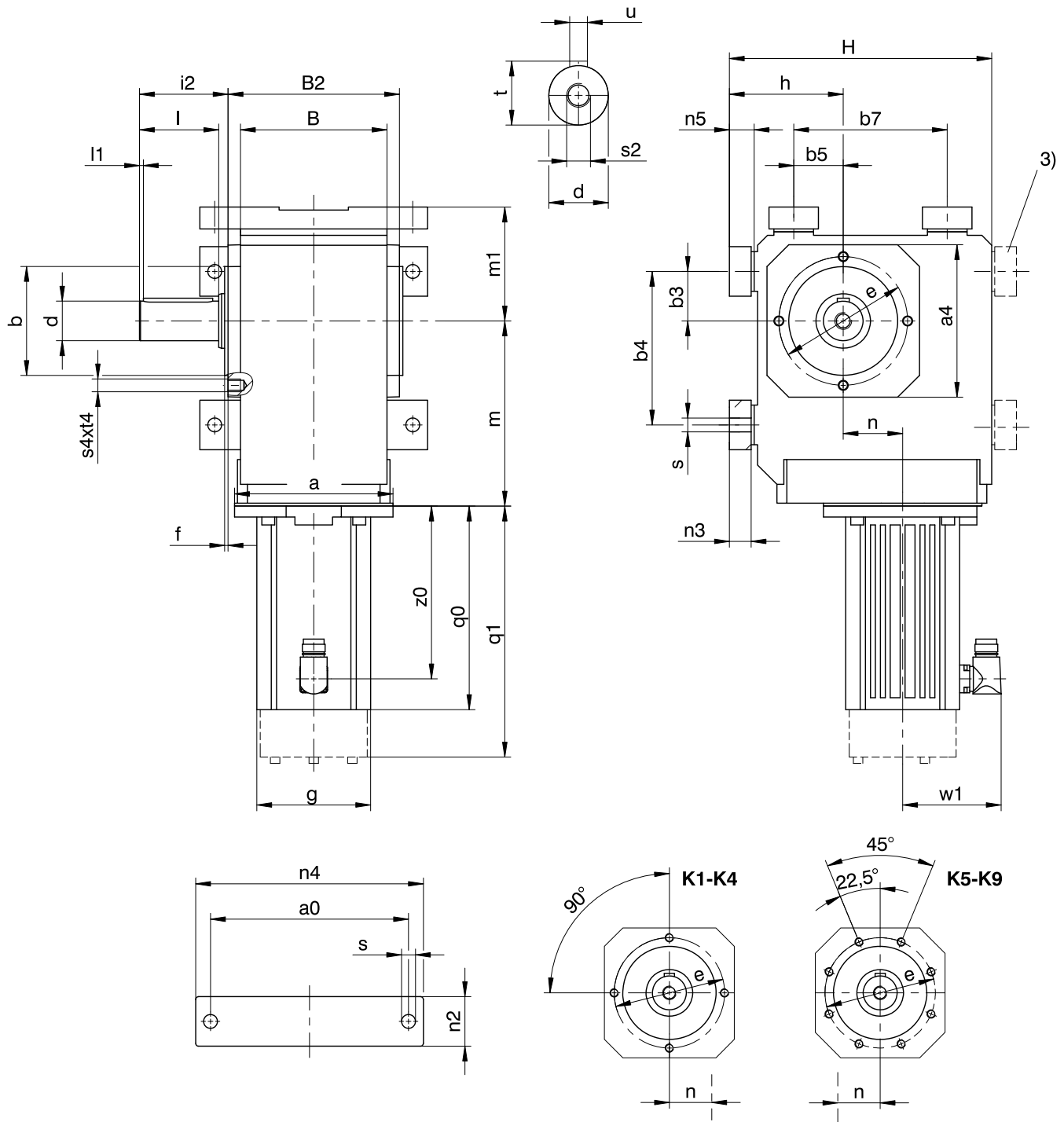
## Dimensions of motors

| 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 |

### 12.3.12 V shaft design (solid shaft), NG housing design (base + pitch circle diameter)



- q0 Applies to motors without brake.
- x Applies to encoders using an optical measuring method.
- K1 – K4: solid shaft without feather key available, on request starting at K5.

- q1 Applies to motors with brake.
- 3) Only for K1 (other sizes on request)
- K1 – K10: Solid shaft on both sides available.

## Dimensions of gear units

| 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 <sub>js</sub>  | 30 | 90  | 30  | 90  | 90  | 106 | 25 <sub>ks</sub> | 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 <sub>js</sub>  | 35 | 115 | 35  | 115 | 115 | 134 | 30 <sub>ks</sub> | 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 <sub>js</sub>  | 40 | 130 | 40  | 130 | 130 | 146 | 30 <sub>ks</sub> | 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 <sub>js</sub> | 50 | 155 | 50  | 155 | 148 | 173 | 40 <sub>ks</sub> | 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 <sub>js</sub> | 40 | 140 | 100 | 140 | 160 | 185 | 45 <sub>ks</sub> | 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 <sub>js</sub> | 50 | 160 | 110 | 160 | 168 | 200 | 50 <sub>ks</sub> | 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 <sub>js</sub> | 55 | 180 | 125 | 180 | 190 | 226 | 60 <sub>ms</sub> | 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 <sub>js</sub> | 75 | 240 | 165 | 240 | 235 | 282 | 70 <sub>ms</sub> | 215 | 4.0 | 310 | 455 | 185.0 | 140 | 5  | 190 | 85 | 41 | 360 | 45 | 27.0 | M20 | M12 | 74.5 | 19 | A20×12×125 |

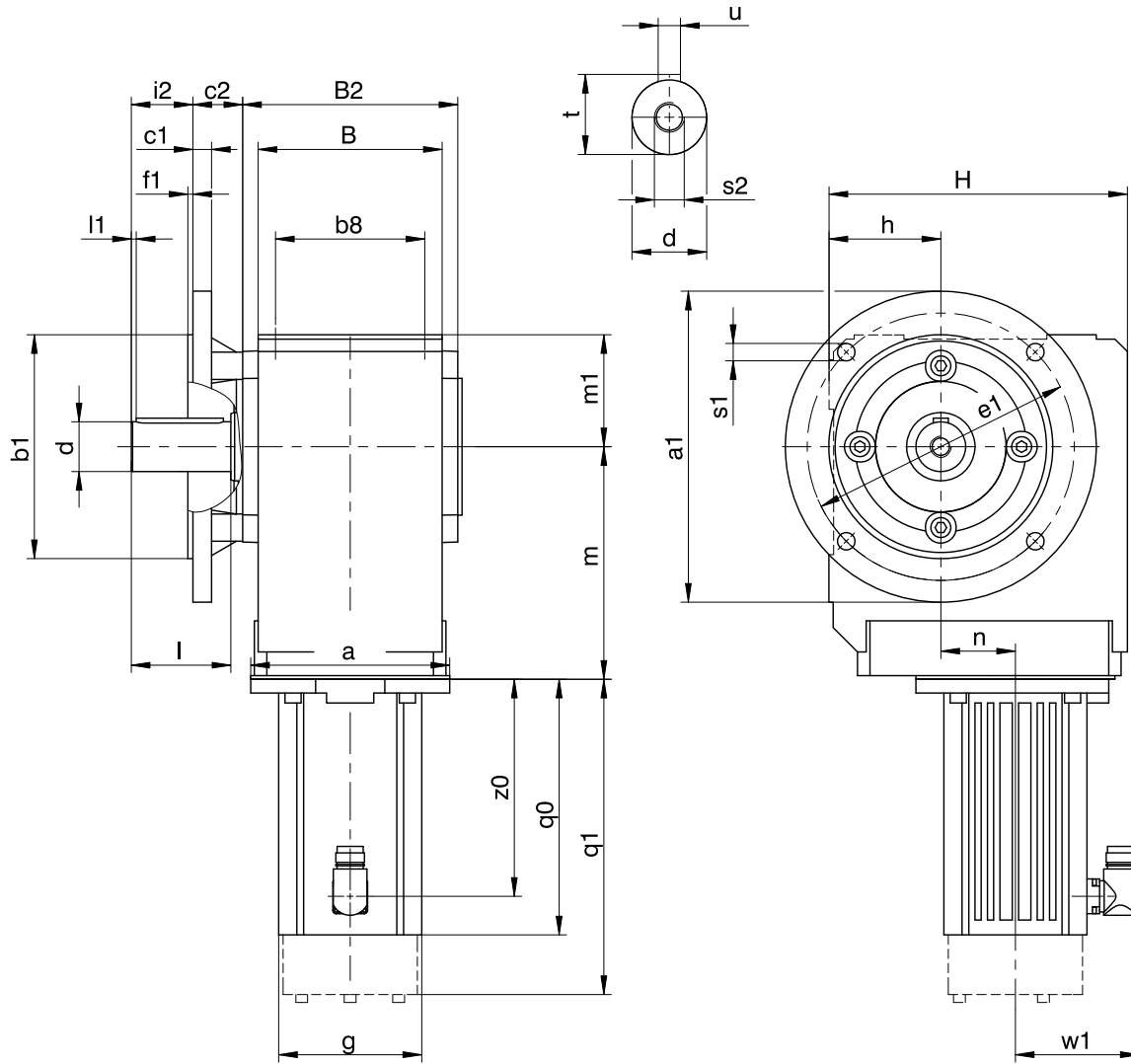
## Dimensions of motors

| 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 |

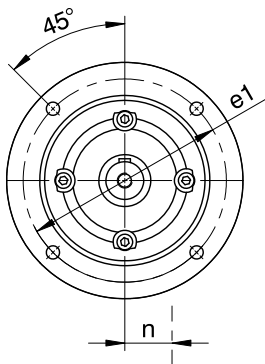
## Dimensions of geared motors

| Type | LM4  |     |      | LM5  |     |      | LM7  |     |      |
|------|------|-----|------|------|-----|------|------|-----|------|
|      | a    | m   | 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 |

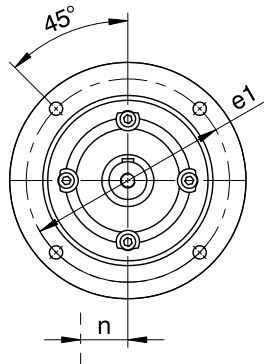
### 12.3.13 V shaft design (solid shaft), F housing design (round flange)



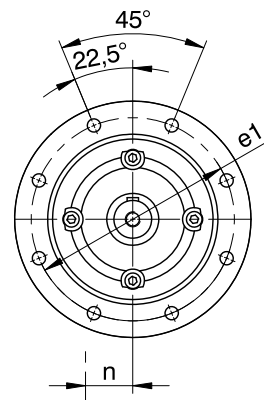
**K1-K4**



**K5-K8**



**K9**



q0 Applies to motors without brake.

x Applies to encoders using an optical measuring method.

- K1 - K9: 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 gear units

| Type | Øa1 | Øb1               | b8  | B   | B2  | c1 | c2   | Ød               | Øe1 | f1  | h   | H   | i2    | l   | l1 | m1  | Øs1 | s2  | t    | u          |
|------|-----|-------------------|-----|-----|-----|----|------|------------------|-----|-----|-----|-----|-------|-----|----|-----|-----|-----|------|------------|
| K1   | 160 | 110 <sub>f6</sub> | 70  | 90  | 106 | 10 | 32.0 | 25 <sub>k6</sub> | 130 | 3.5 | 60  | 160 | 30.0  | 50  | 4  | 60  | 9   | M10 | 28.0 | A8×7×40    |
| K2   | 200 | 130 <sub>f6</sub> | 90  | 115 | 134 | 12 | 32.0 | 30 <sub>k6</sub> | 165 | 3.5 | 65  | 190 | 36.0  | 60  | 4  | 65  | 11  | M10 | 33.0 | A8×7×50    |
| K3   | 200 | 130 <sub>f6</sub> | 105 | 130 | 146 | 14 | 38.0 | 30 <sub>k6</sub> | 165 | 3.5 | 75  | 213 | 31.0  | 60  | 4  | 75  | 11  | M10 | 33.0 | A8×7×50    |
| K4   | 250 | 180 <sub>f6</sub> | 120 | 148 | 173 | 15 | 40.0 | 40 <sub>k6</sub> | 215 | 4.0 | 90  | 240 | 49.5  | 80  | 4  | 90  | 14  | M16 | 43.0 | A12×8×70   |
| K5   | 250 | 180 <sub>f6</sub> | 125 | 160 | 185 | 15 | 39.5 | 45 <sub>k6</sub> | 215 | 4.0 | 160 | 260 | 90.0  | 90  | 4  | 100 | 14  | M16 | 48.5 | A14×9×80   |
| K6   | 300 | 230 <sub>f6</sub> | 130 | 168 | 200 | 17 | 36.0 | 50 <sub>k6</sub> | 265 | 4.0 | 190 | 310 | 100.0 | 100 | 4  | 120 | 14  | M16 | 53.5 | A14×9×90   |
| K7   | 350 | 250 <sub>h6</sub> | 145 | 190 | 226 | 18 | 44.0 | 60 <sub>m6</sub> | 300 | 5.0 | 212 | 342 | 120.0 | 120 | 4  | 125 | 18  | M20 | 64.0 | A18×11×110 |
| K8   | 400 | 300 <sub>h6</sub> | 185 | 235 | 282 | 20 | 45.0 | 70 <sub>m6</sub> | 350 | 5.0 | 265 | 410 | 140.0 | 140 | 5  | 145 | 18  | M20 | 74.5 | A20×12×125 |

## Dimensions of additional round flanges

| Type | Øa1 | Øb1               | c1 | Øe1 | f1  | Øs1 |
|------|-----|-------------------|----|-----|-----|-----|
| K1   | 140 | 95 <sub>f6</sub>  | 10 | 115 | 3.0 | 9   |
| K2   | 160 | 110 <sub>f6</sub> | 12 | 130 | 3.5 | 9   |
| K3   | 160 | 110 <sub>f6</sub> | 14 | 130 | 3.5 | 9   |
| K3   | 250 | 180 <sub>f6</sub> | 14 | 215 | 4.0 | 14  |
| K8   | 350 | 250 <sub>h6</sub> | 18 | 300 | 5.0 | 18  |
| K8   | 450 | 350 <sub>h6</sub> | 20 | 400 | 5.0 | 18  |

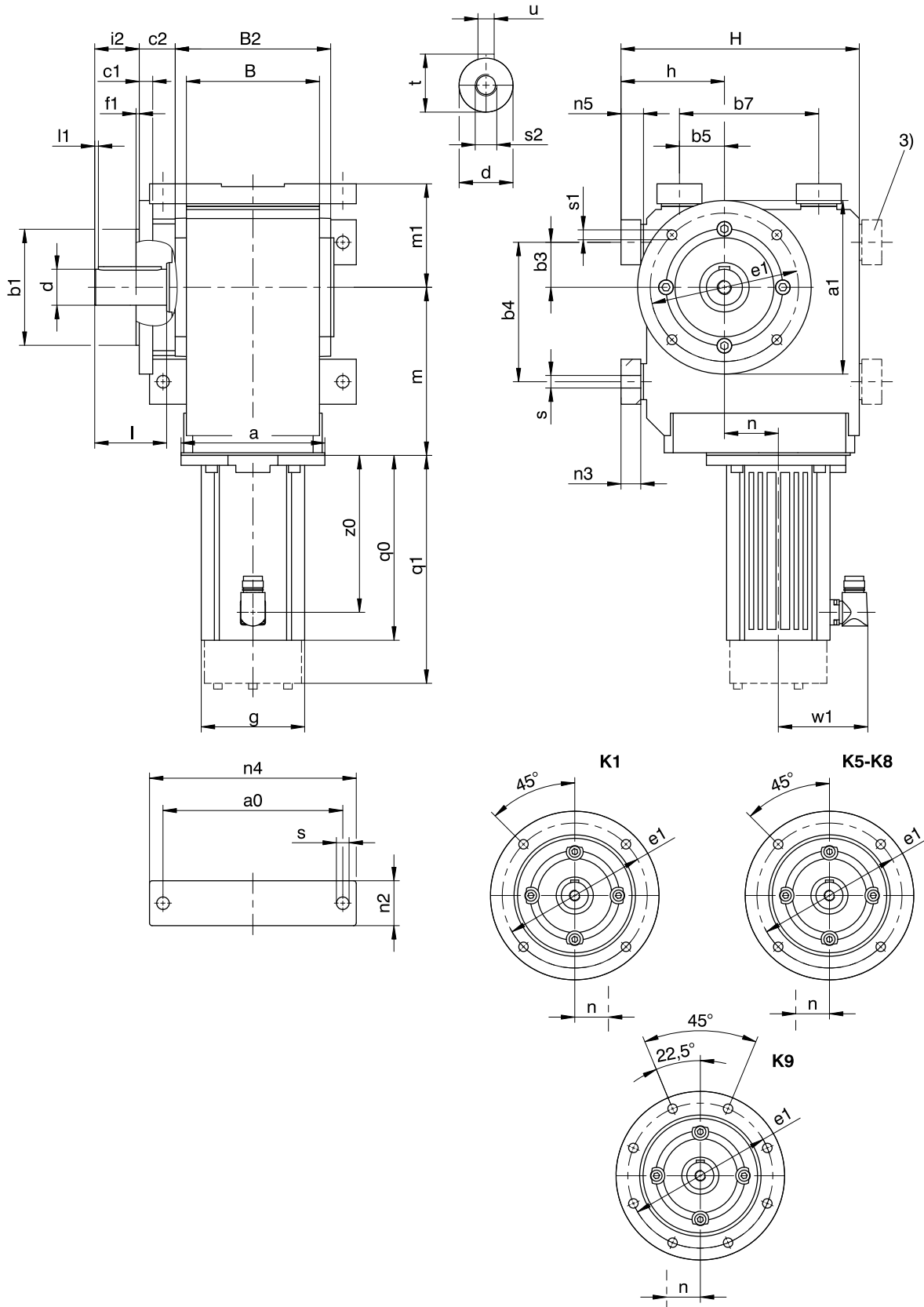
## Dimensions of motors

| 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 |

### 12.3.14 V shaft design (solid shaft), NF housing design (base + round flange)



q0 Applies to motors without brake.

x Applies to encoders using an optical measuring method.

- K1 – K4: solid shaft without feather key available, on request starting at K5.

q1 Applies to motors with brake.

3) Only for K1 (other sizes on request)

- K1 – K10: Solid shaft on both sides available.

## Dimensions of gear units

| Type | a0  | Øa1 | Øb1               | b3 | b4  | b5  | b7  | B   | B2  | c1 | c2   | Ød               | Øe1 | f1  | h   | H   | i2    | l   | l1 | m1  | n2 | n3 | n4  | n5 | Øs   | Øs1 | s2  | t    | u          |
|------|-----|-----|-------------------|----|-----|-----|-----|-----|-----|----|------|------------------|-----|-----|-----|-----|-------|-----|----|-----|----|----|-----|----|------|-----|-----|------|------------|
| K1   | 115 | 160 | 110 <sub>js</sub> | 30 | 90  | 30  | 90  | 90  | 106 | 10 | 32.0 | 25 <sub>ks</sub> | 130 | 3.5 | 75  | 175 | 30.0  | 50  | 4  | 75  | 30 | 13 | 140 | 15 | 9.0  | 9   | M10 | 28.0 | A8×7×40    |
| K3   | 170 | 160 | 110 <sub>js</sub> | 40 | 130 | 40  | 130 | 130 | 146 | 14 | 38.0 | 30 <sub>ks</sub> | 130 | 3.5 | 98  | 236 | 31.0  | 60  | 4  | 98  | 45 | 20 | 200 | 23 | 11.0 | 9   | M10 | 33.0 | A8×7×50    |
| K5   | 200 | 250 | 180 <sub>js</sub> | 40 | 140 | 100 | 140 | 160 | 185 | 15 | 39.5 | 45 <sub>ks</sub> | 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 <sub>js</sub> | 50 | 160 | 110 | 160 | 168 | 200 | 17 | 36.0 | 50 <sub>ks</sub> | 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 <sub>hs</sub> | 55 | 180 | 125 | 180 | 190 | 226 | 18 | 44.0 | 60 <sub>ms</sub> | 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 <sub>hs</sub> | 75 | 240 | 165 | 240 | 235 | 282 | 20 | 45.0 | 70 <sub>ms</sub> | 350 | 5.0 | 310 | 455 | 140.0 | 140 | 5  | 190 | 85 | 41 | 360 | 45 | 27.0 | 18  | M20 | 74.5 | A20×12×125 |

## Dimensions of additional round flanges

| Type | Øa1 | Øb1               | c1 | Øe1 | f1 | Øs1 |
|------|-----|-------------------|----|-----|----|-----|
| K1   | 140 | 95 <sub>js</sub>  | 10 | 115 | 3  | 9   |
| K8   | 350 | 250 <sub>hs</sub> | 18 | 300 | 5  | 18  |
| K8   | 450 | 350 <sub>hs</sub> | 20 | 400 | 5  | 18  |

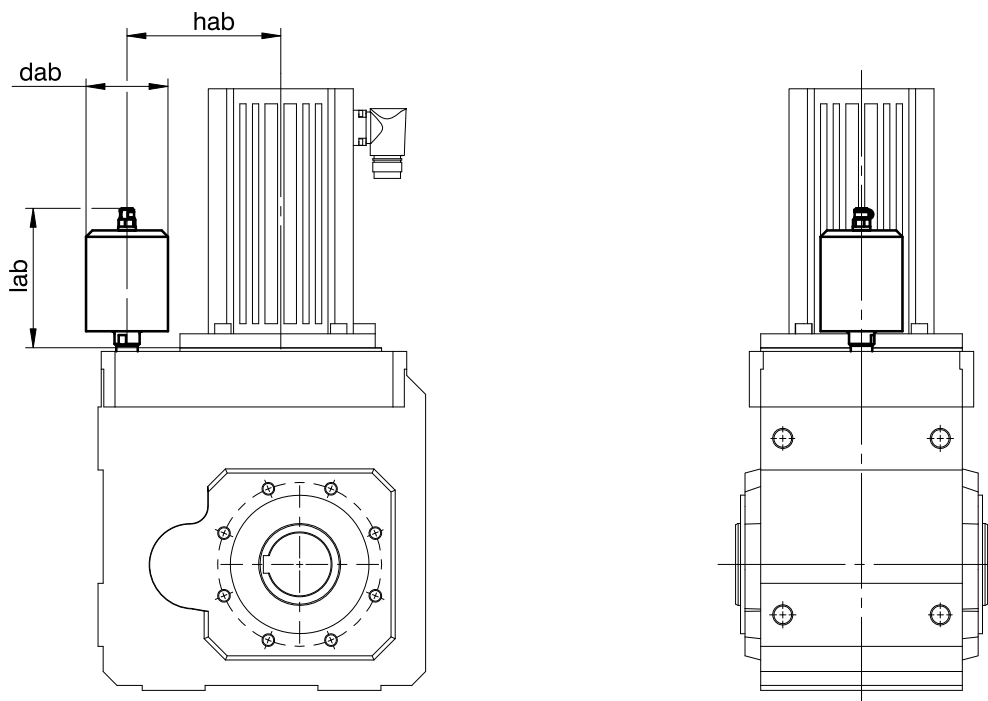
## Dimensions of motors

| 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 | –    | –   | –    |
| K302 | Ø140 | 163 | 52.5 | □115 | 167 | 52.5 | □145 | 169 | 52.5 |
| K303 | Ø140 | 200 | 52.5 | Ø160 | 210 | 16.0 | –    | –   | –    |
| 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 |

### 12.3.15 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 [12.6.4](#)

## 12.4 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.

### Sample code

|   |   |   |   |   |   |      |        |
|---|---|---|---|---|---|------|--------|
| K | 4 | 0 | 2 | A | G | 0280 | LM704U |
|---|---|---|---|---|---|------|--------|

### Explanation

| Code   | Designation                                 | Design  |
|--------|---|---|
| K      | Type  | Helical bevel gear unit                           |
| 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 ( $i \times 10$ rounded) | $i = 28.24$ (example)                             |
| LM704U | Motor                                       | LM Lean motor                                     |

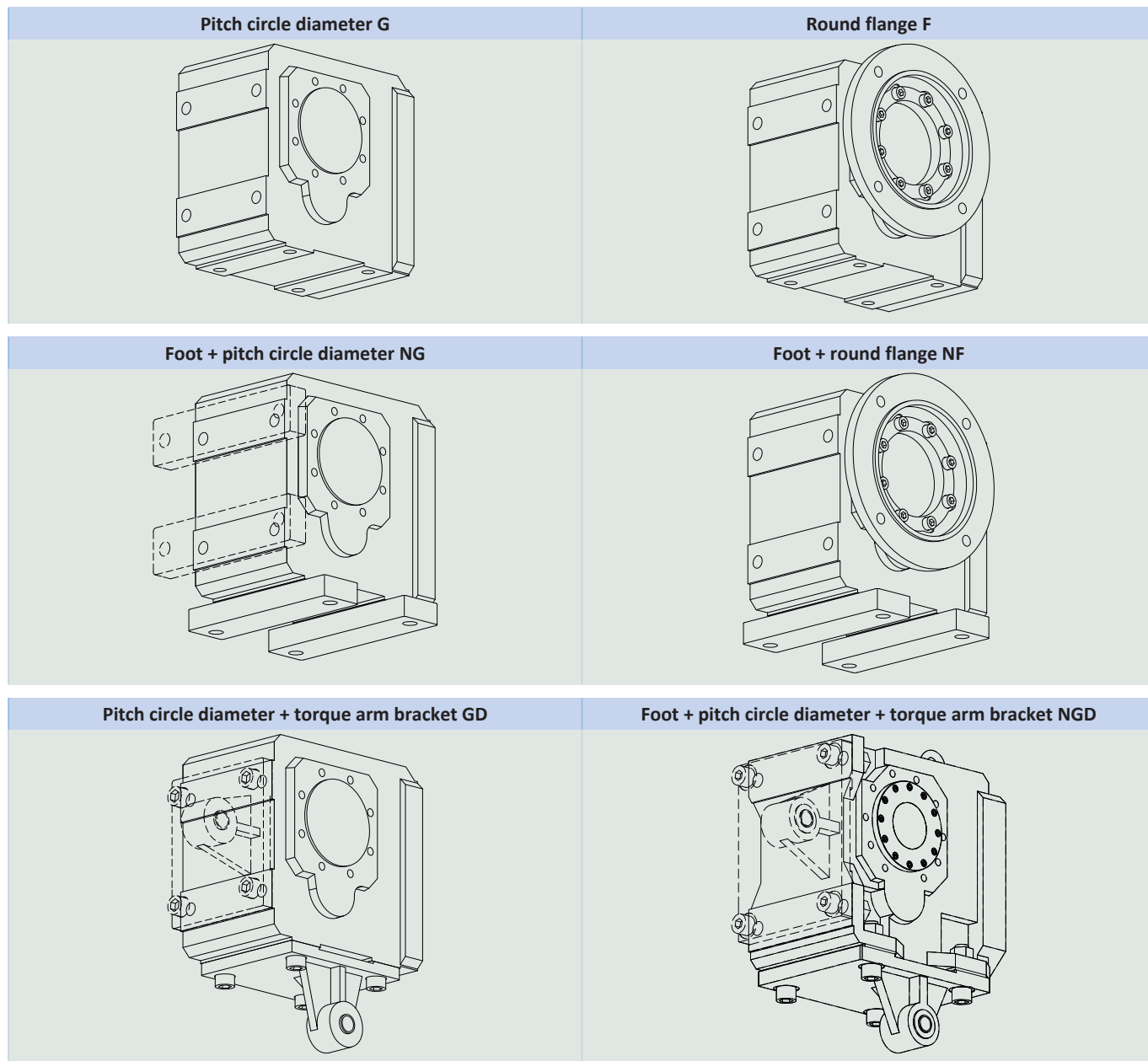
### In order to complete the type designation, also specify:

- A detailed type designation of the motor, see the chapter [\[ 2 \]](#)
- The mounting position, see the chapter [\[ 12.5.4 \]](#)
- Attachment of solid shaft: gear unit 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 disk: shrink disk on gear unit side 3 or 4
- Attachment of baseboards: gear unit side 1 or 5
- Attachment of flange: gear unit side 3 or 4
- Pitch circle diameter: gear unit side 3 or 4
- Attachment of torque arm bracket: torque arm bracket on gear unit side 1 or 5, eye on gear unit side 3 or 4
- The position of the plug connector, see the chapter [\[ 12.5.6 \]](#)
- Oil expansion tank (recommended for gear units in mounting position EL5), see the chapter [\[ 12.6.4 \]](#)
- Backlash: standard/class II/class I. Backlash class II and class I for an additional charge.  
Backlash class I with reduced input speeds (see the chapter [\[ 12.6.1 \]](#)) and only possible in conjunction with synthetic oil.
- Standard or reinforced output bearing

An explanation of the gear unit sides can be found in the chapter [\[ 12.5.4 \]](#).

## 12.5 Product description

### 12.5.1 Housing design



|     | G | F | NG | NF | GD | NGD |
|-----|---|---|----|----|----|-----|
| K1  | ✓ | ✓ | ✓  | ✓  | ✓  | -   |
| K2  | ✓ | ✓ | ✓  | -  | ✓  | -   |
| K3  | ✓ | ✓ | ✓  | -  | ✓  | -   |
| K4  | ✓ | ✓ | ✓  | -  | ✓  | -   |
| K5  | ✓ | ✓ | ✓  | ✓  | ✓  | -   |
| K6  | ✓ | ✓ | ✓  | ✓  | ✓  | -   |
| K7  | ✓ | ✓ | ✓  | ✓  | ✓  | -   |
| K8  | ✓ | ✓ | ✓  | ✓  | ✓  | -   |
| K9  | ✓ | ✓ | ✓  | ✓  | ✓  | -   |
| K10 | - | - | ✓  | ✓  | -  | ✓   |

## 12.5.2 Combinatorial shaft/housing design

| Shaft design                  | Housing 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 <sup>1)</sup>     | V              | VG | VF | VNG | VNF | –   | –    |

<sup>1)</sup> Gear units in sizes K1 – K10 come with a solid shaft with feather key as standard. Gear units in sizes K1 – K4 can be ordered with the option of a solid shaft without feather key. Only upon request starting at size K5.

## 12.5.3 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 gear unit hollow shaft when attaching the gear unit.

Maximum deviation  $\leq 0.03$  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:

| Gear unit 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  $p \geq 325$  N/mm<sup>2</sup>.

Possible materials:

- C45E +QT
- 42CrMo4

### Fastening the gear units on the machine side using the pitch circle diameter

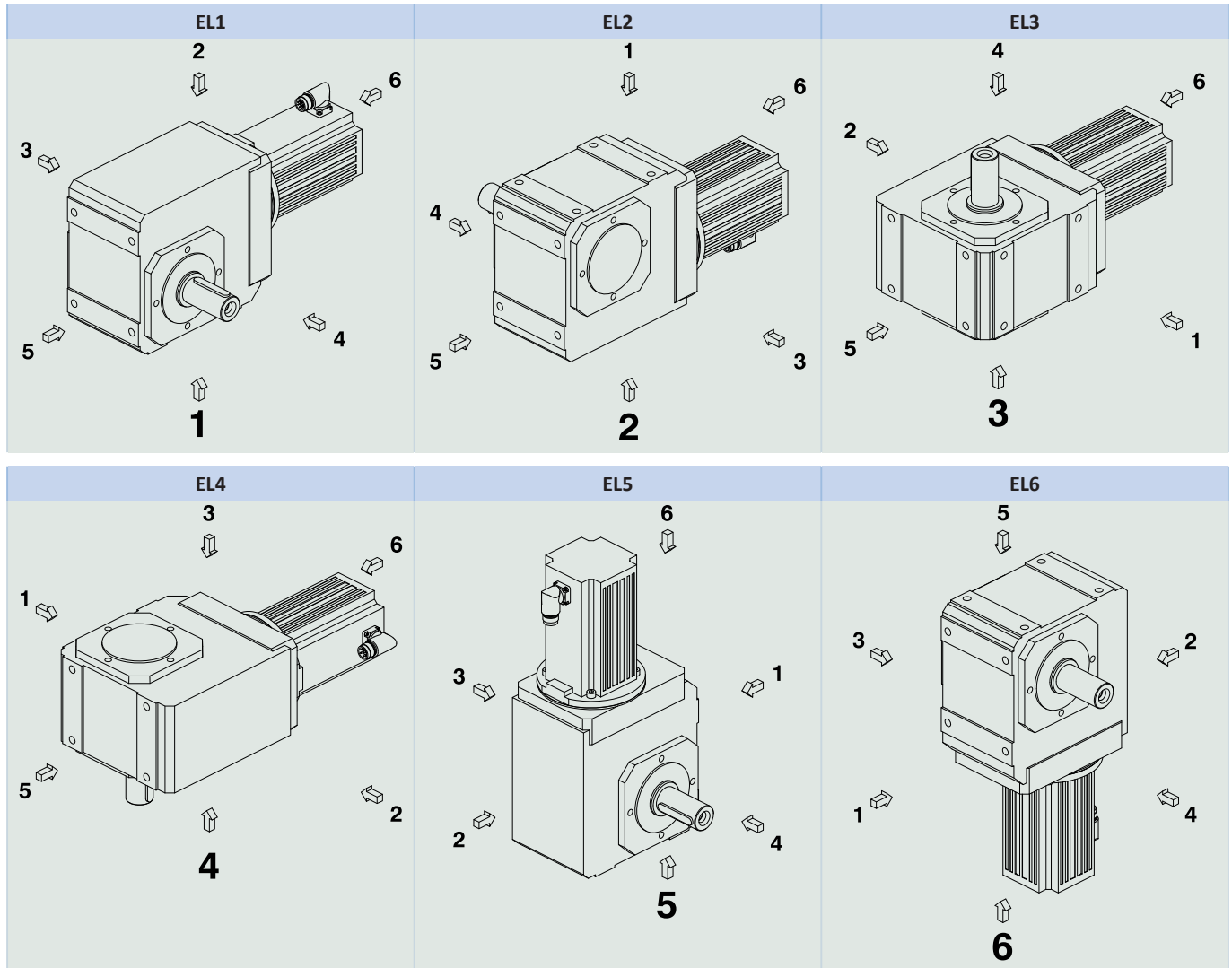
The specified torques and forces only apply when fastening gear units at the machine side using screws of quality 10.9. In addition, the gear unit housings must be adjusted at the pilot. The machine-side fit must be H7.

### 12.5.4 Mounting positions

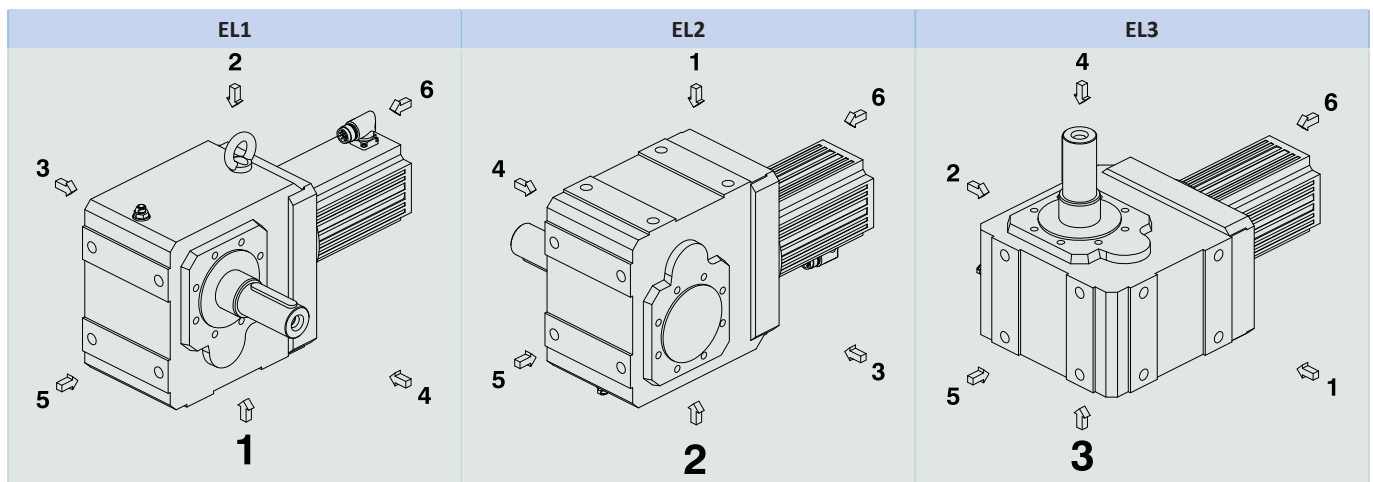
The following table shows the standard mounting positions.

The numbers identify the gear unit sides. The mounting position is defined by the gear side facing downwards.

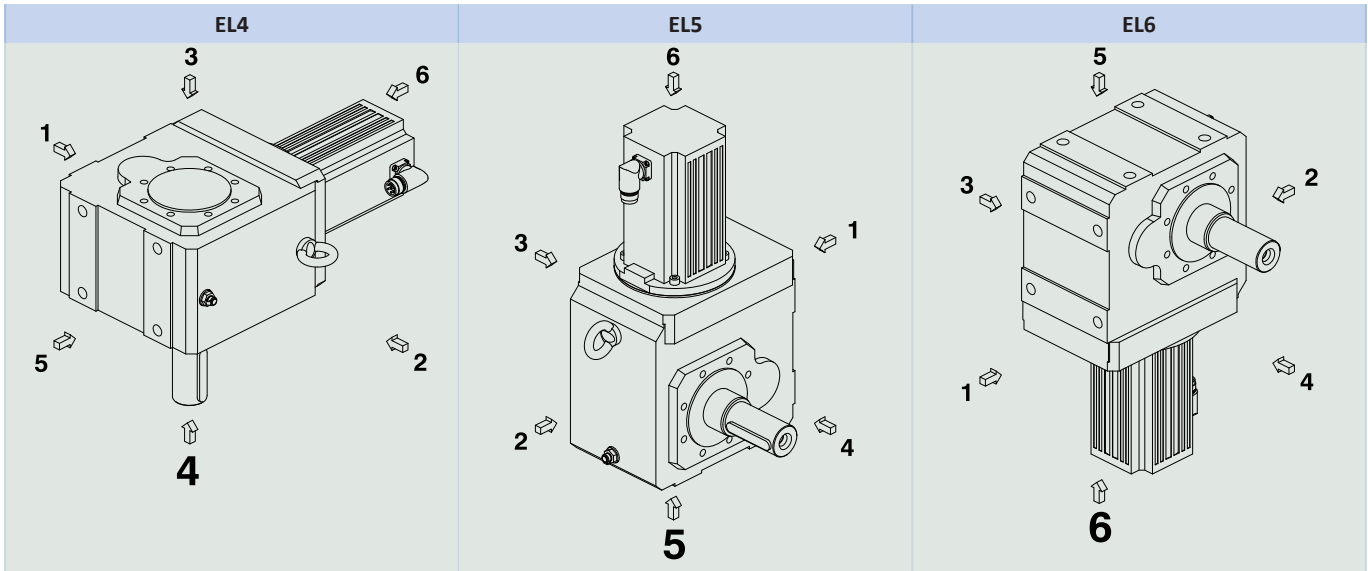
Mounting positions for gear unit sizes K1 – K4



Mounting positions for gear unit sizes K5 – K10







Since the lubricant filling volume of the gear unit depends on the mounting position, the mounting position must be specified when ordering.

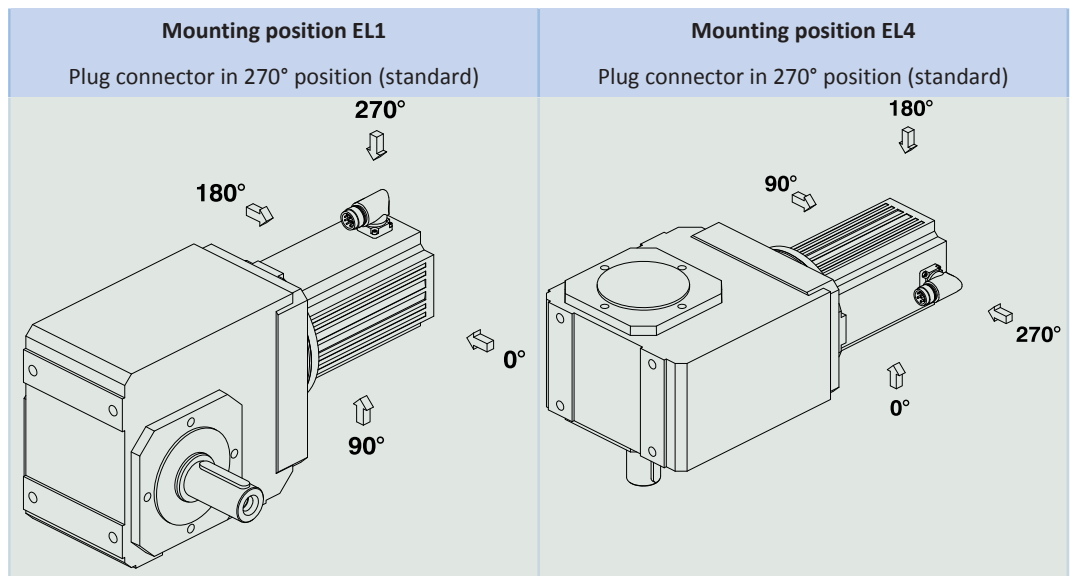
### 12.5.5 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate. The filling volume and the structure of the gear units depend on the mounting position.

Only install the gear units in the intended mounting position! Reposition the gear units only after consulting STOBER. Otherwise, STOBER assumes no liability for the gear units.

Lubricant filling quantities for gear units, document ID 441871, can be found online at <http://www.stober.de/en/download>. Enter the ID of the documentation in the Search... field.

### 12.5.6 Position of the plug connector



Indicate variations for your geared motor in the purchase order.

Note that the plug connector position rotates along with the geared motor if the geared motor is in another mounting position.

## 12.5.7 Other product features

| Feature  | Value                 |
|--|-----------------------|
| Max. permitted gear unit temperature (on the surface of the gear unit) | ≤ 80 °C               |
| Paint  | Black RAL 9005        |
| (ATEX) Directive 2014/34/EU (option)                                   | Not suitable          |
| <b>Protection class:<sup>1</sup></b>                                   |                       |
| Gear unit  | IP65                  |
| Motor  | IP56, optionally IP66 |

## 12.5.8 Maintenance

The instructions for maintenance can be found in the operating manual, ID 443027\_en, at <http://www.stoeber.de/en/download>. 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 gear unit sizes K5 to K10.

For the position and dimensions of the air release valve, refer to the 3D model at <http://cad.stoeber.de>.

## 12.5.9 Direction of rotation

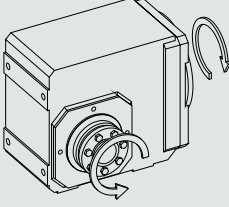
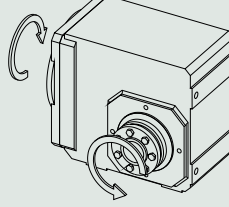
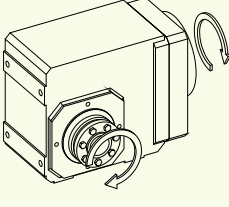
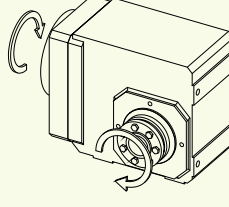
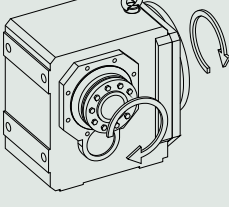
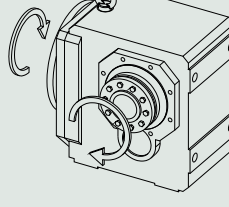
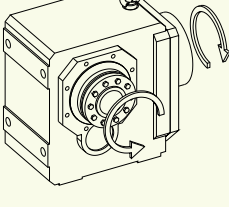
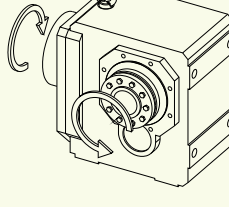
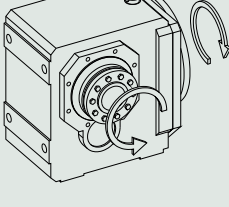
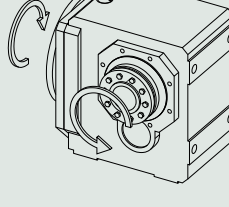
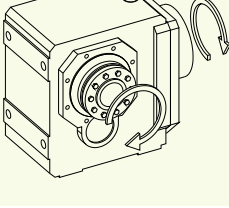
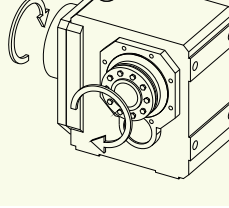
Solid shaft (V), solid shaft on both sides (V), hollow shaft with keyway (A)

| Type         | Output side 4 | Output side 3 |
|--------------|---------------|---------------|
| K102 – K402  |               |               |
| K203 – K403  |               |               |
| K513 – K1013 |               |               |
| K514 – K1014 |               |               |

The specified directions of rotation also apply to gear units with hollow shaft (A) if the insertion side of the machine shaft corresponds to the side of the solid shaft that is shown.

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.

## 12.6 Project configuration

Project your drives using our SERVOnsoft designing software. You can receive SERVOnsoft for free from your adviser at one of our sales centers. Observe the limit conditions in this chapter to ensure a safe design for your drives.

An explanation of the formula symbols can be found in Chapter Symbols in formulas.

### 12.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point  $M_{2N}$  specified in the selection tables.

For continuous operation in mounting positions EL1, EL2:

$$n_{1m^*} \leq \frac{n_{1\max\text{DBEL}1,2}}{fB_T}$$

For continuous operation in mounting positions EL3, EL4, EL5, EL6:

$$n_{1m^*} \leq \frac{n_{1\max\text{DBEL}3,4,5,6}}{fB_T}$$

For all mounting positions:

$$n_{1\max^*} \leq \frac{n_{1\max\text{ZB}}}{fB_T}$$

$$M_{2\text{eff}^*} \leq M_{2\text{th}}$$

$$M_{2\text{acc}^*} \leq M_{2\text{acc}}$$

$$M_{2\text{NOT}^*} \leq M_{2\text{NOT}}$$

$$M_{2\text{eq}^*} \leq M_{2N} \cdot \frac{S}{fB_{\text{op}} \cdot fB_t}$$

**Notes**

Note that for gear units with backlash class I the maximum permitted input speed of the gear unit in continuous operation is reduced by 20%.

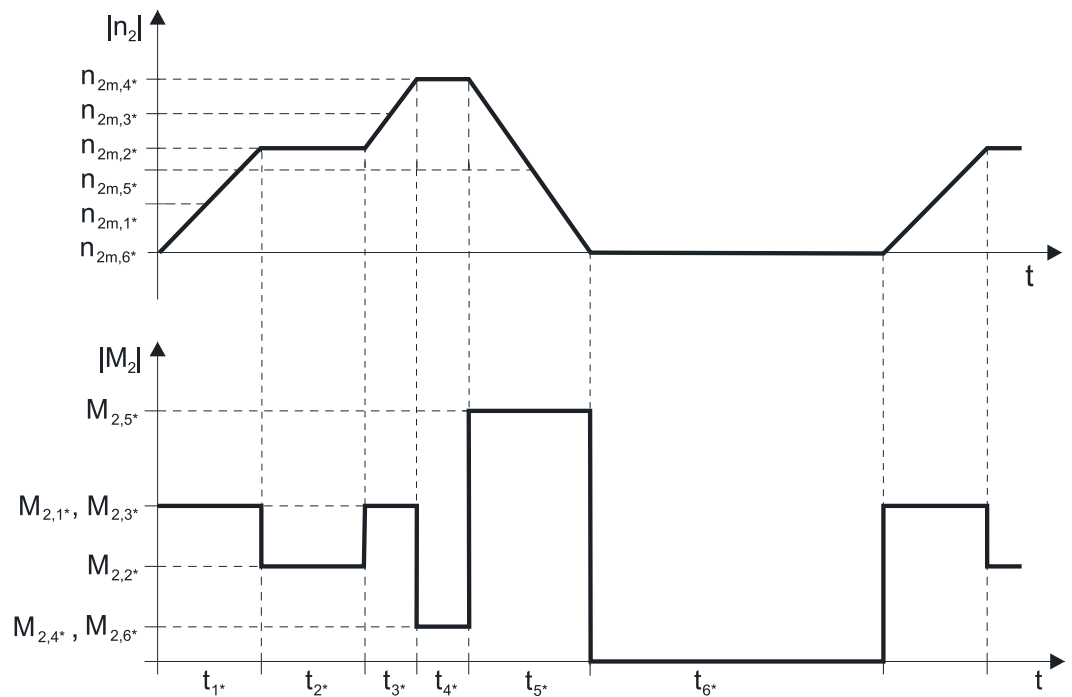
Refer to the selection tables for the values for  $n_{1\max\text{DBEL}1,2}$  and  $n_{1\max\text{DBEL}3,4,5,6}$ ,  $n_{1\max\text{ZB}}$ ,  $M_{2\text{acc}}$ ,  $M_{2\text{NOT}}$ ,  $M_{2N}$  and  $S$ .

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

Calculate the thermal limit torque  $M_{2\text{th}}$  for a duty cycle > 50%.

**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 average input speed**

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

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

If  $t_{1^*} + \dots + t_{5^*} \geq 10$  min, calculate  $n_{2m^*}$  without the rest phase  $t_{6^*}$ .

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

#### Calculation of the actual effective torque

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

#### Calculation of the actual equivalent torque

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

#### Calculation of the thermal limit torque

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

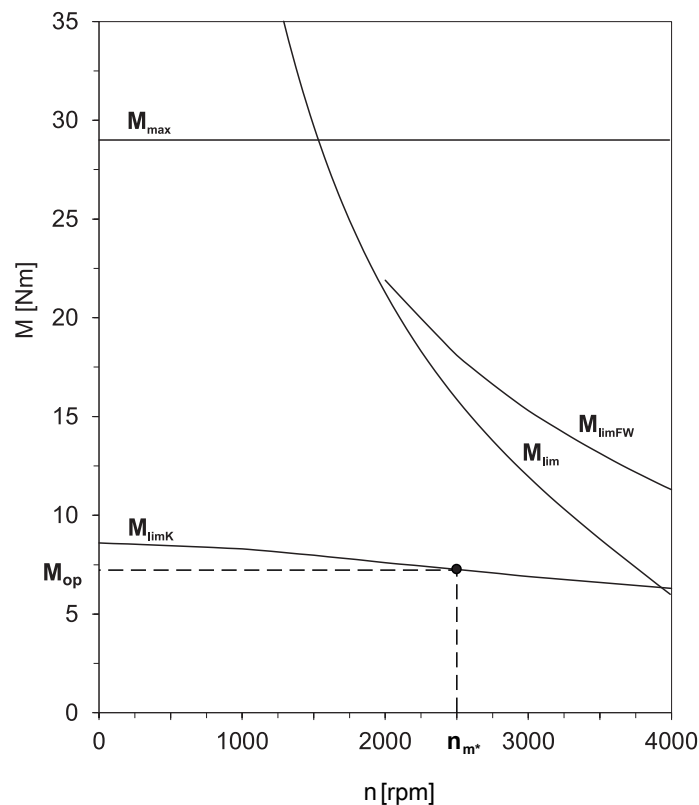
$$M_{2\text{th}} = M_{\text{op}} \cdot i \cdot K_{\text{mot,th}}$$

$$K_{\text{mot,th}} = 0,95 - \frac{a_{\text{th}}}{1000} \cdot \text{athEL} \cdot f_{\text{B}_T} \cdot \left(\frac{n_{1m^*}}{1000}\right)^2$$

The values for  $i$  and  $a_{\text{th}}$  can be found in the selection tables.

The values for  $f_{\text{B}_T}$  can be found in the corresponding table in this chapter.

The value for the torque of the motor at operating point  $M_{\text{op}}$  with the determined average input speed  $n_{1m^*}$  can be found in the motor curve of Chapter [▶ 2.3](#). Note the size and nominal speed  $n_N$  of the motor. The figure below shows an example of reading the torque  $M_{\text{op}}$  of a motor with convection cooling 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 run time $\leq 8$ h       |                         | 1.00       |
| Daily run time $\leq 16$ h      |                         | 1.15       |
| Daily run time $\leq 24$ h      |                         | 1.20       |
| Temperature                     |                         | $fB_T$     |
| Motor cooling                   | Surrounding temperature |            |
| Motor with convection cooling   | $\leq 20$ °C            | 1.0        |
|                                 | $\leq 30$ °C            | 1.1        |
|                                 | $\leq 40$ °C            | 1.25       |

**Notes**

- The maximum permitted gear unit 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 gear unit 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  $n_{2m^*} \leq 20$  rpm ( $F_{2axN} = F_{2ax20}$ ;  $F_{2radN} = F_{2rad20}$ ;  $M_{2kN} = M_{2k20}$ )
- Only if radial forces on the gear unit are stabilized by its pilots for the pitch circle diameter and flange housing design

### 12.6.2.1 V shaft design

**Permitted shaft loads for V shaft design (solid shaft)**

| Type | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| K1   | 40.0          | 1900               | 5000                | 360                |
| K2   | 42.0          | 2100               | 6000                | 430                |
| K3   | 45.0          | 2400               | 7000                | 525                |
| K4   | 52.0          | 3500               | 11200               | 1050               |
| K5   | 72.0          | 3500               | 13450               | 1580               |
| K6   | 72.0          | 4000               | 16000               | 1960               |
| K8   | 60.0          | 7250               | 29000               | 3800               |
| K9   | 87.0          | 16500              | 65000               | 11200              |
| K10  | 84.0          | 25000              | 80000               | 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 | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| K10  | 132.0         | 25000              | 64000               | 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 <http://configurator.stoeber.de>.

The following applies to output speeds  $n_{2m^*} > 20$  rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}}$$

The values for  $F_{2ax20}$ ,  $F_{2rad20}$  and  $M_{2k20}$  can be found in the table "Permitted shaft loads" in this chapter.

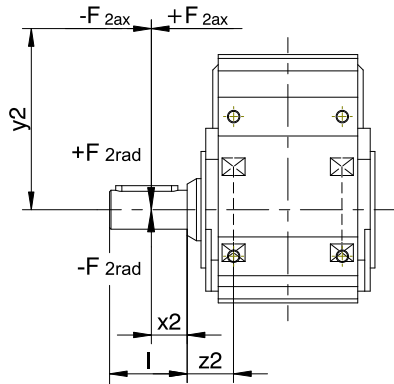


Fig. 1: Force application points for solid shaft

The specified values for  $F_{2rad20}$  are based on application of force at the middle 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:

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

$$F_{2rad^*} \leq F_{2radN}$$

$$F_{2ax^*} \leq F_{2axN}$$

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.

### 12.6.2.2 A and S shaft design

Permitted shaft loads for A shaft design (hollow shaft with keyway)

| Type | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| K1   | 40.0          | 1900               | 5000                | 240                |
| K2   | 42.0          | 2100               | 6000                | 310                |
| K3   | 45.0          | 2400               | 7000                | 380                |
| K4   | 52.0          | 3500               | 11200               | 740                |
| K5   | 39.0          | 2500               | 13450               | 1000               |
| K6   | 42.0          | 3000               | 16000               | 1300               |
| K7   | 45.0          | 4100               | 22000               | 2100               |
| K8   | 50.0          | 5300               | 29000               | 2600               |
| K9   | 56.0          | 7000               | 65000               | 3600               |
| K10  | 56.0          | 9000               | 80000               | 5000               |

**Permitted shaft loads for S shaft design (hollow shaft with shrink ring)**

| Type | $z_2$<br>[mm] | $F_{2ax20}$<br>[N] | $F_{2rad20}$<br>[N] | $M_{2k20}$<br>[Nm] |
|------|---------------|--------------------|---------------------|--------------------|
| K1   | 40.0          | 1900               | 5000                | 240                |
| K2   | 42.0          | 2100               | 6000                | 310                |
| K3   | 45.0          | 2400               | 7000                | 380                |
| K4   | 52.0          | 3500               | 11200               | 740                |
| K5   | 39.0          | 2500               | 13450               | 1000               |
| K6   | 42.0          | 3000               | 16000               | 1300               |
| K7   | 45.0          | 4100               | 22000               | 2100               |
| K8   | 50.0          | 5300               | 29000               | 2600               |
| K9   | 56.0          | 7000               | 65000               | 3600               |
| K10  | 56.0          | 9000               | 80000               | 5000               |

For other output speeds, download diagrams at <http://configurator.stoeber.de>.

The following applies to output speeds  $n_{2m^*} > 20$  rpm:

$$F_{2axN} = \frac{F_{2ax20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad F_{2radN} = \frac{F_{2rad20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}} \quad M_{2kN} = \frac{M_{2k20}}{\sqrt[3]{\frac{n_{2m^*}}{20 \text{ rpm}}}}$$

The values for  $F_{2ax20}$ ,  $F_{2rad20}$  and  $M_{2k20}$  can be found in the table "Permitted shaft loads" in this chapter.

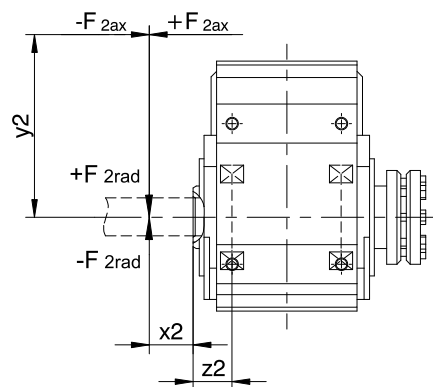


Fig. 2: Force application points for hollow shaft

You can determine the permitted radial forces from the permitted breakdown torque  $M_{2kN^*}$ . The actual radial forces may not exceed the permitted radial forces. The permitted radial forces are in relation to the end of the hollow shaft ( $x_2 = 0$ ).

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

$$F_{2ax^*} \leq F_{2axN}$$

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.

### 12.6.3 Radial shaft seal rings

#### Leak-proofness

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



## 12.6.4 Oil expansion tank

The gear units have a higher fill level in mounting position EL5. The oil expansion tank prevents oil from escaping out of the gear unit.

### Notes

- We recommend using an oil expansion tank in mounting position EL5 (additional cost) for fast running gear units 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 [▶ 12.3.15]

## 12.7 Additional documentation

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

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

| Documentation   | ID        |
|---|-----------|
| Operating manual for C/F/K/S gear units and gear motors | 443027_en |
| Lubricant filling quantities for gear units             | 441871    |



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# 14 Appendix

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## 14.1 Formula symbols

| Symbol             | Unit             | Explanation   |
|--------------------|------------------|---|
| $a_{th}$           | –                | Parameter for calculating $K_{mot,th}$  |
| $C_2$              | Nm/<br>arcmin    | Torsional stiffness relative to the gear unit output                                |
| $C_{maxPU}$        | F                | Charging capacity of the power unit   |
| $C_{PU}$           | F                | Self-capacitance of the power unit  |
| $\Delta J_B$       | kgm <sup>2</sup> | Additive mass moment of inertia of a motor with brake                               |
| $\Delta m_B$       | kg               | Additive weight of a motor with brake   |
| $\Delta \phi_2$    | arcmin           | 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  |
| $\eta_{get}$       | %                | Efficiency of the gear unit   |
| $\eta_{mot}$       | %                | Efficiency of the motor   |
| $F_{2ax*}$         | N                | Actual axial force at the gear unit output  |
| $F_{2ax100}$       | N                | Permitted axial force at the gear unit output for $n_{2m*} \leq 100$ rpm            |
| $F_{2ax20}$        | N                | Permitted axial force on the gear unit output for $n_{2m*} \leq 20$ rpm             |
| $F_{2axN}$         | N                | Permitted nominal axial force at the gear unit output                               |
| $f_{2PU}$          | Hz               | Output frequency of the power unit  |
| $F_{2rad100}$      | N                | Permitted radial force at the gear unit output for $n_{2m*} \leq 100$ rpm           |
| $F_{2rad20}$       | N                | Permitted radial force on the gear unit output for $n_{2m*} \leq 20$ rpm            |
| $F_{2rad,acc}$     | N                | Permitted radial acceleration force at the gear unit output                         |
| $F_{2rad,acc*}$    | N                | Radial acceleration force present at the gear unit output                           |
| $F_{2rad,acc,1*}$  | N                | Radial acceleration force present at the gear unit output in the first time period  |
| $F_{2rad,acc,n*}$  | N                | Radial acceleration force present at the gear unit output in the nth time period    |
| $F_{2rad,eq*}$     | N                | Actual equivalent force at the gear unit output                                     |
| $F_{2radN}$        | N                | Permitted nominal radial force at the gear unit 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   |
| $fB_t$             | –                | Run-time operating factor   |
| $fB_T$             | –                | Temperature operating factor  |
| $f_N$              | Hz               | Rotating magnetic field frequency at nominal speed                                  |
| $f_{PWM,PU}$       | Hz               | 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   |
| $I_{1maxPU}$       | A                | Maximum input current of the power unit   |
| $I_{1N,PU}$        | A                | Nominal input current of the power unit   |
| $I_{2maxPU}$       | A                | Maximum output current of the power unit  |
| $I_{2N,PU}$        | A                | Nominal output current of the power unit  |
| $I_{2N,PU(red)}$   | A                | Reduced nominal output current of the power unit                                    |
| $I_{2PU(A)}$       | 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   |

| Symbol            | Unit             | Explanation  |
|-------------------|------------------|--|
| $I_{N,B}$         | A                | Nominal current of the brake at 20 °C  |
| $I_{N,MF}$        | A                | Nominal current of the choke or motor filter   |
| $J$               | kgm <sup>2</sup> | Mass moment of inertia   |
| $J_1$             | kgm <sup>2</sup> | Mass moment of inertia relative to the gear unit input   |
| $J_{Bstop}$       | kgm <sup>2</sup> | Reference mass moment of inertia when braking from full speed: $J_{Bstop} = J \times 2$  |
| $J_{tot}$         | kgm <sup>2</sup> | Total mass moment of inertia (based on the motor shaft)  |
| $K_{EM}$          | V/1000 rpm       | Voltage constant: Peak value of the induced motor voltage at a speed of 1000 rpm and a winding temperature $\Delta\vartheta = 100$ K (tolerance $\pm 10\%$ ) |
| $K_H$             | –                | 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 $\pm 10\%$ )                              |
| $K_{mot,th}$      | –                | Factor for determining the thermal limit torque  |
| $K_\vartheta$     | –                | Derating factor for surrounding temperature  |
| $l$               | mm               | Length of the output shaft   |
| $L_{10h}$         | h                | Bearing service life   |
| $m$               | kg               | Weight   |
| $M$               | Nm               | Torque   |
| $M_0$             | Nm               | Stall torque: The continuous torque the motor is able to deliver at a speed of 10 rpm (tolerance $\pm 5\%$ )   |
| $M_{1*} - M_{6*}$ | Nm               | Actual torque of the motor in the respective time segment (1 to 6)   |
| $M_{2,0}$         | Nm               | Stall torque on the gear unit output   |
| $M_{2,acc}$       | Nm               | Maximum permitted acceleration torque on the gear unit output  |
| $M_{2,acc*}$      | Nm               | Actual acceleration torque on the gear unit output   |
| $M_{2,acc,max}$   | Nm               | Maximum permitted acceleration torque of a group of geared motors whose size and nominal torque $n_{1N}$ are the same  |
| $M_{2,eff*}$      | Nm               | Actual effective torque on the gear unit output  |
| $M_{2,eq*}$       | Nm               | Equivalent torque present on the gear unit output  |
| $M_{2k*}$         | Nm               | Actual breakdown torque on the gear unit output  |
| $M_{2k100}$       | Nm               | Permitted breakdown torque on the gear unit output for $n_{2m*} \leq 100$ rpm  |
| $M_{2k20}$        | Nm               | Permitted breakdown torque on the gear unit output for $n_{2m*} \leq 20$ rpm   |
| $M_{2k,acc}$      | Nm               | Permitted acceleration breakdown torque at the gear unit output  |
| $M_{2k,acc*}$     | Nm               | Acceleration breakdown torque present at the gear unit output  |
| $M_{2k,acc,1*}$   | Nm               | Acceleration breakdown torque present at the gear unit output in the first time period   |
| $M_{2k,acc,n*}$   | Nm               | Acceleration breakdown torque present at the gear unit output in the nth time period   |
| $M_{2k,eq*}$      | Nm               | Actual equivalent breakdown torque on the gear unit output   |
| $M_{2kN}$         | Nm               | Permitted nominal breakdown torque at the gear unit output   |
| $M_{2N}$          | Nm               | Nominal torque on the gear unit output (relative to $n_{1N}$ )   |
| $M_{2NOT}$        | Nm               | Gear unit emergency-off torque on the gear unit output for max. 1000 load changes  |
| $M_{2NOT*}$       | Nm               | Actual emergency off torque for the gear unit on the gear unit output  |
| $M_{2th}$         | Nm               | Thermal limit torque on the gear unit output   |
| $M_{Bdyn}$        | Nm               | Dynamic braking torque at 100 °C (Tolerance +40%, -20%)  |
| $M_{Bstat}$       | Nm               | Static braking torque at 100 °C (Tolerance +40%, -20%)   |
| $M_{eff*}$        | Nm               | Actual effective torque of the motor   |
| $M_k$             | Nm               | Permitted breakdown torque on the output   |
| $M_{k*}$          | Nm               | Actual breakdown torque on the output  |
| $M_{k100}$        | Nm               | Permitted breakdown torque on the output for $n_{m*} \leq 100$ rpm   |
| $M_L$             | Nm               | Load torque  |
| $M_{lim}$         | Nm               | Torque limit without compensating for field weakening  |
| $M_{limFW}$       | Nm               | Torque limit with compensation for field weakening (applies to operation on STOBBER drive controllers only)  |
| $M_{limK}$        | Nm               | Torque limit of the motor with convection cooling  |
| $M_{max}$         | Nm               | Maximum torque: the maximum permitted torque the motor is able to deliver over a short period (when accelerating or decelerating) (tolerance $\pm 10\%$ )    |
| $M_N$             | Nm               | Nominal torque: the maximum torque of a motor in S1 mode at nominal speed $n_N$ (tolerance $\pm 5\%$ )   |

| Symbol                    | Unit              | Explanation   |
|---------------------------|-------------------|---|
| $M_{n^*}$                 | 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 <sup>-1</sup> | Maximum permitted input speed of the gear unit in continuous operation (at surrounding temperature of 20 °C)  |
| $n_{1maxDBEL1,2}$         | rpm               | Maximum permitted input speed of the gear unit in continuous operation<br>Mounting positions EL1, EL2<br>(at surrounding temperature of 20 °C)  |
| $n_{1maxDBEL1,2,3,4}$     | rpm               | Maximum permitted input speed of the gear unit in continuous operation<br>Mounting positions EL1, EL2, EL3, EL4<br>(at surrounding temperature of 20 °C)  |
| $n_{1maxDBEL1,2,5,6}$     | rpm               | Maximum permitted input speed of the gear unit in continuous operation<br>Mounting positions EL1, EL2, EL5, EL6<br>(at surrounding temperature of 20 °C)  |
| $n_{1maxDBEL3,4}$         | rpm               | Maximum permitted input speed of the gear unit in continuous operation<br>Mounting positions EL3, EL4<br>(at surrounding temperature of 20 °C)  |
| $n_{1maxDBEL3,4,5,6}$     | rpm               | Maximum permitted input speed of the gear unit in continuous operation<br>Mounting positions EL3, EL4, EL5, EL6<br>(at surrounding temperature of 20 °C)  |
| $n_{1maxDBEL5,6}$         | rpm               | Maximum permitted input speed of the gear unit in continuous operation<br>Mounting positions EL5, EL6<br>(at surrounding temperature of 20 °C)  |
| $n_{1maxZB}$              | min <sup>-1</sup> | Maximum permitted input speed of the gear unit in cyclic operation (at surrounding temperature of 20 °C)  |
| $n_{1N}$                  | rpm               | Nominal speed at the gear unit input  |
| $n_{2m^*}$                | rpm               | Actual average output speed   |
| $n_{2m,1^*} - n_{2m,6^*}$ | rpm               | Actual average output speed in the respective time segment (1 to 6)   |
| $n_{2m,n^*}$              | rpm               | Actual average output speed in the n-th time segment  |
| $n_{2N}$                  | min <sup>-1</sup> | Nominal speed at the gear unit output   |
| $N_{Bstop}$               | –                 | 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  |
| $n_{m,1^*} - n_{m,6^*}$   | rpm               | Actual average speed of the motor in the respective time segment (1 to 6)   |
| $n_{m,n^*}$               | 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 $\pm 5$ %)   |
| $P_{N,PU}$                | W                 | Nominal power of the power unit   |
| $P_V$                     | W                 | Power loss  |
| $P_{V,CU}$                | W                 | Power loss of the control unit  |
| $R_{2minRB}$              | $\Omega$          | Minimum resistance of the external braking resistor   |
| $S$                       | –                 | Service factor: Quotient of the nominal torque from the gear unit and the motor without consideration for thermal limiting performance. Represents a value for the reserve of the geared motor.                   |
| $\vartheta_{amb}$         | °C                | Surrounding temperature   |
| $\vartheta_{amb,max}$     | °C                | Maximum surrounding temperature   |
| $t_{1^*} - t_{6^*}$       | s                 | Duration of the respective time segment (1 to 6)  |



| Symbol            | Unit | Explanation  |
|-------------------|------|--|
| $t_{1B}$          | 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  |
| $\vartheta_{NAT}$ | °C   | Nominal response temperature   |
| $t$               | s    | Time   |
| $\tau_{th}$       | °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   |
| $U_{max}$         | 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  |
| $W_{B,Rlim}$      | J    | Work done by friction until wear limit is reached  |
| $W_{B,Rmax/h}$    | J    | 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                                 |

## 14.2 Trademarks

The following names used in connection with the device, its optional equipment and its accessories are trademarks or registered trademarks of other companies:

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