

maxon gear – Important considerations

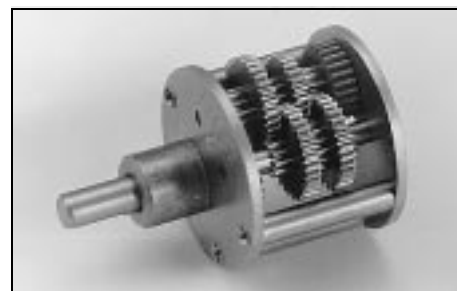
When selecting a gear-motor, please keep the following suggestions in mind: Reduce the motor speed by dividing by the reduction ratio. Increase the motor torque by multiplying times gearhead ratio times gearhead efficiency. The maximum efficiency is stated in the table. It is dependent on the number of stages and is measured at maximum continuous torque and nominal speed. The efficiency is reduced for lower torque requirements. This must be taken into consideration when selecting a gear-motor. To keep noise and gearhead wear low it is advisable not to exceed the max. recommended input speed. Also, the permissible output torque must be observed with a clear distinction between short-term and continuous operation. We will gladly assist you with any gearmotor problem you might have.

Important:

- Primary consideration should be given speed and torque at the output shaft when determining a gear-motor combination.
- An extensive adaption to desired output requirements is achieved by taking advantage of the various windings available with maxon motors as well as the wide selection of gear reduction ratios.
- The recommended maximum gearhead input speed should, if possible, not be exceeded (see gearhead pages, «Technical Data»).
- When ordering a gearhead, state maxon motor or give details of the mounting.
- You will find spur and planetary gearheads on page 104 up to 134 sorted by diameter.

Spur gearheads:

Output torques up to 0.6 Nm.
Reduction ratios from 4:1 to 3000:1.
One or several stages. Each pair of gear wheels represents one stage, whereas the first gear wheel (pinion) is mounted on the motor shaft.
Normally, gearhead output shaft bearings are the sinter sleeve type.



Planetary gearheads:

Output torques up to 180 Nm.
Reduction ratios from 4:1 to 6285:1.
Planetary gearheads are particularly suitable for the transmission of high torque. Gearheads 22 mm in diameter and larger are equipped with ball bearings.



Sequence of steps in determining the components of a gearmotor combination:

1. Power requirement estimate

$$P_L = M \cdot \omega = M_L \cdot \frac{\pi}{30} \cdot n_L$$

2. Gearhead selection

Choose the one gearhead from the gearhead pages that just meets the application's torque requirements.

3. Determination of the theoretical reduction ratio:

$$i_{\text{theor}} = \frac{n_{\text{Gear perm}}}{n_L}$$

4. Determination of motor speed based on the nearest available gearhead reduction ratio.

$$n_{\text{Mot}} = i \cdot n_L$$

5. Gearhead efficiency

$$\eta_{\text{Gear}} = (\eta_{\text{Stage}})^s = \eta_1 \cdot \eta_2 \cdot \eta_3 \cdot \dots$$

6. Calculation of necessary motor torque

$$M_{\text{Mot}} = \frac{M_L [\text{Nm}] \cdot 1000}{i \cdot \eta_{\text{Gear}}} = [\text{mNm}]$$

7. Choice of motor type

The gearhead data pages indicate the motor types compatible with the chosen gearhead. Choose a type that meets power requirements and other prerequisites such as dimensions, tachometer option, etc.

8. Motor choice, a cursory assessment

$$n_{\text{Mot}} < n_{\text{limit}}$$

$$M_{\text{Mot}} < M_{\text{permiss}}$$

9. Choice of winding number

a) Determination of the motor's no load speed

$$n_i = n_{\text{Mot}} + \left(\frac{\Delta n}{\Delta M} \cdot M_{\text{Mot}} \right)$$

b) Calculation of theoretical speed constant

$$k_{ni} = \frac{n_i}{U}$$

c) Effective speed constant

The speed constant of the motor selected under item 7 can be obtained from line 15 of the motor data sheet.

d) Choice of winding

$$k_{ni} \approx k_{n\text{Mot}}$$

10. Verification of calculated values

Compare gearmotor speed of the unit assembled using the components selected with the initial requirements. The procedure may need to be repeated with other motor and gearhead data, if necessary.

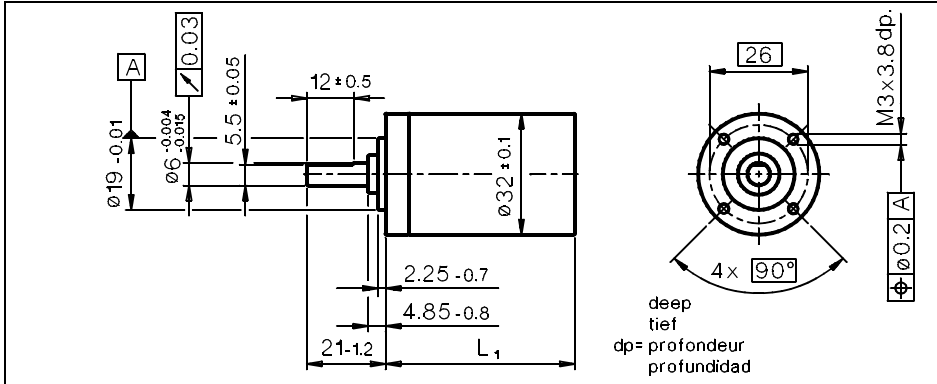
Definition of abbreviations:

i	= Actual gearhead reduction
i_{theor}	= theoretical gearhead reduction
I_{permiss}	= Max. permissible continuous current (Line 10) [mA]
k_M	= Torque constant (Line 14) [mNm/A]
k_{ni}	= Theoretical speed constant [rpm/V]
$k_{n\text{Mot}}$	= Actual motor speed constant (Line 15) [rpm/V]
M_L	= Output torque [Nm]
M_{Mot}	= Motor torque [mNm]
M_{permiss}	= Max. permissible continuous torque (Line 11) [mNm]
	= $k_M \cdot I_{\text{permiss}}/1000$
$n_{\text{Gear perm}}$	= Recommended input speed [rpm]
n_i	= Theoretical no load speed [rpm]
n_L	= Output speed under load [rpm]
n_{limit}	= Max. permissible speed [rpm] (Line 9)
n_{Mot}	= Motor speed [rpm]
P_L	= Output power [W]
s	= Number of gearhead stages
U	= Available voltage [V]
U_N	= Nominal voltage (Line 2) [V]
$\frac{\Delta n}{\Delta M}$	= Speed/torque gradient (Line 5) [rpm/mNm]
η_{gear}	= Gearhead efficiency
η_{stage}	= Efficiency per gearhead stage
Note:	Line references above pertain to motor data pages.

Planetary Gearhead
 Ø32 mm, 0.75-4.5 Nm

CERAMIC VERSION
 on request. New performance levels!

METAL VERSION
 Plastic version see page 125 - 128



Technical Data

Planetary gearhead	straight teeth
Bearing at output	ball bearing
Output shaft	steel not hardened
Radial play, 5 mm from flange	0.28 mm
Axial play	max. 0.47 mm
Max. perm. radial load, 12 mm from flange	140 N
Max. perm. axial load	120 N
Max. permissible force for press fits	120 N
Average backlash no load per stage	< 1.3°
Mass inertia	1.87-1.687 gcm ²
Sense of direction	=
Recommended input speed	< 5000 rpm
Recommended temperature range	-15/+80°C

Order Number	Reduction	Reduction absolute	Order Number	Reduction	Reduction absolute	Order Number	Reduction	Reduction absolute	No. of stages	max. Torque		Weight [g]	L ₁ max. [mm]	L ₂ max. [mm]	L ₃ max. [mm]	L ₄ max. [mm]	L ₅ max. [mm]	L ₆ max. [mm]	L ₇ max. [mm]	L ₈ max. [mm]	
										Continuous [Nm]	Intermittent [Nm]										
114435	3.7 : 1	3 ⁵ / ₇	110364	4.8 : 1	4 ⁴ / ₅	114436	5.8 : 1	5 ³ / ₄	1	0.75	1.13	80	118	26.50	83.50	100.40	105.30	103.25	90.90	109.00	111.85
110365	14 : 1	13 ³⁹ / ₁₄₉	110366	18 : 1	17 ²⁹ / ₁₃₅	114437	21 : 1	21 ⁵ / ₁₄	2	2.25	3.38	75	162	36.40	93.40	110.30	115.20	113.15	100.80	118.90	121.75
110367	23 : 1	23 ¹ / ₂₅	110368	28 : 1	27 ³ / ₁₅	110369	33 : 1	33 ¹ / ₁₆	2	2.25	3.38	75	162	36.40	93.40	110.30	115.20	113.15	100.80	118.90	121.75
114438	51 : 1	51 ⁸³ / ₂₄₃	110370	66 : 1	66 ⁵⁴ / ₂₄₅	114439	79 : 1	79 ¹⁶ / ₁₄₉	3	4.50	6.75	70	194	43.10	100.10	117.00	121.90	119.85	107.50	125.60	128.45
110371	86 : 1	85 ¹⁰¹ / ₁₇₅	114440	103 : 1	102 ¹⁹ / ₃₅	110372	111 : 1	110 ⁷⁴ / ₁₂₅	3	4.50	6.75	70	194	43.10	100.10	117.00	121.90	119.85	107.50	125.60	128.45
114441	123 : 1	122 ⁴⁵ / ₅₆	114442	132 : 1	132 ¹² / ₂₅	110373	159 : 1	158 ⁷ / ₁₁₀	3	4.50	6.75	70	194	43.10	100.10	117.00	121.90	119.85	107.50	125.60	128.45
110374	190 : 1	190 ⁷ / ₆₄							3	4.50	6.75	70	194	43.10	100.10	117.00	121.90	119.85	107.50	125.60	128.45
110375	246 : 1	245 ¹⁶⁴⁹ / ₁₇₁₅	114443	295 : 1	294 ²²⁰ / ₃₄₃	110376	318 : 1	317 ¹⁰⁵¹ / ₁₂₂₅	4	4.50	6.75	60	226	49.80	106.80	123.70	128.60	126.55	114.20	132.30	135.15
110377	411 : 1	410 ⁶⁷⁴ / ₈₇₅	114444	456 : 1	456 ²⁵ / ₁₉₆	114445	492 : 1	492 ¹² / ₁₇₅	4	4.50	6.75	60	226	49.80	106.80	123.70	128.60	126.55	114.20	132.30	135.15
110378	531 : 1	530 ⁵²⁶ / ₆₂₅	114446	589 : 1	589 ¹⁶ / ₃₅	114447	636 : 1	635 ¹¹³ / ₁₂₅	4	4.50	6.75	60	226	49.80	106.80	123.70	128.60	126.55	114.20	132.30	135.15
114448	706 : 1	706 ²⁷ / ₂₂₄	110379	762 : 1	761 ¹⁹ / ₂₅	114449	913 : 1	912 ²¹ / ₄₀	4	4.50	6.75	60	226	49.80	106.80	123.70	128.60	126.55	114.20	132.30	135.15
114450	1093 : 1	1093 ³³ / ₂₅₆							4	4.50	6.75	60	226	49.80	106.80	123.70	128.60	126.55	114.20	132.30	135.15
110380	1181 : 1	1180 ²⁷⁶ / ₈₅₇₅	114451	1414 : 1	1414 ⁴⁷⁸ / ₁₇₁₅	110381	1526 : 1	1525 ³⁹⁹ / ₆₁₂₅	5	4.50	6.75	50	258	56.50	113.50	130.40	135.30	133.25	120.90	139.00	141.85
114452	1694 : 1	1694 ¹²⁹ / ₆₈₆	114453	1828 : 1	1827 ⁸³⁷ / ₁₂₂₅	110382	1972 : 1	1971 ³⁰⁵¹ / ₄₃₇₅	5	4.50	6.75	50	258	56.50	113.50	130.40	135.30	133.25	120.90	139.00	141.85
114454	2189 : 1	2189 ¹⁰¹ / ₂₄₅	114455	2362 : 1	2361 ⁸¹³ / ₈₇₅	110383	2548 : 1	2548 ¹²⁴ / ₃₁₂₅	5	4.50	6.75	50	258	56.50	113.50	130.40	135.30	133.25	120.90	139.00	141.85
114456	2623 : 1	2622 ⁵⁷⁵ / ₇₈₄	114457	2829 : 1	2829 ⁶⁹ / ₁₇₅	114458	3052 : 1	3052 ²¹² / ₆₂₅	5	4.50	6.75	50	258	56.50	113.50	130.40	135.30	133.25	120.90	139.00	141.85
114459	3389 : 1	3389 ⁵³ / ₁₄₀	114460	3656 : 1	3656 ⁵⁶ / ₁₂₅	114461	4060 : 1	4060 ¹⁷³ / ₈₉₆	5	4.50	6.75	50	258	56.50	113.50	130.40	135.30	133.25	120.90	139.00	141.85
114462	4380 : 1	4380 ³ / ₂₅	114463	5247 : 1	5247 ⁹ / ₁₆₀	114464	6285 : 1	6285 ⁵⁰³ / ₁₀₂₄	5	4.50	6.75	50	258	56.50	113.50	130.40	135.30	133.25	120.90	139.00	141.85

Stock program
 Standard program
 Special program (on request!)

Continued from page 121

Continued on page 123

+ Motor Order Number

23 32 - 62 . 2 1 6 - 2 0 0
 Basic motor 2332....-12.216-200
 Details see page 63

23 32 - 75 . 2 3 6 - 2 0 0
 Basic motor 2332....-51.236-200
 Details see page 63

23 32 - 75 . 2 3 6 - 2 0 0
 Basic motor 2332....-51.236-200
 Details see page 63

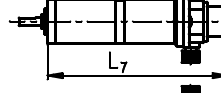
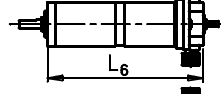
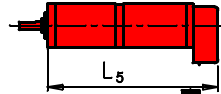
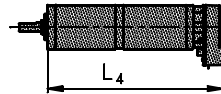
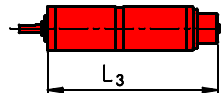
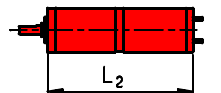
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 Basic motor 2332....-51.236-200
 Details see page 63

23 32 - 81 . 2 2 5 - 2 0 0
 Basic motor 2332....-52.215-200
 Details see page 64

23 32 - 75 . 2 2 5 - 2 0 0
 Basic motor 2332....-52.215-200
 Details see page 64

23 32 - 76 . 2 2 5 - 2 0 0
 Basic motor 2332....-52.215-200
 Details see page 64

+ Tacho/Encoder



DC-Tacho
 Ø22 mm, 0.52 V
 Details see page 141

DC-Tacho/Encoder 36 04
 Details see page 153

Digital Encoder
 HED_ 5540, 500 CPT, 3 channels
 Details see page 146

DC-Tacho
 Ø22 mm, 0.52 V
 Details see page 141

Digital Encoder
 HED_ 5540, 500 CPT, 3 channels
 Details see page 147