

L-force

Geared servo motors



Dynamic, powerful and compact



Lenze

This is what we stand for.

You want to implement your machine and plant concepts efficiently and easily or optimise existing concepts to reduce costs? Then, Lenze is the partner you are looking for. For more than 60 years, drive and automation systems have been our core competence.



Drive and automation technology from Lenze keep things moving – for example in the areas of materials handling, robotics and component handling as well as in packaging facilities for the intralogistics and automotive sectors and the food and beverage industries.

Lenze | about us

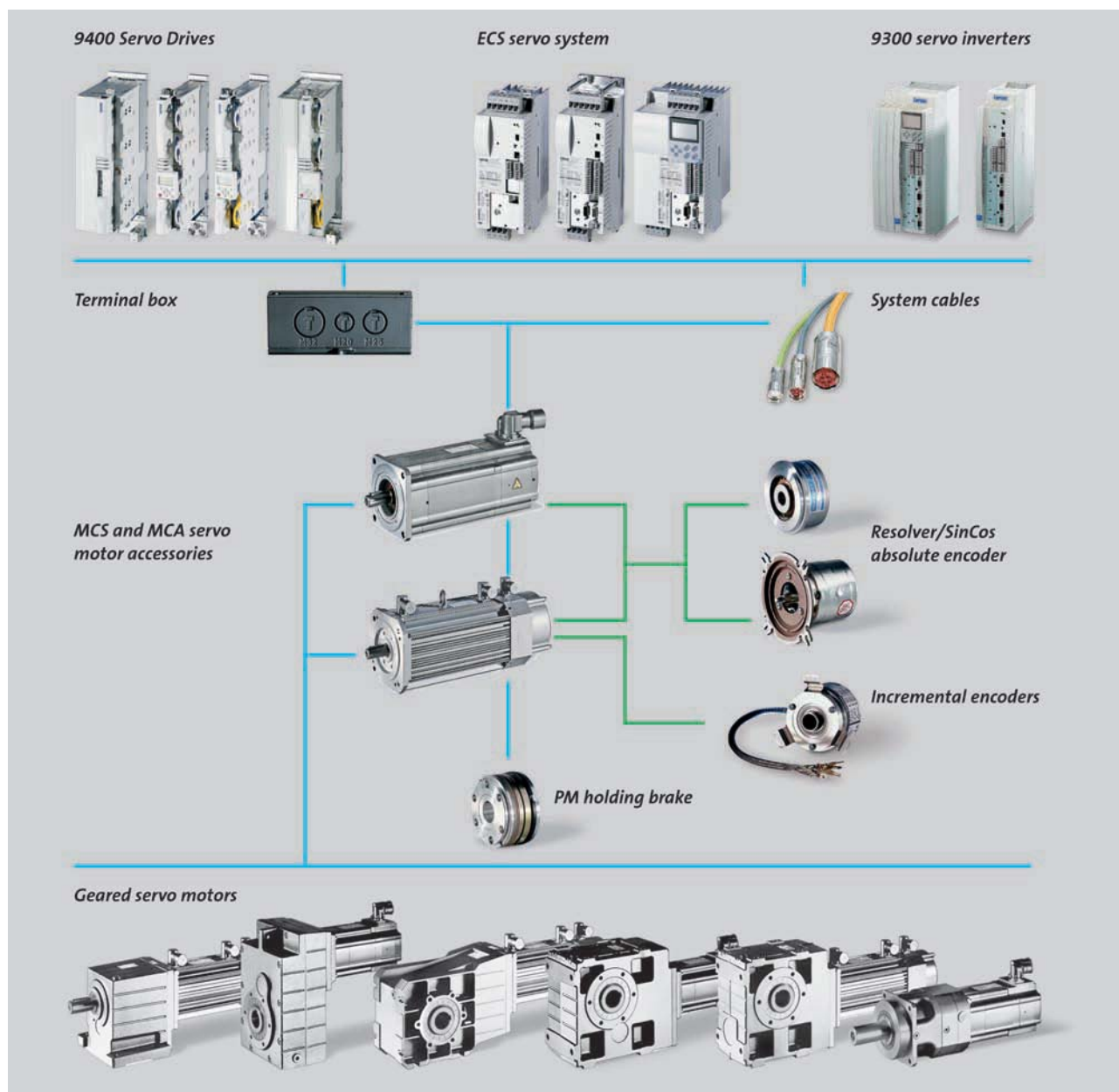
We can offer you automation solutions, including control, visualisation and drive technology, from a single source. Our drive systems will improve the performance of your machines. From project planning to commissioning, we have the know-how, while our international sales and service network can provide you with expert help and advice at any time.

Cut your process costs and increase your competitiveness. Let us analyse your drive technology tasks and support you with tailor-made solutions. The scalability of our products and the scope of our portfolio allow us to take a holistic approach to projects. We can get the best from your machines and systems.



At your side all over the world – with thorough and professional support from our motivated team.

System overview | Geared servo motors



Further catalogues

This catalogue describes geared servo motors in the G-motion Servo MC series. Further components in the above system overview may be found in the following catalogues:

Components	Catalogue
9400 Servo Drives	▶ 9400 Servo Drives
ECS servo system	▶ ECS servo system
9300 servo inverter	▶ 9300 servo inverter
MCS/MCA servo motors and built-on accessories	▶ Servo motors

Overview | Geared servo motors

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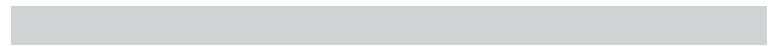
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GPA planetary gearbox _____ 451



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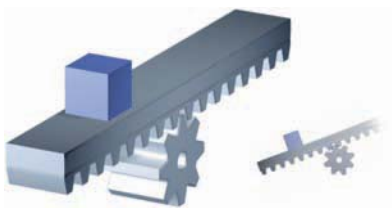
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GSS helical-worm gearbox



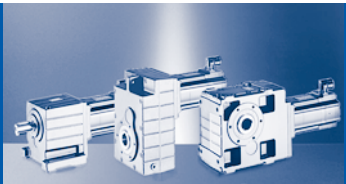
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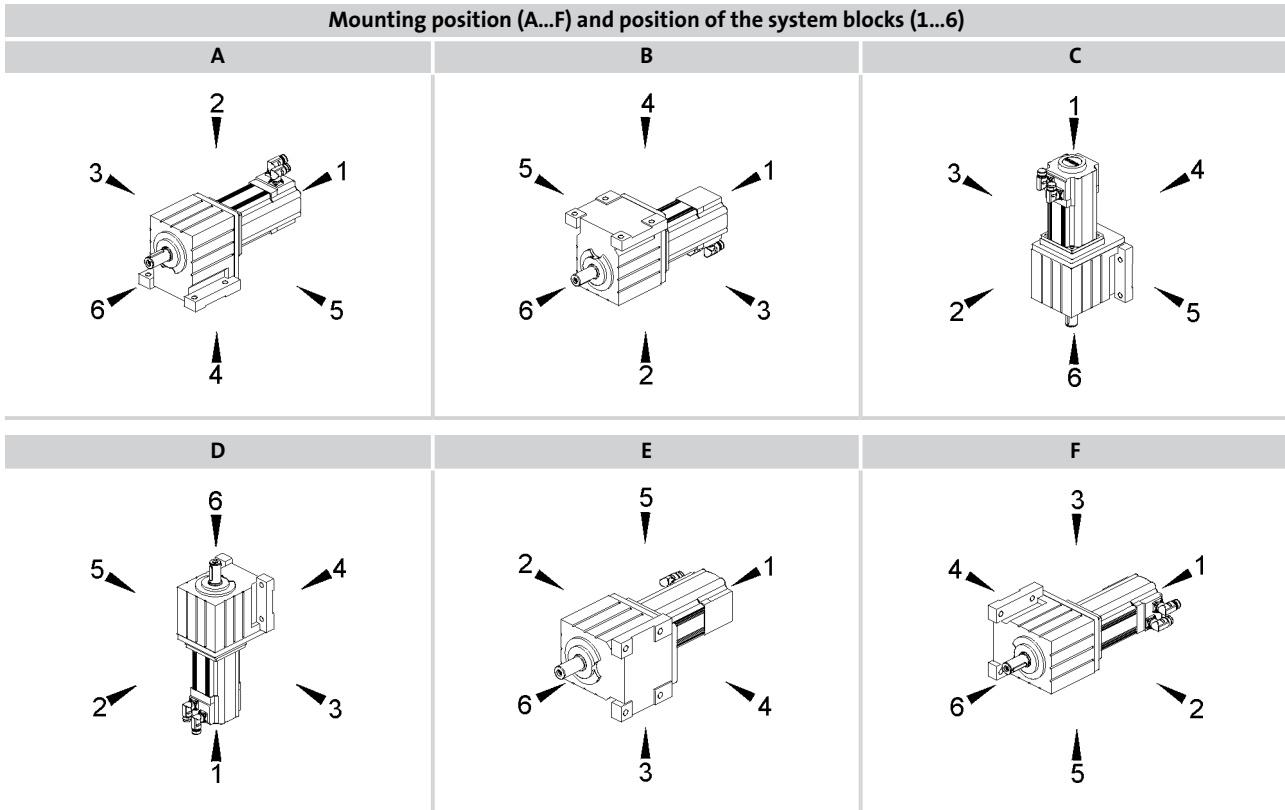


Servo motors

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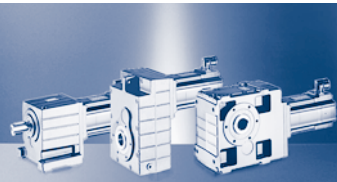
Mounting position (A...F) and position of the system blocks (1...6)



Connector/terminal box: 2, 3, 4, 5

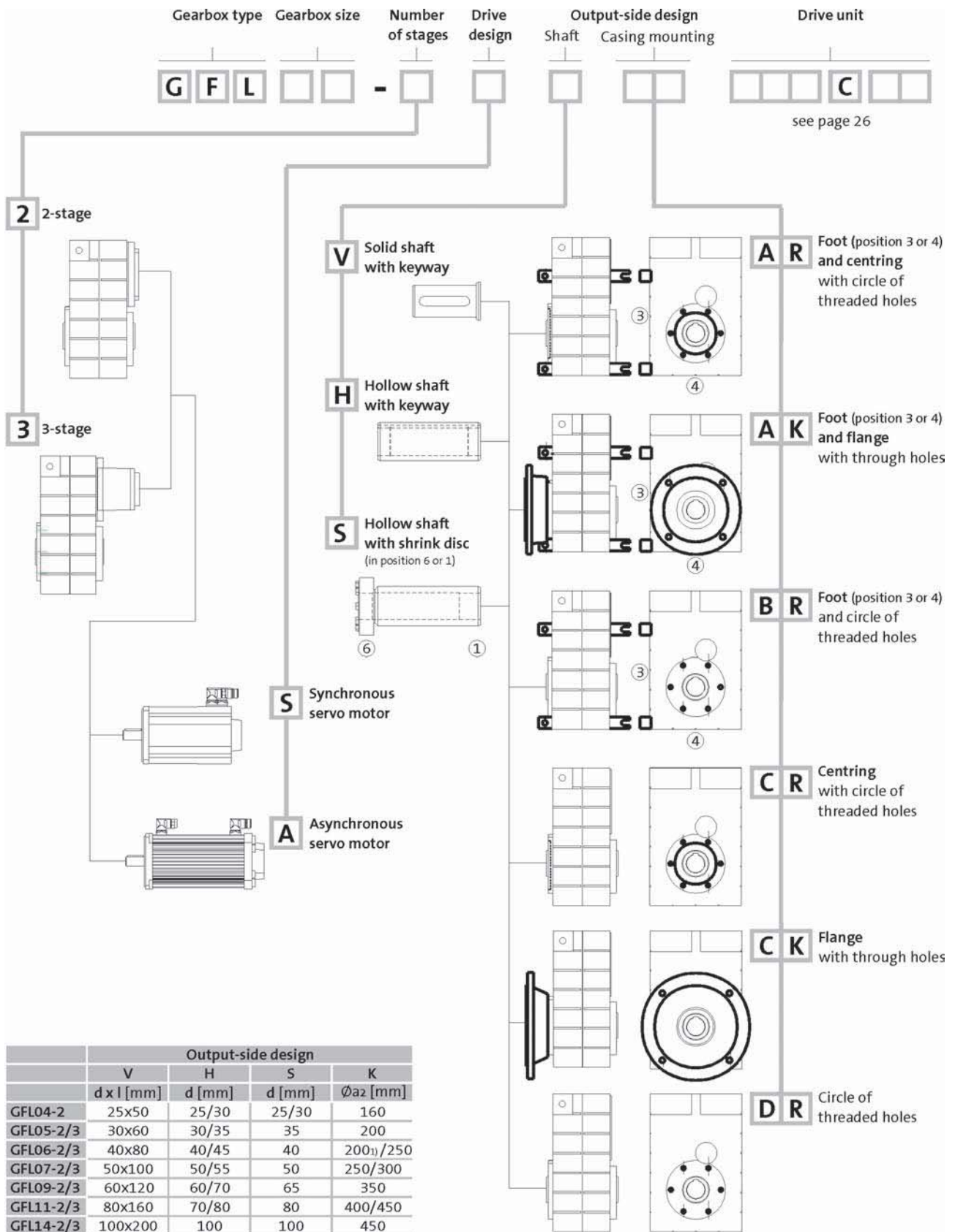
Basic versions	
Colour	Grey primer RAL 9005 (jet black matt) paint
Lubricant	Synthetic CLP HC 320
Ventilation	Oil control plugs for GST05 - 14 Breather elements for GST06...14
Options	
Colour	Special paint in accordance with RAL
Lubricant	CLP HC 220 USDA H1
Ventilation	Breather elements for GST05 Compensation reservoir for GST09...14 in mounting position C
Bearing	GST04 ... 09-2: Reinforced driven shaft
Shaft sealing rings	Driven shaft: Viton

Ordering details checklist	
Product key	GST...
Ratio	$i = \dots$
Shaft diameter	$d = \dots$ [mm]
Flange diameter	$a_2 = \dots$ [mm]
Mounting position	A, B, C, D, E, F
Position of system blocks	Connector/terminal box: 2, 3, 4, 5
Colour	
Options	



General information

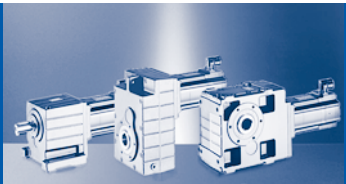
Shaft-mounted helical gearbox product key



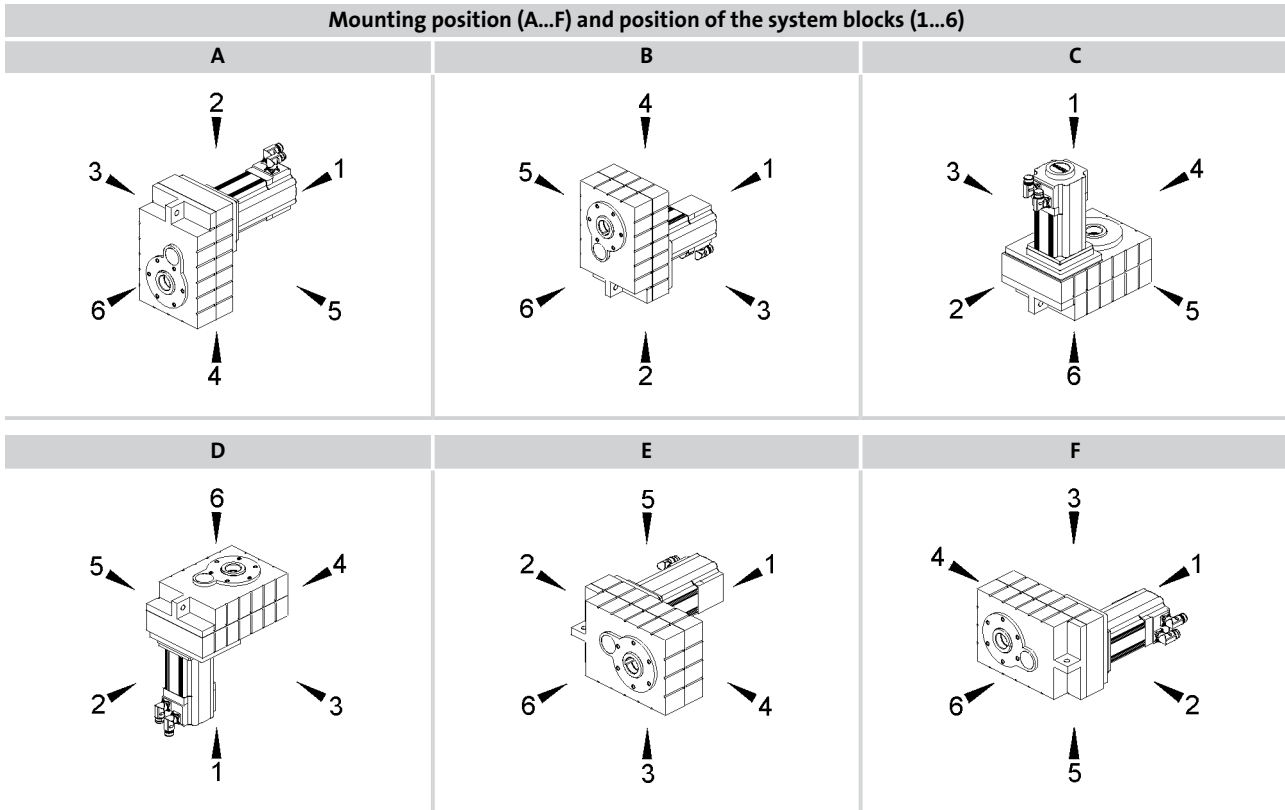
1) Only with output-side design H and S

General information

Shaft-mounted helical gearbox product key



Mounting position (A...F) and position of the system blocks (1...6)

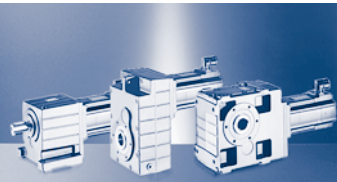


Solid shaft: 6
Hollow shaft: 0
Hollow shaft with shrink disc: 1, 6

Without foot: 0
Foot: 3, 4
Connector/terminal box: 2, 3, 4, 5

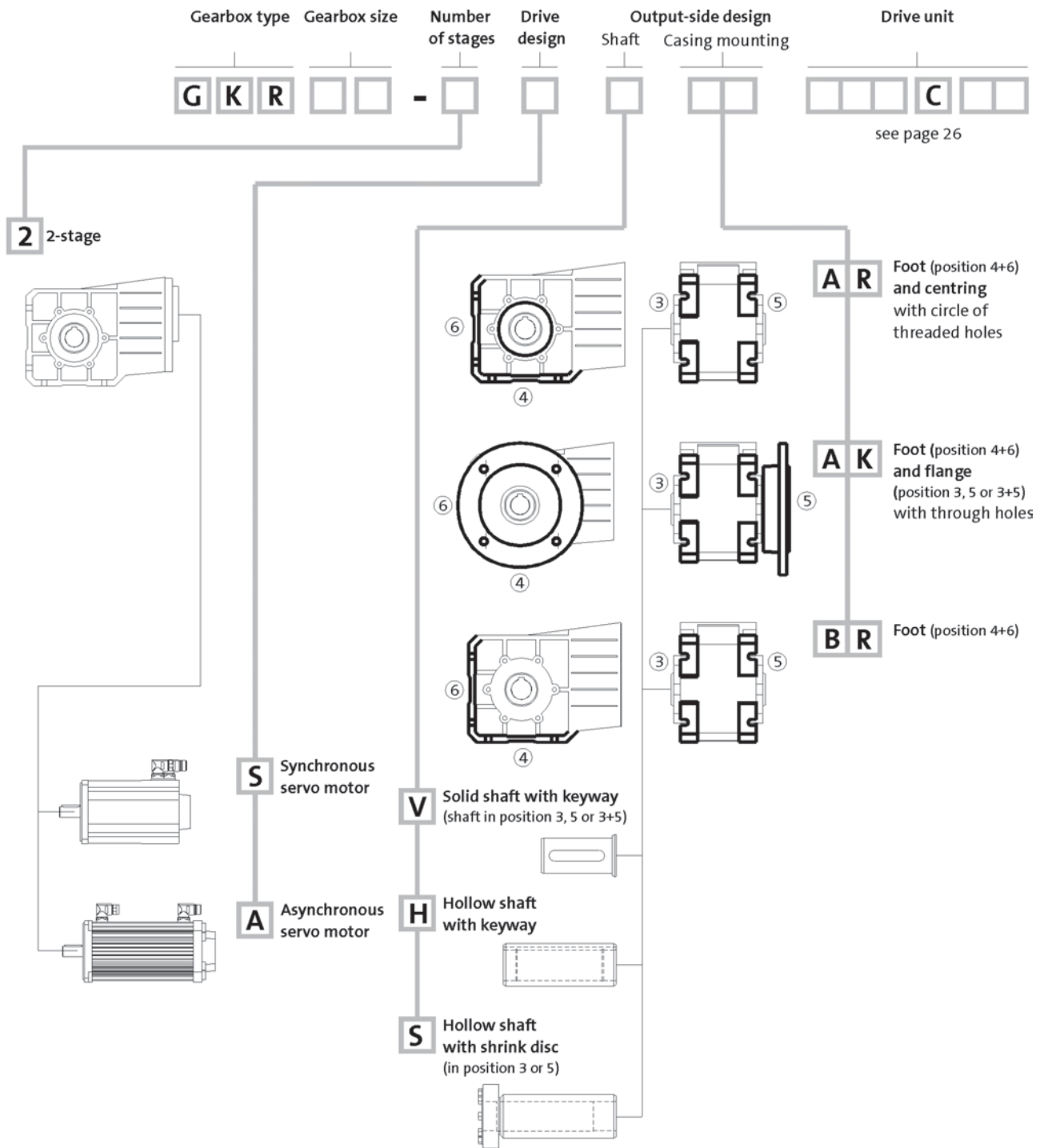
Basic versions	
Colour	Grey primer RAL 9005 (jet black matt) paint
Lubricant	Synthetic CLP HC 320
Ventilation	Oil control plugs for GFL05 - 14 Breather elements for GFL06...14
Options	
Colour	Special paint in accordance with RAL
Lubricant	CLP HC 220 USDA H1
Ventilation	Breather elements for GFL05 Compensation reservoir for GFL09...14 in mounting position C
Shaft sealing rings	Driven shaft: Viton
Accessories	Rubber buffer for torque plate Cover shrink disc Hollow shaft circlip assembly kit

Ordering details checklist	
Product key	GFL...
Ratio	$i = \dots$
Shaft diameter	$d = \dots$ [mm]
Flange diameter	$a_2 = \dots$ [mm]
Mounting position	A, B, C, D, E, F
Position of system blocks	Shaft: 0, 1, 6 Foot: 0, 3, 4 Connector/terminal box: 2, 3, 4, 5
Colour	
Options	



General information

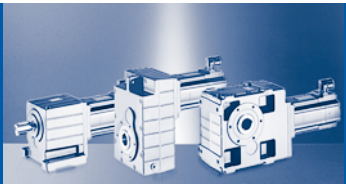
Bevel gearbox product key



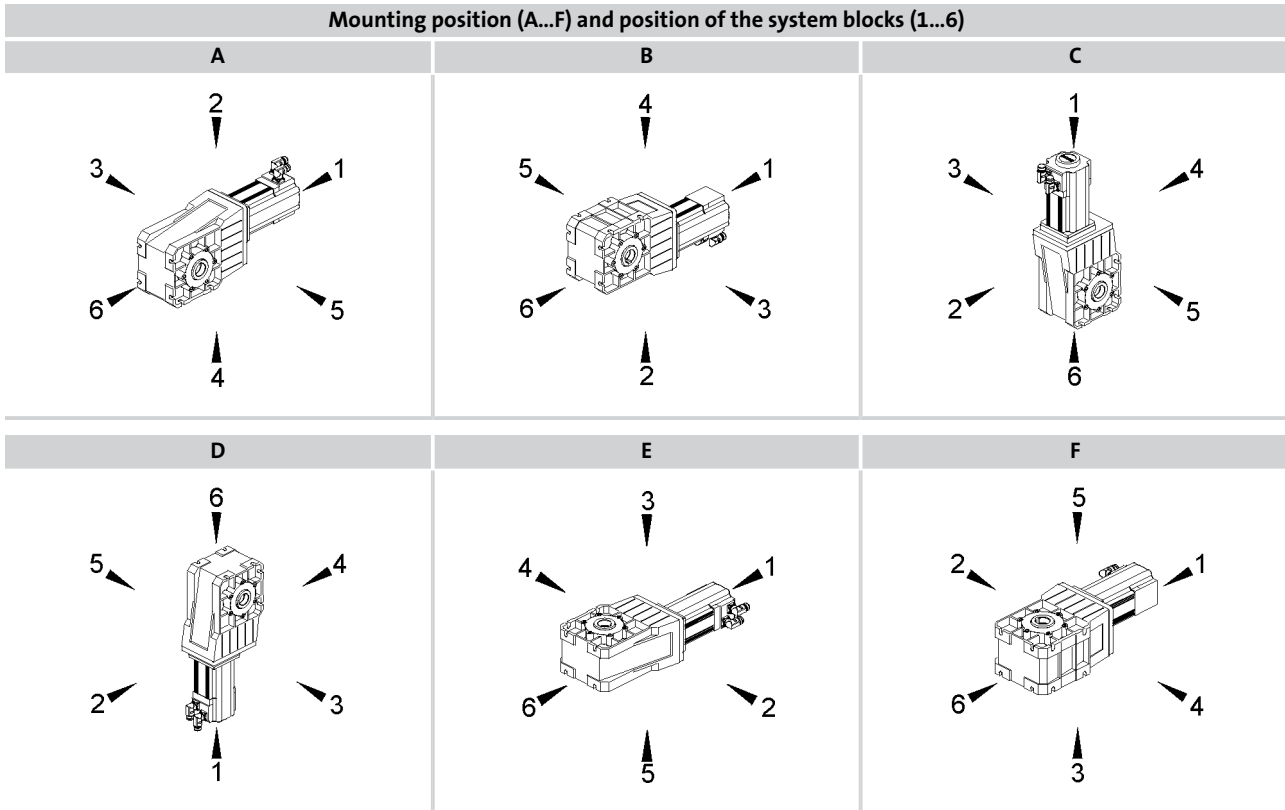
	Output-side design			
	V	H	S	K
	d x l [mm]	d [mm]	d [mm]	Øa2 [mm]
GKR03-2	20x40	18/20	20	110/120
GKR04-2	20x40	20/25	20	120/160
GKR05-2	30x60	30/35	30/35	160/200
GKR06-2	35x70	40/45	40	200/250

General information

Bevel gearbox product key



Mounting position (A...F) and position of the system blocks (1...6)



Solid shaft: 3, 5, 8 (3+5)
 Hollow shaft: 0
 Hollow shaft with shrink disc: 3, 5

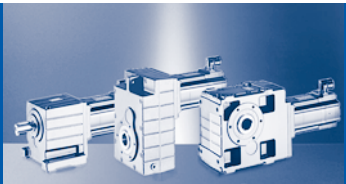
Without flange: 0
 Flange: 3, 5, 8 (3+5)
 Connector/terminal box: 2, 3, 4, 5

Basic versions	
Colour	Grey primer RAL 9005 (jet black matt) paint
Lubricant	Synthetic CLP HC 320
Ventilation	Breather elements for GKR06
Options	
Colour	Special paint in accordance with RAL
Lubricant	CLP HC 220 USDA H1
Shaft sealing rings	Driven shaft: Viton
Accessories	Rubber buffer for torque plate (GKR03/04 only) Threaded hole circle torque plate Torque plate for casing foot (GKR05/06 only) 2nd output shaft end Cover shrink disc Hoseproof hollow shaft cover Hollow shaft circlip assembly kit

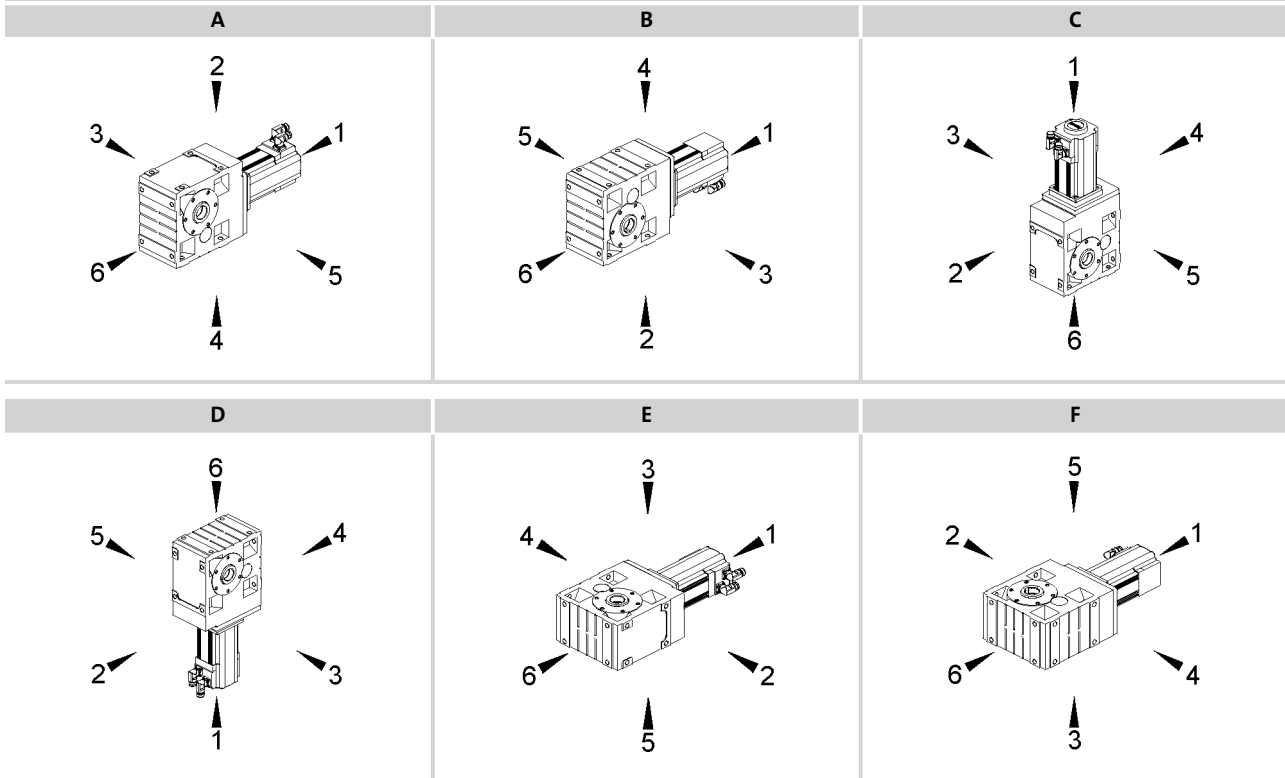
Ordering details checklist	
Product key	GKR...
Ratio	$i = \dots$
Shaft diameter	$d = \dots$ [mm]
Flange diameter	$a_2 = \dots$ [mm]
Mounting position	A, B, C, D, E, F
Position of system blocks	Shaft: 3, 5, 8 Flange: 0, 3, 5, 8 Connector/terminal box: 2, 3, 4, 5
Colour	
Options	

General information

Helical-bevel gearbox product key



Mounting position (A...F) and position of the system blocks (1...6)

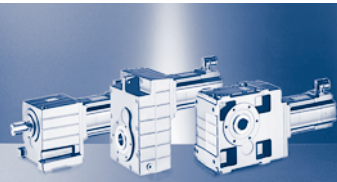


Solid shaft: 3, 5, 8 (3+5)
 Hollow shaft: 0
 Hollow shaft with shrink disc: 3, 5

Without flange: 0
 Flange: 3, 5, 8 (3+5)
 Connector/terminal box: 2, 3, 4, 5

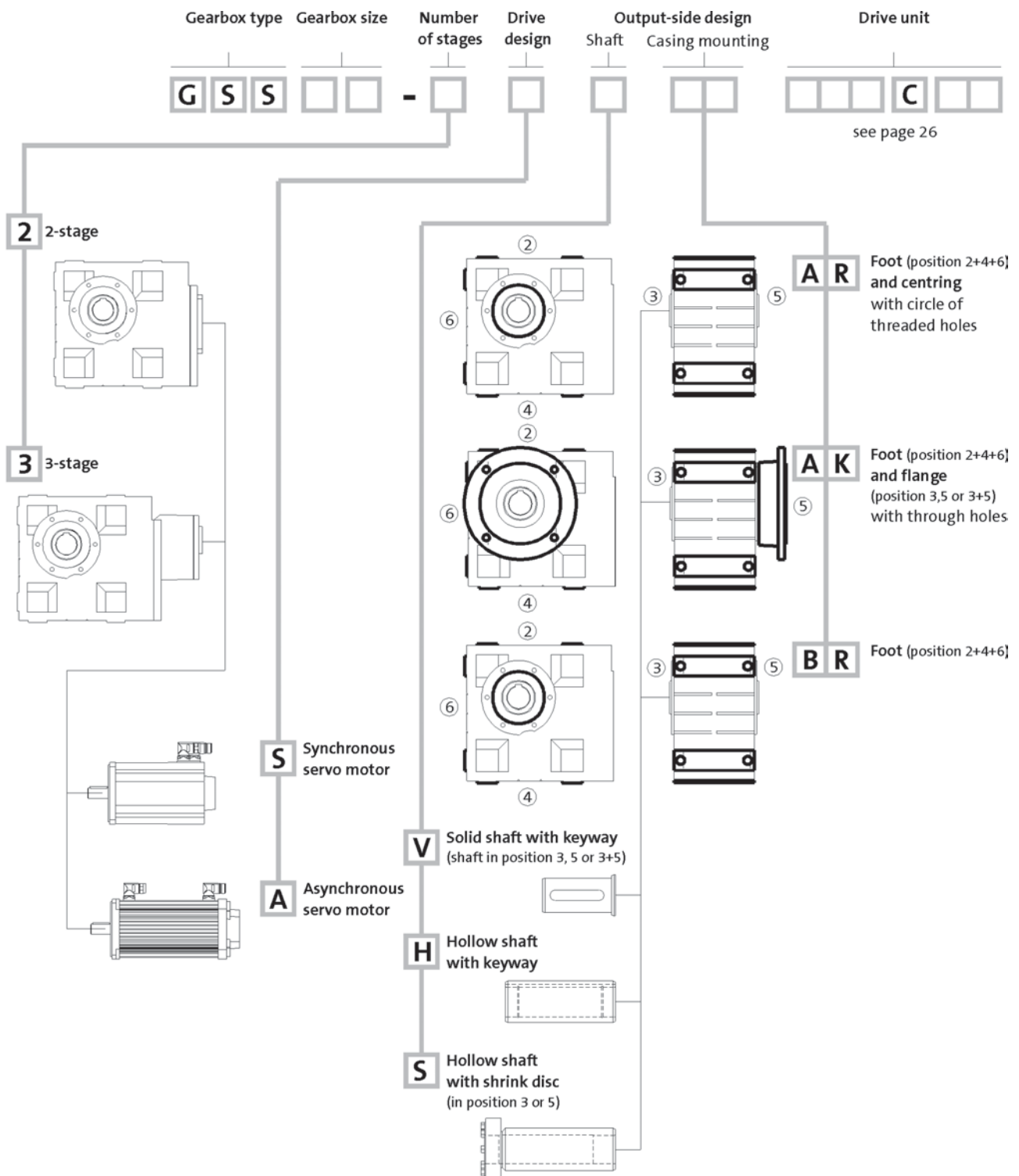
Basic versions	
Colour	Grey primer RAL 9005 (jet black matt) paint
Lubricant	Synthetic CLP HC 320
Ventilation	Oil control plugs for GKS05 - 14 Breather elements for GKS06...14
Options	
Colour	Special paint in accordance with RAL
Lubricant	CLP HC 220 USDA H1
Ventilation	Breather elements for GKS05 Compensation reservoir for GKS09...14 in mounting position C
Shaft sealing rings	Driven shaft: Viton
Accessories	Threaded hole circle torque plate Casing foot torque plate 2nd output shaft end Cover shrink disc Hoseproof hollow shaft cover Hollow shaft circlip assembly kit

Ordering details checklist	
Product key	GKS...
Ratio	$i = \dots$
Shaft diameter	$d = \dots$ [mm]
Flange diameter	$a_2 = \dots$ [mm]
Mounting position	A, B, C, D, E, F
Position of system blocks	Shaft: 3, 5, 8 Flange: 0, 3, 5, 8 Connector/terminal box: 2, 3, 4, 5
Colour	
Options	



General information

Helical-worm gearbox product key

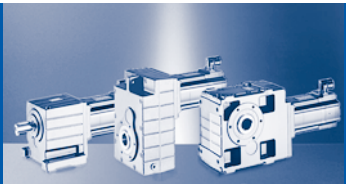


	Output-side design			
	V	H	S	K
	d x l [mm]	d [mm]	d [mm]	Øa2 [mm]
GSS04-2	25x50	25/30	25/30	160
GSS05-2/3	30x60	30/35	35	200
GSS06-2/3	40x80	40/45	40	200 ₁ /250
GSS07-2/3	50x100	50/55	50	250/300

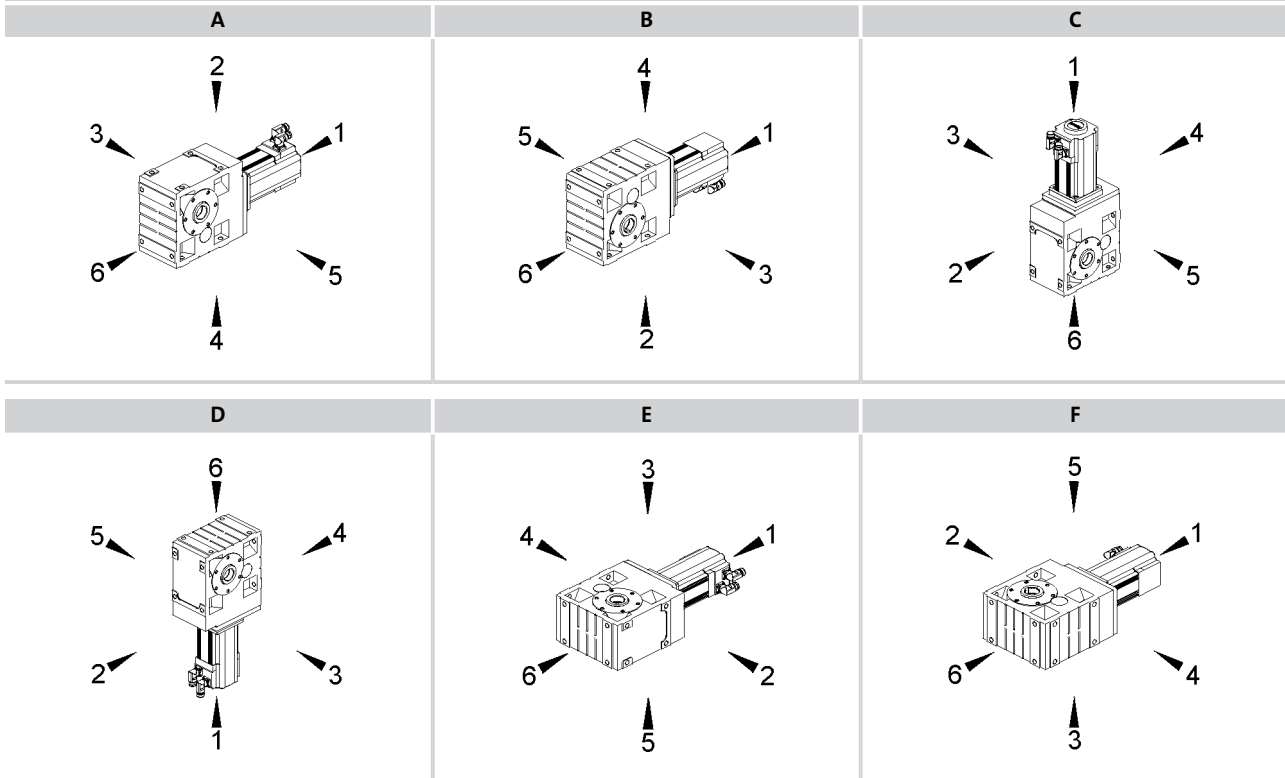
1) Only with output-side design H and S

General information

Helical-worm gearbox product key



Mounting position (A...F) and position of the system blocks (1...6)

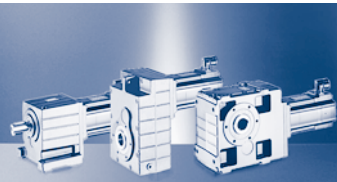


Solid shaft: 3, 5, 8 (3+5)
 Hollow shaft: 0
 Hollow shaft with shrink disc: 3, 5

Without flange: 0
 Flange: 3, 5, 8 (3+5)
 Connector/terminal box: 2, 3, 4, 5

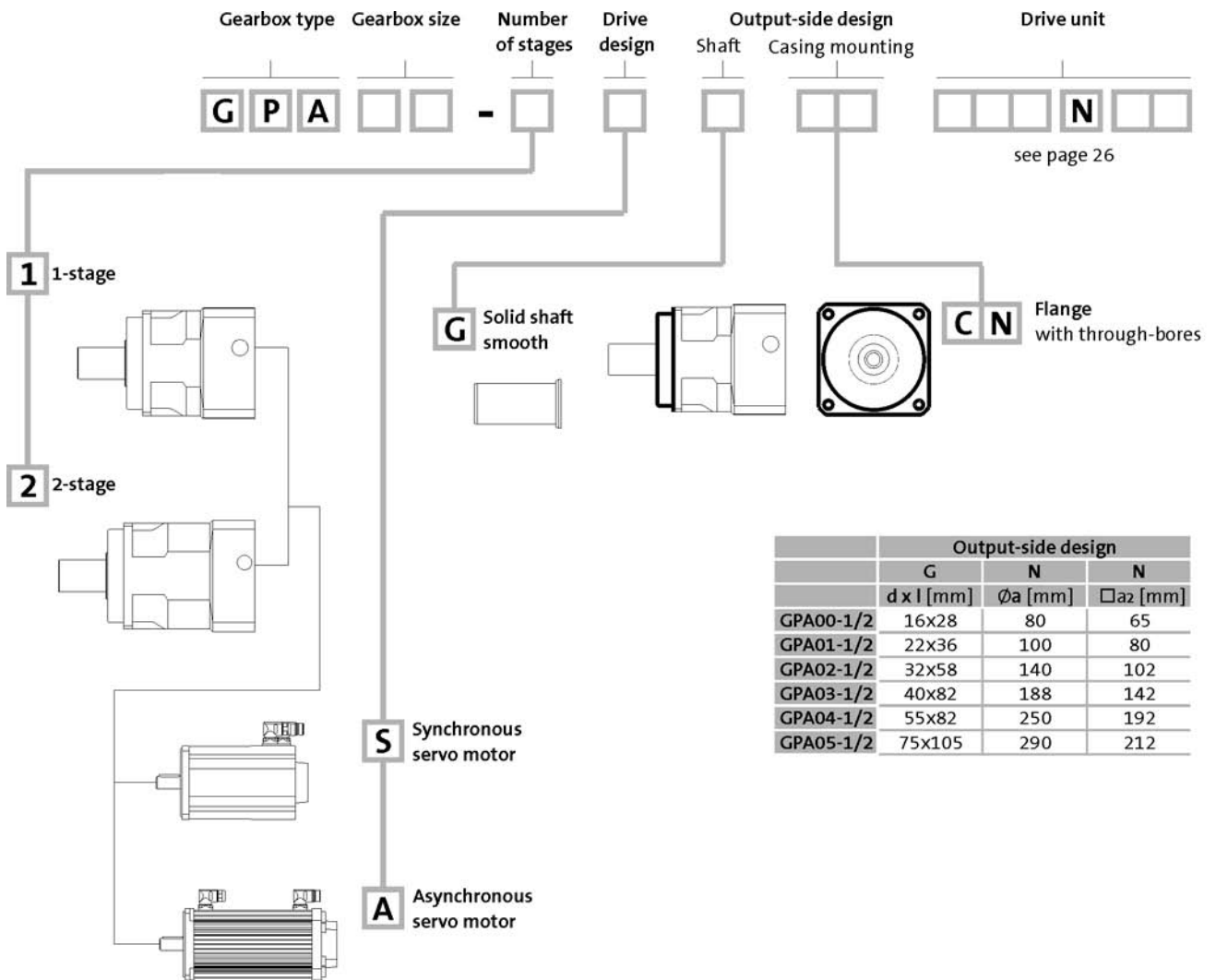
Basic versions	
Colour	Grey primer RAL 9005 (jet black matt) paint
Lubricant	Synthetic CLP PG 460
Ventilation	Breather elements for GSS05...07 Oil control plugs for GSS05 - 07
Options	
Colour	Special paint in accordance with RAL
Lubricant	CLP HC 220 USDA H1
Shaft sealing rings	Driven shaft: Viton
Accessories	Threaded hole circle torque plate Casing foot torque plate 2nd output shaft end Cover shrink disc Hoseproof hollow shaft cover Hollow shaft circlip assembly kit

Ordering details checklist	
Product key	GSS...
Ratio	$i = \dots$
Shaft diameter	$d = \dots$ [mm]
Flange diameter	$a_2 = \dots$ [mm]
Mounting position	A, B, C, D, E, F
Position of system blocks	Shaft: 3, 5, 8 Flange: 0, 3, 5, 8 Connector/terminal box: 2, 3, 4, 5
Colour	
Options	



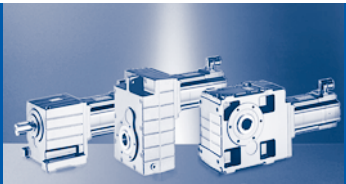
General information

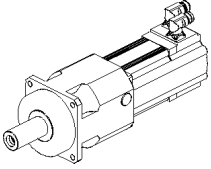
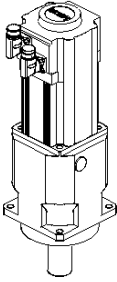
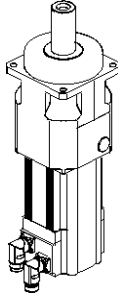
Planetary gearbox product key



General information

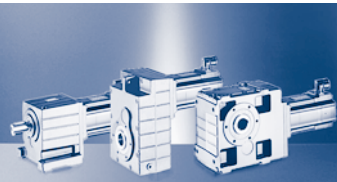
Planetary gearbox product key



Mounting position (A...D)		
A	C	D
		

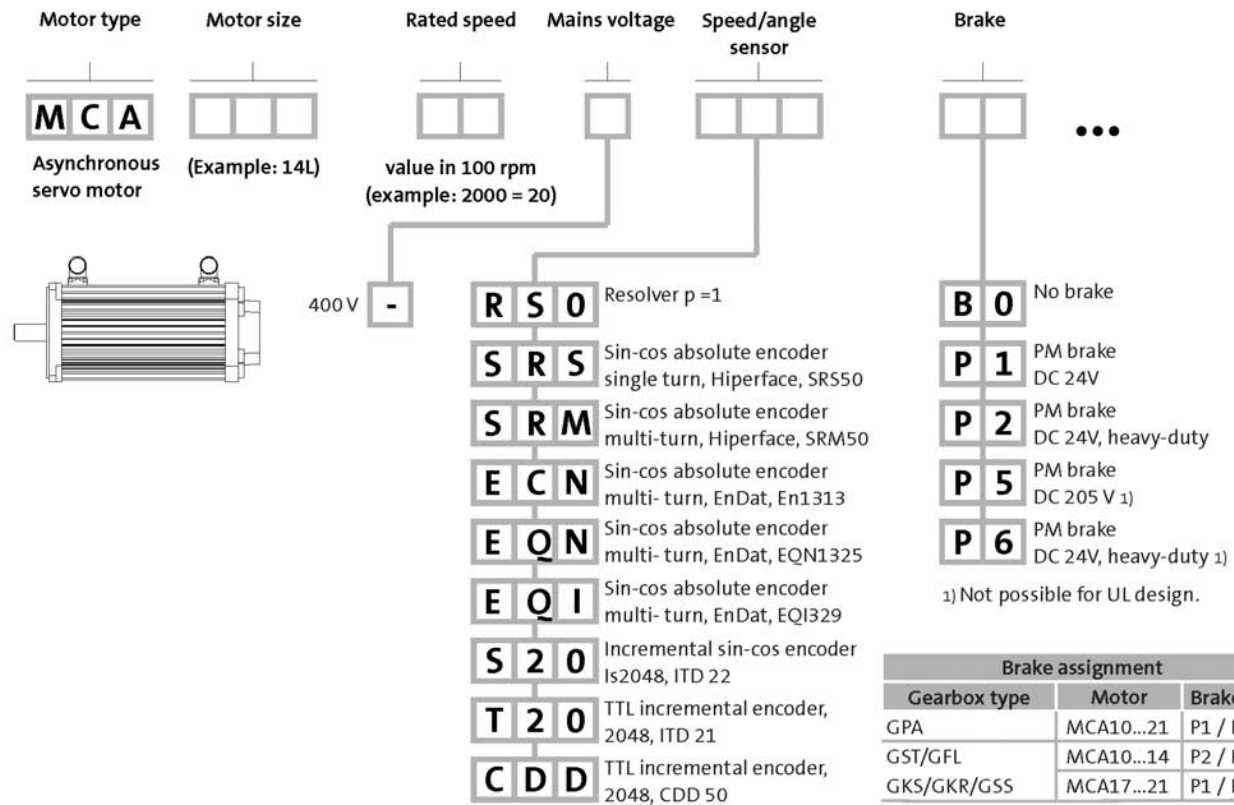
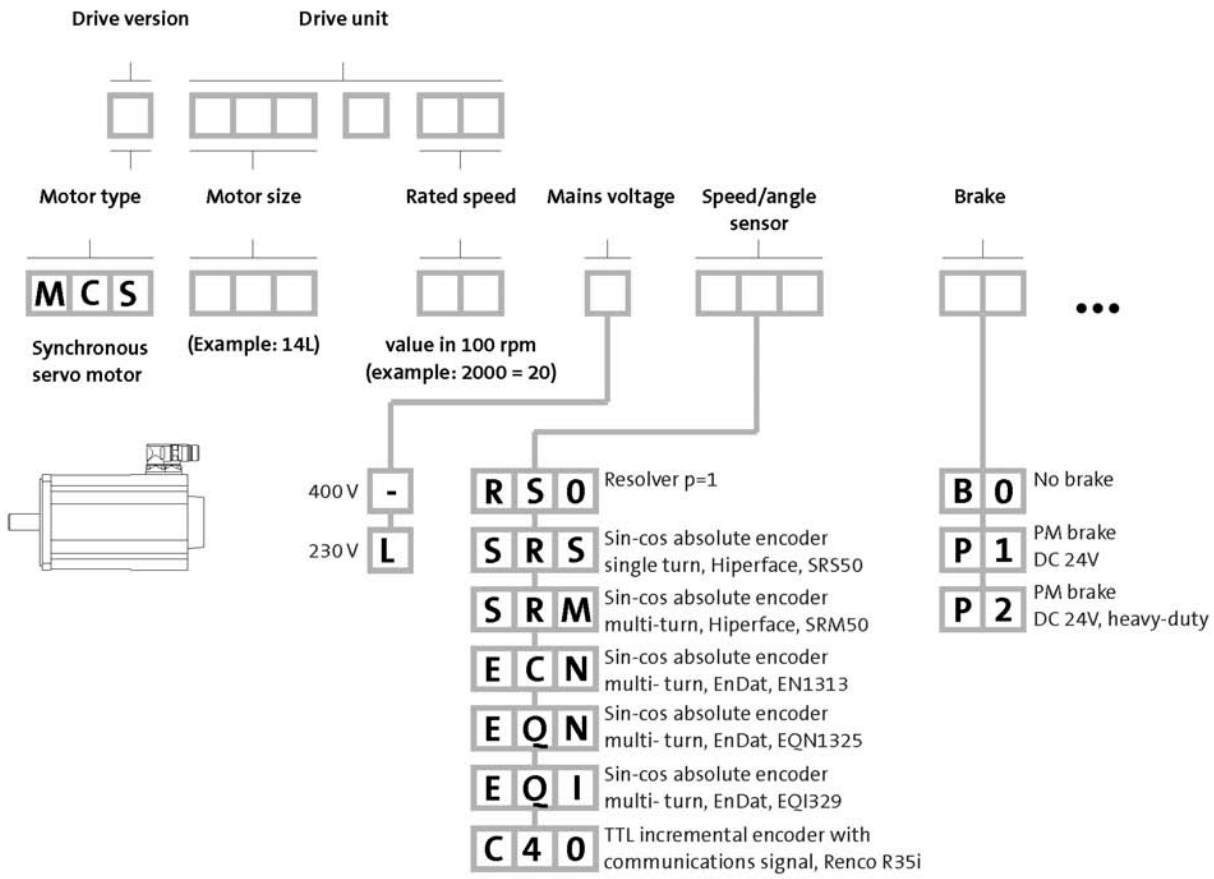
Basic versions	
Colour	RAL 9005 (jet black matt) paint
Lubricant	Synthetic CLP PAO 150

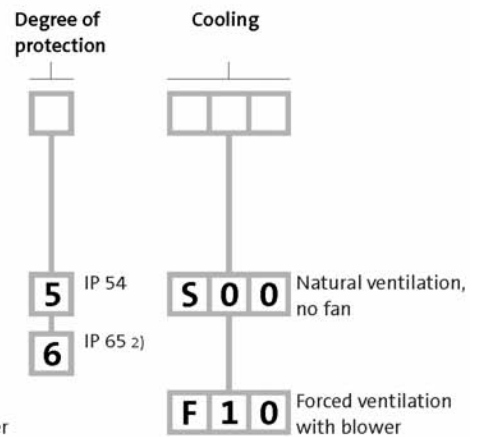
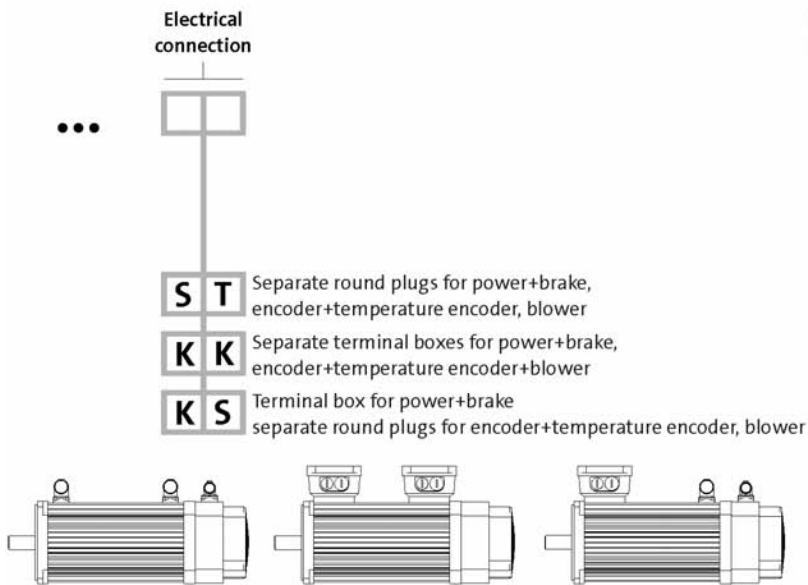
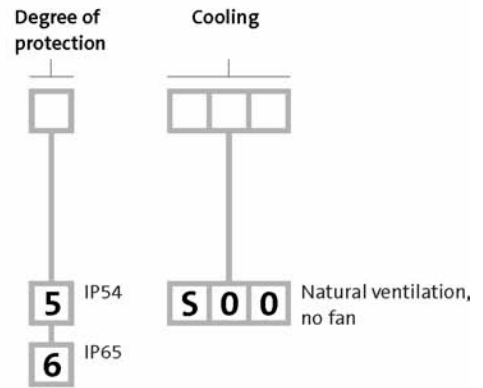
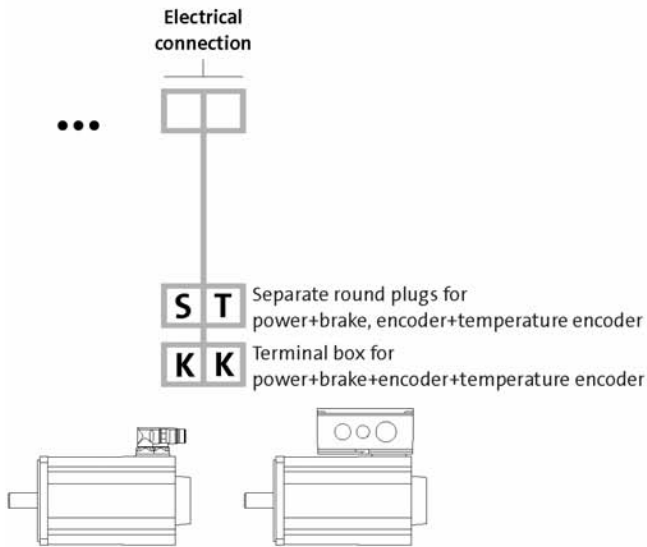
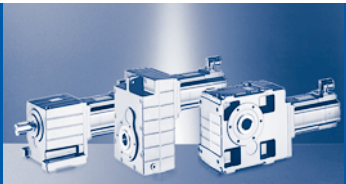
Ordering details checklist	
Product key	GPA...
Mounting position	A, C, D



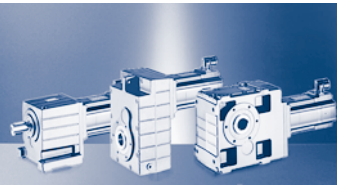
General information

Servo motor product key





2) Not possible with blower.



General information

Product information

Innovative geared motors combined with powerful drive electronics to meet the highest standards in terms of dynamics, positioning accuracy and robustness: the G-motion servo.

Featuring a wide variety of geared motors in the following variants:

- ▶ Helical gearboxes
- ▶ Shaft-mounted helical gearboxes
- ▶ Bevel gearboxes
- ▶ Helical-bevel gearboxes
- ▶ Helical-worm gearboxes
- ▶ Servo-planetary gearboxes

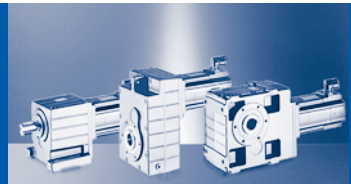
Lenze offers high levels of functionality while complying with many industrial standards. Closely stepped output speeds allow you to make the perfect choice for your drive task.

Lenze geared servo motors are available in a power range from 0.25...20.3 kW.

Together with the Lenze servo controllers, these geared motors offer a perfect drive combination with high dynamic performance.

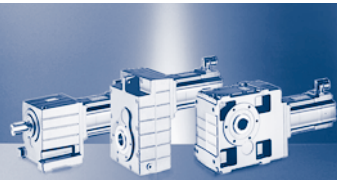
- ▶ Power range of the synchronous servo motors: 0.25...10 kW
- ▶ Power range of the asynchronous servo motors: 0.8...20.3 kW





Designations used in the catalogue:

□	Wildcard	k_{n1}	Speed correction factor for ambient temperature
α	Angle of action of radial force	k_{n2}	Speed correction factor for mounting position
φ	Ratio step	k_{n3}	Speed correction factor for duty time/average speed
η [%]	Mechanical efficiency	k_m	Speed correction factor for average speed
η_A [%]	Mechanical start-up efficiency of gearbox	KE_{LL} [V / 1000 r/min]	Voltage constant (phase-to-phase)
$\eta_{c=1}$ [%]	Mechanical efficiency of gearbox with gearbox loading $c = 1$	Kt_0 [Nm/A]	Torque constant at standstill
η_G [%]	Mechanical efficiency of gearbox	$L_{1\sigma}$ [mH]	Stator leakage inductance
ϑ [°C]	Temperature	$L_{2\sigma'}$ [mH]	Rotor leakage inductance (referred to stator)
AC	Alternating current/voltage	L_h [mH]	Mutual inductance
BD [h]	Operating time	L_{St} [mH]	Winding inductance per phase
c	Load capacity of geared motors	m [kg]	Mass
DC	Direct current/voltage	M_B [Nm]	Brake holding torque
ED	Duty time	M_{eff} [Nm]	Effective torque
f_α	Effective direction factor at output shaft	M_L [Nm]	Load torque
f_N [Hz]	Rated frequency	$M_{L,max}$ [Nm]	Maximum load torque
f_w	Additional load factor at output shaft	$M_{L,z}$ [Nm]	Stationary load torque per time segment
f_z	Additional radial force factor of transmission element	M_{max} [Nm]	Maximum torque
Fa [N]	Applied axial force	M_N [Nm]	Rated torque
Fa_{Tab} [N]	Table value of axial force	$M_{S,z}$ [Nm]	Acceleration torque
Fa_{zul} [N]	Permissible axial force	$M_{S,eff}$ [Nm]	Effective torque at the motor
Fr [N]	Applied radial force	M_z [Nm]	Output torque per time segment
Fr_{Tab} [N]	Table value of radial force	$M_{p,max}$ [Nm]	Maximum torque of profile
Fr_{zul} [N]	Permissible radial force	M_0 [Nm]	Continuous standstill torque
H [m]	Site altitude above mean sea level	M_1 [Nm]	Input torque
i	Ratio	M_2 [Nm]	Output torque
i_g	Precise ratio	$M_{2,max}$ [Nm]	Maximum output torque
I_B [A]	Rated brake current	$M_{2,GN}$ [Nm]	Rated gearbox torque at the output at $c=1$ and $n_1 = 1400$ r/min
I_{max} [A]	Maximum current	N	Start-ups
I_M [A]	Rated motor current	$n_{L,z}$ [r/min]	Load speed per time segment
I_0 [A]	Continuous standstill current	$\Delta n_{L,z}$ [r/min]	Load speed difference per time segment
J_B [kgcm ²]	Moment of inertia of the brake	n_{max} [r/min]	Maximum speed
J_G [kgcm ²]	Moment of inertia of the gearbox reduced to the motor shaft	n_N [r/min]	Rated speed
J_L [kgcm ²]	Moment of inertia of load at output shaft	n_m [r/min]	Mean speed
J_M [kgcm ²]	Moment of inertia of the motor	n_1 [r/min]	Input speed
k	Application factor (following DIN 3990)	$n_{1,max}$ [r/min]	Maximum input speed
k_l	Intensity of gearbox load capacity	n_2 [r/min]	Output speed
k_j	Load-matching factor	$n_{2,Eck}$ [r/min]	Output speed at rated motor speed
k_L	Overload factor		



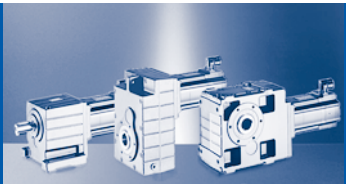
General information

List of abbreviations

Designations used in the catalogue:

$n_{2,th}$ [r/min]	Thermal limit speed at output
P_N [kW]	Rated power
R_1 [Ω]	Winding resistance per phase
R_2 [Ω]	Rotor resistance (referred to stator)
R_{UV} [Ω]	Winding resistance between 2 terminals
T [s]	Load cycle duration
t_L [%]	Runtime at maximum torque
T_U [$^{\circ}\text{C}$]	Ambient operating temperature
Δt_z [s]	Individual time segments
U_B [V]	Rated brake voltage
U_N [V]	Rated voltage
z_g	Multiplied numbers of teeth (driven gears)
z_t	Multiplied numbers of teeth (driving gears)

IM	International Mounting Code
IP	International Protection Code
CE	Communauté Européenne
CSA	Canadian Standards Association
DIN	Deutsches Institut für Normung
EMV	Electromagnetic compatibility
EN	European standard
IEC	International Electrotechnical Commission
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratory
UR	Underwriters Laboratory recognized component
VDE	Verband deutscher Elektrotechniker



General information about the data provided in this catalogue

Power ratings, torques and speeds

The power ratings, torques and speeds specified in the catalogue are rounded values and apply for

- ▶ Daily running time of 8h, 240 days a year
- ▶ Ambient temperature up to 30°C
- ▶ Operating time 5.5 hrs a day
- ▶ Average speed utilisation in relation to the load speed of the geared motor: 80%
- ▶ Site altitude up to 1000 m above mean sea level.
- ▶ Mounting positions and designs listed in the catalogue (selection table relates to mounting position A).
- ▶ Standard lubricant.

Under different operating conditions, the values obtained may vary from those listed here.

In the case of extreme operating conditions, please contact your Lenze sales office.

Load capacity c of the gearboxes

Characteristic value for the load capacity of Lenze geared motors.

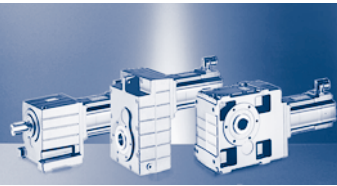
- ▶ c is the ratio of the permissible rated torque of the gearbox to the rated torque supplied by the drive component (e.g. the internal Lenze motor).
- ▶ c must always be greater than the application factor k determined for the application.

Application factor k (in accordance with DIN 3990)

Takes into account the influence of temporally variable loads which are actually present during the anticipated runtime of geared motors.

k depends on

- ▶ The type of load
- ▶ The intensity of the load
- ▶ Temporary factors



General information

Notes on ordering

We aim to process your order quickly and accurately. Therefore, please ensure that your order details are complete.

In order to receive the correct products in good time, please provide the following information:

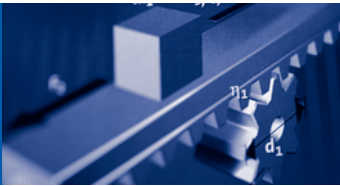
- ▶ Your address and order data
- ▶ Our product keys for the individual products in this catalogue
- ▶ Your delivery details, such as delivery date and delivery address

Ordering procedure

Use the ordering details checklist to ensure that you provide all the necessary information for each product.

You can find the ordering details checklist, product key, basic designs, options, mounting position and system block positions in the chapter General information - Product key.

A list of Lenze sales offices can be found at the end of this catalogue.



Drive dimensioning

Aim of dimensioning

This section describes the dimensioning of drives with geared servo motors.

The aim of dimensioning

is to select the right geared servo motor for a given application, ensuring that the requirements for the specific application are reliably met. The operating conditions concerned are taken into consideration in this process:

- ▶ Ambient temperature
- ▶ Mounting position
- ▶ Load cycle

For the sake of simplicity, the dimensioning given is for standard operating modes and for general load cycles:

- ▶ Constant load, operating mode **S1** *
- ▶ Short-time operation **S2**
- ▶ Intermittent operation **S3**
- ▶ Continuous operation **S6** *
- ▶ Load profiles for an **application-specific load cycle**

* For maximum life expectancy, Lenze recommends the use of motors with a low rated speed for operating modes S1 and S6.

Dimensioning involves 3 elements:

- ▶ **Satisfying the drive function** - Can the required speeds, torques, accelerations be achieved with the chosen drive?
- ▶ **Mechanical strength** - Can the drive transmit the torques and forces that occur?
- ▶ **Thermal dimensioning** - Does the operating temperature remain within the permissible limits, preventing premature ageing?

Drive function

The process values required are used to select a drive for which all working points lie within the speed/torque characteristic curves. This results in the selection of a gearbox of the correct ratio with a motor of the correct speed and an inverter with the correct maximum current. Other limits (maximum speed, site altitude) are shown in tables.

Mechanical strength

The forces and torques arising together with the application factor and the gearbox torque are used to select a drive with adequate mechanical strength (endurance strength of the gearing for periodically occurring torques and endurance limit for sporadically occurring torques).



Thermal dimensioning

For the **inverter**, thermal dimensioning uses the continuous inverter current or the continuous torque achievable by the motor-inverter combination.

For the **motor**, thermal dimensioning uses the average speed and the effective torque.

For the **gearbox**, thermal dimensioning uses the average speed and the continuous torque of the motor-gearbox combination. The thermal limit speed specified is intended as a recommendation. The average speed of the drive should not exceed the specified values.

Dimensioning in three steps

The dimensioning of geared servo motors can be divided into three steps, which are listed separately for each of the operating modes referred to above (S1, S2, S3, S6, profile):

Determination of input variables, including:

- ▶ Load torque, load speed, acceleration (for speed profiles, several working points with times)
- ▶ Maximum torque
- ▶ Mounting position
- ▶ Power loading
- ▶ Method of torque transmission

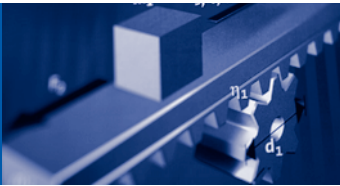
Calculation of values required for the process, including:

- ▶ Overall torques from load torque and acceleration
- ▶ Maximum load torque
- ▶ Effective torque
- ▶ Average speed
- ▶ Maximum speed

Selection of the geared servo motor and checking the selection for fulfilment of required values, including:

- ▶ Calculation of overall torque on the motor end (effective torque, maximum torque)
- ▶ Thermal checking of the motor by reference to effective torque and average speed
- ▶ Thermal checking of the gearbox by reference to average speed and effective torque
- ▶ Checking of maximum gearbox torque by reference to periodically occurring torques and sporadically occurring maximum torques
- ▶ Checking of the motor-inverter combination by reference to maximum torques
- ▶ Checking of load adjustment
- ▶ Checking of axial and radial force on the gearbox

To obtain a **reliable drive**, **particular attention** must be given to selecting and checking it. The various elements involved in dimensioning and checking are described in more detail below. Special emphasis is placed on **compliance with the limits of the geared servo motor drive** (functional limits, thermal limits, mechanical limits).



Dimensioning of geared servo motors for kinematic profiles, operating modes S1, S2, S3, S6 and speed profiles

Suitable for simple linear speed profiles, not for S-curves or similar. For complex or full-load dimensioning, please contact your local Lenze subsidiary.

Standard operating conditions:

- ▶ Single shift operation, 8 hours a day, 240 days a year
- ▶ Ambient temperature up to 30 °C
- ▶ Operating time 5.5 hours a day
- ▶ Average speed utilisation in relation to the load speed of the geared motor 80%
- ▶ Mounting position A
- ▶ Site altitude up to 1000 m amsl

Included

- ▶ Rated mains voltage AC 400 V, 3-phase
- ▶ Ambient temperature
- ▶ Site altitude
- ▶ Dimensioning with 9400, 9300 and ECS speed-torque characteristic curves for mains voltages of 400 V, 3-phase
- ▶ Process requirement
- ▶ Preselection of motor
- ▶ Load capacity of gearbox
- ▶ Intended transmission ratio
- ▶ Maximum permissible gearbox input speed
- ▶ Axial and radial load on gearbox output shaft
- ▶ Overall reduced moment of inertia
- ▶ Load adjustment to moments of inertia

Not included

- ▶ Correct consideration of efficiency in motor mode/generator mode
- ▶ Accessories such as brake choppers, brake resistors, feedback systems, mains filters
- ▶ Current derating on 9300 servo at low speeds
- ▶ Special ambient conditions such as special power system characteristics, high temperatures/site altitudes, contamination, outdoor use, explosion protection
- ▶ Maximum standstill current
- ▶ Setting the controller inhibit to reduce the heat load on the drive



The operating mode is important when selecting a motor. For example, the temperature rise on a motor subject to short-term load will be lower than that on a motor subject to long-term load. EN 60034 defines operating modes S1 to S8.

Continuous operation S1

The operating time at rated power is long enough for the machine to reach steady-state temperature. The motor operates continuously at rated power.

Short-time operation S2

In comparison with the subsequent pause, the operating time is too short for the machine to reach steady-state temperature. During the subsequent lengthy pause, the motor cools down to the initial temperature.

Intermittent operation S3, S4, S5

Cycles of the same type combine to form a sequence. The cycle time is usually 10 minutes.

- ▶ S3: The starting current is not significant for the temperature rise in the motor
- ▶ S4: The starting current contributes to the temperature rise in the motor
- ▶ S5: Starting current and braking current contribute to the temperature rise in the motor

Continuous operation with intermittent loading S6

The motor continues to be ventilated during the no-load phases, enabling it to cool down.

Uninterrupted operation with acceleration and braking S7

The motor runs almost without break.

Uninterrupted operation S8 with pole changing

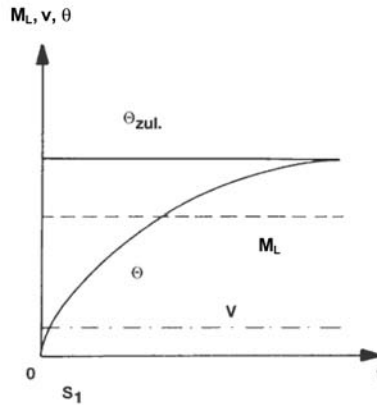
The machine runs constantly under load but with frequent speed variation.

Drive dimensioning

Operating mode S1

Dimensioning of geared servo motors for operating mode S1 (EN 60034)

The drive is constantly loaded in operating mode S1, there may be a change of direction of rotation or an alternating load.
Precondition: constant power loss, neglect of start-up process (constant temperature rise)



Required input variables			
Operating time/day	BD =		[h]
Average speed utilisation of the geared motor related to the speed under load n_L			[%]
Ambient temperature	$T_u =$		[°C]
Site altitude above mean sea level	H =		[m]
Radial force	$F_r =$		[N]
Axial force	$F_a =$		[N]
Transmission element at gearbox (gear wheels, sprockets...)			
Pitch circle diameter of the transmission element	$d_w =$		[mm]
Load torque	$M_L =$		[Nm]
Load speed	$n_L =$		[r/min]
Momentary maximum torque (emergency off, quick stop, occasional high starting duty)	$M_{L,max} =$		[Nm]
Runtime at maximum torque	$t_L =$		[%]
Determine gearbox design and servo motor design			
Gearbox type (GST, GFL, GKR, GKS, GSS, GPA)			
Mounting position (A, B, C, D, E, F)			
Output designs (shaft design: hollow shaft, solid shaft...)			
Input design (A asynchronous/S synchronous)			
Cooling type (S00 without fan/F10 with blower)			

→  14 - General information - Product key



Determine gearbox size from the forces		
Determination of the axial and radial forces acting on the gearbox shaft		
	Calculation	Check
Additional radial force factor of transmission element	$f_z =$	
Radial force	$Fr = 2000 \cdot \frac{M_{L,max} \cdot f_z}{d_w}$	$Fr \leq Fr_{zul} = \min(f_w \cdot f_\alpha \cdot Fr_{Tab}; f_w \cdot Fr_{max})$
Axial force		$Fa \leq Fa_{zul} = Fa_{Tab} \quad , \quad Fr = 0$

→ 52 - f_z

→ Permissible radial and axial forces $G \square \square$ [N]
 $Fr_{Tab}, Fa_{Tab}, f_w, f_\alpha$

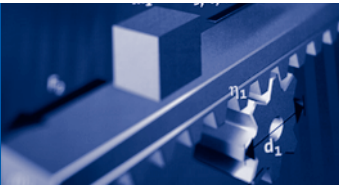
Determine speed correction factors	
Ambient temperature, site altitude	$k_{n1} =$
Mounting position	$k_{n2} =$
Average speed utilisation of the geared motor (in % of n_L) and daily operating time	$k_{n3} =$
	$k_n = k_{n1} \cdot k_{n2} \cdot k_{n3}$

→ 51 - k_{n1}, k_{n2}, k_{n3}

Select and check the geared servo motor-inverter combination			
For maximum life expectancy, Lenze recommends the use of motors with a low rated speed for operating modes S1 and S6.			
	Check	Selection	
Output torque	$M_2 \geq M_L$	$M_2 =$	[Nm]
Output speed (recommendation)	$n_{2,th} \geq \frac{n_L}{k_n}$	$n_{2,th} =$	[r/min]
Output speed	$n_{2,Eck} \geq n_L$	$n_{2,Eck} =$	
Alternating load influence: without alternating load	$M_{2,GN} \geq M_L$	$M_{2,GN} =$	[Nm]
Alternating load influence: with alternating load	$M_{2,GN} \geq M_L \cdot 1.4$		
Ratio		$i =$	
Load capacity of the geared motor		$c =$	
Momentary maximum torque	$M_{2,max} = M_{2,GN} \cdot 1.5 \geq M_{L,max}$	$M_{2,max} =$	[Nm]

→ Selection tables $G \square \square$ [Nm]
 $M_2, M_{2,GN}, n_{2,th}, n_{2,Eck}, i, c$

→ 50 - Motors for operating modes S1 and S6



Drive dimensioning

Operating mode S1

Determine the required gearbox load capacity		
Calculate intensity	Without alternating load $k_1 = \frac{M_{L,max}}{M_2}$	k ₁ =
	With alternating load $k_1 = \frac{M_{L,max}}{M_2} \cdot 1.4$	
At runtime t _L > 10%: take intensity k ₁ from the calculation into account At runtime t _L ≤ 10%: take load factor k from the diagram into account		k =
Required load capacity	t _L > 10% → c ≥ k ₁ t _L ≤ 10% → c ≥ k	c =

→  52 - k



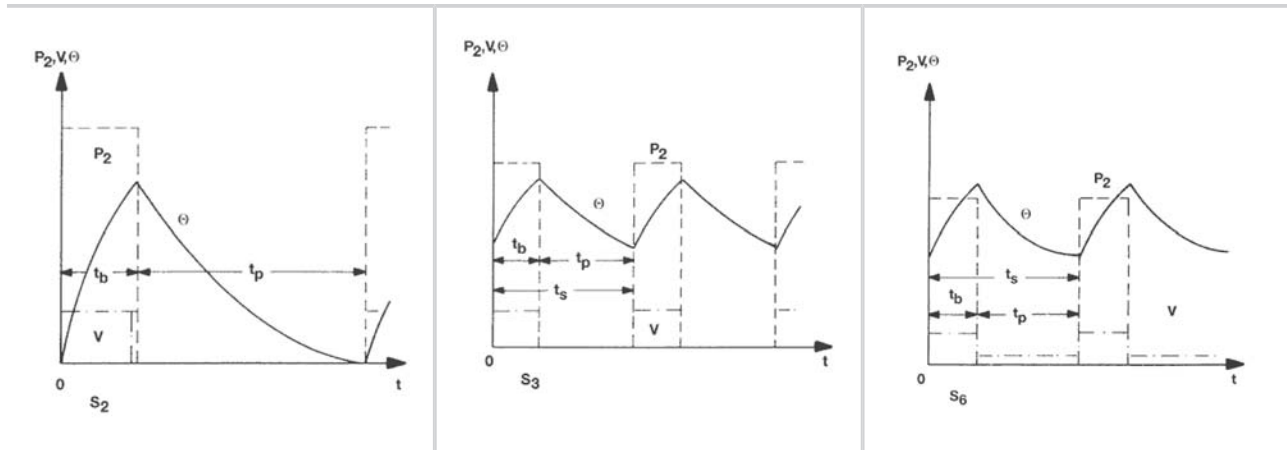
Dimensioning of geared servo motors for operating modes S2, S3 and S6 (EN 60034)

Short-time operation S2: Short-time running of the drive followed by a “long” pause

Periodic intermittent operation S3: Periodic alternation of the drive between on and off (maximum cycle time 10 minutes)

Periodic intermittent loading S6: The load alternates between on and off with the motor running constantly (maximum cycle time 10 minutes).

The acceleration process is ignored. Dimensioning for profile is required for dynamic applications.




Required input variables			
Operating time/day	BD =		[h]
Average speed utilisation of the geared motor related to the speed under load n_L			[%]
Operating mode	S2 - ED = S3, S6 - ED =		[min] [%]
Ambient temperature	$T_u =$		[°C]
Site altitude above mean sea level	H =		[m]
Radial force	$F_r =$		[N]
Axial force	$F_a =$		[N]
Transmission element at gearbox (gear wheels, sprockets...)			
Pitch circle diameter of the transmission element	$d_w =$		[mm]
Load torque	$M_L =$		[Nm]
Load speed	$n_L =$		[r/min]
Momentary maximum torque (emergency off, quick stop, occasional high starting duty)	$M_{L,max} =$		[Nm]
Runtime at maximum torque	$t_L =$		[%]

Drive dimensioning

Operating modes S2, S3 and S6

Determine gearbox design and servo motor design	
Gearbox type (GST, GFL, GKR, GKS, GSS, GPA)	
Mounting position (A, B, C, D, E, F)	
Output designs (shaft design: hollow shaft, solid shaft...)	
Input design (A asynchronous/S synchronous)	
Cooling type (S00 without fan/F10 with blower)	


→  14 - General information - Product key

Determine gearbox size from the forces		
Determination of the axial and radial forces acting on the gearbox shaft		
	Calculation	Check
Additional radial force factor of transmission element	$f_z =$	
Radial force	$Fr = 2000 \cdot \frac{M_{L,max} \cdot f_z}{d_w}$	$Fr \leq Fr_{zul} = \min(f_w \cdot f_\alpha \cdot Fr_{Tab}; f_w \cdot Fr_{max})$
Axial force		$Fa \leq Fa_{zul} = Fa_{Tab}$, $Fr = 0$

→  52 - f_z

→ Permissible radial and axial forces $G \square \square$ [N]
 $Fr_{Tab}, Fa_{Tab}, f_w, f_\alpha$

Determine speed correction factors	
Ambient temperature, site altitude	$k_{n1} =$
Mounting position	$k_{n2} =$
Average speed utilisation of the geared motor (in % of n_l) and daily operating time	$k_{n3} =$

→  51 - k_{n1}, k_{n2}, k_{n3}

Speed correction factors for average speed k_m					
Op. mode S2		Op. mode S3		Op. mode S6	
ED [min]	k_m	ED [%]	k_m	ED [%]	k_m
10	0.16	15	0.15	15	1.00
30	0.50	25	0.25	25	
60	1.00	40	0.40	40	
90		60	0.60	60	

$$k_m =$$

$$k_n = \frac{k_{n1} \cdot k_{n2} \cdot k_{n3}}{k_m}$$



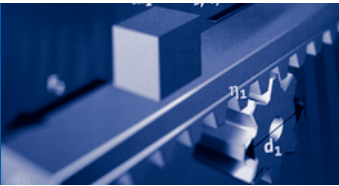
Specify the overload factor k_L (guide values) as a function of the application/kinematics					
Op. mode S2		Op. mode S3		Op. mode S6	
ED [min]	k_L	ED [%]	k_L	ED [%]	k_L
10	1.4-1.5	15	1.4-1.5	15	1.5-1.6
30	1.15-1.2	25	1.3-1.4	25	1.4-1.5
60	1.07-1.1	40	1.15-1.2	40	1.3-1.4
90	1.0-1.05	60	1.05-1.1	60	1.15-1.2

$k_L =$

Select and check the geared servo motor-inverter combination			
For maximum life expectancy, Lenze recommends the use of motors with a low rated speed for operating modes S1 and S6.			
	Check	Selection	
Output torque	$M_2 \geq \frac{M_L}{k_L}$	$M_2 =$	[Nm]
Output speed (recommendation)	$n_{2,th} \geq \frac{n_L}{k_n}$	$n_{2,th} =$	[r/min]
Output speed	$n_{2,Eck} \geq n_L$	$n_{2,Eck} =$	
Alternating load influence: without alternating load	$M_{2,GN} \geq M_L$	$M_{2,GN} =$	[Nm]
Alternating load influence: with alternating load	$M_{2,GN} \geq M_L \cdot 1.4$		
Ratio		$i =$	
Load capacity of the geared motor		$c =$	
Efficiency of gearbox	$\eta_G = \eta_{c=1} - (c-1) \cdot 0.01$	$\eta_G =$	
Momentary maximum torque	$M_{2,max} = M_{2,GN} \cdot 1.5 \geq M_{L,max}$	$M_{2,max} =$	[Nm]
Thermally effective working point (○) below S1 torque characteristic of the servo motor		$\left(\frac{i \cdot k_m \cdot n_L}{k_{n3}}, \frac{M_L}{k_L \cdot i \cdot \eta_G} \right)$	
All working points (●) below the maximum torque characteristic curve of the servo motor-inverter combination, taking $M_{L,max}$ into account		$\left(i \cdot n_L, \frac{M_L}{i \cdot \eta_G} \right)$	

- Selection tables G□□ [Nm]
 $M_2, M_{2,GN}, n_{2,th}, n_{2,Eck}, i, c$
- Servo motors catalogue
Torque characteristics

- 50 - Motors for operating modes S1 and S6
- 53 - $\eta_{c=1}$



Drive dimensioning

Operating modes S2, S3 and S6

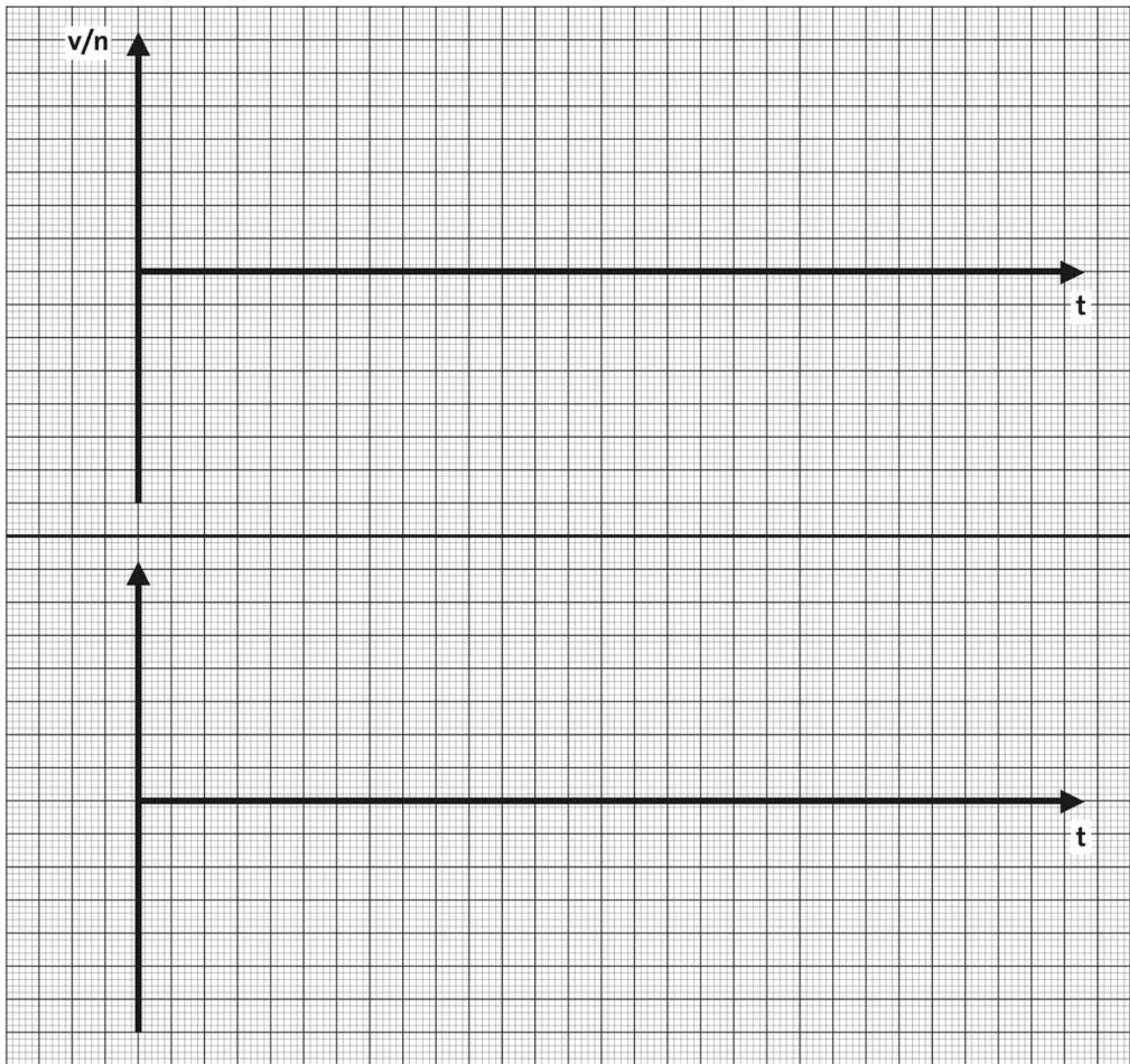
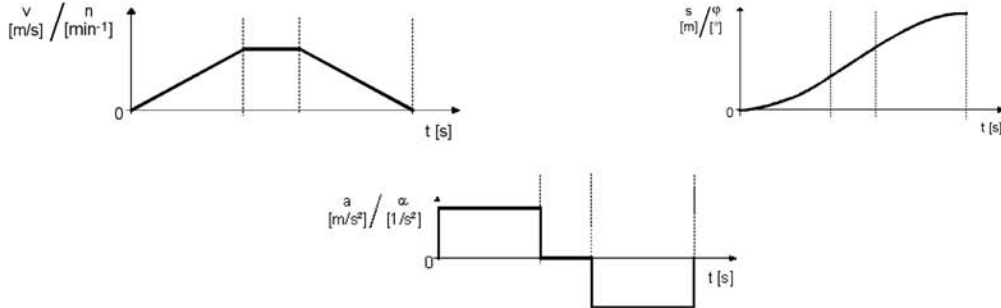
Determine the required gearbox load capacity		
Calculate intensity	Without alternating load $k_1 = \frac{M_{L,max}}{M_2}$	k ₁ =
	With alternating load $k_1 = \frac{M_{L,max}}{M_2} \cdot 1.4$	
At runtime t _L > 10%: take intensity k ₁ from the calculation into account At runtime t _L ≤ 10%: take load factor k from the diagram into account		k =
Required load capacity	t _L > 10% → c ≥ k ₁ t _L ≤ 10% → c ≥ k	c =

→  52 - k



Dimensioning of geared servo motors with speed profiles, cycle time/load cycle duration ≤ 1 min

The profiles, some examples of which are shown below, must be determined.
A small sketch of the movement to be carried out can help with the subsequent calculation.





Determine gearbox design and servo motor design	
Gearbox type (GST, GFL, GKR, GKS, GSS, GPA)	
Mounting position (A, B, C, D, E, F)	
Output designs (shaft design: hollow shaft, solid shaft...)	
Input design (A asynchronous/S synchronous)	
Cooling type (S00 without fan/F10 with blower)	

→ 14 - General information - Product key

Determine gearbox size from the forces		
Determination of the axial and radial forces acting on the gearbox shaft		
	Calculation	Check
Additional radial force factor of transmission element	$f_z =$	
Radial force	$Fr = 2000 \cdot \frac{M_{L,max} \cdot f_z}{d_w}$	$Fr \leq Fr_{zul} = \min(f_w \cdot f_\alpha \cdot Fr_{Tab}; f_w \cdot Fr_{max})$
Axial force		$Fa \leq Fa_{zul} = Fa_{Tab}$, $Fr = 0$

→ 52 - f_z

→ Permissible radial and axial forces $G \square \square$ [N]
 $Fr_{Tab}, Fa_{Tab}, f_w, f_\alpha$

Determine speed correction factors	
Ambient temperature, site altitude	$k_{n1} =$
Mounting position	$k_{n2} =$
Average speed utilisation of the geared motor (in % of n_1) and daily operating time	$k_{n3} =$
	$k_n = k_{n1} \cdot k_{n2} \cdot k_{n3}$

→ 51 - kn_1, kn_2, kn_3


Drive dimensioning


Speed profiles

Select and check the geared servo motor-inverter combination	Check	Preselection	
Output torque	$M_2 > M_{\text{eff}}$	$M_2 =$	[Nm]
Output speed (recommendation)	$n_{2,\text{th}} \geq \frac{n_m}{k_n}$	$n_{2,\text{th}} =$	
Output speed	$n_{2,\text{Eck}} \geq n_L$	$n_{2,\text{Eck}} =$	[r/min]
Maximum speed	$n_{1,\text{max}} \geq n_{\text{max}} \cdot i$	$n_{1,\text{max}} =$	
Alternating load influence: without alternating load	$M_{2,\text{GN}} \geq M_{\text{P,max}}$	$M_{2,\text{GN}} =$	[Nm]
Alternating load influence: with alternating load	$M_{2,\text{GN}} \geq M_{\text{P,max}} \cdot 1,4$		
Load capacity of the geared motor		$c =$	
Efficiency of gearbox	$\eta_G = \eta_{c=1} - (c-1) \cdot 0,01$	$\eta_G =$	
Ratio	$i \approx \sqrt{\frac{J_L}{J_G + J_M + J_B}}$ (Optimum $k_j = 1$)	$i =$	
Load-matching factor (for optimum dynamics/control properties)	Requirement $k_j = 0,5 \dots 10$ Optimum $k_j = 1$	$k_j = \frac{J_L}{i^2 \cdot (J_G + J_M + J_B)}$	

→ Selection tables G□□ [Nm]
 $M_2, M_{2,\text{GN}}, n_{2,\text{th}}, n_{2,\text{Eck}}, i, c, J_G, J_M$

→ Servo motors catalogue
 J_B

→  50 - $n_{1,\text{max}}$

→  53 - $\eta_{c=1}$



Check the motor torques		
Taking into account the mass inertia of gearbox, motor and brake		
Acceleration torque	$M_{S,z} = M_z + (J_{GM} + J_B) \cdot \frac{2 \pi \cdot \Delta n_{L,z}}{60 \cdot \Delta t_z} \cdot i^2$	$M_{S,z} =$
Effective torque	$M_{S,eff} = \sqrt{\frac{1}{T} \sum_z M_{S,z}^2 \cdot \Delta t_z}$	$M_{S,eff} =$
Thermally effective working point (○) below S1 torque characteristic of the servo motor		$\left(\frac{i \cdot n_m}{k_{n3}}, \frac{M_{S,eff}}{i \cdot \eta_G} \right)$
All working points (●) below the maximum torque characteristic curve of the servo motor-inverter combination		$\left(i \cdot n_{L,z}, \frac{M_{S,z}}{i \cdot \eta_G} \right)$

→ Servo motors catalogue
Torque characteristics

Determine the required gearbox load capacity		
Calculate intensity	Without alternating load $k_1 = \frac{M_{L,max}}{M_2}$	$k_1 =$
	With alternating load $k_1 = \frac{M_{L,max}}{M_2} \cdot 1.4$	
At runtime $t_L > 10\%$: take intensity k_1 from the calculation into account At runtime $t_L \leq 10\%$: take load factor k from the diagram into account		$k =$
Required load capacity	$t_L > 10\% \rightarrow c \geq k_1$ $t_L \leq 10\% \rightarrow c \geq k$	$c =$

→ 52 - k

Drive dimensioning

Maximum input speeds/Recommended motors for S1 and S6

Maximum gearbox input speeds

- ▶ These may not be exceeded, even momentarily.

Motor type	Input speeds $n_{1,max}$ [r/min]	Motor type	Input speeds $n_{1,max}$ [r/min]
MCA10...	5000	MCS06...	5000
MCA13...		MCS09...	
MCA14...		MCS12...	
MCA17...		MCS14...	
MCA19...		MCS19...	
MCA21...	4000		4000

Recommended motors for operating modes S1 and S6

- ▶ With operating modes S1 and S6, the motor rotates at a constant, high speed. Motors with low rated speeds are preferable in respect of service life and oil temperature rise.

Motor type	Motor type
MCA10I40	MCS06C41
MCA13I41	MCS06F41
MCA13I34	MCS06I41
MCA14L20	MCS09D41
MCA14L16	MCS09F38
MCA17N23	MCS09H41
MCA17N17	MCS09L41
MCA19S23	MCS12D20
MCA19S17	MCS12H15
MCA21X25	MCS12L20
MCA21X17	MCS14D15
-	MCS14H15
-	MCS14L15
-	MCS14P14
-	MCS19F14
-	MCS19J14
-	MCS19P14



Ambient temperature and site altitude k_{n1}

Ambient temperature	Site altitude H [m] above mean sea level			
	< 1000	< 2000	< 3000	< 4000
T_u [°C]	k_{n1}	k_{n1}	k_{n1}	k_{n1}
≤ 20	1.15	1.04	0.92	0.81
30	1.00	0.90	0.80	0.70
40	0.80	0.72	0.64	0.56
50	0.60	0.54	0.48	0.42
60	0.40	0.36	0.32	0.28

Mounting positions k_{n2}

Gearbox type	Mounting position					
	A	B	E	D	E	F
	k_{n2}	k_{n2}	k_{n2}	k_{n2}	k_{n2}	k_{n2}
GST	1.00	0.80	0.80	0.70 ¹⁾	1.00	1.00
GFL	1.00	0.80	0.85	0.70 ¹⁾	0.90	0.80
GKR	1.00	0.90	0.80	0.80 ¹⁾	0.95	0.95
GKS	1.00	0.80	0.80	0.70 ¹⁾	0.80	0.80
GSS	1.00	0.90	0.80	0.80 ¹⁾	0.95	0.95
GPA	1.00	-	0.80	0.70 ¹⁾	-	-

¹⁾ The average input speed n_1 should not exceed 1500 r/min.

Daily operating time and average speed utilisation of the geared motor k_{n3}

Daily operating time	Average speed utilisation of the geared motor related to the speed under load n_L				
	100%	80%	60%	50%	25%
[h]	k_{n3}	k_{n3}	k_{n3}	k_{n3}	k_{n3}
1.0	1.29	1.33	1.38	1.42	1.55
2.0	1.15	1.20	1.25	1.29	1.42
3.0	1.08	1.12	1.17	1.21	1.34
4.0	1.02	1.06	1.12	1.15	1.29
5.5	0.96	1.00	1.06	1.09	1.22
8.0	0.89	0.93	0.99	1.02	1.15
12.0	0.81	0.85	0.91	0.94	1.08
16.0	0.76	0.80	0.85	0.89	1.02
22.0	0.71	0.76	0.81	0.85	0.98
24.0	0.68	0.72	0.78	0.81	0.94

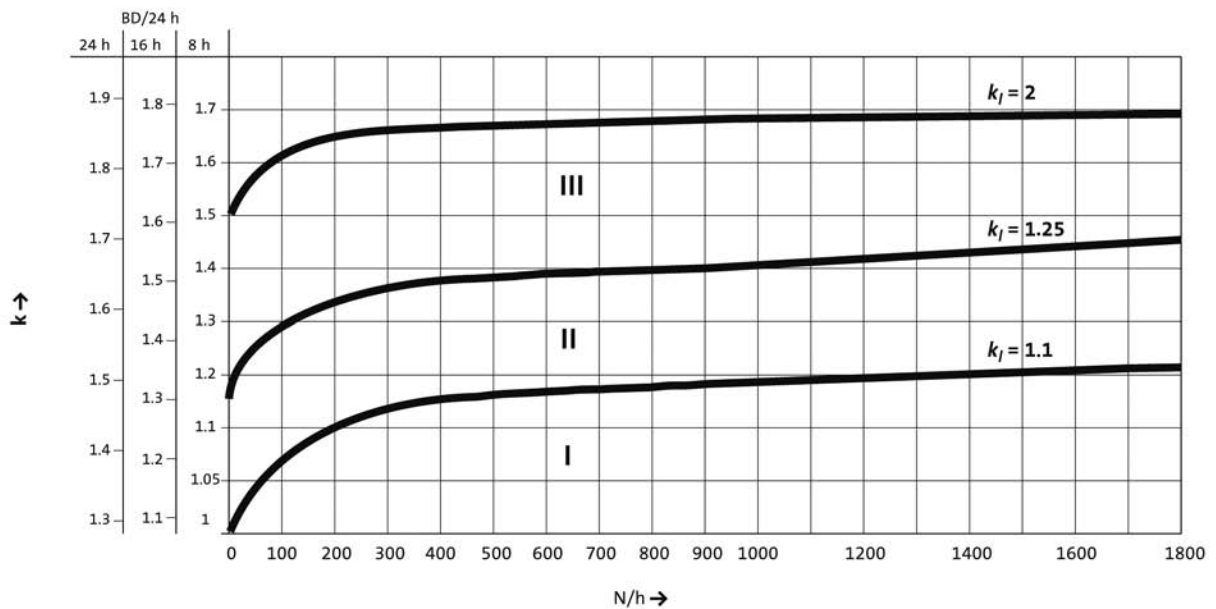
Additional radial force factors for the transmission elements

Transmission element	Additional radial force factor
	f_z
Gear wheels	1.12
Sprockets	1.25...1.4
Toothed belt pulleys	1.5
Narrow V-belt, depending on tension	1.5 ... 2.0

Application factors

GPA

Take application factor k of the machine from the diagram into account.
Interpolation between the curves is permissible.

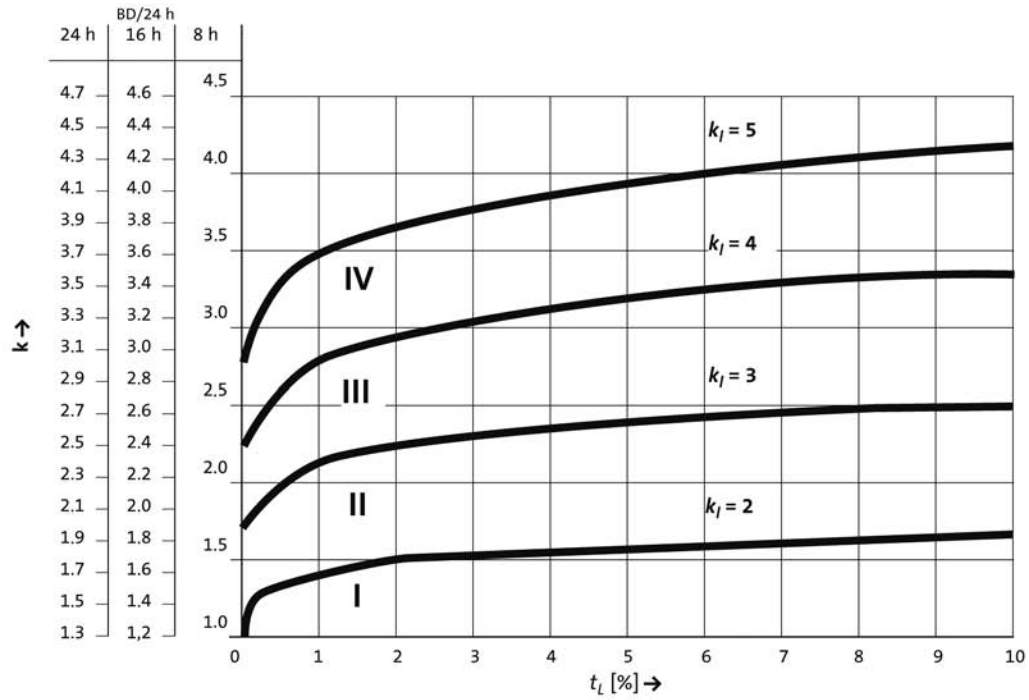




Application factors

GST, GFL, GKR, GKS, GSS

Take application factor k of the machine from the diagram into account.
Interpolation between the curves is permissible.



Efficiencies

Gearbox type	Number of stages			
	1	2	3	4
	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$
GST	0.98	0.97	0.95	
GFL		0.97	0.95	
GKR		0.95		
GKS			0.95	0.93
GPA	0.97	0.95		

Drive dimensioning

GSS efficiencies

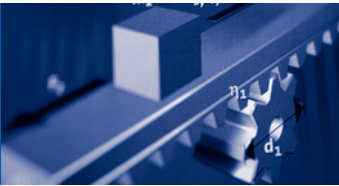
The start-up efficiency η_A of a helical-worm gearbox is lower than its operative efficiency at rated speed.

The start-up efficiency η_A must therefore always be taken into consideration when starting under load.

		Output speeds n_2 [r/min]															
		I	1	5	10	16	25	32	40	63	100	160	250	400	630	800	
		η_A	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	
GSS04-2	5.639	0.71	0.78	0.79	0.83	0.86	0.88	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.89	0.89	
	7.733	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	-	
	9.042	0.71	0.78	0.79	0.83	0.86	0.88	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.89	0.89	
	9.897	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	-	
	10.827	0.71	0.78	0.79	0.83	0.86	0.88	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.89	0.89	
	12.400	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	-
	13.810	0.71	0.78	0.79	0.83	0.86	0.88	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.89	0.89
	15.869	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	-
	17.360	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	-
	20.417	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-
	22.143	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	0.87
	24.800	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-
	27.125	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	0.87
	31.738	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-
	34.100	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	0.87
	39.200	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-
	43.917	0.67	0.74	0.76	0.81	0.84	0.86	0.87	0.87	0.87	0.88	0.88	0.87	0.87	0.87	0.87	0.87
	50.000	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-
	54.250	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-
	61.250	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-
	68.200	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-
	77.000	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-
	87.833	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-
	99.167	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-
111.318	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-	
125.682	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-	
139.500	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-	
157.500	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-	
183.786	0.56	0.62	0.72	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.79	-	-	-	
207.500	0.55	0.60	0.71	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.78	0.78	-	-	-	



		Output speeds n_2 [r/min]														
		I	1	5	10	16	25	32	40	63	100	160	250	400	630	800
		η_A	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$
GSS05-2	5.639	0.71	0.79	0.81	0.85	0.87	0.89	0.90	0.90	0.91	0.91	0.91	0.91	0.90	0.90	0.90
	7.733	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	-
	9.042	0.71	0.79	0.81	0.85	0.87	0.89	0.90	0.90	0.91	0.91	0.91	0.91	0.90	0.90	0.90
	9.897	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	-
	10.827	0.71	0.79	0.81	0.85	0.87	0.89	0.90	0.90	0.91	0.91	0.91	0.91	0.90	0.90	0.90
	12.400	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	-
	13.810	0.71	0.79	0.81	0.85	0.87	0.89	0.90	0.90	0.91	0.91	0.91	0.91	0.90	0.90	0.90
	15.869	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	-
	17.360	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	-
	20.417	0.55	0.62	0.74	0.79	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-
	22.143	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	0.88
	24.800	0.57	0.63	0.75	0.79	0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-
	27.125	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	0.88
	31.738	0.57	0.63	0.75	0.79	0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-
	35.306	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	0.88
	39.200	0.55	0.62	0.74	0.79	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-
	43.917	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	0.88
	50.000	0.55	0.62	0.74	0.79	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-
	54.250	0.57	0.63	0.75		0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-
	61.250	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-
	70.611	0.57	0.63	0.75		0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-
	79.722	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-
	87.833	0.57	0.63	0.75		0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-
	99.167	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-
113.667	0.57	0.63	0.75	0.81		0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-	
128.333	0.55	0.62	0.74	0.80		0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-	
137.950	0.57	0.63	0.75	0.81		0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-	
155.750	0.55	0.62	0.74	0.80		0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-	
176.313	0.57	0.63	0.75	0.81		0.82	0.82	0.83	0.83	0.82	0.82	0.82	0.82	-	-	
199.063	0.55	0.62	0.74	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	-	-		



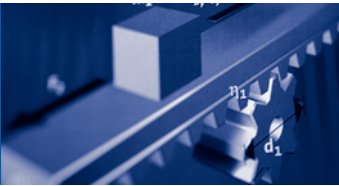
Drive dimensioning

GSS efficiencies

		Output speeds n_2 [r/min]														
		I	1	5	10	16	25	32	40	63	100	160	250	400	630	800
		η_A	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$
GSS05-3	125.476															
	153.708	0.67	0.75	0.79	0.83	0.86	0.87	0.88	0.88	0.89	0.89	0.88	0.88	0.88	0.88	
	193.233															
	222.133	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81			
	250.952	0.57	0.63	0.75		0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82			
	283.333	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81			
	307.417	0.57	0.63	0.75		0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82			
	347.083	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81			
	386.467	0.57	0.63	0.75	0.79	0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82	-	-	
	436.333	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81			
	497.722	0.57	0.63	0.75		0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82			
	561.944	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81			
	630.803	0.57	0.63	0.75		0.81	0.82	0.82	0.83	0.83	0.82	0.82	0.82			
	712.197	0.55	0.62	0.74		0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81			



		Output speeds n_2 [r/min]															
		I	1	5	10	16	25	32	40	63	100	160	250	400	630	800	
		η_A	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	
GSS06-2	5.833	0.72	0.80	0.83	0.87	0.89	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.91	0.91	0.91	
	8.000	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	-	
	9.042	0.72	0.80	0.83	0.87	0.89	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.91	0.91	0.91	
	10.238	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	-	
	11.200	0.72	0.80	0.83	0.87	0.89	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.91	0.91	0.91	
	12.400	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	-	
	14.286	0.72	0.80	0.83	0.87	0.89	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.91	0.91	0.91	
	15.869	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	-	
	17.360	0.57	0.64	0.77	0.81	0.82	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-	-	
	20.417	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	
	22.143	0.57	0.64	0.77	0.81	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-	-	
	24.800	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	
	27.125	0.57	0.64	0.77	0.81	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-	-	
	31.738	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	
	35.306	0.57	0.64	0.77	0.81	0.82	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-	-	
	39.200	0.67	0.75	0.81	0.85	0.87	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	
	43.917	0.57	0.64	0.77	0.81	0.82	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-	-	
	50.000						0.82										
	54.250						0.83										-
	61.250						0.82										
	70.611						0.83										
	79.722						0.82										
	87.833						0.83										
	99.167	0.57	0.64	0.77	0.81	0.82	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-	-	
113.667						0.83											
128.333						0.82											
137.950						0.83											
155.750						0.82											
174.375						0.83											
196.875						0.82											



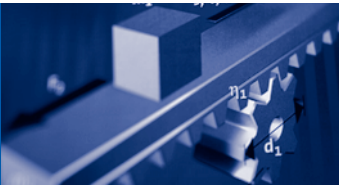
Drive dimensioning

GSS efficiencies

		Output speeds n_2 [r/min]														
		I	1	5	10	16	25	32	40	63	100	160	250	400	630	800
		η_A	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$
GSS06-3	126.531					0.83										
	142.857					0.82										
	155.000					0.83										
	175.000					0.82										
	194.857					0.83										
	220.000					0.82										
	238.700					0.83										
	269.500					0.82										
	310.689					0.83										
	350.778					0.82										
	386.467					0.83										
	436.333	0.57	0.64	0.77	0.81	0.82	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-	-	-
	497.722					0.83										
	561.944					0.82										
	630.803					0.83										
	712.197					0.82										
	816.333					0.83										
	921.667					0.82										
	1023.000					0.83										
	1155.000					0.82										
1241.550					0.83											
1401.750					0.82											
1635.693					0.83											
1846.750					0.82											



		Output speeds n_2 [r/min]														
		I	1	5	10	16	25	32	40	63	100	160	250	400	630	800
		η_A	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$
GSS07-2	5.862	0.74	0.82	0.86	0.89	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	8.125	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	-
	9.086	0.74	0.82	0.86	0.89	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	10.000	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	-
	11.200	0.74	0.82	0.86	0.89	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	12.594	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	-
	14.286	0.74	0.82	0.86	0.89	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	15.500	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	-
	17.360	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	-
	20.517	0.60	0.67	0.81	0.84	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	-	-
	22.143	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	25.188	0.60	0.66	0.80	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	-	-
	27.125	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	31.000	0.60	0.66	0.80	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	-	-
	35.306	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	39.200	0.60	0.67	0.81	0.84	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	-	-
	43.271	0.69	0.77	0.84	0.88	0.89	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	50.000	0.60	0.67	0.81	0.84	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	-	-
	54.250		0.66	0.80		0.85										
	61.250		0.67	0.81		0.84										
	70.611		0.66	0.80		0.85										
	79.722		0.67	0.81		0.84										
	86.542		0.66	0.80		0.85										
	97.708		0.67	0.81		0.84										
	113.667		0.66	0.80		0.85										
	128.333		0.67	0.81		0.84										
137.950	0.66		0.80	0.85												
155.750	0.67		0.81	0.84												
174.375	0.66		0.80	0.85												
196.875	0.67		0.81	0.84												



Drive dimensioning

GSS efficiencies

		Output speeds n_2 [r/min]														
		I	1	5	10	16	25	32	40	63	100	160	250	400	630	800
		η_A	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$	$\eta_{c=1}$
GSS07-3	126.531	0.60	0.66	0.80	0.84	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	-	-	-
	142.857		0.67	0.81		0.84										
	155.000		0.66	0.80		0.85										
	175.000		0.67	0.81		0.84										
	201.746		0.66	0.80		0.85										
	227.778		0.67	0.81		0.84										
	247.139		0.66	0.80		0.85										
	279.028		0.67	0.81		0.84										
	321.673		0.66	0.80		0.85										
	363.179		0.67	0.81		0.84										
	394.245		0.66	0.80		0.85										
	445.116		0.67	0.81		0.84										
	490.403		0.66	0.80		0.85										
	553.681		0.67	0.81		0.84										
	634.639		0.66	0.80		0.85										
	716.528		0.67	0.81		0.84										
	833.556		0.66	0.80		0.85										
	941.111		0.67	0.81		0.84										
	1011.633		0.66	0.80		0.85										
	1142.167		0.67	0.81		0.84										
1227.755	0.66	0.80	0.85													
1386.175	0.67	0.81	0.84													
1569.181	0.66	0.80	0.85													
1771.656	0.67	0.81	0.84													



General data

Gearbox type	GST	GFL	GKR	GKS	GSS
Housing					
Design	Cuboid				
Material	Aluminium/grey cast iron				
Solid shaft					
Design	With keyway in accordance with DIN 6885 Centring hole in accordance with DIN 332, Part 2				
Tolerance	k6 (d ≤ 50 mm) m6 (d > 50 mm)				
Material	Tempering steel C45 or 42CrMo4				
Hollow shaft					
Design	-	Hollow shaft (H): with keyway Hollow shaft with shrink disc (S): smooth			
Tolerance	-	Bore measured in accordance with ISO H7 with plug gauge			
Material	-	Tempering steel C45			
Geared parts					
Design	Optimised tooth flanks and profile geometry; ground tooth flanks				
Material	Case-hardened steel			Case-hardened steel, worm gear bronze	
Shaft-hub joint					
Design	1st stage/pre-stage: friction-type connection (= 2nd, 3rd or 4th stage): friction-type or positive-fit				
Shaft sealing rings					
Design	With dust lip				
Material	NB/FP (Viton)				
Bearing					
Design	Ball bearings/tapered-roller bearings depending on frame size and design				
Lubricants					
Design	In accordance with DIN 51502				
Fill volumes	Depending on the mounting position (see Operating Instructions)				
Mechanical efficiency					
At rated torque	$0.95 \leq \eta \leq 0.98$	$0.95 \leq \eta \leq 0.96$	$0.93 \leq \eta \leq 0.95$	$0.79 \leq \eta \leq 0.92$ ▶ depending on ratio ▶ when $n_1 = 1400$ r/min ▶ gearbox at operating temperature and gearing run in	
Noises	Does not exceed the emission values specified in VDI Guideline 2159				
Enclosure					
Design	IP55 and IP65				

General data

Gearbox type	GPA
Housing	
Design	Cuboid
Material	Cast iron with nodular graphite
Solid shaft	
Design	Smooth without keyway Centring hole in accordance with DIN 332, Part 2
Tolerance	k6
Material	Tempering steel C45
Geared parts	
Design	Spur toothing, optimised tooth flanks and profile geometry
Planet pinions + sun wheel	Design: case-hardened and tooth flanks ground Material: case-hardened steel 17 Cr Ni Mo 6
Internal gearing	Design: shaped or broached Material: ductile cast iron EN-GJS-700-2
Ratios	Design: all ratios are mathematically exact
Shaft-hub joint	
	Positive-fit with special splined shaft profile
Shaft sealing rings	
Design	With dust lip
Material	FP (Viton)
Bearing	
Design	Ball bearings/tapered-roller bearings/needle bearings depending on frame size
Lubricants	
Design	In accordance with DIN 51502
Fill volumes	Depending on the mounting position (see Operating Instructions)
Mechanical efficiency	
At rated torque	$0.95 \leq \eta \leq 0.98$
Noises	
	Does not exceed the emission values specified in VDI Guideline 2159
Enclosure	
Design	IP54 and IP65



Ventilation

Gearboxes without ventilation

Ventilation is not required for the following gearboxes:

GST03/04
GFL04
GPA00...05
GKR03...05
GKS04
GSS04

Gearboxes that can be fitted with optional ventilation

If you are using these gearboxes, in most cases you will not need to provide special means of ventilation. In borderline cases, e.g. at input speeds > 2000 r/min, we recommend the use of breather elements, which can be purchased separately from us.

GST05
GFL05
GKS05

Gearboxes with ventilation

The following gearboxes are supplied with breather elements as standard:

GST06...14
GFL06...14
GKR06
GKS06...14
GSS05...07

Special precautions for mounting position C (motor on top)

For gearbox sizes G□□09...14 in this mounting position, we recommend the use of an oil compensation reservoir. This can be purchased separately. Depending on the gearbox type, you can find illustrations and special precautions under ventilation G□□ [⊗].

It is not required at high ratios or low input speeds. Please contact Lenze in such cases.

Lubricants

Lenze gearboxes and geared motors are ready for operation on delivery and are filled with lubricants that are specific to both the drive and the design. The mounting position and design specified in the order are decisive factors in choosing the volume of lubricant.

The lubricants listed in the lubricant table are approved for use in Lenze drives.

Lubricant table

- ▶ Please contact us you are working at ambient temperatures < -20°C or > +40°C.

Lubricants in accordance with DIN 51517-3: CLP-ISO 12925-1: CKC/CKD	CLP HC 320	CLP HC 150	CLP HC 220 USDA H1	CLP PG 460
GST / GFL / GKR / GKS	•		•	
GPA		•		
GSS				•
Ambient temperature [°C]	-25 ... +50		-20 ... +40	
Specification	Synthetic oil (synthetic hydrocarbon/poly-alpha-olefin oil)			Synthetic oil (polyglycol)
Note			For the foodstuffs processing industry.	Not mixable with other oil types.
Change interval	25000 operating hours		16000 operating hours	25000 operating hours
	After no more than three years (oil temperature 70 ... 80°C)			
Fuchs	Fuchs Renolin Unisyn CLP 320			
Klüber	Klübersynth GEM4-320		Klüberoil 4 UH1-220 N	Klübersynth GH 6-460
Shell	Shell Omala Oil HD 320		Shell Cassida Fluid GL 220	Shell Tivela S 460
Mobil			Mobil SHC 629	

- ▶ Caution: when using the lubricant CLP HC 220 on the GSS helical-worm gearbox, the torque M_2 must be reduced to 80 % of the values stated in the catalogue!