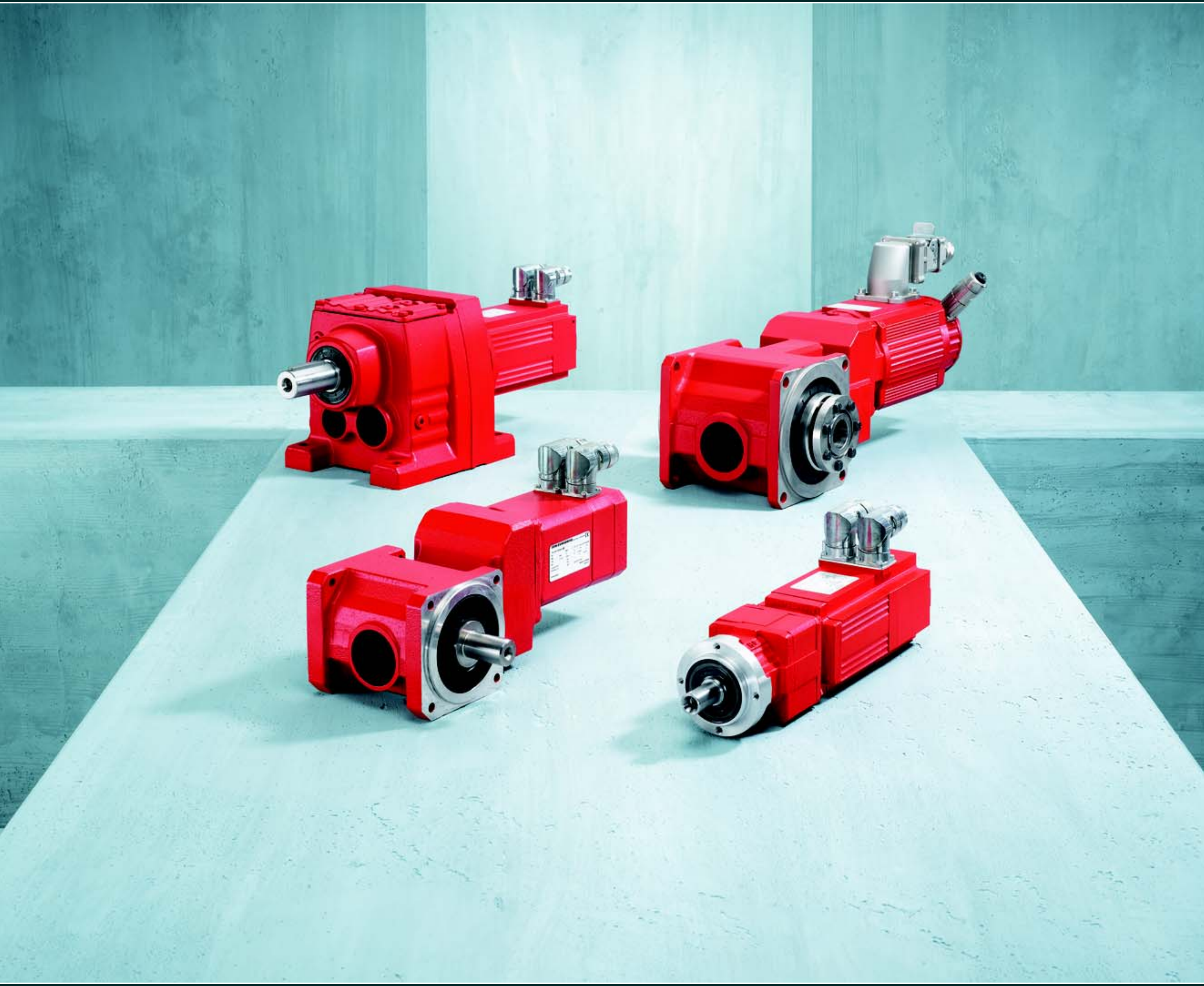

Synchronous Servo Gearmotors

Edition 04/2008

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Catalog

Color code system for catalogs and system manuals

Our catalogs and system manuals are identified by a color code system at the back to make it easier to work with these publications. The short designation of the publication is indicated as well. In this way you can immediately recognize the publication even if it is standing on a shelf together with other publications. The following overview shows an exemplary assignment of colors to product groups and products.

Mechanics

DR-GM 2008	GSE1 2008	GSE2 2008	GK 2008
DR gearmotors	Synchronous servo gearmotors	Asynchronous servo gearmotors	Gear units

Electromechanics

MOT1 2008	MOT2 2008
DR series AC motors	DT/DV/CT/CV series AC motors

Explosion-proof drives

EXG 2008	EXS 2008	EXM 2008
Explosion-proof gearmotors	Explosion-proof servo gearmotors	Explosion-proof motors

Control cabinet inverters, control technology and HMI

MDX 2008	MC 2008	MX 2008	PLC 2008	HMI 2008
MOVIDRIVE®	MOVITRAC®	MOVIAXIS®	MOVI-PLC®	DOP11B®

Decentralized technology

MM 2008	DI 2007	MG 2008
MOVIMOT® gearmotors	Decentralized installation	MOVIGEAR®

Industrial gear units

IGX1 2008	IGX2 2008
X series horizontal industrial gear units	X series vertical industrial gear units

1 Introduction

1.1 The SEW-EURODRIVE Group of Companies

Global presence

Driving the world with innovative drive solutions for all branches and for every application. Products and systems from SEW-EURODRIVE are used in a multitude of applications – worldwide. Be it in the automotive, building materials, food and beverage or metal-processing industry – The decision to use drive technology 'made by SEW-EURODRIVE' stands for reliability for both functionality and investment.

Not only are we represented in all important branches of industry today – we are found all over the world: with 12 manufacturing plants, 64 assembly plants in 46 countries and our comprehensive range of services, which we consider an integrative service that continues our commitment to outstanding quality.

Always the right drive

The SEW-EURODRIVE modular concept offers millions of combinations. This wide selection enables you to choose the correct drive for all applications, each based on the required speed and torque range, space available and the ambient conditions. Gear units and gearmotors offering a unique and finely tuned performance range and the best economic prerequisites to face your drive challenges.

The gearmotors are electronically empowered by MOVITRAC® frequency inverters, MOVIDRIVE® drive and MOVIAXIS® multi-axis servo drives, a combination that blends perfectly with the existing SEW-EURODRIVE systems program. As is the case with the mechanical systems, development, production and assembly is carried out completely by SEW-EURODRIVE. In combination with our drive electronics, these drives will provide the utmost in flexibility.

Products of the servo drive system, such as low backlash servo gear units, compact servomotors or MOVIAXIS® multi-axis servo drives provide precision and dynamics. From single-axis or multi-axis applications all the way to synchronized process sequences, servo drive systems by SEW-EURODRIVE offer a flexible and customized implementation of your application.

For economical, decentralized installations, SEW-EURODRIVE offers components from its decentralized drive system, such as MOVIMOT®, the gearmotor with integrated frequency inverter or MOVI-SWITCH®, the gearmotor with integrated switching and protection function. SEW-EURODRIVE has developed hybrid cables to provide cost-effective functional solutions, independent of the philosophy behind or the size of the system. The latest developments from SEWEURODRIVE: MOVITRANS® – system components for contactless energy transfer, MOVIPRO® – the decentralized drive control and MOVIFIT® – the new decentralized intelligence.

Power, quality and sturdy design combined in one standard product: with SEW-EURODRIVE, high-torque industrial gear units achieve large movements. The modular concept once again provides optimum adaptation of industrial gear units to meet a wide range of the most varying applications.

Your ideal partner

Its global presence, extensive product range and broad spectrum of services make SEW-EURODRIVE the ideal partner for the machinery and plant construction industry when it comes to providing drive systems for demanding applications in all applications and branches of industry.

1.2 Products and systems from SEW-EURODRIVE

The products and systems from SEW-EURODRIVE are divided into four product groups. These four product groups are:

1. Gearmotors and frequency inverters
2. Servo Drive Systems
3. Decentralized drive systems
4. Industrial gear units

Products and systems used in several group applications are listed in a separate group "Products and systems covering several product groups." Consult the following tables to locate the products and systems included in the respective product group:

1. Gearmotors and frequency inverters		
Gear units / gearmotors	**Motors**	**Frequency inverters**
• Helical gear units/ helical gearmotors • Parallel shaft helical gear units / parallel shaft helical gearmotors • Helical-bevel gear units / helical-bevel gearmotors • Helical-worm gear units/ helical-worm gearmotors • Spiroplan® right-angle gearmotors • Drives for electrified monorail systems • Geared torque motors • Pole-changing gearmotors • Variable speed gear units / variable speed gearmotors • Aseptic gearmotors • Gear units / gearmotors to ATEX standard • Variable speed gear units / variable speed gearmotors to ATEX standard	• Asynchronous AC motors / AC brake motors • Pole-changing AC motors / AC brakemotors • Energy efficient motors • Explosion-proof AC motors / AC brakemotors • Torque motors • Single-phase motors / single-phase brakemotors • Asynchronous linear motors	• MOVITRAC® frequency inverters • MOVIDRIVE® inverters • Control, technology and communication options for inverters

2. Servo Drive Systems		
Servo gear units/servo gearmotors	**Servomotors**	**Servo drive inverters/servo inverters**
• Low backlash planetary servo gear units/planetary gearmotors • Low backlash helical-bevel servo gear units/helical-bevel gearmotors • R, F, K, S, W gear units/gearmotors • Explosion-proof servo gear units/servo gearmotors	• Asynchronous servomotors/servo brakemotors • Synchronous servomotors/servo brakemotors • Explosion-proof servomotors/servo brakemotors • Synchronous linear motors	• MOVIDRIVE® servo inverters • MOVIAXIS® multi-axis servo inverter • Control, technology and communication options for servo drive inverters and servo inverters

3. Decentralized drive systems		
Decentralized drives	**Communication and installation**	**Contactless energy transfer**
• MOVIMOT® gearmotors with integrated frequency inverter • MOVIMOT® motors/brakemotors with integrated frequency inverter • MOVI-SWITCH® gearmotors with integrated switching and protection function • MOVI-SWITCH® motors/brakemotors with integrated switching and protection function • Explosion-proof MOVIMOT® and MOVI-SWITCH® gearmotors	• Fieldbus interfaces • Field distributors for decentralized installation • MOVIFIT® product range – MOVIFIT® MC for controlling MOVIMOT® drives – MOVIFIT®-SC with integrated electronic motor switch – MOVIFIT® FC with integrated frequency inverter	• MOVITRANS® system – Stationary components for energy supply – Mobile components for energy absorption – Line cables and installation material

4. Industrial gear units
• Helical gear units • Bevel-helical gear units • Planetary gear units

Products and systems covering several product groups
• Operator terminals • MOVI-PLC® drive-based control system

In addition to its products and systems, SEW-EURODRIVE offers a comprehensive range of services. These include:

- Technical consulting
- Application software
- Seminars and training
- Extensive technical documentation
- International customer service

Visit our home page:

→ **www.sew-eurodrive.com**

The website offers a great deal of information and services.

1.3 Additional documentation

Content of this publication

This "Synchronous Servo Gearmotors" catalog provides a detailed description of the following product groups from SEW-EURODRIVE:

- The combination of synchronous servomotors DS, CM and CMP with
  - R, F, K, S, W gear units
  - BS.F gear units
  - PS.F gear units
  - PS.C gear units

The descriptions include:

- Product descriptions
- Type overviews
- Project planning information
- Visual representation of mounting positions
- Explanation on the order information
- Combination overviews and technical data
- Dimension sheets

For details on motor options, refer to the "AC Motors" catalog/price catalog.

For details on gear unit options and adapters, refer to the "Gear Units" catalog/price catalog.

Additional documentation

The following price catalogs and catalogs are available from SEW-EURODRIVE in addition to this "Synchronous Servo Gearmotors" catalog:

- AC motors
- Gear unit catalog

These price catalogs and catalogs offer the following information:

- Product descriptions
- Technical data and inverter assignments
- Important information on tables and dimension sheets
- Visual representation of the different types
- Selection tables
- Dimension sheets
- Technical data
- Notes on adapter mounting

1.4 Copyright notice

2 Product Description of Gear Units and Gearmotors

2.1 General information

Coating

The gear units, synchronous servomotors and servo gearmotors from SEW-EURODRIVE are coated as follows:

Type	Coating according to DIN 1843
Synchronous gearmotor with BS.F../PS.F../..PS.C..	RAL 9005 black
Synchronous gearmotor with R, F, K, S, W gear unit	RAL 7031 blue gray

Special coatings are available on request.

Weight specifications

Please note that all weights shown in the catalogs exclude the oil fill for the gear units and gearmotors. The weights vary according to gear unit design and gear unit size. The lubricant fill depends on the mounting position selected, which means that in this case no universally applicable information can be given. For approximate lubricant fill volumes depending on the mounting position, refer to the gear unit catalog. For the exact weight, refer to the order confirmation.

Brakemotors

On request, motors and gearmotors can be supplied with an integrated mechanical brake. The SEW-EURODRIVE brakes can be divided into 3 categories:

- Type 1: DC-operated electromagnetic disk brake that is released electrically and applied with spring force, with working capacity and emergency stop properties.
- Type 2: DC-operated electromagnetic disk brake that is released electrically and applied with spring force, with the typical properties of a holding brake for highly dynamic servomotors.
- Type 3: DC-operated permanent-magnet disk brake that is released electrically and applied with solenoid force, with the typical properties of a holding brake for highly dynamic servomotors. This brake type is only used for the DS56.

Due to their operating principle, all brake types are applied if the power fails. This means they meet the basic safety requirements. A type 1 brake can also be released mechanically if equipped with manual brake release. All brake types are controlled by a control element that is either installed in the motor wiring space or the control cabinet.

Type 2 or type 3 brakes can also be controlled directly by a suitable inverter/servo inverter (e.g. MOVIAXIS®).

A characteristic feature of the brakes is their very short design. The brake bearing end shield is a part of both the motor and the brake. The integral construction of the SEW-EURODRIVE brakemotor permits particularly compact and sturdy solutions.

International markets

On request, SEW-EURODRIVE supplies UL registered motors or CSA certified motors with connection conditions according to CSA and NEMA standard.

For the Japanese market, SEW-EURODRIVE offers motors conforming to JIS standard. Contact your sales representative to assist you in such cases.

2

2.2 Corrosion and surface protection

General information

SEW-EURODRIVE offers various optional protective measures for operation of motors and gearmotors under special ambient conditions.

The protective measures comprise two groups:

- Corrosion protection KS for motors
- Surface protection OS for motors and gear units

For motors, optimum protection is offered by a combination of corrosion protection KS and surface protection OS.

In addition, special optional protective measures for the output shafts are also available.

KS corrosion protection

The KS corrosion protection for motors comprises the following measures:

- All retaining screws that are loosened during operation are made of stainless steel.
- The nameplates are made of stainless steel.
- A top coating is applied to various motor parts.
- The flange contact surfaces and shaft ends are treated with a temporary anti-corrosion agent.
- Additional measures for brakemotors.

A sticker labeled "KORROSIONSSCHUTZ" (corrosion protection) indicates that special treatment has been applied.

	NOTE
i	Motors with forced cooling fan are not available with KS corrosion protection.

Surface protection OS

In addition to standard surface protection, motors and gear units also available with surface protection OS1 to OS4. The special procedure Z can also be performed in addition. The special procedure Z means that large surface recesses are sprayed with a rubber filling prior to painting.

Surface protection	Permutation of layers	NDFT[1] on gray-cast iron [µm]	Suitable for
Standard	1 × Dip primer 1 × One-pack top coat	Approx. 50-70	• Normal ambient conditions • Relative humidity below 90% • Surface temperature up to max. 120 °C • Corrosivity category C1[2]
OS1	1 × Dip primer 1 × Two-pack base coat 1 × Two-pack top coat	Approx. 120-150	• Low environmental impact • Relative humidity max. 95% • Surface temperature up to max. 120 °C • Corrosivity category C2[2]
OS2	1 × Dip primer 2 × Two-pack base coat 1 × Two-pack top coat	Approx. 170-210	• Medium environmental impact • Relative humidity up to 100% • Surface temperature up to max. 120 °C • Corrosivity category C3[2]
OS3	1 × Dip primer 2 × Two-pack base coat 2 × Two-pack top coat	Approx. 220-270	• High environmental impact • Relative humidity up to 100% • Surface temperature up to max. 120 °C • Corrosivity category C4[2]
OS4	1 × Dip primer 2 × Two-pack epoxy base layer 2 × Two-pack top coat	Approx. 320	• Very high environmental impact • Relative humidity up to 100% • Surface temperature up to max. 120 °C • Corrosivity category C5-1[2]

1) NDFT (**n**ominal **d**ry **f**ilm **t**hickness) = Required coating thickness; Minimum thickness = 80 % NDFT; Maximum thickness = 3 x NDFT (DIN EN ISO 12944-5)

2) To DIN EN ISO 12,944-2

Special protection measures

Gearmotor output shafts can be treated with special optional protective measures for operation subject to severe environmental pollution or in particularly demanding applications.

Gear unit type	Measure	Protection principle	Suitable for
R, F, K, S, W BS.F202 ... 602	**FKM oil seal (Viton)[1]**	High quality material	Drives subject to chemical contamination
R, F, K, S, W	**surface coating of the contact surface of the oil seal**	Protective layer	Severe environmental impact and in conjunction with FKM oil seal (Viton)
R, F, K, S, W	**Stainless steel output shaft**	Surface protection with high-quality material	Particularly demanding applications in terms of surface protection

1) For PS.F, PS.C and BS.F802, FKM oil seals (Viton) are used as standard.

NOCO® fluid

As standard, SEW-EURODRIVE supplies NOCO® fluid corrosion protection and lubricant with every hollow shaft gear unit. Use NOCO® fluid when installing hollow shaft gear units. Using this fluid helps prevent contact corrosion and makes it easier to assemble the drive at a later date.

NOCO® fluid is also suitable for protecting machined metal surfaces that do not have corrosion protection, such as parts of shaft ends or flanges. You can also order larger quantities of NOCO® fluid from SEW-EURODRIVE.

NOCO® fluid is food grade according to USDA-H1. You can tell that NOCO® fluid is a food grade oil by the USDA-H1 identification label on its packaging.

2.3 Extended storage – R, F, K, S, W gear units

Design

You can also order gear units prepared for "extended storage." SEW-EURODRIVE recommends the "extended storage" type for storage periods longer than 9 months.

In this case, a VCI corrosion inhibitor (**v**olatile **c**orrosion **i**nhibitor) is added to the lubricant in these gear units. Please note that this VCI is only effective in a temperature range of -25 °C ... +50 °C. The flange contact surfaces and shaft ends are also treated with an anti-corrosion agent. If not specified otherwise in your order, the gear unit will be supplied with OS1 surface protection. You can order OS2, OS3 or OS4 instead of OS1.

Surface protection	Suitable for
OS1	Low environmental impact
OS2	Medium environmental impact
OS3	High environmental impact
OS4	Very high environmental impact

NOTE

The gear units must remain tightly sealed until taken into operation to prevent the VCI corrosion protection agent from evaporating.

Gear units will be supplied with an oil fill according to the mounting position (M1 ... M6) and are ready for operation. Check the oil level before you start operating the gear unit for the first time!

Storage conditions

Observe the storage conditions specified in the following table for extended storage:

Climate zone	Packaging[1)]	Storage location[2)]	Storage duration
Temperate (Europe, USA, Canada, China and Russia, excluding tropical zones)	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap.	With roof, protected against rain and snow, no shock loads.	Up to 3 years with regular checks of the packaging and moisture indicator (rel. humidity < 50 %).
	open	Under roof, enclosed at constant temperature and atmospheric humidity (5°C < ϑ< 60°C, < 50% relative atmospheric humidity). No sudden temperature fluctuations. Controlled ventilation with filter (free from dust and dirt). Protected against aggressive vapors and shocks.	2 years or more with regular inspections. Check for cleanliness and mechanical damage during inspection. Check corrosion protection.
Tropical (Asia, Africa, Central and South America, Australia, New Zealand excluding temperate zones)	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap. Protected against insect damage and mildew by chemical treatment.	Under roof, protected against rain and shocks.	Up to 3 years with regular checks of the packaging and moisture indicator (rel. humidity < 50 %).
	open	Under roof, enclosed at constant temperature and atmospheric humidity (5°C < ϑ< 50°C, < 50% relative atmospheric humidity). No sudden temperature fluctuations. Controlled ventilation with filter (free from dust and dirt). Protected against aggressive vapors and shocks. Protected against insect damage.	2 years or more with regular inspections. Check for cleanliness and mechanical damage during inspection. Check corrosion protection.

1) Packaging must be carried out by an experienced company using the packaging materials that have been explicitly specified for the particular application.

2) SEW-EURODRIVE recommends to store the gear units according to the mounting position.

2.4 General product description – R, F, K, S, W gear units

Ambient temperature

Gear units and gearmotors from SEW-EURODRIVE can be operated in a wide ambient temperature range. The following standard temperature ranges are permitted for filling the gear units according to the lubricant table:

Gear unit	Filled with	Permitted standard temperature range
Helical, parallel shaft helical and helical-bevel gear units	CLP(CC) VG220	-10 °C ... +40 °C
Helical-worm gear unit	CLP(CC) VG680	0 °C ... +40 °C
Spiroplan® gear units	CLP(SEW-PG) VG460	-10 °C ... +40 °C

The rated data of the gear units and gearmotors specified in the catalog/price catalog refer to an ambient temperature of +25 °C.

Gear units and gearmotors from SEW-EURODRIVE can be operated outside the standard temperature range if project planning is adapted to ambient temperatures from as low as -40 °C in the intensive cooling range until up to +60 °C. Project planning must take special operating conditions into account and adapt the drive to the ambient conditions by selecting suitable lubricants and seals. This kind of project planning is generally recommended for increased ambient temperatures as of size 97 and for helical-worm gear units with small gear ratios. SEW-EURODRIVE will gladly perform this project planning for you.

If the drive is to be operated on a frequency inverter, you must also consider the project planning notes of the inverter and take into account the thermal effects of inverter operation.

Installation altitude

Due to the low air density at high installation altitudes, heat dissipation on the surface of motors and gear units decreases. The rated data listed in the catalog/price catalog applies to an installation altitude of maximum 1000 m above sea level. Installation altitudes of more than 1000 m asl must be taken into account for project planning of gear units and gearmotors.

Power and torque

The power and torque ratings listed in the catalogs refer to mounting position M1 and similar mounting positions in which the input stage is not completely submerged in oil. In addition, the gearmotors are assumed to be standard versions with standard lubrication and under normal ambient conditions.

Please note that the motor power shown in the selection tables for gearmotors is subject to selection. However, the output torque and the desired output speed are essential for the application and need to be checked.

Speed

The quoted output speeds of the gearmotors are recommended values. You can calculate the rated output speed based on the rated motor speed and the gear unit ratio. Please note that the actual output speed depends on the motor load and the supply system conditions.

Noises

The noise levels of all SEW-EURODRIVE gear units, motors and gearmotors are well within the maximum permitted noise levels set forth in the VDI guideline 2159 for gear units and IEC/EN 60034 for motors.

Weights

Please note that all weights shown in the catalogs exclude the oil fill for the gear units and gearmotors. The weights vary according to gear unit design and gear unit size. The lubricant fill depends on the mounting position selected, which means that in this case no universally applicable information can be given. Please refer to "Lubricants" in the "Design and Operating Notes" section for recommended lubricant fill quantities depending on the mounting position. For the exact weight, refer to the order confirmation.

Air admission and accessibility

The gearmotors/brakemotors must be mounted on the driven machine in such a way that both axially and radially there is enough space left for unimpeded air admission, for maintenance work on the brake and, if required, for the MOVIMOT® inverter. Please also refer to the notes in the motor dimension sheets.

Multi-stage gearmotors

You can achieve particularly low output speeds by using multi-stage gear units or multi-stage gearmotors. Such a setup requires a helical gear unit or gearmotor on the input end as a second gear unit.

When doing this, it is necessary to limit the motor power depending on the maximum permitted output torque of the gear unit.

Reduced backlash design

Helical, parallel shaft helical and helical-bevel gear units with reduced backlash are available as of gear unit size 37. The circumferential backlash of these gear units is considerably less than that of the standard versions so that positioning tasks can be solved with great precision. The circumferential backlash is specified in angular minutes [’] in the technical data. The circumferential backlash for the output shaft is specified without load (max. 1% of the rated output torque); the gear unit input end is blocked. The dimension drawings for the standard versions are applicable.

RM gear units, RM gearmotors

RM gear units and RM gearmotors are a special type of helical gear units with an extended output bearing hub. They were designed especially for agitating applications and allow for high overhung and axial loads and bending moments. The other data are the same as for standard helical gear units and standard helical gearmotors.

2

Spiroplan® right-angle gearmotors

Spiroplan® right-angle gearmotors are robust, single- and two-stage right-angle gearmotors with Spiroplan® gearing. The difference to the helical-worm gear units is the material combination of the steel-on-steel gearing, the special tooth meshing relationships and the aluminum housing. As a result, Spiroplan® right-angle gearmotors are wear-free, very quiet-running and lightweight.

The particularly short design and the aluminum housing make for very compact and lightweight drive solutions.

After the running-in period, Spiroplan® right-angle gearmotors are below the following sound pressure level in 4-pole motor operation on a 50 Hz supply system:

- Spiroplan® W..10 to W..30: 55 dB(A)
- Spiroplan® W..37: 60 dB(A)

The sound-pressure level may be 3 to 5 dB(A) higher at time of delivery than after hours of regular operation.

The wear-free gearing and the life-long lubrication facilitate long periods of maintenance-free operation. The oil filling being independent of the mounting position (except for Spiroplan® W..37 in mounting position M4) makes any mounting position possible for Spiroplan® right-angle gearmotors without altering the quantity of oil. The identical hole spacing in the foot and face as well as the same shaft height to both makes for a number of mounting options.

Two different flange diameters are available. On request, Spiroplan® right-angle gearmotors can be equipped with a torque arm.

Components on the input side

The following components on the input side are available for the gear units from SEW-EURODRIVE:

- **Input covers with input shaft extension, optionally with**
  - Centering shoulder
  - Backstop
  - Motor mounting platform
- **Adapter**
  - for mounting IEC or NEMA motors with the option of a backstop
  - for mounting servomotors with a square flange
  - with torque limiting safety couplings and speed or slip monitor
  - with hydraulic centrifugal coupling, also with disc brake or backstop

Swing base

A swing base is a drive unit consisting of helical-bevel gear unit, hydraulic centrifugal coupling and electric motor. The complete arrangement is mounted to a rigid mounting rail.

Motor swings are available with the following optional accessories:

- Torque arm
- Mechanical thermal monitoring unit
- Contactless thermal monitoring unit

2.5 General product description – BS.F, PS.F, PS.C gear units

Ambient temperature

Servo gear units can be operated at ambient temperatures between - 20 °C and + 40 °C. It is essential that you contact SEW-EURODRIVE if ambient temperatures exceed this temperature range.

Installation altitude

Due to the low air density at high installation altitudes, heat dissipation on the surface of motors and gear units decreases. The rated data listed in the catalog/price catalog applies to an installation altitude of maximum 1000 m above sea level. Installation altitudes of more than 1000 m asl must be taken into account for project planning of gear units and gearmotors.

Power and torque

The power and torque values listed in the catalogs apply to normal environmental conditions.

Please note that the motor torques shown in the selection tables for gearmotors is subject to selection. However, the output torque and the desired output speed are essential for the application and need to be checked.

Noises

The noise levels of all SEW geared servomotors and servomotors are well within the maximum permitted noise levels laid down by the VDI guideline 2159 for gear units and EN 60034 for motors.

Heat dissipation and accessibility

Servo gearmotors and brakes can reach surface temperatures > 100 °C during operation. Make sure to maintain adequate distance from heat-sensitive components when installing gearmotors / brakemotors to the driven machine.

Direct motor mounting

The servo gearmotors from SEW-EURODRIVE make it possible to mount servo gear units directly to the synchronous servomotors from SEW-EURODRIVE without an adapter. These integrated servo gearmotors feature shaft-hub connections that are all positive and free from backlash.

Motor mounting with adapter

Use the modular motor adapters to connect all other commercial servomotors in a simple and time-efficient manner to the servo gear units from SEW-EURODRIVE.

Low backlash and positioning accuracy

The optimum gearing geometry paired with precisely manufactured components and careful assembly make for low circumferential backlash.

The BS.F and PS.F gear units ensure low backlash already for standard designs. The circumferential backlash can be further reduced for all types and even minimized for PS.F gear units. Circumferential backlash will remain constantly low for the entire gear unit life due to the wear-free operating performance and high-endurance design of the running gears.

Wide gear ratio range with finely-graduated steps

All ratios from i=3 to i=100 are integers and finely graduated. This means that the gear units are especially suitable for use with controllers that require integer resolution ratios.

Reliability, longevity and low maintenance

The high reliability of servo gear units from SEW-EURODRIVE in the system is ensured by the use of high-strength materials, high-quality anti-friction bearings, long-lived oil seals and synthetic lubricants.

High overload capacity

Exactly matched components as well as backlash-free and positively connected drive elements ensure that highest torques can be transferred and that large axial and radial forces can be absorbed.

Torsionally rigid

The special design of SEW-EURODRIVE servo gear units in conjunction with large shaft diameters ensures high torsional rigidity.

3 Overview of Types and Unit Designation

3.1 Design variants and options – R, F, K, S, W gear units

The unit designations for the R, F, K, S, and W gear units and their options are listed below.

Helical gear unit

Designation	
RX..	Single-stage foot-mounted design
RXF..	Single-stage B5 flange-mounted design
R..	Foot-mounted design
R..F	Foot-mounted and B5 flange-mounted design
RF..	B5 flange-mounted design
RZ..	B14 flange-mounted design
RM..	B5 flange-mounted design with extended bearing housing

Parallel shaft helical gear unit

Designation	
F..	Foot-mounted design
FA..B	Foot-mounted design and hollow shaft
FH..B	Foot-mounted and hollow shaft with shrink disk
FV..B	Foot-mounted design and hollow shaft with splined hollow shaft to DIN 5480
FF..	B5 flange-mounted design
FAF..	B5 flange-mounted design and hollow shaft
FHF..	B5 flange-mounted and hollow shaft with shrink disk
FVF..	B5 flange-mounted design and hollow shaft with splined hollow shaft to DIN 5480
FA..	Hollow shaft
FH..	Hollow shaft with shrink disk
FT..	Hollow shaft with TorqLOC® hollow shaft mounting system
FV..	Hollow shaft with splined hollow shaft to DIN 5480
FAZ..	B14 flange-mounted design and hollow shaft
FHZ..	B14 flange-mounted and hollow shaft with shrink disk
FVZ..	B14 flange-mounted design and hollow shaft with splined hollow shaft to DIN 5480

Helical-bevel gear unit

Designation	
K..	Foot-mounted design
KA..B	Foot-mounted design and hollow shaft
KH..B	Foot-mounted and hollow shaft with shrink disk
KV..B	Foot-mounted design and hollow shaft with splined hollow shaft to DIN 5480
KF..	B5 flange-mounted design
KAF..	B5 flange-mounted design and hollow shaft
KHF..	B5 flange-mounted and hollow shaft with shrink disk
KVF..	B5 flange-mounted design and hollow shaft with splined hollow shaft to DIN 5480
KA..	Hollow shaft
KH..	Hollow shaft with shrink disk
KT..	Hollow shaft with TorqLOC® hollow shaft mounting system
KV..	Hollow shaft with splined hollow shaft to DIN 5480
KAZ..	B14 flange-mounted design and hollow shaft
KHZ..	B14 flange-mounted and hollow shaft with shrink disk
KVZ..	B14 flange-mounted design and hollow shaft with splined hollow shaft to DIN 5480

Helical-worm gear unit

Designation	
S..	Foot-mounted design
SF..	B5 flange-mounted design
SAF..	B5 flange-mounted design and hollow shaft
SHF..	B5 flange-mounted and hollow shaft with shrink disk
SA..	Hollow shaft
SH..	Hollow shaft with shrink disk
ST..	Hollow shaft with TorqLOC® hollow shaft mounting system
SAZ..	B14 flange-mounted design and hollow shaft
SHZ..	B14 flange-mounted and hollow shaft with shrink disk

Spiroplan® gear unit

For all gear unit sizes (W..10 to W..37):

Designation	
W..	Foot-mounted design
WF..	Flange-mounted design
WAF..	Flange-mounted design and hollow shaft
WA..	Hollow shaft

Only for gear unit size 37 (W..37):

Designation	
WA37B	Foot-mounted design and hollow shaft
WH37B	Foot-mounted and hollow shaft with shrink disk
WHF37	Flange-mounted and hollow shaft with shrink disk
WH37	Hollow shaft with shrink disk
WT37	Hollow shaft with TorqLOC® hollow shaft mounting system

Options

R, F and K gear units:

Designation	
/R	Reduced backlash

K, S and W gear units:

Designation	
/T	With torque arm

F gear units:

Designation	
/G	With rubber buffer

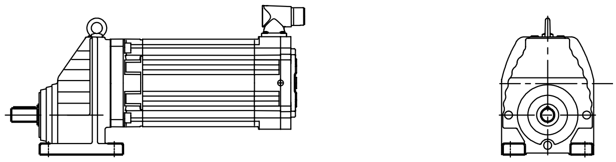
Condition monitoring

Designation	Option
/DUO	Diagnostic Unit Oil = Oil aging sensor
/DUV	Diagnostic Unit Vibration = Vibration sensor

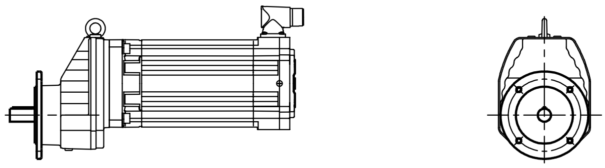
	NOTE
	The design variants described in this section refer to DS, CM, CMP gearmotors from SEW-EURODRIVE. They also apply to gear units without motors.

Helical gearmotors

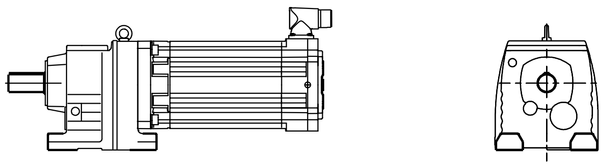
The following variants of helical gearmotors can be supplied:



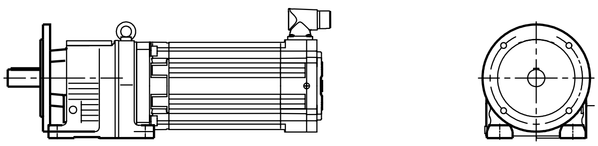
RX..DS../ CM../ CMP..
Single-stage helical gearmotor in foot-mounted design



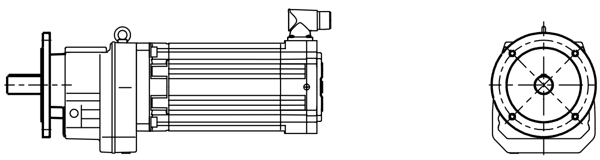
RXF..DS../ CM../ CMP..
Single-stage helical gearmotor in B5 flange-mounted design



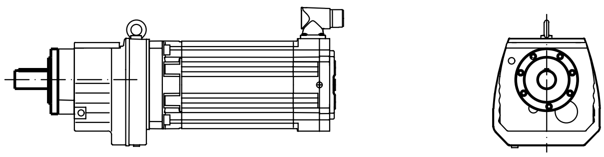
R..DS../ CM../ CMP..
Foot-mounted helical gearmotor



R..F DS../ CM../ CMP..
Foot and B5 flange-mounted helical gearmotor



RF..DS../ CM../ CMP..
Helical gearmotor in B5 flange-mounted design



RZ..DS../ CM../ CMP..
Helical gearmotor in B14 flange-mounted design

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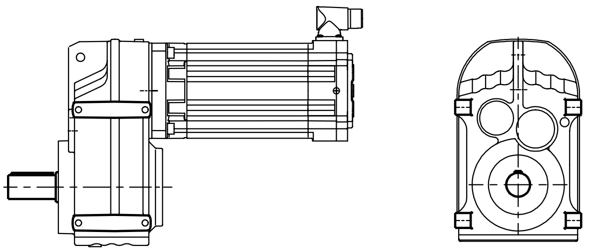
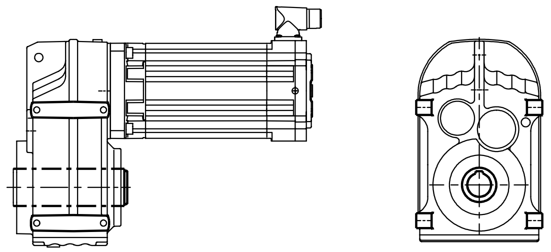
Parallel shaft helical gearmotors

The following variants of parallel shaft helical gearmotors can be supplied:

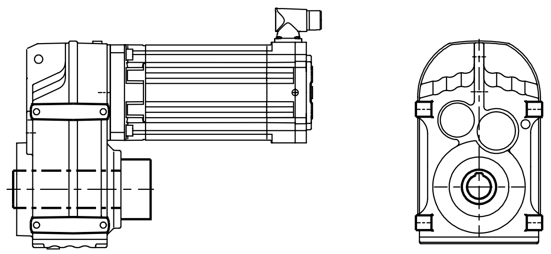


F..DS../ CM../ CMP..
Foot-mounted parallel shaft helical gearmotor

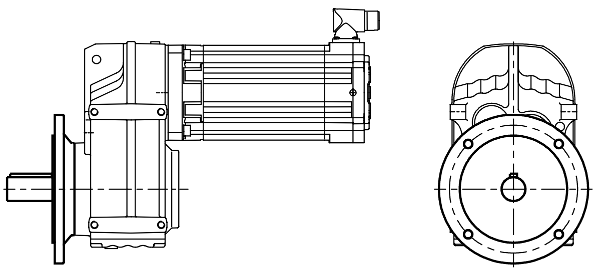


FA..B DS../ CM../ CMP..
Foot-mounted parallel shaft helical gearmotor with hollow shaft

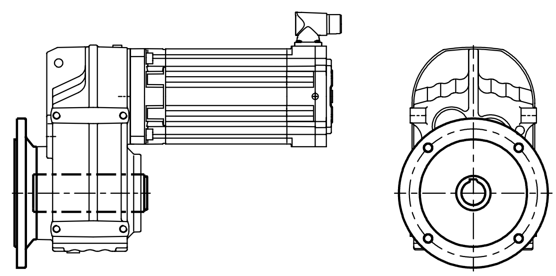
FV..B DS../ CM../ CMP..
Foot-mounted parallel shaft helical gearmotor with hollow shaft and splined hollow shaft to DIN 5480



FH..B DS../ CM../ CMP..
Foot-mounted parallel shaft helical gearmotor with hollow shaft and shrink disk



FF..DS../ CM../ CMP..
B5 flange-mounted parallel shaft helical gearmotor



FAF..DS../ CM../ CMP..
Parallel shaft helical gearmotor in B5 flange-mounted design with hollow shaft

FVF..DS../ CM../ CMP..
Parallel shaft helical gearmotor in B5 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480

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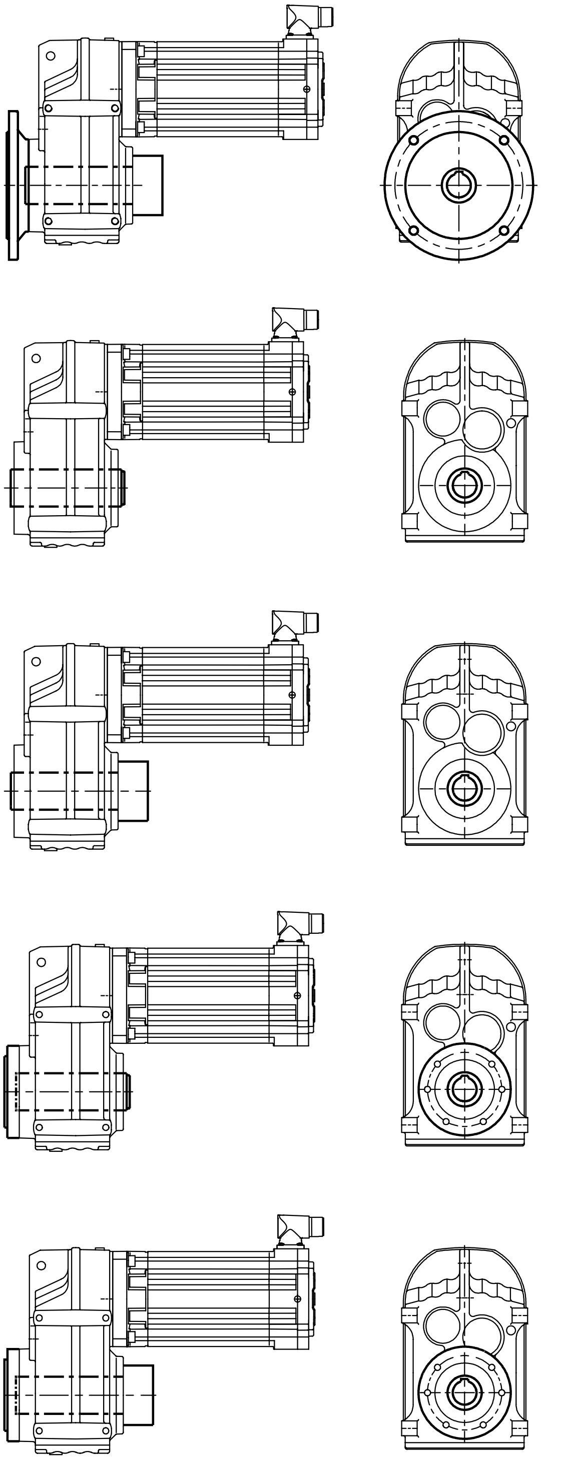

FHF..DS../ CM../ CMP..
Parallel shaft helical gearmotor in B5 flange-mounted design with hollow shaft and shrink disk

FA..DS../ CM../ CMP..
Parallel shaft helical gearmotor with hollow shaft

FV..DS../ CM../ CMP..
Parallel shaft helical gearmotor with hollow shaft and splined hollow shaft to DIN 5480

FH..DS../ CM../ CMP..
Parallel shaft helical gearmotor with hollow shaft and shrink disk

FT..DS../ CM../ CMP..
Parallel shaft helical gearmotor with hollow shaft and TorqLOC® hollow shaft mounting system

FAZ..DS../ CM../ CMP..
Parallel shaft helical gearmotor in B14 flange-mounted design with hollow shaft

FVZ..DS../ CM../ CMP..
Parallel shaft helical gearmotor in B14 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480

FHZ..DS../ CM../ CMP..
Parallel shaft helical gearmotor in B14 flange-mounted design with hollow shaft and shrink disk

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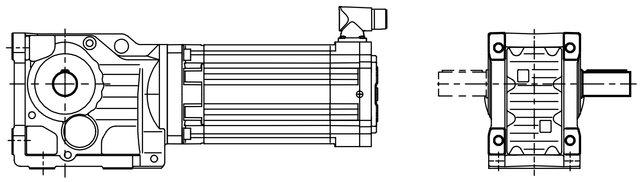
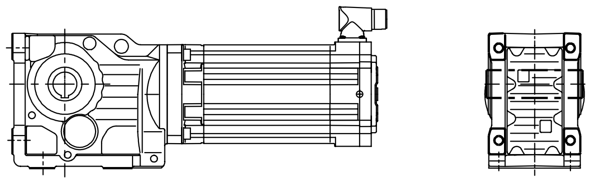
Helical-bevel gearmotors

The following variants of helical-bevel gearmotors can be supplied:

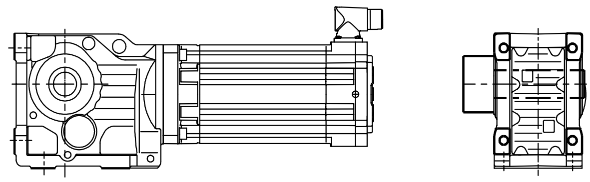


K..DS../ CM../ CMP..
Foot-mounted helical-bevel gearmotor

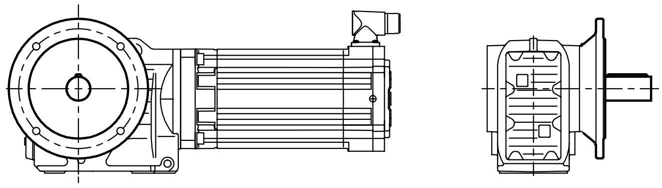


KA..B DS../ CM../ CMP..
Helical-bevel gearmotor in foot-mounted design with hollow shaft

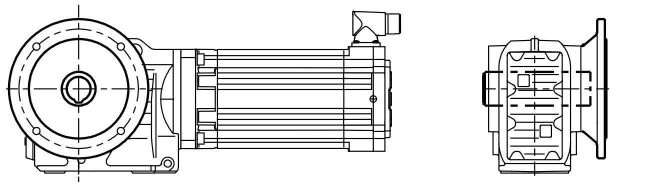
KV..B DS../ CM../ CMP..
Foot-mounted helical-bevel gearmotor with hollow shaft and splined hollow shaft to DIN 5480



KH..B DS../ CM../ CMP..
Foot-mounted helical-bevel gearmotor with hollow shaft and shrink disk



KF..DS../ CM../ CMP..
Helical-bevel gearmotor in B5 flange-mounted design



KAF..DS../ CM../ CMP..
Helical-bevel gearmotor in B5 flange-mounted design with hollow shaft

KVF..DS../ CM../ CMP..
Helical-bevel gearmotor in B5 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480

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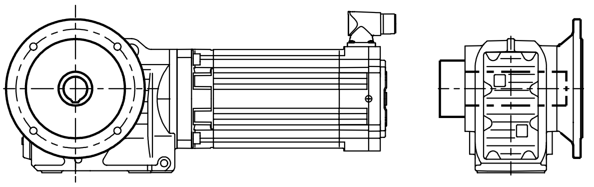
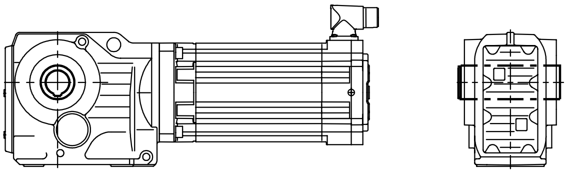
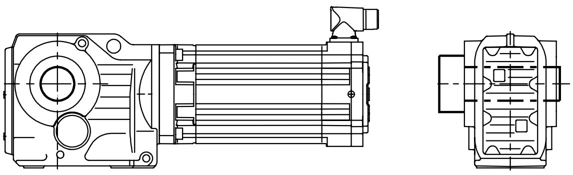


KHF..DS../ CM../ CMP..
Helical-bevel gearmotor in B5 flange-mounted design with hollow shaft and shrink disk



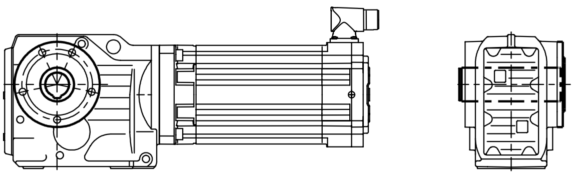
KA..DS../ CM../ CMP..
Helical-bevel gearmotor with hollow shaft

KV..DS../ CM../ CMP..
Helical-bevel gearmotor with hollow shaft and splined hollow shaft to DIN 5480



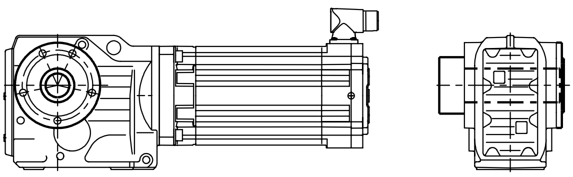
KH..DS../ CM../ CMP..
Helical-bevel gearmotor with hollow shaft and shrink disk

KT..DS../ CM../ CMP..
Helical-bevel gearmotor with hollow shaft and TorqLOC® hollow shaft mounting system



KAZ..DS../ CM../ CMP..
Helical-bevel gearmotor in B14 flange-mounted design with hollow shaft

KVZ..DS../ CM../ CMP..
Helical-bevel gearmotor in B14 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480



KHZ..DS../ CM../ CMP..
Helical-bevel gearmotor in B14 flange-mounted design with hollow shaft and shrink disk

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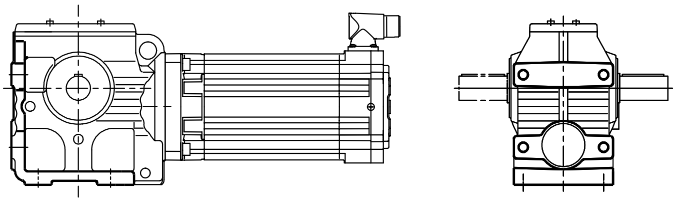
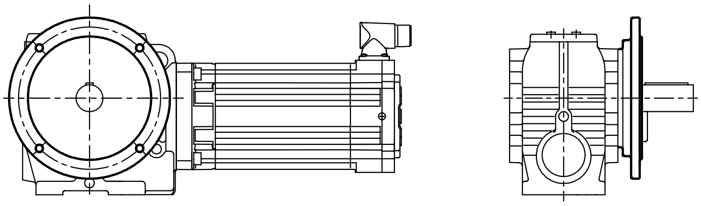
Helical-worm gearmotors

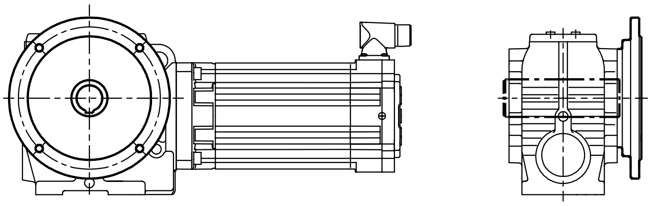
The following variants of helical-worm gearmotors can be supplied:



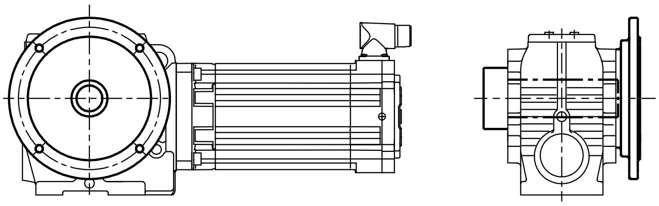
S..DS../ CM../ CMP..
Foot-mounted helical-worm gearmotor



SF..DS../ CM../ CMP..
Helical-worm gearmotor in B5 flange-mounted design



SAF..DS../ CM../ CMP..
Helical-worm gearmotor in B5 flange-mounted design with hollow shaft



SHF..DS../ CM../ CMP..
Helical-worm gearmotor in B5 flange-mounted design with hollow shaft and shrink disk

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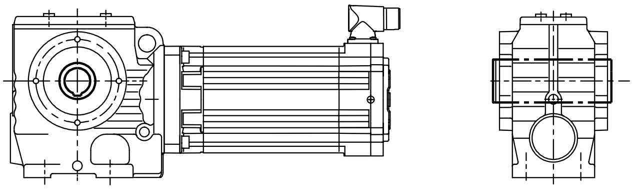
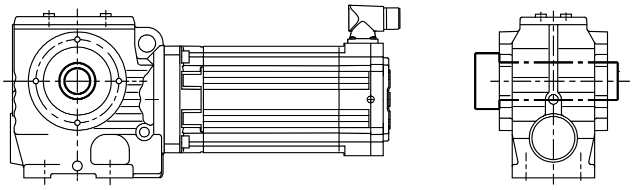
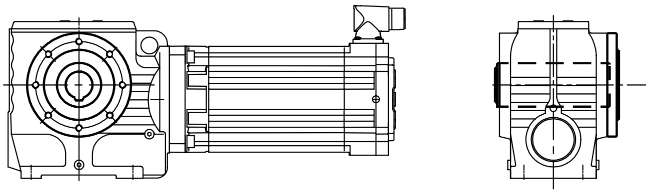


SA..DS../ CM../ CMP..
Helical-worm gearmotor with hollow shaft

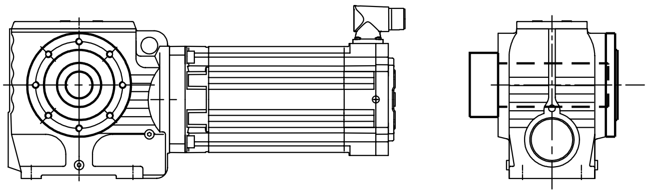


SH..DS../ CM../ CMP..
Helical-worm gearmotor with hollow shaft and shrink disk

ST..DS../ CM../ CMP..
Helical-worm gearmotor with hollow shaft and TorqLOC® hollow shaft mounting system



SAZ..DS../ CM../ CMP..
Helical-worm gearmotor in B14 flange-mounted design with hollow shaft



SHZ..DS../ CM../ CMP..
Helical-worm gearmotor in B14 flange-mounted design with hollow shaft and shrink disk

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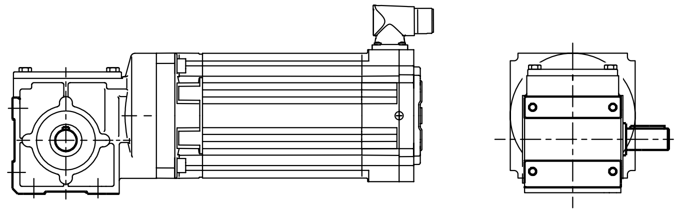
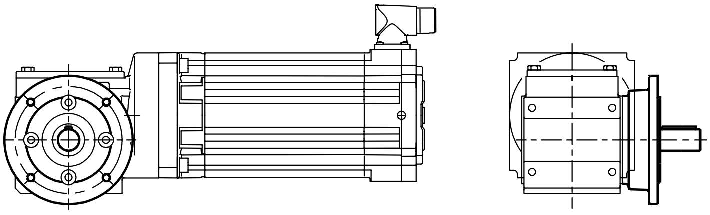
Spiroplan® gearmotors

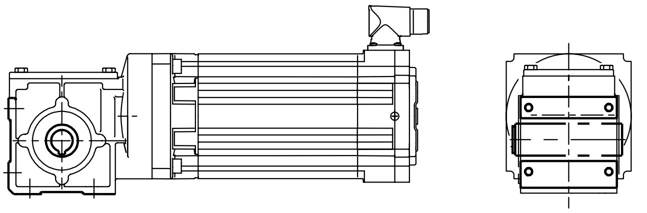
The following variants of Spiroplan® gearmotors size W..10 to W..37 can be supplied:



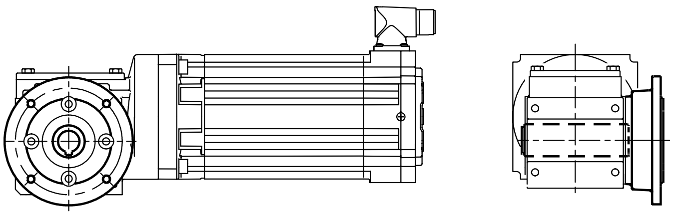
W..DS../ CM../ CMP..
Spiroplan® gearmotor in foot-mounted design



WF..DS../ CM../ CMP..
Spiroplan® gearmotor in flange-mounted design



WA..DS../ CM../ CMP..
Spiroplan® gearmotor with hollow shaft



WAF..DS../ CM../ CMP..
Spiroplan® gearmotor in flange-mounted design with hollow shaft

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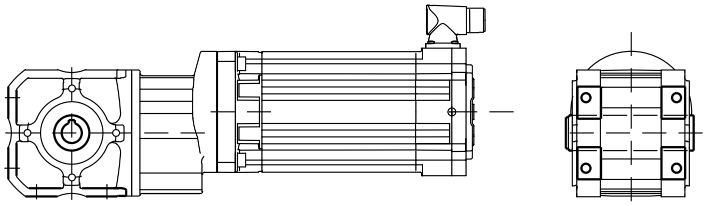
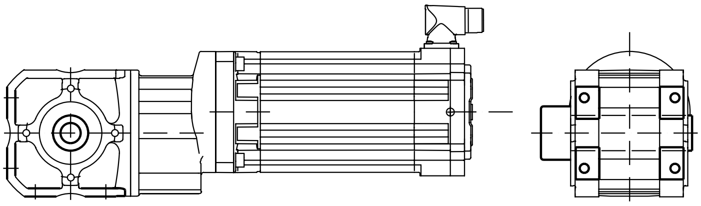
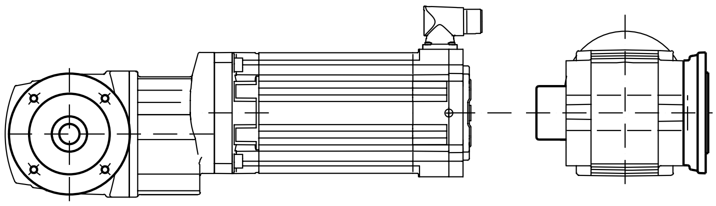
The following variants of Spiroplan® gearmotors size W..37 can be supplied in addition:



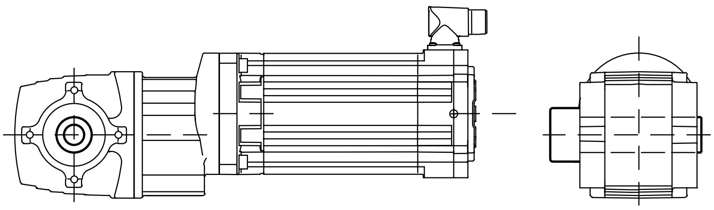
WA37B DS../ CM../ CMP..
Spiroplan® gearmotor in foot-mounted design with hollow shaft



WH37B DS../ CM../ CMP..
Spiroplan® gearmotor in foot-mounted design with hollow shaft and shrink disk



WHF37 DS../ CM../ CMP..
Spiroplan® gearmotor in flange-mounted design with hollow shaft and shrink disk



WH37 DS../ CM../ CMP..
Spiroplan® gearmotor with hollow shaft and shrink disk

WT37 DS../ CM../ CMP..
Spiroplan® gearmotor with hollow shaft and TorqLOC®

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3.2 Design variants and options of – BS.F, PS.F and PS.C gear units

Helical-bevel gear units BS.F

Designation	
BSKF..	Solid shaft with key
BSBF..	Solid shaft with flange block shaft
BSHF..	Hollow shaft with shrink disk
BS.F..B	Foot and face mounting
BSKF..B	Solid shaft with key
BSBF..B	Solid shaft with flange block shaft
BSHF..B	Hollow shaft with shrink disk
BSAF..	Hollow shaft with keyway

Planetary gear unit PS.F

Designation	
PSKF..	Solid shaft with key
PSBF..	Solid shaft with flange block shaft

Planetary gear unit PS.C

Designation	
PSKC..	B5 output flange, solid shaft with key
PSCZ..	B14 output flange, solid shaft
PSKCZ..	B14 output flange, solid shaft with key

Options

BS.F gear units

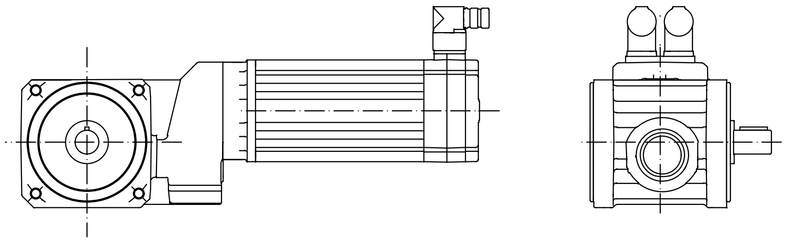
Designation	
../R	Reduced backlash
../T	Torque arm
../I	Hollow shaft and shrink disk at the output end

PS.F gear units

Designation	
../R	Reduced backlash
../M	Minimized backlash

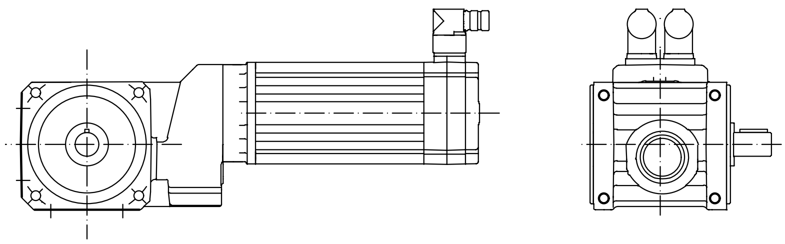
BS.F helical-bevel gearmotors

The following variants of BS.F helical-bevel gear units can be supplied:



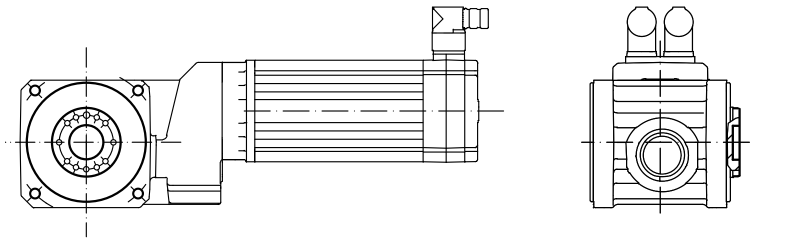
BSF.. DS../ CM../ CMP..
Gear motor with solid shaft, B5 output flange

BSKF.. DS../ CM../ CMP..
Gear motor with solid shaft and key, B5 output flange

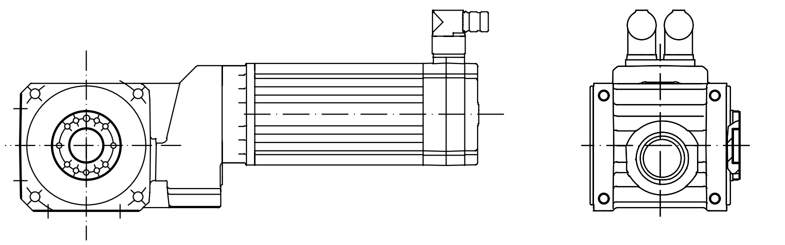


BSF..B DS../ CM../ CMP..
Gearmotor with solid shaft and front-end mounting

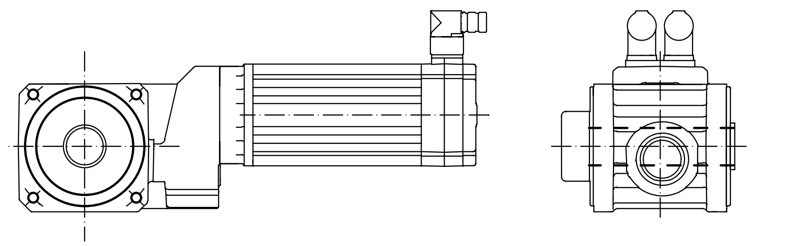
BSKF..B DS../ CM../ CMP..
Gearmotor with solid shaft, key and front-end mounting



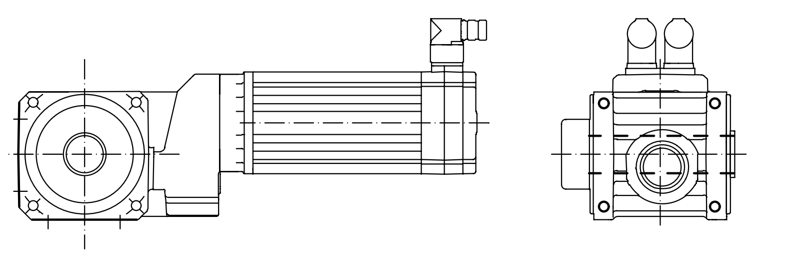
BSBF.. DS../ CM../ CMP..
Gear motor with flange block shaft, B5 output flange



BSBF..B DS../ CM../ CMP..
Gearmotor with flange block shaft and front-end mounting



BSHF.. DS../ CM../ CMP..
Gear motor with hollow shaft and shrink disk, B5 output flange



BSHF..B DS../ CM../ CMP..
Gearmotor with hollow shaft, shrink disk and front-end mounting

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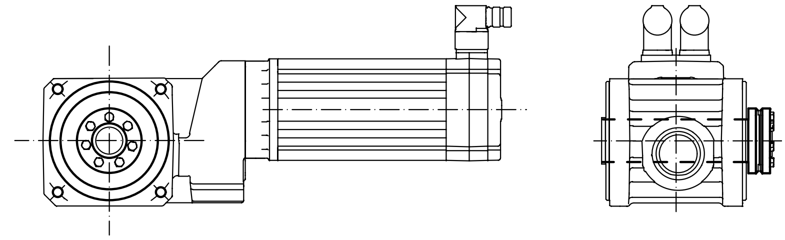
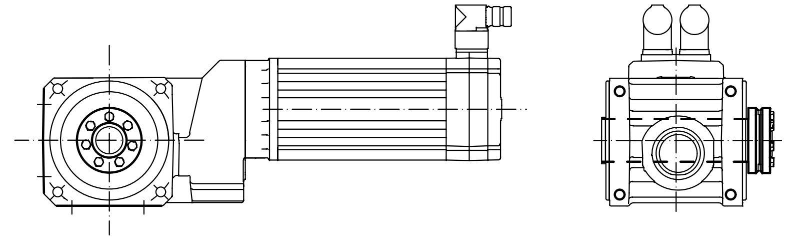
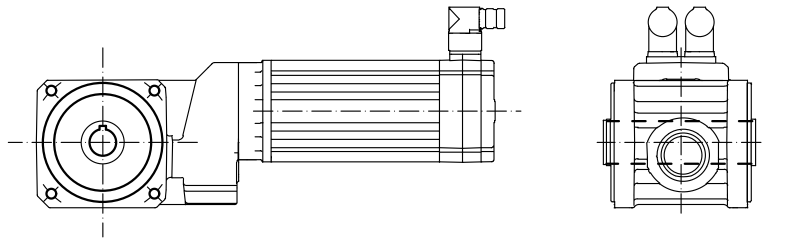


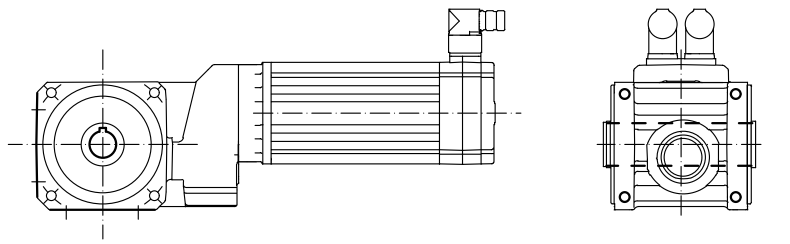
BSHF../I DS../ CM../ CMP..
Gearmotor with hollow shaft and shrink disk at the output end



BSHF..B /I DS../ CM../ CMP..
Gearmotor with hollow shaft and shrink disk at the output end



BSAF.. DS../ CM../ CMP..
Gear motor with hollow shaft and keyway, B5 output flange



BSAF..B DS../ CM../ CMP..
Gear motor with hollow shaft and keyway, B5 output flange

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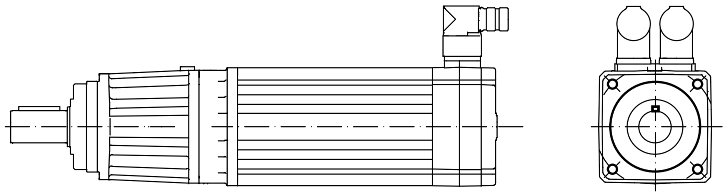
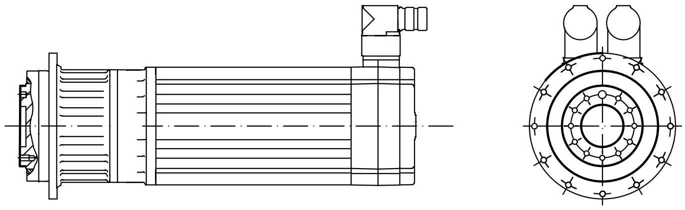
PS.F planetary gearmotors

The following variants of PS.F.. planetary gear units can be supplied:



PSF DS../ CM../ CMP..
Gearmotor with solid shaft, B5 output flange

PSKF DS../ CM../ CMP..
Gearmotor with solid shaft and key, B5 output flange



PSBF DS../ CM../ CMP..
Gear motor with flange block shaft, B5 output flange

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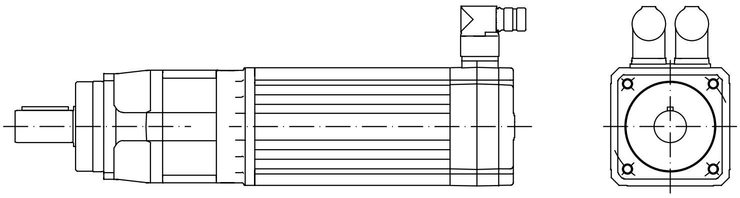
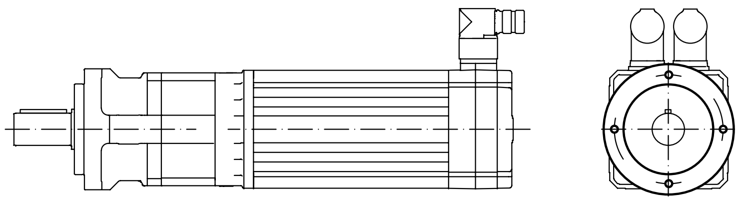
PS.C planetary gearmotors

The following variants of PS.C.. planetary gear units can be supplied:



PSC DS../ CM../ CMP..
Gearmotor with solid shaft, B5 output flange

PSKC DS../ CM../ CMP..
Gear motor with solid shaft and key, B5 output flange



PSCZ DS../ CM../ CMP..
Gearmotor with solid shaft, B14 output flange

PSKCZ DS../ CM../ CMP..
Gear motor with solid shaft and key, B14 output flange

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3.3 Unit designation of servo gearmotors

Example: Order code for PS.C.. servo gearmotors

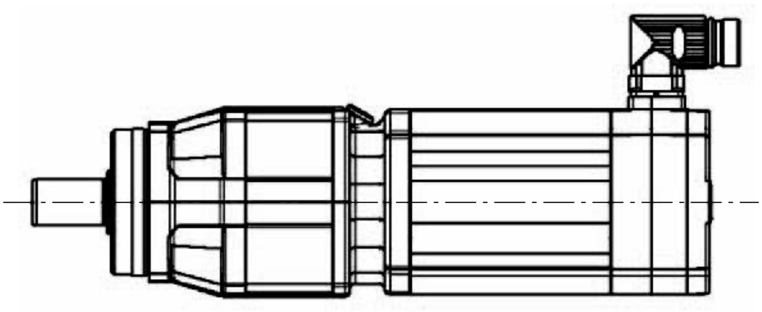

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Figure 1: Example for a PS.C.. servo gearmotor

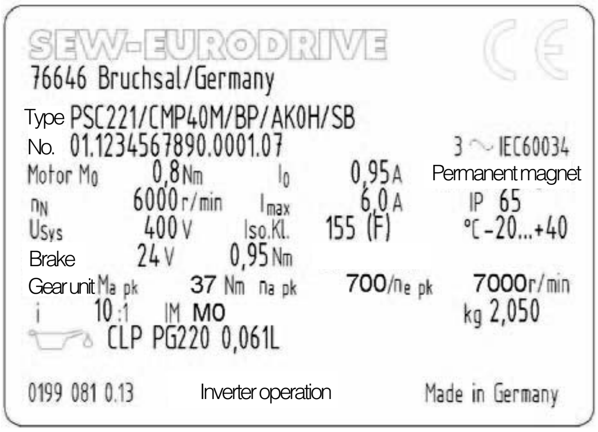
For example, a servo gearmotor with brake, manual brake release, positive temperature coefficient thermistor and plug connector has the following unit designation:

PSC 321 CMP 50M /BP /KTY /AS1H /SB

/SB	Plug connector for motor and brake, plug housing with axial encoder cable entry
/AS1H	Motor option: Absolute encoder multi-turn
/KTY	Temperature sensor
/BP	Brake
50M	Motor size
CMP	Motor series
321	Gear unit size: e.g. 321
PSC	Gear unit type: PSC

3.4 Servo gearmotor nameplate

Example: Nameplate for PS.C.. servo gearmotor



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Key

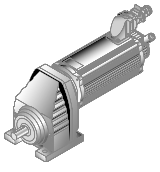
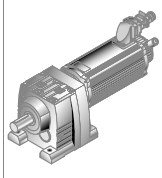
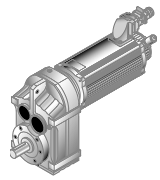
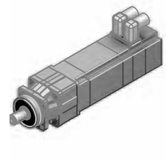
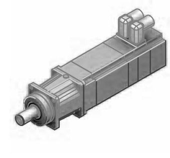
i		Gear unit reduction ratio	n_N	[rpm]	Rated speed
IM		Mounting position	M_o	[Nm]	Rated torque
IP		Degree of protection	I_o	[A]	Rated current
n_{epk}	[rpm]	Maximum permitted input speed	I_{max}	[A]	Maximum permitted current
n_{apk}	[rpm]	Maximum permitted output speed	f_N	[Hz]	Rated frequency
M_{apk}	[Nm]	Maximum permitted output torque	U_{max}	[V]	Maximum permitted voltage

NOTE

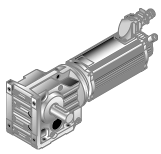
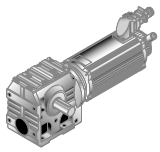
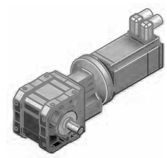
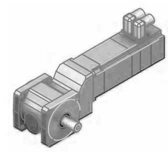
The nameplate of servo gearmotors is fixed to the servomotor!

3.5 Servo gearmotors at a glance

Axially parallel gear units

Gear unit type For details, refer to		RX.. page 155	R.. page 181	F.. page 256	PS.C.. page 630	PS.F.. page 567
Technical data						
Peak torque	M_{apk} [Nm]	54-1150	46-4360	130-8860	37-427	26-4200
Max. continuous torque	M_{amax} [Nm]	36-830	31-4300	87-7840	29-347	20-3000
Selected max. speed	n_{epk} [1/min]	Up to 4500	Up to 4500	Up to 4500	Up to 7000	Up to 8000
Peak overhung load	F_{rapk} [N]	3970-30000	1220-32100	4500-65000	2000-11000	1900-83000
Gear ratio	i	1.3-8.23	3.21-216.28	3.77-276.77	3-100	3-100
Option with reduced backl.	/R	x	x	x	-	x
Option w. minimized backl.	/M	-	-	-	-	x
Mechanical data						
Hollow shaft		-	-	x	-	-
Flange mounting		x	x	x	x	x
Foot mounting		x	x	-	-	-
Flange block		-	-	-	-	x
B5 flange		x	x	x	x	x
B14 flange		-	x	x	x	-

Right-angle gear units

Gear unit type For details, refer to		K.. page 354	S.. page 440	W37 page 488	BS.F.. page 502
Technical data					
Peak torque	M_{apk} [Nm]	187-9090	60-655	91-155	51-1910
Max. continuous torque	M_{amax} [Nm]	125-8000	43-480	70-110	40-1500
Selected max. speed	n_{epk} [1/min]	4500	4500	4500	4500
Peak overhung load	F_{rapk} [N]	5140-65000	300-12000	2950-5000	2380-36000
Gear ratio	i	3.98-176.05	6.8-75.06	3.2-69.05	3-40
Option with reduced backl.	/R	x	x	-	x
Option w. minimized backl.	/M	-	-	-	-
Mechanical data					
Hollow shaft		x	x	x	x
Flange mounting		x	x	x	x
Foot mounting		x	x	x	x
Flange block		-	-	-	x
B5 flange		x	x	x	x
B14 flange		x	x	-	-

For information on all available options and variants, refer to page 20 ff.

4 Project Planning Notes for Servo Gearmotors

4.1 Additional documentation

In addition to the information in this catalog, SEW-EURODRIVE offers extensive documentation covering the entire topic of electrical drive engineering. These are mainly the publications in the "Drive Engineering – Practical Implementation" series as well as the manuals and catalogs for electronically controlled drives.

You will find additional links to a wide selection of our documentation in many languages for download on the SEW-EURODRIVE homepage (http://www.sew-eurodrive.com). The list below includes other documents that are of interest in terms of project planning. You can order these publications from SEW-EURODRIVE.

Technical data for motors and gear units

The following price catalogs and catalogs are available from SEW-EURODRIVE in addition to this "Synchronous Servo Gearmotors" catalog:

- AC motors
- Gear unit catalog

Drive Engineering – Practical Implementation

- Drive Planning
- Controlled AC Drives
- Servo Technology.
- EMC in Drive Engineering.
- Explosion-Proof Drives to EU Directive 94/9/EC.
- SEW Disc Brakes.

Electronics documentation

- MOVIDRIVE® MDX60/61B system manual
- MOVIAXIS® MX project planning manual

Mechanical brakes

- "Brakes and Accessories" manual

4.2 Data for drive and gear unit selection

The data of the application must be known for projecting a drive. The abbreviations used for project planning are summarized in the following table:

Designation	Meaning	Unit
φ	Circumferential backlash	[`]
η	Gear unit efficiency for M_{apk}	
a, b, f	Gear unit constants as regards the overhung load conversion	[mm]
c	Gear unit constants as regards the overhung load conversion	[Nmm]
a_0, a_1, a_2	Gear unit constants as regards the rise in temperature in the gear unit	
F_A	Axial load (tension and compression) on the output shaft	[N]
f_k	Speed ratio	
F_R	Overhung load on the output shaft	[N]
F_{Rapk}	Maximum permitted overhung load at the output shaft for short-time duty (load application point is the middle of the shaft end)	[N]
F_{Ramax}	Maximum permitted overhung load at the output shaft for continuous duty (load application point is the middle of the shaft end)	[N]
F_{Repk}	Maximum permitted overhung load at the input shaft for short-time duty (load application point is the middle of the shaft end)	[N]
F_{Remax}	Maximum permitted overhung load at the input shaft for continuous duty (load application point is the middle of the shaft end)	[N]
H	Installation altitude	[m above sea level]
I_0	Current consumption of the motor at M_0	[A]
I_{max}	Maximum permitted motor current (root-mean-square value)	[A]
Ins.Cl.	Thermal classification of the motor	
i	Gear unit reduction ratio	
IM	Mounting position of gear unit (international mounting position) M1...M6	
IP..	Degree of protection according to IEC60034-5	
J_A	Mass moment of inertia of the adapter	[kgm^2]
J_G	Mass moment of inertia of the gear unit	[kgm^2]
J_{ext}	Mass moment of inertia (external) reduced on motor shaft	[kgm^2]
J_{Mot}	Mass moment of inertia of the motor	[kgm^2]
J_L	Mass moment of inertia of the load	[kgm^2]
k	Inertia ratio J_{ext} / / J_{Mot}	
l	Length of output shaft	
M_1 … M_n	Output torque in time period t_1 to t_n	[Nm]
M_0	Thermally permitted output torque of the motor in continuous duty at low speed (not to be confused with standstill torque)	[Nm]
M_a^{DYN}	Dynamic output torque assumed for the drive in project planning	[Nm]
M_{aeff}	Effective torque for component testing calculated in project planning	[Nm]
M_{akub}	Effective torque for bearing testing calculated in project planning	[Nm]
M_{amax}	Maximum permitted output torque for continuous duty	[Nm]
M_{apk}	Maximum permitted torque for short-time duty	[Nm]
$M_{aNOTAUS}$	Maximum permitted emergency stop torque, max. 1000 emergency stops	[Nm]
M_{ath}	Effective torque for thermal testing calculated in project planning	[Nm]
M_B	Rated brake torque	[Nm]
M_{pk}	Dynamic limit torque of the servomotor	[Nm]

Table continued on next page.

Designation	Meaning	Unit
M_{eff}	Effective torque requirement (in relation to the motor)	[Nm]
M_{max}	Maximum output torque assumed for the drive in project planning	[Nm]
ML	Mounting location (UL)	
n_{apk}	Maximum permitted output speed for short-time duty	[rpm]
n_{epk}	Maximum permitted input speed for short-time duty	
n_{em}	Mean input speed	[rpm]
n_{am}	Mean output speed	[rpm]
n_{ak}	Breakpoint speed (output)	[rpm]
n_N	Rated speed	[rpm]
$n_1 ... n_n$	Output speed in time period t_1 to t_n	[rpm]
n_{etn_pk}	Maximum input speed in section	[rpm]
P_{Br}	Braking power	[W]
P_{Br_pk}	Peak braking power	[W]
P_{Br_eff}	Effective braking power	[W]
P_{Br_tn}	Braking power in section t_n	[W]
S.., ..% cdf	Duty type and cyclic duration factor (cdf) or exact load cycle can be entered.	[s]
$t_1 ... t_n$	Time period 1 to n	[s]
t_z	Cycle time	[s]
T_{Amb}	Ambient temperature	[°C]
U_{sys}	System voltage, voltage of the supplying inverter	[V]
U_{Br}	Operating voltage of the brake	[V]
x	Distance between overhung load application point and shaft shoulder	[mm]
F_{Rmax}	Calculated auxiliary variable	
F_{Rkub}	Calculated auxiliary variable	

Determining the application data

It is necessary to have data on the machine to be driven (mass, speed, setting range, etc.) to project the drive correctly.

This data helps to determine the required power, torque and speed. Refer to the SEW publication "Drive Engineering - Practical Implementation / Drive Planning" or the SEW project planning tool SEW Workbench for assistance.

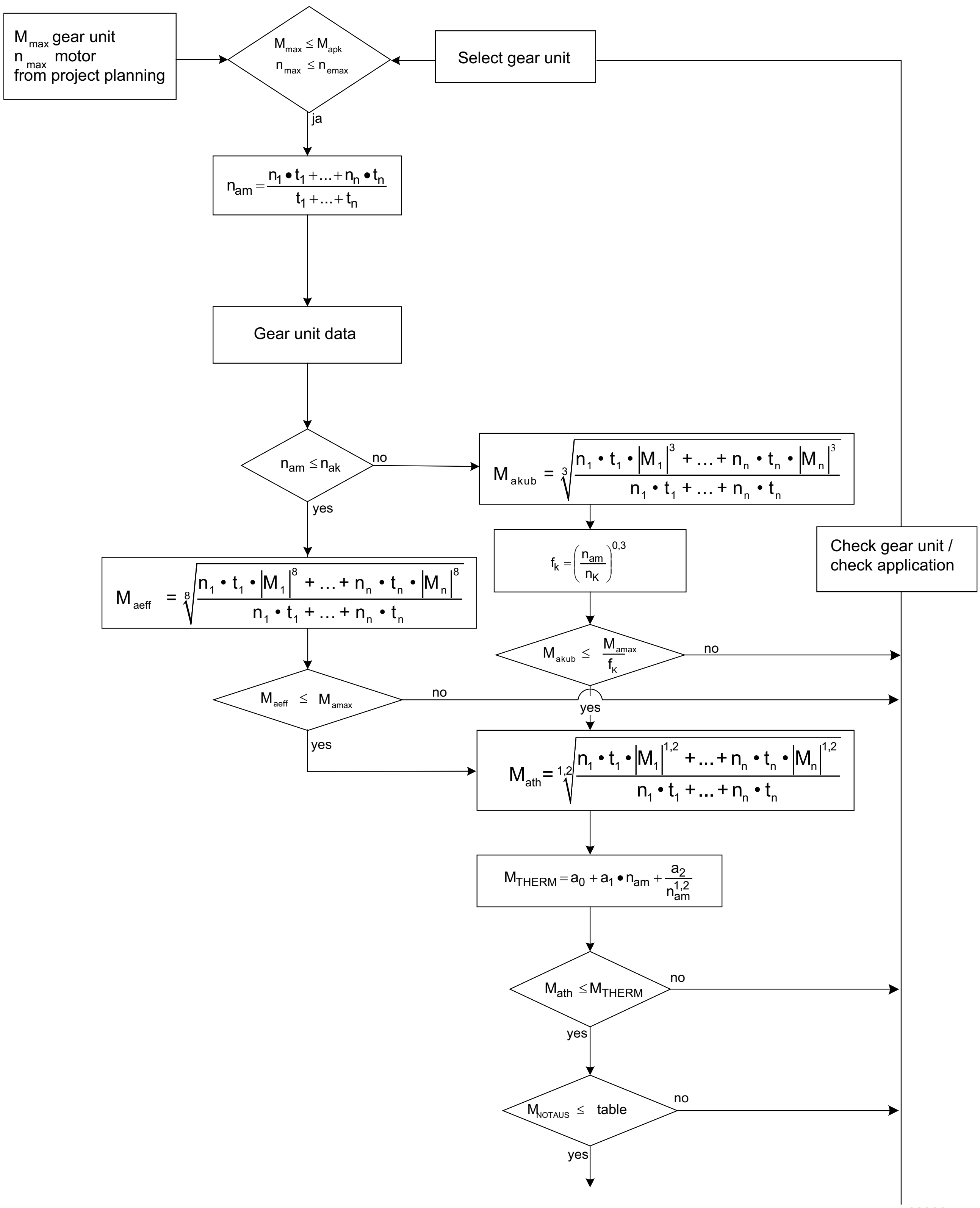
Selecting the correct drive

The appropriate drive can be selected once the power and speed of the drive have been calculated and with regard to mechanical requirements.

4.3 Project planning procedure

The following flowcharts show a schematic view of the project planning procedure of a servo gear unit for a positioning drive in S3 operation.

Project planning procedure part 1, servo gear units



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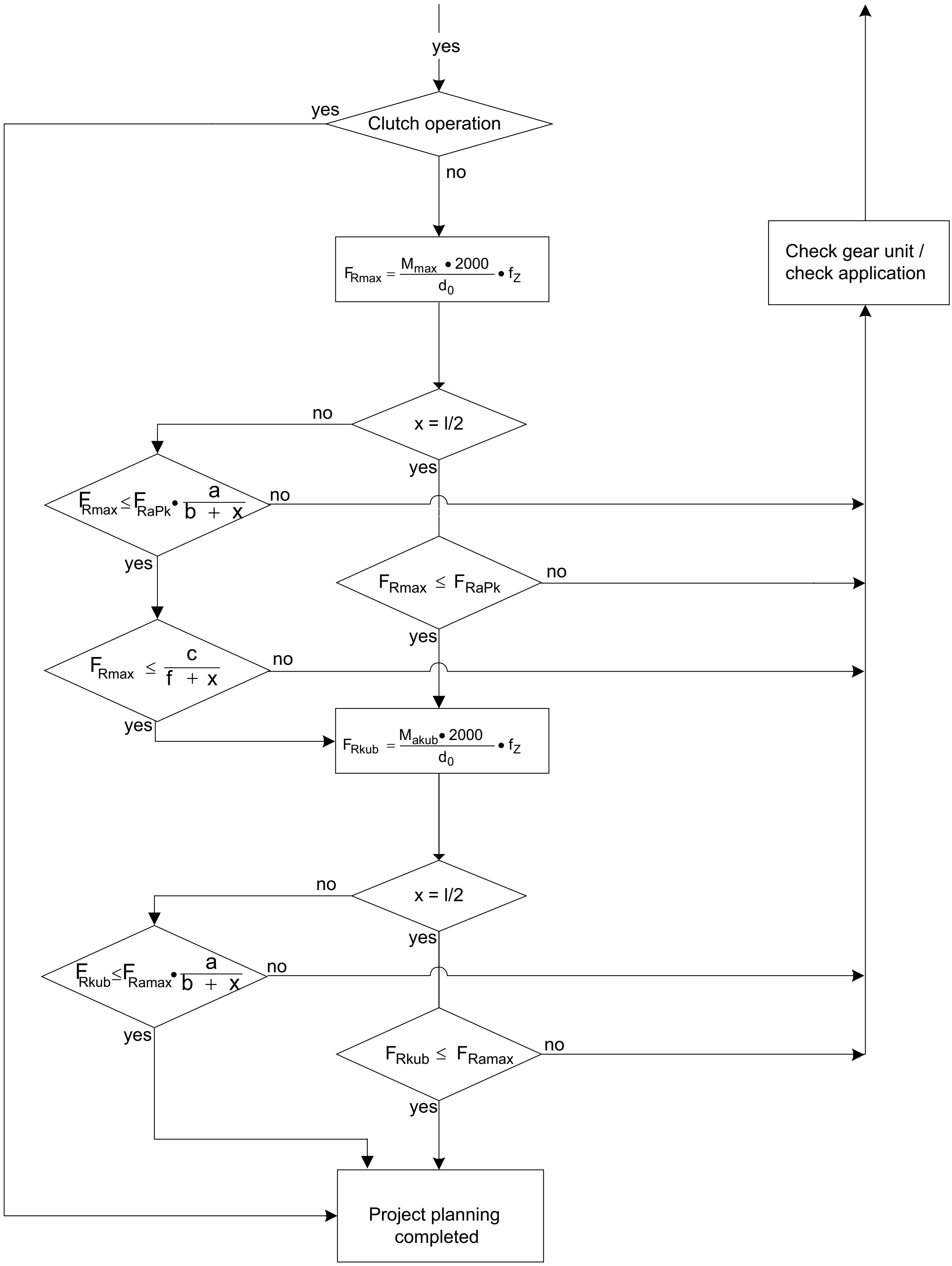
* For thermal project planning of R, F, K, S, W gear units, please contact SEW-EURODRIVE.

Project planning procedure part 2, servo gear units



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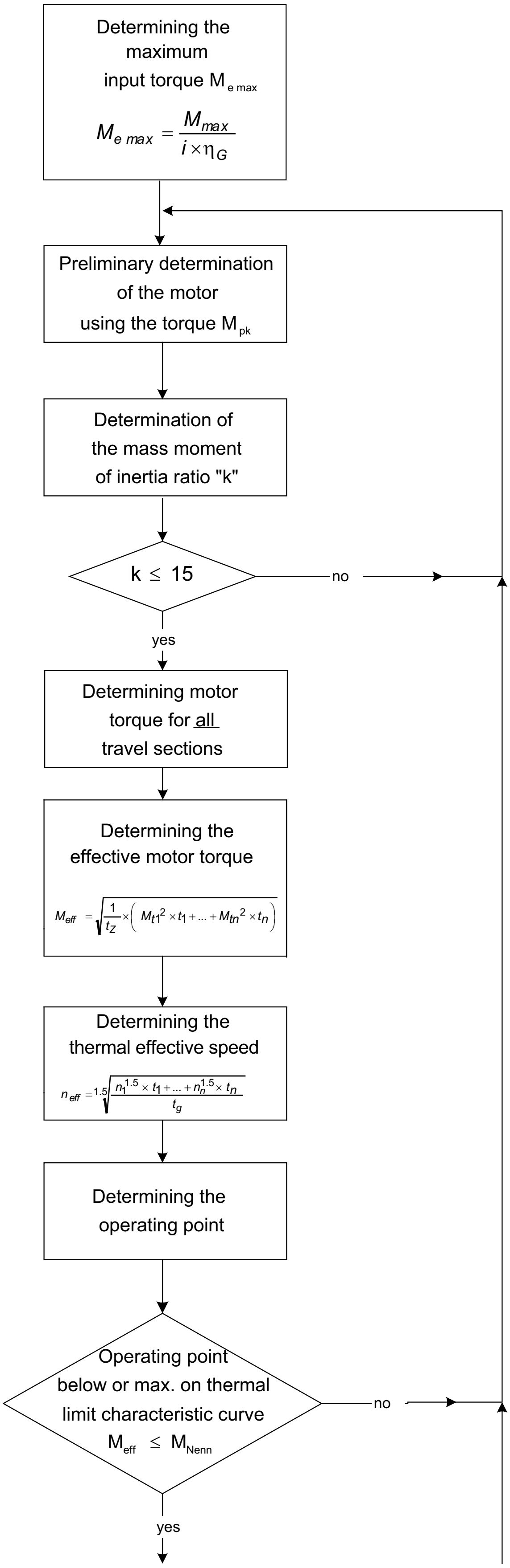
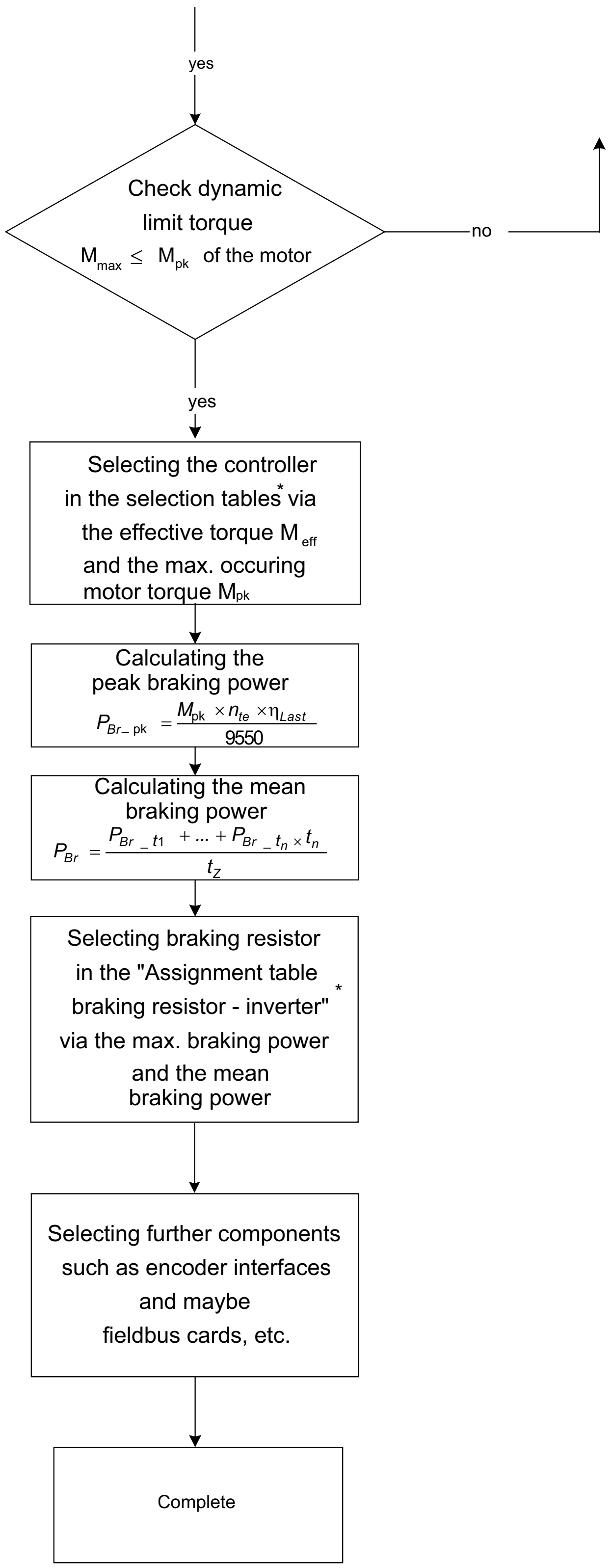
Project planning procedure part 3, servomotors



Project planning procedure part 4, servomotors



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* MOVIDRIVE® system manual, MOVIAXIS® project planning manual

4.4 Project planning notes – R, F, K, S, W gear units

Efficiency of the gear units

General information

The efficiency of gear units is mainly determined by the gearing and bearing friction. Keep in mind that the starting efficiency of a gear unit is always less than its efficiency at operating speed. This factor is especially pronounced in the case of helical-worm and Spiroplan® right-angle gearmotors.

R, F, K gear units

The efficiency of helical, parallel shaft and helical-bevel gear units varies with the number of gear stages, between 96% (3-stage), 97% (2-stage) and 98 % (1-stage).

S and W gear units

The gearing in helical-worm and Spiroplan® gear units produces a high proportion of sliding friction. As a result, these gear units have higher gearing losses than R, F or K gear units and thus be less efficient.

The efficiency depends on the following factors:

- Gear ratio of the helical-worm or Spiroplan® stage
- Input speed
- Gear unit temperature

Helical-worm gear units from SEW-EURODRIVE are helical gear/worm combinations that are significantly more efficient than plain worm gear units.

The efficiency may reach $\eta < 0.5$ if the helical-worm gear stage has a very high gear ratio.

The Spiroplan® gear unit W37 from SEW-EURODRIVE has an efficiency of up to 93%, which drops only slightly even for large gear unit ratios.

Self-locking

Retrodriving torques on helical-worm or Spiroplan® gear units produce an efficiency of $\eta' = 2 - 1/\eta$, which is significantly less favorable than the forward efficiency η. The helical-worm or Spiroplan® gear unit is self-locking if the forward efficiency $\eta \leq 0.5$. Some Spiroplan® gear units are also dynamically self-locking. Contact SEW-EURODRIVE if you wish to make technical use of the braking effect of self-locking characteristics.

NOTE

Note that the self-locking effect of helical-worm and ® gear units is not permitted as the sole safety function for hoists.

Run-in phase

The tooth flanks of new helical-worm and Spiroplan® gear units are not yet completely smooth. That fact makes for a greater friction angle and less efficiency than during later operation. This effect intensifies with increasing gear unit ratio. Subtract the following values from the listed efficiency during the running-in phase:

	Worm	
	i range	**η reduction**
1 start	approx. 50 ... 280	approx. 12 %
2 start	approx. 20 ... 75	approx. 6 %
3 start	approx. 20 ... 90	approx. 3 %
5 start	approx. 6 ... 25	approx. 3 %
6 start	approx. 7 ... 25	approx. 2 %

Spiroplan® W37	
i range	**η reduction**
approx. 30 ... 70	approx. 8 %
approx. 10 ... 30	approx. 5 %
approx. 3 ... 10	approx. 3 %

The run-in phase usually lasts 48 hours. Helical-worm and Spiroplan® gear units achieve their listed rated efficiency values when:

- the gear unit has been completely run-in,
- the gear unit has reached nominal operating temperature,
- the recommended lubricant has been filled in and
- the gear unit is operating in the rated load range.

Churning losses

In certain gear unit mounting positions (→ chapter "Gear Unit Mounting Positions"), the first gearing stage is completely immersed in the lubricant. When the circumferential velocity of the input stage is high, considerable churning losses occur in larger gear units that must be taken into account. Contact SEW-EURODRIVE if you wish to use gear units of this type.

If possible, use mounting position M1 for R, K and S gear units to keep the churning losses low.

Overhung and axial loads

Determining overhung loads

An important factor for determining the resulting overhung load is the type of transmission element mounted to the shaft end. The following transmission element factors f_Z have to be considered for various transmission elements.

Transmission element	Transmission element factor f_Z	Comments
Gears	1.15	< 17 teeth
Chain sprockets	1.40	< 13 teeth
Chain sprockets	1.25	< 20 teeth
Narrow V-belt pulleys	1.75	Influence of the pre-tensioning
Flat belt pulleys	2.50	Influence of the pre-tensioning
Toothed belt pulleys	2.00 - 2.50	Influence of the pre-tensioning
Gear rack pinion, prestressed:	2.00	Influence of the pre-tensioning

Permitted overhung load

The basis for determining the permitted overhung loads is the computation of the rated bearing service life L_{10h} of the anti-friction bearings (according to ISO 281).

For special operating conditions, the permitted overhung loads can be determined with regard to the modified service life L_{na} on request.

NOTE

The values refer to force applied to the center of the shaft end (in right-angle gear units as viewed onto drive end). The values for the force application angle α and direction of rotation are based on the most unfavorable conditions.

NOTE

Reduction of overhung loads

- Only 50 % of the F_{Ramax} and F_{Rapk} values specified in the selection tables are permitted in mounting positions M1 and M3 with wall attachment on the front face for K and S gear units.
- Helical-bevel gearmotors K167 and K187 in mounting positions M1 to M4: A maximum of 50 % of the overhung load F_{Ramax} specified in the selection tables in the case of gear unit mounting other than as shown in the mounting position sheets.
- Foot and flange-mounted helical gearmotors (R..F): A maximum of 50 % of the overhung load F_{Ramax} specified in the selection tables in the case of torque transmission via the flange mounting.

Higher permitted overhung loads

Exactly considering the force application angle α and the direction of rotation makes it possible to achieve a higher overhung load than listed in the selection tables.

Furthermore, higher output shaft loads are permitted if heavy duty bearings are installed, especially with R, F and K gear units.

Contact SEW-EURODRIVE in such cases.

Definition of force application point

Force application is defined according to the following figure:

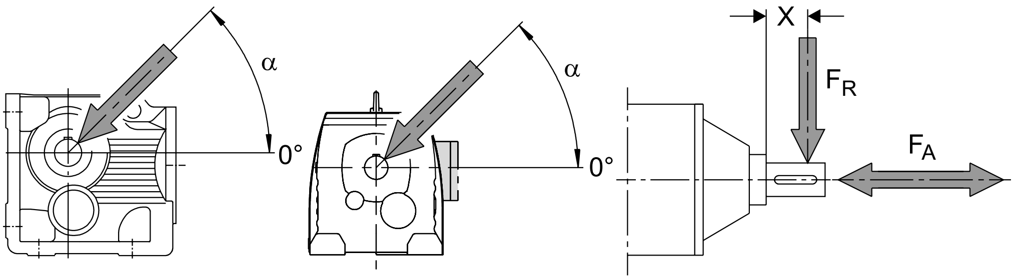

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Figure 2: Definition of force application

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Permitted axial loads

If there is no overhung load, then an axial force F_A (tension or compression) amounting to 50 % of the overhung load given in the selection tables is permitted. This condition applies to the following gearmotors:

- Helical gearmotors except for R..137... to R..167...
- Parallel shaft and helical-bevel gearmotors with solid shaft except for F97...
- Helical-worm gearmotors with solid shaft

	NOTE
	Contact SEW-EURODRIVE for all other types of gear units and in the event of significantly greater axial forces or combinations of overhung load and axial force.

On the output side: Overhung load conversion for off-center force application

The permitted overhung loads F_{Ramax} and F_{Rapk} listed in the data tables apply for force application at l / 2 (solid shaft) or for force application at the shaft end face (hollow shaft). If the distance between the force application point an the gear unit is different, the overhung load must be determined anew using the project planning procedure page 42.

$$F_R \le F_{Ra\max} \cdot \frac{a}{b+x}\ [N] \qquad F_R \le \frac{c}{f+x}\ [N]$$

F_{Ramax} = Permitted overhung load [N]
x = Distance from the shaft shoulder to the force application point in [mm]
a, b, f = Gear unit constant for overhung load conversion [mm]
c = Gear unit constant for overhung load conversion [mm]

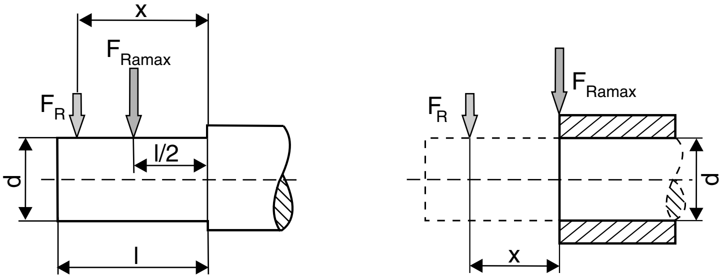

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Figure 3: Overhung load F_R with increased distance x to the gear unit

Gear unit constants for overhung load conversion

Gear unit type	a [mm]	b [mm]	c [Nmm]	f [mm]	d [mm]	l [mm]
RX57	43.5	23.5	1.51×10^5	34.2	20	40
RX67	52.5	27.5	2.42×10^5	39.7	25	50
RX77	60.5	30.5	1.95×10^5	0	30	60
RX87	73.5	33.5	7.69×10^5	48.9	40	80
RX97	86.5	36.5	1.43×10^6	53.9	50	100
RX107	102.5	42.5	2.47×10^6	62.3	60	120
R07	72.0	52.0	4.67×10^4	11	20	40
R17	88.5	68.5	6.527×10^4	17	20	40
R27	106.5	81.5	1.56×10^5	11.8	25	50
R37	118	93	1.24×10^5	0	25	50
R47	137	107	2.44×10^5	15	30	60
R57	147.5	112.5	3.77×10^5	18	35	70
R67	168.5	133.5	2.65×10^5	0	35	70
R77	173.7	133.7	3.97×10^5	0	40	80
R87	216.7	166.7	8.47×10^5	0	50	100
R97	255.5	195.5	1.06×10^6	0	60	120
R107	285.5	215.5	2.06×10^6	0	70	140
R137	343.5	258.5	4.58×10^6	0	90	170
R147	402	297	8.65×10^6	33	110	210
R167	450	345	1.26×10^7	0	120	210
F27	109.5	84.5	1.13×10^5	0	25	50
F37	123.5	98.5	1.07×10^5	0	25	50
F47	153.5	123.5	1.40×10^5	0	30	60
F57	170.7	135.7	2.70×10^5	0	35	70
F67	181.3	141.3	4.12×10^5	0	40	80
F77	215.8	165.8	7.87×10^5	0	50	100
F87	263	203	1.06×10^6	0	60	120
F97	350	280	2.09×10^6	0	70	140
F107	373.5	288.5	4.23×10^6	0	90	170
F127	442.5	337.5	9.45×10^6	0	110	210
F157	512	407	1.05×10^7	0	120	210
K37	123.5	98.5	1.30×10^5	0	25	50
K47	153.5	123.5	1.40×10^5	0	30	60
K57	169.7	134.7	2.70×10^5	0	35	70
K67	181.3	141.3	4.12×10^5	0	40	80
K77	215.8	165.8	7.69×10^5	0	50	100
K87	252	192	1.64×10^6	0	60	120
K97	319	249	2.8×10^6	0	70	140
K107	373.5	288.5	5.53×10^6	0	90	170
K127	443.5	338.5	8.31×10^6	0	110	210
K157	509	404	1.18×10^7	0	120	210
K167	621.5	496.5	1.88×10^7	0	160	250
K187	720.5	560.5	3.04×10^7	0	190	320
W10	84.8	64.8	3.6×10^4	0	16	40
W20	98.5	78.5	4.4×10^4	0	20	40
W30	109.5	89.5	6.0×10^4	0	20	40
W37	121.1	101.1	6.95×10^4	0	20	40
S37	118.5	98.5	6.0×10^4	0	20	40
S47	130	105	1.33×10^5	0	25	50
S57	150	120	2.14×10^5	0	30	60
S67	184	149	3.04×10^5	0	35	70
S77	224	179	5.26×10^5	0	45	90
S87	281.5	221.5	1.68×10^6	0	60	120
S97	326.3	256.3	2.54×10^6	0	70	140

Values for types not listed are available on request.

4.5 Project planning notes – BS.F, PS.F, PS.C gear units

Efficiency of gear units

General information

The efficiency of gear units is mainly determined by the gearing and bearing friction. Keep in mind that the starting efficiency of a gear unit is always less than its efficiency at operating speed.

BS.F gear units

The efficiency of BS.F gear units is up to 94% (2-stage).

PS.F, PS.C gear units

The efficiency of planetary gear units varies with the number of gear stages, between 98 % (2-stage) and 99 % (1-stage).

NOTE

For PS.F gear units with circumferential backlash option "M" used in operating mode S1, please contact SEW-EURODRIVE.

NOTE

When input and output elements are mounted on **servo gear units**, the **shaft shoulder can be used as a stop** for transmission elements (belt pulley, pinion gear, etc.).

Overhung and axial loads

Overhung load calculation

An important factor for determining the resulting overhung load is the type of transmission element mounted to the shaft end. The following transmission element factors f_Z also have to be considered for various transmission elements according to the following formula:

$$f_Z = f_{Z1} \times f_{Z2}$$

Transmission element	Transmission element factor f_{Z1}	Comments
Gears	1.15	< 17 teeth
Chain sprockets	1.40	< 13 teeth
Chain sprockets	1.25	< 20 teeth
Narrow V-belt pulleys	1.75	Influence of the pre-tensioning
Flat belt pulleys	2.50	Influence of the pre-tensioning
Toothed belt pulleys	2.00 - 2.50	Influence of the pre-tensioning
Gear rack pinion, prestressed:	2.00	Influence of the pre-tensioning

NOTE

Factor f_{Z2} only applies to helical output elements.

Helical output elements		
Gear unit	**Helix angle β1) 2)**	**f_{Z2}**
BS.F502-802 PS.F621-922, PSBF321-521 PS.C221 - PS.C622	≤ 11 °	1.00
	20 °	1.20

1) For 11 ° < β < 20 °, f_Z must be interpolated linearly.

2) For helix angles > 20 °, please contact SEW-EURODRIVE.

Permitted overhung load

The basis for determining the permitted overhung loads is the computation of the rated bearing service life L_{H10} of the anti-friction bearings (according to ISO 281).

For special operating conditions, the permitted overhung loads can be determined with regard to the modified bearing service life L_{na} on request.

NOTE

The values refer to force applied to the center of the shaft end (in right-angle gear units as viewed onto drive end). The values for the force application angle α and direction of rotation are based on the most unfavorable conditions.

NOTE

Reduction of overhung loads

- Only 50 % of the F_{Ramax} and F_{Rapk} values specified in the selection tables are permitted in mounting positions M1 and M3 with wall attachment on the front face for BS.F gear units.

Higher permitted overhung loads

Exactly considering the force application angle α and the direction of rotation makes it possible to achieve a higher overhung load than listed in the selection tables.

Contact SEW-EURODRIVE in such cases.

Definition of force application point

Force application is defined according to the following diagram:

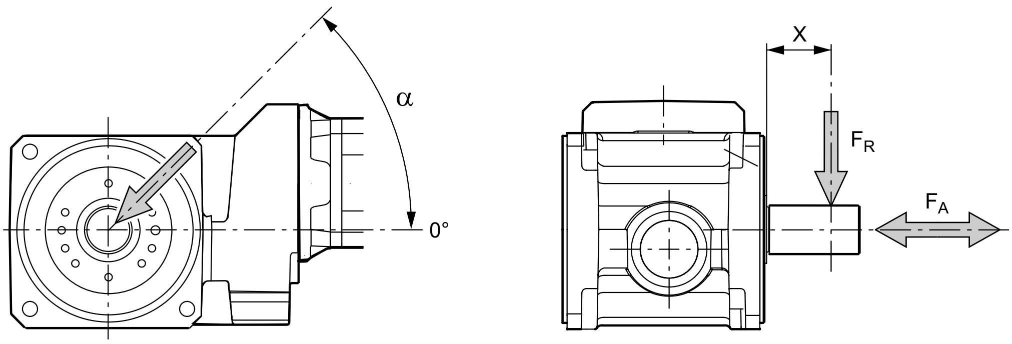

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Figure 4: Definition of force application

Permitted axial loads

If there is no overhung load, then an axial force F_A (tension or compression) amounting to 50 % of the overhung load given in the selection tables is permitted.

Output end: Overhung load conversion for off-center force application

The permitted overhung loads F_{Ramax} and F_{Rapk} listed in the data tables apply for force application at l / 2 (solid shaft) or for force application at the shaft end face (hollow shaft, flange block). If the distance between the force application point an the gear unit is different, the overhung loads must be determined anew according to the project planning procedure page 42 .

$$F_R \leq F_{Ra\max} \cdot \frac{a}{b+x}\ [N] \qquad F_R \leq \frac{c}{f+x}\ [N]$$

F_{Ramax} = Permitted overhung load [N]
x = Distance from the shaft shoulder to the force application point in [mm]
a, b, f = Gear unit constant for overhung load conversion [mm]
c = Gear unit constant for overhung load conversion [mm]

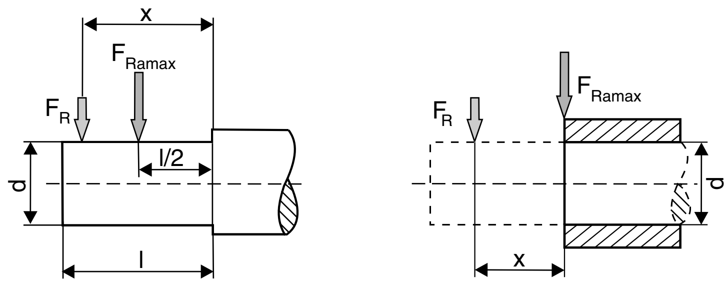

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Figure 5: Overhung load F_R with increased distance x to the gear unit

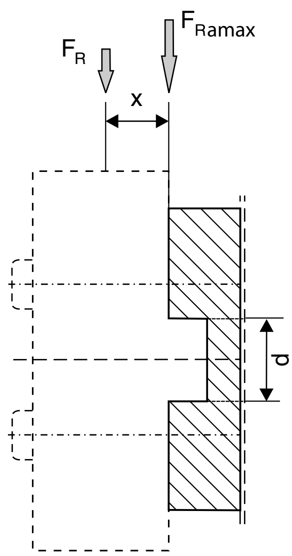

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Figure 6: Overhung load F_R with increased distance x to the gear unit

Gear unit constants for overhung load conversion

Gear unit type	a [mm]	b [mm]	c [Nmm]	f [mm]	d [mm]	l [mm]
BSF / BSKF202	113.1	95.6	7.35×10^4	0	20	35
BSHF / BSAF202	116.6	116.6	8.40×10^4	20	--	--
BSBF202	101.5	101.5	--	--	--	--
BSF / BSKF302	122.6	104.6	8.61×10^4	0	22	36
BSHF / BSAF302	126.6	126.6	1.20×10^5	22	--	--
BSBF302	111.0	111.0	--	--	--	--
BSF / BSKF402	152.2	123.2	2.56×10^5	0	32	58
BSHF / BSAF402	143.7	143.7	3.85×10^5	0	--	--
BSBF402	132.0	132.0	--	--	--	--
BSF / BSKF502	175.4	134.4	4.92×10^5	0	40	82
BSHF / BSAF502	162.4	162.4	4.75×10^5	28	--	--
BSBF502	145.3	145.3	--	--	--	--
BSF / BSKF602	195.9	154.9	9.84×10^5	0	55	82
BSHF / BSAF602	189.9	189.9	9.54×10^5	0	--	--
BSBF602	170.8	170.8	--	--	--	--
BSF / BSKF802	242.7	190.2	1.89×10^6	0	75	105
BSHF / BSAF802	243.2	243.2	2.70×10^6	0	--	--
BSBF802	206.0	206.0	--	--	--	--

Gear unit type	a [mm]	b [mm]	c [Nmm]	f [mm]	d [mm]	l [mm]
PSF / PSKF121/122.	47.6	36.6	2.08×10^4	0	14	22
PSF / PSKF221/222	53.6	39.6	2.41×10^4	0	16	28
PSBF221/222	64.1	64.1	--	--	--	--
PSF / PSKF321/322	65.0	47.0	7.97×10^4	0	22	36
PSBF321/322	72.5	72.5	--	--	--	--
PSF / PSKF521/522	83.1	54.1	2.52×10^5	0	32	58
PSBF521/522	87.5	87.5	--	--	--	--
PSF / PSKF621/622	113.6	72.3	5.48×10^5	0	40	82
PSBF621/622	105.0	105.0	--	--	--	--
PSF / PSKF721/722	126.6	85.6	1.42×10^6	0	55	82
PSBF721/722	138.5	138.5	--	--	--	--
PSF / PSKF821/822	153.2	100.7	3.21×10^6	0	75	105
PSBF821/822	156.0	156.0	--	--	--	--
PSF / PSKF921/922	170.7	105.7	5.30×10^6	0	85	130

Gear unit type	a [mm]	b [mm]	c [Nmm]	f [mm]	d [mm]	l [mm]
PS.C220	57	43	3.41×10^4	0	16	28
PS.C320	63.5	45.5	7.55×10^4	0	22	36
PS.C520	95.5	66.5	2.13×10^4	0	32	58
PS.C620	107.5	66.5	3.68×10^4	0	40	82

4

4.6 Project planning example: Gantry with servo drives

X-axis planning (travel axis)

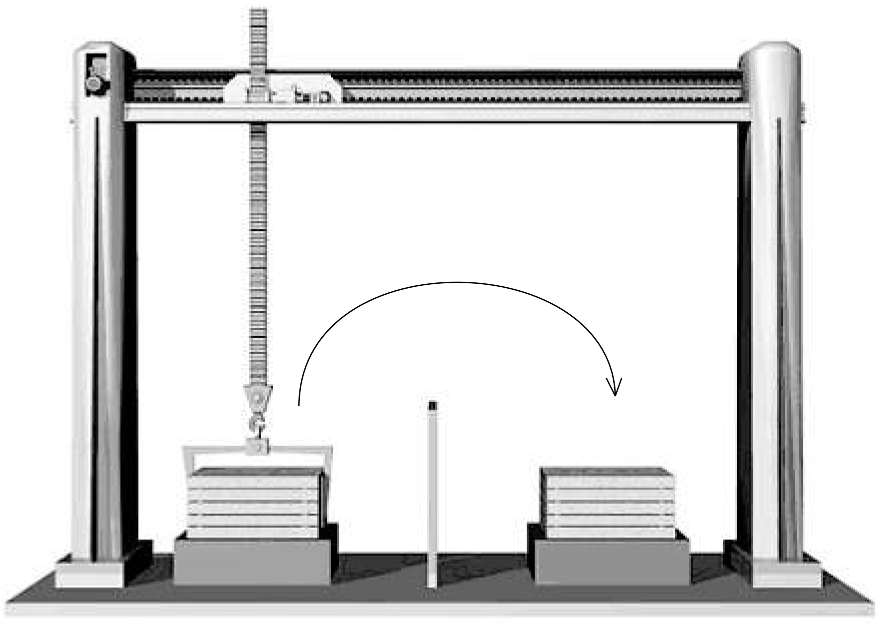

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Figure 7: Project planning example: Gantry with servo drives travel axis

Reference data:

- Total moved mass: m_L = 50 kg
- Diameter of the belt pulley: d_0 = 75 mm
- Friction coefficient of the axis: μ = 0.01
- Traveling velocity: v_{max} = 2 m/s
- Maximum occurring acceleration/deceleration: a_{max} = 10 m/s^2
- Cycle time: t_z = 3 s
- Rest period: t_p = 1.8 s
- Load efficiency: η_L= 0.9
- Mounting position of the gear unit: IM = M1

For the drive, a PC.C gear unit is designed to be mounted directly to a CMP servomotor.

The overhung load is to act on the shaft center.

Power is transmitted via a belt pulley.

Travel sections

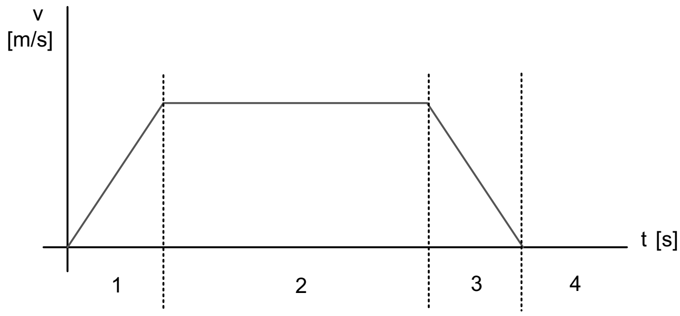

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Figure 8: Travel sections 1 - 4

Acceleration time in travel section 1, deceleration time in travel section 3

$$t_1 = t_3 = \frac{v_{max}}{a_{max}} = \frac{2\ m/s}{10\ m/s^2} = 0.2\,s$$

Travel time for constant travel in travel section 2

$$t_2 = t_z - t_p - t_1 - t_3$$
$$t_2 = 3\,s - 1.8\,s - 0.2\,s - 0$$
$$t_2 = 0.8s$$

M_{stat} for all travel sections

$$M_{stat} = \frac{(m \cdot g \cdot \mu) \cdot \frac{d_0}{2}}{\eta_L}$$
$$M_{stat} = \frac{50kg \cdot 9.81\frac{m}{s^2} \cdot 0.01 \cdot \frac{0.075m}{2}}{0.9}$$
$$M_{stat} = 0.2043Nm$$

M_{dyn} during acceleration in travel section 1

$$M_{dyn} = \frac{(m \cdot a) \cdot \frac{d_0}{2}}{\eta_L}$$
$$M_{dyn} = \frac{50kg \cdot 10\frac{m}{s^2} \cdot \frac{0.075m}{2}}{0,9}$$
$$M_{dyn} = 20.83Nm$$

4

***M*$_{dyn}$ during deceleration in travel section 3**

$$M_{dyn} = m \cdot a \cdot \frac{d_0}{2} \cdot \eta_L$$
$$M_{dyn} = 50kg \cdot (-10\frac{m}{s^2}) \cdot \frac{0.075m}{2} \cdot 0.9$$
$$M_{dyn} = -16.875Nm$$

***M*$_{max}$ during acceleration in travel section 1**

$$M_{max} = M_{stat} + M_{dyn1}$$
$$M_{max} = 0.2043\,Nm + 20.8333Nm$$
$$M_{max} = 21.04Nm$$

***M*$_{max}$ during deceleration in travel section 3**

$$M_{max} = M_{stat} + M_{dyn3}$$
$$M_{max} = 0.2043\,Nm + (-16.87Nm)$$
$$M_{max} = -16.6657Nm$$

Output speed

$$n_{a\max} = \frac{v_{max}}{d_0 \cdot \pi} \cdot 60$$
$$n_{a\max} = \frac{2\frac{m}{s}}{0.075m \cdot \pi} \cdot 60$$
$$n_{a\max} = 506.295\frac{1}{\min}$$

Gear ratio including 10% motor speed reserve

n_N = 4500 1/min is an assumption

$$i = \frac{n_N \cdot 0.9}{n_{a\max}}$$
$$i = \frac{4500\frac{1}{\min} \cdot 0.9}{509.295\frac{1}{\min}}$$
$$i = 7.95$$

Maximum input speed

$$n_{max} = n_{a\,max} \cdot i$$

$$n_{max} = 509.295 \frac{1}{min} \cdot 7$$

$$n_{max} = 3565.065 \frac{1}{min}$$

Servo gear unit project planning

Project planning follows the project planning procedure on page 42 ff.

The gear unit is selected on the basis of the table below:

	i	M_{amax} [Nm]	M_{apk} [Nm]	$M_{aNotaus}$ [Nm]	n_{ak} [rpm]	J_G 10^{-4} kgm^2	c_T PSC [Nm/']	F_{Ra} PSC [N]	F_{Rapk} PSC [N]
PSC221 1	3	29	40	60	1500	0.172	3.46	1170	2000
	5	34	42	63	720	0.0578	3.44	1390	2000
	7	32	**39**	59	800	**0.03**	3.28	1550	2000
	10	30	37	56	700	0.0144	2.92	1750	2000

	i	n_{epk} [rpm]	η [%]	M1;M3;M5-6 a_0	M1;M3;M5-6 a_1	M1;M3;M5-6 a_2	M2 a_0	M2 a_1	M2 a_2	M4 a_0	M4 a_1	M4 a_2	φ [']
PSC221 1	3	7000	99	101.00	-0.093	0	106.00	-0.104	0	109.00	-0.110	0	10
	5	7000	99	160.00	-0.181	0	163.00	-0.190	0	167.00	-0.200	0	10
	7	**7000**	**99**	186.00	-0.257	0	187.00	-0.264	0	186.00	-0.267	0	10
	10	7000	99	158.00	-0.178	0	161.00	-0.184	0	164.00	-0.194	0	10

Selection condition:

$$M_{max} \le M_{apk}$$

$$21.04 Nm \le 39 Nm$$

$$n_{max} \le n_{epk}$$

$$3565 \frac{1}{min} \le 7000 \frac{1}{min}$$

Condition is fulfilled.

Mean output speed

$$n_{am} = \frac{n_1 \cdot t_1 + ... + ...n_n \cdot t_n}{t_1 + ... + ...t_n}$$

$$n_{am} = \frac{\frac{509.295 \frac{1}{\min}}{2} \cdot 0.2s + 509.295 \frac{1}{\min} \cdot 0.8s + \frac{509.295 \frac{1}{\min}}{2} \cdot 0.2s}{0.2s + 0.8s + 0.2s + 1.8s}$$

$$n_{am} = 169.765 \frac{1}{\min}$$

Selection condition:

$$n_{am} \leq n_{ak}$$

$$169.765 \frac{1}{\min} \leq 809 \frac{1}{\min}$$

Condition is fulfilled.

Effective torque of servo gear unit

$$M_{aeff} = \sqrt[8]{\frac{n_1 \cdot t_1 \cdot |M_1|^8 + ... + ...n_n \cdot t_n \cdot |M_n|^8}{n_1 \cdot t_1 + ... + n_n \cdot t_n}}$$

$$M_{aeff} = \sqrt[8]{\frac{\frac{509.295 \frac{1}{\min}}{2} \cdot 0.2s \cdot |21.04Nm|^8 + 509.295 \frac{1}{\min} \cdot 0.8s \cdot |0.2043Nm|^8 + \frac{506.295 \frac{1}{\min}}{2} \cdot 0.2s \cdot |-16.67Nm|^8}{0.2s \cdot 254.64 \frac{1}{\min} + 0.8s \cdot 509.295 \frac{1}{\min} + 0.2s \cdot 254.64 \frac{1}{\min}}}$$

$$M_{aeff} = 16.065Nm$$

Selection condition:

$$M_{aeff} \leq M_{a\max}$$

$$16.065Nm \leq 32Nm$$

Condition is fulfilled.

Thermal torque of servo gear unit

$$M_{ath} = \sqrt[1.2]{\frac{n_1 \cdot t_1 \cdot |M_1|^{1.2} + ... + ... n_n \cdot t_n \cdot |M_n|^{1.2}}{n_1 \cdot t_1 + ... + n_n \cdot t_n}}$$

$$M_{ath} = \sqrt[1,2]{\frac{\frac{509.295 \frac{1}{min}}{2} \cdot 0.2s \cdot |21.04 Nm|^{1.2} + 509.295 \frac{1}{min} \cdot 0.8s \cdot |0.2043 Nm|^{1.2} + \frac{506.295 \frac{1}{min}}{2} \cdot 0.2s \cdot |-16.67 Nm|^{1.2}}{0.2s \cdot 254.64 \frac{1}{min} + 0.8s \cdot 509.295 \frac{1}{min} + 0.2s \cdot 254.64 \frac{1}{min}}}$$

$$M_{ath} = 5.009 Nm$$

Thermal factors for mounting position M1

a_0=186

a_1=-0.257

a_3=0

$$M_{Therm} = a_0 + a_1 \cdot n_{am} + \frac{a_2}{n_{am}^{1.2}}$$

$$M_{Therm} = 186 + (-0.257 \cdot 169.765 \frac{1}{min}) + \frac{0}{169.765^{1,2}}$$

$$M_{Therm} = 142.37 Nm$$

Selection condition:

$$M_{ath} \leq M_{Therm}$$
$$5.035 Nm \leq 142.37 Nm$$

Condition is fulfilled.

Overhung load calculation

For transmission element factors for overhung loads of different transmission elements at the output shaft, refer to page 48 and to 51.

$$F_{R\max} = \frac{M_{\max}}{\frac{d_0}{2}} \cdot f_z$$

$$F_{R\max} = \frac{21.04 Nm}{\frac{0.075 m}{2}} \cdot 2.5$$

$$F_{R\max} = 1402 N$$

The force application point is the center of the output shaft.

Selection condition:

$$F_{R\max} \leq F_{RaPk}$$
$$1402 N \leq 2000 N$$

Condition is fulfilled.

Calculating the bearing force

$$M_{akub} = \sqrt[3]{\frac{n_1 \cdot t_1 \cdot |M_1|^3 + ... + ... n_n \cdot t_n \cdot |M_n|^3}{n_1 \cdot t_1 + ... + n_n \cdot t_n}}$$

$$M_{akub} = \sqrt[3]{\frac{\frac{509.295\frac{1}{min}}{2} \cdot 0.2s \cdot |21.04Nm|^3 + 509.295\frac{1}{min} \cdot 0.8s \cdot |0.2043Nm|^3 + \frac{506.295\frac{1}{min}}{2} \cdot 0.2s \cdot |-16.67Nm|^3}{0.2s \cdot 254.64\frac{1}{min} + 0.8s \cdot 509.295\frac{1}{min} + 0.2s \cdot 254.64\frac{1}{min}}}$$

$$M_{akub} = 11.172\,Nm$$

$$F_{Rkub} = \frac{M_{akub}}{\frac{d_0}{2}} \cdot f_z$$

$$F_{Rkub} = \frac{11.12Nm}{\frac{0.075m}{2}} \cdot 2.5$$

$$F_{Rkub} = 744.8N$$

Selection condition:

$$F_{Rkub} \le F_{R\max}$$
$$744.8N \le 1402N$$

Condition is fulfilled.

Load torques in travel sections 1 to 3

Travel section 1

$$M_{e\max 1} = \frac{M_{dyn1}}{i \cdot \eta_G}$$

$$M_{e\max 1} = \frac{21.04Nm}{7 \cdot 0.99}$$

$$M_{e\max 1} = 3.036Nm$$

Travel section 2

$$M_{e\max 2} = \frac{M_{stat}}{i \cdot \eta_G}$$

$$M_{e\max 2} = \frac{0.2043Nm}{7 \cdot 0.99}$$

$$M_{e\max 2} = 0.0294Nm$$

Travel section 3

$$M_{e\max 3} = \frac{M_{dyn3} \cdot \eta_G}{i}$$

$$M_{e\max 3} = \frac{-16.67Nm \cdot 0.99}{7}$$

$$M_{e\max 3} = -2.357Nm$$

Motor selection Preliminary determination of motor using torque M_{pk}.

n_N	Motor	M_0	I_0	M_{pk}	I_{max}	M_{0VR}	I_{0VR}	J_{mot}	J_{bmot}	M_{B1}	M_{B2}	L_1	R_1	U_{p0} cold
[min^{-1}]		[Nm]	[A]	[Nm]	[A]	[Nm]	[A]	[$kgcm^2$]		[Nm]		[mH]	Ω	[V]
4500	CMP40S	0.5	1.2	1.9	6.1	-	-	0.1	0.13	0.85	--	23	11.94	27.5
	CMP40M	0.8	0.95	3.8	6.0	-	-	0.15	0.18	0.95	--	45.5	19.92	56
	CMP50S	1.3	1.32	5.2	7.0	1.7	1.7	0.42	0.48	3.1	4.3	37	11.6	62
	CMP50M	2.4	2.3	10.3	13.1	3.5	3.35	0.67	0.73	4.3	3.1	20.5	5.29	66
	CMP50L	3.3	3.15	15.4	19.5	4.8	4.6	0.92	0.99	4.3	3.1	14.6	3.56	68
	CMP63S	2.9	3.05	11.1	18.3	4	4.2	1.15	1.49	7	9.3	18.3	3.34	64
	CMP63M	5.3	5.4	21.4	32.4	7.5	7.6	1.92	2.26	9.3	7	9.8	1.49	67
	CMP63L	7.1	6.9	30.4	41.4	10.3	10	2.69	3.03	9.3	7	7.2	1.07	71

Selected motor:
CMP63M
M_{pk}= 21.4 Nm
J_{mot}= 1.92 × 10^{-4} kgm^2

Determining the inertia ratio "k"

$$J_{ext} = 91.2 \cdot m \cdot \left(\frac{v_{max}}{n_{max}}\right)^2 + J_G$$

$$J_{ext} = 91.2 \cdot 50kg \cdot \frac{\left(2\frac{m}{s}\right)^2}{3565.065\frac{1}{\min}} + 0.03 \cdot 10^{-4} kgm^2$$

$$J_{ext} = 14.38125 \cdot 10^{-4} kgm^2$$

J_{ext} is thus in relation to the motor shaft.

$$k = \frac{J_{ext}}{J_{Motor}}$$

$$k = \frac{14.38125 \cdot 10^{-4} kgm^2}{1.92 \cdot 10^{-4} kgm^2}$$

$$k = 7.49$$

Selection condition:

$$k \leq 15$$

$$7.49 \leq 15$$

Condition is fulfilled.

Intrinsic acceleration or deceleration of motor in sections 1 and 3

$$M_{Eigen} = (J_G + J_{Mot}) \cdot \frac{n_{max}}{9.55 \cdot t}$$

$$M_{Eigen} = \left(0.03 \cdot 10^{-4}\,kgm^2 + 1.92 \cdot 10^{-4}\,kgm^2\right) \cdot \frac{3565.065 \frac{1}{\min}}{9.55 \cdot 0.2s}$$

$$M_{Eigen} = 0.3639\,Nm$$

Maximum motor torques in sections 1 and 3

Travel section 1

$$M_{t1} = M_{e\max 1} + M_{Eigen}$$

$$M_{t1} = 3.036\,Nm + 0.3639\,Nm$$

$$M_{t1} = 3.3999\,Nm$$

Travel section 2

$$M_{t3} = M_{e\max 3} + M_{Eigen}$$

$$M_{t3} = -2.357\,Nm + 0.3639\,Nm$$

$$M_{t3} = -1.9931\,Nm$$

Effective motor torque

$$M_{eff} = \sqrt{\frac{1}{t_z}\left(M_{t1}^2 \cdot t_1 + ... + M_{tn}^2 \cdot t_n\right)}$$

$$M_{eff} = \sqrt{\frac{(3.399\,Nm)^2 \cdot 0.2s + (0.0294\,Nm)^2 \cdot 0.8\,s + (-1.9931\,Nm)^2 \cdot 0.2\,s}{3s}}$$

$$M_{eff} = 1.0174\,Nm$$

Thermal effective motor speed

$$n_{eff} = \sqrt[1.5]{\frac{n_1^{1.5} \cdot t_1 + ... + n_n^{1.5} \cdot t_n}{t_g}}$$

$$n_{eff} = \sqrt[1.5]{\frac{\left(\frac{3565.065 \frac{1}{\min}}{2}\right)^{1.5} \cdot 0.2s + \left(3565.065 \frac{1}{\min}\right)^{1.5} \cdot 0.8s + \left(\frac{3565.065 \frac{1}{\min}}{2}\right)^{1.5} \cdot 0.2s}{3s}}$$

$$n_{eff} = 1646.3 \frac{1}{\min}$$

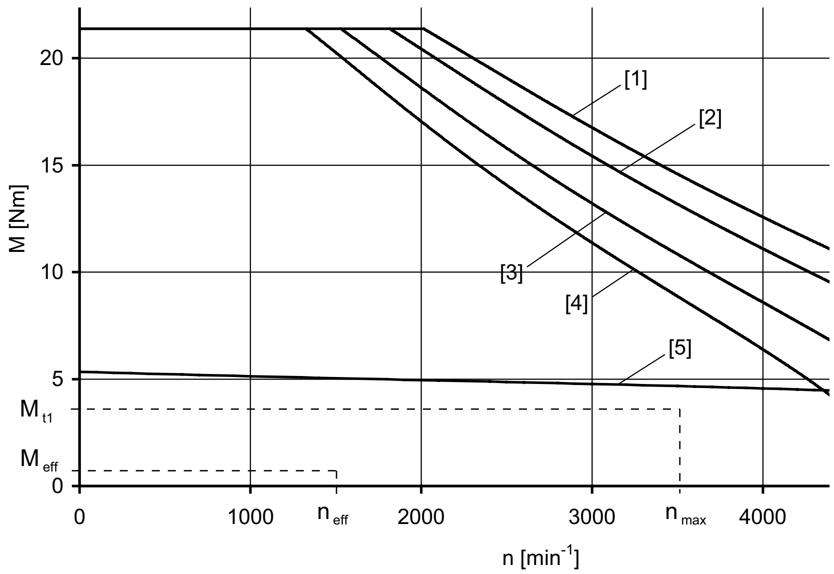
Determining the dynamic and thermal motor operating points

- The thermal operating point must be below or exactly on the thermal limit characteristic curve:

$$M_{eff} \leq M_{Nenn}$$

- The dynamic limit torque must be checked:

$$M_{\max Mot} \leq M_{pk}$$



[1] $M_{dynamic}$ (n) 500 V

[2] $M_{dynamic}$ (n) 460 V

[3] $M_{dynamic}$ (n) 400 V

[4] $M_{dynamic}$ (n) 360 V

[5] M $S1_{thermal}$ (derating)

Inverter assignment

The inverter assignment of CMP servomotors to MOVIAXIS® and MOVIDRIVE® can be found in the "CMP40/50/63 Synchronous Servomotors" catalog.

Calculating the braking resistor

Peak braking power in travel section 3

$$P_{Br\_pk} = \frac{M_{tn} \cdot n_{tn} \cdot \eta_{Last}}{9550}$$

$$P_{Br\_pk} = \frac{1.9931Nm \cdot 3565\frac{1}{\min} \cdot 0.9}{9550}$$

$$P_{Br\_pk} = 0.6696kW$$

Mean braking power in travel section 3

$$P_{Br} = \frac{M_{tn} \cdot n_{tn} \cdot \eta_{Last}}{9550}$$

$$P_{Br} = \frac{1.9931Nm \cdot \frac{3565\frac{1}{\min}}{2} \cdot 0.9}{9550}$$

$$P_{Br} = 0.3348kW$$

Effective braking power

$$P_{Br\_eff} = \frac{P_{Br} \cdot t_3}{t_g}$$

$$P_{Br\_eff} = \frac{0.3348kW \cdot 0.2s}{3s}$$

$$P_{Br\_eff} = 0.223kW$$

The selection of the braking resistor depends, among other factors, on which braking resistor may be connected to the respective inverter. If you use a MOVIDRIVE® inverter, refer to the system manual for relevant notes.

If you use a MOVIAXIS® servo inverter, a suitable braking resistor must be determined using "SEW Workbench".