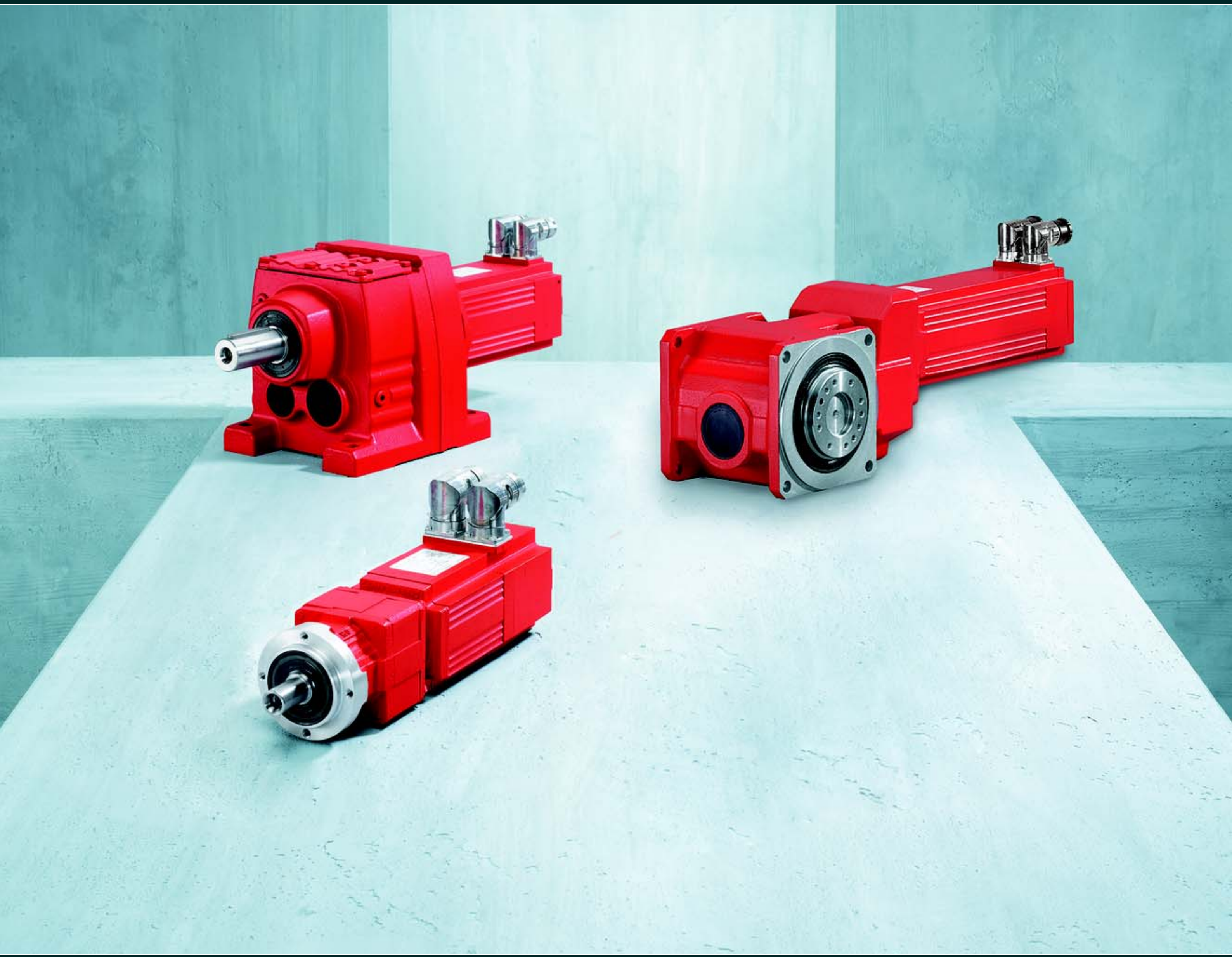
Drive Technology \ Drive Automation \ System Integration \ Services

SEW EURODRIVE

Catalog



Synchronous Servo Gearmotors
CMP40 – 100 Servomotors
with R, F, K, S, W, BS.F, PS.F, PS.C Gear Units

Edition 05/2010

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1 Introduction

1.1 The SEW-EURODRIVE Group of Companies

Global presence

Driving the world with innovative drive solutions for all branches and 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.

We are represented in the most important branches of industry all over the world: with 13 manufacturing plants, 67 assembly plants in 47 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 powered by MOVITRAC® frequency inverters, MOVIDRIVE® inverters and MOVIAXIS® multi-axis servo inverters, a combination that blends perfectly with the existing SEW-EURODRIVE program. As in the case for mechanical systems, the development, production and assembly is also carried out completely by SEW-EURODRIVE. In combination with our drive electronics, these drives 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 inverters 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 hybrid cables have been designed specifically to ensure cost-effective solutions, independent of the philosophy behind or the size of the system. The latest developments from SEW-EURODRIVE: 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 high torque levels, industrial gear units from SEW-EURODRIVE realize major movements. The modular concept will once again provide optimum adaptation of industrial gear units to meet a wide range of different 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 branches of industries and applications.

1.2 Products and systems from SEW-EURODRIVE

The products and systems from SEW-EURODRIVE are divided into 4 product groups. These 4 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 • EMS drives • 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 brakemotors • 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 gear-motors	**Servomotors**	**Servo drive inverters/servo inverters**
• Low backlash planetary servo gear units/planetary gear-motors • Low backlash helical-bevel servo gear units/helical-bevel gearmotors • R, F, K, S, W gear units/gear-motors • Explosion-proof servo gear units/servo gearmotors	• Asynchronous servo-motors/servo brakemotors • Synchronous servo-motors/servo brakemotors • Explosion-proof servo-motors/servo brakemotors • Synchronous linear motors	• MOVIDRIVE® servo inverters • MOVIAXIS® multi-axis servo inverters • 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/brake-motors 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® gear-motors	• Fieldbus interfaces • Field distributors for decentralized installation • MOVIFIT® product range – MOVIFIT® MC to control 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 consumption – 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 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 homepage at

→ **www.sew-eurodrive.com**

The website provides comprehensive 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 CMP synchronous servomotors mounted directly to
  - R, F, K, S, W gear units
  - BS.F gear units
  - PS.F gear units
  - PS.C gear units

The descriptions include:

- Product descriptions
- Overview of types
- 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 "Synchronous Servomotors" catalog/price catalog.

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

For information on the combination of CFM servomotors with the above mentioned gear units, refer to the catalog/price catalog "Synchronous Servo Gearmotors", edition 04/2008.

Additional documentation

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

- "Synchronous Servomotors" catalog/price catalog
- "AC Motors" price catalog/catalog
- "Gear Units" price catalog/catalog
- "Servo Gear Units" price catalog/catalog
- "AC Motors Inverter Assignments and Characteristic Curves" manual

These price catalogs and catalogs offer the following information:

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

1.4 Product names and trademarks

The brands and product names in this catalog are trademarks or registered trademarks of the titleholders.

1.5 Copyright notice

2 Product Description of Gear Units and Gearmotors

2.1 General information

2

Coating

The gear units, synchronous servomotors and servo gearmotors from SEW-EURODRIVE are painted 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	

Special paints 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 type and gear unit size. The lubricant fill depends on the mounting position which means 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. SEW-EURODRIVE brakes can be divided into two types:

- 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.

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 brakes can also be controlled directly by a suitable inverter or servo inverter, such as MOVIAXIS®.

A characteristic feature of the brakes is their extremely 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 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 KS corrosion protection and surface OS protection.

Special optional protective measures for the output shafts are also available.

KS corrosion protection

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.

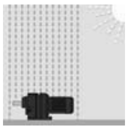
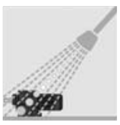
INFORMATION

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

2

OS surface protection

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

Surface protection[1)]		**Ambient conditions**	**Sample applications**
Standard		Suitable for machines and systems in buildings and rooms indoors with neutral atmospheres. According to corrosivity category [2)]: • C1 (negligible)	• Machines and systems in the automobile industry • Transport systems in logistics • Conveyor belts at airports
OS1		Suited for environments prone to condensation and atmospheres with low humidity or contamination, such as applications outdoors under roof or with protection. According to corrosivity category [2)]: • C2 (low)	• Systems in saw mills • Hall gates • Agitators and mixers
OS2		Suitable for environments with high humidity or mean atmospheric contamination, such as applications outdoors subject to direct weathering. According to corrosivity category [2)]: • C3 (moderate)	• Applications in amusement parks • Funiculars and chair-lifts • Applications in gravel plants • Systems in nuclear power plants
OS3		Suitable for environments with high humidity and occasionally severe atmospheric and chemical contamination. Occasionally acidic or caustic wet cleaning. Also for applications in coastal areas with moderate salt load. According to corrosivity category [2)]: • C4 (high)	• Sewage treatment plants • Port cranes • Mining applications
OS4		Suitable for environments with permanent humidity or severe atmospheric or chemical contamination. Regular acidic and caustic wet cleaning also with chemical cleaning agents. According to corrosivity category [2)]: • C5-1 (very high)	• Drives in malting plants • Wet areas in the beverage industry • Conveyor belts in the food industry

1) Motors/brakemotors in degree of protection IP56 or IP66 are only available with OS2, OS3, or OS4 surface protection

2) To DIN EN ISO 12944-2 classification of ambient conditions

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 can help prevent contact corrosion and makes it easier to disassemble the drive at a later time.

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 order larger quantities of NOCO® fluid from SEW-EURODRIVE.

NOCO® fluid is a food grade substance 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 of R, F, K, S, W gear units

Type

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 anti-corrosion agent is only effective in a temperature range of -25 °C to +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

INFORMATION

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

At the factory, the gear units are filled with oil to the appropriate level depending on the specified mounting position (M1 to M6). 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.	Under 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	Roofed, enclosed at constant temperature and atmospheric humidity (5 °C < ϑ < 60°C, < 50% relative 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	Roofed, enclosed at constant temperature and atmospheric humidity (5 °C < ϑ < 50°C, < 50% relative 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 to +40 °C
Helical-worm gear units	CLP(CC) VG680	0 °C to +40 °C
SPIROPLAN® gear units	CLP(SEW-PG) VG460	-10 °C to +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 up to -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 100 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.

Speeds

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.

Noise levels

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 type and gear unit size. The lubricant fill depends on the mounting position which means 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. For further information, refer to section "Reduced backlash gear units" on page 109.

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.

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 and light.

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

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 SPRIOPLAN® W..37 in mounting position M4) makes any position possible for SPRIOPLAN® right-angle gearmotors without altering the quantity of oil. Identical hole spacing in the foot and face, as well as the equal shaft height to both, provides you with diverse mounting options.

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

Input components

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 disk 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.

Noise levels

The noise levels of all SEW servo gearmotors 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/geared 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

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.

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 sheets for standard versions are applicable.

Extensive ratio range with fine graduation

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, long service life 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 rolling 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.

2.6 Explosion protection according to ATEX

Validity

EU directive 94/9/EC or ATEX lays down new regulations for explosion protection in all types of devices for the European market. This directive applies to gearmotors and motors as well. Since July 1, 2003, EU directive 94/9/EC has been applicable without restrictions to the use of gearmotors and motors within the European Union. Other European countries, such as Switzerland, have fallen in with this regulation since.

Scope

SEW-EURODRIVE now only supplies explosion-proof gear units in accordance with the corresponding ATEX directive. This also applies to options and accessories in explosion-proof design.

Depending on their features and dimensions, explosion-proof gear units are suitable for:

- Potentially explosive gas atmosphere, zone 1 or 2.
- Potentially explosive dust atmosphere, zone 21 or 22.

SEW-EURODRIVE offers gearmotors and motors of categories

- II2G
- II2D
- II3GD
- II3D

for use in zones 1, 21, 2 and 22.

Stand-alone gear units with components on the input side are available in the following categories:

- Gear units with adapters AQA, EBH, and EPH for use in zones 1, 21, 2 and 22
  - II2GD

Adapters AQH according to ATEX directive are not available.

Other documentation

The "Explosion-Proof Drives to EU Directive 94/9/EC" system description and the volume of the same name in the "Drive Engineering – Practical Implementation" series provide you with basic information about this topic.

Please refer to the "Explosion-Proof Drives" catalog and the "Variable Speed Gear-motors" catalog for detailed information on explosion-proof products from SEW-EURODRIVE.

3 Overview of Types and Unit Designation

3.1 Types and options of R, F, K, S, W gear units

Below an overview of unit designations for R, F, K, S, and W gear units and their options.

Helical gear units

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

Parallel shaft helical gear units

Designation	
F..	Foot-mounted type
FA..B	Foot-mounted, hollow shaft
FH..B	Foot-mounted, hollow shaft with shrink disk
FV..B	Foot-mounted, hollow shaft with splined hollow shaft to DIN 5480
FF..	B5 flange-mounted type
FAF..	B5 flange-mounted type and hollow shaft
FHF..	B5 flange-mounted type and hollow shaft with shrink disk
FVF..	B5 flange-mounted type 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 splining to DIN 5480
FAZ..	B14 flange-mounted type and hollow shaft
FHZ..	B14 flange-mounted type and hollow shaft with shrink disk
FVZ..	B14 flange-mounted type and hollow shaft with splined hollow shaft to DIN 5480

Helical-bevel gear units

Designation	
K..	Foot-mounted
KA..B	Foot-mounted, hollow shaft
KH..B	Foot-mounted, hollow shaft with shrink disk
KV..B	Foot-mounted, hollow shaft with splined hollow shaft to DIN 5480
KF..	B5 flange-mounted
KAF..	B5 flange-mounted type and hollow shaft
KHF..	B5 flange-mounted type and hollow shaft with shrink disk
KVF..	B5 flange-mounted type 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 splining to DIN 5480
KAZ..	B14 flange-mounted type and hollow shaft
KHZ..	B14 flange-mounted type and hollow shaft with shrink disk
KVZ..	B14 flange-mounted type and hollow shaft with splined hollow shaft to DIN 5480

Helical-worm gear unit

Designation	
S..	Foot-mounted
SF..	B5 flange-mounted
SAF..	B5 flange-mounted type and hollow shaft
SHF..	B5 flange-mounted type 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 type and hollow shaft
SHZ..	B14 flange-mounted type and hollow shaft with shrink disk

SPIROPLAN® gear units

Designation	
W..	Foot-mounted
WF..	Flange-mounted type
WAF..	Flange-mounted type and hollow shaft
WA..	Hollow shaft
WA..B	Foot-mounted, hollow shaft
WH..B	Foot-mounted, hollow shaft with shrink disk
WHF..	Flange-mounted, hollow shaft with shrink disk
WH..	Hollow shaft with shrink disk
WT..	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

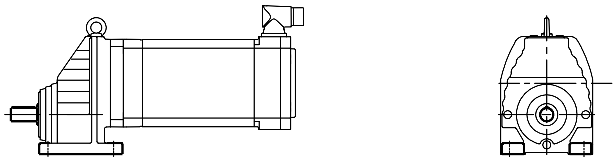
Designation	Option
/DUO	Diagnostic Unit Oil = Oil aging sensor
/DUV	Diagnostic Unit Vibration = Vibration sensor

INFORMATION

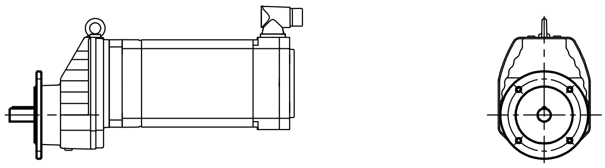
The types described in this section refer to CMP gearmotors from SEW-EURODRIVE. They also apply to gear units without motors.

Helical gearmotors

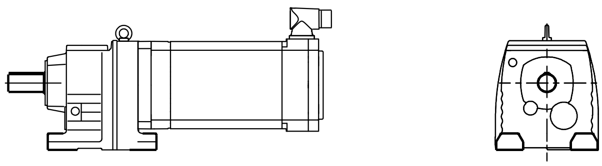
The following types of helical gearmotors are available:



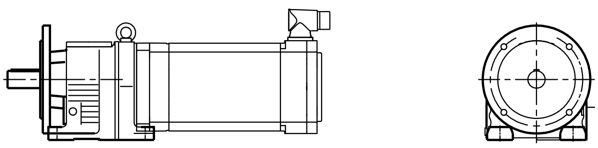
RX.. CMP..
Foot-mounted single stage helical gear unit



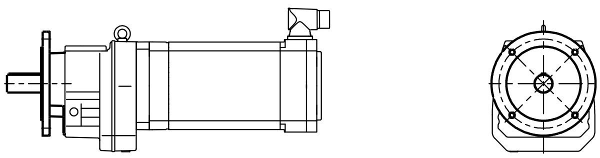
RXF.. CMP..
Single-stage helical gearmotor in B5 flange-mounted design



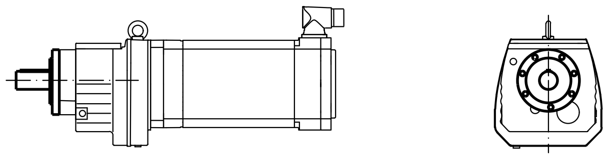
R.. CMP..
Foot-mounted helical gearmotor



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



RF.. CMP..
B5 flange-mounted helical gearmotor



RZ.. CMP..
B14 flange-mounted helical gearmotor

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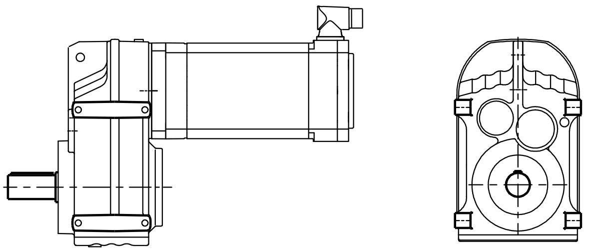
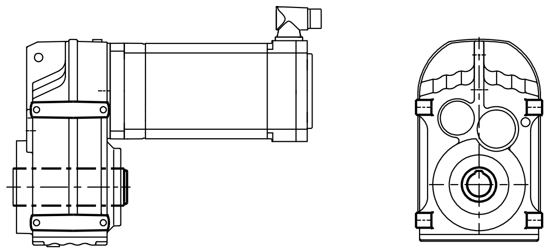
Parallel shaft helical gearmotors

The following types of parallel shaft helical gearmotors is available:

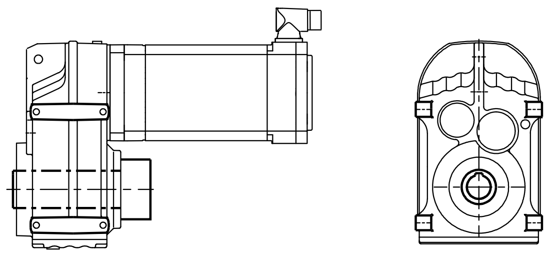


F.. CMP..
Foot-mounted parallel shaft helical gearmotor

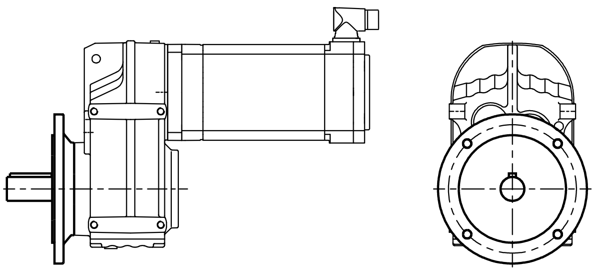


FA..B CMP..
Foot-mounted parallel shaft helical gearmotor with hollow shaft

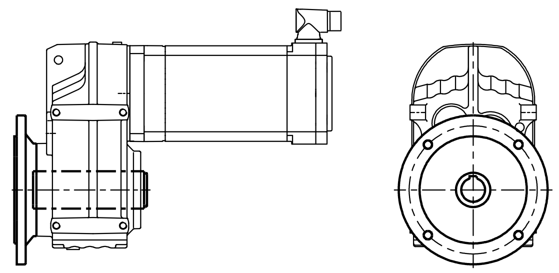
FV..B CMP..
Foot-mounted parallel shaft gearmotor with hollow shaft and splining according to DIN 5480



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



FF.. CMP..
B5 flange-mounted parallel shaft helical gearmotor



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

FVF.. CMP..
Parallel shaft helical gearmotor in B5 flange-mounted design with hollow shaft and splining according to DIN 5480

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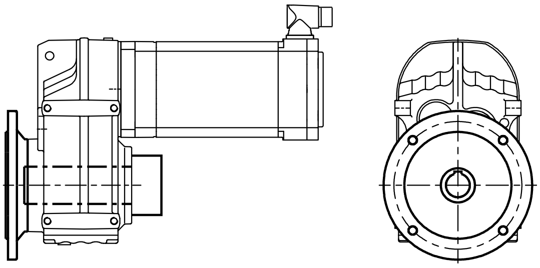
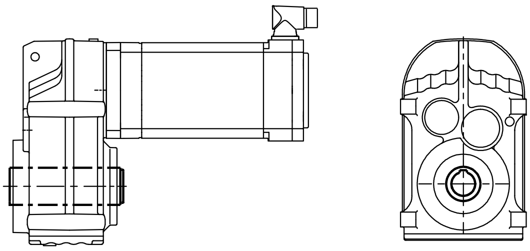
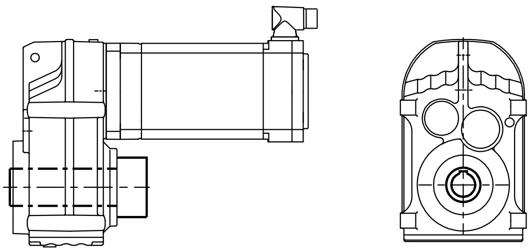


FHF.. CMP..
B5 flange-mounted parallel shaft helical gearmotor with hollow shaft and shrink disk



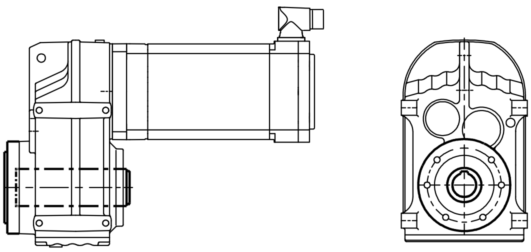
FA.. CMP..
Parallel shaft helical gearmotor with hollow shaft

FV.. CMP..
Parallel shaft helical gearmotor with hollow shaft and splining according to DIN 5480



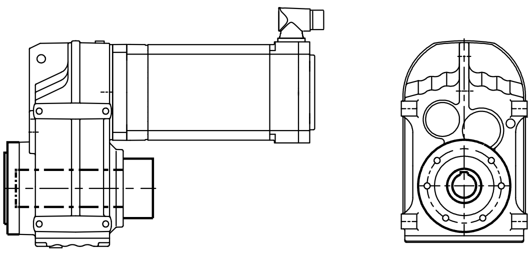
FH.. CMP..
Parallel shaft helical gearmotor with hollow shaft and shrink disk

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



FAZ.. CMP..
B14 flange-mounted parallel shaft helical gearmotor with hollow shaft

FVZ.. CMP..
B14 flange-mounted parallel shaft helical gearmotor in B14 with hollow shaft and splining according to DIN 5480



FHZ.. CMP..
B14 flange-mounted parallel shaft helical gearmotor with hollow shaft and shrink disk

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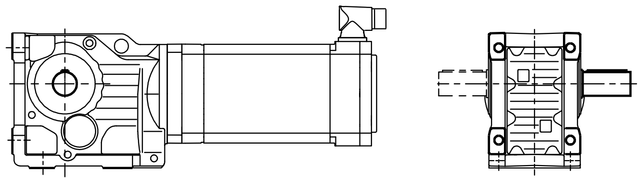
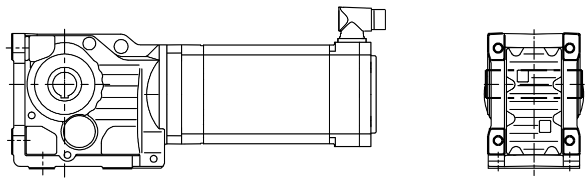
Helical-bevel gearmotors

The following types of helical-bevel gearmotors are available:

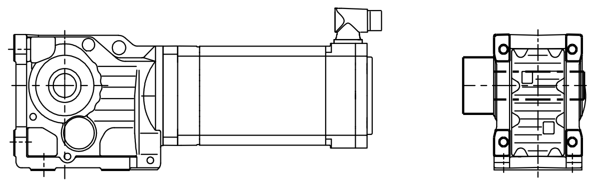


K.. CMP..
Foot-mounted helical-bevel gearmotor

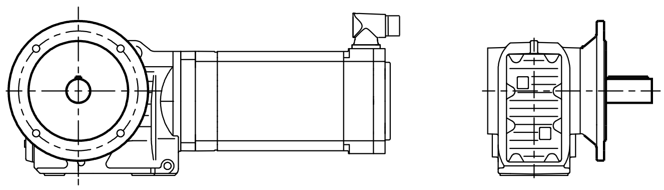


KA..B CMP..
Foot-mounted helical-bevel gearmotor with hollow shaft

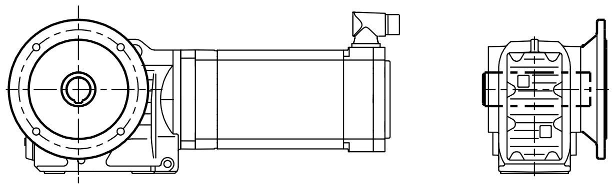
KV..B CMP..
Foot-mounted helical-bevel gearmotor with hollow shaft and splining according to DIN 5480



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



KF.. CMP..
B5 flange-mounted helical-bevel gearmotor



KAF.. CMP..
B5 flange-mounted helical-bevel gearmotor with hollow shaft

KVF.. CMP..
B5 flange-mounted helical-bevel gearmotor with hollow shaft and splined hollow shaft to DIN 5480

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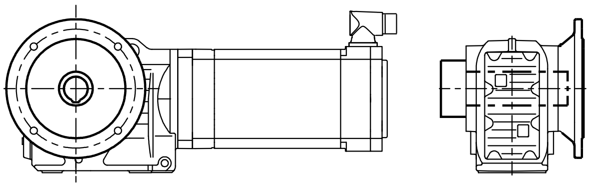
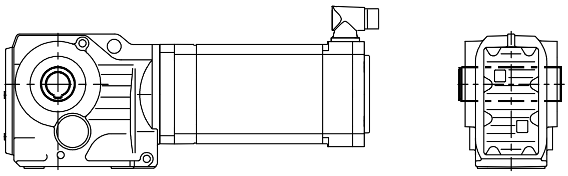
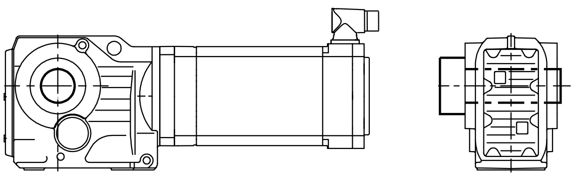


KHF.. CMP..
B5 flange-mounted helical-bevel gearmotor with hollow shaft and shrink disk



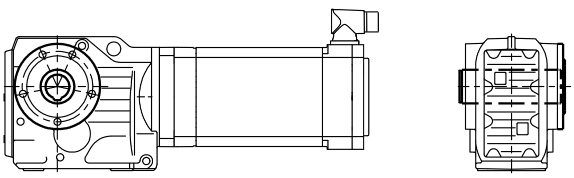
KA.. CMP..
Helical-bevel gearmotor with hollow shaft

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



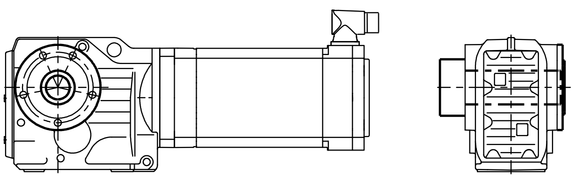
KH.. CMP..
Helical-bevel gearmotor with hollow shaft and shrink disk

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



KAZ.. CMP..
B14 flange-mounted helical-bevel gearmotor with hollow shaft

KVZ.. CMP..
B14 flange-mounted helical-bevel gearmotor with hollow shaft and splined hollow shaft to DIN 5480



KHZ.. CMP..
B14 flange-mounted helical-bevel gearmotor with hollow shaft and shrink disk

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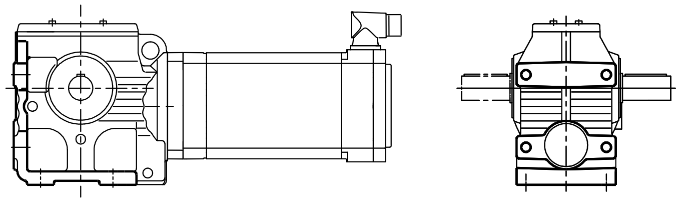
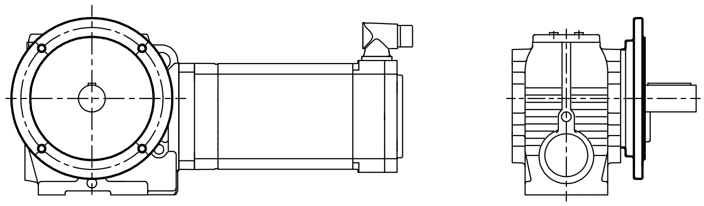
Helical-worm gearmotors

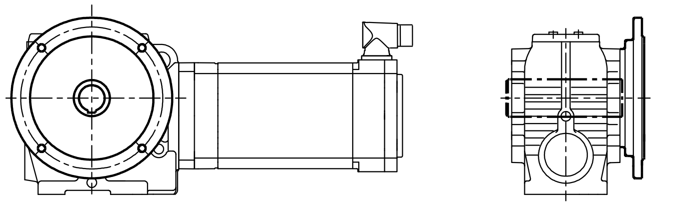
The following types of helical-worm gearmotors are available:



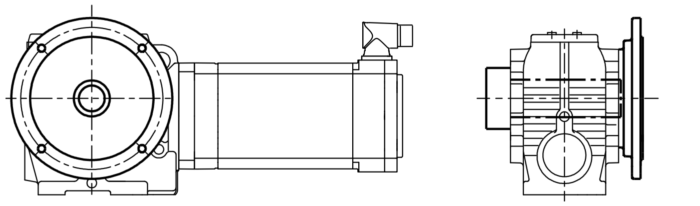
S.. CMP..
Foot-mounted helical-worm gearmotor



SF.. CMP..
B5 flange-mounted helical-worm gearmotor



SAF.. CMP..
B5 flange-mounted helical-worm gearmotor with hollow shaft



SHF.. CMP..
B5 flange-mounted helical-worm gearmotor with hollow shaft and shrink disk

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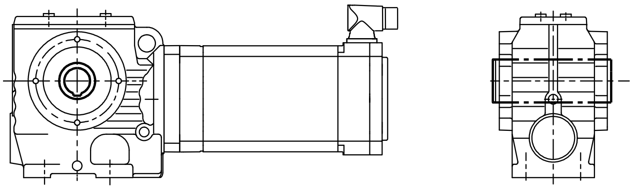
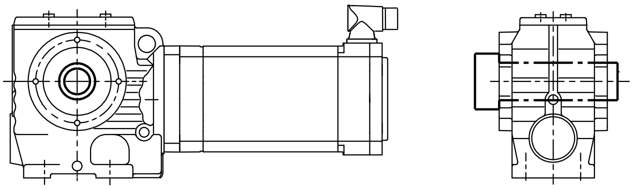
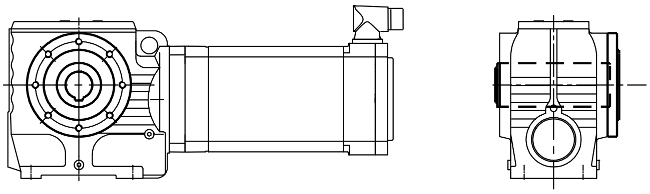


SA.. CMP..
Helical-worm gearmotor with hollow shaft

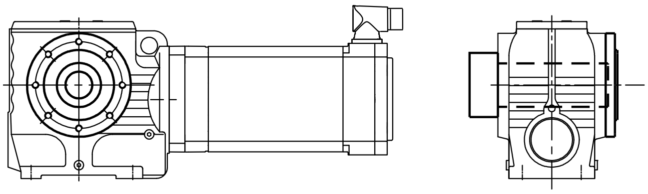


SH.. CMP..
Helical-worm gearmotor with hollow shaft and shrink disk

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



SAZ.. CMP..
B14 flange-mounted helical-worm gearmotor with hollow shaft



SHZ.. CMP..
B14 flange-mounted helical-worm gearmotor with hollow shaft and shrink disk

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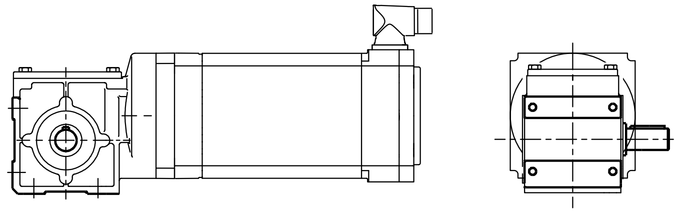
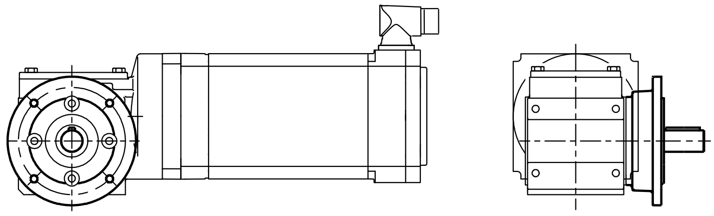
SPIROPLAN® gearmotors

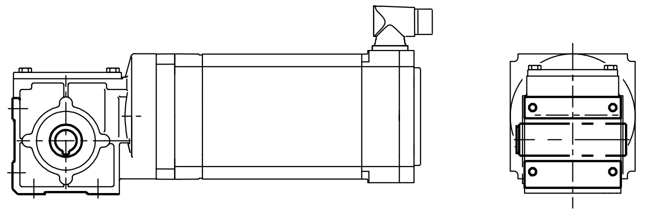
The following types of SPIROPLAN® gearmotors are available:



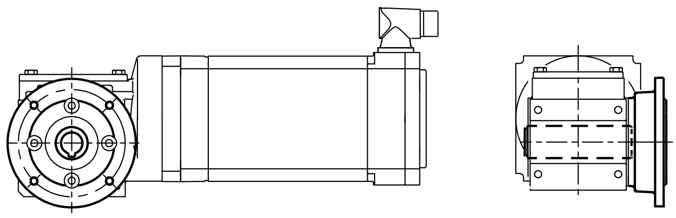
W.. CMP..
Foot-mounted SPRIOPLAN® gearmotor



WF.. CMP..
Flange-mounted SPIROPLAN® gearmotor



WA.. CMP..
SPIROPLAN® gearmotor with hollow shaft



WAF.. CMP..
Flange-mounted SPIROPLAN® gearmotor with hollow shaft

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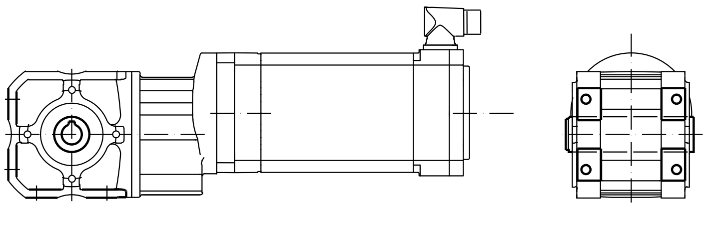
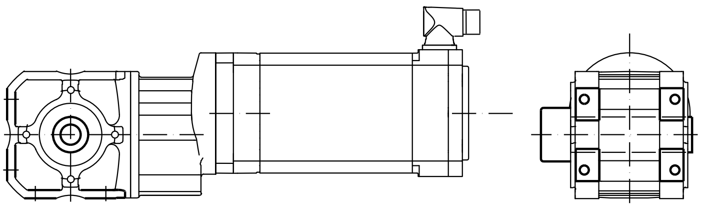
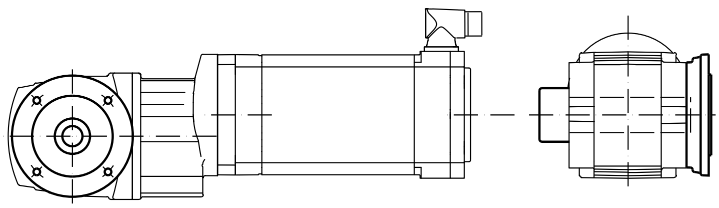


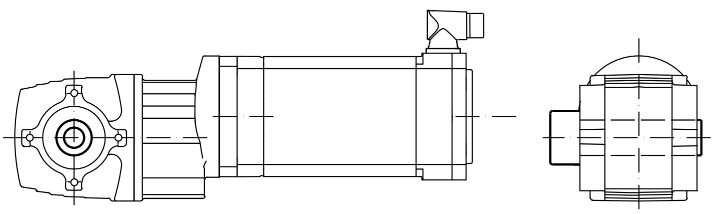
WA..B CMP..
Foot-mounted SPIROPLAN® gearmotor with hollow shaft



WH..B CMP..
Foot-mounted SPIROPLAN® gearmotor with hollow shaft and shrink disk



WHF.. CMP..
Flange-mounted SPIROPLAN® gearmotor with hollow shaft and shrink disk



WH.. CMP..
SPIROPLAN® gearmotor with hollow shaft and shrink disk

WT.. CMP..
SPIROPLAN® gearmotor with hollow shaft and TorqLOC®

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3.2 Types and options of BS.F, PS.F and PS.C gear units

Bs.F helical-bevel gear units

Designation	
BSF..	Solid shaft without key
BSKF..	Solid shaft with key
BSBF..	Solid shaft with flange block shaft
BSHF..	Hollow shaft with shrink disk
BSAF..	Hollow shaft with keyway
BSKF..B	Solid shaft with key and foot/front-end mounting
BSBF..B	Solid shaft with flange block shaft and foot/front-end mounting
BSHF..B	Hollow shaft with shrink disk and foot/front-end mounting
BSAF..B	Hollow shaft with keyway and foot/front-end mounting

PS.F planetary gear units

Designation	
PSF..	Solid shaft without key
PSKF..	Solid shaft with key
PSBF..	Solid shaft with flange block shaft

PS.C planetary gear units

Designation	
PSC..	Solid shaft without key
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

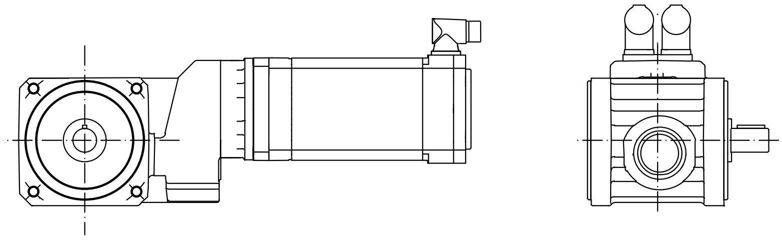
Designation	
../R	Reduced backlash
../T	Torque arm
../I	Hollow shaft and shrink disk at the output end

PS.F gear units

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

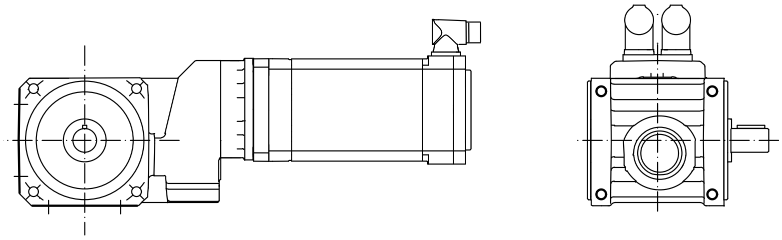
BS.F helical-bevel gearmotors

The following types of BS.F helical-bevel gear units are available:



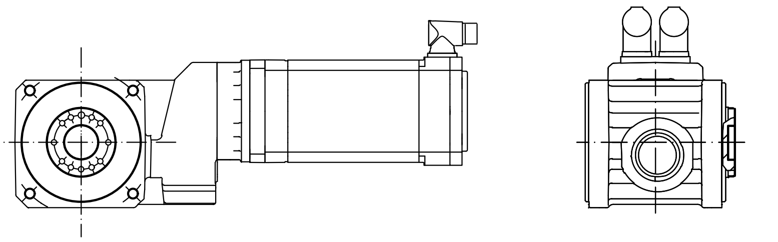
BSF.. CMP..
Gearmotor with solid shaft, B5 output flange

BSKF.. CMP..
Gearmotor with solid shaft and key, B5 output flange

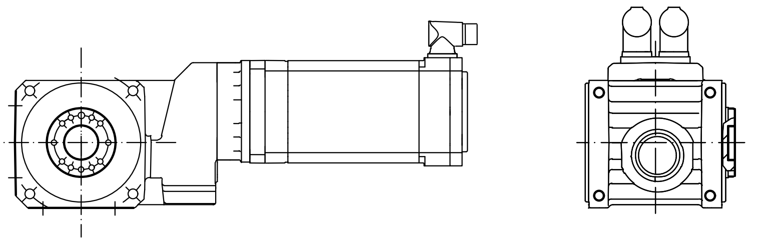


BSF..B CMP..
Gearmotor with solid shaft and front-end mounting

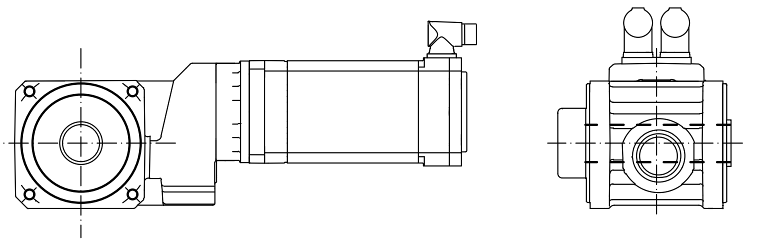
BSKF..B CMP..
Gearmotor with solid shaft, key and front-end mounting



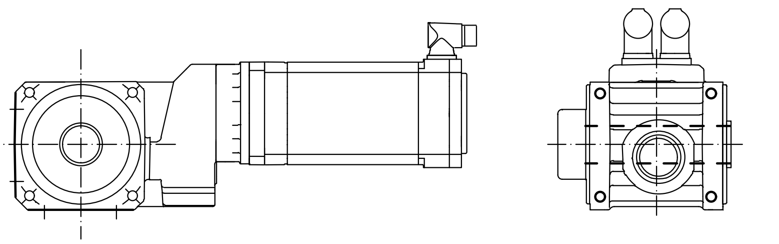
BSBF.. CMP..
Gearmotor with flange block shaft, B5 output flange



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



BSHF.. CMP..
Gearmotor with hollow shaft and shrink disk, B5 output flange



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

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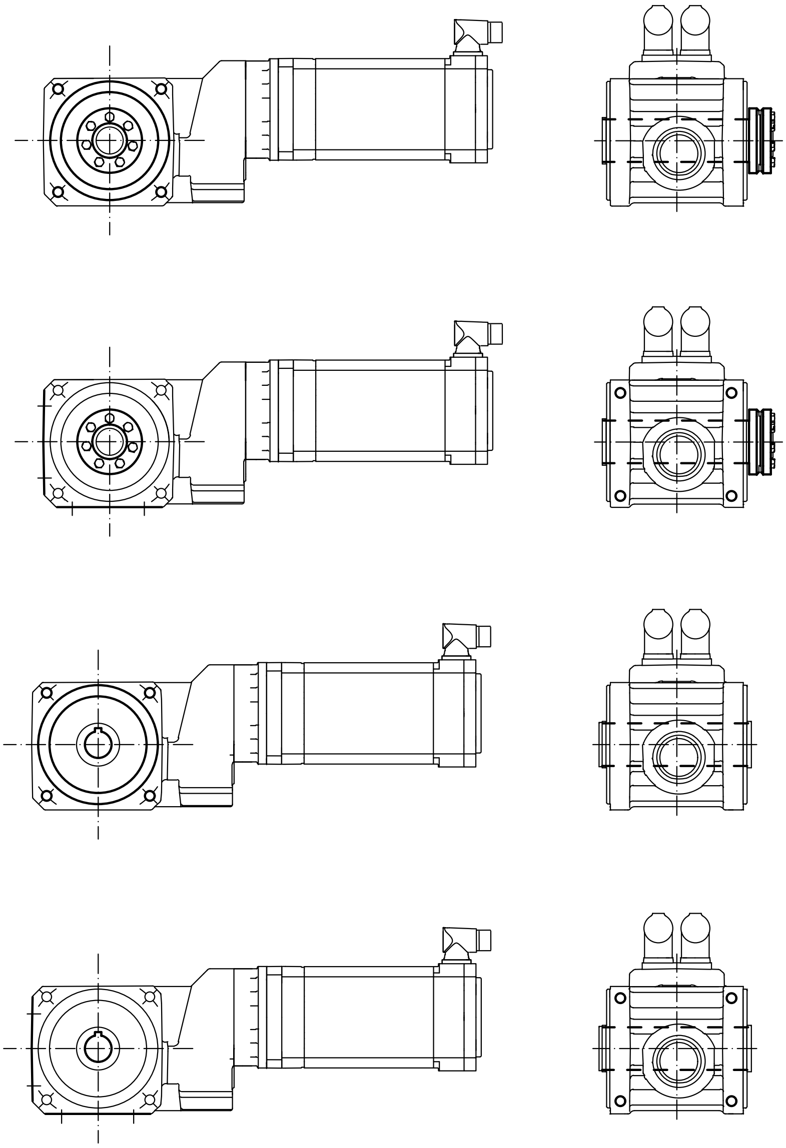

BSHF../I CMP..
Gearmotor with hollow shaft and shrink disk at the output end

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

BSAF.. CMP..
Gearmotor with hollow shaft and keyway, B5 output flange

BSAF..B CMP..
Gearmotor with hollow shaft and keyway, B5 output flange

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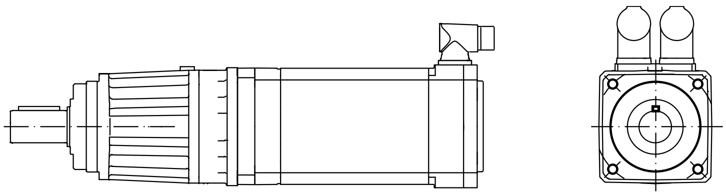
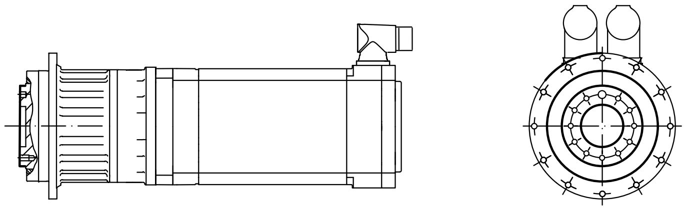
PS.F planetary gearmotors

The following PS.F.. planetary gearmotor types are available:



PSF.. CMP..
Gearmotor with solid shaft, B5 output flange

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



PSBF.. CMP..
Gearmotor with flange block shaft, B5 output flange

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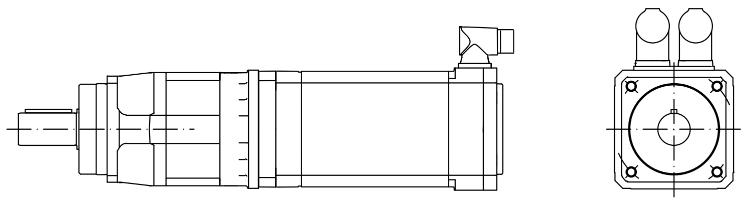
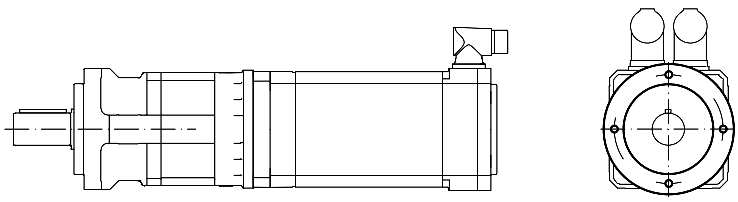
PS.C planetary gearmotors

The following types of PS.C.. planetary gear units are available:



PSC.. CMP..
Gearmotor with solid shaft, B5 output flange

PSKC.. CMP..
Gearmotor with solid shaft and key, B5 output flange



PSCZ.. CMP..
Gearmotor with solid shaft, B14 output flange

PSKCZ.. CMP..
Gearmotor with solid shaft and key, B14 output flange

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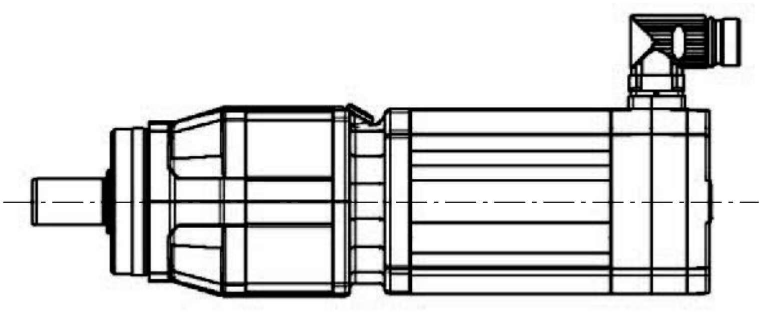
3.3 Type designations of servo gearmotors

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



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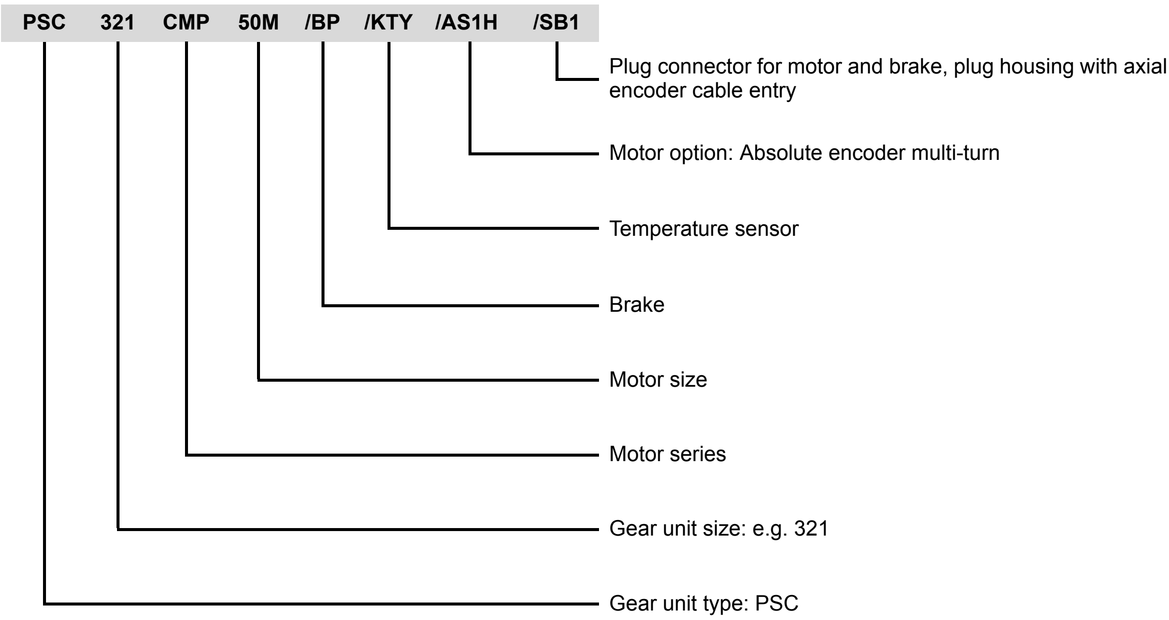
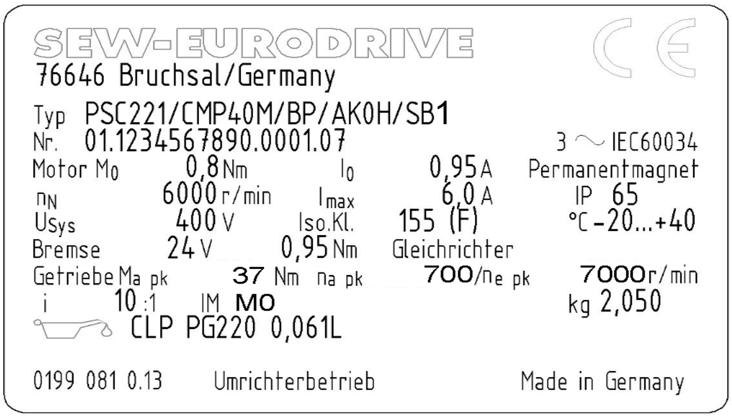
For example, a servo gearmotor with brake, manual brake release, positive temperature coefficient thermistor and plug connector has the following type designation:



3.4 Nameplate for servo gearmotors

Example: Nameplate for PS.C.. servo gearmotors



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Key

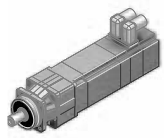
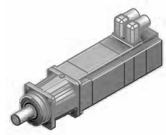
i		Gear unit reduction ratio	n_N	[rpm]	Rated speed
IM		Mounting position	M_o	[Nm]	Rated torque
IP		Degree of protection	I_o	[A]	Rated current
n_{epk}	[rpm]	Maximum permitted input speed	I_{max}	[A]	Maximum permitted current
n_{apk}	[rpm]	Maximum permitted output speed	f_N	[Hz]	Rated frequency
M_{apk}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

INFORMATION

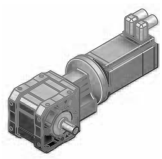
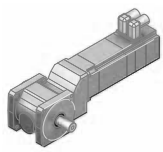
The nameplate of servo gearmotors is fixed to the servomotor.

3.5 Overview of servo gearmotors

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
Max. input speed	n_{epk} [rpm	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 range	i	1.3-8.23	3.21-216.28	3.77-276.77	3-100	3-100
Reduced backlash option	/R	x	x	x	-	x
Minimum backlash option	/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	W.. page 488	BS.F.. page 502
Technical data					
Peak torque	M_{apk} [Nm]	187-9090	60-655	91-270	51-1910
Max. continuous torque	M_{amax} [Nm]	125-8000	43-480	70-180	40-1500
Max. input speed	n_{epk} rpm	4500	4500	4500	4500
Peak overhung load	F_{rapk} [N]	5140-65000	300-12000	2950-7600	2380-36000
Gear ratio range	i	3.98-176.05	6.8-75.06	3.2-74.98	3-40
Reduced backlash option	/R	x	x	-	x
Minimum backlash option	/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 22 et seq.

4 Project Planning Notes for Servo Gearmotors

4.1 Additional documentation

In addition to the information in this publication, 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 documents are available from SEW-EURODRIVE in addition to this "Synchronous Servo Gearmotors" catalog:

- "Synchronous Servomotors" catalog/price catalog
- "Servo Gear Units" price catalog/catalog
- "Gear Units" price catalog/catalog
- "AC Motors Inverter Assignments and Characteristic Curves" manual

Drive Engineering Practical Implementation

- Project Planning for Drives
- Controlled AC Drives
- SEW encoder systems
- Servo technology
- EMC in Drive Engineering
- Explosion-Proof Drives to EU Directive 94/9/EC
- SEW Disk Brakes

Electronics documentation

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

Mechanical brakes

- "Synchronous Servomotors" catalog/price catalog
- "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 the 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	mm
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	1/min
n_{epk}	Maximum permitted input speed for short-time duty	1/min
n_{em}	Mean input speed	1/min
n_{am}	Mean output speed	1/min
n_{ak}	Breakpoint speed (output)	1/min
n_N	Rated speed	1/min
n_1 - n_n	Output speed in time period t_1 to t_n	1/min
n_{etn_pk}	Maximum input speed in section	1/min
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

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.

These data help 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.

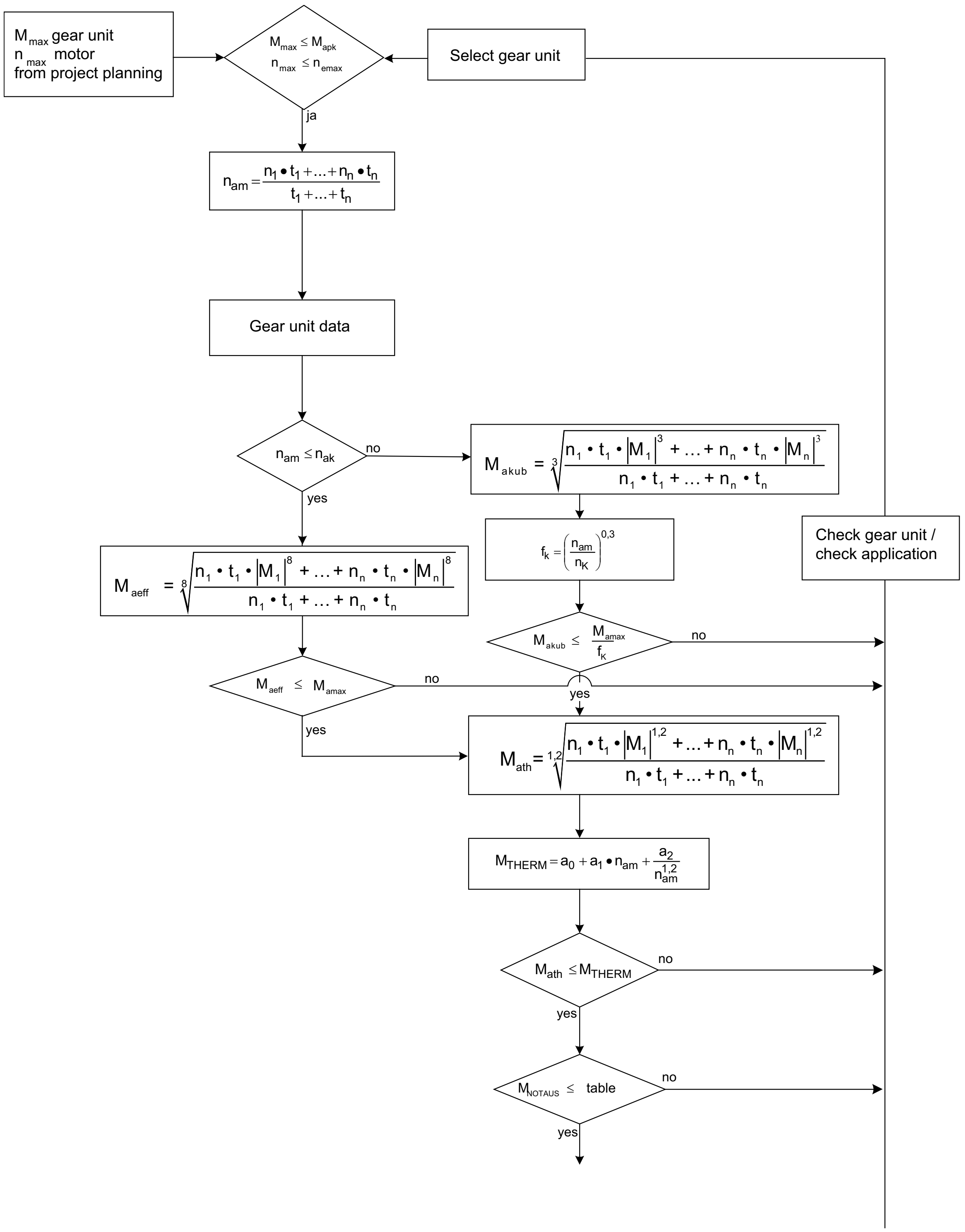
Selecting the correct drive

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 duty cycle.

Project planning procedure part 1, servo gear units



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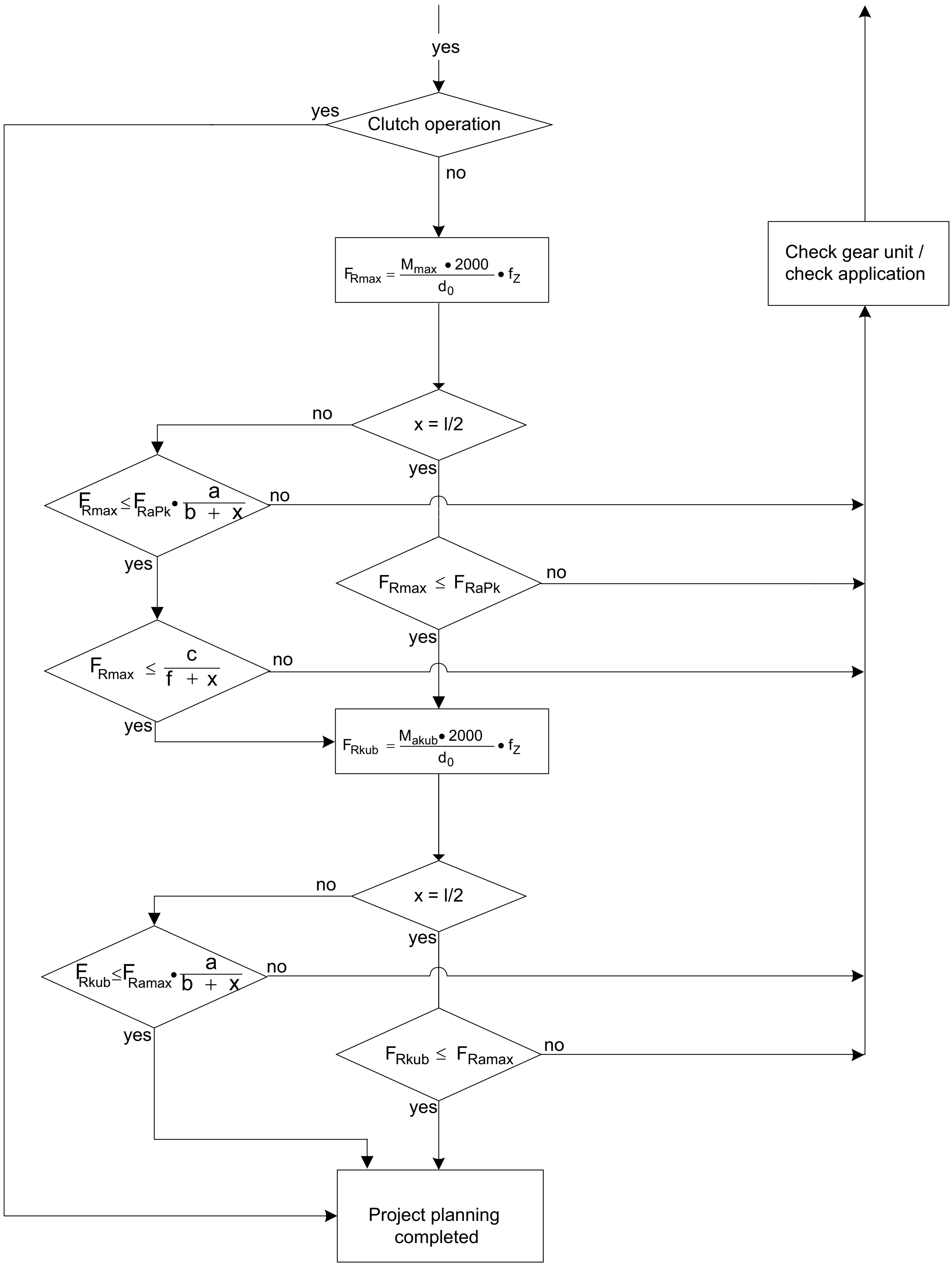
* For thermal project planning of R, F, K, S, W gear units, please contact SEW-EURODRIVE.

Project planning procedure part 2, servo gear units



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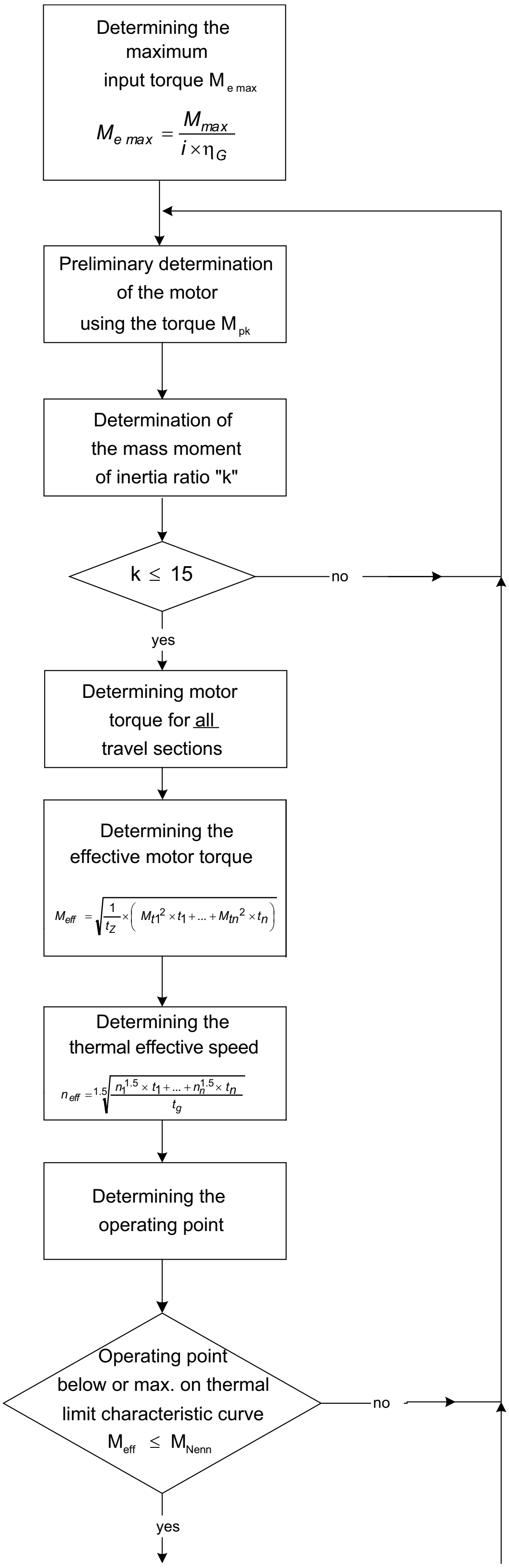
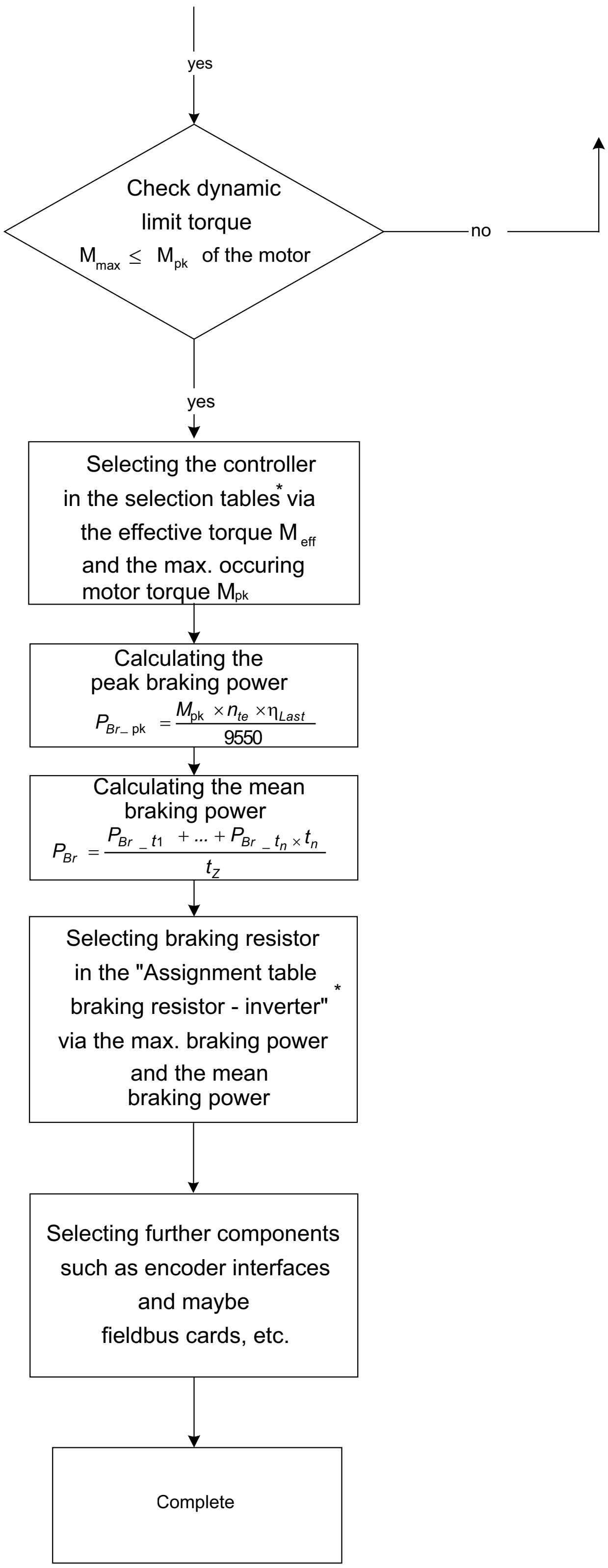
Project planning procedure part 3, servomotors



Project planning procedure part 4, servomotors



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* MOVIDRIVE® system manual, MOVIAXIS® system manual

4.4 Project planning notes for 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 applies in particular to 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.

SPIROPLAN® gear units W37 and W47 from SEW-EURODRIVE have an efficiency of more than 90%, which drops only slightly even with 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. Helical-worm or SPIROPLAN® gear units are self-locking if the forward efficiency $\eta \leq 0.5$. Some SPIROPLAN® gear units are dynamically self-locking. Contact SEW-EURODRIVE if you want to make technical use of the braking effect of self-locking characteristics.

INFORMATION

Note that the self-locking effect of helical-worm and SPIROPLAN® 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. This fact results in 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	ca. 50 - 280	ca. 12%
2-start	ca. 20 - 75	ca. 6%
3-start	ca. 20 - 90	ca. 3%
5-start	ca. 6 - 25	ca. 3%
6-start	ca. 7 - 25	ca. 2%

SPIROPLAN® W..	
i range	**η reduction**
ca. 30 - 70	ca. 8%
ca. 10 - 30	ca. 5%
ca. 3 - 10	ca. 3%

The run-in phase usually lasts 48 hours. Helical-worm and SPRIOPLAN® 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 (see 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.

To reduce churning losses to a minimum, use gear units in M1 mounting position.

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
Gear rack pinion, not prestressed	1.15	< 17 teeth

Permitted overhung load

The basis for determining the permitted overhung loads is the computation of the rated bearing service life L_{10h} of the rolling 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.

INFORMATION

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.

INFORMATION

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

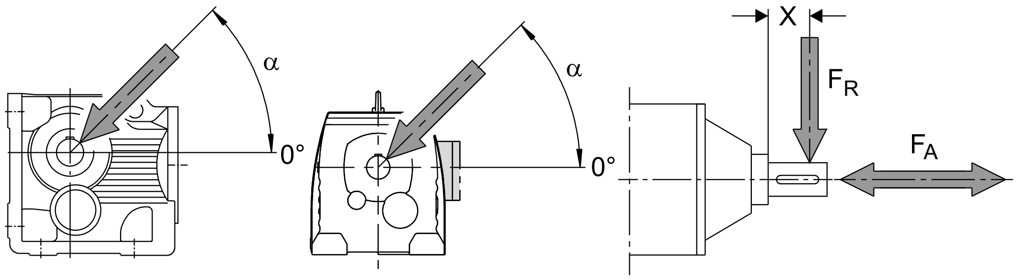
Exactly considering the force application angle α and the direction of rotation makes it possible to achieve a higher overhung load than listed in the selection tables.

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

The force application is defined according to the following figure:



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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

INFORMATION

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

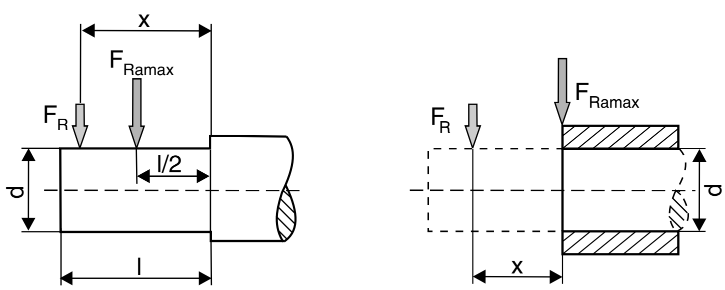
Output end: Overhung load conversion for off-center force application

The permitted overhung loads F_{Ramax} and F_{Rapk} listed in the data tables apply to 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 loads must be determined anew according to the project planning procedure page 44 .

The following conditions must be met:

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

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 [Nmm]



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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	2.80×10^6	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	$6.95\ \xi\ 10^4$	0	20	40
W47	145.5	115.5	$4.26\ x\ 10^5$	35.6	30	60
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 in the table are available on request.

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

Efficiency level 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).

INFORMATION

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

INFORMATION

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, pre-tensioned	2.00	Influence of the pre-tensioning
Gear rack pinion, not pre-tensioned	1.15	< 17 teeth

INFORMATION

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

Helical output elements		
Gear unit	**Helix angle β 1) 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 rolling 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.

INFORMATION

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.

INFORMATION

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.

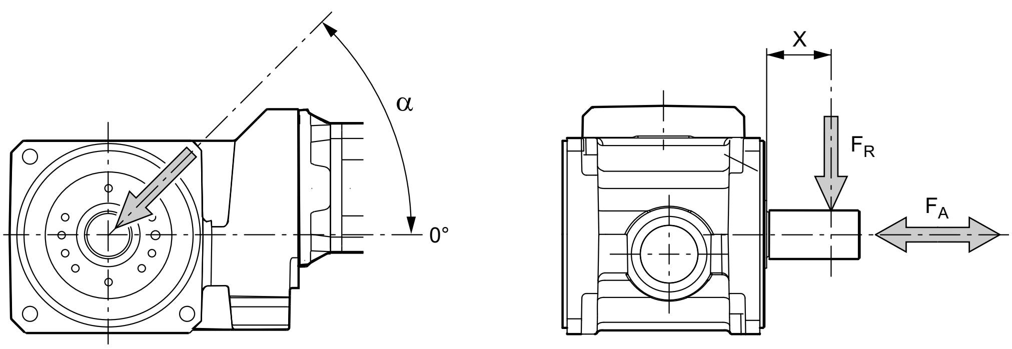
Higher permitted overhung loads

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

The force application is defined according to the following figure:



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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.

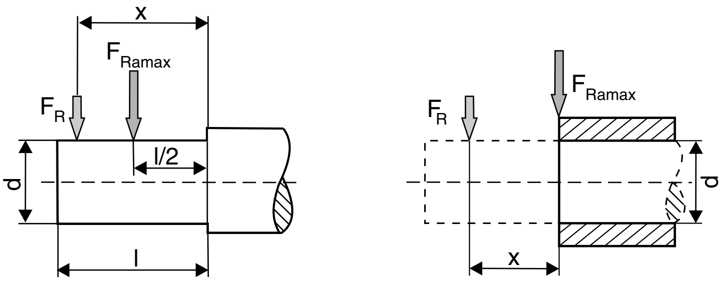
Output end: Overhung load conversion for off-center force application

The permitted overhung loads F_{Ramax} and F_{Rapk} listed in the data tables apply to 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 44 .

The following conditions must be met:

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

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 [Nmm]



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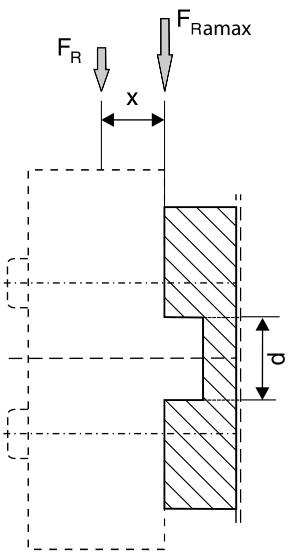

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Gear unit constants for overhung load conversion

Gear unit	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	--	--	--	--
BSBF202	101.5	101.5	--	--	--	--
BSF / BSKF302	122.6	104.6	8.61×10^4	0	22	36
BSHF / BSAF302	126.6	126.6	--	--	--	--
BSBF302	111.0	111.0	--	--	--	--
BSF / BSKF402	152.2	123.2	2.56×10^5	0	32	58
BSHF / BSAF402	143.7	143.7	--	--	--	--
BSBF402	132.0	132.0	--	--	--	--
BSF / BSKF502	175.4	134.4	4.92×10^5	0	40	82
BSHF / BSAF502	162.4	162.4	--	--	--	--
BSBF502	145.3	145.3	--	--	--	--
BSF / BSKF602	195.9	154.9	9.84×10^5	0	55	82
BSHF / BSAF602	189.9	189.9	--	--	--	--
BSBF602	170.8	170.8	--	--	--	--
BSF / BSKF802	242.7	190.2	1.89×10^6	0	75	105
BSHF / BSAF802	243.2	243.2	--	--	--	--
BSBF802	206.0	206.0	--	--	--	--

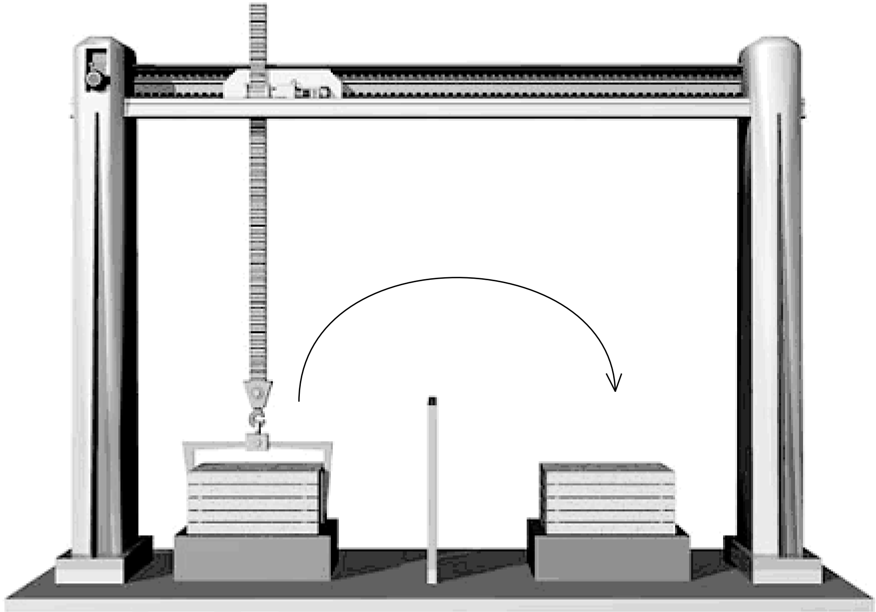
Gear unit	a mm	b mm	c Nmm	f mm	d mm	l mm
PSF / PSKF121/122	47.6	36.6	2.08×10^4	0	14	22
PSF / PSKF221/222	53.6	39.6	2.41×10^4	0	16	28
PSBF221/222	64.1	64.1	--	--	--	--
PSF / PSKF321/322	65.0	47.0	7.97×10^4	0	22	36
PSBF321/322	72.5	72.5	--	--	--	--
PSF / PSKF521/522	83.1	54.1	2.52×10^5	0	32	58
PSBF521/522	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	a mm	b mm	c Nmm	f mm	d mm	l mm
PS.C221/222	57	43	3.41×10^4	0	16	28
PS.C321/322	63.5	45.5	7.55×10^4	0	22	36
PS.C521/522	95.5	66.5	2.13×10^5	0	32	58
PS.C621/622	107.5	66.5	3.68×10^5	0	40	82

Values for types not listed in the table are available on request.

4.6 Project planning example Gantry with servo drives

X-axis planning (travel axis)



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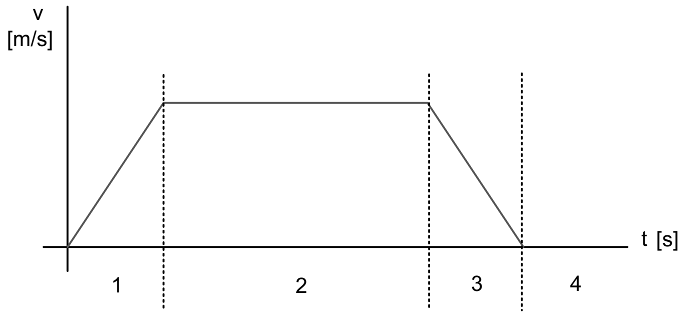
Reference data:

- 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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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

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

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

$$n_{a\max} = \frac{v_{\max}}{d_0 \cdot \pi} \cdot 60$$
$$n_{a\max} = \frac{2\frac{m}{s}}{0.075m \cdot \pi} \cdot 60$$
$$n_{a\max} = 509.295\frac{1}{\min}$$

Gear ratio including 10 % motor speed reserve
n_N = 4500 rpm 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 44 et seq.

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

	i	M_{amax} Nm	M_{apk} Nm	$M_{aNotaus}$ Nm	n_{ak} 1/min	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

				M1;M3;M5-6			M2			M4			φ
	i	n_{epk} 1/min	η %	a_0	a_1	a_2	a_0	a_1	a_2	a_0	a_1	a_2	'
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:

$$M_{max} \leq M_{apk}$$

$$21.04 Nm \leq 39 Nm$$

$$n_{max} \leq n_{epk}$$

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

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

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

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

$$M_{ath} = 5.009\,Nm$$

Thermal factors for mounting position M1

a_0=186

a_1=-0.257

a_3=0

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

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

$$M_{Therm} = 142.37Nm$$

Selection condition:

$$M_{ath} \leq M_{Therm}$$

$$5.035Nm \leq 142.37Nm$$

Condition is fulfilled.

Overhung load calculation

For transmission element factors for overhung loads of different transmission elements at the output shaft, refer to page 50 and page 53.

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

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

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

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

Selection condition:

$$F_{R\max} \leq F_{RaPk}$$

$$1402N \leq 2000N$$

Condition is fulfilled.

4

Calculating the bearing force

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

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

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

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

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

$$F_{Rkub} = 744.8\,N$$

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

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

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

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

Travel section 2

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

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

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

Travel section 3

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

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

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

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"

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

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

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

This means J_{ext} is with reference 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.

4

Intrinsic acceleration or deceleration of motor in sections 1 and 3

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

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

$$M_{Eigen} = 0.3639 Nm$$

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

$$M_{eff} = \sqrt{\frac{1}{t_z}\left(M_1^2 \cdot t_1 + ... + M_n^2 \cdot t_n\right)}$$

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

$$M_{eff} = 1.0174 Nm$$

Thermal effective motor speed

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

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

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

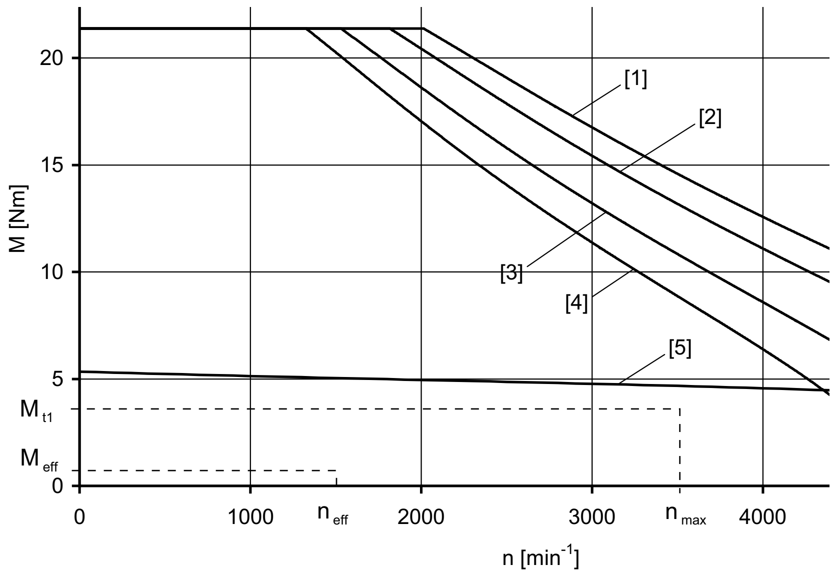
Determining the dynamic and thermal motor operating points

- 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

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

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

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

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".