



**SEW**  
EURODRIVE



## Synchronous Servo Gearmotors

Edition 04/2008

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Catalog

## Color code system for catalogs and system manuals

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

### Mechanics

**DR-GM  
2008**

DR gearmotors

**GSE1  
2008**

Synchronous  
servo gearmotors

**GSE2  
2008**

Asynchronous  
servo gearmotors

**GK  
2008**

Gear units

### Electromechanics

**MOT1  
2008**

DR series AC motors

**MOT2  
2008**

DT/DV/CT/CV series  
AC motors

### Explosion-proof drives

**EXG  
2008**

Explosion-proof  
garmotors

**EXS  
2008**

Explosion-proof  
servo gearmotors

**EXM  
2008**

Explosion-proof motors

### Control cabinet inverters, control technology and HMI

**MDX  
2008**

MOVIDRIVE®

**MC  
2008**

MOVITRAC®

**MX  
2008**

MOVIAXIS®

**PLC  
2008**

MOVI-PLC®

**HMI  
2008**

DOP11B®

### Decentralized technology

**MM  
2008**

MOVIMOT®  
garmotors

**DI  
2007**

Decentralized  
installation

**MG  
2008**

MOVIGEAR®

### Industrial gear units

**IGX1  
2008**

X series horizontal  
industrial gear units

**IGX2  
2008**

X series vertical  
industrial gear units



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

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

#### *Always the right drive*

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

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

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

For economical, decentralized installations, SEW-EURODRIVE offers components from its decentralized drive system, such as MOVIMOT®, the gearmotor with integrated frequency inverter or MOVI-SWITCH®, the gearmotor with integrated switching and protection function. SEW-EURODRIVE has developed hybrid cables to provide cost-effective functional solutions, independent of the philosophy behind or the size of the system. The latest developments from 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 SEW-EURODRIVE, high-torque industrial gear units achieve large movements. The modular concept once again provides optimum adaptation of industrial gear units to meet a wide range of the most varying applications.

#### *Your ideal partner*

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



## 1.2 Products and systems from SEW-EURODRIVE

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

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

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

1. Gearmotors and frequency inverters		
Gear units / gearmotors	Motors	Frequency inverters
<ul style="list-style-type: none"> <li>Helical gear units/ helical gearmotors</li> <li>Parallel shaft helical gear units / parallel shaft helical gearmotors</li> <li>Helical-bevel gear units / helical-bevel gearmotors</li> <li>Helical-worm gear units/ helical-worm gearmotors</li> <li>Spiroplan® right-angle gearmotors</li> <li>Drives for electrified monorail systems</li> <li>Geared torque motors</li> <li>Pole-changing gearmotors</li> <li>Variable speed gear units / variable speed gearmotors</li> <li>Aseptic gearmotors</li> <li>Gear units / gearmotors to ATEX standard</li> <li>Variable speed gear units / variable speed gearmotors to ATEX standard</li> </ul>	<ul style="list-style-type: none"> <li>Asynchronous AC motors / AC brake motors</li> <li>Pole-changing AC motors / AC brakemotors</li> <li>Energy efficient motors</li> <li>Explosion-proof AC motors / AC brakemotors</li> <li>Torque motors</li> <li>Single-phase motors / single-phase brakemotors</li> <li>Asynchronous linear motors</li> </ul>	<ul style="list-style-type: none"> <li>MOVITRAC® frequency inverters</li> <li>MOVIDRIVE® inverters</li> <li>Control, technology and communication options for inverters</li> </ul>

2. Servo Drive Systems		
Servo gear units/servo gearmotors	Servomotors	Servo drive inverters/servo inverters
<ul style="list-style-type: none"> <li>Low backlash planetary servo gear units/planetary gearmotors</li> <li>Low backlash helical-bevel servo gear units/helical-bevel gearmotors</li> <li>R, F, K, S, W gear units/gearmotors</li> <li>Explosion-proof servo gear units/servo gearmotors</li> </ul>	<ul style="list-style-type: none"> <li>Asynchronous servomotors/servo brakemotors</li> <li>Synchronous servomotors/servo brakemotors</li> <li>Explosion-proof servomotors/servo brakemotors</li> <li>Synchronous linear motors</li> </ul>	<ul style="list-style-type: none"> <li>MOVIDRIVE® servo inverters</li> <li>MOVIAxis® multi-axis servo inverter</li> <li>Control, technology and communication options for servo drive inverters and servo inverters</li> </ul>



## Introduction

### Products and systems from SEW-EURODRIVE

3. Decentralized drive systems		
Decentralized drives	Communication and installation	Contactless energy transfer
<ul style="list-style-type: none"> <li>• MOVIMOT<sup>®</sup> gearmotors with integrated frequency inverter</li> <li>• MOVIMOT<sup>®</sup> motors/brakemotors with integrated frequency inverter</li> <li>• MOVI-SWITCH<sup>®</sup> gearmotors with integrated switching and protection function</li> <li>• MOVI-SWITCH<sup>®</sup> motors/brakemotors with integrated switching and protection function</li> <li>• Explosion-proof MOVIMOT<sup>®</sup> and MOVI-SWITCH<sup>®</sup> gearmotors</li> </ul>	<ul style="list-style-type: none"> <li>• Fieldbus interfaces</li> <li>• Field distributors for decentralized installation</li> <li>• MOVIFIT<sup>®</sup> product range               <ul style="list-style-type: none"> <li>– MOVIFIT<sup>®</sup> MC for controlling MOVIMOT<sup>®</sup> drives</li> <li>– MOVIFIT<sup>®</sup>-SC with integrated electronic motor switch</li> <li>– MOVIFIT<sup>®</sup> FC with integrated frequency inverter</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• MOVITRANS<sup>®</sup> system               <ul style="list-style-type: none"> <li>– Stationary components for energy supply</li> <li>– Mobile components for energy absorption</li> <li>– Line cables and installation material</li> </ul> </li> </ul>

4. Industrial gear units
<ul style="list-style-type: none"> <li>• Helical gear units</li> <li>• Bevel-helical gear units</li> <li>• Planetary gear units</li> </ul>

Products and systems covering several product groups
<ul style="list-style-type: none"> <li>• Operator terminals</li> <li>• MOVI-PLC<sup>®</sup> drive-based control system</li> </ul>

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

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

Visit our home page:

→ [www.sew-eurodrive.com](http://www.sew-eurodrive.com)

The website offers a great deal of information and services.





### 1.3 Additional documentation

#### **Content of this publication**

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

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

The descriptions include:

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

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

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

#### **Additional documentation**

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

- AC motors
- Gear unit catalog

These price catalogs and catalogs offer the following information:

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

### 1.4 Copyright notice

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## 2 Product Description of Gear Units and Gearmotors

### 2.1 General information

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

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

Special coatings are available on request.

### Weight specifications

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

### Brakemotors

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

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

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

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

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

### International markets

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

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



## 2.2 Corrosion and surface protection

### General information

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

The protective measures comprise two groups:

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

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

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

### KS corrosion protection

The KS corrosion protection for motors comprises the following measures:

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

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



#### NOTE

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



#### Surface protection OS

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

Surface protection	Permutation of layers	NDFT <sup>1)</sup> on gray-cast iron [μm]	Suitable for
<b>Standard</b>	1 × Dip primer 1 × One-pack top coat	Approx. 50-70	<ul style="list-style-type: none"> <li>Normal ambient conditions</li> <li>Relative humidity below 90%</li> <li>Surface temperature up to max. 120 °C</li> <li>Corrosivity category C1<sup>2)</sup></li> </ul>
<b>OS1</b>	1 × Dip primer 1 × Two-pack base coat 1 × Two-pack top coat	Approx. 120-150	<ul style="list-style-type: none"> <li>Low environmental impact</li> <li>Relative humidity max. 95%</li> <li>Surface temperature up to max. 120 °C</li> <li>Corrosivity category C2<sup>2)</sup></li> </ul>
<b>OS2</b>	1 × Dip primer 2 × Two-pack base coat 1 × Two-pack top coat	Approx. 170-210	<ul style="list-style-type: none"> <li>Medium environmental impact</li> <li>Relative humidity up to 100%</li> <li>Surface temperature up to max. 120 °C</li> <li>Corrosivity category C3<sup>2)</sup></li> </ul>
<b>OS3</b>	1 × Dip primer 2 × Two-pack base coat 2 × Two-pack top coat	Approx. 220-270	<ul style="list-style-type: none"> <li>High environmental impact</li> <li>Relative humidity up to 100%</li> <li>Surface temperature up to max. 120 °C</li> <li>Corrosivity category C4<sup>2)</sup></li> </ul>
<b>OS4</b>	1 × Dip primer 2 × Two-pack epoxy base layer 2 × Two-pack top coat	Approx. 320	<ul style="list-style-type: none"> <li>Very high environmental impact</li> <li>Relative humidity up to 100%</li> <li>Surface temperature up to max. 120 °C</li> <li>Corrosivity category C5-1<sup>2)</sup></li> </ul>

1) NDFT (nominal dry film thickness) = Required coating thickness; Minimum thickness = 80 % NDFT; Maximum thickness = 3 x NDFT (DIN EN ISO 12944-5)

2) To DIN EN ISO 12,944-2

#### Special protection measures

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

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

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



### NOCO® fluid

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

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

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

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

### Design

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

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

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



### NOTE

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

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



## Product Description of Gear Units and Gearmotors

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

#### Storage conditions

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

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

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

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



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

### Ambient temperature

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

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

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

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

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

### Installation altitude

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

### Power and torque

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

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

### Speed

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



## Product Description of Gear Units and Gearmotors

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

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### **Noises**

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

### **Weights**

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

### **Air admission and accessibility**

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

### **Multi-stage gearmotors**

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

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

### **Reduced backlash design**

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

### **RM gear units, RM gearmotors**

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





### **Spiroplan® right-angle gearmotors**

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

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

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

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

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

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

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

### **Components on the input side**

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

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

### **Swing base**

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

Motor swings are available with the following optional accessories:

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



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

#### **Ambient temperature**

Servo gear units can be operated at ambient temperatures between  $-20\text{ }^{\circ}\text{C}$  and  $+40\text{ }^{\circ}\text{C}$ . It is essential that you contact SEW-EURODRIVE if ambient temperatures exceed this temperature range.

#### **Installation altitude**

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

#### **Power and torque**

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

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

#### **Noises**

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

#### **Heat dissipation and accessibility**

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

#### **Direct motor mounting**

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

#### **Motor mounting with adapter**

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

#### **Low backlash and positioning accuracy**

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

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



**Wide gear ratio range with finely-graduated steps**

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

2

**Reliability, longevity and low maintenance**

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

**High overload capacity**

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

**Torsionally rigid**

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



## 3 Overview of Types and Unit Designation

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

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

#### *Helical gear unit*

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

#### *Parallel shaft helical gear unit*

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



## Helical-bevel gear unit

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

## Helical-worm gear unit

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



## Overview of Types and Unit Designation

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

### Spiroplan® gear unit

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

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

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

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

### Options

R, F and K gear units:

Designation	
/R	Reduced backlash

K, S and W gear units:

Designation	
/T	With torque arm

F gear units:

Designation	
/G	With rubber buffer

### Condition monitoring

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

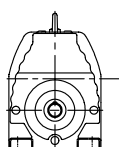
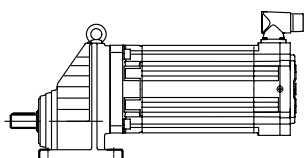


## NOTE

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

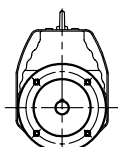
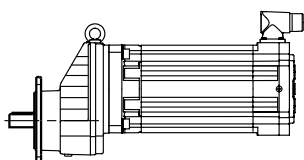
## Helical gearmotors

The following variants of helical gearmotors can be supplied:



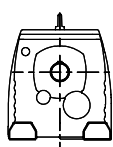
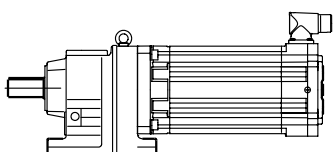
**RX..DS../CM../CMP..**

Single-stage helical gearmotor in foot-mounted design



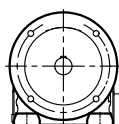
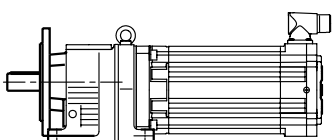
**RXF..DS../CM../CMP..**

Single-stage helical gearmotor in B5 flange-mounted design



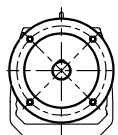
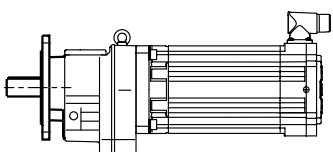
**R..DS../CM../CMP..**

Foot-mounted helical gearmotor



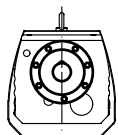
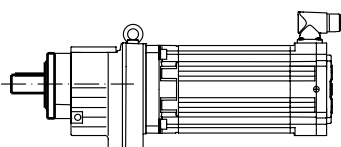
**R..F DS../CM../CMP..**

Foot and B5 flange-mounted helical gearmotor



**RF..DS../CM../CMP..**

Helical gearmotor in B5 flange-mounted design



**RZ..DS../CM../CMP..**

Helical gearmotor in B14 flange-mounted design

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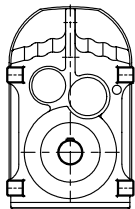
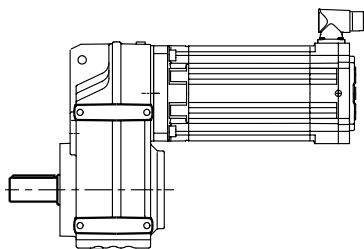


## Overview of Types and Unit Designation

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

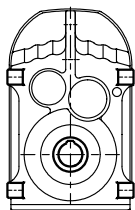
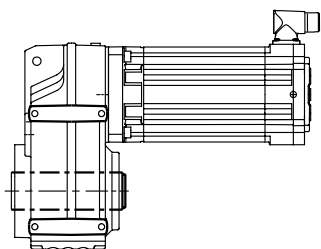
### Parallel shaft helical gearmotors

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



#### **F..DS../CM../CMP..**

Foot-mounted parallel shaft helical gearmotor

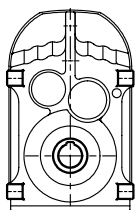
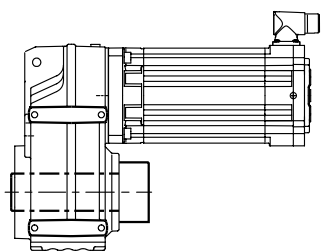


#### **FA..B DS../CM../CMP..**

Foot-mounted parallel shaft helical gearmotor with hollow shaft

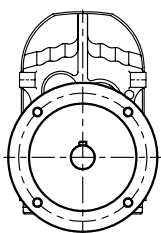
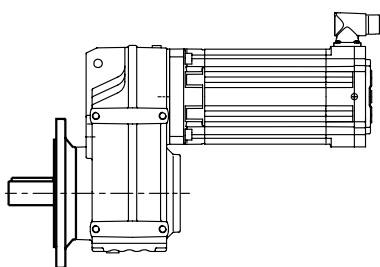
#### **FV..B DS../CM../CMP..**

Foot-mounted parallel shaft helical gearmotor with hollow shaft and splined hollow shaft to DIN 5480



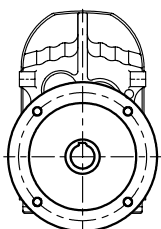
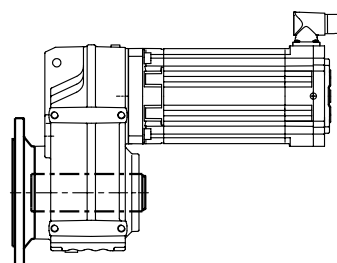
#### **FH..B DS../CM../CMP..**

Foot-mounted parallel shaft helical gearmotor with hollow shaft and shrink disk



#### **FF..DS../CM../CMP..**

B5 flange-mounted parallel shaft helical gearmotor



#### **FAF..DS../CM../CMP..**

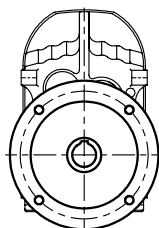
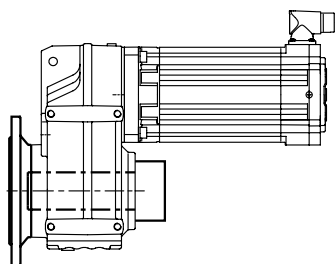
Parallel shaft helical gearmotor in B5 flange-mounted design with hollow shaft

#### **FVF..DS../CM../CMP..**

Parallel shaft helical gearmotor in B5 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480

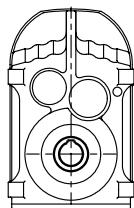
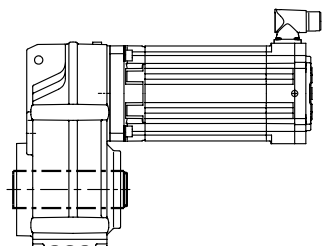
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### **FHF..DS../CM../CMP..**

Parallel shaft helical gearmotor in B5 flange-mounted design with hollow shaft and shrink disk

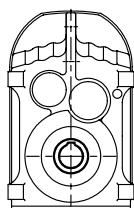
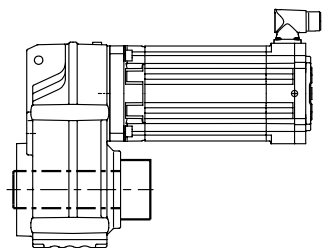


### **FA..DS../CM../CMP..**

Parallel shaft helical gearmotor with hollow shaft

### **FV..DS../CM../CMP..**

Parallel shaft helical gearmotor with hollow shaft and splined hollow shaft to DIN 5480

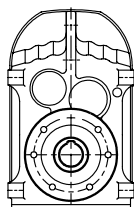
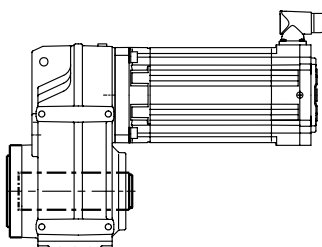


### **FH..DS../CM../CMP..**

Parallel shaft helical gearmotor with hollow shaft and shrink disk

### **FT..DS../CM../CMP..**

Parallel shaft helical gearmotor with hollow shaft and TorqLOC® hollow shaft mounting system

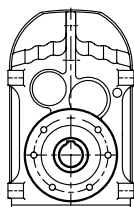
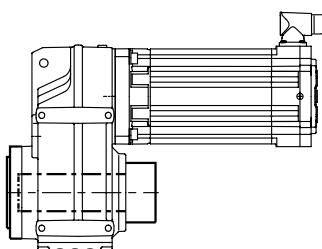


### **FAZ..DS../CM../CMP..**

Parallel shaft helical gearmotor in B14 flange-mounted design with hollow shaft

### **FVZ..DS../CM../CMP..**

Parallel shaft helical gearmotor in B14 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480



### **FHZ..DS../CM../CMP..**

Parallel shaft helical gearmotor in B14 flange-mounted design with hollow shaft and shrink disk

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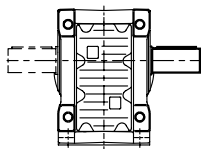
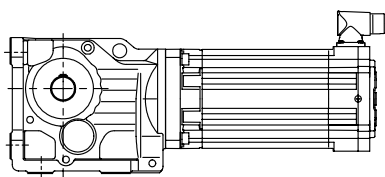


## Overview of Types and Unit Designation

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

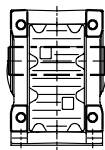
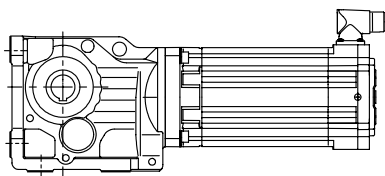
### Helical-bevel gearmotors

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



#### **K..DS../ CM../ CMP..**

Foot-mounted helical-bevel gearmotor

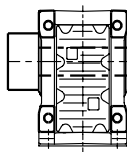
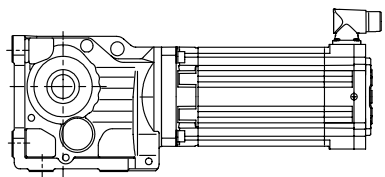


#### **KA..B DS../ CM../ CMP..**

Helical-bevel gearmotor in foot-mounted design with hollow shaft

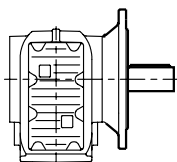
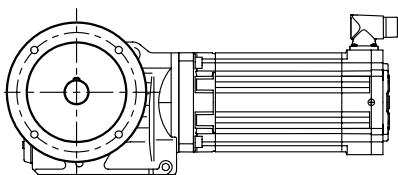
#### **KV..B DS../ CM../ CMP..**

Foot-mounted helical-bevel gearmotor with hollow shaft and splined hollow shaft to DIN 5480



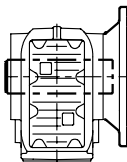
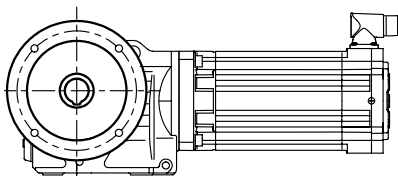
#### **KH..B DS../ CM../ CMP..**

Foot-mounted helical-bevel gearmotor with hollow shaft and shrink disk



#### **KF..DS../ CM../ CMP..**

Helical-bevel gearmotor in B5 flange-mounted design



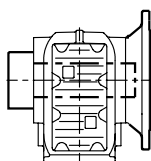
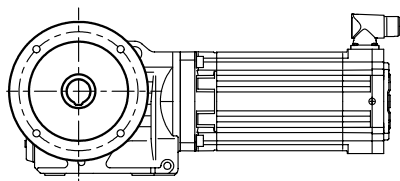
#### **KAF..DS../ CM../ CMP..**

Helical-bevel gearmotor in B5 flange-mounted design with hollow shaft

#### **KVF..DS../ CM../ CMP..**

Helical-bevel gearmotor in B5 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480

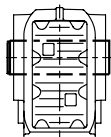
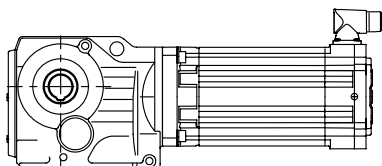
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### **KHF..DS../CM../CMP..**

Helical-bevel gearmotor in B5 flange-mounted design with hollow shaft and shrink disk

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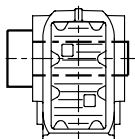
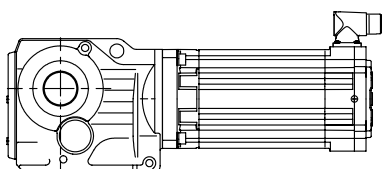


### **KA..DS../CM../CMP..**

Helical-bevel gearmotor with hollow shaft

### **KV..DS../CM../CMP..**

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

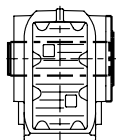
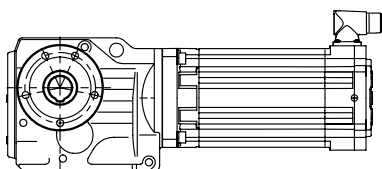


### **KH..DS../CM../CMP..**

Helical-bevel gearmotor with hollow shaft and shrink disk

### **KT..DS../CM../CMP..**

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

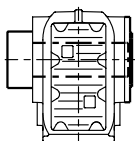
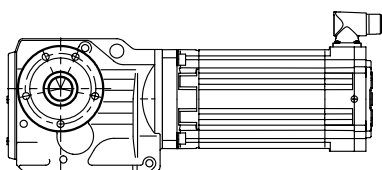


### **KAZ..DS../CM../CMP..**

Helical-bevel gearmotor in B14 flange-mounted design with hollow shaft

### **KVZ..DS../CM../CMP..**

Helical-bevel gearmotor in B14 flange-mounted design with hollow shaft and splined hollow shaft to DIN 5480



### **KHZ..DS../CM../CMP..**

Helical-bevel gearmotor in B14 flange-mounted design with hollow shaft and shrink disk

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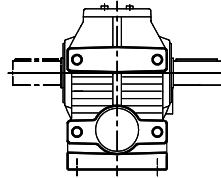
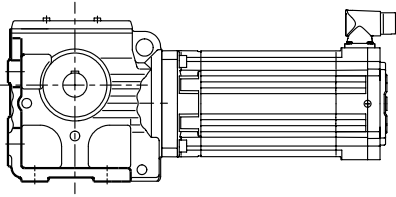


## Overview of Types and Unit Designation

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

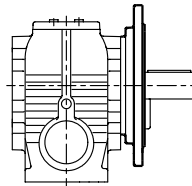
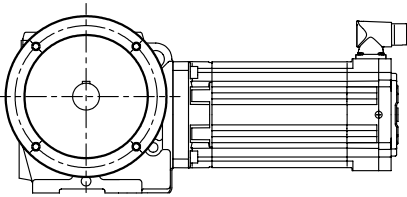
### Helical-worm gearmotors

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



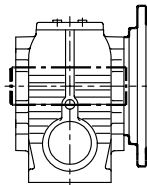
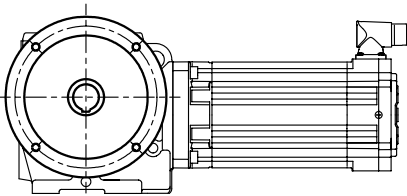
**S..DS../ CM../ CMP..**

Foot-mounted helical-worm gearmotor



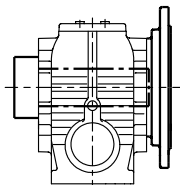
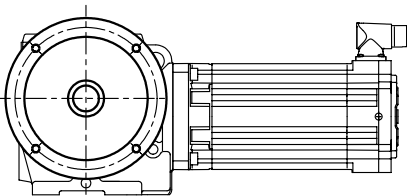
**SF..DS../ CM../ CMP..**

Helical-worm gearmotor in B5 flange-mounted design



**SAF..DS../ CM../ CMP..**

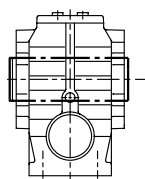
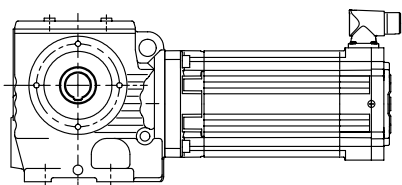
Helical-worm gearmotor in B5 flange-mounted design with hollow shaft



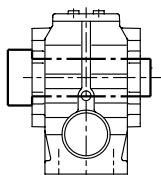
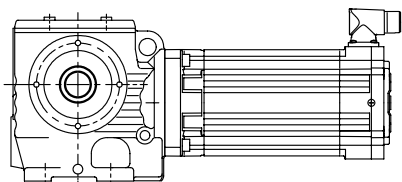
**SHF..DS../ CM../ CMP..**

Helical-worm gearmotor in B5 flange-mounted design with hollow shaft and shrink disk

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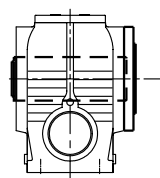
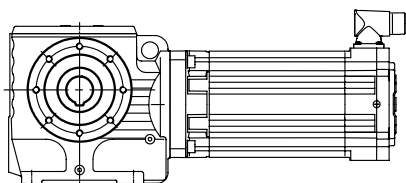


**SA..DS../CM../CMP..**  
Helical-worm gearmotor with hollow shaft

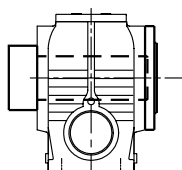
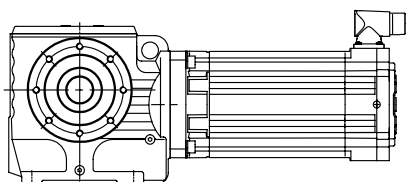


**SH..DS../CM../CMP..**  
Helical-worm gearmotor with hollow shaft and shrink disk

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



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



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

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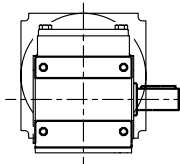
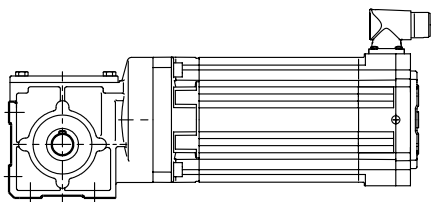


## Overview of Types and Unit Designation

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

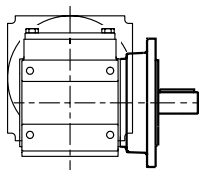
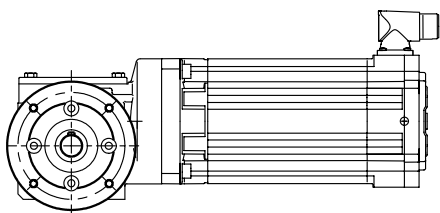
### Spiroplan® gearmotors

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



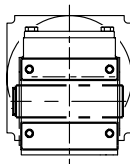
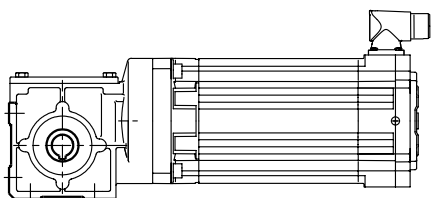
#### **W..DS../CM../CMP..**

Spiroplan® gearmotor in foot-mounted design



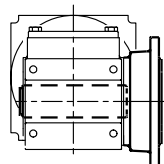
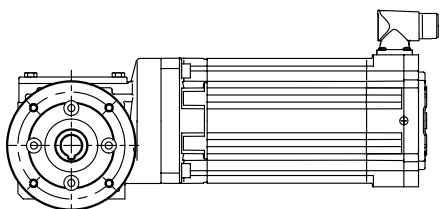
#### **WF..DS../CM../CMP..**

Spiroplan® gearmotor in flange-mounted design



#### **WA..DS../CM../CMP..**

Spiroplan® gearmotor with hollow shaft



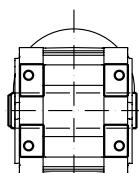
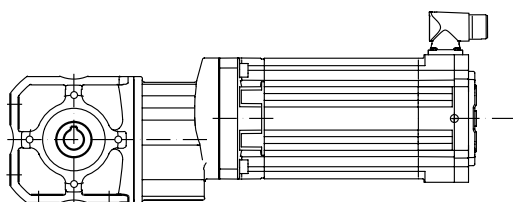
#### **WAF..DS../CM../CMP..**

Spiroplan® gearmotor in flange-mounted design with hollow shaft

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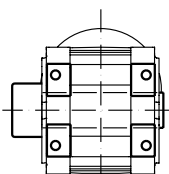
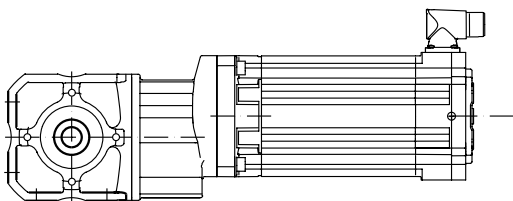


The following variants of Spiroplan® gearmotors size W..37 can be supplied in addition:



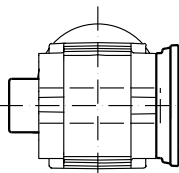
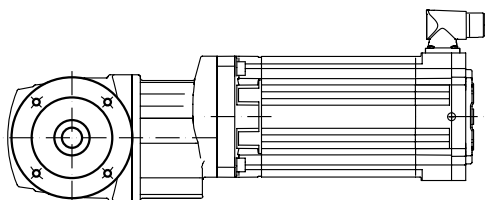
### **WA37B DS../CM../CMP..**

Spiroplan® gearmotor in foot-mounted design with hollow shaft



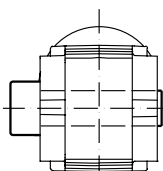
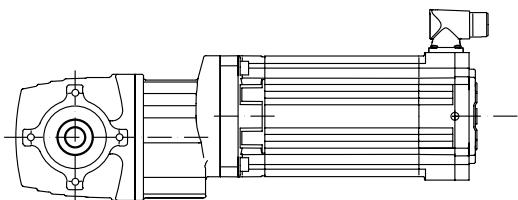
### **WH37B DS../CM../CMP..**

Spiroplan® gearmotor in foot-mounted design with hollow shaft and shrink disk



### **WHF37 DS../CM../CMP..**

Spiroplan® gearmotor in flange-mounted design with hollow shaft and shrink disk



### **WH37 DS../CM../CMP..**

Spiroplan® gearmotor with hollow shaft and shrink disk

### **WT37 DS../CM../CMP..**

Spiroplan® gearmotor with hollow shaft and TorqLOC®

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## Overview of Types and Unit Designation

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

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

#### Helical-bevel gear units BS.F

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

#### Planetary gear unit PS.F

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

#### Planetary gear unit PS.C

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

#### Options

##### BS.F gear units

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

##### PS.F gear units

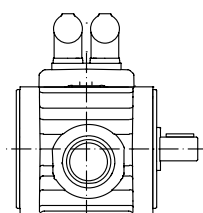
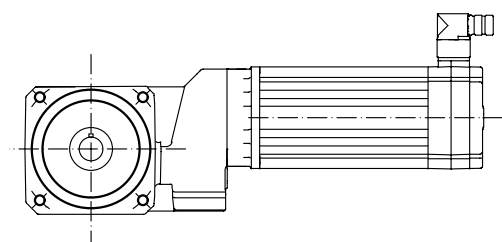
Designation	
../R	Reduced backlash
../M	Minimized backlash





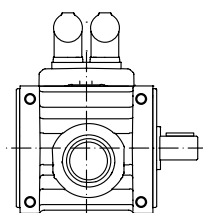
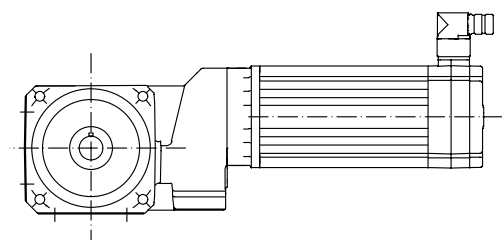
## BS.F helical-bevel gearmotors

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



### **BSF.. DS../CM../CMP..**

Gear motor with solid shaft, B5 output flange

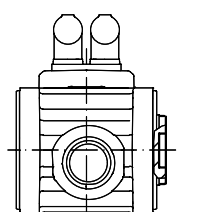
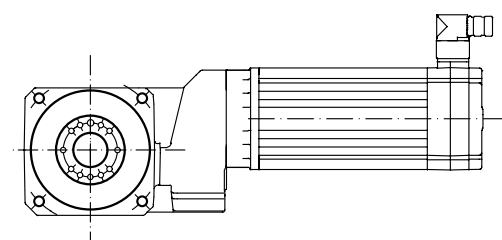


### **BSF..B DS../CM../CMP..**

Gearmotor with solid shaft and front-end mounting

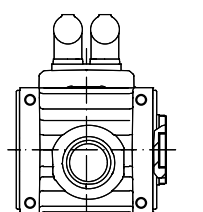
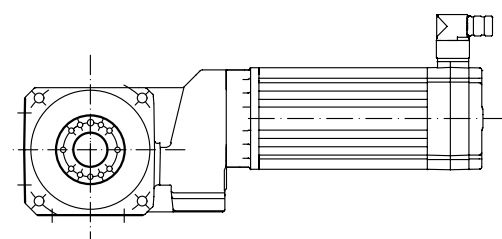
### **BSKF..B DS../CM../CMP..**

Gearmotor with solid shaft, key and front-end mounting



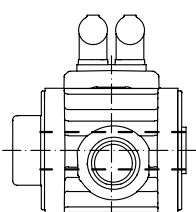
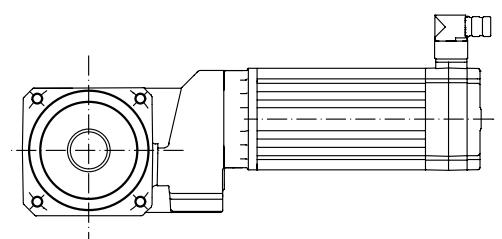
### **BSBF.. DS../CM../CMP..**

Gear motor with flange block shaft, B5 output flange



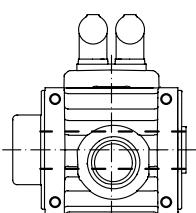
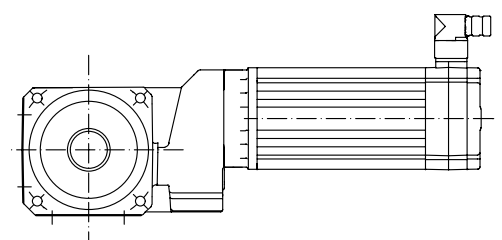
### **BSBF..B DS../CM../CMP..**

Gearmotor with flange block shaft and front-end mounting



### **BSHF.. DS../CM../CMP..**

Gear motor with hollow shaft and shrink disk, B5 output flange



### **BSHF..B DS../CM../CMP..**

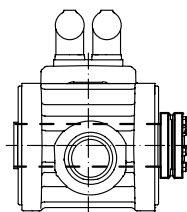
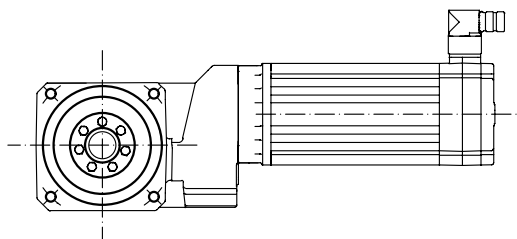
Gearmotor with hollow shaft, shrink disk and front-end mounting

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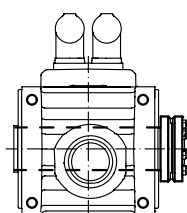
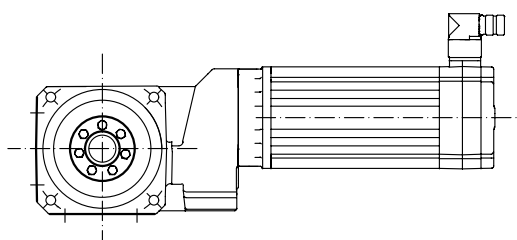
## Overview of Types and Unit Designation

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



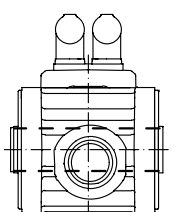
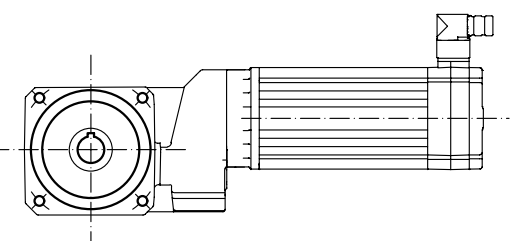
### **BSHF../I DS../CM../CMP..**

Gearmotor with hollow shaft and shrink disk at the output end



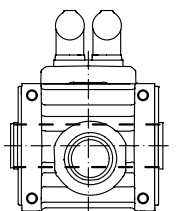
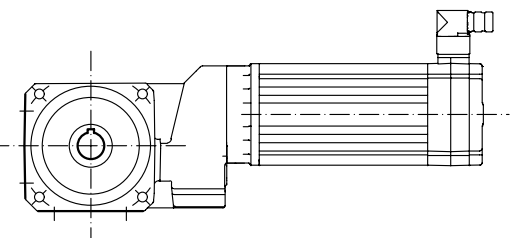
### **BSHF..B /I DS../CM../CMP..**

Gearmotor with hollow shaft and shrink disk at the output end



### **BSAF.. DS../CM../CMP..**

Gear motor with hollow shaft and keyway, B5 output flange



### **BSAF..B DS../CM../CMP..**

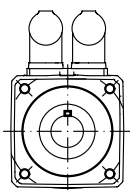
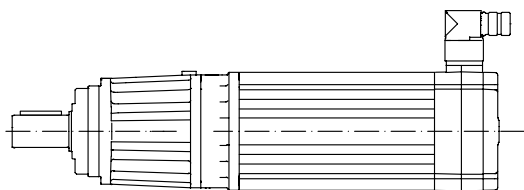
Gear motor with hollow shaft and keyway, B5 output flange

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## PS.F planetary gearmotors

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

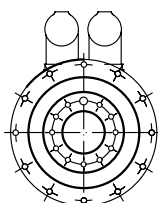
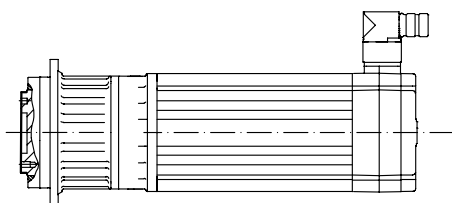


### PSF DS../ CM../ CMP..

Gearmotor with solid shaft, B5 output flange

### PSKF DS../ CM../ CMP..

Gearmotor with solid shaft and key, B5 output flange



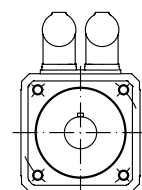
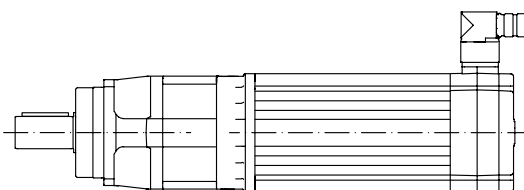
### PSBF DS../ CM../ CMP..

Gear motor with flange block shaft, B5 output flange

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## PS.C planetary gearmotors

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

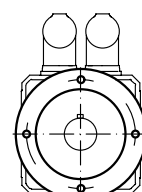
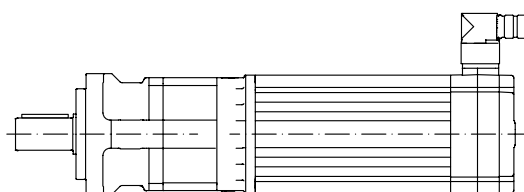


### PSC DS../ CM../ CMP..

Gearmotor with solid shaft, B5 output flange

### PSKC DS../ CM../ CMP..

Gear motor with solid shaft and key, B5 output flange



### PSCZ DS../ CM../ CMP..

Gearmotor with solid shaft, B14 output flange

### PSKCZ DS../ CM../ CMP..

Gear motor with solid shaft and key, B14 output flange

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### 3.3 Unit designation of servo gearmotors

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

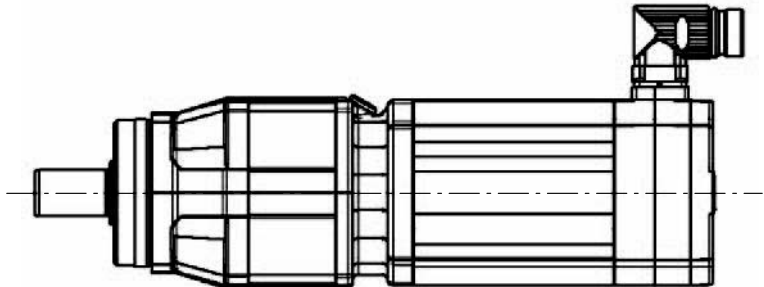
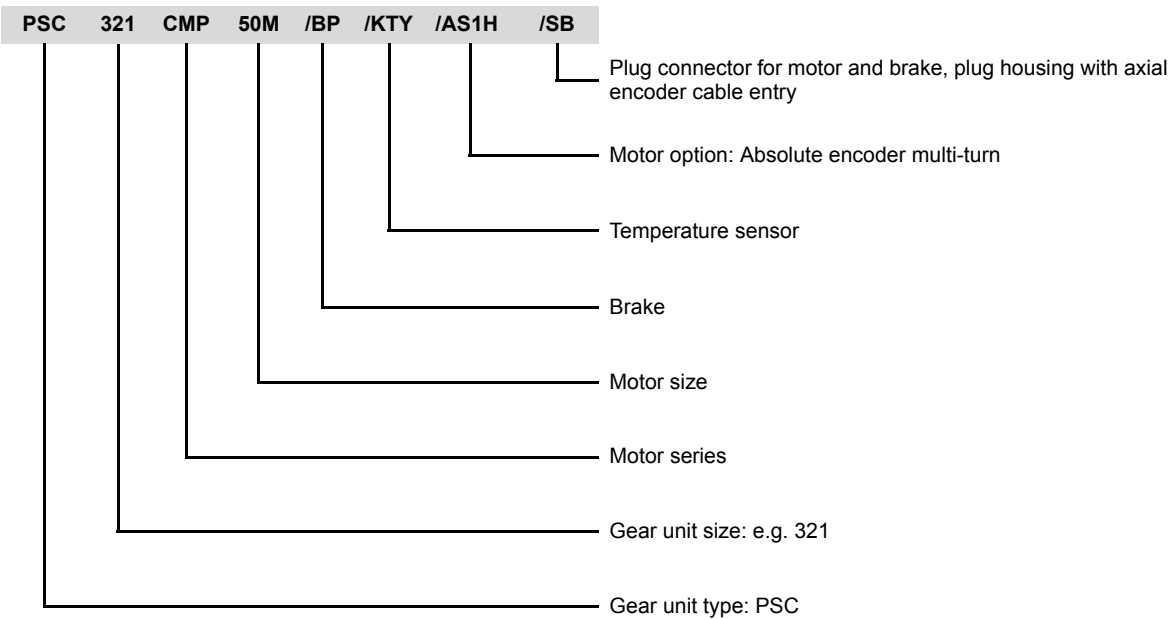


Figure 1: Example for a PS.C.. servo gearmotor

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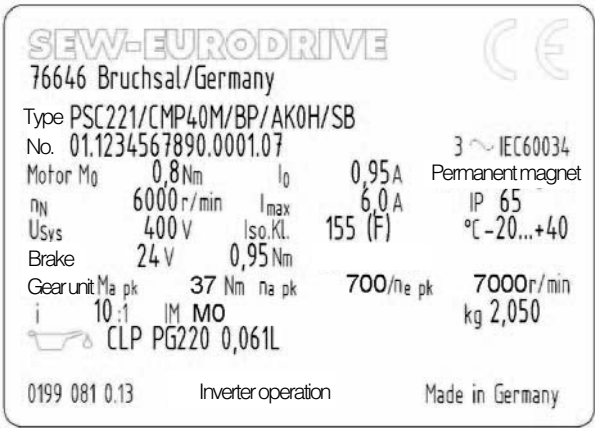
For example, a servo gearmotor with brake, manual brake release, positive temperature coefficient thermistor and plug connector has the following unit designation:





3.4 Servo gearmotor nameplate

Example: Nameplate for PS.C.. servo gearmotor



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Key

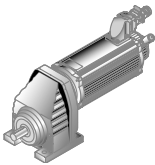
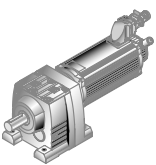
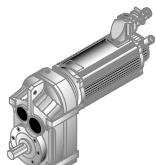

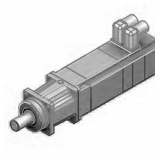
i	Gear unit reduction ratio	n <sub>N</sub>	[rpm]	Rated speed
IM	Mounting position	M <sub>o</sub>	[Nm]	Rated torque
IP	Degree of protection	I <sub>o</sub>	[A]	Rated current
n <sub>epk</sub>	[rpm] Maximum permitted input speed	I <sub>max</sub>	[A]	Maximum permitted current
n <sub>apk</sub>	[rpm] Maximum permitted output speed	f <sub>N</sub>	[Hz]	Rated frequency
M <sub>apk</sub>	[Nm] Maximum permitted output torque	U <sub>max</sub>	[V]	Maximum permitted voltage

	<b>NOTE</b>
	The nameplate of servo gearmotors is fixed to the servomotor!

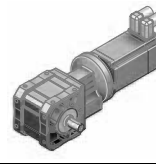
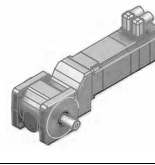


### 3.5 Servo gearmotors at a glance

#### Axially parallel gear units

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

#### Right-angle gear units

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

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



## 4 Project Planning Notes for Servo Gearmotors

### 4.1 Additional documentation

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

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

#### **Technical data for motors and gear units**

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

- AC motors
- Gear unit catalog

#### **Drive Engineering – Practical Implementation**

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

#### **Electronics documentation**

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

#### **Mechanical brakes**

- "Brakes and Accessories" manual



#### 4.2 Data for drive and gear unit selection

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

Designation	Meaning	Unit
$\varphi$	Circumferential backlash	[°]
$\eta$	Gear unit efficiency for $M_{apk}$	
<b>a, b, f</b>	Gear unit constants as regards the overhung load conversion	[mm]
<b>c</b>	Gear unit constants as regards the overhung load conversion	[Nmm]
<b>a<sub>0</sub>, a<sub>1</sub>, a<sub>2</sub></b>	Gear unit constants as regards the rise in temperature in the gear unit	
<b>F<sub>A</sub></b>	Axial load (tension and compression) on the output shaft	[N]
<b>f<sub>k</sub></b>	Speed ratio	
<b>F<sub>R</sub></b>	Overhung load on the output shaft	[N]
<b>F<sub>Rapk</sub></b>	Maximum permitted overhung load at the output shaft for short-time duty (load application point is the middle of the shaft end)	[N]
<b>F<sub>Ramax</sub></b>	Maximum permitted overhung load at the output shaft for continuous duty (load application point is the middle of the shaft end)	[N]
<b>F<sub>Repk</sub></b>	Maximum permitted overhung load at the input shaft for short-time duty (load application point is the middle of the shaft end)	[N]
<b>F<sub>Remax</sub></b>	Maximum permitted overhung load at the input shaft for continuous duty (load application point is the middle of the shaft end)	[N]
<b>H</b>	Installation altitude	[m above sea level]
<b>I<sub>0</sub></b>	Current consumption of the motor at $M_0$	[A]
<b>I<sub>max</sub></b>	Maximum permitted motor current (root-mean-square value)	[A]
<b>Ins.Cl.</b>	Thermal classification of the motor	
<b>i</b>	Gear unit reduction ratio	
<b>IM</b>	Mounting position of gear unit (international mounting position) M1...M6	
<b>IP..</b>	Degree of protection according to IEC60034-5	
<b>J<sub>A</sub></b>	Mass moment of inertia of the adapter	[kgm <sup>2</sup> ]
<b>J<sub>G</sub></b>	Mass moment of inertia of the gear unit	[kgm <sup>2</sup> ]
<b>J<sub>ext</sub></b>	Mass moment of inertia (external) reduced on motor shaft	[kgm <sup>2</sup> ]
<b>J<sub>Mot</sub></b>	Mass moment of inertia of the motor	[kgm <sup>2</sup> ]
<b>J<sub>L</sub></b>	Mass moment of inertia of the load	[kgm <sup>2</sup> ]
<b>k</b>	Inertia ratio $J_{ext} / J_{Mot}$	
<b>l</b>	Length of output shaft	
<b>M<sub>1</sub> ... M<sub>n</sub></b>	Output torque in time period $t_1$ to $t_n$	[Nm]
<b>M<sub>0</sub></b>	Thermally permitted output torque of the motor in continuous duty at low speed (not to be confused with standstill torque)	[Nm]
<b>M<sub>a</sub><sup>DYN</sup></b>	Dynamic output torque assumed for the drive in project planning	[Nm]
<b>M<sub>aeff</sub></b>	Effective torque for component testing calculated in project planning	[Nm]
<b>M<sub>akub</sub></b>	Effective torque for bearing testing calculated in project planning	[Nm]
<b>M<sub>amax</sub></b>	Maximum permitted output torque for continuous duty	[Nm]
<b>M<sub>apk</sub></b>	Maximum permitted torque for short-time duty	[Nm]
<b>M<sub>aNOTAUS</sub></b>	Maximum permitted emergency stop torque, max. 1000 emergency stops	[Nm]
<b>M<sub>ath</sub></b>	Effective torque for thermal testing calculated in project planning	[Nm]
<b>M<sub>B</sub></b>	Rated brake torque	[Nm]
<b>M<sub>pk</sub></b>	Dynamic limit torque of the servomotor	[Nm]

Table continued on next page.





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

### Determining the application data

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

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

### Selecting the correct drive

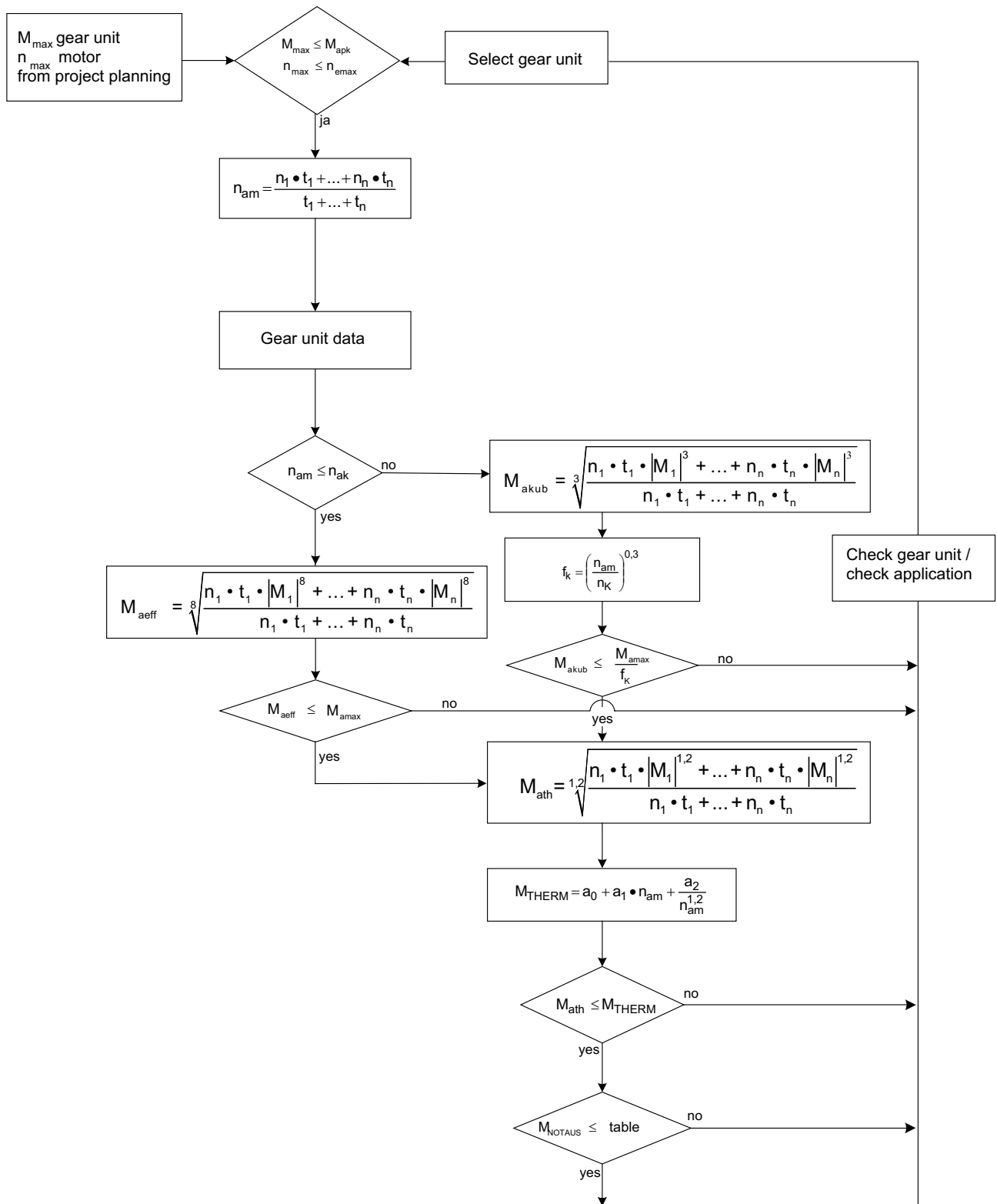
The appropriate drive can be selected once the power and speed of the drive have been calculated and with regard to mechanical requirements.

## 4.3 Project planning procedure

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



### Project planning procedure part 1, servo gear units

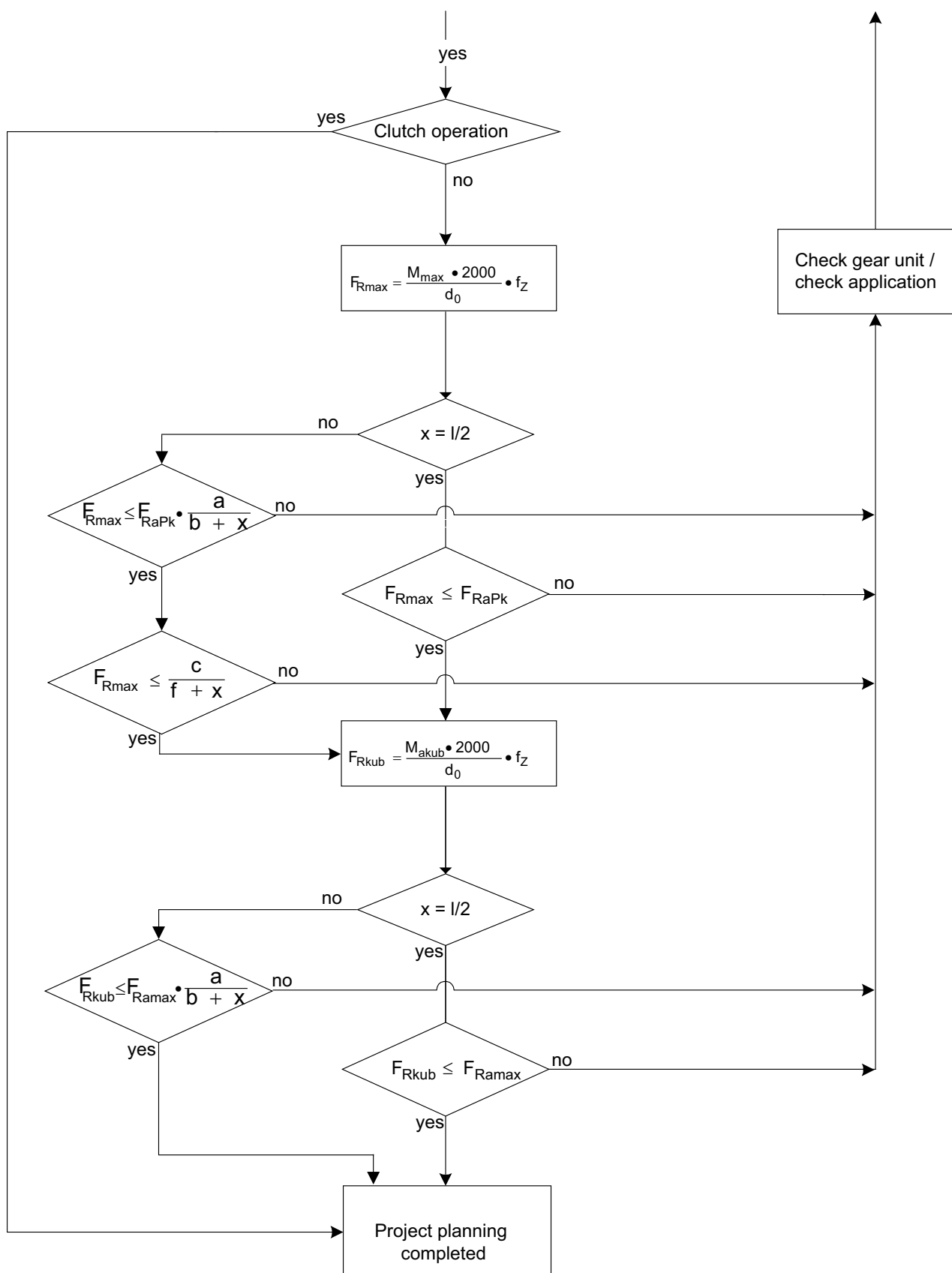


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\* For thermal project planning of R, F, K, S, W gear units, please contact SEW-EURODRIVE.



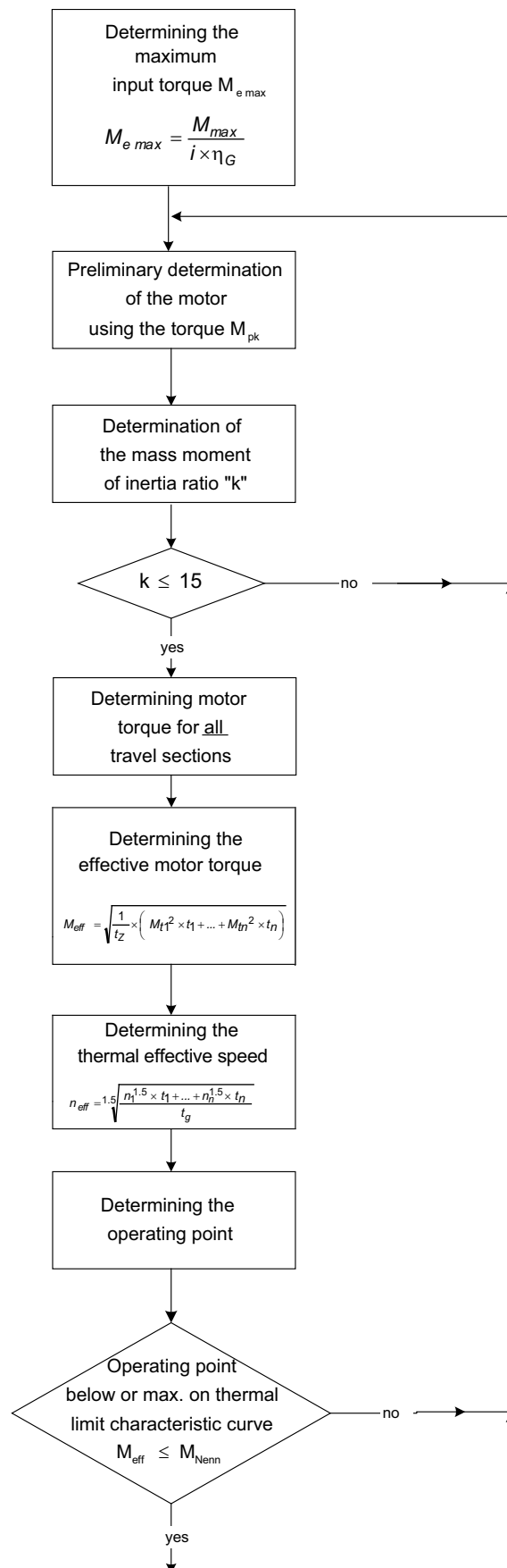
Project planning procedure part 2, servo gear units



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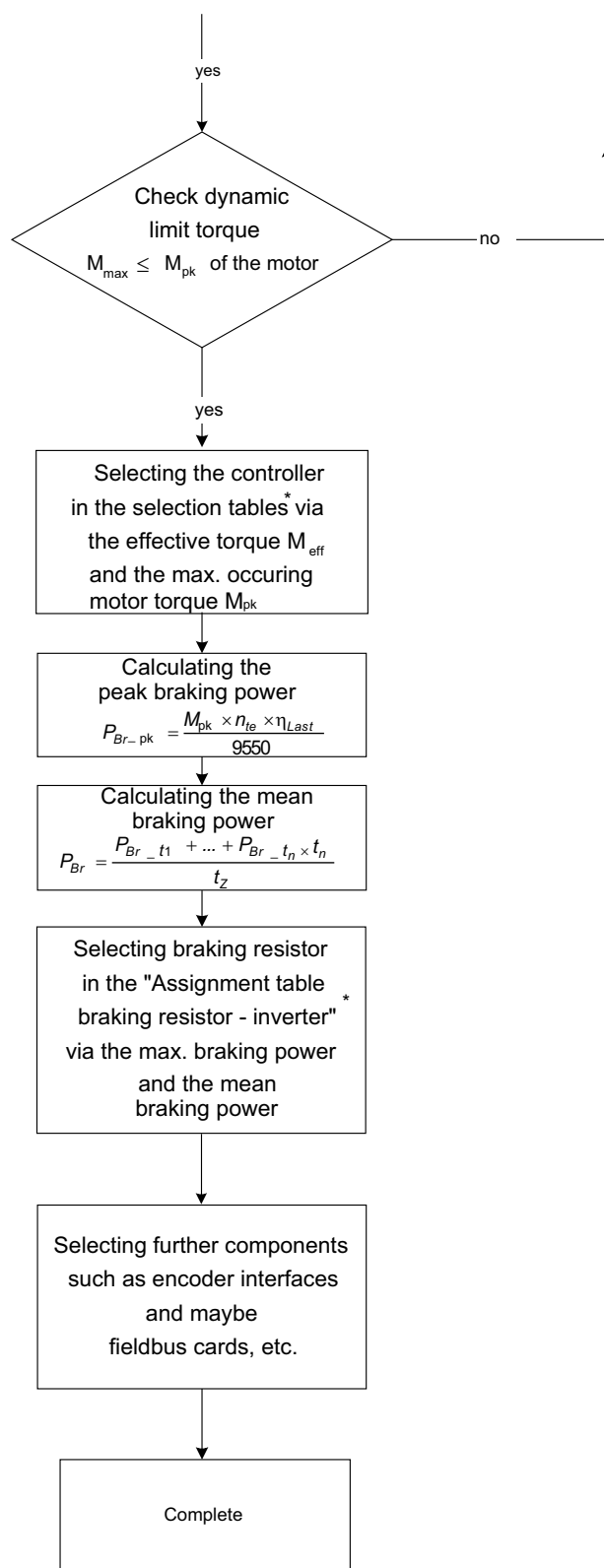


### Project planning procedure part 3, servomotors





### Project planning procedure part 4, servomotors



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\* MOVIDRIVE® system manual, MOVIAXIS® project planning manual



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

##### Efficiency of the gear units

###### General information

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

###### R, F, K gear units

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

###### S and W gear units

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

The efficiency depends on the following factors:

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

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

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

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

###### Self-locking

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



##### NOTE

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



### Run-in phase

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

	Worm	
	i range	$\eta$ reduction
<b>1 start</b>	approx. 50 ... 280	approx. 12 %
<b>2 start</b>	approx. 20 ... 75	approx. 6 %
<b>3 start</b>	approx. 20 ... 90	approx. 3 %
<b>5 start</b>	approx. 6 ... 25	approx. 3 %
<b>6 start</b>	approx. 7 ... 25	approx. 2 %

Spiroplan® W37	
i range	$\eta$ reduction
approx. 30 ... 70	approx. 8 %
approx. 10 ... 30	approx. 5 %
approx. 3 ... 10	approx. 3 %

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

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

### Churning losses

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

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



### Overhung and axial loads

#### Determining overhung loads

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

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

#### Permitted overhung load

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

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



#### NOTE

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



#### NOTE

##### Reduction of overhung loads

- Only 50 % of the  $F_{Rmax}$  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  $F_{Rmax}$  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  $F_{Rmax}$  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  $\alpha$  and the direction of rotation makes it possible to achieve a higher overhung load than listed in the selection tables.

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

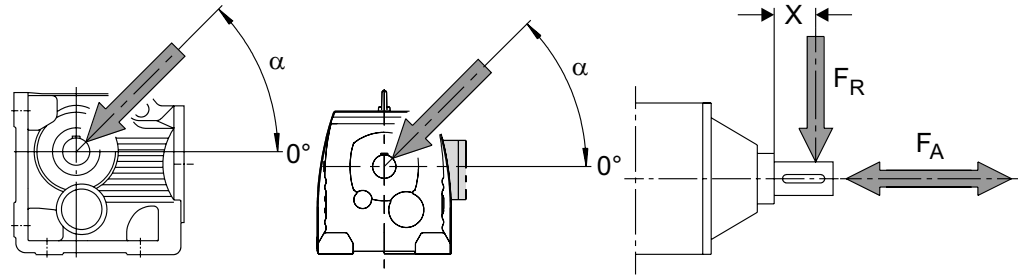
Contact SEW-EURODRIVE in such cases.





**Definition of force application point**

Force application is defined according to the following figure:



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Figure 2: Definition of force application

**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

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

**On the output side:  
Overhung load  
conversion for off-  
center force appli-  
cation**

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

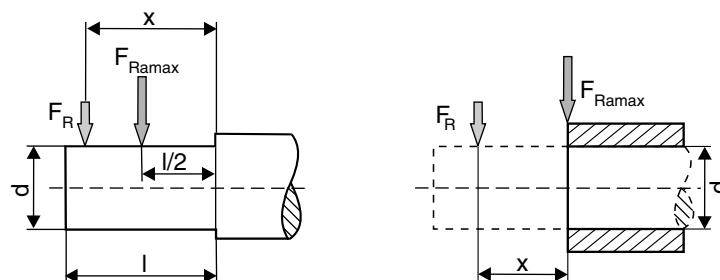
$$F_R \leq F_{Rmax} \cdot \frac{a}{b+x} [N] \quad F_R \leq \frac{c}{f+x} [N]$$

$F_{Rmax}$  = Permitted overhung load [N]

$x$  = Distance from the shaft shoulder to the force application point in [mm]

$a, b, f$  = Gear unit constant for overhung load conversion [mm]

$c$  = Gear unit constant for overhung load conversion [mm]



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



## Project Planning Notes for Servo Gearmotors

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

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

Values for types not listed are available on request.





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

##### Efficiency of gear units

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

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

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

	<b>NOTE</b>
	For PS.F gear units with circumferential backlash option "M" used in operating mode S1, please contact SEW-EURODRIVE.
	<b>NOTE</b>
	When input and output elements are mounted on <b>servo gear units</b> , the <b>shaft shoulder can be used as a stop</b> for transmission elements (belt pulley, pinion gear, etc.).


##### Overhung and axial loads

##### Overhung load calculation

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

$$f_z = f_{z1} \times f_{z2}$$

Transmission element	Transmission element factor $f_{z1}$	Comments
Gears	1.15	< 17 teeth
Chain sprockets	1.40	< 13 teeth
Chain sprockets	1.25	< 20 teeth
Narrow V-belt pulleys	1.75	Influence of the pre-tensioning
Flat belt pulleys	2.50	Influence of the pre-tensioning
Toothed belt pulleys	2.00 - 2.50	Influence of the pre-tensioning
Gear rack pinion, prestressed:	2.00	Influence of the pre-tensioning

	<b>NOTE</b>
	Factor $f_{z2}$ only applies to helical output elements.



## Project Planning Notes for Servo Gearmotors

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

Helical output elements		
Gear unit	Helix angle $\beta^{1) 2)}$	$f_z$
BS.F502-802	$\leq 11^\circ$	1.00
PS.F621-922, PSBF321-521 PS.C221 - PS.C622	$20^\circ$	1.20

1) For  $11^\circ < \beta < 20^\circ$ ,  $f_z$  must be interpolated linearly.

2) For helix angles  $> 20^\circ$ , please contact SEW-EURODRIVE.

#### Permitted overhung load

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

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

	<b>NOTE</b>
	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 $\alpha$ and direction of rotation are based on the most unfavorable conditions.
	<b>NOTE</b>
	<b>Reduction of overhung loads</b> <ul style="list-style-type: none"> <li>Only 50 % of the <math>F_{Rmax}</math> and <math>F_{Rapk}</math> 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.</li> </ul>

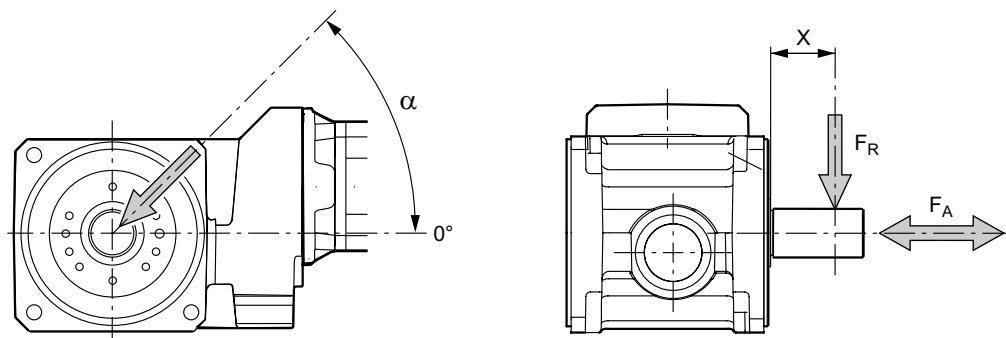
#### Higher permitted overhung loads

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

Contact SEW-EURODRIVE in such cases.

#### Definition of force application point

Force application is defined according to the following diagram:



63232axx

Figure 4: Definition of force application

#### Permitted axial loads

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



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

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

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

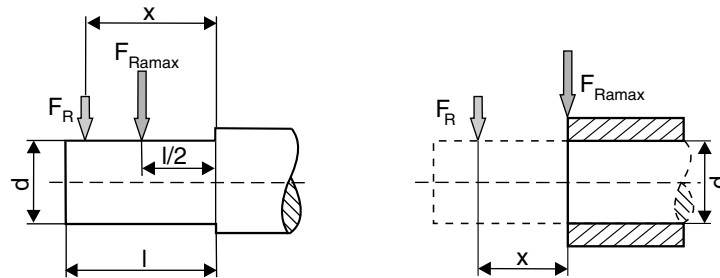
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$F_{R\max}$  = Permitted overhung load [N]

$x$  = Distance from the shaft shoulder to the force application point in [mm]

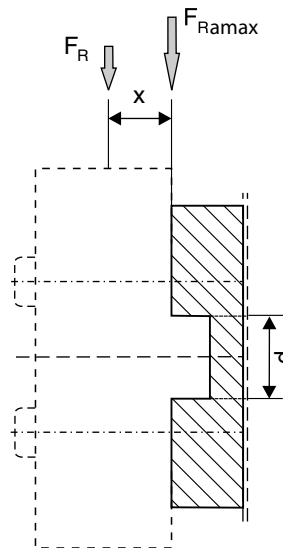
$a, b, f$  = Gear unit constant for overhung load conversion [mm]

$c$  = Gear unit constant for overhung load conversion [mm]



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



63102axx

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



## Project Planning Notes for Servo Gearmotors

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

*Gear unit constants for overhung load conversion*

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

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

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



#### 4.6 Project planning example: Gantry with servo drives

##### X-axis planning (travel axis)

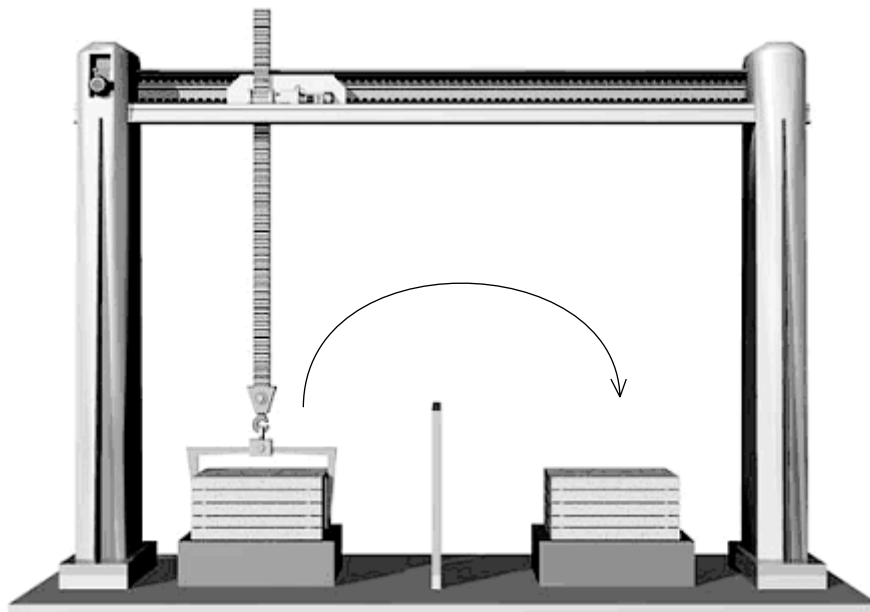


Figure 7: Project planning example: Gantry with servo drives travel axis

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Reference data:

- Total moved mass:  $m_L = 50 \text{ kg}$
- Diameter of the belt pulley:  $d_0 = 75 \text{ mm}$
- Friction coefficient of the axis:  $\mu = 0.01$
- Traveling velocity:  $v_{\max} = 2 \text{ m/s}$
- Maximum occurring acceleration/deceleration:  $a_{\max} = 10 \text{ m/s}^2$
- Cycle time:  $t_z = 3 \text{ s}$
- Rest period:  $t_p = 1.8 \text{ s}$
- Load efficiency:  $\eta_L = 0.9$
- 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

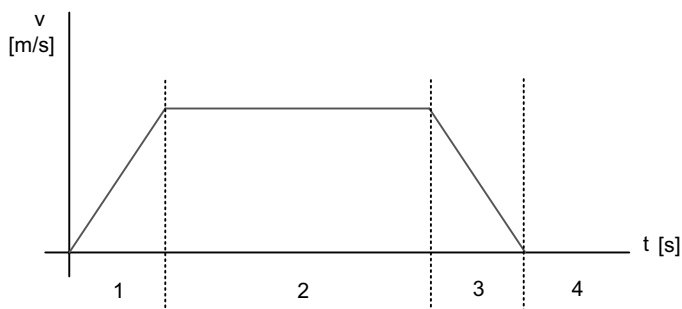


Figure 8: Travel sections 1 - 4

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

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

## Travel time for constant travel in travel section 2

$$\begin{aligned} t_2 &= t_z - t_p - t_1 - t_3 \\ t_2 &= 3 \text{ s} - 1.8 \text{ s} - 0.2 \text{ s} - 0 \\ t_2 &= 0.8 \text{ s} \end{aligned}$$

## $M_{stat}$ for all travel sections

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

## $M_{dyn}$ during acceleration in travel section 1

$$\begin{aligned} M_{dyn} &= \frac{(m \cdot a) \cdot \frac{d_0}{2}}{\eta_L} \\ M_{dyn} &= \frac{50 \text{ kg} \cdot 10 \frac{\text{m}}{\text{s}^2} \cdot \frac{0.075 \text{ m}}{2}}{0.9} \\ M_{dyn} &= 20.83 \text{ Nm} \end{aligned}$$





**$M_{dyn}$  during deceleration in travel section 3**

$$M_{dyn} = m \cdot a \cdot \frac{d_0}{2} \cdot \eta_L$$

$$M_{dyn} = 50kg \cdot \left(-10 \frac{m}{s^2}\right) \cdot \frac{0.075m}{2} \cdot 0.9$$

$$M_{dyn} = -16.875Nm$$

4

**$M_{max}$  during acceleration in travel section 1**

$$M_{max} = M_{stat} + M_{dyn1}$$

$$M_{max} = 0.2043Nm + 20.8333Nm$$

$$M_{max} = 21.04Nm$$

**$M_{max}$  during deceleration in travel section 3**

$$M_{max} = M_{stat} + M_{dyn3}$$

$$M_{max} = 0.2043Nm + (-16.87Nm)$$

$$M_{max} = -16.6657Nm$$

**Output speed**

$$n_{amax} = \frac{v_{max}}{d_0 \cdot \pi} \cdot 60$$

$$n_{amax} = \frac{2 \frac{m}{s}}{0.075m \cdot \pi} \cdot 60$$

$$n_{amax} = 506.295 \frac{1}{min}$$

**Gear ratio including 10% motor speed reserve**

$n_N = 4500 \text{ 1/min}$  is an assumption

$$i = \frac{n_N \cdot 0.9}{n_{amax}}$$

$$i = \frac{4500 \frac{1}{min} \cdot 0.9}{509.295 \frac{1}{min}}$$

$$i = 7.95$$



## Project Planning Notes for Servo Gearmotors

### Project planning example: Gantry with servo drives

#### Maximum input speed

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


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


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

#### Servo gear unit project planning

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

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

	i	M <sub>amax</sub> [Nm]	M <sub>apk</sub> [Nm]	M <sub>aNotaus</sub> [Nm]	n <sub>ak</sub> [rpm]	J <sub>G</sub> 10 <sup>-4</sup> kgm <sup>2</sup>	c <sub>T</sub> PSC [Nm/°]	F <sub>Ra</sub> PSC [N]	F <sub>Rapk</sub> PSC [N]
 <b>PSC221</b> <b>1</b>	3	29	40	60	1500	0.172	3.46	1170	2000
	5	34	42	63	720	0.0578	3.44	1390	2000
	7	32	<b>39</b>	59	800	<b>0.03</b>	3.28	1550	2000
	10	30	37	56	700	0.0144	2.92	1750	2000

	i	n <sub>epk</sub> [rpm]	η [%]	M1;M3;M5-6			M2			M4			φ [°]
	i	n <sub>epk</sub> [rpm]	η [%]	a <sub>0</sub>	a <sub>1</sub>	a <sub>2</sub>	a <sub>0</sub>	a <sub>1</sub>	a <sub>2</sub>	a <sub>0</sub>	a <sub>1</sub>	a <sub>2</sub>	φ [°]
 <b>PSC221</b> <b>1</b>	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	<b>7000</b>	<b>99</b>	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

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

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

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

Selection condition:

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

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

Condition is fulfilled.

### Effective torque of servo gear unit

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

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

$$M_{aeff} = 16.065Nm$$

Selection condition:

$$M_{aeff} \leq M_{amax}$$

$$16.065Nm \leq 32Nm$$

Condition is fulfilled.



### Thermal torque of servo gear unit

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

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

$$M_{ath} = 5.009Nm$$

Thermal factors for mounting position M1

$$a_0 = 186$$

$$a_1 = -0.257$$

$$a_3 = 0$$

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

$$M_{Therm} = 186 + (-0.257 \cdot 169.765 \frac{1}{\text{min}}) + \frac{0}{169.765^{1.2}}$$

$$M_{Therm} = 142.37Nm$$

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 48 and to 51.

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

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

$$F_{Rmax} = 1402N$$

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

Selection condition:

$$F_{Rmax} \leq F_{RaPk}$$

$$1402N \leq 2000N$$

Condition is fulfilled.



### Calculating the bearing force

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

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

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

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

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

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

Selection condition:

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

$$744.8 \text{ N} \leq 1402 \text{ N}$$

Condition is fulfilled.

### Load torques in travel sections 1 to 3

#### Travel section 1

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

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

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

#### Travel section 2

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

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

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



## 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  $M_{pk}$ .

$n_N$ [min <sup>-1</sup> ]	Motor	$M_0$ [Nm]	$I_0$ [A]	$M_{pk}$ [Nm]	$I_{max}$ [A]	$M_{0VR}$ [Nm]	$I_{0VR}$ [A]	$J_{mot}$ [kgcm <sup>2</sup> ]	$J_{bmot}$ [kgcm <sup>2</sup> ]	$M_{B1}$ [Nm]	$M_{B2}$ [Nm]	$L_1$ [mH]	$R_1$ Ω	$U_{p0 \text{ cold}}$ [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

$M_{pk} = 21.4 \text{ Nm}$

$J_{mot} = 1.92 \times 10^{-4} \text{ kgm}^2$

## Determining the inertia ratio "k"

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

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

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

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

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

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

$$k = 7.49$$

Selection condition:

$$k \leq 15$$

$$7.49 \leq 15$$

Condition is fulfilled.



**Intrinsic acceleration or deceleration of motor in sections 1 and 3**

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

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

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

**4**

**Maximum motor torques in sections 1 and 3**

*Travel section 1*

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

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

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

*Travel section 2*

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

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

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

**Effective motor torque**

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

$$M_{eff} = \sqrt{\frac{(3.3999 \text{ Nm})^2 \cdot 0.2 \text{ s} + (0.0294 \text{ Nm})^2 \cdot 0.8 \text{ s} + (-1.9931 \text{ Nm})^2 \cdot 0.2 \text{ s}}{3 \text{ s}}}$$

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

**Thermal effective motor speed**

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

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

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



## Project Planning Notes for Servo Gearmotors

### Project planning example: Gantry with servo drives

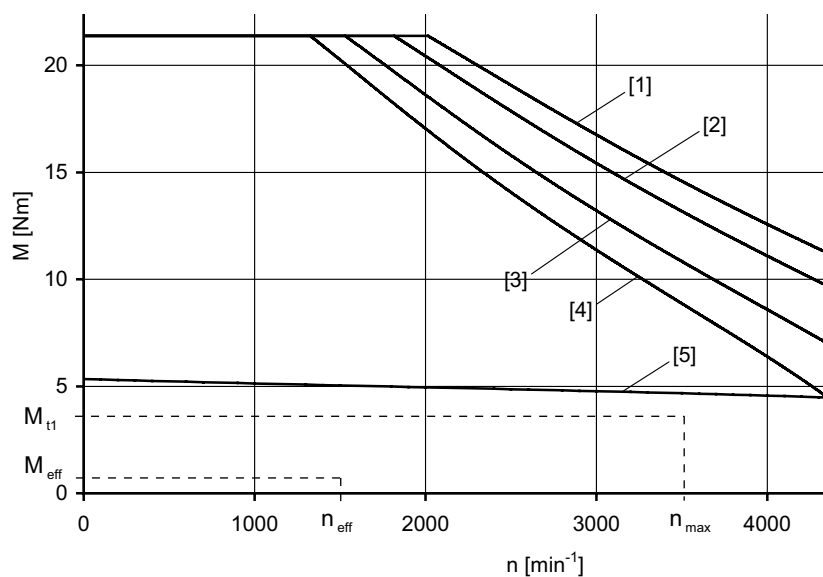
#### Determining the dynamic and thermal motor operating points

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

$$M_{eff} \leq M_{Nem}$$

- 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

$$P_{Br\_pk} = \frac{M_m \cdot n_m \cdot \eta_{Last}}{9550}$$

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

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

Mean braking  
power in travel  
section 3

$$P_{Br} = \frac{M_m \cdot n_m \cdot \eta_{Last}}{9550}$$

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

$$P_{Br} = 0.3348 kW$$

Effective braking  
power

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

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

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

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".