

# PS two-speed gearboxes

## Operating manual

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# 1 User information

This documentation is a part of the product. It applies to products in the standard design according to the corresponding STOBER catalog.

## 1.1 Storage and transfer

As this documentation contains important information for handling the product safely and efficiently, it must be stored in the immediate vicinity of the product until product disposal and be accessible to qualified personnel at all times.

Also pass on this documentation if the product is transferred or sold to a third party.

## 1.2 Original language

The original language of this documentation is German; all other language versions are derived from the original language.

## 1.3 Formatting conventions

Orientation guides in the form of signal words are used to emphasize specific information so that you are able identify it in this documentation quickly.

Safety notes indicate special risks when handling the product and are accompanied by relevant signal words that express the extent of the risk. In addition, warning notes for possible property damage and useful information are also indicated by signal words.

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### **DANGER!**

#### **Danger**

This word with a warning triangle indicates that there is a considerable risk of fatal injury

- if the stated precautionary measures are not taken.
- 

---

### **WARNING!**

#### **Warning**

This word with a warning triangle means there may be a considerable risk of fatal injury

- if the stated precautionary measures are not taken.
- 

---

### **CAUTION!**

#### **Caution**

This word with a warning triangle indicates that minor personal injury may occur

- if the stated precautionary measures are not taken.
- 

---

### **ATTENTION!**

#### **Attention**

This indicates that damage to property may occur

- if the stated precautionary measures are not taken.
-

## Information

Information indicates important information about the product or serves to emphasize a section in the documentation that deserves special attention from the reader.

### Embedded warning information

Embedded warning information is integrated directly into the instruction manual and is structured as follows:

**SIGNAL WORD! Type of hazard, its cause and possible consequences of disregarding it!** Measures for avoiding the hazard.

Signal words in embedded warning information have the same meaning as in the normal warning information described previously.

## 1.4 Limitation of liability

This documentation was created taking into account the applicable standards and regulations as well as the current state of technology.

No warranty or liability claims for damage shall result from failure to comply with the documentation or from use that deviates from the intended use of the product. This is especially true for damage caused by individual technical modifications to the product or the project configuration and operation of the product by unqualified personnel.

## 1.5 Additional documentation

Additional documentation related to the product can be found at

<http://www.stoeber.de/en/downloads/>

Enter the ID of the documentation in the Search... field.

Documentation	ID
Two-speed gearboxes catalog	442712_en
Lubricant filling quantities for gear units	441871

## 1.6 Copyright notice

Copyright © STOBBER. All rights reserved.

## 2 General safety instructions

There are risks associated with the product described in this documentation that can be prevented by complying with the described warning and safety instructions as well as the included technical rules and regulations.

### 2.1 Intended use

The two-speed gearbox described in this documentation is intended for installation in industrial machines or systems. The two-speed gearbox is designed to drive the main feeds on machine tools, test benches and other machines which require alternating high speeds and high torques on one axis.

The following is considered non-intended use:

- Overloading the two-speed gearbox in any way
- Using the two-speed gearbox in ambient conditions that deviate from those described in this documentation
- Modifying or refitting the two-speed gearbox
- Using the two-speed gearbox for a different application than that defined during project configuration

The machine in which the two-speed gearbox is installed may not be commissioned until it is determined that the machine is in compliance with regional laws and guidelines. In particular, the 2006/42/EC Machinery Directive is to be observed in the respective scope.

Operating the two-speed gearbox in potentially explosive areas is not permitted.

### 2.2 Requirements for personnel

All mechanical tasks that arise during the assembly, commissioning, maintenance and removal of the product may be performed only by specialized personnel who hold a corresponding qualification in the field of metal technology.

All electrical tasks that arise during the assembly, commissioning, maintenance and removal of the product may be performed only by electrically skilled persons who hold a corresponding qualification in the field of electrical engineering.

Tasks that arise during transport, storage and disposal may be performed by personnel who have been instructed in the suitable method for doing so.

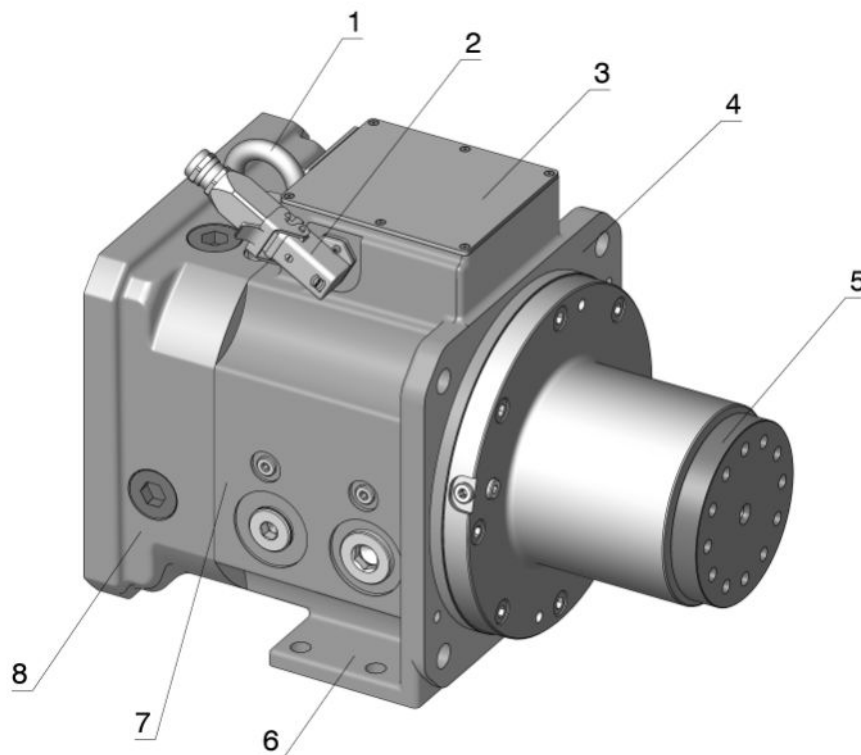
Furthermore, personnel who handle the product must carefully read, understand and observe the valid regulations, legal requirements and applicable basic rules as well as this documentation and the safety instructions it contains.

## 3 Product description

In this chapter, you can find product details that are relevant for assembly, commissioning and maintenance. Detailed technical data on your two-speed gearbox can be found in the order confirmation. You will find more product information and dimensional drawings in the corresponding catalog ([Additional documentation](#) [▶ 5]). The respective separate technical documentation applies to the attached motors.

### 3.1 Structure

The figure below illustrates the basic structure of a two-speed gearbox with flange shaft. The structure of a design with a solid shaft is identical, except for the shaft.



1	Eyebolt	2	Plug connectors
3	Switching unit	4	Output flange
5	Flange shaft	6	Base mount
7	Housing	8	Motor adapter

### 3.2 Type designation

**Example code**

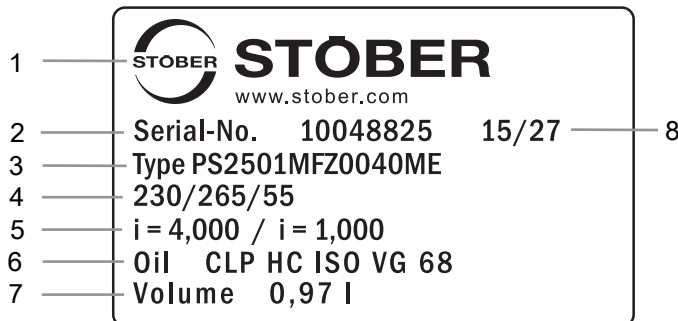
PS	25	0	1	M	F	Z	0040	ME
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**Explanation**

Code	Designation	Design
PS	Type	Two-speed gearboxes
25	Size	25
30		30
0	Generation	Generation 0
1	Stages	Single-stage
S	Housing	Short bearing distance
M		Medium bearing distance
L		Long bearing distance
F	Shaft	Flange shaft
G		Solid shaft without feather key
P		Solid shaft with two feather keys
R	Bearing	Standard bearing (deep-groove ball bearing)
S		Axially reinforced bearing (angular contact ball bearing)
Z		Radially reinforced bearing (cylindrical roller bearing)
0040	Transmission ratio (i x 10)	i = 4 (example)
ME	Motor adapter	Motor adapter with EasyAdapt coupling

### 3.3 Nameplate

The figure below illustrates the nameplate of a two-speed gearbox.



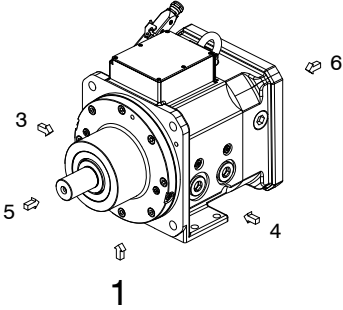
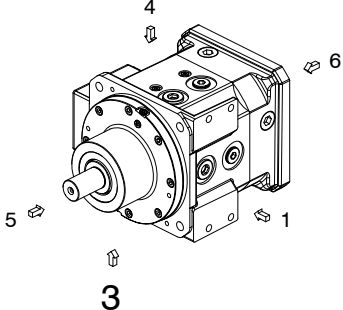
- |   |                                     |   |  |
|---|-------------------------------------|---|--|
| 1 | Name of manufacturer                | 2 | Serial number of the two-speed gearbox   |
| 3 | Type designation                    | 4 | Motor connection dimensions              |
| 5 | Gear ratio of the two-speed gearbox | 6 | Oil specification                        |
| 7 | Oil fill volume                     | 8 | Date of manufacture (year/calendar week) |

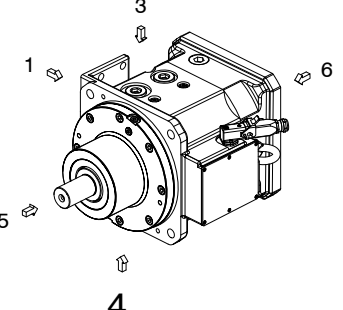
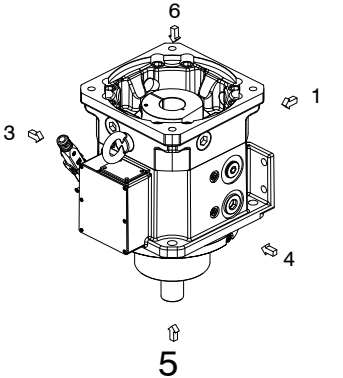


## 3.4 Mounting positions

The following table shows the standard mounting positions.

The numbers indicate the sides of the two-speed gearbox. The mounting position is defined by the side of the two-speed gearbox that is facing downward.

EL1	EL2	EL3
 <p>1</p>	Not permitted	 <p>3</p>

EL4	EL5	EL6
 <p>4</p>	 <p>5</p>	Not permitted

## 3.5 Ambient conditions

Feature	Description
Transport/storage surrounding temperature	-10 °C to +50 °C
Surrounding operating temperature	0 °C to +40 °C
Relative humidity	< 60%
Installation altitude	≤ 1000 m above sea level

### 3.6 Requirements for the circulating lubrication system

Requirements for the circulating lubrication system of the machine that facilitate error-free operation of the two-speed gearbox are described in this chapter.

For circulating lubrication, use gear oil with a specification of CLP HC ISO VG 46. Gear oil with a specification of CLP HC ISO VG 32 can be used if the maximum gear oil temperature of 50 °C is not exceeded in the application. Other gear oil specifications are available on request.

If the two-speed gearbox with circulating lubrication is being operated in your application for several days in a row using a direct gear, the gear oil escapes out of the tothing of the shifting elements due to centrifugal force. This can lead to faults during gear shifting. In application cases such as this, shift into the transmitted gear every 3 days by the latest and allow the main feed motor to spin counterclockwise at 3000 rpm for 30 seconds. The gear unit can be switched back to the direct gear afterwards.

Feature	Description
Specific cooling performance	≥ 0.07 kW/K
Absolute cooling performance	≥ 1.4 kW at $\Delta\vartheta = \vartheta_1 - \vartheta_2 = 60\text{ °C} - 40\text{ °C} = 20\text{ K}$ and $\vartheta_{\text{amb}} = 30\text{ °C}$
Flow rate $q_{v,\text{lub}}$	Refer to the table above
Filter on the two-speed gearbox supply connection	60 µm filter mesh
Inner diameter of threaded fitting on return <sup>1</sup>	≥ 21 mm for G1" thread ≥ 19 mm for G3/4" thread

### 3.7 Performance data

The values specified in the following tables apply to the ambient conditions outlined in Chapter [Ambient conditions \[▶ 9\]](#).

An explanation of the formula symbols can be found in the chapter [Formula symbols \[▶ 45\]](#).

#### 3.7.1 Maximum speeds

Note that the maximum values in the following tables may have to be reduced depending on the specific application. You can find more details in Chapter Permitted speeds and torques.

The table values for speeds in S3 operation apply in the case of a duty cycle ≤ 30%. The table values for S1 operation apply in the case of a duty cycle ≥ 80%. For a duty cycle between 30% and 80%, the maximum speeds can be calculated as follows.

$$n_{1\text{maxS3}^*} = \frac{n_{1\text{maxS1}} - n_{1\text{maxS3}}}{50} \cdot (ED^* - 30) + n_{1\text{maxS3}}$$

<sup>1</sup>Threaded fittings should not limit the line cross-sections specified by threaded connections

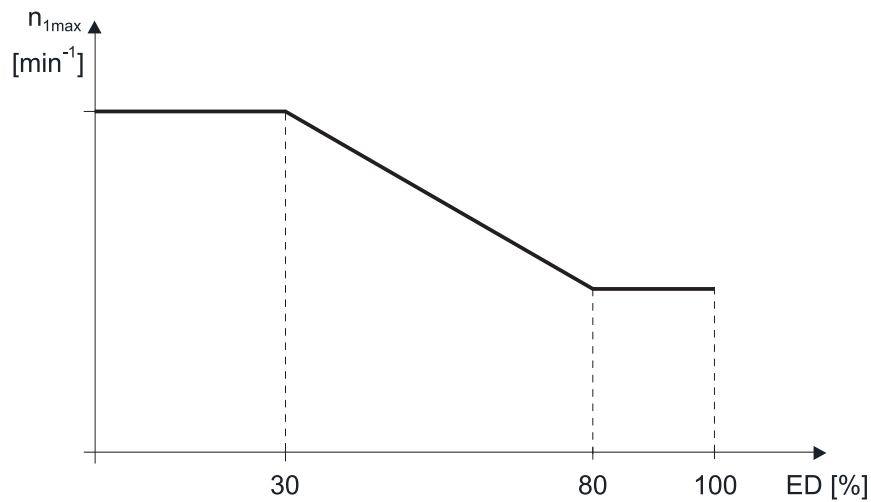


Fig. 1: Maximum speeds in S3 operation

### Maximum speeds with splash lubrication in R (deep-groove ball bearing) or Z (cylindrical roller bearing) design

Type	i	$n_{1maxS1H}$	$n_{1maxS1V}$	$n_{1maxS3H}$	$n_{1maxS3V}$
		EL1, EL3, EL4	EL5	EL1, EL3, EL4	EL5
		S1	S1	S3	S3
		[rpm]	[rpm]	[rpm]	[rpm]
PS2501_0040 ME	4.0	3000	2500	6300	5300
–	1.0	5000	4500	6300	5300
PS2501_0055 ME	5.5	3000	2500	6300	6300
–	1.0	5000	4500	6300	5300
PS3001_0040 ME	4.0	3000	2500	6300	5300
–	1.0	5000	4500	6300	5300
PS3001_0055 ME	5.5	3000	2500	6300	6300
–	1.0	5000	4500	6300	5300

**Maximum speeds with splash lubrication in S (angular contact ball bearing) design**

Type	i	$n_{1maxS1H}$	$n_{1maxS1V}$	$n_{1maxS3H}$	$n_{1maxS3V}$
		EL1, EL3, EL4	EL5	EL1, EL3, EL4	EL5
		S1	S1	S3	S3
		[rpm]	[rpm]	[rpm]	[rpm]
PS2501_0040 ME	4.0	3000	2500	6300	5300
–	1.0	3000	2700	5500	5000
PS2501_0055 ME	5.5	3000	2500	6300	6300
–	1.0	3000	2700	5500	5000
PS3001_0040 ME	4.0	3000	2500	6300	5300
–	1.0	3000	2700	5500	5000
PS3001_0055 ME	5.5	3000	2500	6300	6300
–	1.0	3000	2700	5500	5000

**Maximum speeds with circulating lubrication system**

Type	i	$n_{1maxS1H}$	$n_{1maxS1V}$	$n_{1maxS3H}$	$n_{1maxS3V}$
		EL1, EL3, EL4	EL5	EL1, EL3, EL4	EL5
		S1	S1	S3	S3
		[rpm]	[rpm]	[rpm]	[rpm]
PS2501_0040	4.0	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000
PS2501_0055	5.5	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000
PS3001_0040	4.0	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000
PS3001_0055	5.5	6500	6500	7000	7000
–	1.0	8000	8000	10000	10000

You can find the specifications for the circulating lubrication system in Chapter Circulating lubrication.

### 3.7.2 Torques

Type	i	$P_{N,GB}$	$M_{1N}$	$M_{2N}$	$M_{1max}$	$M_{2max}$
		[kW]	[Nm]	[Nm]	[Nm]	[Nm]
PS2501_0040 ME	4.0	47	300	1200	400	1600
–	1.0	47	300	300	400	400
PS2501_0055 ME	5.5	39	250	1375	400	2200
–	1.0	47	300	300	400	400
PS3001_0040 ME	4.0	47	300	1200	400	1600
–	1.0	47	300	300	400	400
PS3001_0055 ME	5.5	39	250	1375	400	2200
–	1.0	47	300	300	400	400

The nominal torque for the output  $M_{2N}$  is based on the input speed  $n_{1N} = 1500$  rpm.

### 3.7.3 Additional technical data

#### G shaft design (solid shaft without feather key)

Type	$J_1$	m	$\Delta\phi_2$	$v_{swS}$	$v_{swRZ}$
	[kgcm <sup>2</sup> ]	[kg]	[arcmin]	[mm/s]	[mm/s]
PS2501	82	86	30/20	1.0	1.4
PS3001	82	95	30/20	1.0	1.4

#### P shaft design (solid shaft with two feather keys)

Type	$J_1$	m	$\Delta\phi_2$	$v_{swS}$	$v_{swRZ}$
	[kgcm <sup>2</sup> ]	[kg]	[arcmin]	[mm/s]	[mm/s]
PS2501	85	86	30/20	1.0	1.4
PS3001	85	95	30/20	1.0	1.4

#### F shaft design (flange shaft)

Type	$J_1$	m	$\Delta\phi_2$	$v_{swS}$	$v_{swRZ}$
	[kgcm <sup>2</sup> ]	[kg]	[arcmin]	[mm/s]	[mm/s]
PS2501	120	86	30/20	1.0	1.4
PS3001	120	95	30/20	1.0	1.4

The mass moment of inertia  $J_1$  applies to both transmitted and direct gear of the respective shaft design.

The oscillation speed  $v_{sw}$  has been determined in accordance with DIN ISO 10816-1 under the following test conditions:  $n_1 = 5000$  rpm, on the housing of the two-speed gearbox, without load, soft mounting.

### 3.7.4 Permitted speeds and torques

The maximum speeds specified in Chapter [Maximum speeds \[► 10\]](#) must be adapted as follows based on the application.

#### S1 operation

Adjust the maximum permitted input speeds as follows according to the surrounding temperature in your application:

For mounting position EL1, EL3 or EL4:

$$n_{1\max S1H^*} = \frac{n_{1\max S1H}}{fB_T}$$

For mounting position EL5:

$$n_{1\max S1V^*} = \frac{n_{1\max S1V}}{fB_T}$$

$\vartheta_{amb}$	$fB_T$
$\leq 20\text{ °C}$	1.0
$\leq 30\text{ °C}$	1.15
$\leq 40\text{ °C}$	1.3

Tab. 1: Surrounding temperature operating factor

#### S3 operation

Check whether the following condition is met in S3 operation for the actual average input speed  $n_{1m^*}$ .

For mounting position EL1, EL3 or EL4:  $n_{1m^*} < n_{1\max S3H}$

For mounting position EL5:  $n_{1m^*} < n_{1\max S3V}$ .

You can calculate  $n_{1m^*}$  as follows:

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{|n_{2m,1^*}| \cdot t_{1^*} + \dots + |n_{2m,n^*}| \cdot t_{n^*}}{t_{1^*} + \dots + t_{n^*}}$$

Also check whether the following condition is met for the actual effective torque  $M_{2\text{eff}^*}$ :  $M_{2\text{eff}^*} \leq M_{2\max}$

You can calculate  $M_{2\text{eff}^*}$  as follows:

$$M_{2\text{eff}^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}^2 + \dots + t_{n^*} \cdot M_{2,n^*}^2}{t_{1^*} + \dots + t_{n^*}}}$$

The calculations are based on a representation of the power taken from the output in accordance with the following figure.

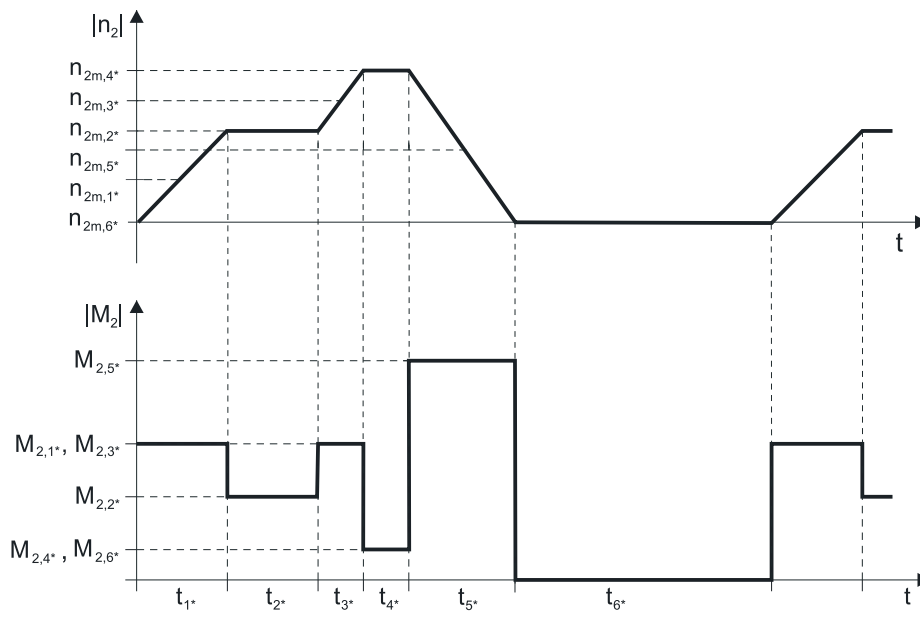


Fig. 2: Example of a cycle in S3 operation

## 4 Transport and storage

### 4.1 Transport

STOBER products are packaged carefully and delivered ready for installation. The type of packaging depends on the product size and the transport method.

Observe the following during transport:

- Inspect the delivery for any transport damage immediately upon receiving it and report any transport damage immediately. Do not put damaged products into operation.
- Check your delivery for completeness using the delivery note and report any missing parts to the supplier.
- Avoid vibrations, impacts and high acceleration during transport.
- Observe the ambient conditions for transport in this documentation.
- Transport the product in the original packaging if possible in order to protect it from damage.
- Only remove the packaging and transport safety devices shortly before assembly.
- Dispose of the packaging at designated disposal locations and observe the local legal regulations that apply when doing so.

#### **WARNING!**

#### **Risk of injury due to heavy loads**

If not handled properly, loads may fall and cause serious injuries or even death!

- Use lifting equipment with a sufficient load capacity. (The weight of your product can be found in the order documents.)
- Check whether the thread of the eyebolt is completely screwed in.
- Attach the two-speed gearbox to the eyebolt intended for this purpose or directly to the housing using a hoist sling.
- The eyebolt of the two-speed gearbox is designed only to support the weight of the two-speed gearbox. Use additional attachment points for loads mounted on the two-speed gearbox, such as motors, and make sure that they do not experience any oblique tension.
- Do not use the centering hole on the output shaft to hold fastening elements for the lifting operation.
- Cordon off the danger zone and ensure that no one stands under the suspended loads.

### 4.2 Storage

The standard storage time of STOBER products is at most 6 months from the date of delivery.

For a longer storage period, the additional measures described in Chapter [Long-term storage \[► 17\]](#) must be taken.

In order to avoid damage to the product, observe the following for storage:

- Store the product in the original packaging if possible in order to protect it from damage.
- Store the product in facilities that are dry, free of dust, free of vibrations and protected from rain and snow.
- Avoid extreme temperature fluctuations in case of high air humidity in order to prevent condensation from forming.
- Protect the product from UV radiation as well as mechanical, chemical and thermal damage, such as scratches, acids, sparks or heat.
- Observe the additional ambient conditions for storage in this documentation.



## 4.2.1 Long-term storage

If you would like to store the two-speed gearbox for longer than 6 months, take the following steps to prevent corrosion damage:

1. Observe the notes in Chapter [Storage |▶ 16](#)
2. Apply a suitable corrosion protection agent to unpainted surfaces, such as shaft ends or flange contact surfaces.
3. Completely fill the two-speed gearbox with gear oil of the same oil specification indicated on the nameplate of the two-speed gearbox.
4. For splash lubrication, reduce the oil fill volume to the correct level before commissioning. Be aware that an incorrect oil fill volume can impair the function of the two-speed gearbox or lead to damage to the two-speed gearbox.
5. For circulating lubrication, completely drain the gear oil from the two-speed gearbox before commissioning.

## 5 Installation

Inspect the two-speed gearbox for transport or storage damage. If the two-speed gearbox has been damaged, do not install it and contact the STOBBER Service department.

Check the oil level before installing a two-speed gearbox with splash lubrication (see the chapter [Checking the oil level](#) [[▶ 40](#)]). A two-speed gearbox with circulating lubrication is installed without oil because it is supplied with lubrication by the circulating lubrication system.

Observe the technical documentation of the motor for the installation and electrical connection of the motor.

The following tools and equipment are required for installing the two-speed gearbox:

- Lifting gear with suitable fastening elements and sufficient load capacity
- Open-end wrench set
- Socket wrench set
- Hexagonal socket insert set
- Torque wrench
- Cleaning agent or solvent

Information about the specific tools or equipment can be found in the respective chapter.

### ATTENTION!

#### Property damage!

Improper handling will result in damage to the two-speed gearbox and motor!

- Do not hit the shafts or housing of the two-speed gearbox or motor with a hammer or other tools.
- Do not expose the two-speed gearbox and motor to compressive stress, impacts or high acceleration.

### 5.1 Mounting the motor on the two-speed gearbox

The motor is mounted on the two-speed gearbox using a motor adapter with clamp coupling. In this process, the motor shaft is coupled with the clamp coupling using a clamping hub. The clamp coupling operates free of any play and is maintenance-free. The easy-to-mount motor adapter has four access holes which can be used for the locking screw depending on the installation situation.

Check the following conditions before installing the motor:

- Does the motor have a smooth shaft? A keyway in the motor shaft has a negative effect on smooth running.
- Do the motor tolerances correspond to the requirements in the chapter [Tolerances](#) [[▶ 20](#)]?
- Does the motor need to be installed on its base mount as well or supported on the B-side (see the chapter [Maximum permitted breakdown torque](#) [[▶ 21](#)])?

For installing the motor, a mounting device (e.g. a suitable piece of pipe) is needed on which the two-speed gearbox with the output flange can be placed. This must not put any load on the output shaft.

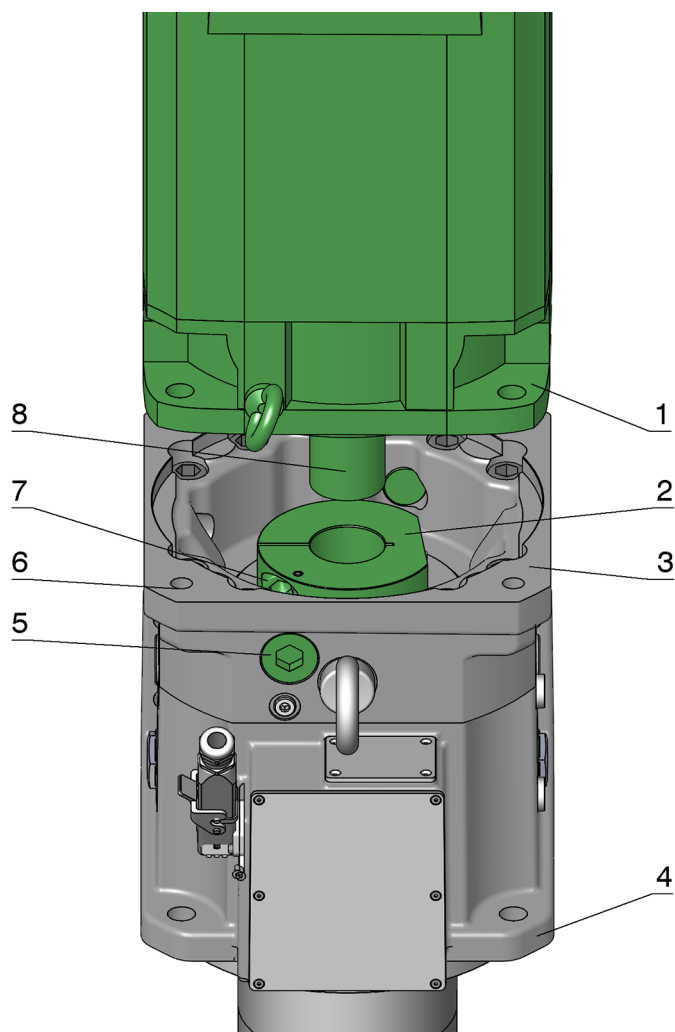


Fig. 3: Installing the motor on the two-speed gearbox

1	Motor flange	2	Clamping hub
3	Motor adapter housing	4	Output flange
5	Screw plug	6	Connection thread
7	Locking screw	8	Motor shaft

Install the motor on the two-speed gearbox as follows:

1. Position the two-speed gearbox vertically using the lifting gear and place it on the mounting device with the output flange.
2. Remove any lubricant from the motor shaft and the bore of the clamping hub. Make sure that solvent does not get into the shaft seal rings.
3. Position the clamping hub so that the locking screw can be screwed into one of the four access holes.
4. Remove the screw plug across from the locking screw and place a suitable hexagon insert with extension in the hexagon socket of the locking screw.
5. Use two suitable attachment points to secure the motor with the lifting gear so that the motor shaft is vertical facing down.
6. Guide the motor shaft into the clamping hub so that it is centered. Make sure it is not at an angle. If the clamping hub is too tight, turn the locking screw approximately 1/4 turn counterclockwise to widen the clamping hub.

7. Rotate the motor relative to the two-speed gearbox so that it is located in the desired mounting position and the bores on the motor adapter and motor flange match up exactly.
8. Install the motor on the two-speed gearbox using four suitable screws of strength class 8.8.
9. Tighten the locking screw using a torque wrench with 210 Nm.
10. Plug the access hole with the screw plug.
11. Pick up the motor and the two-speed gearbox at suitable attachment points and take them off the mounting device.

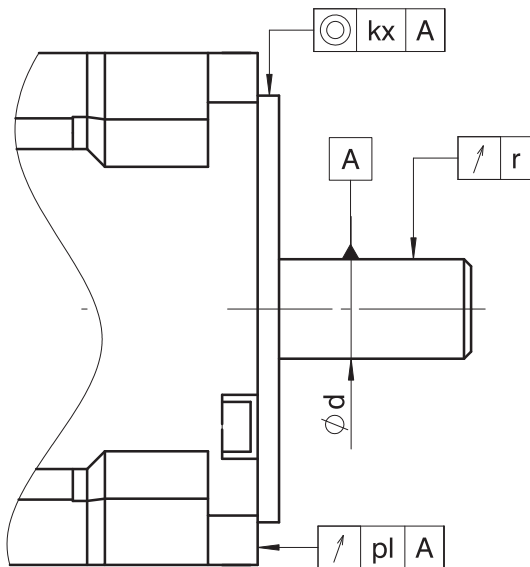
The motor is now fully installed.

### 5.1.1 Tolerances

The motor to be attached must be within the following tolerances for error-free operation.

An explanation of the formula symbols can be found in the chapter [Formula symbols](#) [▶ 45].

#### Tolerance for radial runout, axial runout and concentricity in accordance with IEC 60072-1 (precision class)



Formula symbols	Tolerance
r	25 μm
kx	63 μm
pl	63 μm

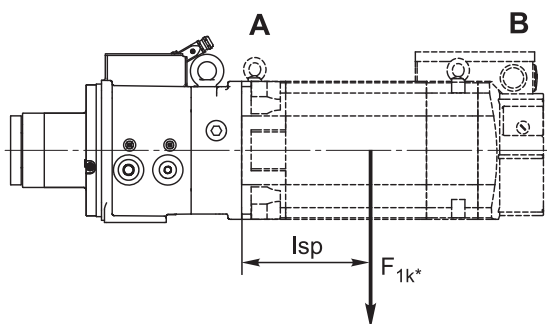
#### Fit tolerances in accordance with EN ISO 286-1

Diameter [mm]	Tolerance
d < 55	ISO k6
d ≥ 55	ISO m6

## 5.1.2 Maximum permitted breakdown torque

This chapter contains information on calculating the maximum permitted tilting torque on a gear unit input.

An explanation of the formula symbols can be found in the chapter [Formula symbols \[▶ 45\]](#).



A Attachment or output side of the motor

B Rear of the motor

Calculate the existing tilting torque at the gear unit input as follows:

$$M_{1k*} = F_{1k*} \cdot lsp.$$

If the calculated tilting torque is > 1000 Nm, also install the motor at its foot mount (IMB35 design) or use a tension-free means of supporting it on the B side. The motor must also be installed on its foot mount if you do not use a flange to install the two-speed gearbox and instead only install it at the foot mount.

## 5.2 Installing the two-speed gearbox

The two-speed gearbox is installed on the machine using the output flange or the foot mount.

Check the following before installing the two-speed gearbox:

- Is the substructure at the installation location even and resistant to warpage?
- Can the cooling air flow to and away from the motor unhindered?
- Can the motor be installed on the two-speed gearbox ahead of time in order to avoid jamming the motor shaft? (Chapter [Mounting the motor on the two-speed gearbox \[▶ 18\]](#))
- Can the transmission element (gear, sprocket, belt drive, coupling hub) be installed on the output shaft ahead of time?
- Does the motor installed on the two-speed gearbox need to be installed on its foot mount or be supported on the B-side? (See [Maximum permitted breakdown torque \[▶ 21\]](#).)

The oil fill volume for a two-speed gearbox with splash lubrication depends on the mounting position. If the mounting position of the two-speed gearbox is different from that in the order information, or if tilted positions result in conjunction with the belt tensioners, coordinate the correct oil fill volume with STOBBER in order to prevent damage to the two-speed gearbox.

Install the two-speed gearbox on the machine as follows:

1. Remove the transport packaging of the two-speed gearbox.
2. Completely remove the corrosion protection from the output shaft and the unpainted contact surfaces of the flange or foot mount. Make sure that solvent does not get into the shaft seal rings.
3. Secure the two-speed gearbox with the lifting gear, taking into account the mounting position. Fasten the attached motor separately. Observe the notes in Chapter [Transport \[▶ 16\]](#) in doing so.
4. Transport the two-speed gearbox (and the attached motor) to the installation location.
5. To fasten on the output flange, fit the two-speed gearbox housing to the pilot (h6).

6. Install the two-speed gearbox on the output flange or the foot mount with suitable screws of strength class 10.9 and tighten them with the corresponding tightening torques.
7. Install the motor according to its documentation and requirements from Chapter [Maximum permitted breakdown torque](#) [▶ 21].

## 5.2.1 Installing the belt drive on the flange shaft

In certain applications, a belt drive is installed on the flange shaft of the two-speed gearbox.

Take the following into account before installing the belt drive:

- The belt drive must have a state of balance rating of 6.3 in accordance with the VDI 2060 guideline for the respective operating speed in order to ensure low-vibration operation.
- The outer diameter of the flange shaft has the tolerance k6.
- The inner diameter of the belt drive must be  $\geq 142$  mm.

Install the belt drive on the flange shaft as follows:

1. If the belt drive will not or is difficult to slide onto the output flange, heat the belt drive.
2. Center the belt drive on the flange shaft.
3. Install the belt drive with suitable screws of strength class 10.9 and tighten them with the corresponding torque.

**ATTENTION! Exceeding the permitted radial forces can cause bearing damage to the two-speed gearbox!**

Observe the permitted radial forces for the flange shaft when tensioning the belt (see the chapter [Additional documentation](#) [▶ 5]).

## 5.2.2 Installing transmission elements on a solid shaft

Transmission elements can be installed on the solid shaft of the two-speed gearbox.

Take the following into account when installing transfer elements:

- The solid shaft is equipped with a centering thread in accordance with DIN 332-2. It can be used to fit and axially secure transfer elements such as gears, sprockets, drive belts or coupling hubs using a central screw.
- The optional feather keys correspond to DIN 6885-1.

## 5.3 Changing the orientation of the plug connector

The orientation of the plug connector can be changed on a two-speed gearbox with dimension  $a6 \leq 260$  mm if this is necessary for line routing.

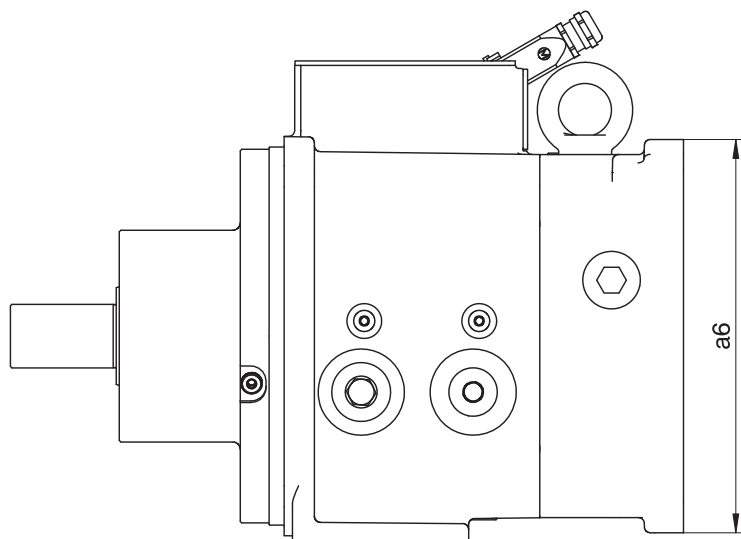
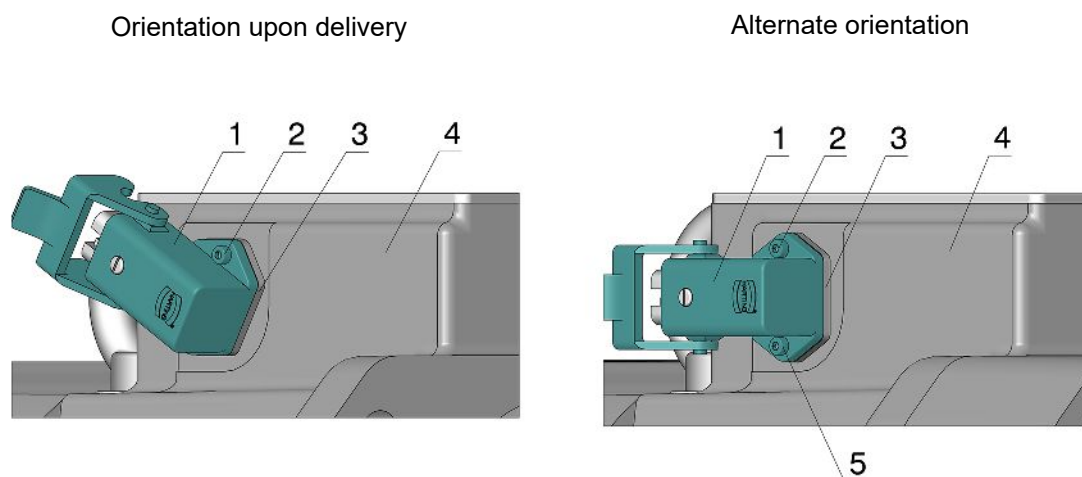


Fig. 4: Dimension a6



- 1 Plug connector housing
- 3 Plug connector sealing
- 5 Cylinder screw

- 2 Cylinder screw
- 4 Switching unit housing

You can change the orientation of the plug connector as follows:

1. Unscrew both cylinder screws from the plug connector housing.
2. Position the housing and the plug connector sealing in the alternate position.
3. Install the plug connector housing on the switching unit housing using both cylinder screws. Make sure that lines do not get jammed between the plug connector housing and the switching unit housing and that the sealing fits correctly.

## 5.4 Connecting the circulating lubrication system

A two-speed gearbox with (optional) circulating lubrication is supplied with lubricant via the circulating lubrication system of the machine.

Connect the two-speed gearbox to the circulating lubrication system as follows:

1. Make sure that there is access to the necessary supply and return connections of the two-speed gearbox (see the chapter Connections and flow rates).
2. Remove the corresponding screw plugs.
3. Connect the supply and return lines to the two-speed gearbox in the appropriate order and observe the following notes when doing so.

**ATTENTION! Dry running or an oil level that is too low can cause damage to the two-speed gearbox!**

Install a check valve on the supply connection of the two-speed gearbox so that the oil level does not drop in the event of a malfunction.

Install an oil level sensor on the oil tank to shut off the motor in case of malfunction.

In the event of a failure in the circulating lubrication system, a two-speed gearbox can generally be operated with splash lubrication at the corresponding maximum speeds. In a case like this, make sure that the two-speed gearbox remains filled with the required oil volume. Information on the oil fill volume can be found in Chapter [Additional documentation](#) [[▶ 5](#)].

**ATTENTION! Performance of the two-speed gearbox decreases if the oil level is too high!**

Always lay the return line so that it runs beneath the return connection of the two-speed gearbox.

If your circulating lubrication system does not have a suction pump for the return, lay the return line vertically running downward from the two-speed gearbox to the circulating lubrication system.



## 5.4.1 Connections and flow rates

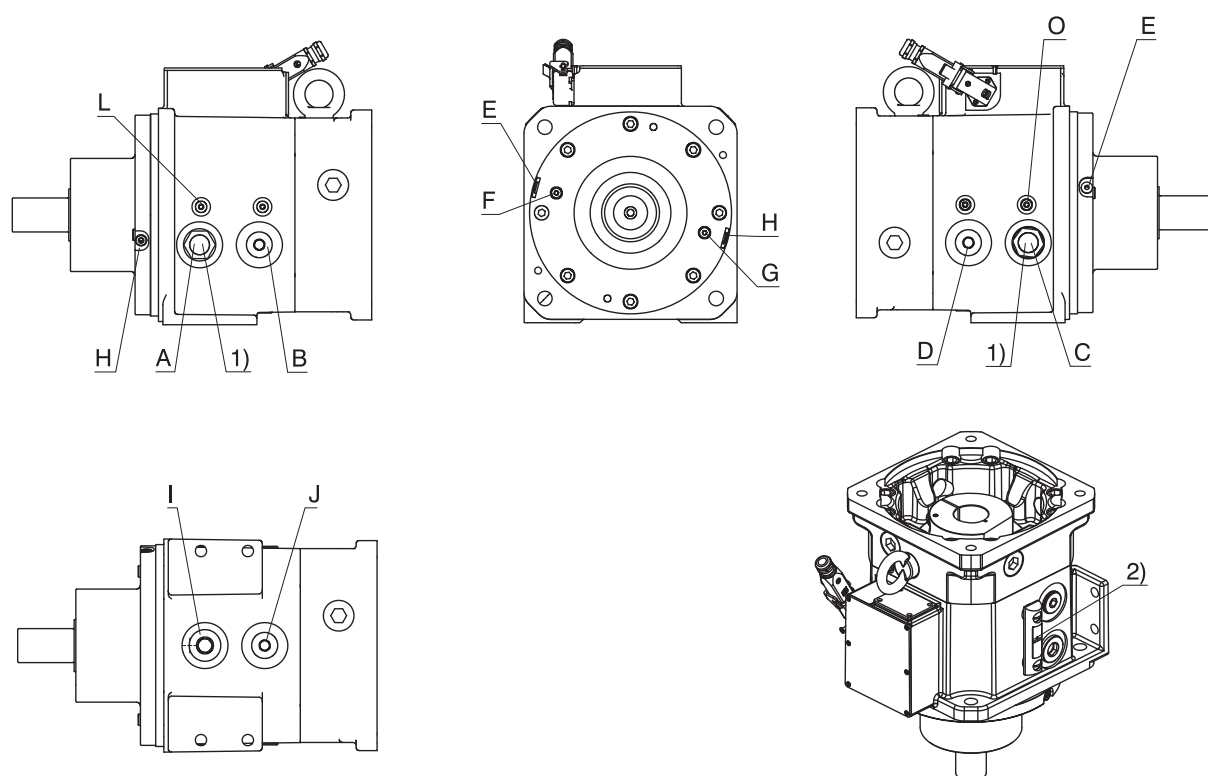


Fig. 5: Position of the connections

- 1 Oil sight glass for splash lubrication and EL1      2 Oil level gauge for splash lubrication and EL5 (optional)

In the following table, note that:

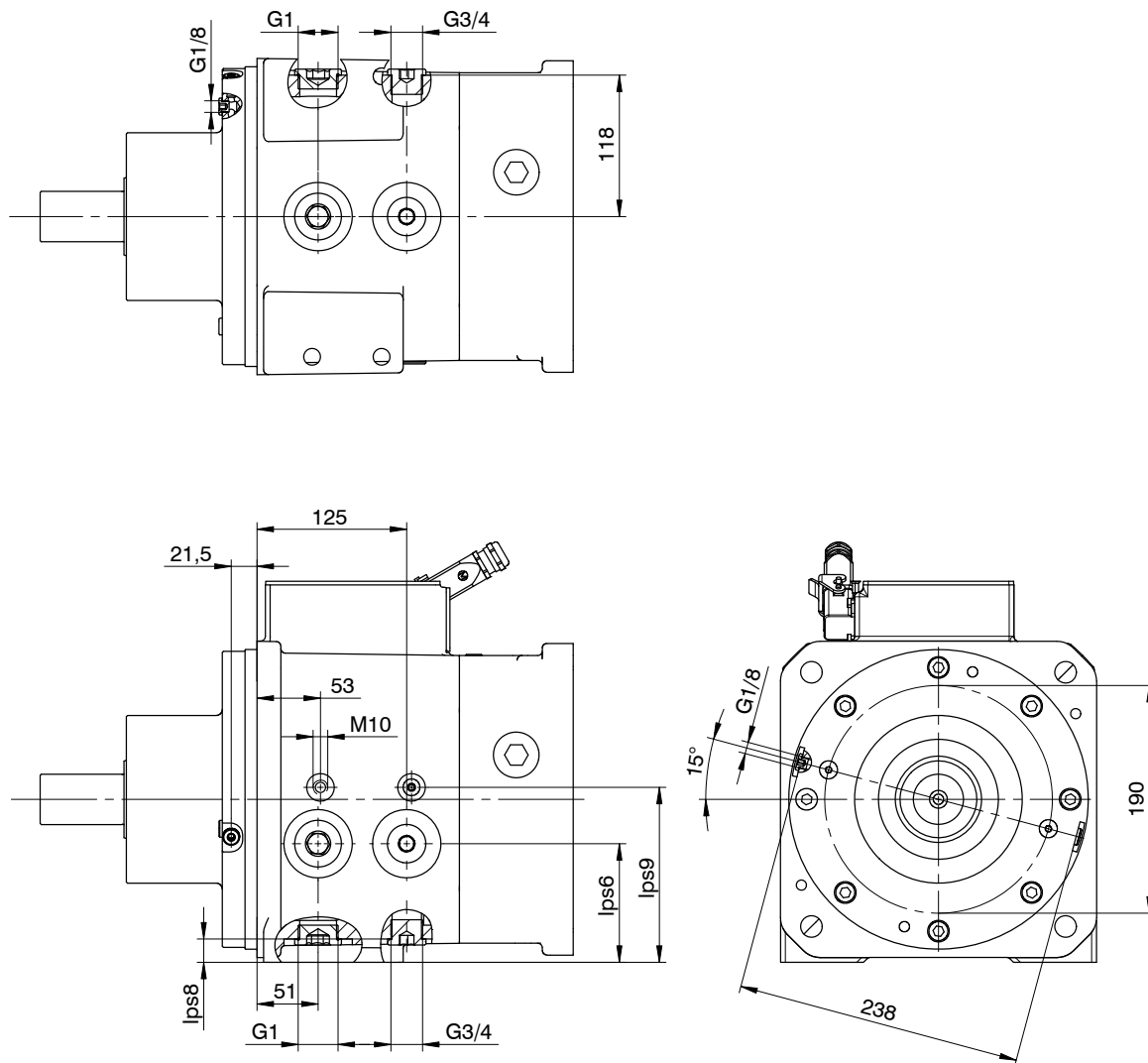
- Two supply connections and one return connection are used in some mounting positions.
- The flow rate for the return must always be slightly higher than the total flow rate for the supply.

Mounting position, main direction of rotation	Supply connection 1		Supply connection 2		Return connection	
	Designation	$q_{v,lub}$ [l/min]	Designation	$q_{v,lub}$ [l/min]	Designation	$q_{v,lub}$ [l/min]
EL1, cw	B	$\geq 2$	E/F/G/H	$\geq 1$	C	$> 3$
EL1, ccw	D	$\geq 2$	E/F/G/H	$\geq 1$	A	$> 3$
EL3, cw and ccw	D	$\geq 2$	E/F/G/H	$\geq 1$	I	$> 3$
EL4, cw and ccw	B	$\geq 2$	E/F/G/H	$\geq 1$	I	$> 3$
EL5, cw and ccw	E/F/G/H	$\geq 3$	–	–	B/D	$> 3$
EL6, cw and ccw	Not permitted					

Tab. 2: Flow rates and connections for circulating lubrication

The forward slash (/) is used to mean "or" for specifying several alternative options.

**Dimensions of the connections for circulating lubrication**



Type	lps6	lps8	lps9
PS25	99	19.5	146
PS30	127	46.0	174

## 6 Electrical connection and programming

### 6.1 Connecting the switching unit

The switching unit must be connected to the machine control system so that the gears of the two-speed gearbox can be shifted. Different specifications apply to the switching unit with microswitches and SensorShift PCB.

For compatibility reasons, the switching unit with SensorShift PCB can be connected like a switching unit with microswitches and activated using the polarity of the power supply.

**ATTENTION!** An incorrect connection can damage the switching unit! The electrical connection may be performed only by a qualified electrically skilled person.

Perform all tasks on completely de-energized switching unit and motor connection cables.

Do not lay the control lines for the switching unit parallel to the lines of the motor. Otherwise, they must be shielded so that the signals are not distorted due to electromagnetic fields from the motor.

#### 6.1.1 Connecting switching unit with SensorShift PCB

An electronic actuator control system called a SensorShift PCB is integrated into the switching unit. The digital inputs of the SensorShift PCB can be connected to the outputs of the machine control system directly.

Connect the plug connector of the switching unit with the machine control system using the corresponding mating connector according to the following specifications.

##### Electrical specification

Feature	Value
Nominal voltage	24 V DC -10%, +20%
Nominal current at gear shift	0.6 A
Starting current at gear shift	5 A
Maximum current of contacts S1 – S3	2 A (use 2 A fuse (time delay) for fuse protection)
Expected service life of S1 – S3	500000 switching cycles (30 V DC, 1 A ohmic load)
Low-level digital inputs	0 – 8 V DC
High-level digital inputs	12 – 30 V DC
Input current for digital inputs	< 10 mA
Debounce time for digital inputs	100 ms
Shock resistance	20 g (10 Hz ≤ f ≤ 500 Hz)

In setting up the power supply, take into account the voltage losses in the lines, the contact resistance values and the increased resistance over time as a result of corrosion.

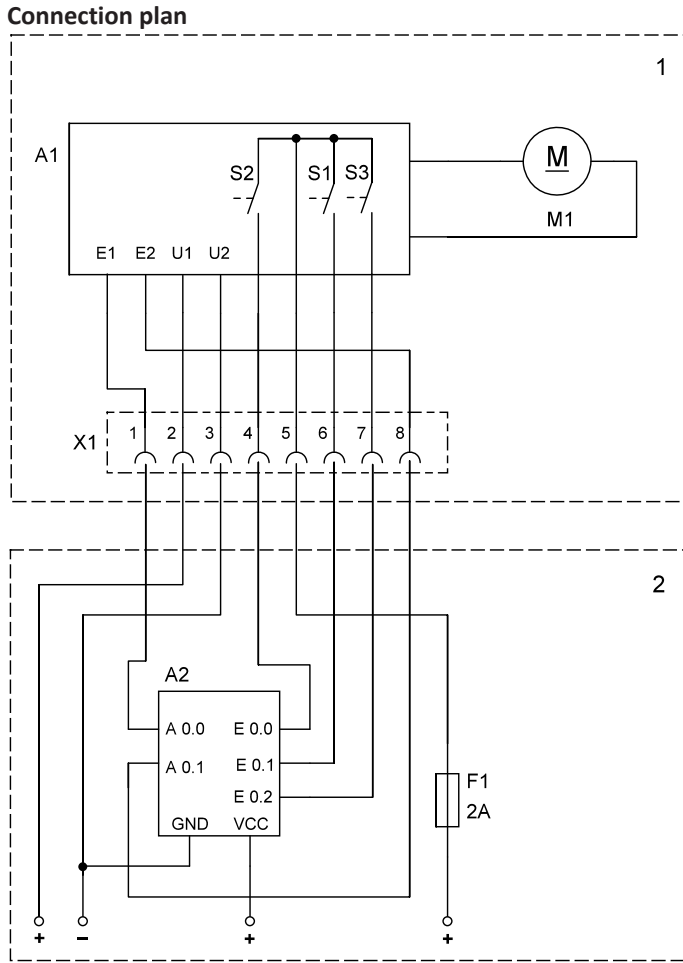


Fig. 6: Connection plan for the switching unit with SensorShift PCB

- |    |                                    |    |                         |
|----|------------------------------------|----|-------------------------|
| 1  | Switching unit                     | 2  | Machine control cabinet |
| A1 | Electronic actuator control system | A2 | PLC                     |
| F1 | Fine-wire fuse, time delay         | M1 | Switching motor         |
| X1 | Plug connectors                    |    |                         |

The connections for the power supply of the switching unit (X1, pin 2), PLC (A2, pin VCC) and reference potential for contacts S1 – S3 (X1, pin 5) can be connected to separate voltage sources as well as to one common voltage source.

Pin	Signal	Description
1	E1	Digital input for gear shifting
2	U1	Power supply
3	U2	Reference potential for power supply, E1 and E2
4	S2	Contact for transmitted gear (4:1 or 5.5:1)
5		Reference potential for contact S1 – S3
6	S1	Contact for direct gear (1:1)
7	S3	Contact for neutral position
8	E2	Digital input for gear shifting

Tab. 3: X1 plug connector terminal assignment

More information on plug connectors and connection cables can be found in the chapter [Plug connectors and connection cables](#) [▶ 31].

## 6.1.2 Connecting a switching unit with SensorShift PCB as replacement for a switching unit with microswitches

The switching unit with SensorShift PCB can be used as a replacement for a switching unit with microswitches without any additional steps, requiring no changes to the wiring in the machine control cabinet or the machine control system software as a result.

Connect the plug connector of the switching unit with the machine control system using the corresponding mating connector according to the following specifications.

### Connection plan

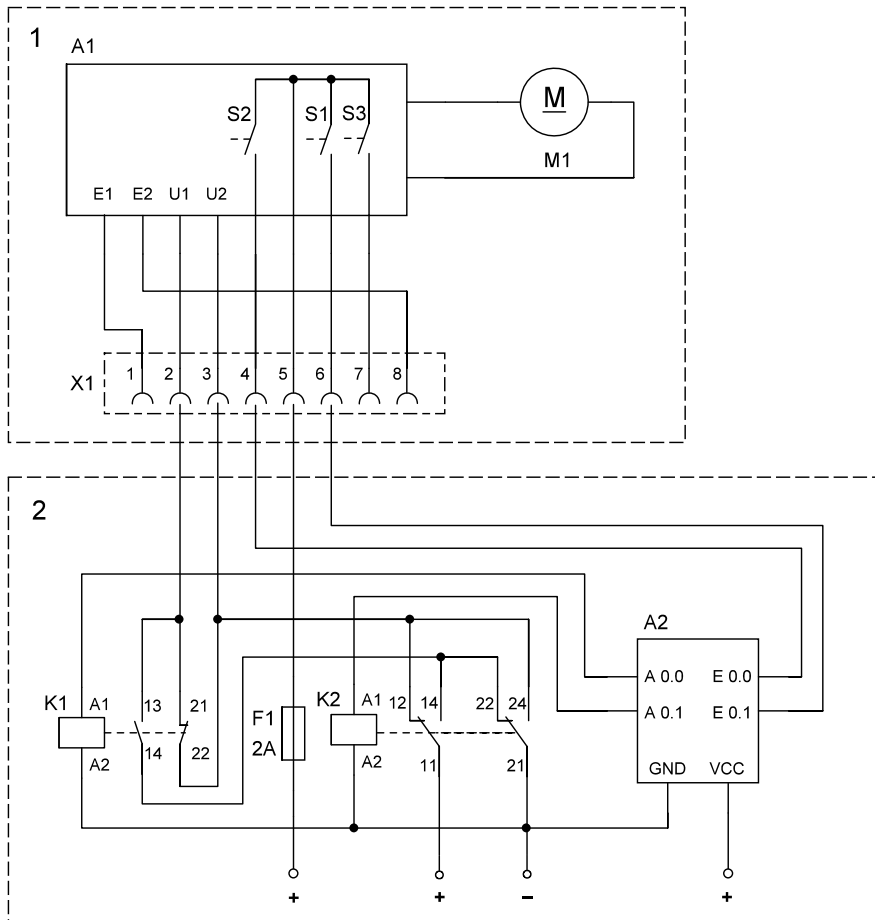


Fig. 7: Connection plan for a switching unit with SensorShift PCB as replacement for a switching unit with microswitches

1	Switching unit	2	Machine control cabinet
A1	Electronic actuator control system	A2	PLC
F1	Fine-wire fuse, time delay	K1	Relay for switching the switching motor on and off
K2	Relay for reversing the polarity of the power supply	M1	Switching motor
S1	Contact for direct gear (1:1)	S2	Contact for transmitted gear (4:1 or 5.5:1)
X1	Plug connectors		

The connections for the power supply of the switching unit (K2, pin 11), PLC (A2, pin VCC) and reference potential for contacts S1 – S3 (X1, pin 5) can be connected to separate voltage sources as well as to one common voltage source.

More information on plug connectors and connection cables can be found in the chapter [Plug connectors and connection cables](#) [▶ 31].

### 6.1.3 Connecting a switching unit with microswitches

In the switching unit design with microswitches, the position of the actuator is determined using a cam and microswitches. The machine control system has to analyze these signals in realtime and activate the switching motor accordingly.

Set up a relay switch for actuating the switching motor according to the following connection plan.

Connect the plug connector of the switching unit with the machine control system using the corresponding mating connector.

#### Electrical specification

Feature	Value
Switching motor nominal voltage	24 V DC ± 10%
Switching motor nominal current	0.6 A
Switching motor starting current	2.76 A
Microswitch nominal voltage	24 V DC
Microswitch nominal current	1 A

Note the following information:

- The specified nominal switching motor voltage has to be applied directly at the switching motor connections. Therefore, in setting up the power supply, take into account the voltage losses in the lines, the contact resistance values and the increased resistance over time as a result of corrosion.
- The microswitches must be energized only by the control current and not by current from the switching motor.

#### Connection plan

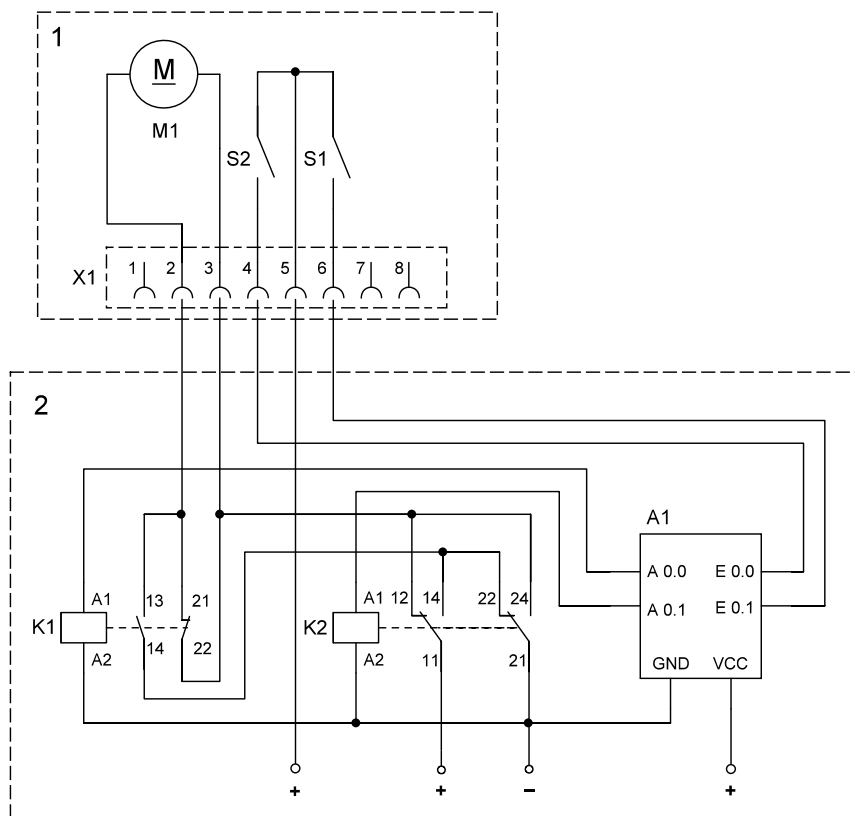


Fig. 8: Connection plan for the switching unit with microswitches

1	Switching unit	2	Machine control cabinet
A1	PLC	K1	Relay for switching the switching motor on and off
K2	Relay for reversing the polarity of the power supply	M1	Switching motor
S1	Microswitches for direct gear (1:1)	S2	Microswitches for transmitted gear (4:1 or 5.5:1)
X1	Plug connectors		

The connections for the power supply of the switching unit (K2, pin 11), PLC (A2, pin VCC) and reference potential for contacts S1 – S3 (X1, pin 5) can be connected to separate voltage sources as well as to one common voltage source.

More information on plug connectors and connection cables can be found in the chapter [Plug connectors and connection cables](#) [▶ 31].

## 6.1.4 Plug connectors and connection cables

This chapter contains information about the plug connectors and connection cables that are required to connect the switching unit with the machine control system.

In the switching unit, a Harting Han 8 D-M plug connector is installed according to the following connection diagram.

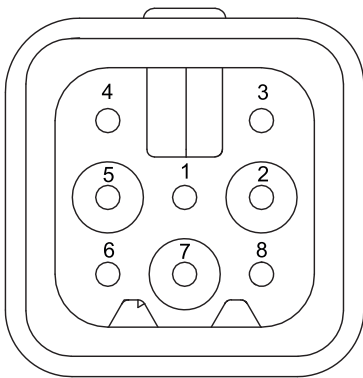


Fig. 9: Connection diagram for plug connector X1

The mating connector for the plug connector is supplied by STOBBER along with the two-speed gearbox if you selected this option when placing the order.

Feature	Value
Connection socket	Han 8D-F Quick Lock 1.5 mm <sup>2</sup>
Connector housing	Han 3A-GG-M20
Cable screw connection	Han CGM-M M20x1.5

Tab. 4: Specifications of the mating connector for the switching unit (example)

The following specifications apply to the connection cable that connects the mating connector with the machine control system:

Feature	Value
Conductor cross-section	0.25 – 1.5 mm <sup>2</sup>
Insulation stripping length	10 mm
Cable type	Fine stranded wires in accordance with VDE 0295 class 5 (e.g. H05V-K)
Clamping area of the cable screw connection	6 – 13 mm

Tab. 5: Specifications for the connection cable

To establish a reliable connection, observe the technical documentation from the manufacturer (Harting) for the plug connector, such as the following video assembly instructions: <https://www.youtube.com/watch?v=OrVfcCuMYcs>. Do not use any cables with solid conductors or twisted pairs; comply with the cable specifications.



## 6.2 Programming gear shifting

Program the machine control system as follows to shift the gears of the two-speed gearbox.

Before testing gear shifting, commission the two-speed gearbox and the motor.

### 6.2.1 Sequence diagram for switching unit with SensorShift PCB

The following sequence diagram describes the gear shift process for the switching unit with SensorShift PCB.

Note the following information:

- Details on oscillations can be found in Chapter [Oscillations](#) [▶ 35].
- Details on the electrical signals for gear shifting can be found in Chapter [Electrical signals](#) [▶ 36].
- In some applications, strong vibrations can change the position of the switching mechanism. If the controller constantly monitors and evaluates contacts S1 – S3, this kind of position change can be detected and damage to the switching mechanism can be prevented.

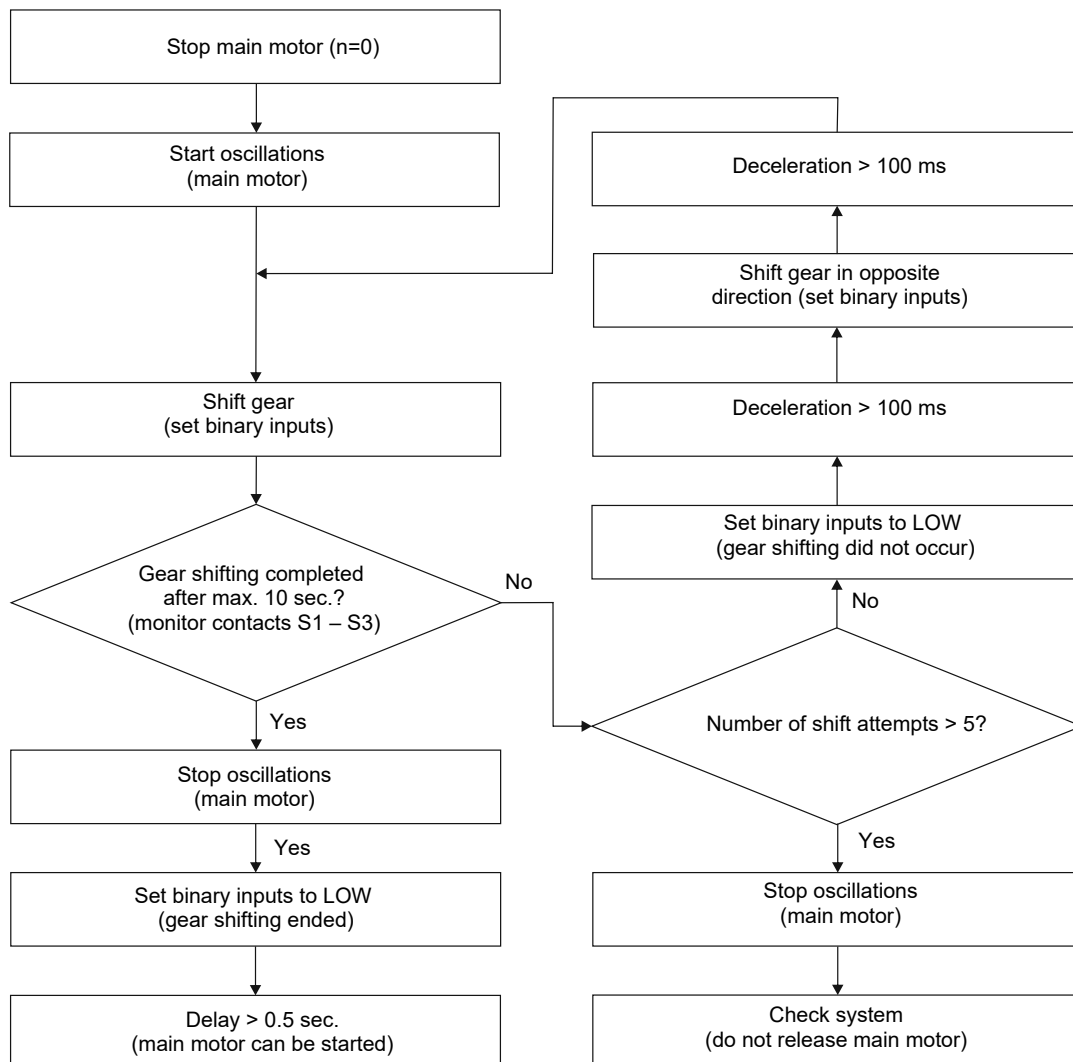


Fig. 10: Sequence diagram for the switching unit with SensorShift PCB

## 6.2.2 Sequence diagram for switching unit with microswitches or with SensorShift PCB as replacement for microswitches

The following sequence diagram describes the gear shift process for the switching unit with microswitches or the switching unit with SensorShift PCB, which is activated like the switching unit with microswitches for compatibility reasons.

Note the following information:

- Details on oscillations can be found in Chapter [Oscillations](#) [▶ 35].
- Details on the electrical signals for gear shifting can be found in Chapter [Electrical signals](#) [▶ 36]
- The limit switches S1 – S3 should be monitored only during gear shifting.

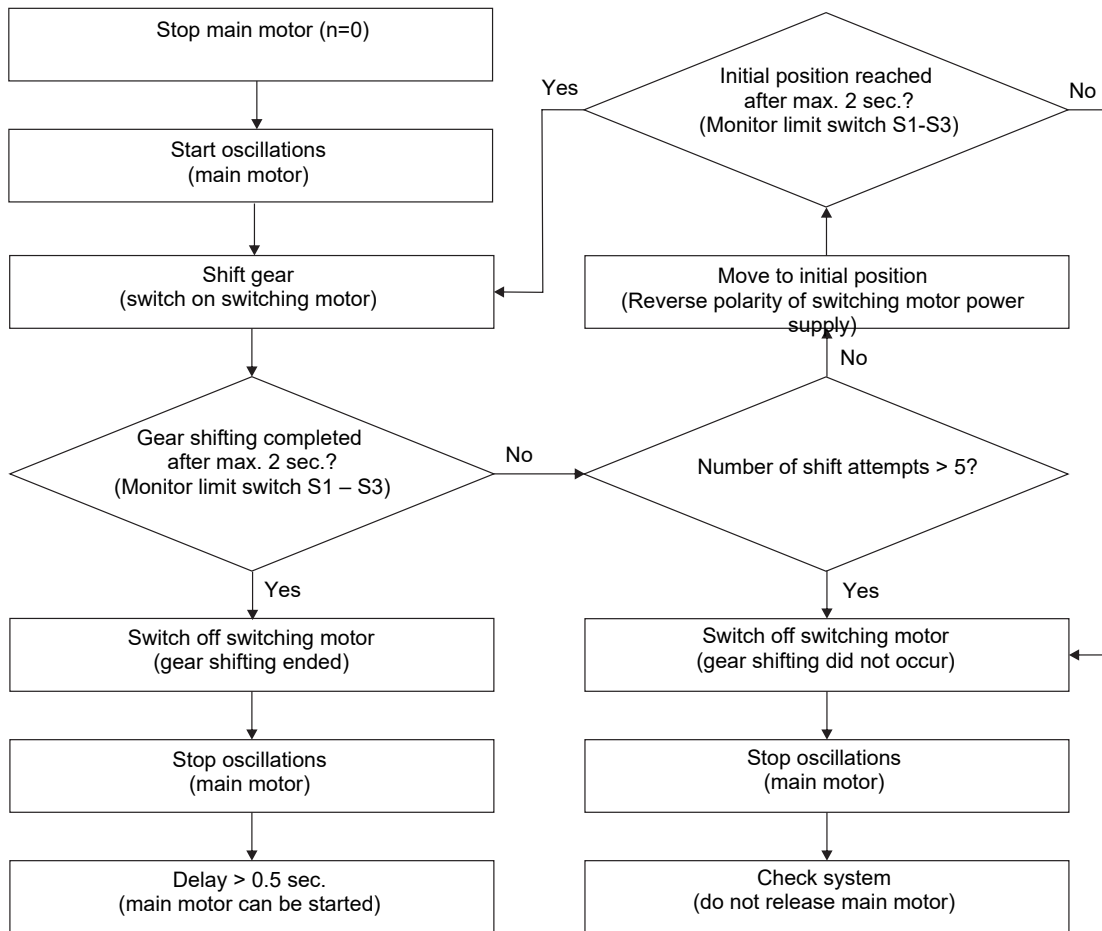


Fig. 11: Sequence diagram for the switching unit with microswitches or with SensorShift PCB as replacement for microswitches

### 6.2.3 Oscillations

In order for the gear shifting to function without any errors, the main motor must oscillate during the shifting process at a rotation angle of  $10^\circ$ . The frequency of change in the direction of rotation depends on the mass moment of inertia of the drive components and can vary in the range from 5 to 20 Hz. Determine the optimal frequency value through shifting tests. In the event that the mass moments of inertia are very high, the rotation angle must be reduced in the event that the maximum torque of the motor is exceeded. The oscillations to be programmed are described in greater detail below.

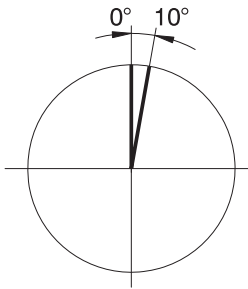


Fig. 12: Rotation angle for oscillations

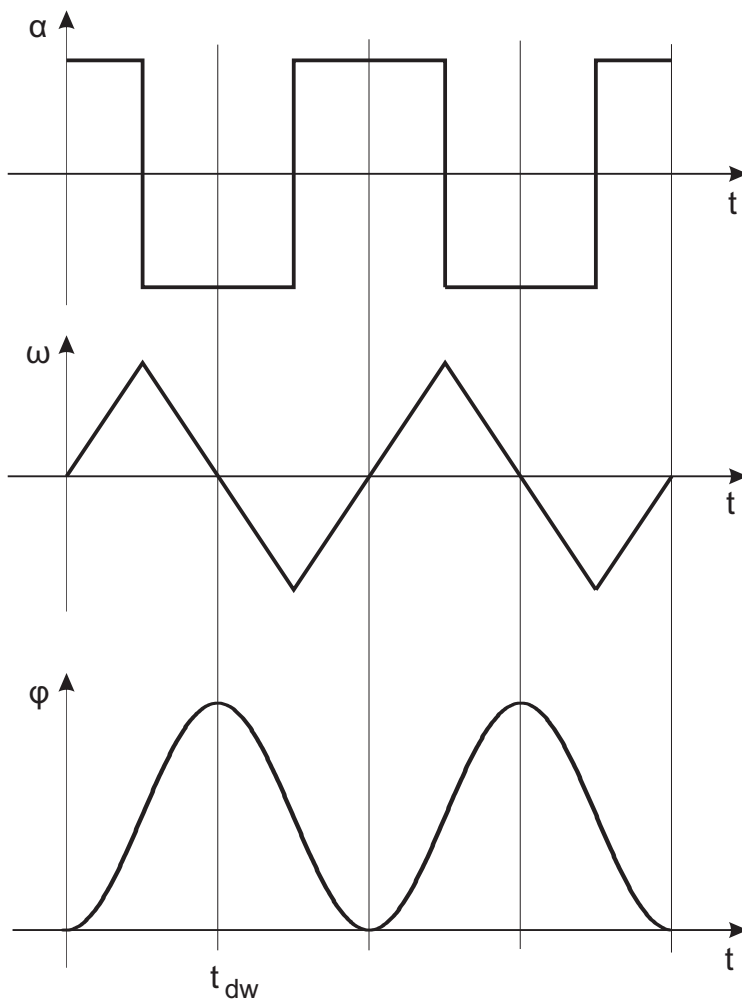


Fig. 13: Oscillations over time

The angular velocity, angular acceleration, speed and frequency of change in the direction of rotation can be calculated as follows:

$$\omega = \frac{2 \cdot \varphi}{t_{dw}} \qquad \varphi = \frac{\omega \cdot t_{dw}}{2} \qquad n = \frac{30^\circ \cdot \omega}{360^\circ} \qquad f_{dw} = \frac{1}{t_{dw}}$$

Sample values for programming the oscillations are specified in the following table.

$\phi$ [°]	$f_{dw}$ [Hz]	$t_{dw}$ [s]	$\alpha$ [°/s <sup>2</sup> ]	$\omega$ [°/s]	$n$ [rpm]
10	5	0.2	1000	100	16.7
10	10	0.1	4000	200	33.3
10	15	0.067	9000	300	50.0
10	20	0.05	16000	400	66.7

### 6.2.4 Electrical signals

Depending on the design of the switching unit, the gears of the two-speed gearbox are switched by different electrical signals.

In this chapter, the following numbering is used for the gears of the two-speed gearbox.

Number	Designation	Ratio	Note
1	Direct gear	1:1	Delivery condition
2	Transmitted gear	4:1 or 5.5:1	
3	Neutral position	–	Applies to the design with SensorShift PCB
n	Any gear		Applies to the design with SensorShift PCB

#### 6.2.4.1 Switching unit with SensorShift PCB

Gear switching of a switching unit with SensorShift PCB takes place using the digital inputs E1 and E2. Details can be found in the following table and in Chapter [Sequence diagram for switching unit with microswitches or with SensorShift PCB as replacement for microswitches](#) [▶ 34].

Gear shifting	Signal combination		Contact monitoring
	Pin 1 (E1)	Pin 8 (E2)	
Hold gear	0	0	–
$n \rightarrow 1$	0	1	S1 closed?
$n \rightarrow 2$	1	0	S2 closed?
$n \rightarrow 3$	1	1	S3 closed?

Note the following information when programming:

- The gear shift may only take place without load and with the two-speed gearbox stationary.
- The signal combination on the digital inputs E1 and E2 determines the gear to be shifted into.
- A closed contact signals the active gear.
- The digital inputs are debounced. That means that a switching process is initiated only if the same signal combination is present on the digital inputs for at least 100 ms.

- The contacts S1 – S3 must be debounced using the machine control system (e.g. using a lowpass filter with debounce time > 10 ms).
- After gear shifting is completed, the digital inputs must be reset to 0 due to the risk of wire break.

### Compatibility mode

For compatibility reasons, the switching unit with SensorShift PCB can be activated using the polarity of the power supply in the same way as a switching unit with microswitches. Details can be found in the following table.

Gear shifting	Polarity of the power supply		Contact monitoring
	Pin 2 (X1)	Pin 3 (X1)	
1 → 2	GND	24 V	S2 closed?
2 → 1	24 V	GND	S1 closed?

### 6.2.4.2 Switching unit with microswitches

The gear shifting of a switching unit with microswitches takes place using the polarity of the power supply of the switching motor. Details can be found in the following table and in Chapter [Sequence diagram for switching unit with microswitches or with SensorShift PCB as replacement for microswitches](#) [▶ 34].

Gear shifting	Polarity of the power supply		Limit switch monitoring
	Pin 2 (X1)	Pin 3 (X1)	
1 → 2	GND	24 V	S2 closed?
2 → 1	24 V	GND	S1 closed?

Note the following information when programming:

- The gear shift may only take place without load and with the two-speed gearbox stationary.
- The polarity of the power supply determines the gear to be shifted into.
- A closed limit switch indicates the active gear.
- The optional neutral position is not available for this design.

# 7 Commissioning

## **WARNING!**

### **Serious injury!**

Moving or rotating parts can cause serious injuries!

- Read through the following checklist.
- Make sure that no one is put at risk by starting up the motor.

## **CAUTION!**

### **Burns!**

The surface temperature of the two-speed gearbox can reach well above 65 °C in operation!

- Allow the two-speed gearbox to cool before touching it.

Read through the following list when commissioning the two-speed gearbox. In multi-axis systems, commission each axis individually.

- Check that the transmission elements installed on the output shaft of the two-speed gearbox fit securely and are set correctly.
- Properly secure any feather keys present on the output shaft against centrifugal forces.
- For a two-speed gearbox with circulating lubrication, check whether the two-speed gearbox is supplied at the necessary flow rate. A drop in the oil level when starting up the circulating lubrication system and the formation of an oil/air emulsion in the return line and tank is harmless.
- Make sure that the output shaft is not blocked.
- Check whether all protective and safety devices are properly installed.
- Observe the documentation for commissioning the motor.
- Check whether the motor rotates in the correct direction.
- Perform all other tests specific to and necessary for commissioning your system.

## 8 Service

### WARNING!

#### Serious injury!

Starting the two-speed gearbox or the machine drives unintentionally during service work can cause serious injuries!

- De-energize the machine drives before beginning service work and secure them from unintentional activation.

### CAUTION!

#### Burns!

The surface temperature of the two-speed gearbox can reach well above 65 °C in operation!

- Allow the two-speed gearbox to cool before touching it.

### CAUTION!

#### Skin irritation!

Gear oil can irritate eyes and skin upon physical contact!

- Wear safety glasses with side protection and rubber gloves when working with gear oil.
- Unscrew the screw plugs slowly and carefully when draining the gear oil.

Be aware that repairs on the two-speed gearbox may be performed only by STOBBER Service or authorized personnel. Unauthorized opening of the two-speed gearbox and improper handling will void the warranty.

## 8.1 Maintenance

### 8.1.1 Cleaning

Dust and contamination build-up prevents heat emission and leads to high temperatures on the two-speed gearbox. The cleaning interval depends on the local pollution degree for the two-speed gearbox.

Clean the two-speed gearbox as follows:

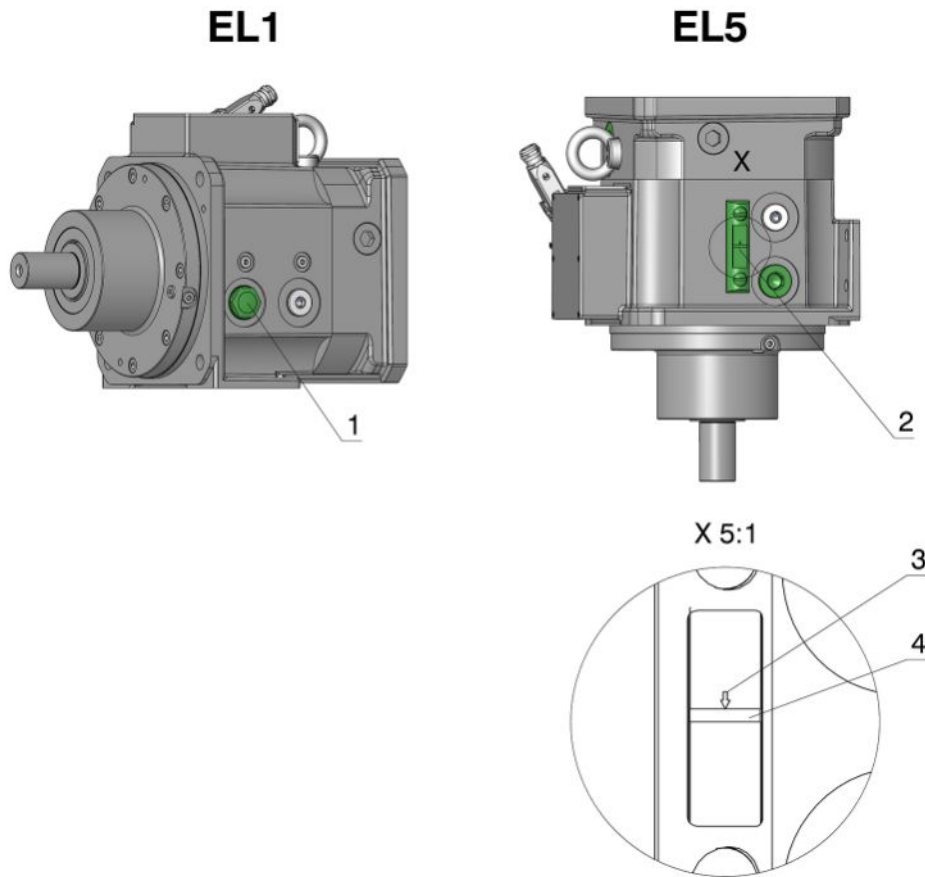
1. If the two-speed gearbox had been in operation immediately beforehand, allow it to cool.
2. De-energize the machine drives and secure them from unintentional activation.
3. Clean dirt and residue from the housing of the two-speed gearbox with a suitable machine cleaner.

In order to avoid damage to the two-speed gearbox, note the following:

- Do not use a high pressure cleaner for the cleaning process as water may enter the two-speed gearbox and sealings may be damaged by doing so.
- Do not use solvent or sharp-edged tools when cleaning.

## 8.1.2 Checking the oil level

For a two-speed gearbox with circulating lubrication, the oil level is determined by the flow rates at the supply and return connections of the two-speed gearbox (see Chapter [Connections and flow rates](#) [▶ 25]).



- |   |                       |   |                            |
|---|-----------------------|---|----------------------------|
| 1 | Oil sight glass       | 2 | Oil level gauge (optional) |
| 3 | Arrow (pointing down) | 4 | Optimal oil level range    |

For a two-speed gearbox with splash lubrication, the oil level can be checked as follows.

- Allow the two-speed gearbox to cool to room temperature so that the oil level is displayed correctly.
- De-energize the machine drives and secure them from unintentional activation.
- In mounting position EL1, read the oil level from the oil sight glass. If the oil level differs significantly from the middle of the oil sight glass, correct it accordingly.
- In mounting position EL5 (with optional oil level gauge), read off the oil level from the oil level gauge. If the oil level differs significantly from the optimal oil level range (indicated by downward-pointing arrow), correct the oil level accordingly.
- In mounting positions EL3 and EL4, the oil level cannot simply be read visually. To ascertain the oil level, you must either place the two-speed gearbox in mounting position EL1 or drain the gear oil, measure the oil volume, correct it if necessary and refill the two-speed gearbox.

Information on how to fill or drain gear oil can be found in the chapter [Oil change](#) [▶ 41].



## 8.1.3 Oil change

### Circulating lubrication

The oil change for a two-speed gearbox with circulating lubrication is performed as part of the oil change for the circulating lubrication system. Additional information on this topic can be taken from the technical documentation of the circulating lubrication system.

For circulating lubrication, use gear oil with a specification of CLP HC ISO VG 46. Gear oil with a specification of CLP HC ISO VG 32 can be used if the maximum gear oil temperature of 50 °C is not exceeded in the application. Other gear oil specifications are available on request.

### Splash lubrication

A two-speed gearbox with splash lubrication is delivered filled with gear oil and ready for operation. The oil change interval is 10000 operating hours.

For splash lubrication, use gear oil with the specification CLP HC ISO VG 68. In order to prevent damage to the two-speed gearbox, do not use gear oil with another specification and do not mix gear oils of differing specifications.

The oil fill volume depends on the mounting position of the two-speed gearbox. The oil fill volume is indicated on the nameplate and in the documentation (see the chapter [Additional documentation \[► 5\]](#)).

The following equipment is required for the oil change:

- A sufficiently large collection container for the used oil
- Rubber gloves and safety glasses with side protection
- Hex key set
- Oil extractor (only for mounting position EL5)

Proceed as follows for the oil change:

1. If the two-speed gearbox had been in operation immediately beforehand, allow it to cool.
2. Allow the two-speed gearbox to run for about 1 min. before the oil change so that dirt deposits do not remain in the two-speed gearbox.
3. De-energize the machine drives and secure them from unintentional activation.
4. Wear rubber gloves and safety glasses with side protection.
5. Ensure access to the filling and draining connections of the two-speed gearbox (see the following table).
6. Place the collection container under the draining connection.
7. Slowly unscrew the screw plug on the draining connection using a hex key.
8. Unscrew the screw plug on the filling connection using a hex key and wait until the used oil has completely run out of the two-speed gearbox.
9. If the two-speed gearbox is installed in mounting position EL5, use an oil extractor to suck the remaining used oil from the draining connection.
10. Close the draining connection and remove the collection container and oil extractor.
11. Fill the two-speed gearbox with the oil volume and oil specification indicated on the nameplate through the filling connection.
12. Close the filling connection.
13. Dispose of the used oil properly.

The oil change is now complete.

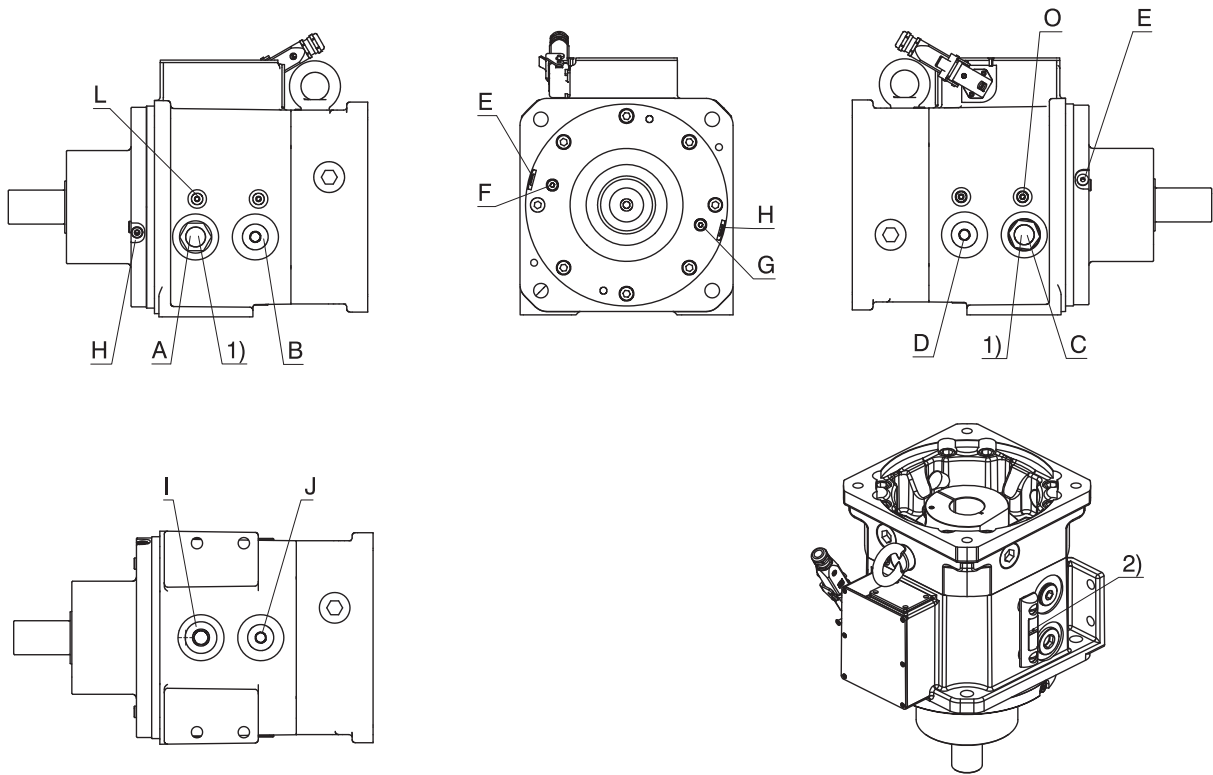


Fig. 14: Position of the connections

- 1 Oil sight glass for splash lubrication and EL1
- 2 Oil level gauge for splash lubrication and EL5 (optional)

Mounting position	Filling connections	Draining connections
EL1	L/O	I
EL3	A/B	C/D
EL4	C/D	A/B
EL5	B/D	E/F/G/H <sup>2</sup>
EL6	Mounting position not permitted	

Tab. 6: Filling and draining connections

The forward slash (/) is used to mean "or" for specifying several alternative options.

## 8.2 Procedure in case of faults

Notify all personnel working on the machine or the two-speed gearbox of deviations from normal operation. These deviations indicate that the function of the two-speed gearbox is impaired. These include:

- Higher operating temperatures or increased vibrations
- Unusual noises or smells
- Leaks on the housing of the two-speed gearbox

In such an event, shut down the two-speed gearbox and notify the responsible service personnel immediately.

<sup>2</sup>The gear oil must be sucked out at Connection H

## 8.2.1 Troubleshooting faults

The following table describes faults that can occur during the operation of the two-speed gearbox. Read through the table from top to bottom when troubleshooting faults.

Faults	Possible causes	Actions
Operating temperature is higher or exceeds the permitted temperature of the two-speed gearbox	Speed or torque is too high	Check the construction of the two-speed gearbox
	Motor heats the two-speed gearbox (too much)	Cool the motor sufficiently
		Check the wiring of the motor
		Replace the motor
	Surrounding temperature is too high	Provide sufficient cooling for the two-speed gearbox
	Bearing damage	Contact STOBBER Service
	Oil level in the two-speed gearbox is too high or too low	Check the oil level
Gear oil is too old	Perform an oil change	
Fault in the circulating lubrication system (if present)	Check the circulating lubrication system	
Increased or different noises or vibrations in operation	Motor is installed with too much tension	Check the installation of the motor
	Two-speed gearbox is installed with too much tension or incorrectly	Check the installation of the two-speed gearbox
	Oil level in the two-speed gearbox is too low	Check the oil level
	Bearing damage	Contact STOBBER Service
	Gear damage	Contact STOBBER Service
Two-speed gearbox loses oil	Oil level in the two-speed gearbox is too high	Check the oil level
	Radial shaft seal ring leaks	Contact STOBBER Service
	Output shaft damaged at the sealing point	Contact STOBBER Service
	Two-speed gearbox leaks	Contact STOBBER Service
Output shaft does not turn although motor is running	Switching unit is in the neutral position (if available)	Shift into the desired gear
	Fault in the switching unit	Check gear shifting
	Clamp coupling is defective or tightened incorrectly	Check the clamp coupling
Gear will not shift	Switching motor not activated correctly (during commissioning)	Check the controller program
	Voltage for switching motor is absent or too low	Check the power supply
	Limit switch is set incorrectly or defective (design with microswitches)	Contact STOBBER Service
	Loose contact in the plug connector of the switching unit	Check the plug connector and clean if necessary
	Switching mechanism is jammed	Contact STOBBER Service
	Switching motor is defective	Contact STOBBER Service

**See also**

- 📖 Additional documentation [▶ 5]
- 📖 Checking the oil level [▶ 40]
- 📖 Oil change [▶ 41]
- 📖 Mounting the motor on the two-speed gearbox [▶ 18]
- 📖 Installing the two-speed gearbox [▶ 21]

## 8.3 Removal

**ATTENTION!****Property damage!**

Improper handling will result in damage to the two-speed gearbox and motor!

- Do not hit the shafts or housing of the two-speed gearbox or motor with a hammer or other tools.
- Do not expose the two-speed gearbox and motor to compressive stress, impacts or high acceleration.

Proceed as follows to remove the two-speed gearbox:

1. If the two-speed gearbox had been in operation immediately beforehand, allow it to cool.
2. De-energize the machine drives and secure them from unintentional activation.
3. Disconnect the plug connector of the switching unit from the machine control system.
4. For a two-speed gearbox with circulating lubrication, place a suitable collection container under the two-speed gearbox for the gear oil and disconnect the two-speed gearbox from the circulating lubrication system.
5. If transfer elements on the output shaft prevent the removal of the two-speed gearbox, remove them.
6. Fasten the two-speed gearbox and the installed motor using lifting gear at suitable attachment points.
7. Unscrew the fastening screws on the output flange and, if present, on the base mount of the two-speed gearbox and motor.
8. If the two-speed gearbox is fitted into the pilot, pull it out of its seating.
9. Transport the two-speed gearbox with the attached motor out of the machine using the lifting gear. Observe Chapter [Transport \[▶ 16\]](#) in this process.
10. Remove the motor from the two-speed gearbox.

The two-speed gearbox has now been removed.

## 8.4 Disposal

Dispose of the two-speed gearbox at designated disposal locations. In this process, observe the separate collection and disposal of used oil as well as applicable local regulations.

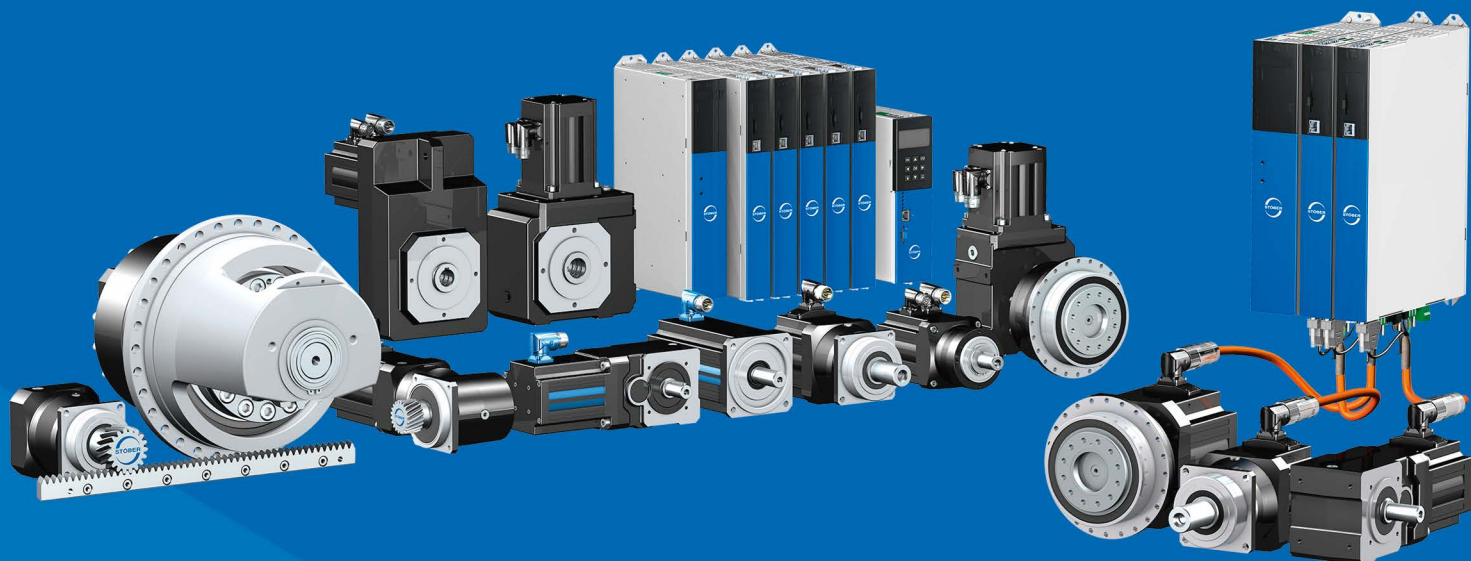
## 9 Appendix

### 9.1 Formula symbols

The formula symbols for values actually present in the application are marked with \*.

Symbol	Unit	Explanation
$\alpha$	$^{\circ}/s^2$	Angular acceleration
ccw	–	Counterclockwise direction of rotation when looking at the output shaft
cw	–	Clockwise direction of rotation when looking at the output shaft
$\Delta\phi_2$	arcmin	Backlash at the output shaft with a blocked input
$\Delta\vartheta$	K	Temperature difference
ED <sub>10</sub>	%	Duty cycle based on 10 minutes
ED*	%	Actual duty cycle between 30% and 80%, relative to 10 minutes
EL	–	Mounting position
f <sub>B<sub>T</sub></sub>	–	Temperature operating factor
f <sub>dw</sub>	Hz	Frequency of the change of direction of rotation
F <sub>1k*</sub>	N	Static and dynamic loads present in the application from the weight of the motor, mass acceleration and vibrations at the gear unit input
i	–	Gear ratio
J <sub>1</sub>	kgcm <sup>2</sup>	Mass moment of inertia relative to the gear unit input
kx	μm	Concentricity of the flange centering in relation to the shaft
l <sub>sp</sub>	m	Distance between the motor's center of mass and the gear unit input's center of mass
m	kg	Weight (for gear units without lubricant)
M <sub>1k*</sub>	Nm	Existing tilting torque on the gear unit input
M <sub>1max</sub>	Nm	Maximum torque at the gear unit input
M <sub>1N</sub>	Nm	Nominal torque at the gear unit input
M <sub>2eff*</sub>	Nm	Actual effective torque on the gear unit output
M <sub>2k*</sub>	Nm	Actual tilting torque on the gear unit output
M <sub>2k300</sub>	Nm	Permitted tilting torque on the gear unit output for n <sub>2m*</sub> ≤ 300 rpm
M <sub>2max</sub>	Nm	Maximum torque at the gear unit output
M <sub>2,n*</sub>	Nm	Actual torque in the n-th time segment
M <sub>2kN</sub>	Nm	Permitted nominal tilting torque at the gear unit output
M <sub>2N</sub>	Nm	Nominal torque on the gear unit output (relative to n <sub>1N</sub> )
n	rpm	Speed
n <sub>1m*</sub>	rpm	Actual average input speed
n <sub>1maxS1</sub>	rpm	Maximum permitted input speed in S1 operation
n <sub>1maxS1H</sub>	rpm	Maximum permitted input speed in S1 operation in a horizontal mounting position
n <sub>1maxS1V</sub>	rpm	Maximum permitted input speed in S1 operation in a vertical mounting position
n <sub>1maxS3*</sub>	rpm	Maximum permitted input speed in S3 operation for ED between 30% and 80%
n <sub>1maxS3H</sub>	rpm	Maximum permitted input speed in S3 operation (ED=30%) in horizontal mounting positions
n <sub>1maxS3V</sub>	rpm	Maximum permitted input speed in S3 operation (ED=30%) in vertical mounting positions

Symbol	Unit	Explanation
$n_{1maxV}$	rpm	Maximum permitted input speed in vertical mounting positions
$n_{1N}$	rpm	Nominal speed at the gear unit input
$n_{2m*}$	rpm	Actual average output speed
$n_{2m,n*}$	rpm	Actual average output speed in the n-th time segment
$\omega$	°/s	Angular velocity
$\phi$	°	Rotation angle
$\rho_l$	$\mu\text{m}$	Axial runout of the flange mounting surface in relation to the shaft
$P_{N,GB}$	kW	Nominal power of the two-speed gearbox
$q_{v,lub}$	l/min	Flow rate in the case of circulating lubrication
$r$	$\mu\text{m}$	Radial runout of the shaft end
S1	–	Continuous operation at a constant load (ED=100%)
S3	–	Periodic cyclic operation (ED=30%)
$t$	s	Time
$t_{1*} - t_{n*}$	s	Duration of the respective time segment
$t_{dw}$	s	Duration of the direction of rotation in one direction
$\vartheta_{amb}$	°C	Surrounding temperature
$\vartheta_{lub1}$	°C	Temperature at the supply connection of the cooling unit
$\vartheta_{lub2}$	°C	Temperature at the return connection of the cooling unit
$v_{swS}$	mm/s	Oscillation speed in an angular contact ball bearing design (RMS value)
$v_{swRZ}$	mm/s	Oscillation speed in a cylindrical roller bearing design (RMS value)



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