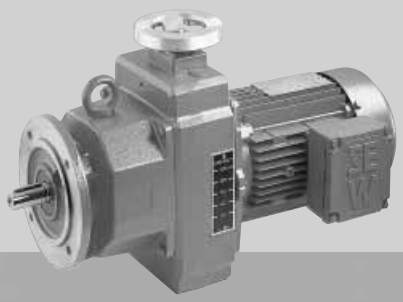
SEW EURODRIVE

VARIMOT® Variable Speed Gear Unit and Options

Edition

09/2000



Operating Instructions

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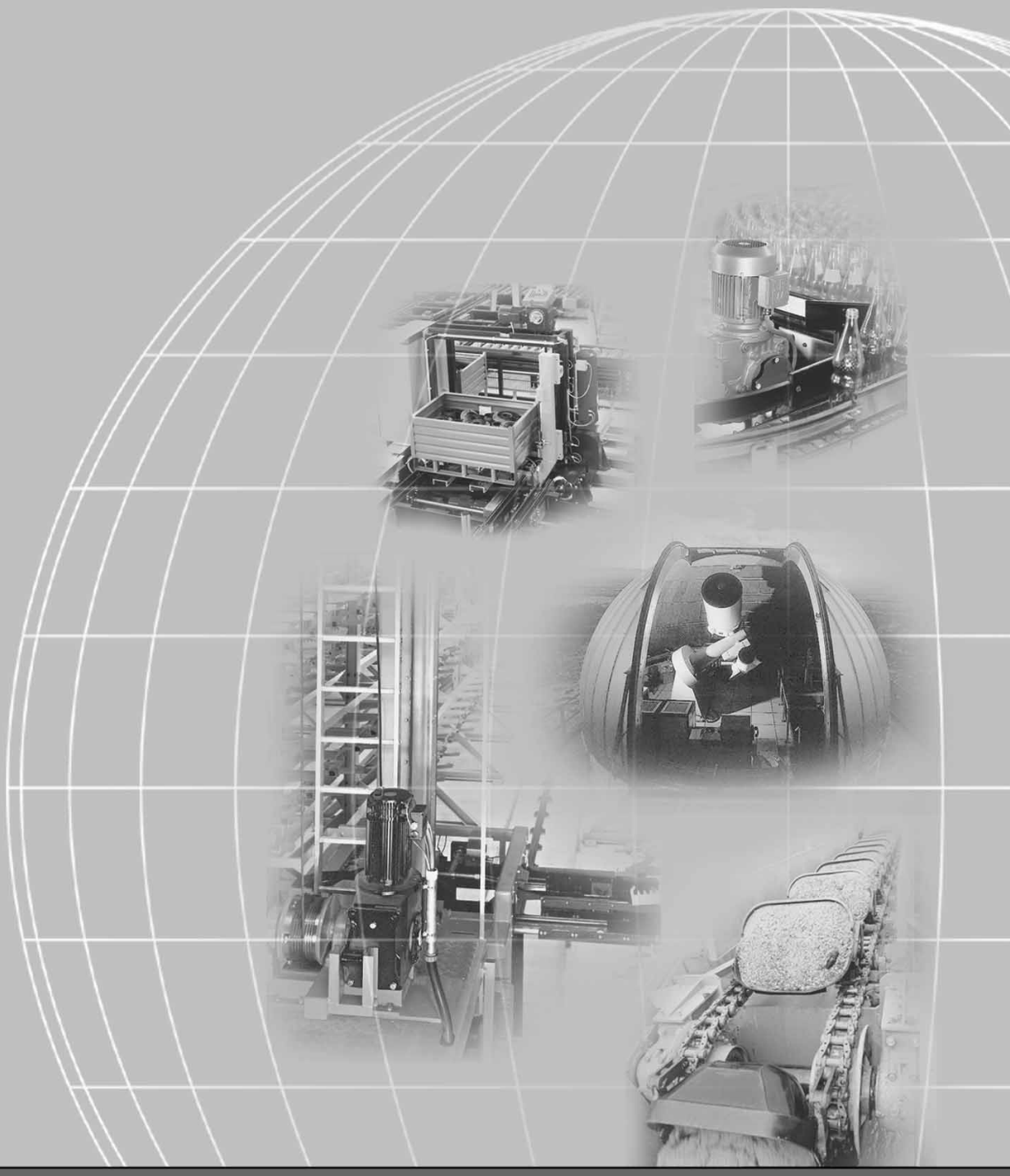

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1 Important Notes

Safety and warning instructions

Always follow warnings and safety instructions in this publication!

Electrical hazard
Possible effects: Serious or fatal injury.

Immediate danger
Possible effects: Serious or fatal injury.

Dangerous situation
Possible effects: Minor injury.

Harmful situation
Possible effects: Damage to equipment or surroundings.

Application hints and useful information.

Close adherence to these instructions is required for fault-free operation and fulfillment of any warranty claims. Read these instructions carefully before you start operating the drive!

These operating instructions contain vital servicing information and should be stored close to the drive unit.

Disposal

(Please observe all applicable regulations):

- Housing components, gear wheels, shafts and rolling bearings of gear units should be disposed of as steel scrap. This also applies to components made of cast iron if no separate collection is available.

Revisions to edition 3/95 are indicated by a gray bar in the margin.

2 Safety Notes

Preliminary remarks

The following safety notes apply to variable speed gear units.

When using **variable speed geared motors**, please observe safety notes for gear units and motors in the appropriate operating instructions.

Please refer to the additional safety notes in the individual sections of these operating instructions.

General

All tasks related to transport, storage, installation/assembly, connection, startup, service and maintenance may be performed by qualified technical personnel only with strict adherence to:

- detailed operating instruction(s) and block diagrams
- warning and safety labels on the gear unit/geared motor
- system-specific regulations and requirements
- national/regional safety and accident prevention regulations

Serious personal injuries and material damage may occur through

- incorrect use
- improper installation or operation
- inadmissible removal of required protective covers or of the housing

Be aware that variable speed geared motors contain live and moving components and hot surfaces during and after operation.

Intended usage

These variable speed geared motors/variable speed gear units are intended for industrial systems. They comply with existing standards and regulations. The technical data and information on approved operating conditions can be found on the nameplate and in the documentation.

All details must be strictly observed!

Transport / Storage

Inspect the shipment for damages upon receipt. Inform the shipping company immediately of any damages. In case of damages, startup may have to be cancelled.

Securely tighten lifting eyebolts. The eyebolts are specifically designed for the weight of the geared motor/gear unit; no additional loads may be applied.

If necessary, use appropriate and sufficiently dimensioned handling equipment. Remove existing shipping braces prior to startup.

3 VARIMOT® Design

3.1 VARIMOT® variable speed gear unit – unit design

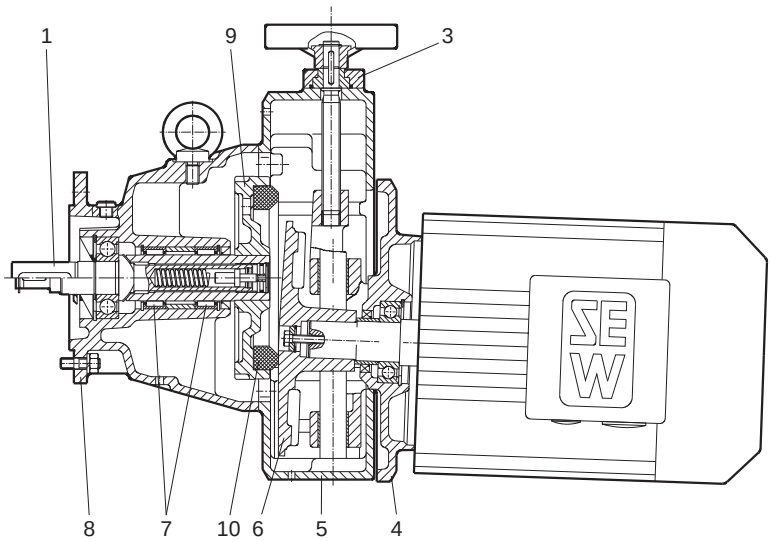

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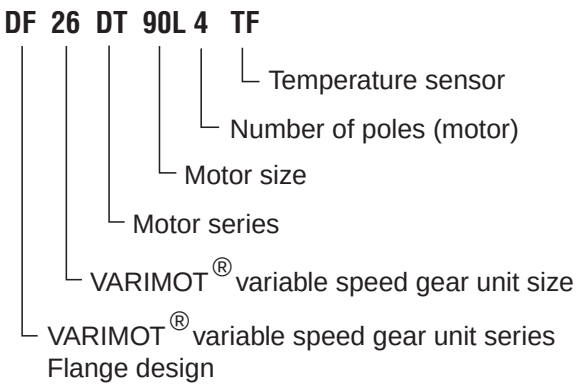
Figure 1: VARIMOT® design

1 Output shaft, complete
3 Plate
4 Adjustable plate
5 Cover
6 Drive disc
7 Needle bearing
8 Housing
9 Hollow shaft, complete
10 Friction ring

3.2 Type designation

Example



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3.3 Overview of VARIMOT® mounting options

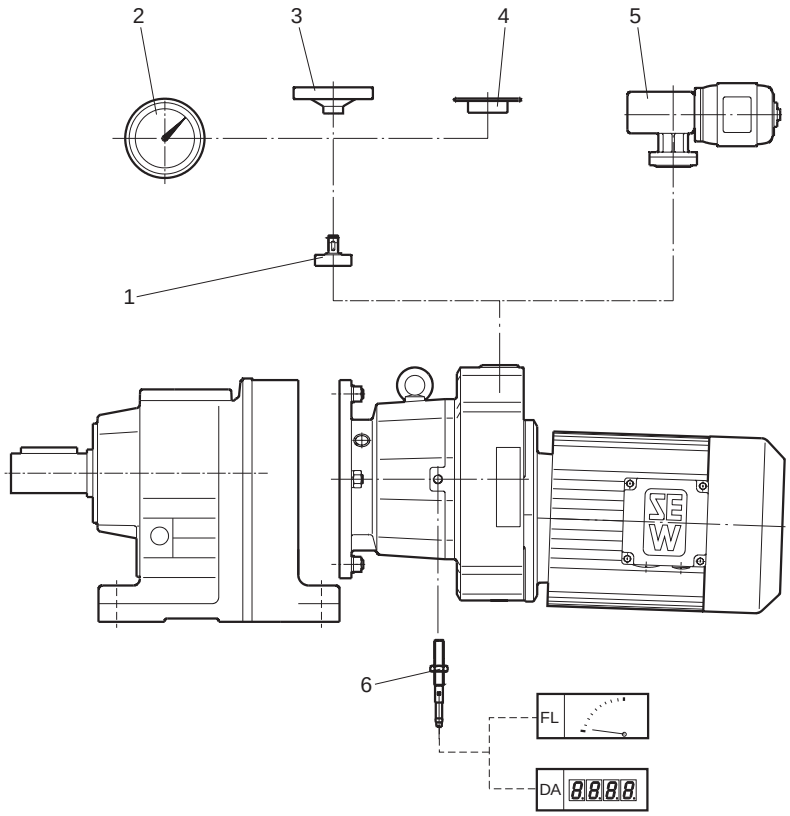

Figure 2: Overview of VARIMOT® mounting options

1 Adjustment device with free shaft end NV
2 Adjustment device with handwheel and position indication HS
3 Adjustment device with handwheel H (standard design)
4 Adjustment device with sprocket wheel K
5 Electromechanical remote adjustment EF and EFPA (with remote position indication)
6 Voltage pulse encoder IG with analog/digital remote speed display FL/DA

4 Installation

4.1 Before you begin

The drive may only be installed if

- the entries on the nameplate of the drive match the supply voltage
- the drive is not damaged (no damage resulting from transport or storage)
- the following requirements have been properly fulfilled:
  - ambient temperature between 0 °C and +40 °C,
  - no oils, acids, gases, vapors, radiation, etc.
- IP enclosure corresponds to ambient conditions

4.2 Preliminary work

Variable-speed gear units

Output shafts and flange surfaces must be completely free of anti-corrosion agents, contamination or other impurities (use a commercially available solvent). Do not let the solvent come into contact with the sealing lips of the oil seals – damage to the material may result!

Please note:

- The service life of the lubricant in the bearings is reduced if the unit is stored for more than one (1) year.

4.3 Installation of VARIMOT®

- The variable speed geared motor may be mounted or installed only in the specified position on a level[1)], vibration-free and torsionally rigid support structure. Do not tighten housing legs and mounting flanges against each other.

Please note:

- VARIMOT® design HS (handwheel with position indication) must be mounted so that the adjusting spindle is horizontal; otherwise the position indication will not function properly.

- **The breather valves must be easily accessible! The plastic plug of the condensate drain hole at the lowest position must be removed prior to operation (danger of corrosion!)**

- Carefully align the motor and driven machine to avoid overloading the motor shaft (observe approved overhung loads and axial forces!).
- Do not hammer or hit the shaft end.

- **Protect vertically mounted motors with an appropriate cover to protect equipment from foreign bodies or fluids! (cowl C)**

- Ensure adequate supply of cooling air and that heated air from other units is not drawn in.

Installation in damp areas or in the open

- VARIMOT® gear units are supplied in corrosion-resistant versions (design B) for use in damp areas or in the open. Any paint damages must be repaired.
- Coat the threads of screwed cable glands and sealing plugs with sealant, and tighten well – apply another coat of sealant.

1) Maximum permitted flatness error for flange mounting (approximate value with reference to DIN ISO 1101): with → flange 120 – 600 mm max. error 0.2 – 0.5 mm

- Properly seal the cable entry.
- Thoroughly clean the sealing surfaces of the terminal box and terminal box cover before re-assembly. Replace porous seals!

Painting the gear unit

If the drive will be painted or partially repainted, ensure that the breather valve and oil seals are carefully covered with tape. Remove tape strips after the paint work is finished.

Required tools

- Wrench set
- Mounting device
- Mounting materials for output components

Installation tolerances

Shaft end	Flanges
Diametric tolerances in accordance with DIN 748 • ISO k6 for solid shafts with d, $d_1 \leq 50$ mm • ISO k7 for solid shafts with d, $d_1 > 50$ mm • Center hole acc. to DIN 332, shape DR..	Centering shoulder tolerances acc. to DIN 42948 • ISO j6 at $b_1 \leq 230$ mm • ISO h6 at $b_1 > 230$ mm

4.4 Mounting of output components

Figure 3 shows an example of a mounting device for mounting clutches or hubs onto variable speed gear unit shaft ends. The thrust bearing on the mounting device may become redundant.

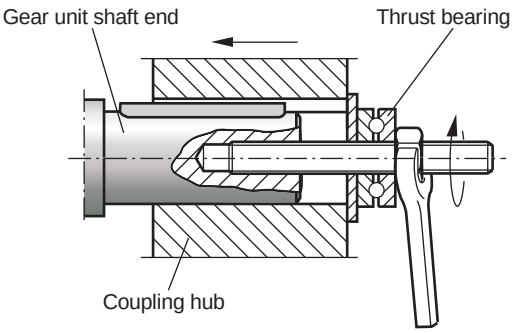

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Figure 3: Example of a mounting device

Figure 4 shows the correct mounting arrangement ② of a gear or sprocket wheel in order to avoid excessive overhung loads.

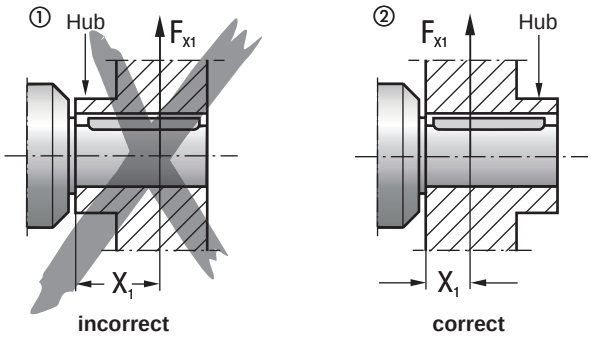

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Figure 4: Correct mounting arrangement of a gear wheel or a sprocket wheel

- Only use a mounting device (see Figure 3) for installing input and output elements. Use the center bore and the thread on the shaft end for positioning purposes.
- **Never drive belt pulleys, clutches, pinions, etc. onto the shaft end by hitting them with a hammer (damage to bearings, housing and the shaft!).**
- **Please observe correct tension of the belt for belt pulleys (in accordance with manufacturer's specifications).**
- Mounted transmission elements should be balanced and may not cause any unacceptable radial or axial forces (see Figure 4).

Note:

Assembly is easier if you first apply lubricant to the output element or heat it up briefly (80–100 °C).

Installation of clutches

While installing clutches, the following items must be balanced in accordance with clutch manufacturer specifications:

a) Maximum and minimum clearance

b) Axial offset

c) Angular offset

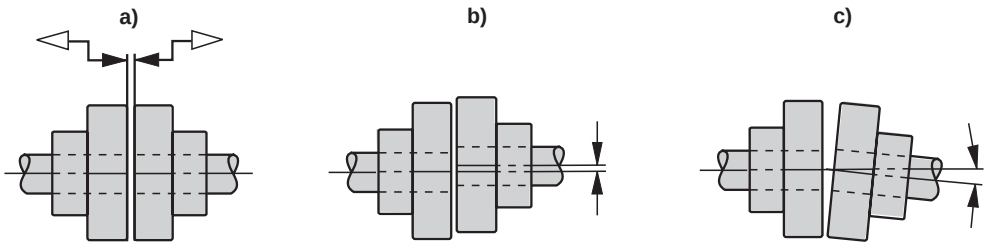

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Figure 5

Input and output elements such as belt pulleys, clutches, etc. must be equipped with a touchguard device!

5 Startup

5.1 VARIMOT® startup

Check the correct direction of rotation in the **disengaged** state (paying special attention to unusual sliding noises during racing phase).

Secure key for operation of output components in trial run. Do not deactivate monitoring and protection devices – not even for the trial run.

If in doubt, modifications to normal operation (e. g. increased temperature, noises, vibrations) may require that the variable speed geared motor be switched off. Determine the cause and contact SEW, if necessary.

6 Installation and Setup of Optional Equipment

Secure key for trial run without output components. Do not deactivate monitoring and protection devices – not even for the trial run.

6.1 Connection and setup of EF/EFPA adjustment device

Electromechanical remote speed adjustment EF, EFPA

The electromechanical remote speed adjustment option consists of a variable speed motor featuring a display unit in the EFPA version. This display unit may be installed in a control cabinet. The display does not indicate speed changes due to load fluctuations.

Note:

The electromechanical remote speed adjustment option EF is designed for 40 % ED and a switching rate of ≤ 20 times per hour. It is not suited for automatic control.

Connecting the variable speed motor EF, EFPA

1. Remove housing cover (1) from the switch element of the variable speed motor
2. Electrically connect the device
   - according to the enclosed wiring diagram
   - in accordance with the information on the nameplate
3. a) if desired, limit the speed range for the variable speed motor EF (see section "Limiting the speed range for EF, EFPA" on page 13), otherwise replace housing cover

   b) for EFPA variable speed motor, connect the display unit according to the enclosed wiring diagram (section "Connecting / adjusting display unit for EFPA" on page 13)

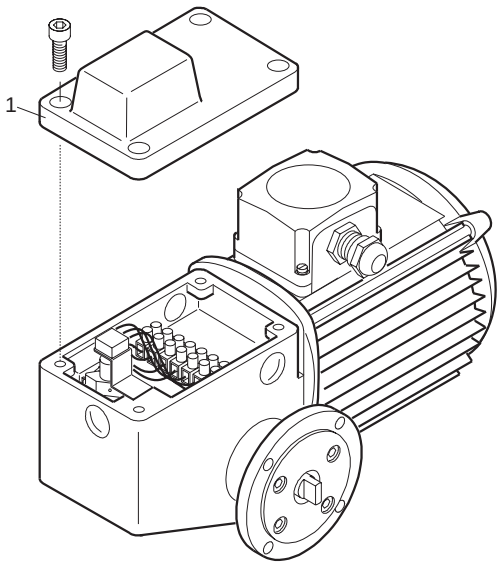

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Figure 6: Connecting variable speed motor EF, EFPA

Connecting / adjusting display unit for EFPA

The display unit for the electromechanical remote speed adjustment option can be used only in conjunction with the EFPA variable speed geared motor.

1. Connect the unit according to the enclosed wiring diagram
2. Adjust variable speed geared motor to desired minimum speed
3. Adjust display unit via "MIN" setting screw:
   - for D16 through D36 to 20 %
   - for D46 to 25 %
4. Adjust variable speed geared motor to desired maximum speed
   - Adjust display unit via "MAX" setting screw to 100 %

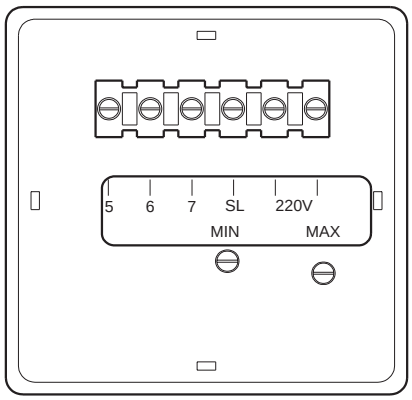

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Figure 7: Location of setting screws on the display unit

Limiting the speed range for EF, EFPA

The operating cams for the limit switches are set in the factory so that the complete speed range of the VARIMOT® variable speed geared motor is available. The range can be limited as follows (Figure 8):

Limit the adjustment range only via limit switches – do not run motor to mechanical stop (potential material damage)!

1. Remove housing cover (1) from switch element of the variable speed motor
2. Adjust VARIMOT® to desired upper limit position (scale ≤ 100 = maximum speed)
3. a) **upper operating cam (3):**
   - loosen with screwdriver
   - turn counterclockwise until tripping point is reached

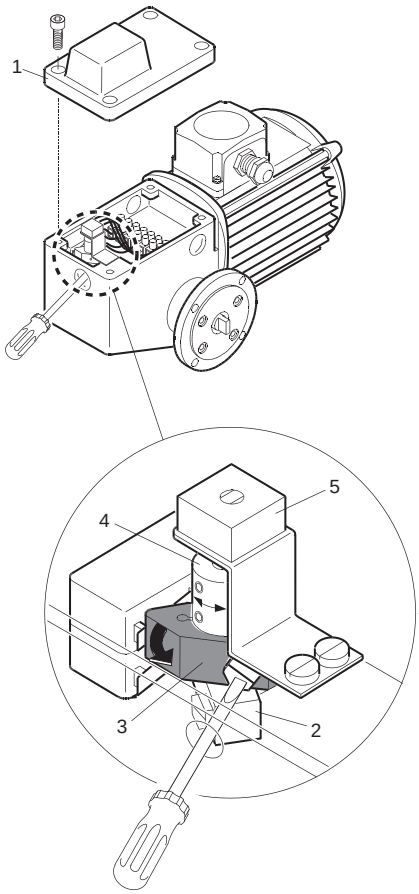

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Figure 8: Position and detail view of setting cams

for design with potentiometer (5)
(Figure 9):

b) loosen lower screw of clutch (4)
c) turn potentiometer (5) on clutch
   – counterclockwise until stop is reached
   – clockwise by approx. 15 ° until 120 to 180 Ω are present on terminals 6 and 7
d) tighten lower screw of clutch (4)

4. tighten upper operating cam (3)
5. set VARIMOT® to desired lower limit position (scale ≥ 100 = minimum speed)
6. **lower operating cam (2)**
   – loosen with screwdriver, turn clockwise until tripping point is reached
   – tighten
7. install housing cover (1) (enclose wiring diagram)

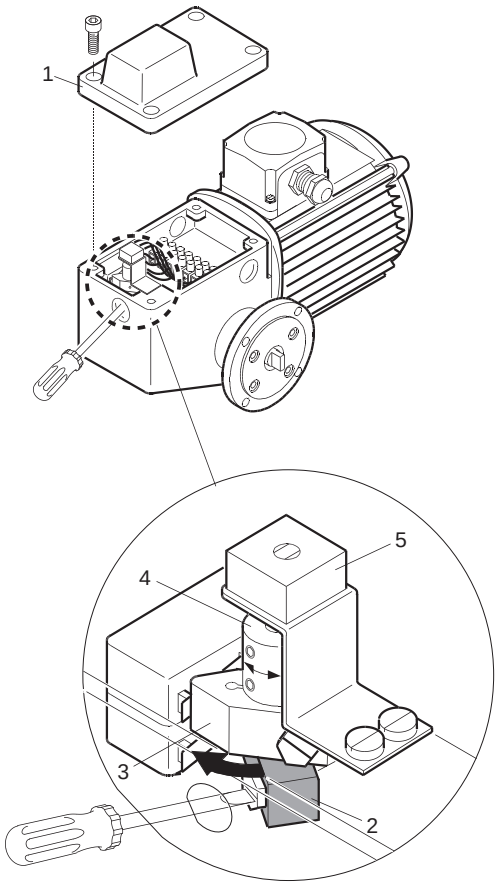

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Figure 9: Position and detail view of setting cams

6.2 Installation, connection and setting of IG, FL and DA

Various designs

The following designs are possible:

1. IG:
   – The scope of delivery for this design contains only the IG voltage pulse encoder without FL or DA display unit.
2. FL:
   – The scope of delivery for this design contains the IG voltage pulse encoder with FL analog remote speed indication.
3. DA:
   – The scope of delivery for this design contains the IG voltage pulse encoder with DA digital remote speed indication.
4. IGV:
   – This design includes an M16x1 thread for attaching a voltage pulse encoder to the housing of the variable speed geared motor.

Installation of the IG voltage pulse encoder

The separate IG voltage pulse encoder is installed as follows:

1. Install voltage pulse encoder (30) into the appropriate thread of the geared motor housing until it touches the pressure disc (31).
2. Turn back voltage pulse encoder (30) by two turns (clearance = 2 mm)
3. Secure voltage pulse encoder (31) with lock nut
4. If no display is present, correct input sensitivity:
   – increase or decrease clearance between voltage pulse encoder and pressure disc

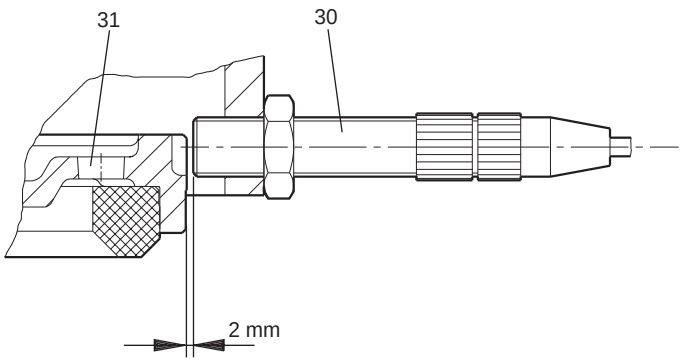

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Figure 10: IG voltage pulse encoder

Contact-free FL analog remote speed display

- IG voltage pulse encoder
- Analog display unit (scale from 0 % to 100 %)
- Supply voltage 230 V, 40-60 Hz
- Encoder connection with two-core shielded cable

Connection/ adjustment of FL

The FL analog remote speed display is connected to the IG voltage pulse encoder at the VARIMOT®.

1. Connect the device
2. Operate drive at maximum speed
3. Adjust the unit via setting screws "GROB" (coarse) or "FEIN" (fine) (at the back of the display unit) to a reading of 100 %
4. Ensure perfect ground connection at terminal M

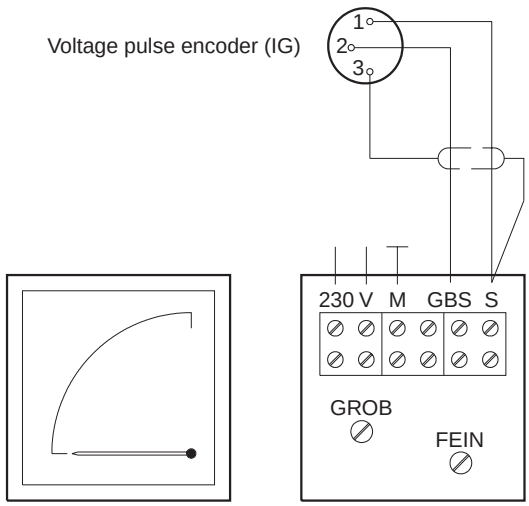

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Figure 11: Connecting and adjusting FL analog remote speed display

Contact-free DA digital remote speed display

- IG voltage pulse encoder
- Digital display unit
- Supply voltage 230 V, 50-60 Hz
- Power consumption approx. 4.2 VA
- Encoder connection with two-core cable, shielded

Connection/ adjustment of DA

The DA digital remote speed display is connected to the IG voltage pulse encoder (Figure 12 and Figure 13):

1. Connect the device (Figure 12)
2. Ensure perfect ground connection at terminal 1
3. Set measuring interval (Figure 13 and Section "DA calculation examples" on page 18)
   - Calculation using a formula
   - Data in accordance with Table 1 on page 18
4. Adjust input sensitivity (Figure 13):
   - Turn potentiometer "input sensitivity" clockwise until pulse indicator light starts to glow

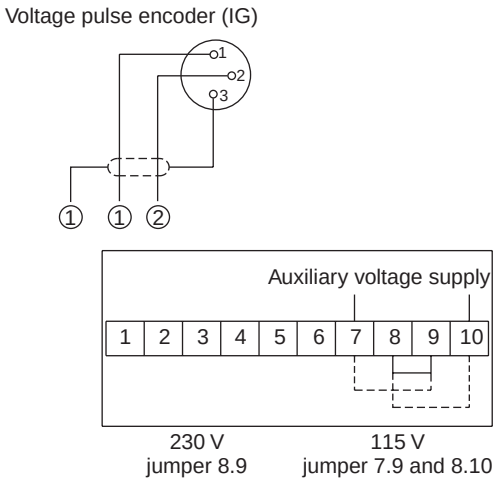

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Figure 12: Connecting the DA digital remote speed display

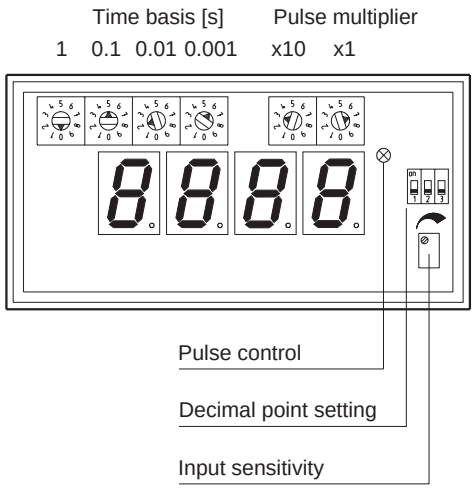

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Figure 13: Adjusting the DA digital remote speed display

DA adjustment information

- Accuracy of indication: + / -1 of last digit
- Measuring interval (quartz): adjustment in increments of 0.001 s in the range of 0.010 s to 9.999 s after removing the face plate, recommended measuring interval: 0.5 to 2 s
- Pulse multiplier: adjustment in the range from 1 to 99 after removing the face plate
- Decimal point setting: via DIP switch after removing the face plate
- Calculation of measuring interval: $\text{Measuring interval} = \frac{60 \cdot A}{n \cdot k \cdot z \cdot f}$

A = 4-digit display (at maximum speed), without decimal indication

n = speed (Table 1 on page 18)

k = pulse multiplier ≥ 1

z = pulses / revolution (Table 1)

f = calculation factor (at 50 Hz = 1, at 60 Hz = 1.2)

Type / Size VARIMOT®	Pulses / Revolution	VARIMOT® reference speed [rpm]			
		2-pole	4-pole	6-pole	8-pole
D 16	6	3305	1690	1065	833
D 26		3520	1825	1200	885
D 36		3370	1675	1080	825
D 46		3240	1610	1073	850

Table 1: DA reference data

DA calculation examples

	Example 1	Example 2
Drive	R103R72D36DADV112M4	R103R72D36DADVDV112M4
Data	Output speed n_a = 1.5 – 7.5 Pulses / revolution z = 6 (Table 1 on page 18) Max. speed var. speed gear n = 1675 rpm (Table 1 on page 18)	Output speed n_a = 1.5 – 7.5 Pulses / revolution z = 6 (Table 1 on page 18) Max. speed var. speed gear n = 1675 rpm (Table 1 on page 18)
Selected display	Output speed A = 1.500 – 7.500 min^{-1}	Belt speed A = 0.5 . 2.5 m/min
$\frac{60 \cdot A}{n \cdot k \cdot z \cdot f}$	$\frac{60 \cdot 7500}{1675 \cdot 1 \cdot 6 \cdot 1} = 44,78s$	$\frac{60 \cdot 2500}{1675 \cdot 1 \cdot 6 \cdot 1} = 14,925s$
Recommended measuring interval	0.5 - 2 s (max. 9.999 s)	
Calculation with new pulse multiplier	k = 50 $\text{Measuring interval} = \frac{60 \cdot 7500}{1675 \cdot 50 \cdot 6 \cdot 1} = 0,896s$	k = 10 $\text{Measuring interval} = \frac{60 \cdot 2500}{1675 \cdot 10 \cdot 6 \cdot 1} = 1,493s$
Device setup	Measuring interval: [0] [8] [9] [6] Pulse multiplier: [5] [0] Decimal point setting: 1	Measuring interval: [1] [4] [9] [3] Pulse multiplier: [1] [0] Decimal point setting: 1

7 Inspection / Maintenance

7.1 Inspection and maintenance intervals

Unit / unit part	Interval	What to do?	-> Section
VARIMOT®	Every **3000** hours of operation At least **every six months**	Check torsional play (wear of friction ring)	see "Check torsional play" on page 19
EF, EFPA	Every **20 000** adjustments At least **every six months**	Check adjusting spindle • replace, if necessary • otherwise lubricate	see "Lubricate EF/ EFPA adjusting spindle" on page 21

7.2 Before you begin

Required tools

- Wrench set
- Hammer
- Mandrel or drift punch
- Hand lever press
- Lubricant "Never Seeze normal"

Before opening the drive, the motor must be disconnected from the power supply and protected from unintentional re-start!

7.3 Inspection / maintenance of VARIMOT®

Check torsional play

The torsional play of the output shaft is increased through wear of the friction ring. The torsional play can be checked as follows:

1. Remove fan cover of drive motor
2. Adjust output to speed ratio 1:1 (approximately value "80" on the scale of the position indication)
3. Check torsional play at motor fan blade with fixed drive shaft
4. If torsional play measures > 45 °, the friction ring must be checked (see "Checking the friction ring" on page 20)

Checking the friction ring

1. Loosen all retaining screws (2)
2. Disconnect drive between housing cover and housing
3. Check friction ring
   - if chamfers are visible: friction ring is OK
   - if friction ring is damaged or chamfer is ground off: replace friction ring

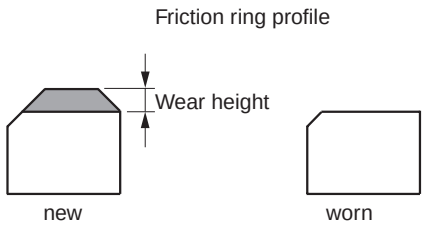

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Figure 14: Check friction ring

Replacing the friction ring

1. Pull entire hollow shaft (9) from housing (8)
2. Remove friction ring (10) from hollow shaft using hammer and mandrel or drift punch
3. Place new friction ring on a clean, level base
4. Place complete hollow shaft on friction ring
   - pre-center via friction ring offset
5. Press hollow shaft and friction ring together using slight pressure (if possible, use hand lever press) until stop is reached
6. Lubricate needle bearing (7) with anti-friction bearing grease

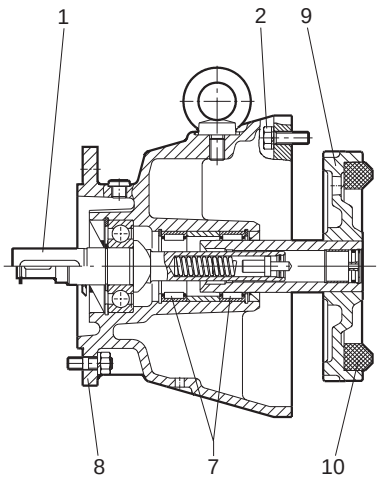

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Figure 15: Checking/replacing friction ring

7. Clean bearing surface:
   - friction ring – use dry paper or cloth
   - drive disc (6) – use degreasing detergent
8. Push entire hollow shaft with friction ring into the housing
   - turn the hollow shaft during insertion until cam lines are engaged (do not turn hollow shaft any further)
9. Carefully join housing and housing cover and tighten evenly
10. Check torsional play at output shaft
    - correct: minor torsional play can be detected
11. Switch on varibale speed geared motor:
    - slowly pass through the speed range
    - correct: drive runs noise-free and vibration-free

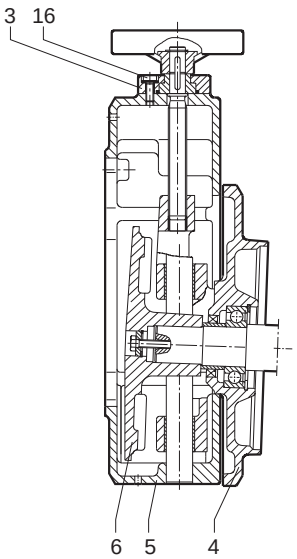

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Figure 16: Checking/replacing friction ring

7.4 Lubricate EF/ EFPA adjusting spindle

1. Remove variable speed motor (11) and intermediate flange (12)
2. Remove adjusting spindle (13) from drive by turning it clockwise
3. Lubricate adjusting spindle (4) with well-adhering lubricant, e. g. "Never Seeze normal"
4. Install in reverse order

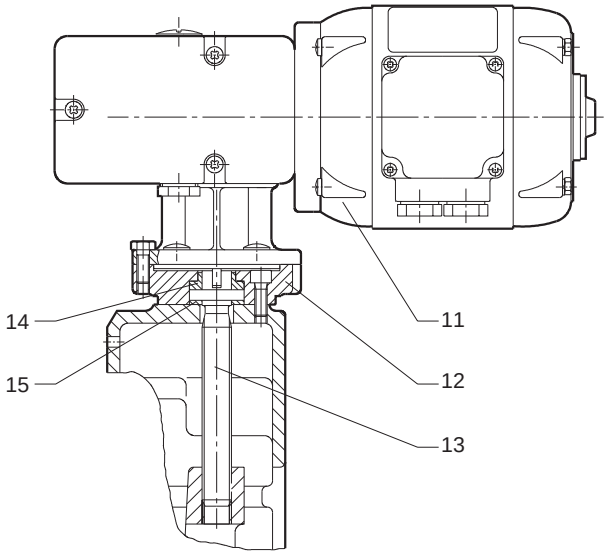

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Figure 17: Lubricate EF/ EFPA adjusting spindle

8 Operation and Service

Please provide the following information if you require assistance from customer service:

- Nameplate information
- State type and extent of the fault
- Time and circumstances of the fault
- Presumed cause

8.1 Malfunction of VARIMOT® variable speed gear unit

Malfunction	Possible cause	Solution
Drive slips	Friction ring is worn	Replace friction ring (Section "Check torsional play" on page 19)
	Friction ring or face of adjustment disc is contaminated	Clean contaminated part. • Friction ring – use dry paper or cloth • Drive disc – use solvent or similar product
	Load is too high	Check measured power and reduce to catalog values
Drive warms up excessively Note: Housing temperatures up to 70 °C are normal	Load is too high Ambient temperature is too high or was not considered during dimensioning	see above Reduce load based on ft factor in accordance with the catalog
Drive is too loud	Friction ring is damaged **Note:** Damage can occur • after brief stalling of the drive • with intermittent loading of the drive	1. Remedy cause 2. Replace friction ring (Section "Replacing the friction ring" on page 20)
Rated motor power is not transferred	Speed range is too small	Increase speed range

8.2 Malfunction of optional equipment

Electromechanical remote speed adjuster EF, EFPA

Malfunction	Possible cause	Solution
Adjustment rate too low	Sluggish conduction (e. g. due to corrosion) if B design is not used in humid locations	Re-establish low-friction conduction • Remove screws between housing and housing cover • Open drive • Place drive vertically on fan cover • Loosen screws under plastic cap next to handwheel • Pull pillar guides down and out of the drive • Lubricate guide screws with well-adhering lubricant, e. g. "Never Seeze normal" **Tip:** • First remove the pillar guides individually, then lubricate and re-assemble them.
Speed cannot be adjusted	Unit is not wired properly	Wire unit correctly in accordance with circuit diagram
Speed range cannot be reached	Limit switches of variable speed motor switch off too early	Adjust cams correctly for limit switch actuation (Section "Limiting the speed range for EF, EFPA" on page 13)
No display	• Display unit is not properly connected • Voltage supply is missing or interrupted	Connect display unit correctly in accordance with circuit diagram
Incorrect display	Display is not properly adjusted	Adjust display on back of unit (Section "Limiting the speed range for EF, EFPA" on page 13)

Contact-free remote speed display FL and DA, voltage pulse encoder IG

Malfunction	Possible cause	Solution
No display or no signal	Input sensitivity (clearance of pulse encoder / screw head) too high or too low	Correct input sensitivity: Increase or decrease clearance between IG voltage pulse encoder and screw head (Section "Various designs" on page 15)
	• Unit is not properly connected • Voltage supply is missing or interrupted	Connect unit correctly in accordance with wiring diagram

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