



EN Operating instructions. . . . . pages 1 to 8  
Original

**Content**

**1 About this document**

1.1 Function . . . . . 1

1.2 Target group: authorised qualified personnel. . . . . 1

1.3 Explanation of the symbols used . . . . . 1

1.4 Appropriate use . . . . . 1

1.5 General safety instructions . . . . . 1

1.6 Warning about misuse . . . . . 2

1.7 Exclusion of liability . . . . . 2

**2 Product description**

2.1 Ordering code . . . . . 2

2.2 Special versions. . . . . 2

2.3 Destination and use . . . . . 2

2.4 Technical data . . . . . 2

2.5 Safety classification . . . . . 3

**3 Mounting**

3.1 General mounting instructions . . . . . 3

3.2 Dimensions . . . . . 3

3.3 Switching point setting . . . . . 3

3.4 Cams and settings . . . . . 3

**4 Electrical connection**

4.1 General information for electrical connection. . . . . 5

**5 Particularities of the G 50-2047 gear switch**

5.1 Selection and setting instructions . . . . . 5

**6 Set-up and maintenance**

6.1 Functional testing. . . . . 6

6.2 Maintenance . . . . . 6

**7 Disassembly and disposal**

7.1 Disassembly. . . . . 6

7.2 Disposal . . . . . 6

**8 EU Declaration of conformity**

**1. About this document**

**1.1 Function**

This operating instructions manual provides all the information you need for the mounting, set-up and commissioning to ensure the safe operation and disassembly of the safety switchgear. The operating instructions must be available in a legible condition and a complete version in the vicinity of the device.

**1.2 Target group: authorised qualified personnel**

All operations described in this operating instructions manual must be carried out by trained specialist personnel, authorised by the plant operator only.

Please make sure that you have read and understood these operating instructions and that you know all applicable legislations regarding occupational safety and accident prevention prior to installation and putting the component into operation.

The machine builder must carefully select the harmonised standards to be complied with as well as other technical specifications for the selection, mounting and integration of the components.

**1.3 Explanation of the symbols used**



**Information, hint, note:**

This symbol is used for identifying useful additional information.



**Caution:** Failure to comply with this warning notice could lead to failures or malfunctions.

**Warning:** Failure to comply with this warning notice could lead to physical injury and/or damage to the machine.

**1.4 Appropriate use**

The products described in these operating instructions are developed to execute safety-related functions as part of an entire plant or machine. It is the responsibility of the manufacturer of a machine or plant to ensure the correct functionality of the entire machine or plant.

The safety switchgear must be exclusively used in accordance with the versions listed below or for the applications authorised by the manufacturer. Detailed information regarding the range of applications can be found in the chapter "Product description".

**1.5 General safety instructions**

The user must observe the safety instructions in this operating instructions manual, the country-specific installation standards as well as all prevailing safety regulations and accident prevention rules.



Further technical information can be found in the Schmersal catalogues or in the online catalogue on the Internet: [www.schmersal.net](http://www.schmersal.net).

The information contained in this operating instructions manual is provided without liability and is subject to technical modifications. There are no residual risks, provided that the safety instructions as well as the instructions regarding mounting, commissioning, operation and maintenance are observed.

### 1.6 Warning about misuse



In case of improper use or manipulation of the safety switch-gear, personal hazards or damages to machinery or plant components cannot be excluded when safety switchgear is used.

### 1.7 Exclusion of liability

We shall accept no liability for damages and malfunctions resulting from defective mounting or failure to comply with this operating instructions manual. The manufacturer shall accept no liability for damages resulting from the use of unauthorised spare parts or accessories.

For safety reasons, invasive work on the device as well as arbitrary repairs, conversions and modifications to the device are strictly forbidden; the manufacturer shall accept no liability for damages resulting from such invasive work, arbitrary repairs, conversions and/or modifications to the device.

## 2. Product description

### 2.1 Ordering code

This operating instructions manual applies to the following types:

**G**①-②-③④⑤/③④⑤/...Y-⑥

No.	Option	Description
①	50 150	Gear ratio ≤ 1:50 Gear ratio ≥ 1:50
②		Gear ratio, refer to technical data
③	M Z T	Snap action M Snap action Z ⊖ Slow action T ⊖
④	1 to 4	Number of NO contacts (max. 4)
⑤	1 to 4	Number of NC contacts (max. 4)
⑥	FL1 1600-1 1368-2 1368-3 2047	with FL1 connecting flange with adjustable pointed cam with Bowex coupling with shaft with tongue and groove for stages and studios



In accordance with the Machinery Directive, the type plate of safety components is type plate is labelled "safety component".

Only if the information described in this operating instructions manual are realised correctly, the safety function and therefore the compliance with the Machinery Directive is maintained.

### 2.2 Special versions

For special versions, which are not listed in the order code below 2.1, these specifications apply accordingly, provided that they correspond to the standard version.

### 2.3 Destination and use

Gear-switches are fit for multiple applications in hoisting technology, materials handling, roller gate control etc. Depending on the contact configuration, they are used for switching-off or positioning movement cycles. They are geared by means of a shaft. The gear revolutions are transmitted through a worm gear and if necessary other toothed wheels. Adjustable cams transmit the actuator travel to the switching elements.

Only type G 50 is admitted as safety gear-switch.

For positioning applications, the M 697-11-1 series microswitches can be used. They have a switching hysteresis. These switches should be used, when a movement cycle must be stopped immediately after the switching point and no faulty switching due to vibrations or for instance the rocking of the boom is admitted.

For emergency end stops, microswitches of the Z 6881-11-1 series with positive break of the NC contact are available. Due to the constant contact force, this element is extremely resistant to vibrations, even right before the snap point. In order to ensure a safe switching of this element in case of error, the actual switching point must be crossed to such extent that a safe contact opening is obtained.

Slow action pushbuttons of the T 6881-11-1 and T 697-01-1 series, also with positive break NC contact, are used when no hysteresis is required. The switch-on and switch-off point are located at the same position. In order to ensure a safe switching of this element, the actual switching point must be crossed to such extent that a safe contact opening is obtained. Contrary to the snap-action switches, the actuating speed of slow-action pushbuttons must be relatively high depending on the electrical load. The T 6881-11-1 switching element has an NC contact and an NO contact, whereas the T 697-01 switching element has only one NC contact. The switching elements are actuated through normal pointed cams.

Depending on the version, the device can be equipped with 4 or 8 switching elements.

The optimal gearing takes place through a torsionally rigid elastic coupling (e.g. ordering suffix- 1368-2) with axial and radial ejection forces. Misalignments and offsets are aligned. When geared through chain transmission, toothed belts, etc. the maximum shear force of 25 N must not be exceeded.

### 2.4 Technical data

Standards:	IEC 60947-5-1, DGUV V 17/18
Enclosure:	light-alloy diecast
Cover:	thermoplastic polyester
Protection class:	IP65 to IEC 60529
Mounting position:	any
Switching point settings rough:	
- Standard:	from 4° to 4° over 360° at the disc cam
- Front setting:	using the supplied slot screw-driver from 3.4° to 3.4°
Switching point fine adjustment:	At the fixing screws of the switching element max. 0.5 revolutions
Gear ratios:	
- G50:	1:50, 1:35, 1:25, 1:17;
- G150:	1:150, 1:75, 1:100, 1:220, 1:300, 1:450
Number of switching elements:	Max. 8: M 697/T 697
	Max. 4: for disc cam diameter 36 mm
	G 50-050 and G 150-150: Z6881/T 6881
	(otherwise additionally 1:1 ratio required)
Contact material:	Silver
Connection:	screw terminals
Rated impulse withstand voltage $U_{imp}$ :	4 kV
Rated insulation voltage $U_i$ :	250 V
Utilisation category:	AC-15
Rated operating current/voltage $I_p/U_p$ :	
- M/T 697:	4 A/230 VAC;
- Z/T 6881:	2.5 A/230 VAC
Max. fuse rating:	
- M/T 697:	10 A slow blow, 16 A quick blow;
- Z/T 6881:	20 A slow blow, 25 A quick blow
Mechanical life:	
- M/T 697:	3 x 10 <sup>6</sup> operations;
- Z/T 6881:	6 x 10 <sup>6</sup> operations
Ambient temperature:	-30 °C ... +80 °C
Weight:	Depending on the version 1.5 to 2 kg

**2.5 Safety classification**

Standards:	ISO 13849-1
B <sub>10d</sub> (NC contact):	2,000,000
Service life:	20 years

$$MTTF_d = \frac{B_{10d}}{0,1 \times n_{op}} \quad n_{op} = \frac{d_{op} \times h_{op} \times 3600 \text{ s/h}}{t_{cycle}}$$

(Specifications can vary depending on the application-specific parameters  $h_{op}$ ,  $d_{op}$  and  $t_{cycle}$  as well as the load.)

**3. Mounting**

**3.1 General mounting instructions**

The gear switch can be fixed through flanges with different slotted holes at the bottom or directly at the front through two M8 threaded holes. Additionally, rounded flanges are available for frontal fixing.

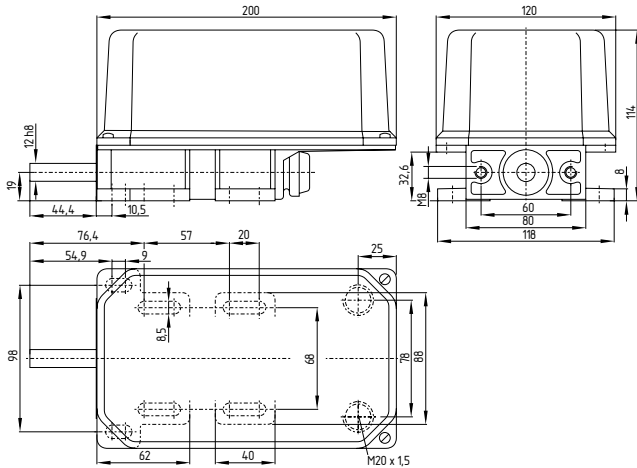


Please observe the relevant requirements of the standards ISO 12100 and DIN 56950-1.

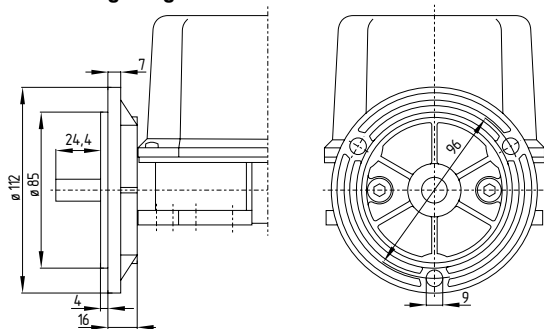
**3.2 Dimensions**

All measurements in mm.

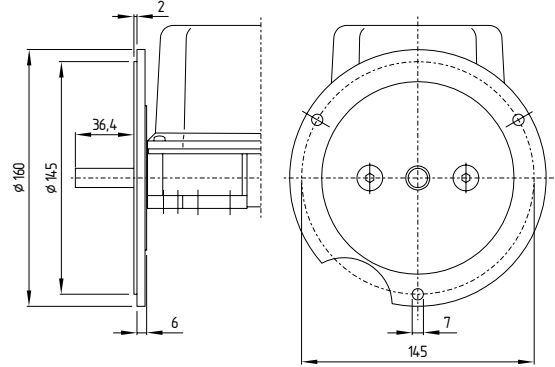
**Gear switch**



**Connecting flange 1**



**Connecting flange 2**



**3.3 Switching point setting**

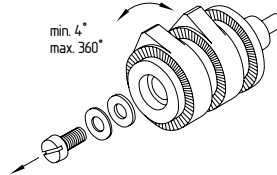


During the switching point setting of the contacts, contact with live parts is possible. Only execute the setting when the switch lever is not on the switch curve to avoid too strong a reduction of the lifetime. Always set the emergency limit switch first.

**Standard version**

In the standard version, the central screw of the disc cam is loosened. A disc cam, which can be adjusted over 4° distances, is assigned to every contact. The disc cams all have gearing as well as a positive linkage with the worm wheel. After the set-up has been carried out, the central screw must be firmly retightened.

**Standard switching point setting**

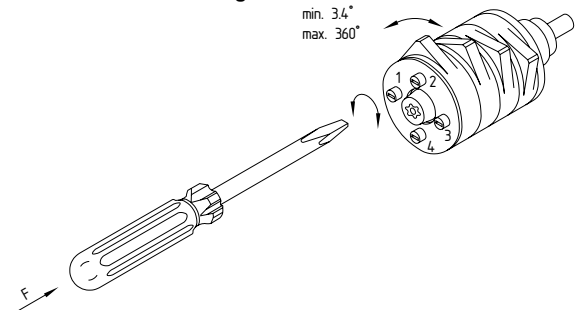


**3.4 Cams and settings**

**Disc cam with front setting**

For the disc cams with front setting (ordering suffix -1600), the dowel of the disc cam must be pushed in using the screwdriver, which is located inside the switch (see figure). At the end of the process, the dowel must autonomously return to the locking position, thus restoring the positive linkage. The central screw must not be loosened to that effect.

**Disc cam with front setting**



**Fine adjustment**

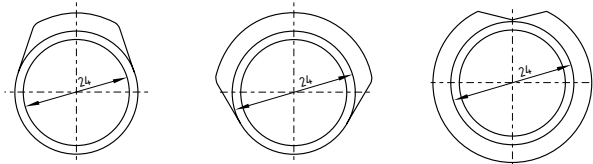
The fine adjustment can take place through the fixing screws of the switching elements. To avoid disassembly, please observe that both screws may only be loosened for approx. half a turn. When the switching point is set by actuation of the switching points, check in particular whether the setting of the emergency limit switch meets the desired value. Then reassemble the cover of the gear switch in order to obtain protection class IP65.

If a special holder for mounting a precision potentiometer is provided, the axle of the potentiometer is fitted by means of a tolerance either using a lock screw. The potentiometer is not included in delivery.

**Special accessories**

Special accessories include, amongst others, different cam forms as well as pointed disc cams with front setting (ordering suffix -1600) and 90°-, 180°- and 360° disc cams. The figure below represents different cam forms.

**Cam forms ø 24 mm (also for front setting)**

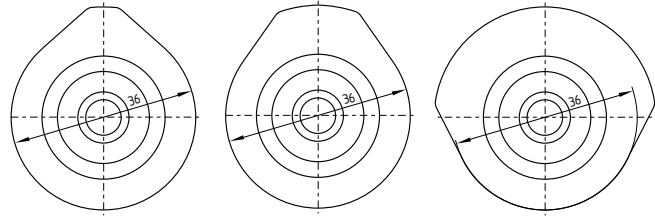


90° cam

180° cam

360° solid cam

**Cam forms ø 36 mm (max. 4 switching elements)**



Pointed cam

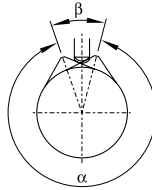
60° cam

180° cam

**Mechanical data**

The useful travel  $\alpha$  and the after-travel  $\beta$  are indicated, depending on the cam version, in useful revolutions or after-travel revolutions in table 1 and 2.

**Useful travel and after-travel**



**Key**

- $\alpha$  Useful travel of the cam
- $\beta$  After-travel of the cam

**Table 1: mechanical data for pointed cam**

Gear ratio	Useful revolution				After-travel revolution				Hysteresis revolutions		Cam travel per shaft revolution	Shaft revolution 1° cam travel	Rotational speed gear	
	M11	Z11	T11	T01	M11	Z11	T11	T01	M11	Z11			min.	max.
G50 1:17	16.1	15.4	15.9	16.1	0.9	1.6	1.1	0.9	0.14	0.2	21.20°	17°	0.6	600
G50 1:25	23.6	22.8	23.4	23.6	1.4	2.2	1.6	1.4	0.2	0.3	14.40°	25°	0.9	600
G50 1:35	33.1	31.7	32.8	33.1	1.9	3.3	2.2	1.9	0.3	0.5	10.30°	35°	1.2	600
G50 1:50	47.3	45.3	46.8	47.3	2.7	4.7	3.2	2.7	0.3	0.7	7.20°	50°	0.7	600
G150 1:75	71.0	68.0	70.2	71.0	4.0	7.0	4.8	4.0	0.6	1.0	4.80°	75°	2.5	600
G150 1:100	94.5	90.6	93.6	94.5	5.5	9.4	6.4	5.5	0.8	1.3	3.60°	100°	3.4	600
G150 1:150	141.7	136.0	140.4	141.7	8.3	14.0	9.6	8.3	1.2	2.0	2.40°	150°	5.0	600
G150 1:220	208.0	199.4	206.0	208.0	12.0	20.6	14.0	12.0	1.8	3.0	1.64°	220°	7.3	600
G150 1:300	283.5	272.0	280.8	283.5	16.5	28.0	19.2	16.5	2.4	4.0	1.20°	300°	10.0	600
G150 1:450	425.2	407.9	421.2	415.2	24.8	42.1	28.8	24.8	3.6	6.0	0.80°	450°	15.0	600

**Table 2: mechanical data for 90° cam**

Gear ratio	Useful revolution				After-travel revolution				Hysteresis revolutions		Cam travel per shaft revolution	Shaft revolution 1° cam travel	Rotational speed gear	
	M11	Z11	T11	T01	M11	Z11	T11	T01	M11	Z11			min.	max.
G50 1:17	13.2	12.5	13.2	13.1	3.8	4.6	4.0	3.9	0.14	0.2	21.20°	17°	0.6	600
G50 1:25	19.4	18.4	19.2	19.4	5.6	6.7	5.9	5.8	0.2	0.3	14.40°	25°	0.9	600
G50 1:35	27.2	25.8	26.9	27.2	7.9	9.4	8.2	8.0	0.3	0.5	10.30°	35°	1.2	600
G50 1:50	38.9	36.9	38.4	38.9	11.3	13.4	11.7	11.6	0.4	0.7	7.20°	50°	1.7	600
G150 1:75	58.3	55.3	57.6	58.3	16.9	20.0	17.6	17.4	0.6	1.0	4.80°	75°	2.5	600
G150 1:100	77.7	73.8	76.8	77.7	22.6	26.8	23.5	23.2	0.8	1.3	3.60°	100°	3.4	600
G150 1:150	116.6	110.7	115.2	116.6	34.0	40.0	35.0	34.0	1.2	2.0	2.40°	150°	5.0	600
G150 1:220	171.0	162.3	169.0	171.0	50.0	59.0	52.0	51.0	1.8	3.0	1.64°	220°	7.3	600
G150 1:300	233.0	223.0	230.4	233.0	68.0	80.0	71.0	70.0	2.4	4.0	1.20°	300°	10.0	600
G150 1:450	349.7	332.0	345.6	349.7	102.0	121.0	106.0	105.0	3.6	6.0	0.80°	450°	15.0	600

**4. Electrical connection**

**4.1 General information for electrical connection**



The electrical connection may only be carried out by authorised personnel in a de-energised condition.

For the cable entry, suitable cable glands with an appropriate degree of protection must be used in the available threaded holes. The factory-installed plastic plugs only serve as transport and dust protection. Non-used open input openings must be sealed by means of threaded plugs. After wiring, the inner part of the switch must be imperatively cleaned (e.g. removal of excess cable), considering that the presence of foreign particles can affect the switching capacity of the switching elements.

An extremely strong tightening of the cover screws can reduce the sealing efficiency and therefore must be avoided.

**5. Particularities of the G 50-2047 gear switch**

The previous paragraphs apply analogously to the G 50-2047 safety gear switch for stage and studios or event locations, i.e. the setting principle is identical, the mechanical data however are different. The mechanical data for this switch type (G50) are indicated in Table 2.



The emergency limit switches must be positioned so that with the machine running at maximum speed and with the delay time to be expected in the system the machine is safely stopped before colliding with fixed parts of the construction (e.g. spindle extremity). For an emergency end shutdown, stop category 0 must become operational. The execution of control functions basically must be chosen in accordance with IEC 60204-32.

The gear switch is available as version G 50-2047-1 with tongue and groove to DIN 6885 Bl. 1 or as version G 50-2047-2 with reduced shaft and mounting hole 4 H11. Shaft and worm have a positive linkage. The switch is supplied with front adjustable 90° cam discs. Only internal switches, i.e. switches in position 4, may be used as emergency limit switches. On each side, maximum 1 Z 6881-11-1 switch may be installed in position 4 (see figure "Position of the emergency limit switch").

**5.1 Selection and setting instructions**

In order to ensure the safe operation of a device, certain safety distances between the fixed surrounding parts and the moving parts must not be dropped below. These safety distances are ensured by the switching points of the emergency contacts and the upstream operating contacts of the gear switch. The possible displacements of the switching points are calculated in a trial series during the prototype test. Based on the useful travel ( $L_{max}$ ) of the gear switch, the following displacements are possible:

Operating contacts:  $y_1 = 0.56\% \text{ of } L_{max}$   
 Emergency contacts (Z type):  $y_2 = 0.68\% \text{ of } L_{max}$

In order to ensure a correct operation of the safety gear switch to the conditions and requirements of BGV C1 and the prototype part test, the distances  $y_1$  and  $y_2$  imperatively must be observed.

The setting instruction with the required magnitudes is represented in the Figure on page 6.

For the selection of the gear switch and for the calculation of the switching point settings, the following is applicable:

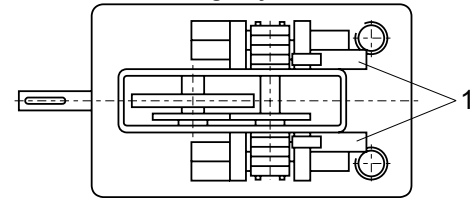
- L: Required operating travel
- $L_{fest}$ : Distance between the fixed parts in the end positions
- $L_{max}$ : Maximum available travel of the gear switch
- $U_{ben}$ : Necessary revolutions for the travel of a device
- $U_{Nutz}$ : Useful revolutions of the gear switch to Table 2
- $N_{A,B}$ : After-travel of the gear after shutdown at full speed depending on the direction of movement and load condition
- D: Diameter of the last rotating part of a device (e.g. cable drum, toothed wheel) before the gear switch being driven in
- $i_E$ : Gear ratio e.g. between cable drum and gear switch

Necessary revolutions for the required operating travel:

$$\frac{L}{\pi \cdot D \cdot i_E} \quad (Gl. 1)$$

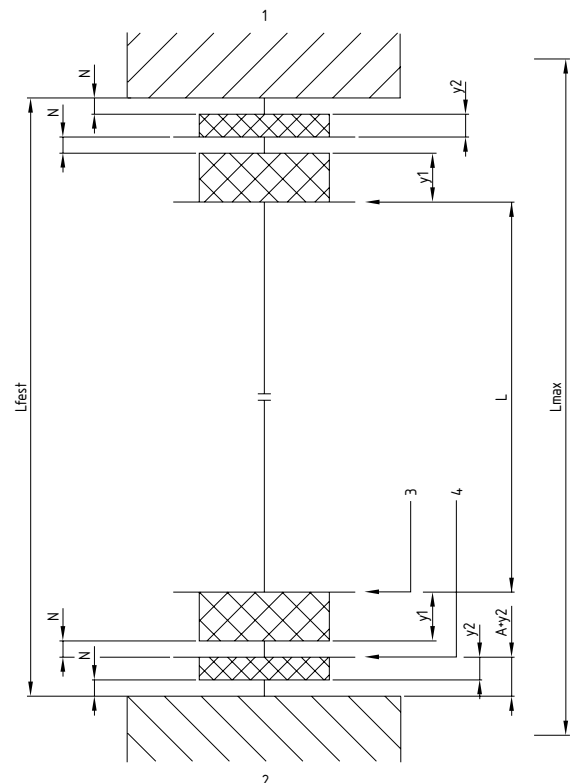
$U_{ben}$  must be smaller as the useful revolutions  $U_{Nutz}$  in Table 2 for type G 50 column Z.

**Position of the emergency limit switch**



**Key**

- 1 Only use interior switches as emergency limit switch.



**Key**

- 1 Fixed part
- 2 Fixed part e.g. stage
- 3 Position of the operating contact
- 4 Position of the emergency contact
- L Operating travel
- $L_{max}$  Useful travel gear switch

Max. possible travel of the gear switch:

$$L_{\max} = \frac{L \cdot U_{\text{nutz}}}{U_{\text{ben}}} \quad (\text{Gl. 2})$$

Max. possible displacement of the switching points:

Operating contacts:  $y_1 = 0.0056 \cdot L_{\max}$  (Gl. 3.1)

Emergency contacts (Z type):  $y_2 = 0.0068 \cdot L_{\max}$  (Gl. 3.2)

Minimum distance between fixed parts in the vicinity:

$$L_{\text{fixed}} = L + 2 [y_1 + y_2 + 2 (N_A + N_B)] \quad (\text{Gl. 4})$$

The possible after-travels  $N_A$  and  $N_B$  must be calculated depending on the hazard for each direction of movement and load condition (full load or partial load) at full speed; they also depend on the gear used and its set-up.

$$L_{\max} > L_{\text{fixed}} \quad (\text{Gl. 5})$$

**Example:**

Required operating travel:	$L = 20 \text{ m}$
Diameter of the last rotating part:	$D = 0.8 \text{ m}$
Gear ratio between cable drum and gear switch:	$i_E = 0.25$
Useful revolution to Table 2:	$U_{\text{nutz}} = 38.9 \text{ (T01)}$
	$U_{\text{nutz}} = 36.9 \text{ (Z)}$

**Calculation example:**

from Gl. 1  $U_{\text{ben}} = \frac{20}{p \cdot 0.8 \cdot 0.25} = 31.8 \text{ ca. } 32 \text{ revolutions}$

from Gl. 2	Operating contacts	Emergency contacts
	$L_{\max} = \frac{20 \text{ m} \cdot 38.9}{32}$	$L_{\max} = \frac{20 \text{ m} \cdot 36.9}{32}$
	$L_{\max} = 24.3$	$L_{\max} = 23.06 \text{ m}$

from Gl. 3.1	$y_1 = 0.0056 \cdot L_{\max}$	$y_2 = 0.0068 \cdot L_{\max}$
and Gl. 3.2:	$y_1 = 0.0056 \cdot 24.3$	$y_2 = 0.0068 \cdot 23.06$
	$y_1 = 0.13 \text{ m}$	$y_2 = 0.15 \text{ m}$

from Gl. 2:  $L_{\text{fixed}} = 20 \text{ m} + 2 [0.13 \text{ m} + 0.15 \text{ m} + 2 (N_A + N_B)]$   
 $L_{\text{fixed}} = 20.58 \text{ m} + (N_A + N_B)$

A possible after-travel  $N$  must be added to this calculated value  $L_{\text{fixed}}$ , which must be calculated depending on the hazard in accordance with the direction of movement and depending on the load condition (full load or partial load). It also depends on the gear of the device and its set-up.

The displacement can be converted in degrees in the following way:

$$Y_{1,2} [\text{DEGREE}] = U_{\text{nutz}} \cdot Y_{1,2} \cdot y_{1,2} (\text{DEGREE}) = U_{\text{nutz}} \cdot y_{1,2} \cdot 360^\circ$$

**6. Set-up and maintenance**

**6.1 Functional testing**

The safety function of the gear switch must be tested. The following conditions must be previously checked and met:

1. Proper fixation of the gear switch
2. Check the integrity of the cable entry and connections
3. Check the switch enclosure for damage

**6.2 Maintenance**

The gear switch generally does not require maintenance or inspection. A regular visual inspection and functional test, including the following steps, is recommended:

1. Check the proper fixation of the gear switch
2. Remove particles of dust and soiling
3. Check cable entry and connections
4. Lubrication of the disc cam (lubricant used in factory: ISOFLEX TOPAS NB 52) can extend the lifetime. The use of silicon-based grease is not authorised.

**Damaged or defective components must be replaced.**

**7. Disassembly and disposal**

**7.1 Disassembly**

The gear switch must be disassembled in a de-energised condition only.

**7.2 Disposal**

The gear switch must be disposed of in an appropriate manner in accordance with the national prescriptions and legislations.

8. EU Declaration of conformity

EU Declaration of conformity



Original  
K.A. Schmersal GmbH & Co. KG  
Möddinghofe 30  
42279 Wuppertal  
Germany  
Internet: www.schmersal.com

We hereby certify that the hereafter described components both in their basic design and construction conform to the applicable European Directives.

**Name of the component:** G50, G150,  
G50-2047

**Type:** See ordering code

**Description of the component:** Gear switch

Relevant Directives:	Valid up to	Valid as of
	April 19, 2016	April 20, 2016
Machinery Directive <sup>1)</sup>	2006/42/EC	2006/42/EC
Low Voltage Directive <sup>2)</sup>	2006/95/EC	2014/35/EU
RoHS-Directive	2011/65/EU	2011/65/EU

**Affixing of the CE conformity mark:** <sup>1)</sup> for safety components, whose type plate is labelled "safety component"  
<sup>2)</sup> for gear switches without safety function

**Applied standards:** DIN EN 60947-5-1: 2010,  
DIN 56950-1: 2012 <sup>1)</sup>

**Person authorised for the compilation of the technical documentation:** Oliver Wacker  
Möddinghofe 30  
42279 Wuppertal

**Place and date of issue:** Wuppertal, 10 February 01, 2016

Authorised signature  
**Philip Schmersal**  
Managing Director

G50\_150-C-EN



The currently valid declaration of conformity can be downloaded from the internet at [www.schmersal.net](http://www.schmersal.net).



**K. A. Schmersal GmbH & Co. KG**  
Möddinghofe 30, D - 42279 Wuppertal  
Postfach 24 02 63, D - 42232 Wuppertal

Phone: +49 - (0)2 02 - 64 74 - 0  
Telefax: +49 - (0)2 02 - 64 74 - 1 00  
E-Mail: [info@schmersal.com](mailto:info@schmersal.com)  
Internet: <http://www.schmersal.com>