# 1. Rotary Cam Switches

## 1.0. General

LEONARD rotary cam switches (formerly VOLLENBROICH) have been built as reliable and economical subassemblies for the industry automation since decades. Due to their robust and flawless operation the switches are indispensable for control of machines and installations, also in the decade of electronic data processing systems.

The beginning and the duration of a switching operation is surely controlled by progressively adjustable cam rings. Our rotary cam switches are used in the control technique as a reproducing tool, positioning tool, automation tool or as a numerator. They are suitable for operating on

- mill and steel works
- mining plant and machinery
- transportation plants
- transfer lines
- cranes and elevators
- presses
- punches
- welding machines
- assembly machines
- machine tools
- automobile industry
- etc.

LEONARD switchgears are rotary (cam) switches cased in housings made of cast aluminum, which contain mechanic and/or electronic switching elements. It is partially possible to couple our rotary cam switches with a second protective housing for a shaft encoder or another rotary cam switch, because the cam shaft (spindle) is brought out on both sides of the switch. In our whole range of products it is also possible to mount an encoder additional into the housing of the rotary cam switch.

LEONARD rotary cam switches can optionally be built with an integrated or a flange-mounted digital transmitter for rotary motion and can be connected to a monitoring unit (digital control). Especially our types GSW100, GSW100E and GSW100M are suitable for it and therefore they are excellent qualified for presses. You can take this and other equipment from our detailed technical data in this brochure.

As a driving unit for LEONARD rotary cam switches different spur or angular gearboxes from our accessories are available as well as rigid and adjustable couplings. The gearboxes can be delivered with maximum ratio of 1:10 or as a reduction gear with maximum ratio of 8000:1. In dependence of the type of the rotary cam switch the gear unit is integrated into the housing or is built for flange-mounting. In opposite to the integrated gear unit the flange-mounted one can be fitted secondary at any time. Please take all details from the chapter of each rotary cam switch or gearbox.

## Function

With LEONARD rotary cam switches pulses could be connected precisely in dependence of a given motion. The beginning and the length (switching angle) of the pulse of each switching point is connected safety by two independent rings with 180°-cams (two cam rings = one cam disk set). The cam rings can be twisted against each other, so a maximum pulse length of 360° can be connected. The LEONARD rotary cam switches GSW100E use switch drums instead of cam disk sets. These switch drums have a unique construction and function. A detailed description about the mechanical construction and the adjustment of the cam disk sets and switch drums is given in the chapter of each type.

Each cam disk set respectively switch drum manipulate a mechanic or electronic switching element. The function depends on the type of the contact: A make-contact element (normally open - NO) closes a conducting path when the switch is actuated while a break-contact element (normally closed – NC) a conducting path opens

when the switch is actuated. A change-over contact element (CO) closes and opens alternating the conducting path when it is actuated.

The mechanic switching elements (miniature switches) have different switching mechanisms: either slow action contacts or snap action contacts, particularly with positive break according to VDE 0113. A slow action contact (touch contact) is a contact element in which the velocity of contact motion depends on the velocity of motion of the actuator while a snap action contact (spring contact) a contact element is in which the velocity of contact motion is substantially independent of the velocity of motion of the actuator.

The electronic switching elements (proximity switches) work in accordance with the principle of the electromagnetic induction. It is possible to fit electronic switching elements for direct current with a plus or minus switching operation (PNP, NPN) or to fit electronic switching elements for alternating voltage.

All technical data of the mechanic and electronic switching elements are shown in figure 1.0.1 and figure 1.0.4. A general view of our standard types of rotary cam limit switches is illustrated in figure 1.0.6. Our large variety of switches should enable you to find the right product for your application. Beyond it we have numerous different special executions. We will be glad to help you to solve your particular problem and find the right product for your application.

## Construction

All LEONARD rotary cam switches have the common design as follows:

| | |
|---|---|
| cam shaft (spindle): | ground according to DIN ISO 286 – tolerance h6<br>feather key according to DIN 6885 part 1<br>centre hole according to DIN 332-A, optional with thread |
| bearing: | deep groove ball bearings, maintenance free |
| housing colour: | RAL 6011 „green hammer finish“,<br>optional seawaterproof |
| resistance of seals: | against oil and gasoline |
| protection: | IP65 according to EN 60529 |
| fitting position: | any |
| cable entries: | M32 or M20 according to EN 50262,<br>depending on the type of switch |

LEONARD rotary cam switches differ in the built-in switching elements , the structural shape and the dimensions. They realize different precision and resolution of their represented pulse length. A general plan is shown in figure 1.0.6 while all details are described in the chapter of each type.

All LEONARD rotary cam switches are permitted for the ambient conditions as follows:

| | |
|---|---|
| ambient temperature: | -25 to +70 °C (electronic switching elements) resp.<br>-30 to +80 °C (mechanic switching elements) |
| storage temperature: | -30 to +75 °C (electronic switching elements) resp.<br>-35 to +90 °C (mechanic switching elements) |
| vibration loading: | max. 1,5 mm amplitude at 55 Hz switching frequency |
| shock loading: | max. 30 g at 11 ms duration |
| shockproof limits: | max. 0,64 g at 24 Hz; max. 0,61 g at 120 Hz |
| frequency range: | 0 - 2000 Hz |
| all-climate protection: | 30 cycles according to DIN 50017,<br>2 cycles according to DIN 50018 |

## Fig. 1.0.1: Technical Data of Mechanic Switching Elements

| | MNS | MNSG | MNST | MNSZ | SÖ | SR | SRG | |
|---|---|---|---|---|---|---|---|---|
| type of contact<br>NO = make-contact element (normally open)<br>NC = break-contact element (normally closed)<br>CO = change-over contact element | NO + NC | NO + NC | NO + NC | NO + NC | NC | NO + NC | NO + NC | |
| switching mechanism<br>S = snap action mechanism (spring contact)<br>T = slow action mechanism (touch contact) | S | S | T | S | T | S | S | |
| type of terminal<br>S = screw connection<br>K = screw connection with clamping saddles | K | K | K | K | K | K | K | |
| switching element with roller lever | no | no | no | no | no | yes | yes | |
| supply voltage | 250 AC | 24 DC | 250 AC | 250 AC | 250 AC | 250 AC | 24 DC | |
| rated load current | 6 | 0,1 | 10 | 10 | 6 | 6 | 0,1 | |
| force separation | no | no | yes | yes | yes | no | no | |
| max. mechanical life | $30 * 10^6$ | $30 * 10^6$ | $30 * 10^6$ | $30 * 10^6$ | $30 * 10^6$ | $30 * 10^6$ | $30 * 10^6$ | |
| max. switching frequency | 500 | 500 | 500 | 500 | 500 | 500 | 500 | |
| max. radial switching hysteresis | 5,5 | 5,5 | 5,5 | 1,0 | 5,5 | 5,5 | 5,5 | |
| min. opening angle of cam rings | 10 | 10 | 10 | 10 | 10 | 10 | 10 | |
| min. switching angle for one switching actuation (switch on and off) | 10,5 | 10,5 | 10,5 | 5,0 | 10,5 | 10,5 | 10,5 | |
| repeating accuracy of switching actuation | ± 0,03 | ± 0,03 | ± 0,03 | ± 0,03 | ± 0,03 | ± 0,03 | ± 0,03 | |
| contact material | silver | gold-nickel | silver | silver | silver | silver | gold-nickel | |
| self-cleaning | yes | yes | yes | yes | yes | yes | yes | |
| material of housing | duro-plastic | duro-plastic | thermoplastic glass-fiber reinforced | Macrolon | duro-plastic | duro-plastic | duro-plastic | |
| weight | 22 | 22 | 20 | 24 | 20 | 36 | 36 | |
| wiring diagram | see fig. 1.0.2.a | see fig. 1.0.2.a | see fig. 1.0.2.b | see fig. 1.0.2.b | | see fig. 1.0.2.a | see fig. 1.0.2.a | |
| terminal designation of the first three switching elements (according to EN 50013D) | see fig. 1.0.3.a | see fig. 1.0.3.a | see fig. 1.0.3.a | see fig. 1.0.3.a | see fig. 1.0.3.c | see fig. 1.0.3.a | see fig. 1.0.3.a | |

## Fig. 1.0.2: Wiring Diagrams of Mechanic Switching Elements

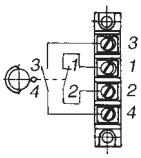

Fig. 1.0.2. a: Switching Element MNS, MNSG, SR, SRG, SB

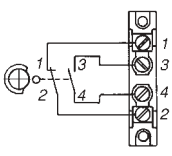

Fig. 1.0.2. b: Switching Element MNST, MNSZ, SRT, SRZ

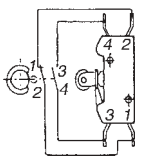

Fig. 1.0.2. c: Switching Element S

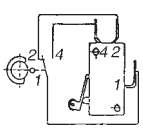

Fig. 1.0.2. d: Switching Element TE

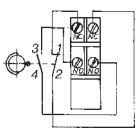

Fig. 1.0.2. e: Switching Element ADT

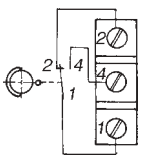

Fig. 1.0.2. f: Switching Element RD

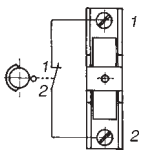

Fig. 1.0.2. g: Switching Element HSÖ

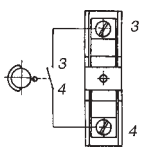

Fig. 1.0.2. h: Switching Element HSS

| | SRT | SRZ | S | SB | TE | ADT | RD | HSÖ | HSS | unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | NO + NC | NO + NC | NO + NC | NO + NC | CO | NO + NC | CO | NC | NO | - |
| | S | S | S | S | S | S | S | T | T | - |
| | K | K | K | K | K | S | S | K | K | - |
| | yes | yes | yes | yes | yes | no | no | no | no | - |
| | 250 AC | 250 AC | 250 AC | 380 AC | 250 AC | 500 AC | 500 AC | 500 AC | 500 AC | V |
| | 6 | 10 | 6 | 10 | 10 | 10 | 15 | 25 | 25 | A |
| | yes | yes | no | yes | yes | no | no | yes | no | - |
| | $30 * 10^6$ | $30 * 10^6$ | $10 * 10^6$ | $10 * 10^6$ | $10 * 10^6$ | $10 * 10^6$ | $10 * 10^6$ | $10 * 10^6$ | $10 * 10^6$ | - |
| | 500 | 500 | 150 | 300 | 150 | 300 | 300 | 200 | 200 | $min^{-1}$ |
| | 5,5 | 1,0 | 3 | 6,5 | 3 | 1,5 | 0,75 | 2 | 2 | ° |
| | 10 | 10 | 10 | 10 | 10 | 7 | 6 | 10 | 10 | ° |
| | 10,5 | 10,5 | 10 | 12 | 10 | 4,0 | 3,0 | 5,0 | 5,0 | ° |
| | ± 0,03 | ± 0,03 | ± 0,1 | ± 0,1 | ± 0,1 | ± 0,03 | ± 0,03 | ± 0,05 | ± 0,05 | ° |
| | silver | silver | silver | silver | silver-nickel | silver | silver | silver-nickel | silver-nickel | - |
| | yes | yes | yes | yes | yes | yes | yes | no | no | |
| | thermoplastic glass-fiber reinforced | Macrolon | thermo-plastic | Macrolon | Macrolon | Phon | phenoli c resin | FS150-DIN7708 | FS150-DIN7708 | - |
| | 36 | 40 | 12 | 30 | 15 | 41 | 37 | 53 | 53 | $10^{-3}$ kg |
| | see fig. 1.0.2.b | see fig. 1.0.2.b | see fig. 1.0.2.c | see fig. 1.0.2.a | see fig. 1.0.2.d | see fig. 1.0.2.e | see fig. 1.0.2.f | see fig. 1.0.2.g | see fig. 1.0.2.h | - |
| | see fig. 1.0.3.a | see fig. 1.0.3.a | see fig. 1.0.3.a | see fig. 1.0.3.a | see fig. 1.0.3.b | see fig. 1.0.3.a | see fig. 1.0.3.b | see fig. 1.0.3.c | see fig. 1.0.3.d | - |

## Fig. 1.0.3: Terminal Designation of the first three Switching Elements (according to EN 50013D)

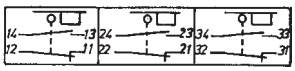


Fig. 1.0.3. a:
Switching Element MNS, MNSG, MNST, MNSZ, SR, SRG, SRT, SRZ, S, SB, ADT

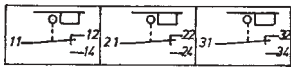


Fig. 1.0.3. b:
Switching Element RD, TE

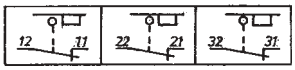


Fig. 1.0.3. c:
Switching Element SÖ, HSÖ

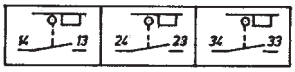


Fig. 1.0.3. d:
Switching Element HSS

## Fig. 1.0.4: Technical Data of Electronic Switching Elements

| | EGA1000.1 | EGA400.5 | EGA400.2 | EGS200.1 | |
|---|---|---|---|---|---|
| type of contact NO = make-contact element (normally open) NC = break-contact element (normally closed) CO = change-over contact element | NO + NC | NO + NC | NO + NC | NO | |
| switching operation | PNP | PNP | NPN | PNP | |
| type of terminal S = screw connection K = screw connection with clamping saddles | K | K | K | K | |
| LED | yes | yes | yes | yes | |
| supply voltage | 10 - 30 DC | 10 - 55 DC | 10 - 30 DC | input: 10 - 30 DC output: 10 - 60 DC | |
| rated load current | 1000 | 200 | 400 | output: 250 | |
| min. load resistor | - | - | - | - | |
| max. residual ripple | 10 | 10 | 10 | 10 | |
| max. residual current | 10 | 10 | 10 | 10 | |
| max. static current | - | - | - | - | |
| short circuit protection | no | yes | yes | no | |
| protection against inductive break peaks (overload protection) | yes | yes | yes | no | |
| protection against incorrect polarity of operating and interference voltage (reverse battery protection) | yes | yes | yes, load current | yes | |
| nominal switching distance | 3 | 3 | 3 | 3 | |
| max. switching frequency | 500 | 500 | 500 | 2500 | |
| max. radial switching hysteresis | 15 | 15 | 15 | 10 | |
| repeating accuracy of switching point | < 5 | < 5 | < 5 | < 5 | |
| min. aperture angle of cam disks | 5 | 5 | 5 | 5 | |
| impulse duplication | no | no | no | no | |
| pulse duration of 2. output (of each side of the impulse of the 1. output) | - | - | - | - | |
| min. module of toothed wheel | - | 3 | - | - | |
| material of housing | PA glass-fiber reinforced | PA glass-fiber reinforced | PA glass-fiber reinforced | PA glass-fiber reinforced | |
| weight | 43 | 29 | 29 | 43 | |
| wiring diagram | see fig. 1.0.5.a | see fig. 1.0.5.b | see fig. 1.0.5.c | see fig. 1.0.5.d | |

## Fig. 1.0.6: Standard Types of LEONARD Rotary Cam Switches

| | GSW100 | GSW100E | GSW100M | SWV100 | GGSW100 | |
|---|---|---|---|---|---|---|
| cam disks: | | | | | | |
| cam rings made of metal, finished | x | | x | x | x | |
| cam rings made of Hostaforrm | | | | | | |
| switch drums made of plastic with steel foil | | x | | x | | |
| diameter [mm] | 100 | 100 | 100 | 100 | 100 | |
| min. graduation of angular scale[°] | 2 | 2 | 2 | 2 | 2 | |
| mechanic switching elements: | | | | | | |
| ADT | | | | | | |
| HSÖ | | | | | | |
| HSS | | | | | | |
| MNS | x | | | x | x | |
| MNSG | x | | | | x | |
| MNST | x | | | | x | |
| RD | x | | x | x | x | |
| S | | | | | | |
| SR | | | | | | |
| TE | | | | | | |
| electronic switching elements: | | | | | | |
| EGA400.5 | | x | x | x | | |
| EGA400.2 | | x | x | | | |
| EWÖ25.1 | | x | x | | | |
| EWS25.1 | | x | x | | | |
| cam shaft: | | | | | | |
| square shaft 22 mm | x | x | x | x | x | |
| square shaft 12 mm | | | | | | |
| gear box: | | | | | | |
| flange-mounted spur gear unit (slip-on gearbox) | x | x | x | | x | |
| integrated spur gear unit | | | | x | | |
| integrated worm gear unit | | | | | | |
| housing: | | | | | | |
| gray cast iron | | | | | x | |
| cast aluminum | x | x | x | x | | |
| cable entries: | | | | | | |
| M20 | | | | | | |
| M32 | x | x | x | x | x | |

| | EWÖ25.1 | EWS25.1 | EGS65.1 | MGS3-12G-01 | MGS4-12S-20 | unit |
|---|---|---|---|---|---|---|
| | NC | NO | NO | NO | NO | - |
| | - | - | PNP | PNP | 2 x NPN | - |
| | K | K | connector M8 x 1 | connector M12 x 1 | K | - |
| | yes | yes | yes | yes | yes (1. output) | - |
| | 20 - 260 AC | 20 - 260 AC | 7 - 35 DC | 10 - 30 DC | 10 - 30 DC | V |
| | 5 - 200 | 5 - 200 | 100 | 200 | 200 | mA |
| | 100 | 100 | - | - | - | Ω |
| | - | - | 10 | 10 | 10 | % |
| | - | - | 20 | 35 | 30 | mA |
| | 1,5 | 1,5 | - | - | - | mA |
| | no | no | yes | yes | yes | - |
| | yes | yes | yes | yes | yes | - |
| | yes | yes | yes | yes | yes | - |
| | 3 | 3 | 1 | ≤1 | ≤1 | mm |
| | 20 | 20 | 1500 | 10000 | 300 | Hz |
| | 15 | 15 | 15 | - | - | % |
| | < 10 | < 10 | < 5 | - | - | % |
| | 10 | 10 | 5 | - | - | ° |
| | no | no | no | no | yes | - |
| | - | - | - | - | 1 | $10^{-3}$ s |
| | - | - | 3 | 1 | 1 | - |
| | PA glass-fiber reinforced | PA glass-fiber reinforced | stainless steel | stainless steel | PA glass-fiber reinforced | - |
| | 25 | 25 | 7 | 25 | 37 | $10^{-3}$ kg |
| | see fig. 1.0.5.e | see fig. 1.0.5.f | see fig. 1.0.5.g | see fig. 1.0.5.h | see fig. 1.0.5.i | - |

| | GGSW120 | LNSE | LNSW | GSWF | GSWFK/u | KSW50 |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | x | | |
| | x | x | x | | x | x |
| | | | | | | |
| | 120 | 100 | 120 | 80 | 80 | 50 |
| | 5 | 2 | 5 | 10 | 10 | 10 |
| | | | | | | |
| | | x | | | | |
| | | | x | | | |
| | | | x | | | |
| | x | | x | x | | |
| | x | | x | x | | |
| | x | | | | | |
| | x | x | x | x | | |
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| | x | x | x | | | |
| | | | | | x | x |
| | | | | x | | |
| | | | | | | |
| | x | | | | | |
| | | x | x | x | x | x |
| | | | | | | |
| | | | | x | | |
| | x | x | x | | x | x |

## Fig. 1.0.5:
## Wiring Diagrams of Electronic Switching Elements

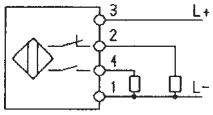


Fig. 1.0.5. a:
Switching Element
EGA1000.1

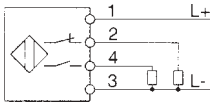


Fig. 1.0.5. b:
Switching Element
EGA400.5

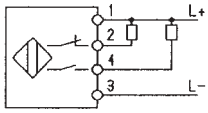


Fig. 1.0.5. c:
Switching Element
EGA400.2

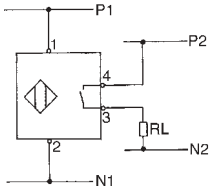


Fig. 1.0.5. d:
Switching Element
EGS200.1

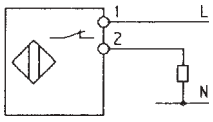


Fig. 1.0.5. e:
Switching Element
EWÖ25.1

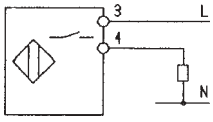


Fig. 1.0.5. f:
Switching Element
EWS25.1

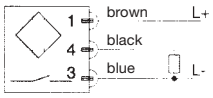


Fig. 1.0.5. g:
Switching Element
EGS65.1

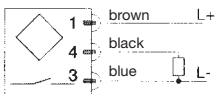


Fig. 1.0.5. h:
Switching Element
MGS3-12G-01

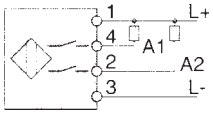


Fig. 1.0.5. i:
Switching Element
MGS4-12S-20