

Snap Switches – Definitions and descriptions

Snap switches are activated by a spring-operated (or “snap-action”) mechanism. Depressing the actuator triggers the switching operation, with a pre-defined force and travel. The switching speed itself is largely independent of the speed of actuation.

Actuator

Applying force to the actuator of a snap switch releases the snap-action mechanism, which in turn triggers the switching operation.

Auxiliary actuator

It is possible to attach an auxiliary actuator to a snap switch in order to meet the specific requirements of a given application. Doing so usually alters the travel and forces involved in the switching operation, depending on the length of the levers. By attaching an appropriate auxiliary actuator, it is possible to increase travel and/or reduce the actuating force required.

Terminals

COM (Common = 1): Base terminal

NC (Normally Closed = 2): The contact is closed in the rest position, that is, the terminal is connected to COM. When the switch is actuated, the contact opens.

NO (Normally Open = 4): The contact is open in the rest position, that is, the terminal is separated from COM. When the switch is actuated, the contact closes.

Contact gap

(contact opening distance)

The contact gap is the distance between a pair of open contacts. For snap switches, it is usually around 0.3 mm. Generally speaking, for switches with contact gaps < 3 mm, additional measures are




necessary for separation from the mains. These switches bear the mark μ for European approvals. Switches with a contact gap > 3 mm can generally be used directly for separation from the mains. Please check the device specifications applying to your particular product, and if there is any doubt, please clarify with the responsible testing agencies.

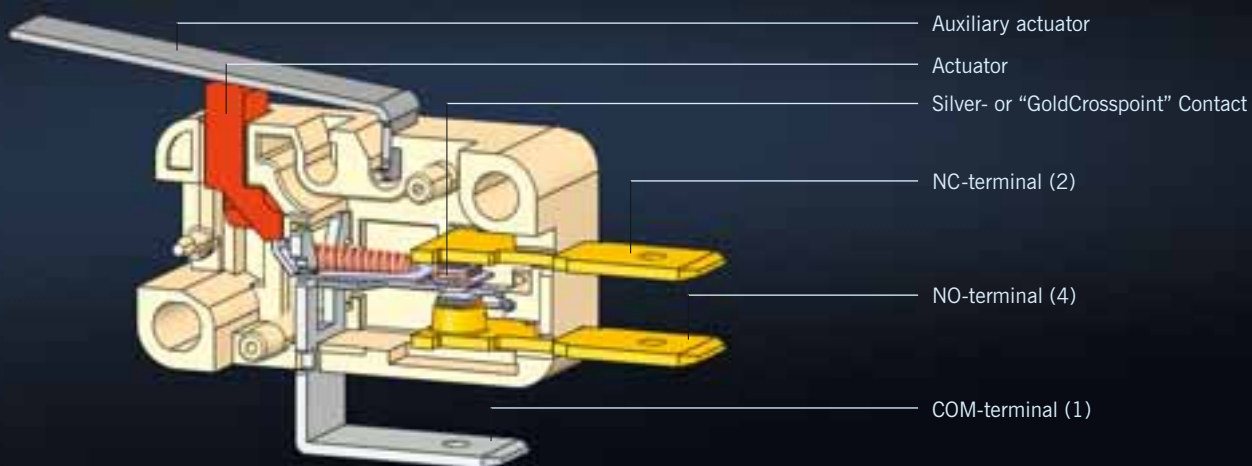
Clearance

and creepage distance

Clearance is the shortest distance through the air between two electrically conductive parts or between an electrically conductive part and a metal foil affixed to an accessible surface of some insulating material. The creepage distance is the shortest distance along the surface of an insulating material between two electrically conductive parts or between an electrically conductive part and a metal foil fixed to an accessible surface of the insulating material.

Graphical symbols

Description	Function	Graphical
S.P.D.T. Single Pole Double Throw (Changeover contact)	In rest position the COM terminal is connected to the NC contact. When the actuator is depressed, COM and NC break contact and COM and NO make contact.	 <p>The diagram shows a switch symbol with three terminals: COM, NC, and NO. The switch is shown in its rest position, where the common terminal (COM) is connected to the normally closed terminal (NC). When the actuator is depressed, the common terminal (COM) disconnects from NC and connects to the normally open terminal (NO).</p>
S.P.S.T. - N.O. Single Pole Single Throw Normally Open (Make contact)	When the switch is actuated, contact is made.	 <p>The diagram shows a switch symbol with two terminals: COM and NO. The switch is shown in its rest position, where the common terminal (COM) is not connected to the normally open terminal (NO). When the actuator is depressed, the common terminal (COM) connects to the normally open terminal (NO).</p>
S.P.S.T. - N.C. Single Pole Single Throw Normally Closed (Break contact)	When the switch is actuated, contact is broken.	 <p>The diagram shows a switch symbol with two terminals: COM and NC. The switch is shown in its rest position, where the common terminal (COM) is connected to the normally closed terminal (NC). When the actuator is depressed, the common terminal (COM) disconnects from the normally closed terminal (NC).</p>



Positions, forces and travels

Actuator positions

Dimensions for actuator positions are always specified in relation to a given reference line.

Rest position

The rest position is the position of the actuator when no external force is being applied. Sometimes referred to as the “free position”.

Operating point (mech.)

The point along the actuator’s travel path at which the spring-operated mechanism is actuated.

Final position (total travelled position)

The position of the actuator at the end of its travel.

Reset point (mech.)

The point along the actuator’s path, as it travels back to its rest position, at which the spring-operated mechanism snaps back to its original position.

Actuator travel

Pretravel

The distance travelled between the actuator’s rest position and the switching point.

Overtravel

The distance travelled between the switching point and the end position. To make absolutely sure that the switching operation takes place, an actuator should use up at least 50 % of the available overtravel.

Reset travel

The distance travelled between the end position and the release point.

Free travel (open circuit travel)

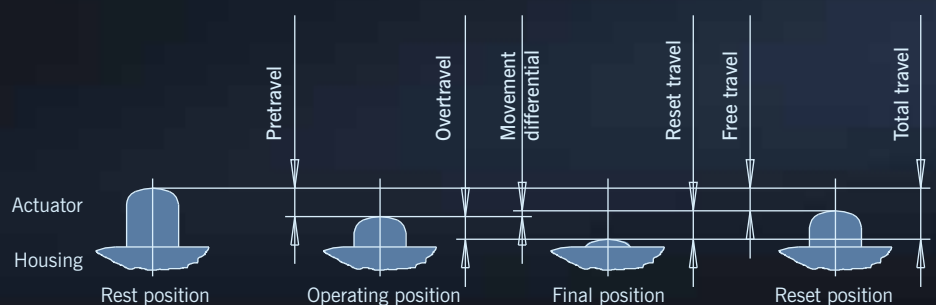
The distance travelled between the reset point and the rest position.

Total travel

The sum of pretravel and overtravel, or of reset travel and free travel.

Movement differential

The distance travelled between the operating point and the reset point.





Forces

Initial force

The force required to move the actuator away from its rest position.

Operating force

The force required to move the actuator through the operating point.

Sustaining force

The force required to hold the actuator in its final position.

Reset force

The level to which the operating force must be reduced to allow the spring-operated mechanism to return to its original position.

Differential force

The difference between the operating force and the reset force.

Conversion US-Units

Inch/millimeter

Generally, measures in this catalogue are based on the metric system and indicated in millimeter (mm). For the conversion please use the following relation:

$$1 \text{ millimeter} = 0.03937 \text{ inches}$$

$$\text{Example: } 27.8\text{mm} \times 0.03937 = 1.094 \text{ inches}$$

And for the reverse calculation:

$$1 \text{ inch} = 25.4 \text{ millimeters}$$

$$\text{Example: } 0.51 \text{ inches} \times 25.4 = 12.95 \text{ mm}$$

Forces

The specifications of the operating force for the switches are indicated in hundredth Newton (cN). For the conversion please use the following relation:

$$1 \text{ Newton (N)} = 100 \text{ cN} = 101.972 \text{ gf}$$

$$1 \text{ cN} = 1.01972 \text{ gf}$$

$$\text{Example: } 250 \text{ cN} \times 1.01972 = 254.93 \text{ gf}$$

The re-conversion corresponds to:

$$1 \text{ gf} = 0.981 \text{ cN,}$$

$$\text{Example: } 850 \text{ gf} \times 0.981 = 833.85 \text{ cN}$$

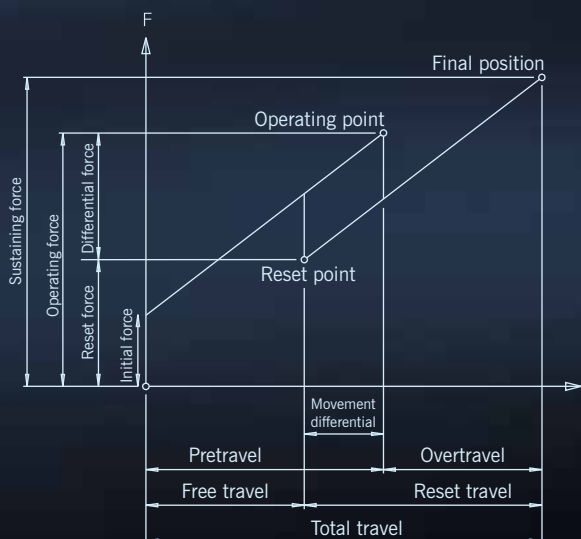


Diagram showing relationship between operating force and travel

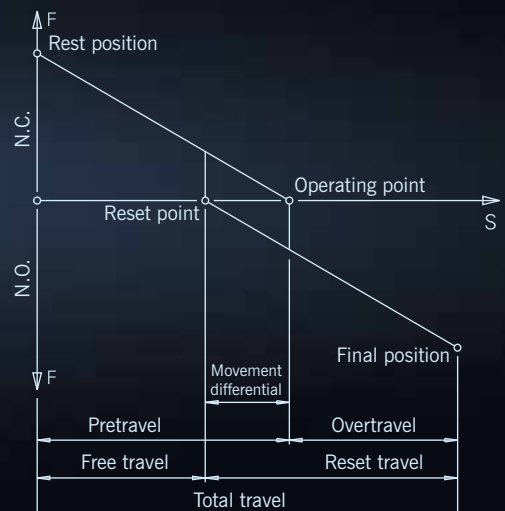


Diagram showing relationship between contact force and travel

Operating life, temperature resistance, vibration and electric resistance

Operating life

The operating life specifies the minimum number of switch cycles within the specific values. It depends on a large number of parameters that are determined by the intended application case. Among these are, for example:

- switched current and switching voltage
- type of load (e.g. ohmic, inductive or lamp load)
- Combination of materials in actuating element/actuator
- Actuator type
- Actuator speed
- Switching frequency (switching cycles / min)
- Pretravel / Overtravel
- Environmental factors such as climate conditions or harmful gases (e.g. SO₂)

Please note:

Media such as greases, oils and materials which contain silicon must not be used on the switch. There is a distinction between mechanical and electrical operating life.

Mechanical life

Indicates how often a switch can be actuated without an electrical load. Mechanical endurance is calculated by actuating the snap switches axially in relation to the actuator in a sinusoidal pattern using about 80% overtravel at a switching frequency of 4 Hz at room temperature.





Electrical life

The selection of the optimal contact material has great influence on the operating life. The electrical life test is conducted at rated voltage, rated current and resistive load at 23°C ambient temperature. The lower the electrical current, the longer the electrical life – under some circumstances it may even equal the switch's mechanical life.

Please note:

For switching loads which deviate from the values specified in the catalogue, we recommend that you discuss the issues involved with Cherry. This is especially important if you are using other loads as linear resistances. These can be electrical circuits with inductive resistances (motors), capacitive resistances (condensers) or lamp loads. To ensure that a switch reaches the maximum of its electrical operating life, the switch should not be subjected to pressure in its rest position (pre-stressed) and at least 50% of the available overtravel must be used. Operating life specifications for direct current loads are available on request. Where higher switching capacities are involved, we recommend the use of fuses to provide protection against arcing.

Please note:

Since the operating life of a snap switch depends on a number of factors, we recommend that field trials be performed in order to establish the likely electrical life of a switch in a given application. This is especially recommended when the application deviates considerably from the test conditions described above. Our specialists are always ready to provide you with more advice regarding possible solutions for your particular application.

Behaviour at different temperatures

Depending on the model, the operating temperatures of our switches range from -25 to +70°C and -40 to +150°C. If you attempt to use a switch at operating temperatures either above or below those recommended for your particular model, the switch's material properties will change and its reliability will be affected. Where switch model codes start with "T" (e.g. 40T125 in compliance with EN 61058), the switches involved have been approved for use at the corresponding temperatures.

Vibration and shock resistance

Snap switches are naturally fairly resistant to shocks and vibrations thanks to their minimal mass of moving parts. They are at their most resistant when the actuator is in the rest position or end position, when vibration resistance is as high as 5g at 20 – 200Hz while shock resistance attains 50g (6ms).

Please note:

Snap switches are more susceptible to vibrations at the switching point and at the release point. In certain conditions, this could result in transient make or break contacts (bouncing) to the detriment of the switch's operating life. This is why snap switches which are regularly exposed to vibration should, wherever possible, not be actuated slowly.

Electric strength

The electric strength of our snap switches – in the case of models suited for mains voltages – exceeds 1500VAC between conducting parts and the earth and 750VAC between the terminals (open contacts) measured over a period of one minute at an ambient temperature of 23°C ± 5°C, relative humidity of < 70% and normal atmospheric pressure.

Operation, contact types and materials

Operating speed

Snap switches are suitable for a broad spectrum of operating speeds. However, extremely slow or fast actuations can affect the switch performance and operating life. For product-specific values, please see the technical specifications. The maximum switching frequency (switchings/s) is limited by the electric load. With low switch loads, up to 10 actuations per second are possible.

Please note:

Sudden actuation must be avoided since it decreases the mechanical operating life.

Contact bounce

Bounce time is the time between the moment closing contacts first touch and final (definitive) contact closure. The typical bounce time for our snap switches is between 1.5 and 3 ms, depending on the series.

Transit time

In two-way (double-throw) switches, transit time is the time between the moment the break contact element (NC contact) first opens and the make contact element (NO contact) first closes. Transit time is generally determined by design features such as e. g. contact travel and elastic characteristics.

It generally varies between 3 and 10 ms, depending on the model.

Please note:

If transit time is critically important to the functioning of your application, don't hesitate to contact us.

Contacts

We supply switches with standard and crosspoint contact technology. For low-voltage and low-current applications, we strongly recommend the use of gold crosspoint contacts. The reduced surface area of the cross-shaped contacts means that the surface pressure is greater, which in turn enhances reliability. Standard contacts are more suitable for higher switched loads.

Contact materials

Gold and gold alloys: primarily AuAg; AuAgPt

Silver and silver alloys: primarily AgNi; AgSnO₂

Gold alloys are especially suitable for low currents and voltages. Typically they are used in the range from 5 V, 1 mA DC to 12 V 100 mA DC. But it may also make sense to use them in switches which are only occasionally operated or in atmospheres with a high sulphur content.

For switching heavier loads, it usually makes sense to use silver or silver alloys. In this case, the range typically extends from 12 V, 100 mA DC to 250 V 21 mA AC.

Please note:

Because choosing the right contact materials depends on a large number of factors, such as switching voltage and current, operating environment, atmospheric conditions, etc., we are always pleased to advise you on the best choice of material for your application. Before making any firm decisions, we do advise you to carry out field trials of our switches in real-life conditions.

Materials and contact resistance

Materials

For our standard switches, we use high-quality, cadmium-free plastics which are optimized for the intended application. As a rule, we seek to avoid the use of toxic or hazardous materials. You can find out more about our materials policy by consulting our hazardous substances exclusion list.

Behaviour of materials in fire

Insulating materials which are directly connected to electrically conductive parts are classified according to their degree of flammability. Most of the materials we use to manufacture housings are self-extinguishing and categorised under the UL 94 V0 standard.

Tracking resistance

Most of the insulating materials we use in our snap switches have a proof tracking index of PTI 250 (PTI 300, e.g. D4) or PTI 175 (PTI 250, e.g. DB, DC). This means that they are capable of 50 drops of test fluid at a test voltage of 250 V without producing any leakage current (IEC 60112).

RoHS

Switches without leads already conform to RoHS. Switches with leads are available in RoHS-conforming models on request. In case of further processing with lead-free soldering, the product-specific solder recommendations must be heeded.

Glow wire test

The insulation materials used for snap switches with ENEC approval fulfil the required filament tests GWFI according to the household appliance standard IEC 60335-1 at 850°C and GWIT at 775°C or alternatively the filament test GWT at 750°C.

Degree of flammability UL	ICE / VDE	In vertical flammability test, goes out after no more than	Drops of molten material capable of igniting wadding	Max. duration of afterglow
V-0	FV-0	5 seconds	no	30 seconds
V-1	FV-1	25 seconds	no	30 seconds
V-2	FV-2	25 seconds	possibly	60 seconds
HB	FH	Burning rate in horizontal flammability test: up to 3 mm thick < 7.5 mm/min; over 3 mm thick > 3.8 mm/min		

Contact resistance

The contact resistance of snap switches is composed of the contact resistance and the resistance of the conductive parts. It depends primarily on the construction and the contact material. The contact resistance of silver contacts is max. 100 mΩ, of gold contacts max. 50 mΩ when they are new.

Insulation resistance

The insulation resistance between the conductive parts of our snap switches and a conductive underlay or between the open contacts exceeds 10 MΩ when they are new, measured over a period of one minute at room temperature with 500V DC.







Caution: humidity and soiling can decrease the insulation resistance.

Designations

ASA	Acrylonitrile-styrene-acrylic ester
LCP	Liquid crystal polymer
LSR	Liquid silicone rubber
PA	Polyamide
PBT	Polybutyleneterephthalate
PET	Polyethyleneterephthalate
POM	Polyacetal
PPHS	Polyphenylene sulphide
PPS	Polyether sulphone
SI	Silicone
TPE	Thermoplastic elastomer
VMQ	Vinyl-methyl-polysiloxane

Approvals, markings and protection

Approvals

ENEC -	VDE		
ENEC -	KEMA		
UL USA			
UL USA and Canada			

Remark

ENEC is the abbreviation for »European Norms Electrical Certification«. The ENEC mark is a common European safety certification mark, based on testing to harmonized European safety standards and includes switches for appliances in accordance with EN61058.

Degree of protection

Degrees of protection are expressed in terms of compliance with IEC 60529. They are designated by the letters IP followed by two numbers. The first number indicates the extent to which the switch is protected against contact with live parts and the ingress of solid parts; the second number indicates the extent to which it is protected against the ingress of water. For the most part, our switches are covered by the following types of protection.

IP00	No special protection
IP40	Protected against access solid foreign objects of 1 mm diameter and greater
IP50	Dust-protected
IP65	Dustproof and protected against flowing water
IP67	Dustproof and protected against short-term immersion

Switch markings (Example)

EN 61058-1	10 A	(3)A	250 V~	μ	40T85	5E4
	Rated current resistive load	Rated current motor load	Rated voltage	Microdisconnection contact gap < 3 mm	Rated ambient temperature (-40°C to +85°C)	Operation cycles 50.000
UL 1054	10 A	1/2 HP	125-250 VAC			
	Rated current inductive load	Rated current motor load	Rated voltage			

Assembly and installation

Please note:

Cherry snap switches should only be installed by trained staff. Generally, adherence to the required air gap and creepage distance must be ensured with suitable measures. These must also be adhered to for lines connected to the switch.

If installation is to occur on a conductive surface, insulating panels must be used. Under some circumstances, their use is also required between switches installed alongside one another and plug-in connections. Switches can be installed in any position. Power transmission to the connections of the switch is not permitted. When fastening with screws, screws with a co-planar contact surface must be used (e.g. in accordance with DIN 84, DIN 912). Smooth, solid surfaces are suitable for installation.

Exceeding of the following tightening torque values is not permissible. We recommend trial installations. If you wish to install your switches using coupling pins, we would be happy to advise you on suitable parameters.

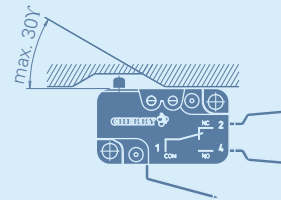
Please note:

If components are likely to be subjected to vibrations, we advise you to take additional measures to secure them. With solder connections, the product-specific solder recommendations must be heeded in order to prevent damage or destruction of the switches.

Please note:

Cleaning agents and solvents in proximity to the switches can impair their function, especially in case of watertight models. When using greases (especially mineral oil-based ones), we recommend consultation with ZF Electronics. The switching action may be initiated by a force acting vertically on the actuator, or by an angled actuation lever.

Example:



The angle of the lever in relation to the top of the switch housing should not exceed 30°. The precise angle will also depend on the actuating speed, combination of materials, surface characteristics and so on. In case of auxiliary actuators with rollers or simulated rollers, steps should be taken to ensure that the lever does not impede its own action. This means that the direction of actuation should be away from the actuator's mounting point towards the roller, and the angle of actuation should be adjusted to allow for the geometry of the actuation system. We would always recommend a preliminary discussion with ZF Electronics.

Please note:

The actuator may not be pre-stressed when at rest. When actuated, the switch should travel well beyond the switching point. For at least 50% of the predefined overtravel, in order to ensure that full contact is made. It is quite unacceptable for the switch to exceed the specified overtravel or end position. Using the switch as a mechanical end stop should be avoided. A high-impact actuation of the switch can have a negative effect on the switch's mechanical life.

Switch	Screw	max. tightening torque
DH	M 1,6	10 N cm
DG	M 2	13 N cm
DB, DZ	M 2,3	12 N cm
DC	M 2,3	20 N cm
D3, D4	M 3	60 N cm

Order code/Preferred parts

Order code

The order code is an 8-digit combination, consisting of letters and numbers which describes the unique characteristics of a switch.

The following scheme gives an abstract on the composition of the order code:

Order code Snap switches (example)

Switch type (1./2. digit)	Electrical rating (3. digit)	Actuator shape (4. digit)	–	Terminals and fixation pins (5./6. digit)	Auxiliary actuator options (7./8. digit)
DR	1	P	–	AL	AO

Order code Keypmodules (example)

Keypmodule type (1./2. digit)	Contact/current material (3. digit)	Number of contacts/functions (4. digit)	–	Operating characteristics / actuator force (5. digit)	Keypsystem configuration (6. digit)	Diode (7. digit)	Pins (8. digit)
MX	1	A	–	1	1	N	M

Preferred parts

The product pages in this brochure contain for each product a list of most common part numbers / preferred versions. The variants in this list are usually those with a high availability and mostly flexible order quantities, which can be also found as a stocking item at our distributors

Generally we can produce any switch variant on a customer-specific basis. But we kindly ask for your understanding that this may eventually cause longer lead-times or the requirement for certain minimum order quantities.

The complete overview of all possible switch variants can be found in the dedicated technical specification for each product which we will be pleased to provide you with on demand.

A checklist on the key parameters and requirements to identify the best suitable product can be found on the fold-out page at the back cover.

Please also make use of this checklist by making a photocopy, fill it out with your requirements and fax it to one of our regional offices on the back cover. We will be pleased to advise you!