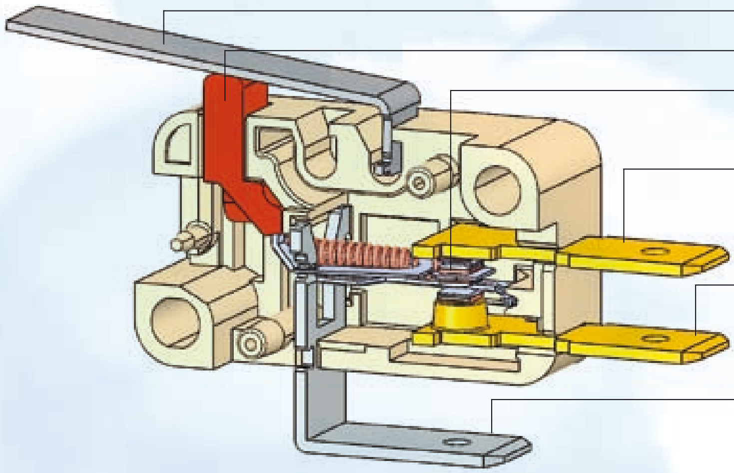
Snap Switches – Definitions and descriptions

Snap switches, also called microswitches, are switches with a spring mechanism. When pressure is applied to the actuator, switching is triggered along a particular path with a defined force. Switch speed is largely independent of the actuation speed.



Actuator

Applying force to the actuator of a snap switchreleases the snap-actionmechanism, which in turntriggers the switching operation.

Auxiliary actuator

It is possible to attach anauxiliary actuator to a snapswitch in order to meet thespecific requirements of a given application. Doingso usually alters the traveland forces involved in the switching operation, depending on the length of the levers. By attachingan appropriate auxiliary actuator, it is possible toincrease travel and/or reduce the actuating forcerequired.

Terminals

COM (Common = 1): Base terminal

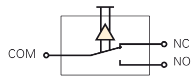
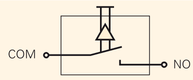
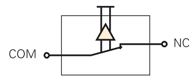
NC (Normally Closed = 2):

The contact is closed in therest position, that is, theterminal is connected to COM. When the switch is actuated, the contact opens.

NO (Normally Open = 4):

The contact is open in therest position, that is, theterminal is separated from COM. When the switch isactuated, the contact closes.

Graphical symbols

Description	Function	Graphical
S.P.D.T. Single Pole Double Throw (Changeover contact)	At rest, the COM connector is connected to the NC connector. If the actuator is pressed, the contact between COM and NC connector is separated and the contact between COM and NO connector is closed.	
S. P. S. T. - N.O. Single Pole Single Throw Normally Open(Make contact)	When the switch is actuated,contact is made.	
S. P. S. T. - N.C. Single Pole Single Throw Normally Closed (Break contact)	When the switch is actuated,contact is broken.	

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 respect the electrical requirements of your products 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 isolating 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.

Positions, forces and travels

Actuator positions

Dimensions for actuatorpositions are always specified in relation to agiven reference line.

Rest position
The rest position is theposition of the actuatorwhen no external force isbeing applied. Sometimesreferred to as the “freeposition”.

Operating point (mech.)
The point along the actuator’s travel path at whichthe spring-operated mechanism is actuated.

Final position (total traveled position)
The position of the actuatorat the end of its travel.

Reset point (mech.)
The point along the actuator’s path as it travelsback to its rest position atwhich the spring-operatedmechanism snaps back toits original position.

Actuator travel

Pretravel
The distance traveled between the actuator’s restposition and the switching-point.

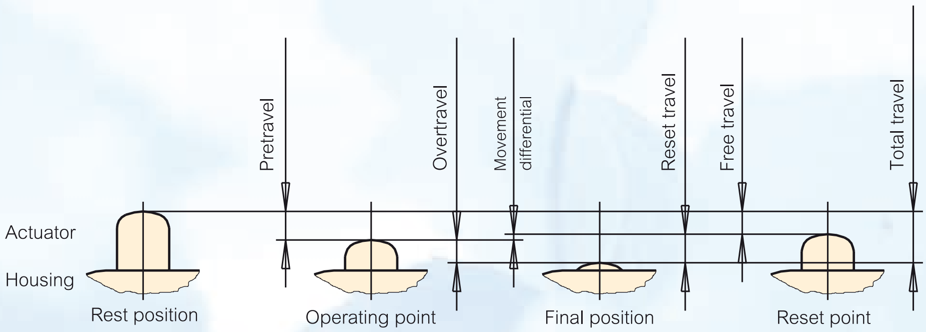
Overtravel
The distance traveled be-tween the switching pointand the end position. Tomake absolutely sure thatthe switching operationtakes place, an actuatorshould use up at least 50 % of the available overtravel.

Reset travel
The distance traveled between the end position andthe release point.

Free travel (open circuit travel)
The distance traveled between the reset point andthe rest position.

Total travel
The sum of pretravel andovertravel, or of reset travel and free travel.

Movement differential
The distance traveled between the operating pointand the reset point.



Forces

Initial force
The force required to movethe actuator away from itsrest position.

Operating force
The force required to movethe actuator through theoperating point.

Sustaining force
The force required to holdthe actuator in its final position.

Reset force
The level to which the operating force must bereduced to allow the spring-operated mechanism toreturn to its original position.

Differential force
The difference between theoperating force and thereset force.

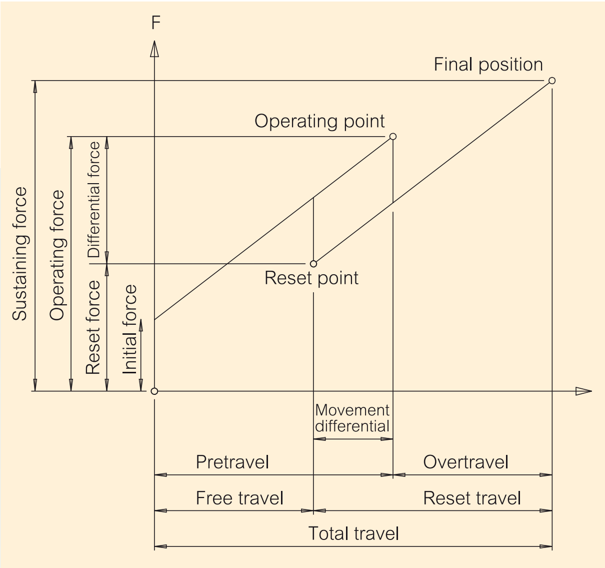


Diagram showing relationship between operating force and travel

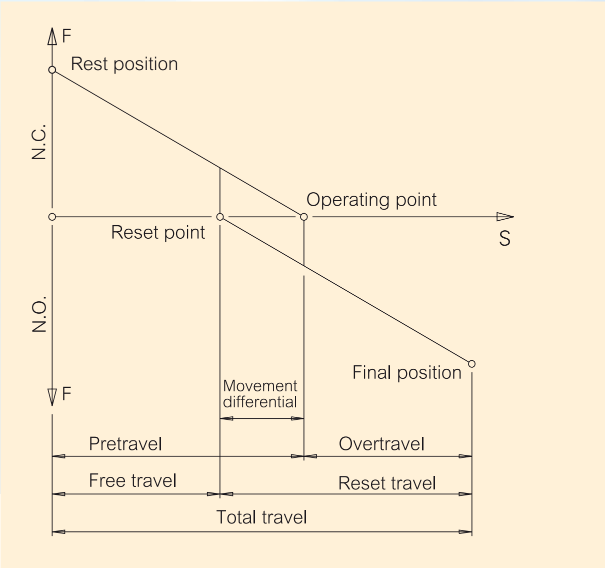


Diagram showing relationship between contact force and travel

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)
- Tool pairing actuation element/ actuator
- Actuator type
- Actuator speed
- Switching frequency (switching cycles/min)
- Pretravel/Overtravel
- Environmental factors such as climate conditions or harmful gases (e.g. SO_2)

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 4Hz 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 consumers 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 end 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 5 g at 20 – 200 Hz while shock resistance attains 20 g (6 ms).

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 is – in the case of models suited for mains voltages – exceeds 1500 VAC between conducting parts and the earth and 750 VAC 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 around 3 ms.

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 5 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 Ag; AgNi; AgPd

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 optimised 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 on request). 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 lines already conform to RoHS. Switches with lines 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. (For more information, see page 20).

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.

Designations

ASA	Acrylonitrile-styrene-acrylicester
PA	Polyamide
PBT	Polybutyleneterephthalate
PET	Polyethyleneterephthalate
POM	Polyacetal
PPHS	Polyphenylene sulphide

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 500 V DC. Caution: humidity and soiling can decrease the insulation resistance.

Degree of flammability		In vertical flammability test, goes out after no more than	Drops of molten material capable of igniting wadding	Max. duration of afterglow
UL	ICE / VDE			
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		

RoHS

RoHS (Restriction of the Use of Certain Hazardous Substances) designates the guideline 2002/95/EG of the European Parliament and Council. This forbids the use of particular substances in electrical and electronic devices, which are brought to the common market starting in July 2006.

Switches as supplied by Cherry are not themselves subject to the guidelines, but they are suitable for use in devices of the categories mentioned above. Cherry, as a leading manufacturer, feels obligated to ensure that its customers have transparency for the greatest possible security in decision-making. Overview of the Cherry switches with respect to conformance with the RoHS regulation.

Type	RoHS content substances					Note
	Hg	Cd	Pb	Br	polybr. FSM	
D3 miniature switch	-	1)	-	-	-	-
D4 miniature switch	-	-	-	-	-	-
DB subminiature switch	-	-	-	-	-	2)
DZ subminiature switch	-	-	-	-	-	2)
DC subminiature switch	-	-	-	-	-	2)
DCJK subminiature switch	-	-	-	-	-	2)
DJ super-subminiature switch	-	-	-	-	-	2)
DK super-subminiature switch	-	-	-	-	-	2)
DR super-subminiature switch	-	-	-	-	-	2)
DG sub-subminiature switch	-	-	-	-	-	2)
DH ultraminiature switch	-	-	-	-	-	2)
NM 02 center-off switch	-	-	-	-	-	2)
F6 / F7 / F8 pushbutton switches	-	-	-	-	-	-
PA / PB / PE selector switches	-	-	3)	-	-	-
ML / MX keymodule	-	-	-	-	-	-

Abbreviations for the content substances: Hg - quicksilver, Cd - cadmium, Pb - lead, Br - bromine, polbr. FSM - polybromine flame retardant

Explanations:

- not included

1) According to the exception granted by the EU Commission (published in the EU Journal L280/18 v. 25/10/05), the use of cadmium and cadmium compounds in electrical contacts is still permissible.

2) Processing after consultation with Cherry. Switches with lines are available in RoHS-conforming models on request. In case of further processing with lead-free solder, the product-specific solder recommendations must be heeded.

3) Conversion of last PB and PE models planned by June 2006.

All cited regulations represent the version at the time of printing. No liability is assumed for subsequent changes.

(Based on the natural degree of soiling, products cannot be completely free of the forbidden substances. In the commission proposal (2004) 606 of 23. September 2004 to the Council of the European Union (EU), therefore, the following was proposed: "In the sense of Article 5, Paragraph 1, Letter a, a maximum concentration value of 0.1 percentage weight of lead, quicksilver, hexavalent chrome, polybromided biphenyles (PBB) or polybromided diphenylethers (PBDE) per homogeneous material and of 0.01 percentage weight cadmium per homogeneous material is tolerated.")

Approvals, markings and protection

Approvals

ENEC - VDE

ENEC - KEMA

UL USA

UL USA und Kanada

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 also switches for appliances in accordance with EN61058.

Degree of protection

Degrees of protection areexpressed in terms of compliance with DIN 40050part 9 and DIN VDE 0470.They are designated by theletters IP followed by twonumbers. The first numberindicates the extent to which the switch is protectedagainst contact with liveparts and the ingress of solidparts; the second numberindicates the extent to whichit is protected against theingress of water. For themost part, our switches arecovered by the followingtypes of protection.

IP00	No special protection
IP40	Protected against access solid foreign objects of 1mm diameter and greater
IP50	Dust-protected
IP65	Dustproof and protected against flowing water
IP6K5	Dustproof and protected against flowing water (for street vehicles)
IP67	Dustproof and protected against short-term immersion
IP6K7	Dustproof and protected against short-term immersion (for street vehicles)

Switch markings (Example)

EN 61058	10 A	(3)A	250 V~	µ	40T85	5E4
	Rated current resistive load	Rated current motor load	Rated voltage alternating voltage	Microdisconnection Contact gap < 3mm	Rated ambient temperature (-40°C upto +85°C)	Rated operation cycles: 50.000

UL 1054	10 A	1/2 HP	125-250 VAC
	Rated current inductive load	Rated current inductive 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.

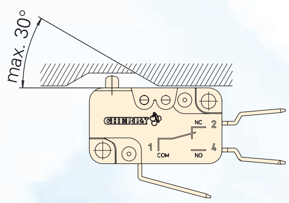
Please note:

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 Cherry. 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 Cherry.

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

CHERRY

Product overview

Miniature switches	Type	Features	Size in mm	Switched current	Switched voltage	Operating force	Actuator travel	Ambient temperature
	D3 >3 mm	contact gap > 3 mm	27,8 x 17,6 x 10,3	8–10 A	250 V AC	500 cN	2,6 mm	-40°C/+85°C
	D3	Standard	27,8 x 15,9 x 10,3	16 A	250 V AC	400 cN	2,6 mm	-40°C/+85°C
	D4	Standard	27,8 x 15,9 x 10,3	0,1–21 A	250 V AC	45–400 cN	2,6 mm	-40°C/+150°C
Subminiature switches	**Type**	**Features**	**Size in mm**	**Switched current**	**Switched voltage**	**Operating force**	**Actuator travel**	**Ambient temperature**
	DB	Standard	20,0 x 9,65 x 6,5	0,1–10 A	250 V AC	70–280 cN	1,6 mm	-40°C/+85°C
	DC	IP6K7	20,0 x 10,05 x 6,5	0,1–10 A	250 V AC	200–340 cN	1,6 mm	-40°C/+85°C
	DZ	Pos. break action	20,0 x 9,7 x 6,5	3 (3) A	250 V AC	220 cN	1,6 mm	-20°C/+85°C
	DCJK	IP6K7	20,0 x 10,2 x 6,4	0,1–10 A	12 V DC	300 cN	1,6 mm	-40°C/+85°C
Super-Subminiature switches	**Type**	**Features**	**Size in mm**	**Switched current**	**Switched voltage**	**Operating force**	**Actuator travel**	**Ambient temperature**
	DJ	IP6K7	15,2 x 8,15 x 6,4	0,005–2 A	12 V DC	120 cN	2,0 mm	-40°C/+85°C
	DK	IP6K5	14,7 x 6,8 x 5,4	0,005–2 A	12 V DC	75 cN	2,0 mm	-40°C/+85°C
	DR	Standard	13,7 x 6,8 x 5,4	0,005–2 A	12 V DC	75 cN	2,0 mm	-40°C/+85°C
Subsubminiatur-switches	**Type**	**Features**	**Size in mm**	**Switched current**	**Switched voltage**	**Operating force**	**Actuator travel**	**Ambient temperature**
	DG	Standard	12,8 x 6,5 x 5,8	0,05-2 A 1-3 A	30 V DC 125 V AC	75–140 cN	0,7 mm	-25°C/+85°C
Ultraminiature switches	**Type**	**Features**	**Size in mm**	**Switched current**	**Switched voltage**	**Operating force**	**Actuator travel**	**Ambient temperature**
	DH	Standard	8,2 x 6,2 x 2,7	0,005–0,5 A	30 V AC	90 cN	0,85 mm	-25°C/+70°C
Center-off switches	**Type**	**Features**	**Size in mm**	**Switched current**	**Switched voltage**	**Operating force**	**Actuator travel**	**Ambient temperature**
	NM02	IP6K7	13,0 x 15,1 x 5,5	0,05–0,1 A	12 V AC	50 cN	2 x 40°	-25°C/+85°C
Pushbutton switches	**Type**	**Features**	**Size in mm**	**Switched current**	**Switched voltage**	**Operating force**	**Actuator travel**	**Ambient temperature**
	F6	Standard	31,8 x 17,63 x 26,6	0,1–10 A	125/250 V AC	425 cN	3,2 mm	-40°C/+85°C