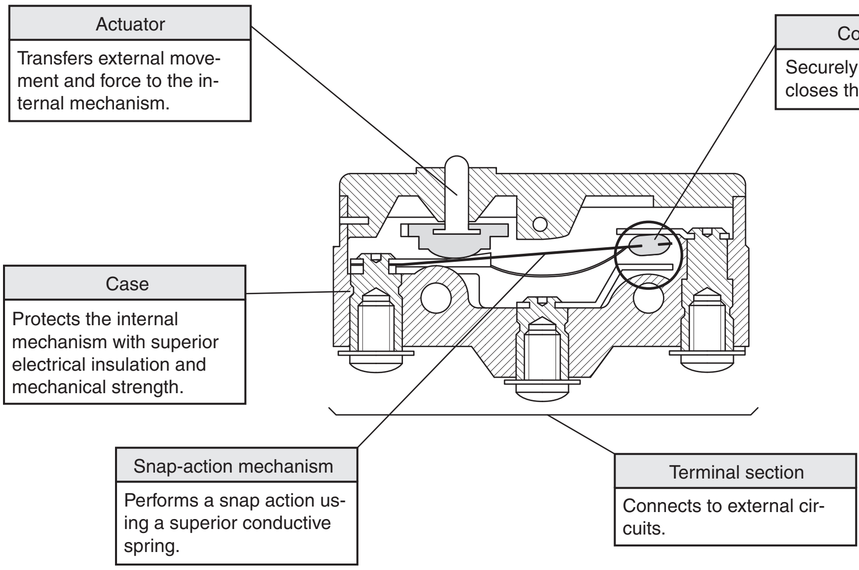
Technical Explanation for Basic Switches

CSM_MicroSwitch_TG_E_3_4

Introduction

What Is a Basic Switch?

A Basic Switch is a small switch with a very small contact gap and snap-action mechanism and with a contact structure that switches for a specified movement and specified force enclosed in a case with an actuator provided on the exterior of the case.
The following Basic Switch structure is shown as an example.
Basic Switches are mainly comprised of five components.



Structural Diagram of Typical Basic Switch

Explanation of Terms

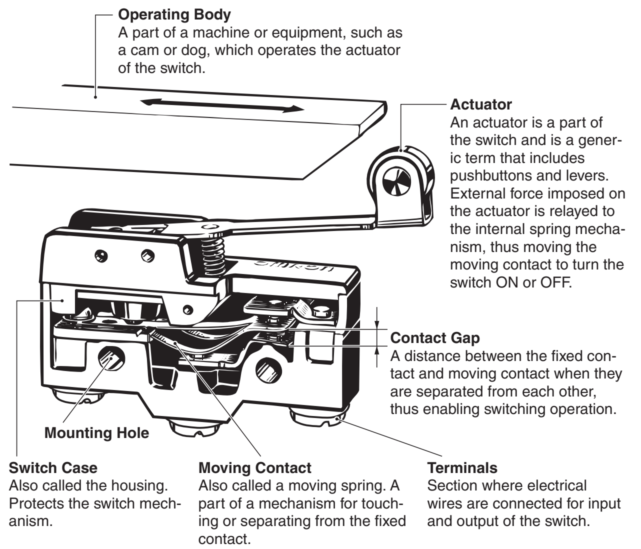
General Terms

(1) General Terms

Basic Switch: A small-size switch with a very small contact gap and snap-action mechanism and with a contact structure that switches by a specified movement and specified force enclosed in a case with an actuator provided on the exterior of the case. (Basic switches are often referred to as merely "switches" in this catalog.)
Switch with Contacts: A type of switch that achieves the switching function through the mechanical switching of contacts. Use as opposed to a semiconductor switch with switch characteristics.
Contact Form: The structure of the electrical I/O circuits of contacts used according to the type of application. (Refer to Contact Form table later in this section.)
Ratings: Value generally used as a reference for ensuring the characteristics and performance of switches, such as the rated current and rated voltage. Ratings are given assuming specific conditions (such as the type of load, current, voltage, and frequency).
Resin Filled (Molded Terminal): A terminal which is filled with resin after being connected to the internal circuit of the switch with a lead to eliminate exposed current-carrying metal parts and thereby to enhance the drip-proof properties of the switch.
Insulation Resistance: The resistance between discontinuous terminals, between terminals and non-current-carrying metal parts, and between terminals and ground.
Dielectric Strength: The threshold value up to which insulation will not be destroyed when a high voltage is applied for 1 minute to a predetermined measurement location.
Contact Resistance: The electrical resistance of the contact point of contacts. Generally, the contact resistance includes the conductive resistance of the spring or terminal section.
Vibration Resistance:
Malfunction: The range of vibration for which closed contacts will not open for longer than a specific time when vibration is applied to a switch currently in operation.
Shock Resistance:
Destruction: The range of shock for which the components of the switch will not be damaged and for which operating characteristics are maintained when mechanical shock is applied to a switch during transportation or installation.
Malfunction: The range of shock for which closed contacts will not open for longer than a specific time when shock is applied to a switch currently in operation.

(2) Terms for Configuration and Structure

Switch Configuration and Structure



(3) Terms Related to Durability

Mechanical Durability: The switching durability when a switch is operated at a specified frequency and specified overtravel (OT) without the contacts energized.
Electrical Durability: The switching durability when a switch is operated at a specified frequency and specified overtravel (OT) under the rated load.

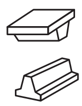
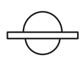
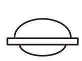
(4) Standard Test Conditions

Switches are tested under the following conditions.
Ambient temperature: 20 ± 2°C
Relative humidity: 65 ± 5%RH
Atmospheric pressure: 101.3 kPa

(5) N-level Reference Value

The N-level reference value indicates the failure rate of the switch. The following formula indicates that the failure rate is 1/2,000,000 at a reliability level of 60% (λ_{60}).
$\lambda_{60} = 0.5 \times 10^{-6}$/operations

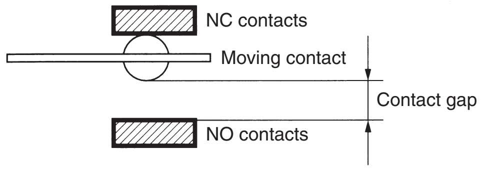
(6) Contact Shape and Type

Shape	Type	Main material	Processing method	Main application
	Crossbar contact	Gold alloy Silver alloy	Welding or riveting	Crossbar contacts are used for ensuring high contact reliability for switching micro loads. The moving contact and fixed contact come in contact with each other at a right angle. Crossbar contacts are made with materials that environment-resistant, such as gold alloy. In order to ensure excellent contact reliability, bifurcated crossbar contacts may be used.
	Needle	Silver		Needle contacts are used for ensuring improvement in contact reliability for switching loads, such as relays. A needle contact is made from a rivet contact by reducing the bending radius of the rivet contact to approximately 1 mm for the purpose of improving the contact pressure per unit area.
	Rivet	Silver Silver plated Silver alloy Gold plated		Rivet contacts are used in a wide application range from standard to high-capacity loads. The fixed rivet contact is usually processed so that it has a groove to eliminate compounds that may be generated as a result of switching. Furthermore, to prevent the oxidation or sulfidization of the silver contacts while the switch is stored, the contacts may be gold-plated. Contacts made with silver alloy are used for switching high current, such as the current supplied to TV sets.

(7) Contact Gap

The contact gap is either 0.25, 0.5, 1.0, or 1.8 mm. The contact gap is a design goal. Check the contact gap of the switch to be used if a minimum contact gap is required. The standard contact gap is 0.5 mm. Even for the same switch configuration, the smaller the contact gap of a switch mechanism is, the less the movement differential (MD) is and the more sensitivity and longer durability the switch has. Such a switch cannot ensure, however, excellent switching performance, vibration resistance, or shock resistance.
A switch becomes less sensitive when the movement differential (MD) increases along with the contact gap due to the wear and tear of the contacts as a result of current switching operations. If a switch with a contact gap of 0.25 mm is used for its high sensitivity, it will be necessary to minimize the switching current in order to prevent the wear and tear of the contacts as a result of current switching operations.
A switch with a wide contact gap excels in vibration resistance, shock resistance, and switching performance.

For information on the MD (movement differential), refer to the terms related to operating characteristics (page 4).



Character displayed	Contact gap	DC switching	Operating force and movement	Accuracy and durability	Vibration and shock resistance	Feature
H	0.25 mm	△	Minimal	☆	△	High precision and long durability
G	0.50 mm	○	Short	◎	○	General-purpose applications
F	1.00 mm	◎	Medium	○	◎	Performance level between G and E
E	1.80 mm	☆	Long	△	☆	Highly vibration and shock resistive

☆:Excellent ◎:Good ○:Ordinary △:Inferior

(8) Snap-action Mechanism

A snap-action mechanism is the mechanism by which the moving contact quickly moves from one fixed contact to another fixed contact with minimal relation to the speed at which the switch is operated. If the handle of a knife switch, for example, is moved quickly, the action is referred to as quick, but the mechanism by which the speed at which the handle is moved directly correlates to the movement speed of the contacts is referred to as slow-action movement rather than snap-action movement. The faster the contact switching speed, the shorter the connection time for arcing generated between the contacts.

As a result, contact wear and damage are reduced, and stable characteristics can be maintained. At this switching speed, however, in addition to mechanical limits, there is a limit to the speed that is effective to reduce arcing (i.e., economical speed). In particular, if the switching speed is too high when the circuit is open, the increased collision energy of the moving and fixed contacts will cause bouncing, and the arcing that is generated will produce marked wear on the contacts and contact welding may render the circuit unable to open.

To perform this quick action, a spring mechanism is used. The spring mechanism generally uses a dead point, which is the critical action point when one condition changes in a springing manner to another condition.

The following figure shows an example of a snap-action mechanism that combines the pulling spring and the compression spring of a Basic Switch.

The following section provides a description of the operating principles of the snap-action mechanism for double-throw Z-series Switches

As shown in the following figure on the Switch force relationship, compression spring counterforce F_1 is at equilibrium because of forces F_2 and F_0 at the free position where no external force is applied to the actuator. F_0 is the force at which moving contact C is pushed to the other contact, fixed contact B.

Next, force is applied to a part of the pulling spring through the actuator, the pulling spring is displaced, forces F_1 and F_2 at point N progressively increase until the two angles together approach 180°, and eventually equilibrium is reached with only F_1 and F_2, i.e., $F_0 = 0$.

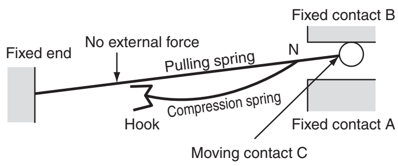
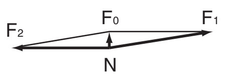
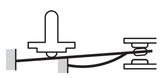
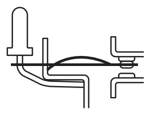
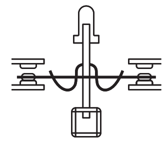
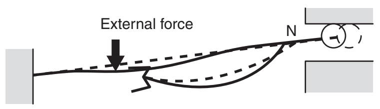
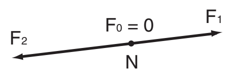
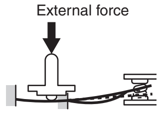
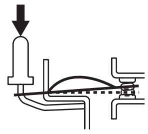
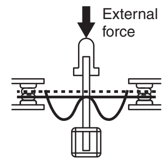
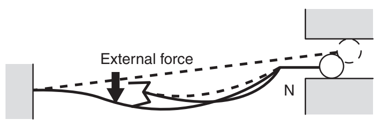
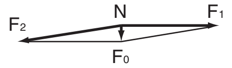
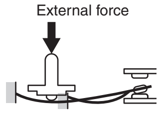
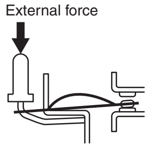
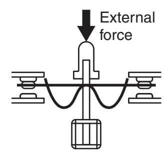
Between the free point and the point where $F_0 = 0$, a bending action works to move the contact horizontally, and the compression spring is even further bent.

From the position where $F_0 = 0$, a minute displacement applied to the pulling spring because of external force produces a force in the opposite direction, F_0, the strong force of the maximally bent compression spring sharply pushes moving spring C downward, and moving spring C transfers to the opposing fixed contact A by crossing open space.

Basic Switches use these operating principles to perform contact switching at a switching speed (i.e., opening speed) specific to the switch, regardless of the speed of the force with which the pulling spring is pushed. The position at which $F_0 = 0$ is referred to as the operating position, which nearly corresponds with the position at which a part of the pulling spring passes through the dead point.

The same operating principles apply if a releasing operation is performed when the external force is removed. The driving force, however, will be the opposing force of the bent spring.

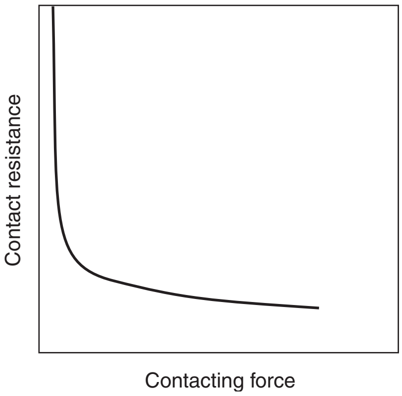
Operating Principles of Basic Switches Using Pulling Spring and Compression Spring

Condition / Position	Switch operating condition (Z Switch)	Force relation (Z Switch)	Double-throw (Z Switch)	Double-throw (V Switch)	Double-break (WL Switch)
Free position					
Operating position					
Total travel position					

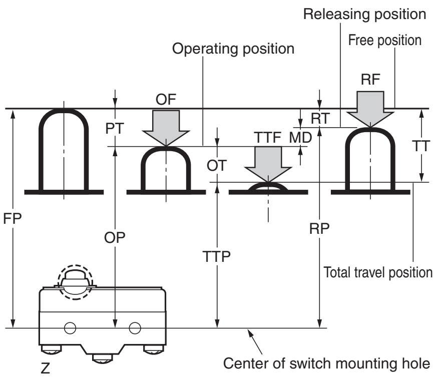
(9) Contact Resistance vs. Contacting Force

The contact resistance depends on the contacting force. The following figure shows the relationship. The contacting resistance becomes stable (i.e., smaller) as the contacting strength increases. Conversely, the contacting resistance becomes unstable (i.e., larger) as the contacting strength decreases.

Contact Resistance vs. Contacting Force



(10) Terms Related to Operating Characteristics

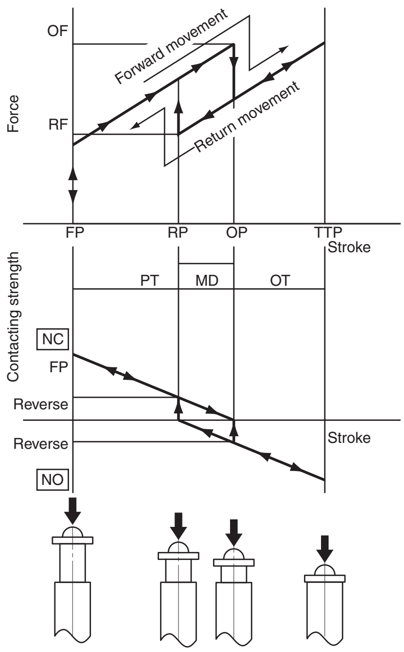
Definitions of Operating Characteristics	Classification	Term	Abbreviation	Unit	Dispersion	Definition
	Force	Operating Force	OF	N	Max.	The force applied to the actuator required to operate the switch contacts from the free position to the operating position.
		Releasing Force	RF	N	Min.	The value to which the force on the actuator must be reduced to allow the contacts to return to the normal position.
		Total Travel Force	TTF	N		The force required for the actuator to reach the total travel position from the free position.
	Travel	Pretravel	PT	mm or degrees	Max.	The distance or angle through which the actuator moves from the free position to the operating position.
		Overtravel	OT	mm or degrees	Min.	The distance or angle of the actuator movement beyond the operating position to the total travel position.
		Movement Differential	MD	mm or degrees	Max.	The distance or angle of the actuator from the operating position to the releasing position.
		Total Travel	TT	mm or degrees		The distance or angle of the actuator movement from the free position to the total travel position.
	Position	Free Position	FP	mm or degrees	Max.	The initial position of the actuator when no external force is applied.
		Operating Position	OP	mm or degrees	±	The position of the actuator at which the contacts snap to the operated contact position when external force is applied from the free position.
		Releasing Position	RP	mm or degrees		The position of the actuator at which the contacts snap from the operated contact position to their free position.
		Total Travel Position	TTP	mm or degrees		The position of the actuator when it reaches the stopper.

Example of Fluctuation:
Example: Z-15G-B with Operating Force of 2.45 to 3.43 N
The above means that each switch sample operates with a maximum operating force (OF) of 3.43 N when increasing the OF imposed on the actuator from 0.
For information of setting the switch stroke, refer to *1. Operating Stroke Setting on page 4 of Safety Precautions for All Basic Switches*.

(11) Force vs. Stroke vs. Contacting Force

The operating characteristics of Basic Switches are expressed in terms of force vs. stroke. The figure at the right shows this relationship. The stroke (i.e., actuator movement) is given on the horizontal axis and the force applied to the actuator is given on the vertical axis. The following describes the characteristics of Basic Switches.

1. The operating position (OP) and releasing position (RP) of the switch can be determined because the switch makes a switching sound as the force suddenly fluctuates when the switch operates and resets.
2. Movement differential makes Basic Switches suitable as detection switches in equipment because the moving contact is stable at either fixed contact even if the operating body that operates the actuator wobbles or moves up and down to some degree.
3. Quickly performing contact switching reduces arc connection time during current switching, which enables switching of large loads for a small switch.

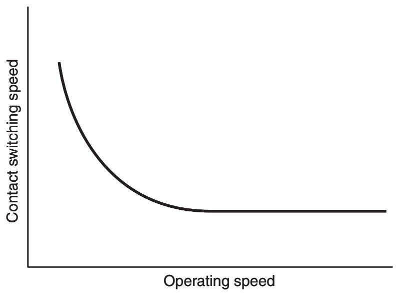


Force vs. Stroke vs. Contacting Force

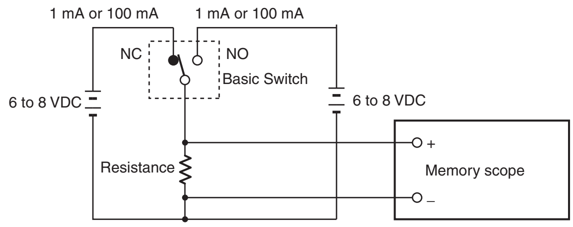
The relation between the stroke and the operating force is shown in the figure above. The contacting force at the free position decreases as the actuator is pressed in, and reaches zero when it is pressed to the OP. The moving contact inverts from the normally closed (NC) side to the normally open (NO) side, and a contacting force is immediately produced. The NO-side contacting force increases when the actuator is further pressed in. When the actuator returns, a contacting force is produced on the NC side after the NO side becomes zero.

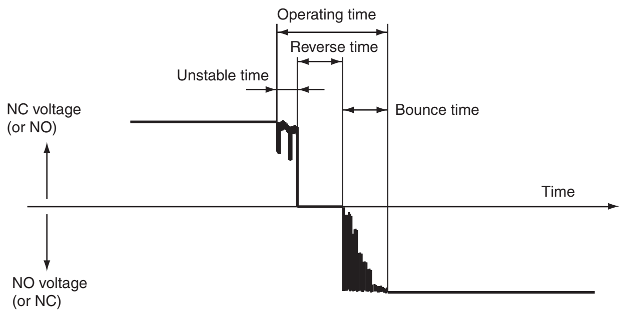
(12) Contact Switching Time

The figure at the right shows the relation between operating speed and contact switching time. Contact switching time increases as the actuator operating speed decreases. The contact switching time is therefore measured at the minimum operating speed. For the measurement circuit in the figure at the right, the applied current is 1 mA for microload Basic Switches and 100 mA for standard Basic Switches. As shown in the figure at the right, the contact switching time is the sum of the unstable time, reverse time, and bounce time, which is 5 to 15 ms for general Basic Switches. The unstable time here derives from the contact resistance instability due to contact wiping and the decrease in contacting force immediately before the contact reversal described above. The reverse time derives from the mechanical reversing of the snap-action mechanism. Bounce time derives from the bouncing that occurs when the moving contact collides with the fixed contact. During the unstable time and bounce time, the contacts become heated, which causes contact welding and may result in incorrect operation of the electronic circuit for connections made with the electronic circuit. The Basic Switches are therefore designed to minimize unstable time and bounce time.



Contact Switching Time and Operating Speed



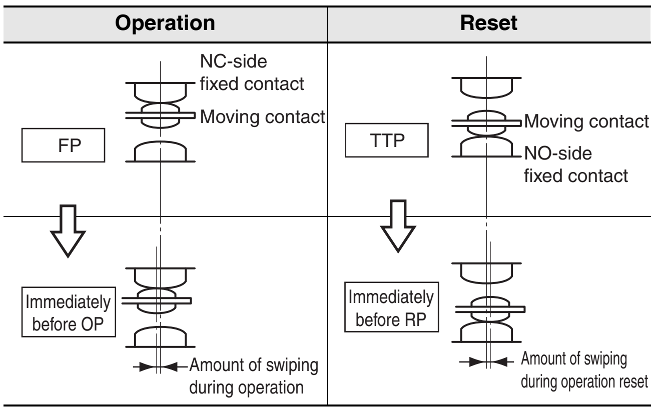


Contact switching time

(13) Contact Wiping

Wiping may occur on the contacts or barely occur at all depending on the type of snap-action mechanism. Wiping is the action of the moving contact wiping the surface of the fixed contact based on the contacting force. The following figure illustrates wiping during operation and reset of the moving contact.

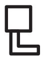
Wiping has the effect of removing contact welding caused by inrush current and cleaning the contact surfaces.



(14) Terminal Symbol and Contact Form

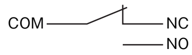
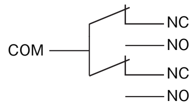
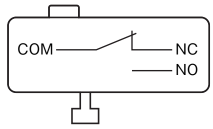
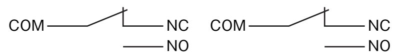
Symbol	Terminal symbol
COM	Common terminal
NC	Normally closed terminal
NO	Normally open terminal

(15) Terminal Types

Type	Shape
Solder terminal	
Quick-connect terminal (#110, #187, and #250)	
Screw terminal	
PCB terminal	
Angle terminal	

Note: In addition to the above, molded terminals with lead wires and snap-on mounting connectors are available.

(16) Contact Form

Symbol	Name
	SPDT
	SPST-NC
	SPST-NO
	Split contacts Z-10FY-B
	Maintained contacts Z-15ER
	DPDT DZ

Terms Related to EN61058-1 Standards

- Electric Shock Protective Class: Indicates the electric shock preventive level. The following classes are provided.
  - Class 0: Electric shocks are prevented by basic insulation only.
  - Class I: Electric shocks are prevented by basic insulation and grounding.
  - Class II: Electric shocks are prevented by double insulation or enforced insulation with no grounding required.
  - Class III: No countermeasures against electric shocks are required because the electric circuits in use operate in a low-enough voltage range (50 VAC max. or 70 VDC max.)
- Proof Tracking Index (PTI): Indicates the index of tracking resistance, that is, the maximum dielectric strength with no short-circuiting between two electrodes attached to the switch sample while 50 drops of 0.1% ammonium chloride solution are dropped between the electrodes drop by drop. Five levels are provided. The following table indicates the relationship between these PTI levels and CTI values according to the UL Plastics Recognized Directory.

PTI	CTI Classified by UL Yellow Book
500	PLC level 1: 400 ≤ CTI < 600 (Check with material manufacturer to see if the material meets CTI 500)
375	PLC level 2: 250 ≤ CTI < 400 (Check with material manufacturer to see if the material meets CTI 375)
300	PLC level 2: 250 ≤ CTI < 400 (Check with material manufacturer to see if the material meets CTI 300)
250	PLC level 2: 250 ≤ CTI < 400
175	PLC level 3: 175 ≤ CTI < 250

- Number of Operations: Indicates the operation number of durability test provided by the standard. They are classified into the following levels and the switch must bear the corresponding symbol. A switch with high switching frequency must withstand 50,000 switching operations and that with low switching frequency must withstand 10,000 operations to satisfy IEC standards.

Number of operations	Symbol
100,000	1E5
50,000	5E4
25,000	25E3
10,000	No symbol required
6,000	6E3
3,000	3E3
1,000	1E3
300	3E2

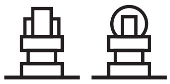
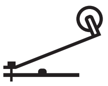
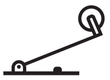
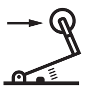
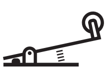
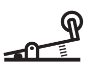
- Ambient Operating Temperature: Indicates the operating temperature range of the switch. Refer to the following table for the meanings of the notation.

Symbol	T85	25T85
Temperature range	0°C to 85°C	–25°C to 85°C

- Solder Terminal Type 1: A type of solder terminal classified by heat resistance under the following test conditions.
  - Dip soldering bath applied:
    The terminal must not wobble or make any change in insulation distance after the terminal is dipped for a specified depth and period into a dip soldering bath at a temperature of 235°C at specified speed.
  - Soldering iron applied:
    The terminal must not wobble or make any change in insulation distance after the terminal is soldered by applying wire solder that is 0.8 mm in diameter for two to three seconds by using a soldering iron, the tip temperature of which is 350°C.
- Solder Terminal Type 2: A type of solder terminal classified by heat resistance under the following test conditions.
  - Dip soldering bath applied:
    The terminal must not wobble or make any change in insulation distance after the terminal is dipped for a specified depth and period into a dip soldering bath at a temperature of 260°C at specified speed.
  - Soldering iron applied:
    The terminal must not wobble or make any change in insulation distance after the terminal is soldered by applying wire solder that is 0.8 mm in diameter for 5 seconds by using a soldering iron, the tip temperature of which is 350°C.
- Clearance distance: The minimum space distance between two charged parts or between a charged part and a metal foil stuck to the non-metal switch housing.
- Creepage distance: The minimum distance on the surface of the insulator between two charged parts or between a charged part and a metal foil stuck to the non-metal switch housing.
- Distance through insulation: The minimum direct distance between the charged part and a metal foil stuck to the isolative switch housing through air plus any other insulator thickness including the housing itself. The distance through insulation will be the insulator thickness when there is no distance through air.

Further Information

Basic Switch Actuator Type and Selection Methods

Appearance	Type	Pretravel (PT)	Overtravel (OT)	Operating force (OF)	Repeat accuracy	Shock and vibration resistance	Description
	Pin plunger	Small	Small	Large	★★★★ / ★★★	★★★★	Suitable for short direct strokes, switch characteristics are used directly, and high-precision position detection is possible. The overtravel, however, is the shortest of any actuator, requiring a reliable stopper.
	Slim spring plunger	Small	Medium	Large	★★	★★★	Overtravel is longer than for a pin plunger, but the same application methods are possible. The plunger diameter is slightly larger, but off-center loads must be avoided, i.e., the load must be on the center of the plunger.
	Short spring plunger	Small	Medium	Large	★★	★★	Overtravel is large, just as for a slim spring plunger. The plunger is short and has a larger diameter to make alignment easier.
	Panel mount plunger	Small	Large	Large	★★	★★	The overtravel is the largest of all plunger types. The switch is mounted to a panel using a hexagonal nut and lock nut (mounting position can be adjusted by adjusting the nuts). The plunger can be operated either manually or mechanically, and usage in combination with a low-speed cam is also possible.
	Panel mounted (cross) roller plunger	Small	Large	Large	★★	★	A roller is attached to a panel mount plunger switch and is operated with a cam or dog. The mounting position can be adjusted the same as a panel mount plunger switch, but the overtravel is slightly smaller. Cross rollers are also available that run parallel to the switch.
	Leaf spring	Medium	Medium	Medium	★	★★	The stroke is larger because of a strong leaf spring, making this actuator suitable for low-speed cams or cylinder drives. The bearing point is fixed, so the overtravel must be maintained within specifications in the application to prevent damage.
	Roller leaf spring	Medium	Medium	Medium	★	★★	A leaf spring actuator with a roller attached. Suitable for cam or dog operation.
	Hinge lever	Large	Medium	Small	★	★	Used with a low-speed, low-torque cam. The shape of the lever can be changed to match the operating body. Steel is mainly used as the material for the lever.
	Simulated roller lever	Large	Medium	Small	★	★	A hinge lever with the end bent into a curve to enable application as a simple roller.
	Hinge roller lever	Large	Medium	Small	★	★	A hinge lever with a roller attached. Suitable for high-speed cam operation.
	One-way action hinge roller lever	Medium	Medium	Medium	★	★	The actuator can be operated with the operating body moving in one direction. If the operating body comes from the other direction, the roller will bend and operation will fail. It can be use to prevent operation in the wrong direction.
	Reverse operation hinge lever	Large	Small	Medium	★	★★★	Used with a low-speed, low-torque cam, the shape of the lever can be changed to match the operating body. Steel is mainly used as the material for the lever. Reverse operation is achieved with a coil spring that continuously presses a pushbutton. The pushbutton is pressed in the free state, so high resistance is provided to vibration and shock. (The operating force is larger.)
	Reverse operation hinge roller lever	Medium	Medium	Medium	★	★★★	A reverse operation hinge lever with a roller attached. Suitable for cam operation.
	Reverse operation short hinge roller lever	Small	Medium	Large	★	★★★	A hinge roller lever that is shorter for reverse operation. The operating force is larger, but it is suitable for cam operation with a short stroke.
	Flexible rod	Large	Large	Small	★	★	Can be operated in any of 360° except in the direction running along the center of the rod. The operating force is small. Effective for detecting when the direction or shape is not consistent. The overtravel is absorbed by the actuator, providing a large leeway in operating object play.

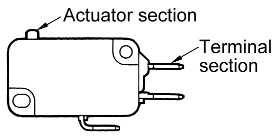
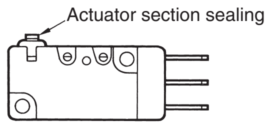
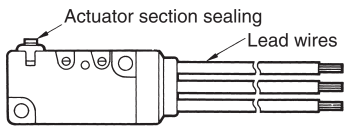
Note: Indications for repeat accuracy and shock and vibration resistance are as follows: ★: OK, ★★: Good, ★★★: Excellent, ★★★★: Superior

Selecting PCB Basic Switches

Selecting PCB Basic Switches According to Environmental Conditions

Use the Basic Switch with the sealing and grade that are suitable to the dirt, gas, dust, and water droplets conditions.

Basic Switches

Dirt and dust	Gas	Water droplets	Degree of protection	Models	Environmental resistance	Sealing
Δ	×	×	IP00	D2A, D3DC, D3C, D2X, D3D	Dirt and dust hardly enter the Switch. No protection is provided against gas, water, oil, or other liquids. If there is a possibility that the Switch will be subject to water or other liquid, use a Basic Switch with IP67 protection or use a Limit Switch.	 Dirt and dust hardly enter the Basic Switches by reducing the gaps at the actuator section (the pushbutton and case), between the case and cover, and at terminal section by means of giving mating sections interlocking shapes.
Δ	×	×	IP40	V, D2S, D3V-01, D2F, VX, J, D2RV, D2MQ, D2MC, D2D, D3M, SS, SS-P		
O	Δ	O (except terminal sections)	IP67 (except terminal sections)	D2VW models with terminals D2SW models with terminals D2SW-P models with terminals D2HW models with terminals D2JW models with terminals D2QW models with terminals	These Switches provide superior dust resistance and water resistance because they have no gaps inside the Switches, for example, at the actuator section or between the case and cover. The terminal sections are exposed, so if there is a possibility that the Switch will be subject to water or other liquid, use a model with lead wires.	
O	Δ	O	IP67	D2VW models with lead wires D2SW models with lead wires D2SW-P models with lead wires D2HW models with lead wires D2JW models with lead wires D2FW-G models	The actuator, between the case and cover, and the terminal section are all sealed to keep out dirt, dust, gas, and water.	

Note: 1. O: Can be used, Δ: Some models can be used (check which models.), ×: Cannot be used.
2. Also refer to *Safety Precautions for **All Basic Switches**.*

Temperature and Humidity

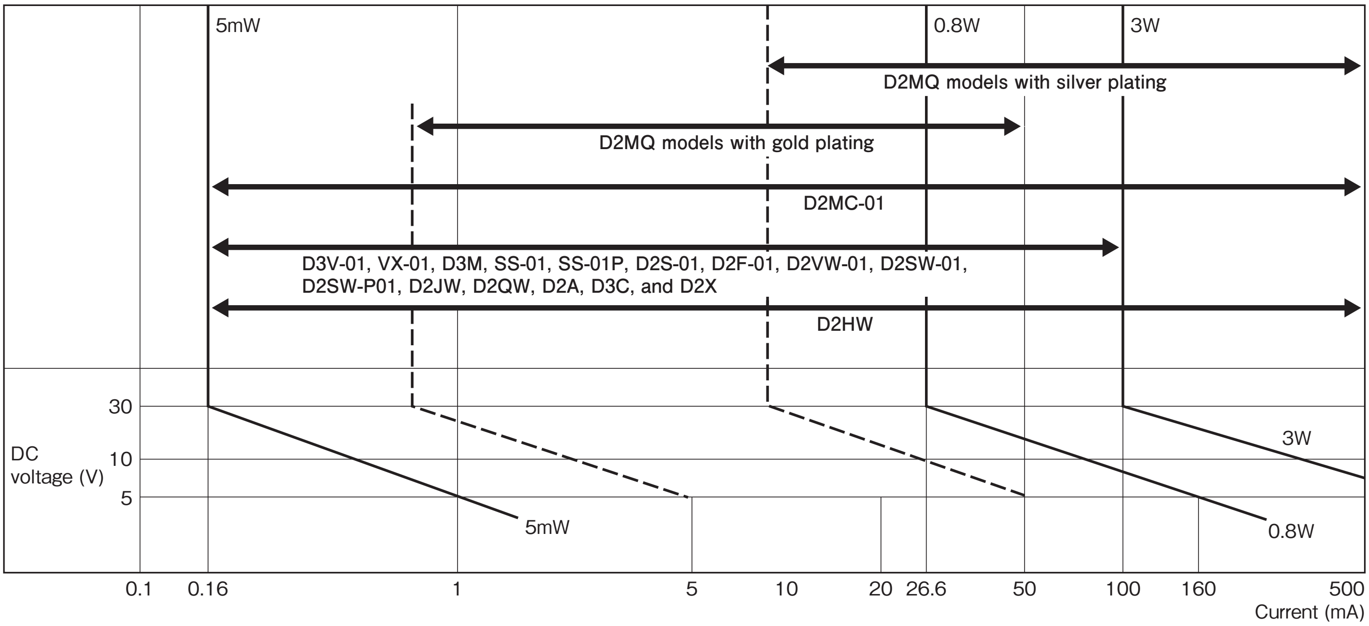
- Check the ambient operating temperature range for each model. (with no icing or condensation)

Shock and vibration resistance

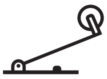
- In the characteristics specifications, malfunction due to vibration or shock means that the contacts open for longer than 1 ms.
- Select Switches that have wide contact gaps and lightweight operating sections.

Selecting Microload Models

If you are switching a microload, we recommend Basic Switches that have contact specifications suited to the application zone in the microload range, as shown in the following figure.



PCB Basic Switch Actuator Types and Selection Methods

Appearance	Type	Pretravel (PT)	Overtravel (OT)	Operating force (OF)	Repeat accuracy	Shock and vibration resistance	Description
	Pin plunger	Small	Small	Large	★★★	★★★★	Suitable for short direct strokes, switch characteristics are used directly, and high-precision position detection is possible.The overtravel, however, is the shortest of any actuator, requiring a reliable stopper.
	Leaf lever	Large	Large	Medium	★	★	Use the deflection of the lever to achieve a large stroke. They are suitable for detecting various operating bodies, such as cams and dogs.
	Simulated roller leaf lever	Large	Large	Medium	★	★	A switch with a leaf lever that is rounded on the end and can be used as a simple roller lever switch.
	Hinge lever	Large	Medium	Small	★	★	Used with a low-speed, low-torque cam, the shape of the lever can be changed to match the operating body.Steel is mainly used as the material for the lever.
	Simulated roller lever	Large	Medium	Small	★	★	A hinge lever with the end bent into a curve to enable application as a simple roller.
	Hinge roller lever	Large	Medium	Small	★	★	A hinge lever with a roller attached. Suitable for high-speed cam operation.
	Rotary action	Large	Large	Small	★	★	These are low-torque rotational movement actuators. These actuators are suitable for detecting coins, paper, and other light objects.

Note: Indications for repeat accuracy and shock and vibration resistance are as follows:
ntlpxSymbol★: OK, ★★: Good, ★★★: Excellent, ★★★★: Superior
Actuators related only to the Z Switches are not covered here.

FAQs

? The load does not turn ON when the switch is pressed. What is causing this?

The following causes are probable.

Causes

1. Contact faults
   - The actuator was not pressed sufficiently.
   - A standard switch (i.e., a switch with silver contacts) is being used for a microload (electronic circuit).
2. Fused contacts
3. Broken internal spring
4. Incorrect operating speed
5. Incorrect operating frequency
6. Dirt or dust adhesion

? What causes degraded insulation and what can be done about it?

The following causes are probable.

Cause 1 A large load capacity is causing arcing and the contacts are scattered about.

Countermeasure 1 Do not use a switch to switch a direct load. Use a relay or contactor to switch the load.

Cause 2 High humidity is high and extreme changes in ambient temperature have caused a lot amount of water droplets to enter the switch. Liquid entering the switch is carbonized by arc heat.

Countermeasure 2 Remove the cause, insert the switch into a box, or use a sealed switch.

? What causes contact failure and what can be done about it?

The following causes are possible.

Cause 1 Dirt or dust adhesion.

Countermeasure 1 Remove the cause, insert the switch into box, or use a sealed switch.

Cause 2 The effects of harmful ambient gases or switching in a low-load range is causing an insulating film to be generated on the contact surface.

Countermeasure 2 Replace the switch with a switch that uses a contact material with excellent environmental resistance (e.g., gold or alloy).

Cause 3 Solder flux entered the switch.

Countermeasure 3 Review the soldering method and use a switch that flux does not enter.

? The input of the programmable controller does not turn ON when the Basic Switch is pressed. What causes this and what can be done about it?

DC inputs of programmable controllers are generally 12 to 24 VDC and several milliamperes. The rated current for standard Basic Switches is 5 to 10 A. Silver contacts are used. Sulfide gas and oxidizing gas in the atmosphere produce an insulating film on the surface of silver contacts, which results in contact failure. Use microload Basic Switches that use gold alloy contacts.

Example: Z Switch

Standard Switch: Z-15GW22-B

↓

Microload Switch: Z-01HW22-B

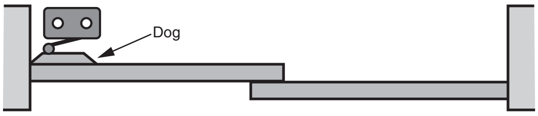
What Basic Switches are suitable as door switches?

Hinge roller lever switches are suitable.

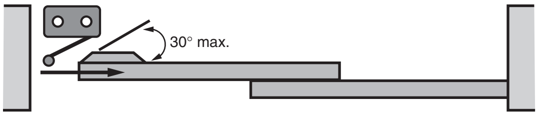
Example: Z-GW22

Sliding Door 1

Turns ON (or OFF) when door closes.



Turns OFF (or ON) when door opens.



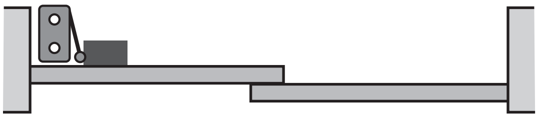
Note: 1. The amount the actuator is pressed is roughly 70% to 100% of the OT rated value.

2. When the door is opened, the first position that the actuator comes into contact with is the slope of the dog.

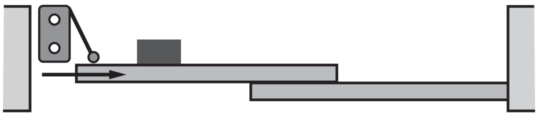
Sliding Door 2

Actuators in D, Q, and S Pushbutton Switches can also be used.

Turns ON (or OFF) when door closes.



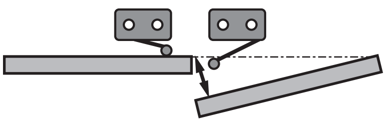
Turns OFF (or ON) when door opens.



Note: The amount the actuator is pressed is roughly 70% to 100% of the OT rated value.

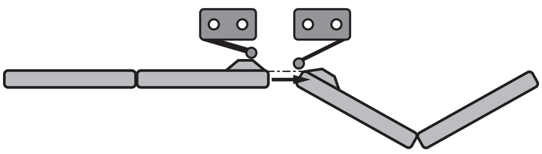
Double Doors

Actuators in D, Q, and S Pushbutton Switches can also be used.



Note: The amount the actuator is pressed is roughly 70% to 100% of the OT rated value.

Closet



Note: The dog is basically the same as with Sliding Door 1.

Note: 1. Do not use the switch with the actuator continuously pressed in. Doing so may accelerate degradation and change the characteristics.

2. Waterproof Z-D55 Switch
The rubber boot (i.e., rubber cap) hardens as the ambient temperature decreases. Therefore, resetting will be delayed and may fail if the switch is used with the actuator pressed in for a long time in a low-temperature environment. If the switch is to be used for this type of environment or application, contact your OMRON representative for special switches that use silicon rubber for the rubber boot (rubber cap) for superior resistance against cold.

The contacts are occasionally open when they should be touching. What causes this and what can be done about it?

The following reasons are possible.

Causes **Vibration or shock imposed on the switch is causing the contacts to open.**

Countermeasure **Replace the switch with one that has a greater contacting force (generally, a switch with high OF).**

Are there high-humidity models of Basic Switches available?

There is no definition of high-humidity models for Basic Switches, and so they are not made by OMRON. Use a standard model.

Troubleshooting

	Location of failure	Failure	Possible cause	Corrective action
Failures related to electrical characteristics	Contact	Contact failure	• Dust and dirt on the contacts.	• Remove the cause of the problem, place the switch in a box, or use a sealed switch.
			• Water or other liquid has penetrated into a switch.	
			• Chemical substances have been generated on the contact surface due to the atmosphere containing chemical corrosive gas.	• Use a switch having contacts with high environmental resistivity (such as gold or alloy contacts).
			• Chemical substances have been generated on the contact surface when the switch switches a very low load.	
			• Solder flux has penetrated into the switch.	• Review the soldering method.
			• Silicon gas exists near the switch.	• Remove the material generating gas, or adjust contact capacity to prevent formation of silicon compounds on the contacts.
		Malfunction	• The contacts are separated from each other by vibration or shock.	• Use a switch having a high contact force (generally a high OF).
		Contact welding	• The load connected to the switch is too high.	• Switch the load with a high-capacity relay or magnetic relay or insert a contact protection circuit.
		Insulation degradation (burning)	• Contacts have been melted and scattered by arc.	• Switch the load with a high-capacity relay or magnetic relay.
			• Water has penetrated into the switch because the switch has been used in an extremely hot environment.	• Remove the cause of the problem, place the switch in a box, or use a sealed switch.
			• Liquid has penetrated into the switch and been carbonized by arc heat.	
Failures related to mechanical characteristics	Actuator	Operating failure	• The sliding part of the actuator has been damaged because an excessive force was applied on the actuator.	• Make sure that no excessive force is applied to the actuator, or use an auxiliary actuator mechanically strong.
			• Foreign material like dust, dirt and oil has penetrated into the switch.	• Remove the cause of the problem or place the switch in a box.
			• The actuator does not release because the operating body is too heavy.	• Use a switch having a higher OF.
			• The switch is loosely installed and thus does not operate even when the actuator is at the rated OP.	• Secure the switch.
		Low durability	• The shape of the dog or cam is improper.	• Change the design of the dog or cam.
			• The operating method is improper. • The operating speed is too high.	• Review the operating stroke and operating speed.
		Damage	• Striking or other excessive shock has been applied to the actuator.	• Remove the cause of problem or use a switch mechanically strong.
			• The caulked part is not good enough or the assembled condition is poor.	• Replace the switch with a new one.
			• Deformation or drop-out • Actuator was subjected to an excessive force and force from an inappropriate direction.	• Review the handling and operating method.
	Mounting section	Damage	• Screws have not been inserted straight.	• Check and correct screw insertion method.
			• The mounting screws were tightened with too much torque.	• Tighten the screws with an appropriate torque.
			• The mounting pitch is wrong.	• Correct the pitch.
			• The switch is not installed on a flat surface.	• Install the switch on a flat surface.
	Terminal	Damage	• An excessive force was applied to the terminal while being wired.	• Do not apply an excessive force.
			• The plastic part has been deformed by soldering heat.	• Reduce the soldering time or soldering temperature. (Refer to the information given under *Safety Precautions* for that model.)