

## Switch Terminology

### General Terms

#### Limit Switch

A Built-in switch enclosed in a metal or resin case to protect it from external forces, water, oil, dust, dirt, etc. Also abbreviated to merely "Switch".

#### Ratings

Generally, the ratings of the Switch refer to values that ensures the characteristics and performance of the Switch, such as rated current and rated voltage under specific conditions.

#### Contacts

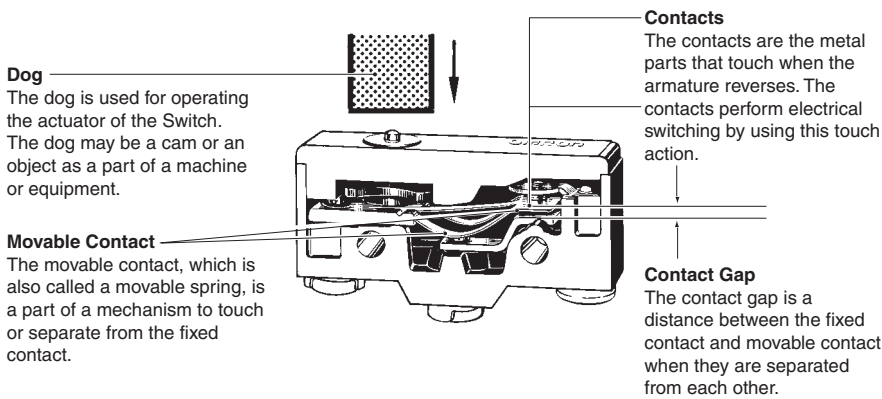
Contacts are mechanically opened and closed for current switching.

#### Contact Configuration

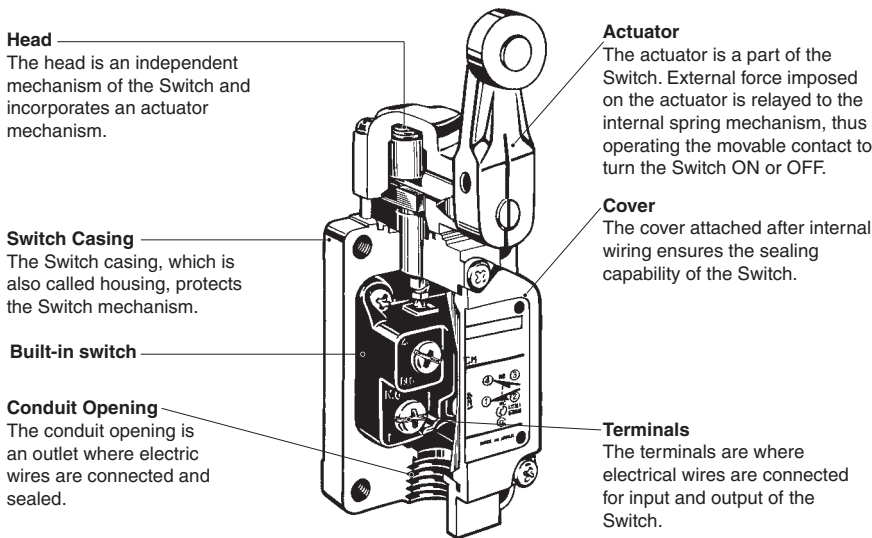
The electrical input/output circuit configuration of contacts which depends on the application.

#### Resin Molding (Molded Terminals)

Terminals that are hardened by applying resin after lead wires have been connected in order to eliminate any exposed current-carrying parts and to improve sealing performance.



### Terms Related to Configuration and Structure



### Terms Related to Characteristics

#### FP (Free Position)

The initial position of the actuator when no external force is applied.

#### OP (Operating Position)

The position where the movable contact reverses from the free position when an external force is applied to the actuator.

#### TTP (Total Travel Position)

The position of the actuator when it reaches the stopper.

#### RP (Releasing Position)

The actuator position where the movable contacts reverse from the operating position to the free position when the external force on the actuator is reduced.

#### OF (Operating Force)

The force applied to the actuator required to operate the switch contacts.

#### RF (Releasing Force)

The value to which the force on the actuator must be reduced to allow the contacts to return to the normal position.

#### PT (Pretravel)

The distance or angle through which the actuator moves from the free position to the operating position.

#### OT (Overtravel)

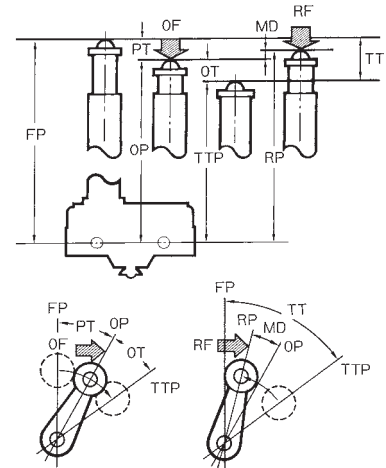
The distance or angle through which the actuator moves from the operating position to the total travel position.

#### MD (Movement Differential)

The distance or angle from the operating position to the releasing position.

#### TT (Total Travel)

The distance or angle through which the actuator moves from the free position to the total travel position.



### Terms Related to Switch Durability

#### Mechanical Durability

The mechanical durability refers to the number of available switching operations on condition that the Switch is actuated to the OT position per operation.

#### Electrical Durability

The electrical durability is the switching durability at the rated load (i.e., a resistive load) with overtravel set as the reference value.

## Terms Used in EN 60947-5-1 Standards

The following provides information on the following terms used in this catalog.

### EN 60947-5-1

EN standards applicable to electronic machine control circuitry, the contents of which are the same as those of IEC 60947-5-1.

#### Application Category

Switch application categories. Refer to the following examples.

Type of current	Category	Typical application
AC	AC-15	Control of electromagnetic loads exceeding 72 VA
	AC-14	Control of electromagnetic loads not exceeding 72 VA
DC	DC-12	Control of resistive loads and semiconductor loads

#### Rated Operating Current (Ie)

Rated current for the Switch to operate.

#### Rated Operating Voltage (Ue)

The rated switch operating voltage, which must not exceed the rated insulation voltage (Ui).

#### Rated Insulation Voltage (Ui)

The maximum rated voltage at which the insulation voltage of the Switch is maintained. This value is used as the parameter of the dielectric strength and creepage distance of the Switch.

#### Conventional Enclosed Thermal Current (Ithe)

The normal carry current that does not increase the permissible upper-limit temperature of the Switch if it is a model with its charged part sealed. The rated permissible upper-limit temperature is 65°C if the terminals are made of brass.

#### Rated Impulse Dielectric Strength (Uimp)

The peak impulse voltage that the Switch can withstand with no insulation breakage.

#### Conditional Short-circuit Current

The current that the Switch can withstand until the circuit breaker operates.

#### Short-circuit Protective Device (SCPD)

The device, such as a breaker or fuse, which breaks the current to protect the Switch from short-circuiting.

#### Pollution Degree

The environment in which the Switch is used.

The pollution degree is divided into four levels as shown below. The Switch falls under pollution degree 3.

Level	Description
Pollution degree 1	No pollution or only dry, non-conductive pollutants exist.
Pollution degree 2	Normally only non-conductive pollutants exist, which are expected to be temporarily conductive due to condensation.
Pollution degree 3	Conductive pollutants exist or existing nonconductive pollutants will be temporarily conductive due to expected condensation.
Pollution degree 4	Conductive pollutants exist or existing nonconductive pollutants will be conductive continuously due to rain or snow.

#### Protection Against Electric Shock

Electric Shock Preventive Levels

Level	Description
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 reinforced 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.

#### Closed-circuit Counter Electromotive Voltage

Instantaneous overvoltage generated from the closed circuit, which must not exceed the Uimp value.

#### Space Distance

The minimum space distance between two charged parts.

#### Creepage Distance






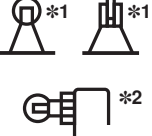






The minimum distance on the surface of the insulator between two charged parts.

#### Distance through Insulation

The minimum direct distance between the charged part and the nonmetal switch housing through air or any other insulator.

# Limit Switch Actuator Types and Selection Methods

CSM\_Selection\_of\_LS\_Actuators\_PL\_E\_1\_1

Appearance	Type	Pretravel (PT)	Overtravel (OT)	Operating force (OF)	Repeat accuracy	Shock and vibration resistance	Description
	Roller lever	Small to large	Large	Medium	★★★★★	★★★	The stroke in the operating direction is as large as 45° to 90°, the actual angle of which varies with the model. The lever can be set in any angle. Highly sensitive models with small PT values and wide angle models with large OT values are available. These models are applied to a wide range of applications including object positioning and detection.
	Adjustable roller lever	Small to large	Large	Medium	★★★★★	★★	Dogs are detected roughly by making use of the characteristics of the roller lever. The length of the lever is adjustable. (Countermeasures against lever shaking*4 may be required.)
	Adjustable rod lever	Large	Large	Medium	★★	★★	This lever is convenient when the dogs are wide or not uniform in size. The OF required by this lever is smaller than that of any other rotating actuator used for Limit Switches. The length of the rod is adjustable and the rod itself can be bent easily. (Countermeasures against lever shaking*4 may be required.)
	Fork lever lock	Large	Medium	Medium	★★	★★★	The lever turns by itself when it is operated to an angle of 55° and the lever keeps its position at an angle of 90°. A single dog in reciprocating operation can actuate the Limit Switch. Two dogs can be used to actuate two Limit Switches positioned slightly different from each other.
	Plunger	Small	Medium	Large	★★★★	★★★★	The plunger operated by hydraulic pressure or air cylinder power detects positions highly accurately. The plunger must be installed according to the movement of the dog so that an incorrect load will not be imposed on the plunger.
	Roller plunger	Small	Medium	Large	★★★★	★★★★	The roller plunger can be operated in a wide range by employing a cam, dog, cylinder, or auxiliary actuator. Position detection accuracy is high.
	Ball plunger	Small	Medium	Large	★★	★★★	The tip of the plunger is made of a steel ball, which can be operated in any direction with no limitations. The ball plunger is convenient when the mounting side is not aligned with the movement direction of the dog or the Limit Switch is actuated by two dogs in X and Y directions.
	Bevel plunger	Small	Medium	Large	★★★★	★★★	Unlike roller plungers, the bevel plunger protects the actuator from abrasion. The bevel plunger is a hardened plunger with an edge angle of 120° that ensures high accuracy and a long life. The bevel plunger is mainly applied to multiple Limit Switches for multi-level control of machining equipment.
	Coil spring	Medium	Large	Small	★	★	The coil spring can be operated in any direction except the axis direction. The OF required by the coil spring is smaller than any other actuator used for Limit Switches. The use of the coil spring is ideal for the detection of dogs that are not uniform in size or direction. The OT is absorbed by the actuator, thus permitting variations in the dog position.
	Hinge lever	Large	Medium	Small	★	★	The hinge lever is used with low-speed, low-torque cams. The lever can be varied in a variety of shapes according to the dog.
	Hinge roller lever	Large	Medium	Small	★	★	This lever consists of a hinge lever with a roller and suitable for a high-speed cam. (The operating speed must be within the permissible rate.)
	Roller arm lever	Medium	Medium	Medium	★	★	The roller position can be changed.

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

\*1. Panel-mounting models are available (D4E-□N, SHL, ZC-□55, and D4MC).

\*2. Horizontal roller models are available (D4A-□N).

\*3. Steel wire modes are available (WL). Plastic rod or wire rod models are available (D4C, D4CC, HL-5000, and D4A-□N).

\*4. Lever shaking may cause the actuator to bounce after being actuated and to move to the operating position on the opposite side. This may result in a failure of the Limit Switch.