

Position & Limit Switches

Common features of electromechanical switches

Switching systems

Switching elements lie at the heart of all electro-mechanical switching devices and must correspond to the respective application. Essentially there are two basic types of switching system that differ in terms of their mechanical design and consequently their scope of application:

- Slow-action contacts
- Snap-action contacts

Slow-action contacts

- On actuation, the normally-closed and normally-open contact functions correspond to the movement of the impact pin
- The approach speed controls the contact opening (closing) time
- Large distance / actuating travel between normally-closed and normally-open contact function
- The switching points are identical in both forward and reverse travel

Snap-action contact

- On actuation, the normally-closed contact function is immediately followed by the normally-open contact function
- In this configuration there is no overlap of the NC/NO contacts. The switch provides a distinct OR-function.
- The changeover accuracy is not dependent on the approach speed
- Consistently effective suppression of the DC arc
- Reliable contact-making also for extremely slow approach speeds
- The snap mechanism triggers the full opening width of the contact on reaching the changeover point
- Due to the force reversal in the mechanical system, a different switching point occurs in both the forward and reverse travel. The lag is referred to as hysteresis.

Overlap

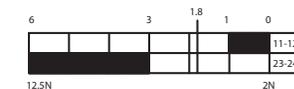
The switching principle of snap-action contacts makes overlapping of the NC/NO contact function possible. The term overlap refers to the area, in which both the normally-closed contact as well as the normally-open contact are closed in connection with a changeover switch with a delay.

Switching diagram

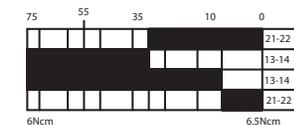
The switching diagram describes the function of the switching device in detail.

It combines the mechanical input variables that act on the contact system via the actuator with the electrical output variables. The user can deduce the following information from the switching diagram:

- Mechanical input variables (force, travel, torque, angle)
- Electrical contact-making in both forward and reverse travel
- Terminal designation
- Point at which positive opening is achieved
- Type of contact system



Slow-action contact



Snap-action contact

- Contact closed
- Contact open

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Contact designation

In accordance with DIN 50013 and DIN 50005, the terminal designations of the contact elements always consist of two digits.

The contact rows are numbered consecutively with the allocating digit (1st digit) in the actuation direction. Contacts of a switching element that belong together have the same allocating digit.

The second digit is the function digit that denotes the type of contact element.

- 1 – 2 Normally-closed contact
- 3 – 4 Normally-open contact
- 5 – 6 Normally-closed contact with delayed opening
- 7 – 8 Normally-open contact with delayed closing

Protection class

The protection class of an enclosed device denotes the degree of protection. The degree of protection includes the protection of persons against contact with parts under voltage and the protection of equipment against the infiltration of foreign bodies and water.

BERNSTEIN standard enclosures mainly correspond to protection classes IP65 and IP67. Higher protection ratings are also available for individual customer solutions. In accordance with DIN EN 60521 (IEC 529), the numerals used in the protection rating denote the following:

1st digit: Degree of protection against contact and infiltration of foreign bodies

2nd digit: Degree of protection against the infiltration of water

Example IP65:

- 6 =**
 - Complete protection against contact with components under voltage or with internal moving parts
 - Protection against dust infiltration
- 5 =**
 - A water jet directed from all directions at the device must not cause any damaging effects
 - Protection against hose water

Designation

The designation of BERNSTEIN switching devices depends on:

- The enclosure designation of the switching device
- The switching function
- The type of actuator

Example:

IN65 → Enclosure designation

U1Z → Switching function

AHK → Actuator

Enclosures

Position switches are supplied in either a plastic enclosure or a metal enclosure. The material selected for a specific application depends on the ambient conditions, the location, and several other factors.

Plastic position switches provide protective insulation and are resistant to many aggressive chemicals and liquids.

The formation of condensation water in moist environments with extreme temperature fluctuations is significantly reduced on plastic enclosures.

Metal-enclosed position switches are able to withstand high mechanical loads and they can also be used wherever hot metal chips and sparks occur, as well as being resistant to many solvents and detergents.

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Designations – Switching systems

The designations of the switching systems are identical for both plastic and metal switches. The positive opening point is indicated in the technical data sheets by the international symbol ⊕.

Switching function:	SU1Z	40
	Snap-action contact, 1NC, 1NO	Slow-action contact, 4NC
NC = Normally-closed contact		
NO = Normally-open contact		
U1Z	SU2Z	04
Slow-action contact, 1NC, 1NO	Snap-action contact, 2NC, 2NO	Slow-action contact, 4NO
UV1Z	A1Z	31
Slow-action contact with overlapping contacts, 1NC, 1NO	Slow-action contact, 1NC	Slow-action contact, 3NC, 2S
UV15Z	A2Z	13
Slow-action contact with overlapping contacts, 2NC, 1NO	Slow-action contact, 2NC	Slow-action contact, 1NC, 3NO
UV16Z	A3Z	22
Slow-action contact with overlapping contacts, 1NC, 2NO	Slow-action contact, 3NC	Slow-action contact, 2NC, 2NO
	E1	
	Slow-action contact, 1NO	
	E2	
	Slow-action contact, 2NO	

Safety switches

The scope of application for position switches has changed over time. Whereas position switches were previously used for the purpose of detecting end positions, today they are increasingly assuming functions designed to protect persons and products in machine, equipment and plant construction.

The BERNSTEIN range of safety switches offers the right solution for the most diverse applications in many branches of industry. And when it comes to safety, users particularly appreciate the fact that they are able to procure and receive all the required safety switches and professional advice from one source.

The decisive factors governing the selection of safety equipment include the ambient conditions, the installation situation and a risk analysis.

A position switch that can be used for safety functions is identified by the standardised symbol ⊕ conforming to EN 60947-5-1 Addendum K.

The switches can, of course, also be used for pure position monitoring purposes.

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Common features of electromechanical switches

Safety switches are divided into two categories, Type 1 and Type 2.

The difference is in the actuating elements which are completely integrated in the enclosure in Type 1 and separated from the switching element in Type 2.

= Mechanical positive opening action

The term positive opening action refers to the contact separation as the direct result of a defined movement of the switch actuator by means of non-sprung parts. All parts involved in contact separation must be form-fit connected.

The positive opening distance describes the minimum travel distance from the start of the actuation of the operating element up to the point where the positive opening action of the opening contacts is completed.

DIN EN 60947-5-1 defines two types of positive opening action contacts with 4 connections and double break:

Type Za

- Positively opening contacts not galvanically isolated

Type Zb

- Positively opening contacts galvanically isolated

Galvanic isolation describes the isolation of electrically conducted parts by insulating material or by air gaps.

In switching devices with several contact elements, galvanically isolated contact elements make it possible to switch voltages with different potentials (e.g. a normally-closed contact in a safety circuit, normally-open contact for an indicator).

In accordance with applicable health and safety requirements, protective devices (guards) must be mounted on machines, devices and systems that perform hazardous movements. Safety switches in the form of electromechanical switching devices are predominantly used for this purpose as they offer the following advantages:

- High degree of safety
- Non-susceptibility to interference
- Safety status easily checked on site
- Rational solutions

Form-fit, mechanical drives or coupling elements in the form of levers, rods, gearwheels etc. are necessary to ensure the optimum operation of these safety components.

Switching devices that are used for safety functions must be identified with the symbol  internationally standardised in accordance with DIN EN 60947-5-1. In defining the class of switching devices, this symbol

denotes two important properties that must be met for personal protection applications:

- Mechanical positive opening action
- Disruptive breakdown voltage > 2,5 kV

Disruptive breakdown voltage

In accordance with DIN EN 60947-5-1, open contacts must be able to maintain a minimum surge voltage of 2.5 kV without any disruptive breakdown.