Installation of single switches for safety applications

- Use only switches with the symbol ⊖ (see figure on the side).
- Connect the safety circuit to **the NC normally closed contacts (11-12, 21-22 or 31-32).**
- **The NO normally open contacts (13-14, 23-24, 33-34)** should be used **only for signalling**; these contacts are not to be connected with the safety circuit. However, if in the same protection two or more switches are used, it is possible to connect the contact NO to safety circuit.
- **The switch must be actuated with the minimum positive opening travel** indicated in the travel diagrams with symbol ⊖.
- **The switch must be actuated with the minimum positive opening force** indicated in brackets below every article, near the value of the min. force.

When the machine guard has been open and during the whole opening travel, **the switch must be triggered directly** (fig. 1) **or through a rigid connection** (fig. 2).
Only in this way the positive opening of the NC normally closed contacts (11-12, 21-22, 31-32) is guaranteed.

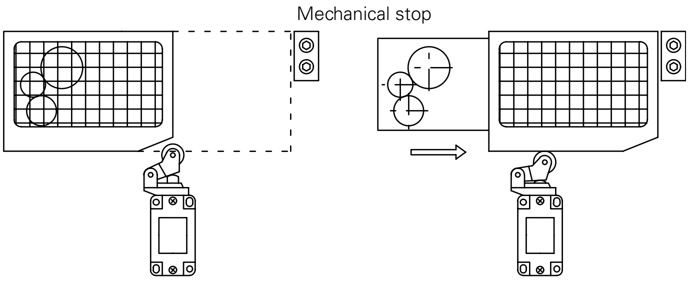


Fig.1

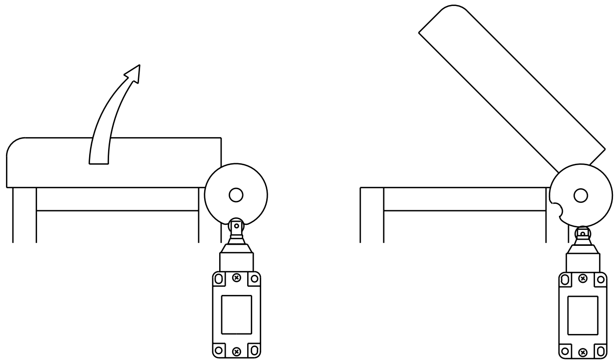


Fig.2

In the safety application with only one switch for each guard, the switches **should not be applied to activate by release** (fig. 3 and 4) **or through a non rigid connection** (i.e. by a spring).

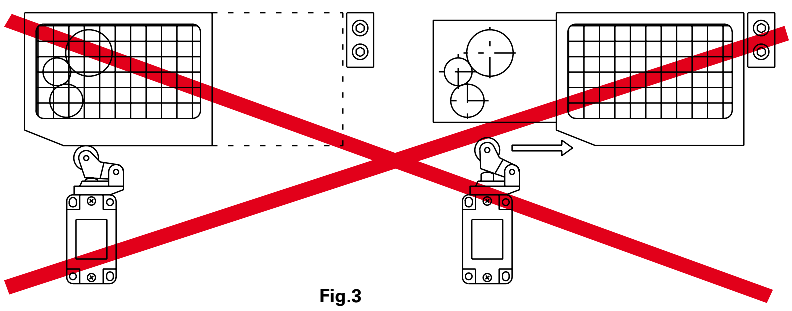


Fig.3

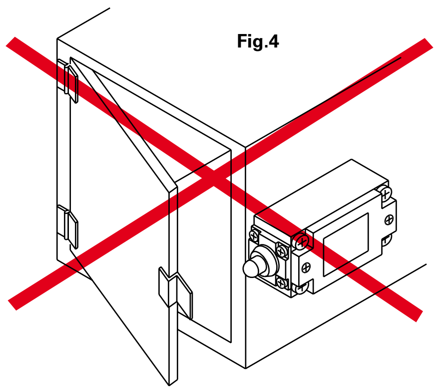
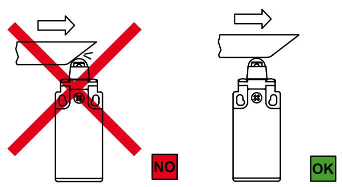


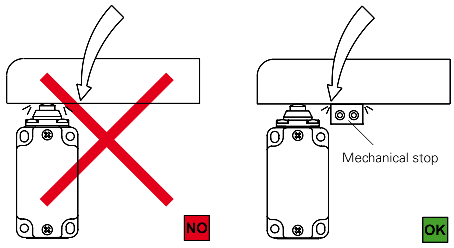
Fig.4

Mechanical stop

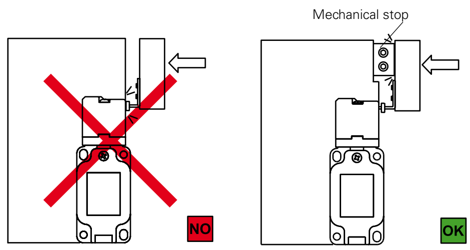
In accordance with the EN 1088 standard, paragraph 5.2.2., “the position sensors should not be used as mechanical stop”.



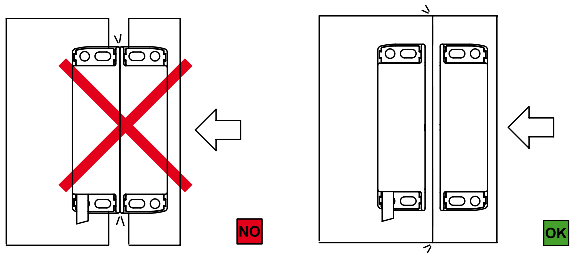
The actuator must not exceed the max. travel as indicated in the travel diagrams.



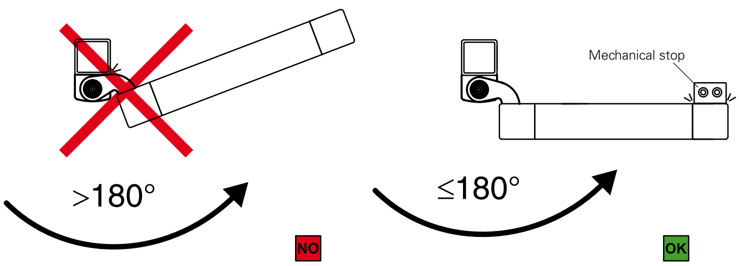
The guard should not make a mechanical stop on the switch head.



The actuator must not strike directly against the switch head.

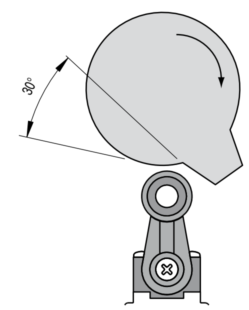
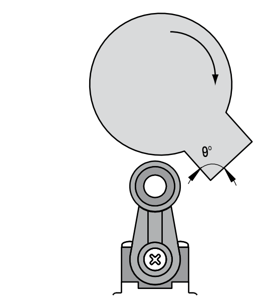
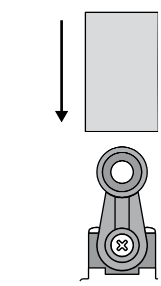
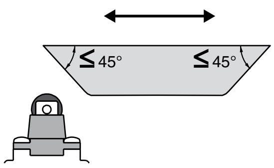
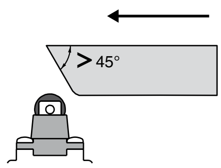
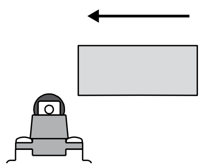
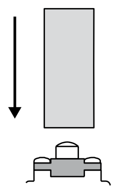
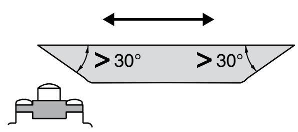
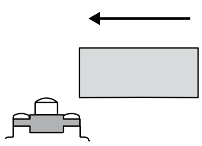


The actuator must not strike directly against the magnetic sensor.



The opening angle of safety hinge switch HP and HC series must not go over 180°.

Actuation modality

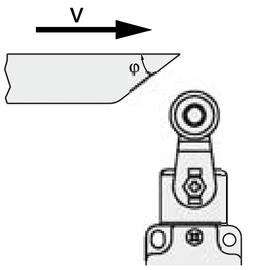
Recommended application	Application to avoid Possible application but with mechanical stress for the switch higher than expected, mechanical endurance is not guaranteed	Forbidden application
		
		
		

Switches for heavy duty FD-FL-FP-FC-FG-FS series

Maximum and minimum actuation speed (FD-FL-FP-FC series)

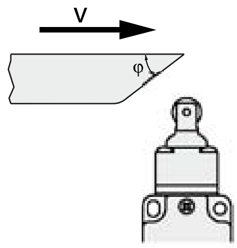
Lever with roller - Type 1

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	2,5	9	0,07
30°	1,5	8	
45°	1	7	
60°	0,75	7	



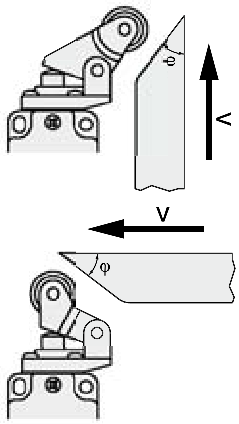
Plunger with roller - Type 2

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	1	4	0,04
30°	0,5	2	0,02
45°	0,3	1	0,01



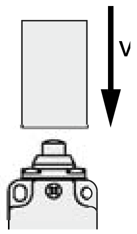
Lever with roller - Type 3

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	1	5	0,05
30°	0,5	2,5	0,025
45°	0,3	1,5	0,015



Plunger - Type 4

Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
0,5	1	0,01

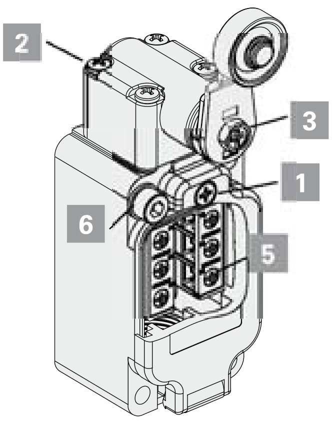


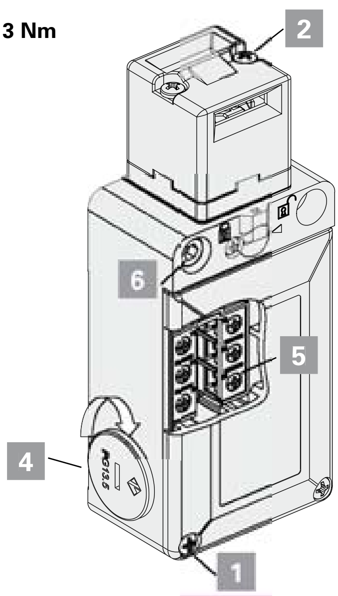
Contacts type:

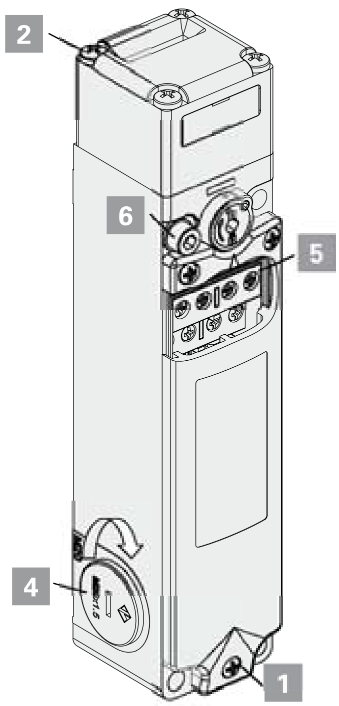
R = snap action
L = slow action

Driving torques (FD-FL-FP-FC-FG-FS series)

Cover screws 1		0,8 ... 1,2 Nm
Head screws 2		0,8 ... 1,2 Nm
Lever screws 3		0,8 ... 1,2 Nm
Protection plugs 4	(conduit entry M20/PG13,5)	1,2 ... 1,6 Nm
	(conduit entry M16/PG11)	1 ... 1,4 Nm
Contact blocks screws 5		0,6 ... 0,8 Nm
M5 screws or the housing fastening with washer (FP-FS series) 6		2... 3 Nm

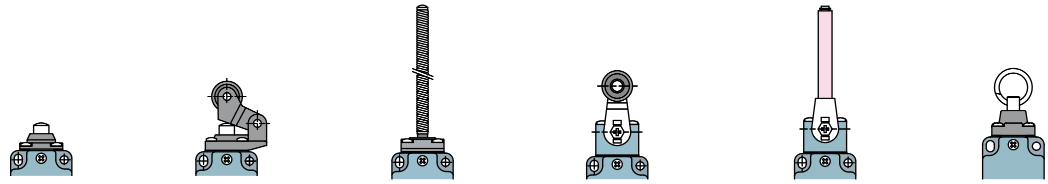






Switches for heavy duty FD-FL-FP-FC-FG-FS series

Diagrams table (FD - FP - FL - FC series)



Contact block	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6 inverted contacts
2 2x(1NO-1NC) 13-14 21-22 43-44 31-32	0 1.3 6 / 0.7	0 1.6 8 / 0.9	0 8° / 4	0 20° 75° / 13°	0 20° 75° / 13°	0 3.3 8 / 2.5
3 1NO-1NC 13-14 21-22	0 1.3 6 / 0.8	0 1.7 8 / 1.1	0 10° / 5°	0 20° 75° / 13°	0 20° 75° / 13°	0 5.3 8 / 4.5
5 1NO+1NC 13-14 21-22	0 2.2 ⊖4 6 / 1.1	0 2.7 ⊖4.9 8 / 1.4	0 15° / 5°	0 30° ⊖60° 75° / 17°	0 22° ⊖52° 75° / 9	0 2.9 8 / 1.7
6 1NO+1NC 11-12 23-24	0 1.5 ⊖3 6 / 3.4	0 1.8 ⊖3.7 8 / 4.2		0 22° ⊖42° 75° / 42°	0 14 ⊖34 75° / 34	0 0.8 8 / 2.3
7 1NO+1NC 11-12 23-24	0 3.1 ⊖4.6 6 / 1.6	0 3.8 ⊖5.7 8 / 2		0 40° 60° ⊖75° / 23°	0 32° ⊖52° 75° / 15°	0 2.2 8 / 1
9 2NC 11-12 21-22	0 2.9 ⊖4.4 6	0 3.6 ⊖5.4 8		0 40° 60° ⊖75°	0 32 ⊖52 75°	0 1 8
10 2NO 13-14 23-24	0 1.4 6	0 1.7 8	0 9	0 2 75°	0 14 75°	0 2.5 8
11 2NC 11-12 21-22	0 2 ⊖4 6 / 0.6	0 2.5 ⊖4.9 8 / 0.7		0° 27° ⊖57° 75° / 11°		0 3.5 8 / 2.1
12 2NO 13-14 23-24	0 2.9 6 / 1.5	0 3.6 8 / 1.8	0 19 / 7°	0 38° 75° / 2	0 30° 75° / 14	0 2.6 8 / 1.1
13 2NC 11-12 21-22	0 3 ⊖4.5 6 / 0.8 ⊖2.3	0 3.7 ⊖5.5 8 / 1 ⊖2.8		0 40° 61° ⊖75° / 14 ⊖34	0 33° ⊖53° 75° / 6° ⊖26°	0 3.2 8 / 1
14 2NC 11-12 21-22	0 3 ⊖4.5 6 / 1.4 ⊖2.9	0 3.7 ⊖5.5 8 / 1.7 ⊖3.6		0 40° 60° ⊖75° / 22° ⊖42°	0 32° ⊖52° 75° / 14 ⊖34	0 2.5 8 / 0.9
15 2NO 13-14 23-24	0 3 6 / 1.4	0 3.7 8 / 1.7		0 40° 75° / 22°	0 32° 75° / 14	0 2.6 8 / 1
16 2NC 11-12 21-22				75° 0 26 ⊖46 / ⊖46 26 75°		
18 1NO+1NC 11-12 23-24	0 1.5 ⊖3 6 / 2	0 1.8 ⊖3.7 8 / 2.5	0 10° / 3	0 23 ⊖43 75 / 29	0 15 ⊖35 75 / 21	0 1.9 8 / 2.4
20 1NO+2NC 11-12 21-22 33-34	0 1.5 ⊖3 6 / 2	0 1.8 ⊖3.7 8 / 2.5	0 10° / 3	0 23 ⊖43 75 / 29	0 15 ⊖35 75 / 21	0 2.4 8 / 1.9
21 3NC 11-12 21-22 31-32	0 1.5 ⊖3 6	0 1.8 ⊖3.7 8	0 10°	0 23° ⊖43° 75°	0 15° ⊖35° 75°	0 2.4 8
22 2NO+1NC 11-12 23-24 33-34	0 1.5 ⊖3 6 / 2	0 1.8 ⊖3.7 8 / 2.5	0 10° / 13°	0 23° ⊖43° 75° / 29	0 15° ⊖35° 75° / 21°	0 2.4 8 / 1.9
33 1NO+1NC 13-14 21-22	0 1.5 ⊖3 6 / 2	0 1.8 ⊖3.7 8 / 2.5	0 10° / 2°	0 23 ⊖43 75 / 27	0 15 ⊖35 75 / 9	0 2.1 8 / 2.4
34 2NC 11-12 21-22	0 1.5 ⊖3 6	0 1.8 ⊖3.7 8	0 10°	0 23 ⊖43 75	0 15 ⊖35 75	0 2.4 8

Legend

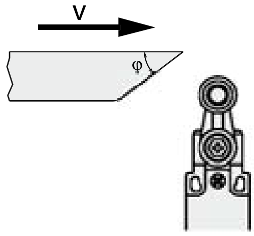
- ▬ Closed contact
- ▭ Opened contact
- ⊖ Positive opening travel
- ▶ ◀ Pushing the switch / Releasing the switch

Switches for normal duty FR-FM-FX-FZ-FK series

Maximum and minimum actuation speed

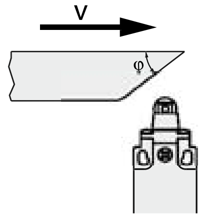
Lever with roller - Type 1

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	2,5	9	
30°	1,5	8	0,07
45°	1	7	
60°	0,75	7	



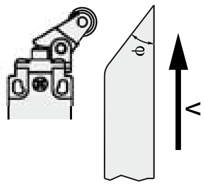
Plunger with roller - Type 2

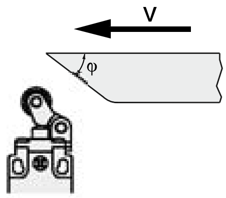
φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	1	4	0,04
30°	0,5	2	0,02
45°	0,3	1	0,01



Lever with roller - Type 3

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	1	5	0,05
30°	0,5	2,5	0,025
45°	0,3	1,5	0,015



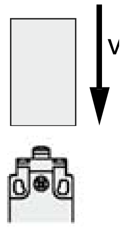


Contacts type:

R = snap action
L = slow action

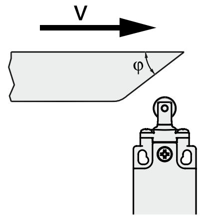
Plunger - Type 4

Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
0,5	1	0,01



Plunger with roller - Type 5

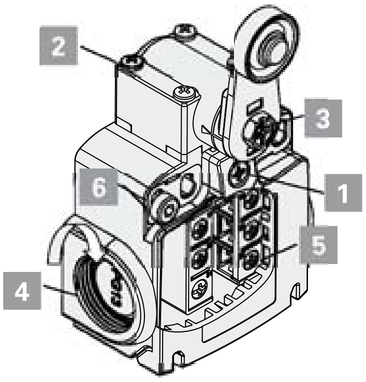
φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	0,3	4	0,04
30°	0,2	2	0,02



Driving torques

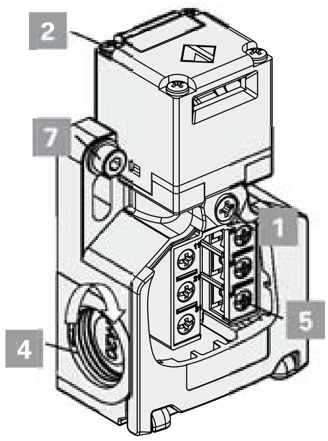
For FR, FX, FK and FW series only:

Cover screws 1		**0,7 ... 0,9 Nm**
Head screws 2		**0,5 ... 0,7 Nm**
Lever screws 3		**0,7 ... 0,9 Nm**
Protection plugs 4	(conduit entry M20/PG13,5)	**1,2 ... 1,6 Nm**
	(conduit entry M16/PG11)	**1 ... 1,4 Nm**
Contact blocks screws 5		**0,6 ... 0,8 Nm**
M4 screws or the housing fastening with washer (FR-FX-FK series) 6		**2... 3 Nm**
M5 screws or the housing fastening with washer (FW series) 7		**2... 3 Nm**



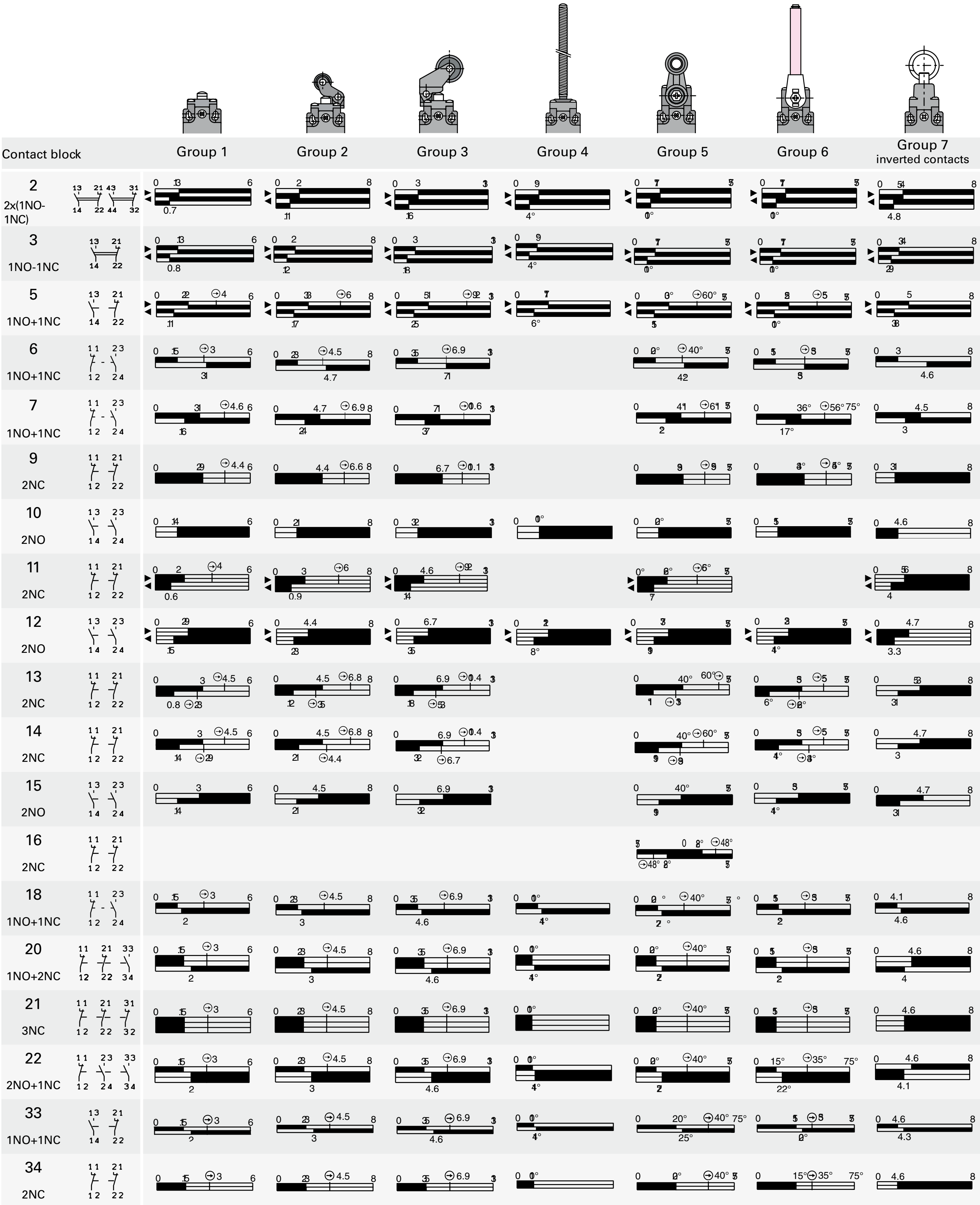
For FM and FZ series only:

Cover screws 1		**0,8 ... 1,2 Nm**
Head screws 2		**0,8 ... 1,2 Nm**
Lever screws 3		**0,8 ... 1,2 Nm**
Protection plugs 4	(conduit entry M20/PG13,5)	**1,2 ... 1,6 Nm**
	(conduit entry M16/PG11)	**1 ... 1,4 Nm**
Contact blocks screws 5		**0,6 ... 0,8 Nm**
M5 screws or the housing fastening 6		**2... 3 Nm**



Switches for normal duty FR-FM-FX-FZ-FK series

Travel diagrams



Legend

Closed contact

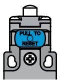
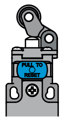
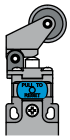
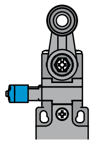
Opened contact

Positive opening travel

Pushing the switch / Releasing the switch

Switches for normal application with reset W3, FR-FM-FX-FZ-FK series

Travel diagrams

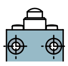
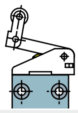
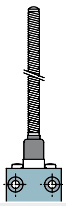
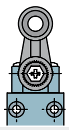
Contact block		Group 1c	Group 2c	Group 3c	Group 4c
6 1NO+1NC	11 23 / 12 24	0 1 ⊖3 6; R 1	0 15 ⊖45 8; R 15	0 23 ⊖6 13; R 23	0 15 ⊖40° 75; R 15
9 2NC	11 21 / 12 22	0 1 ⊖44 6; R 1	0 15 ⊖6 8; R 15	0 23 ⊖10.1 13; R 23	0 15 ⊖9 75; R 15
10 2NO	13 23 / 14 24	0 1 6; R 1	0 15 8; R 15	0 23 13; R 23	0 15 75; R 15
20 1NO+2NC	11 21 33 / 12 22 34	0 1 ⊖3 6; R 1	0 15 ⊖45 8; R 15	0 23 ⊖6 13; R 23	0 15 ⊖40° 75; R 15
21 3NC	11 21 31 / 12 22 32	0 1 ⊖3 6; R 1	0 15 ⊖45 8; R 15	0 23 ⊖6 13; R 23	0 15 ⊖40° 75; R 15
22 2NO+1NC	11 23 33 / 12 24 34	0 1 ⊖3 6; R 1	0 15 ⊖45 8; R 15	0 23 ⊖6 13; R 23	0 15 ⊖40° 75; R 15
33 1NO+1NC	13 21 / 14 22	0 1 ⊖3 6; R 1	0 15 ⊖45 8; R 15	0 23 ⊖6 13; R 23	0 15 ⊖40° 75; R 15
34 2NC	11 21 / 12 22	0 1 ⊖44 6; R 1	0 15 ⊖6 8; R 15	0 23 ⊖10.1 13; R 23	0 15 ⊖9 75; R 15
2 2x(1NO-1NC)	13 21 43 31 / 14 22 44 32	0 1 6; R 1	0 15 8; R 15	0 23 13; R 23	0 15 75; R 15

Legend

- Closed contact
- Opened contact
- ⊖ Positive opening travel
- Pushing the switch / Releasing the switch

Prewired switches FA

Travel diagrams

Contact block		Group 1	Group 2	Group 3	Group 4
41 1NO+1NC	13 21 / 14 22	0 18 5; 11	0 42 9; 23	0 12°; 4°	0 22° 70°; 8°
45 1NO+1NC	13 21 / 14 22	0 1.8 ⊖4 5; 1	0 42 ⊖8 9; 2	0 13°; 3°	0 22° ⊖52° 70°; 7°
46 1NO+1NC	13 21 / 14 22	0 13 ⊖28 5; 32	0 27 ⊖6 9; 8		0 13° ⊖33° 70°; 43°
48 1NO+1NC	13 21 / 14 22	0 13 ⊖28 5; 18	0 27 ⊖6 9; 4	0° 7°; 12°	0 14° ⊖34° 70°; 22°

Legend

- Closed contact
- Opened contact
- ⊖ Positive opening travel
- Pushing the switch / Releasing the switch

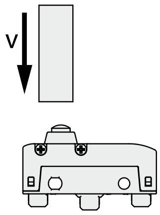
All measures in the drawings are in mm or degrees

Microswitches MK series

Max and min. actuating speed

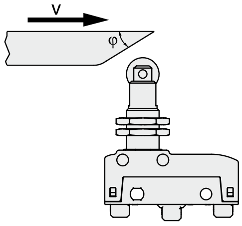
Plunger - Type 1

Vmax (m/s)	Vmin (mm/s)
0,5	0,05



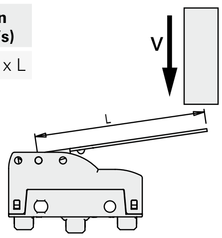
Roller plunger - Type 2

φ	Vmax (m/s)	Vmin (mm/s)
15°	0,6	0,2
30°	0,3	0,1
45°	0,1	0,05



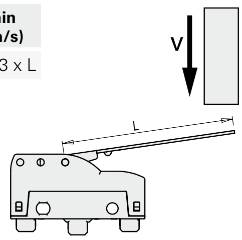
Lever with direct action (D) - Type 3

Vmax (m/s)	Vmin (mm/s)
0,03 x L	0,0166 x L



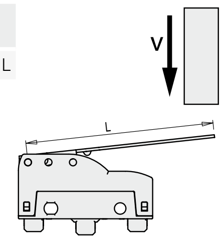
Lever with inverted action (R) - Type 4

Vmax (m/s)	Vmin (mm/s)
0,015 x L	0,0083 x L



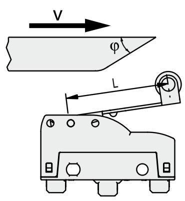
Lever with back direct action (F) - Type 5

Vmax (m/s)	Vmin (mm/s)
0,01 x L	0,0047 x L



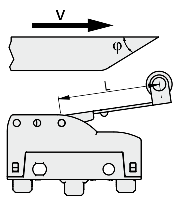
Roller lever with direct action (D) - Type 6

φ	Vmax (m/s)	Vmin (mm/s)
15°	0,1 x L	0,0664 x L
30°	0,05 x L	0,0332 x L
45°	0,03 x L	0,0166 x L



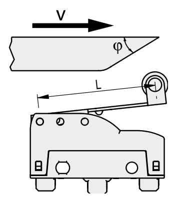
Roller lever with inverted action (R) - Type 7

φ	Vmax (m/s)	Vmin (mm/s)
15°	0,048 x L	0,0332 x L
30°	0,024 x L	0,0166 x L
45°	0,015 x L	0,0083 x L

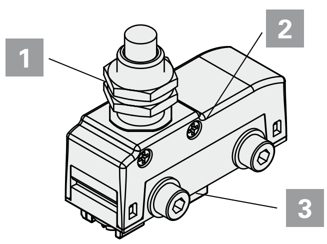


Roller lever with back direct action (F) - Type 8

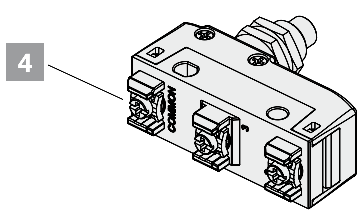
φ	Vmax (m/s)	Vmin (mm/s)
15°	0,032 x L	0,0188 x L
30°	0,016 x L	0,0094 x L
45°	0,01 x L	0,0047 x L



Driving torques



Tighten the nut 1 with a driving torque **2** ... **3** Nm.
Tighten the screws 2 with a driving torque **0,4** ... **0,5** Nm.
Tighten the nut 3 M4 with a driving torque **0,8** ... **1,2** Nm, interposing a washer.
Attention: a driving torque higher than 1,2 Nm can cause the breaking of the microswitch.



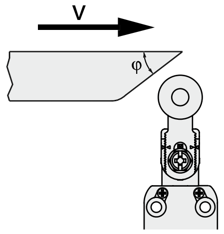
Tighten the screws 4 with a driving torque **0,6** ... **0,8** Nm.

Modular prewired switches NA-NB-NF series

Maximum and minimum actuation speed

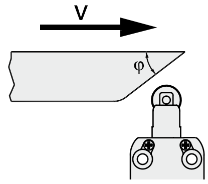
Roller lever - Type 1

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	2,5	9	0,07
30°	1,5	8	
45°	1	7	
60°	0,75	7	



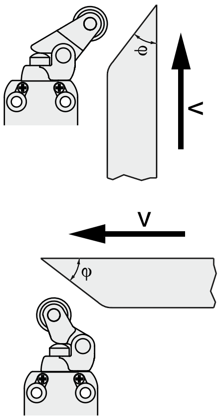
Plunger with roller - Type 2

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	1	4	0,04
30°	0,5	2	0,02
45°	0,3	1	0,01



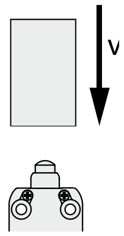
Roller lever - Type 3

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	1	5	0,05
30°	0,5	2,5	0,025
45°	0,3	1,5	0,015



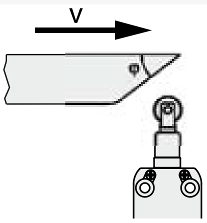
Plunger - Type 4

Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
0,5	1	0,01



Plunger with roller - Type 5

φ	Vmax (m/s)	Vmin (mm/s) L	Vmin (mm/s) R
15°	0,3	4	0,04



Contacts type:
R = snap action
L = slow action

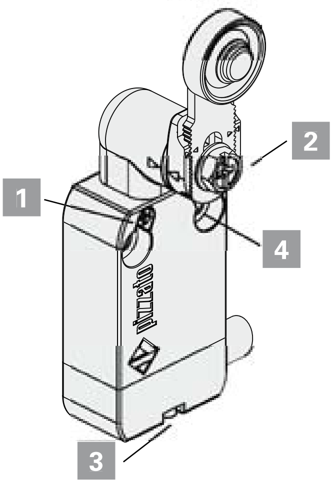
Driving torques:

NA and NB series:

Head screws 1	**0,5 ... 0,7 Nm**
Lever screws 2	**0,8 ... 1,2 Nm**
Connectors screws 3	**0,3 ... 0,6 Nm**
M4 housing fastening screws 4	**2... 3 Nm**

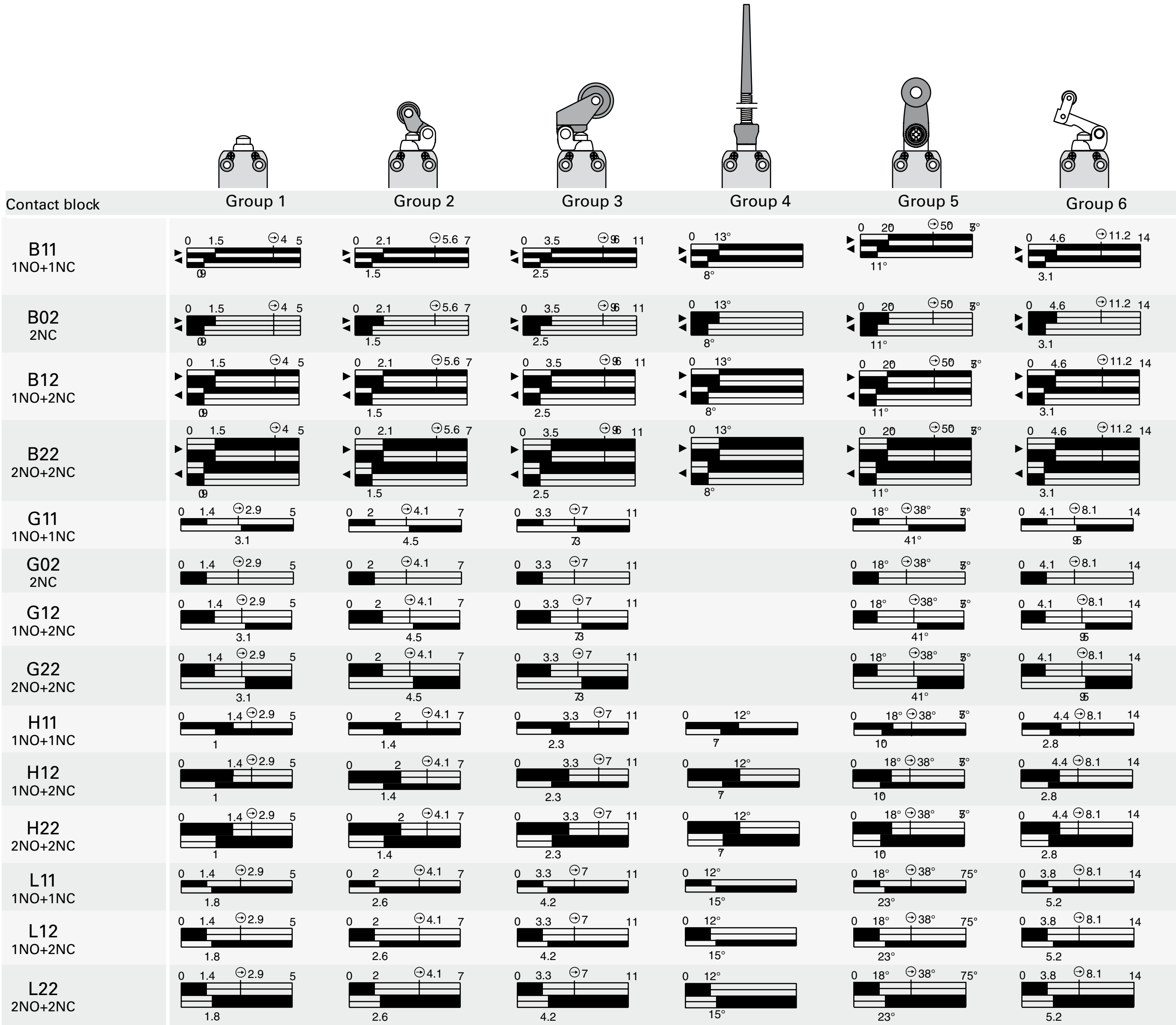
NF series:

Head screws 1	**0,3 ... 0,4 Nm**
Lever screws 2	**0,8 ... 1,2 Nm**
Connectors screws 3	**0,2 ... 0,3 Nm**
M4 housing fastening screws 4	**2... 3 Nm**



Modular prewired switches NA-NB-NF series

Travel diagrams



Legend

Closed contact

Opened contact

Positive opening travel

Pushing the switch / Releasing the switch

Features

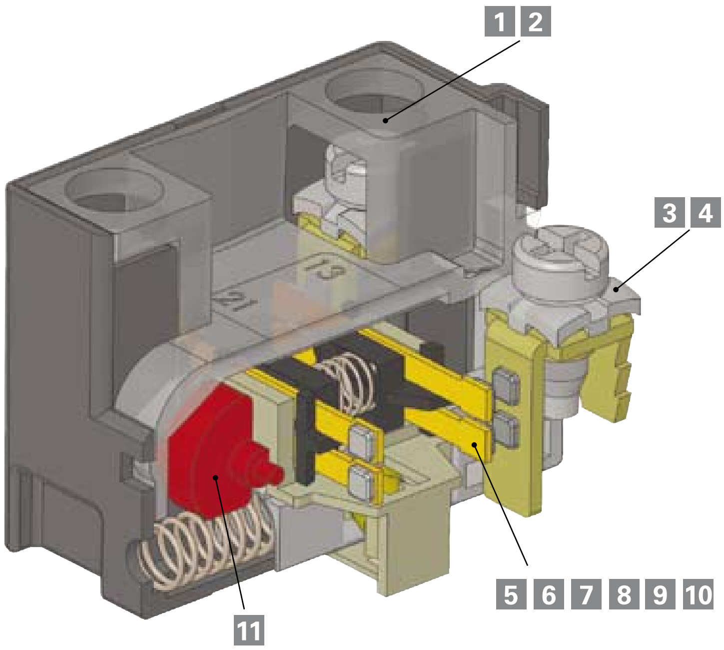
The contact blocks developed by the company Pizzato Elettrica contain the experience gained in 30 years of technological development and in millions of pieces sold. The contact blocks range available shown in this chapter is one of the widest in the world in the sector of position switches.

This chapter introduces to some features of Pizzato Elettrica contact blocks, in order to give the final user a better understanding of the technologies behind that element simply named "contact".

We underline that contact blocks are not available for sale (to the public) separately from switches, both because some of them are mechanically connected to the switch and because some technical features may change in accordance with the switch and its function. The following data intend to be a selection of all contact blocks, but cannot be used to determine complete characteristics of the switch equipped with that contact block.
For example, when a contact block with positive opening is used in a switch with a not rigid actuator, the result is a switch that on the whole is not one with positive opening.

The complete list of contact blocks currently in production is visible on page 7/17.

On page 6/17, the features of the electronic contact block E1, which can be used on position switches for a series of surveys, otherwise complex even with electronic sensors, are explained in detail. On the market doesn't exist an electronic sensor that at the same time has the characteristics of operation precision and repeatability, ability of the switching point adjustment, working temperature and price of this unit.



	Description	Page
1	Retained screws	6/12
2	Finger protection terminals	6/12
3	Clamping screw plates for different diameter cables	6/12
4	Self-lifting clamping screw plates	6/12
5	Contact material: Silver alloy or gold-plated silver alloy	6/12
6	Contact block technology and reliability: Single bridge, double bridge	6/13
7	Operation voltage and current for reliable switching	6/14

	Description	Page
8	Classification of the contact blocks according to the standard IEC 947-5-1: X, Y, C, Za, Zb	6/15
9	Contact type: Slow action / snap action / snap action with steady pressure	6/16
10	Force on the contacts	6/16
11	Positive opening of the contacts	6/39

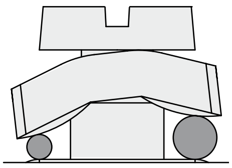
1 Retained screws

Switches with this characteristic have clamping screws that remain in seat even if completely unscrewed. This feature reduces wiring time, since the operator does not have to be careful not to unscrew the screws completely and does not risk to lose them by mistake, which is very useful in case of wirings in uncomfortable position.

2 Finger protection terminals

All terminals in the contact blocks have a protection degree IP20, in accordance with the standard EN 60529, therefore they are protected against access to dangerous parts with diameter over 12 mm.

3 Clamping screw plates for different diameter cables



These clamping screw plates have a particular "roofing tile" structure and are connected loosely to the clamping screw. In this way, during the wires fixing, the clamping screw plate is able to suit to cables of different diameter (see picture) and tends to tighten the wires toward the screw instead of permitting them to escape towards the outside.

4 Self-lifting clamping screw plates

Switches with this feature have clamping screw plates that go up or down turning the clamping screw, permitting an easy and quick wiring.

5 Contact material: gold-plated silver alloy

The contact blocks can be supplied with silver electric contacts with a special gold-plated surface, with total gold thickness of one micron. This type of treatment can be useful in environments which are aggressive against silver (very humid or sulphurous atmospheres) and in case of very small electric charges, usually with low voltages and supply currents. The gold thickness used has been studied for resistance to millions of mechanical cycles.

6 Contact block technology and reliability

Sometimes, hardly ever, an electric contact may not work. A commutation failure is a typical consequence of an occasional presence of a high resistance on the contacts due to dust, a slight layer of oxidation, or impurity of any kind that remains inside the switch during its wiring. The repeatability of this type of phenomena depends not only on the switch, but also on the environmental working conditions and the type of load the switch drives. These effects are more evident with low electrical loads, when the electric voltage does not succeed in perforating thin layers of oxide or small dust grains.

This type of malfunction may be accepted in the hand-operated devices, because it is enough to repeat the operation in order to make everything work again. This is not the case with position switches, where a failure in a switch could cause considerable damage to the machinery.

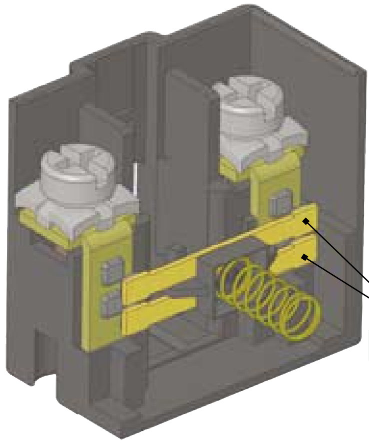
In the following table we refer to two typical contact structures (type A and B) normally used in the industry and the ones which have been used by Pizzato Elettrica for several years in most of the switches: movable contacts with double interruption and twin bridge (type C).

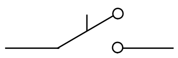
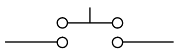
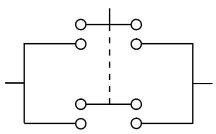
As you can see from the table below, this last structure (type C) features the same contact resistance (R) of the simple mobile contact (type A), but with a much lower probability of failure (fe).

In fact, defined x the probability of a single interruption failure, it results that in the contact type A the commutation failure probability $fe=x$, in the type B $fe \cong 2 \cdot x$, whereas in the type C it is $fe \cong 4 \cdot x^2$.

This means that if in a certain situation the probability of a single interruption failure x is equal, for instance, to 1×10^{-4} (1 failed interruption every 10.000) we will have:

- In type A one failed commutation every 10.000
- In type B one failed commutation every 5.000
- In type C one failed commutation every 25.000.000



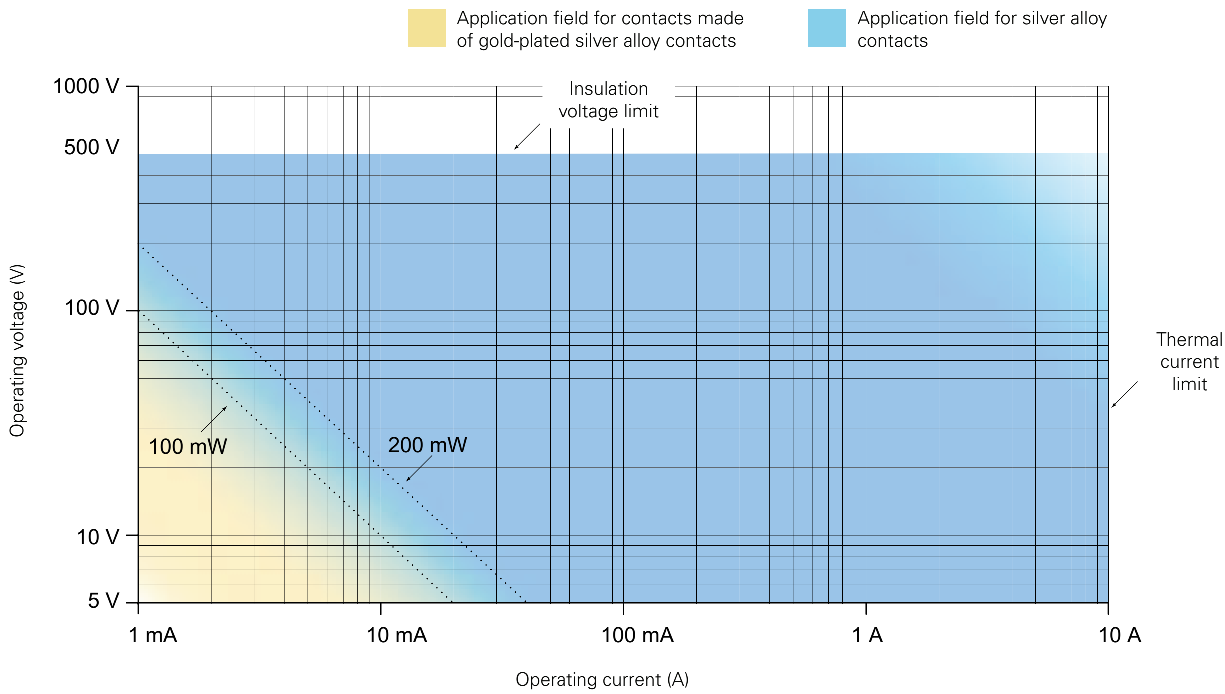
Type	Figure	Description	Contact resistance R	Probability of failure fe
A		simple contact	R=Rc	fe=x
B		contacts with double interruption	$R=2 \cdot Rc$	$fe=2x-x^2$
C		contacts with double interruption and twin bridge	$R=\frac{2 \cdot Rc}{2}=Rc$	$fe=4x^2-4x^3+x^4$

7 Operation voltage and current for reliable switching

The electric contact reliability depends on a lot of elements that change their effect in accordance with the load type. For high power loads it is essential that the contact should be able to eliminate the heat created during switching. For low power loads, instead, it is important that oxides or other impurities do not obstruct the passing of the electric signal. The choice of the electric contacts material is a compromise between different and sometimes opposing requirements. For position switches contacts it is usually used a silver alloy that has resulted suitable for switching of loads in the range between about 1 KW and 0,1 W. Moving below this power range, it is possible to have some effects because of the oxide naturally created by silver on contact with the air; just as possible contaminations or impurities in the contact switching chamber, for example the talc powder in wires sheathes that an installer could accidentally insert in the switch, become very important.

It is not possible to define a fix threshold beyond which the “missing switching phenomenon” does not appear, because there are a lot of mechanical end electric parameters that influence this value. For example, a good twin bridge electric contact in laboratory is able to switch without signal loosing loads of about microW for dozens of millions of handling operations. However, this does not mean that the same contact is able to provide the same services when the switch operates in an area with sudden changes of temperature (condensate formation) or with few switchings (oxides formation).
To avoid part of this type of problems, for very low loads are used gold plated contacts, profiting from the non-oxidability of this material. The thickness of the gold-plating should be adequate to be mechanically resistant to switching and to be electrically resistant to possible sparks that may vaporize it. It is for this reason that Pizzato Elettrica uses micron thickness gold plating suitable for millions of working cycles. Gold platings with lower thickness have simply an aesthetic function, suitable only for protection of the product against oxidation when kept in stock for long time.

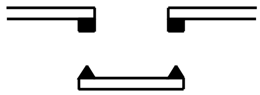
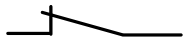
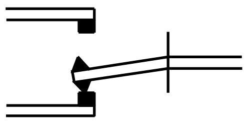
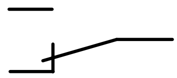
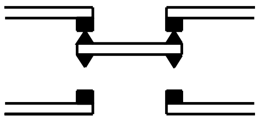
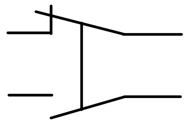
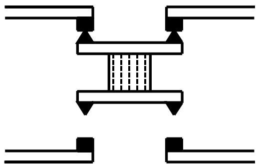
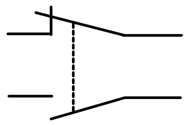
The minimum current and voltage values suggested by Pizzato Elettrica are readable on the diagram below, divided in two areas defined by a steady power limit. These values identify voltage and current combinations with high commutation reliability in most industrial fields. The lower voltage and current limits shown in the diagram are typical minimum values in industrial application that may also be reduced in not generical conditions. It is recommended, however, to always evaluate that the power signal to commutate should be at least one magnitude order higher than the noise produced in the electric circuit, in particular when circuit cables are long and pass through areas with high electromagnetic fields, especially with signal powers lower than 10 mW.



100 mW Suggested limit for general applications with snap action contact blocks with silver alloy contacts.

200 mW Suggested limit for general applications with slow action contact blocks with silver alloy contacts.

8 Classification of the contact blocks according to the standard IEC 947-5-1

Form	Figure	Symbol	Description
X			Contact component having double gap with two terminals.
Y			
C			Change-over contact component having simple gap with three terminals.
Za			Shifting contact component having double gap with four terminals. **Contacts have the same polarity**
Zb			Shifting contact component having double gap with four terminals. **Moving contacts are electrically separated**

Electrically separated contacts
Symbol "+" between contact forms (e.g. X+X, Za+Za, X+X+Y, etc.) indicates the combinations of simple contact blocks **electrically separated** between each other.
The **electrically separated contacts allow** the application of different voltages on the contacts and the connection of loads on different polarities (figure 1).

Prescriptions and restrictions for Za contacts
Electrical loads must be connected to the same phase or polarity. The contacts **are not** electrically separated, connection of different voltages between the NC contact and the NO contact is not allowed. Also, as prescribed by the standard EN 60947-5-1 paragraph K.7.1.4.6.1, if Za contacts with positive opening for safety applications are used, the following restrictions have to be adopted:
" If the control accessory has shifting contacts components with form C or Za, **you have to use only one contact component** (closure or cutoff). In case of shifting contact with form Zb, both contacts may be used..."

Zb form contact

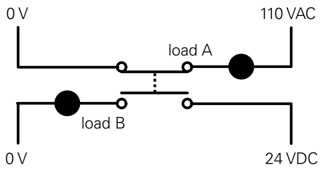


figure 1: **correct**

Za form contact

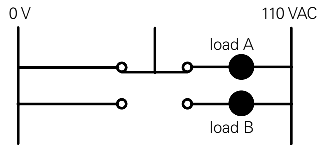


figure 2: **correct**

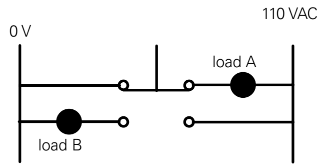
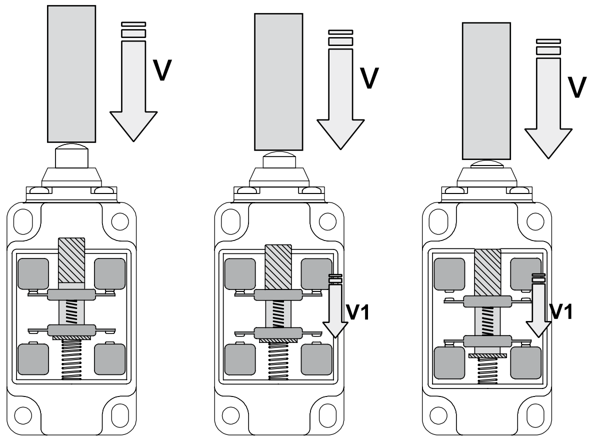


figure 3: **incorrect**

9 Contact block with dependent action: slow action and snap action

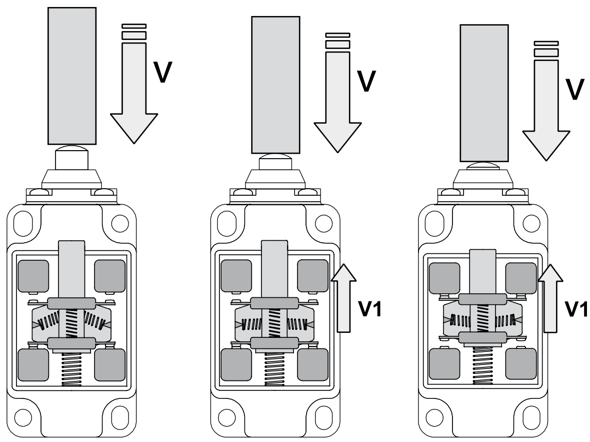
Contact blocks with slow action: component where the speed of the contact movement **(V1)** depends on the speed of the switch actuation **(V)**. The contact armature advances at a rate proportional to the actuation speed. The slow action contact block is suitable for applications having low to medium currents and quick actuation movements. It has no differential travel.

V = V1



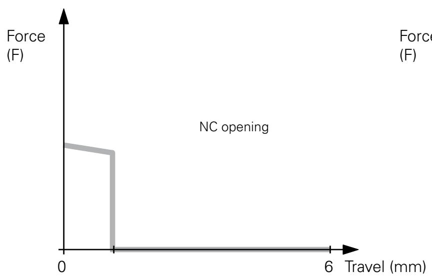
Contact block with snap action: component where the speed of the contact movement **(V1)** doesn't depend on the speed of the switch actuation **(V)**. After reaching a predetermined point in travel, the contact armature snaps causing the contacts switching. The snap action contact block is suitable for applications having high currents and/or slow actuation movements. This kind of contact block has a differential travel.

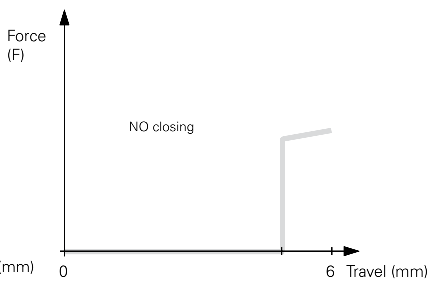
V ≠ V1

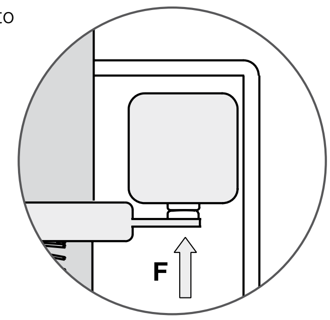


10 Contact block: diagrams of the force on the contacts

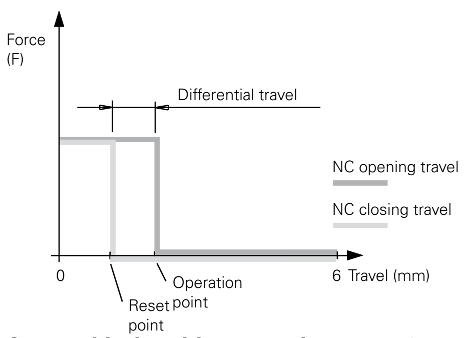
The following diagrams shows the relationship between of the force exerted on the contacts **(F)** compared to the switch armature travel.



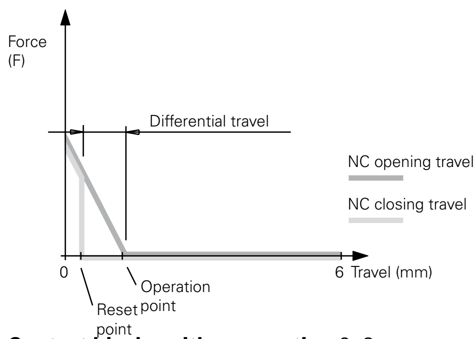




Contact blocks with slow action



Contact blocks with snap action 5, 11, 12.
The pressure on the contact remains constant while approaching to the snap point.



Contact blocks with snap action 2, 3.
The pressure on the contact decreases while approaching to the snap point.

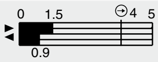
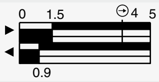
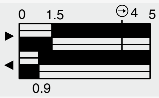
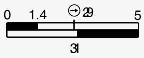
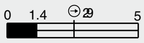
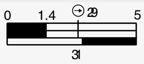
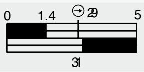
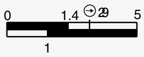
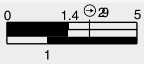
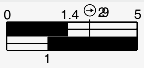
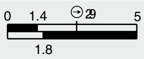
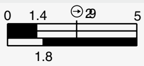
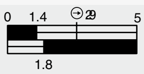
Contact blocks FD-FP-FL-FC-FR-FM-FX-FZ-FK-FW-FS series

Contact block		Contact diagram	Linear travel diagram	Contact form	Contact type	Positive opening	Contact technology	Retained screws	Finger protection terminals	Gold-plated contacts
2	2x(1NO-1NC)			Za+Za	snap action	no	Double gap	no	no	Not available
3	1NO-1NC			Za	snap action	no	Double gap	no	no	Not available
5	1NO+1NC			Zb	snap action	yes	Double gap and double bridge	yes	yes	Available
6	1NO+1NC			Zb	slow action	yes	Double gap and double bridge	yes	yes	Available
7	1NO+1NC			Zb	slow action	yes	Double gap and double bridge	yes	yes	Available
8	1NC			Y	slow action	yes	Double gap and double bridge	yes	yes	Available
9	2NC			Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
10	2NO			X+X	slow action	no	Double gap and double bridge	yes	yes	Available
11	2NC			Y+Y	snap action	yes	Double gap and double bridge	yes	yes	Available
12	2NO			X+X	snap action	no	Double gap and double bridge	yes	yes	Available
13	2NC			Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
14	2NC			Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
15	2NO			X+X	slow action	no	Double gap and double bridge	yes	yes	Available
16	2NC			Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
18	1NO+1NC			Zb	slow action	yes	Double gap and double bridge	yes	yes	Available
20	1NO+2NC			Y+Y+X	slow action	yes	Double gap and double bridge	yes	yes	Available
21	3NC			Y+Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
22	2NO+1NC			Y+X+X	slow action	yes	Double gap and double bridge	yes	yes	Available
28	1NO+2NC			Y+Y+X	slow action	yes	Double gap and double bridge	yes	yes	Available
29	3NC			Y+Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
30	3NC			Y+Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
33	1NO+1NC			Zb	slow action	yes	Double gap and double bridge	yes	yes	Available
34	2NC			Y+Y	slow action	yes	Double gap and double bridge	yes	yes	Available
E1	1NO-1NC			PNP	electronic	no	electronic	no	no	/

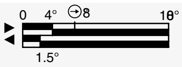
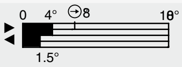
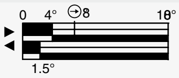
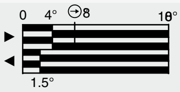
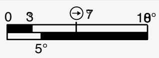
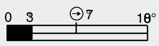
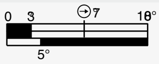
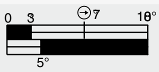
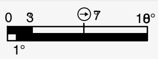
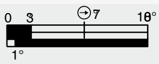
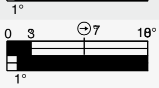
Contact blocks FG series

Contact block	Contact diagram	Linear travel diagram	Contact form	Contact type	Positive opening	Contact technology	Retained screws	Finger protection terminals	Gold-plated contacts
60•	Contact block with 4 poles, with multiple forms of contact. See page 4/59			slow action	yes	Double gap, simple bridge and double bearing	yes	yes	Available

Contact blocks NA-NB-NF series

Contact block		Contact diagram	Linear travel diagram	Contact form	Contact type	Positive opening ⊖	Contact technology	Retained screws	Finger protection terminals	Gold-plated contacts
B11	1NO+1NC			Zb	snap action	yes	Double gap	/	/	Available
B02	2NC			Y+Y	snap action	yes	Double gap	/	/	Available
B12	1NO+2NC			X+Y+Y	snap action	yes	Double gap	/	/	Available
B22	2NO+2NC			X+X+Y+Y	snap action	yes	Double gap	/	/	Available
G11	1NO+1NC			Zb	slow action	yes	Double gap	/	/	Available
G02	2NC			Y+Y	slow action	yes	Double gap	/	/	Available
G12	1NO+2NC			X+Y+Y	slow action	yes	Double gap	/	/	Available
G22	2NO+2NC			X+X+Y+Y	slow action	yes	Double gap	/	/	Available
H11	1NO+1NC			Zb	slow action	yes	Double gap	/	/	Available
H12	1NO+2NC			X+Y+Y	slow action	yes	Double gap	/	/	Available
H22	2NO+2NC			X+X+Y+Y	slow action	yes	Double gap	/	/	Available
L11	1NO+1NC			Zb	slow action	yes	Double gap	/	/	Available
L12	1NO+2NC			X+Y+Y	slow action	yes	Double gap	/	/	Available
L22	2NO+2NC			X+X+Y+Y	slow action	yes	Double gap	/	/	Available

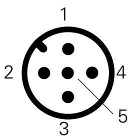
Contact blocks HP series

Contact block		Contact diagram	Linear travel diagram	Contact form	Contact type	Positive opening ⊖	Contact technology	Retained screws	Finger protection terminals	Gold-plated contacts
50C	1NO+1NC			Zb	snap action	yes	Double gap	/	/	Available
50D	2NC			Y+Y	snap action	yes	Double gap	/	/	Available
50F	1NO+2NC			X+Y+Y	snap action	yes	Double gap	/	/	Available
50M	2NO+2NC			X+X+Y+Y	snap action	yes	Double gap	/	/	Available
52C	1NO+1NC			Zb	slow action	yes	Double gap	/	/	Available
52D	2NC			Y+Y	slow action	yes	Double gap	/	/	Available
52F	1NO+2NC			X+Y+Y	slow action	yes	Double gap	/	/	Available
52M	2NO+2NC			X+X+Y+Y	slow action	yes	Double gap	/	/	Available
53C	1NO+1NC			Zb	slow action	yes	Double gap	/	/	Available
53F	1NO+2NC			X+Y+Y	slow action	yes	Double gap	/	/	Available
53M	2NO+2NC			X+X+Y+Y	slow action	yes	Double gap	/	/	Available

Assembled connectors pins wiring

For FD - FL - FM - FZ - FC series with metal housing

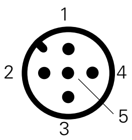
Contact block 5 – 1NO+1NC



5 poles M12 connector

Contacts	N° pin
NC	1-2
NO	3-4
ground	5

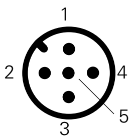
Contact block 6 – 1NO+1NC



5 poles M12 connector

Contacts	N° pin
NC	1-2
NO	3-4
ground	5

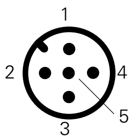
Contact block 7 – 1NO+1NC



5 poles M12 connector

Contacts	N° pin
NC	1-2
NO	3-4
ground	5

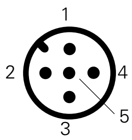
Contact block 9 – 2NC



5 poles M12 connector

Contacts	N° pin
NC	1-2
NC	3-4
ground	5

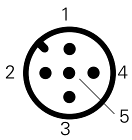
Contact block 10 – 2NO



5 poles M12 connector

Contacts	N° pin
NO	1-2
NO	3-4
ground	5

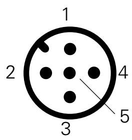
Contact block 11 – 2NC



5 poles M12 connector

Contacts	N° pin
NC	1-2
NC	3-4
ground	5

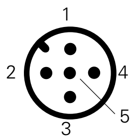
Contact block 12 – 2NO



5 poles M12 connector

Contacts	N° pin
NO	1-2
NO	3-4
ground	5

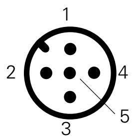
Contact block 13 – 2NC



5 poles M12 connector

Contacts	N° pin
NC (1°)	1-2
NC (2°)	3-4
ground	5

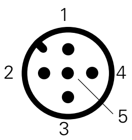
Contact block 14 – 2NC



5 poles M12 connector

Contacts	N° pin
NC (1°)	1-2
NC (2°)	3-4
ground	5

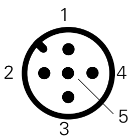
Contact block 15 – 2NO



5 poles M12 connector

Contacts	N° pin
NC (1°)	1-2
NC (2°)	3-4
ground	5

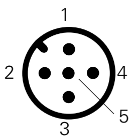
Contact block 16 – 2NC



5 poles M12 connector

Contacts	N° pin
NC lever on right	1-2
NC lever on left	3-4
ground	5

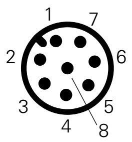
Contact block 18 – 1NO+1NC



5 poles M12 connector

Contacts	N° pin
NC	1-2
NO	3-4
ground	5

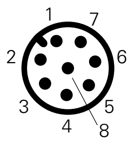
Contact block 20 – 2NC+1NO



8 poles M12 connector

Contacts	N° pin
NC	3-4
NC	5-6
NO	7-8
ground	1

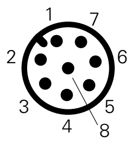
Contact block 21 – 3NC



8 poles M12 connector

Contacts	N° pin
NC	3-4
NC	5-6
NC	7-8
ground	1

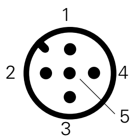
Contact block 22 – 1NC+2NO



8 poles M12 connector

Contacts	N° pin
NC	3-4
NO	5-6
NO	7-8
ground	1

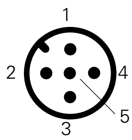
Contact block 33 – 1NC+1NO



5 poles M12 connector

Contacts	N° pin
NC	1-2
NO	3-4
ground	5

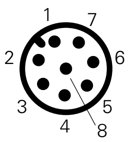
Contact block 34 – 2NC



5 poles M12 connector

Contacts	N° pin
NC	1-2
NC	3-4
ground	5

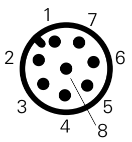
Contact block 28 – 2NC+1NO



8 poles M12 connector

Contacts	N° pin
NC	3-4
NC	5-6
NO	7-8
ground	1

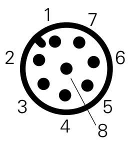
Contact block 29 – 3NC



8 poles M12 connector

Contacts	N° pin
NC	3-4
NC	5-6
NC	7-8
ground	1

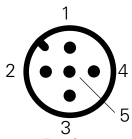
Contact block 30 – 3NC



8 poles M12 connector

Contacts	N° pin
NC	3-4
NC	5-6
NC	7-8
ground	1

Contact block E1 – PNP

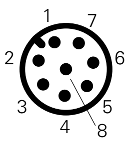


5 poles M12 connector

Contacts	N° pin
+	1
-	3
NC	2
NO	4
ground	5

For FS series with polymer housing

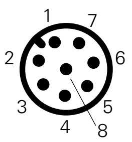
Contact block 18 – 1NO+1NC



8 poles M12 connector

Contacts	N° pin
A1-A2	1-2
NC	3-4
NO	5-6

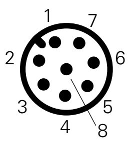
Contact block 20 – 2NC+1NO



8 poles M12 connector

Contacts	N° pin
A1-A2	1-2
NC	3-4
NC	5-6
NO	7-8

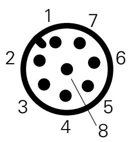
Contact block 21 – 3NC



8 poles M12 connector

Contacts	N° pin
A1-A2	1-2
NC	3-4
NC	5-6
NC	7-8

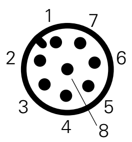
Contact block 28 – 2NC+1NO



8 poles M12 connector

Contacts	N° pin
A1-A2	1-2
NC	3-4
NC	5-6
NO	7-8

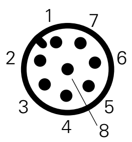
Contact block 29 – 3NC



8 poles M12 connector

Contacts	N° pin
A1-A2	1-2
NC	3-4
NC	5-6
NC	7-8

Contact block 30 – 3NC



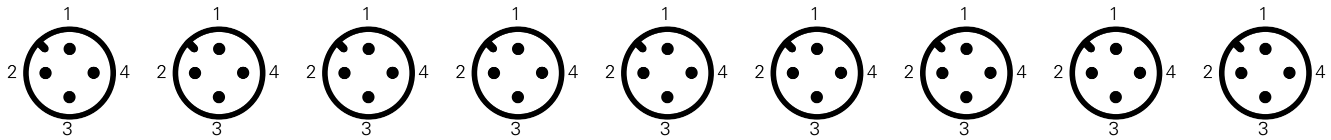
8 poles M12 connector

Contacts	N° pin
A1-A2	1-2
NC	3-4
NC	5-6
NC	7-8

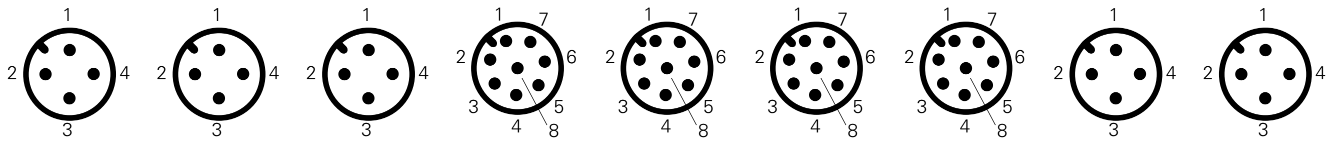
Assembled connectors pins wiring

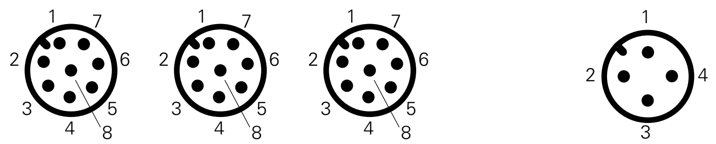
For FP - FR - FX - FW - FK series with polymer housing

Contact block 5 1NO+1NC		Contact block 6 1NO+1NC		Contact block 7 1NO+1NC		Contact block 9 2NC		Contact block 10 2NO		Contact block 11 2NC		Contact block 12 2NO		Contact block 13 2NC		Contact block 14 2NC	
4 poles M12 connector		4 poles M12 connector		4 poles M12 connector		4 poles M12 connector		4 poles M12 connector		4 poles M12 connector		4 poles M12 connector		4 poles M12 connector		4 poles M12 connector	
Contacts	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**
NC	1-2	NC	1-2	NC	1-2	NC	1-2	NO	1-2	NC	1-2	NO	1-2	NC (1°)	1-2	NC (1°)	1-2
NO	3-4	NO	3-4	NO	3-4	NC	3-4	NO	3-4	NC	3-4	NO	3-4	NC (2°)	3-4	NC (1°)	3-4



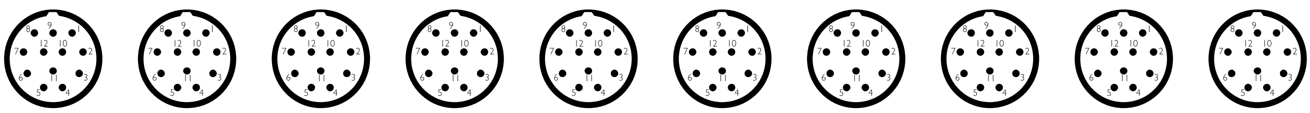
Contact block 15 2NO		Contact block 16 2NC		Contact block 18 1NO+1NC		Contact block 20 2NC+1NO		Contact block 21 3NC		Contact block 22 1NC+2NO		Contact block 2 1NO-1NC+1NO+1NC		Contact block 33 1NC+1NO		Contact block 34 2NC	
4 poles M12 connector		4 poles M12 connector		4 poles M12 connector		8 poles M12 connector		8 poles M12 connector		8 poles M12 connector		8 poles M12 connector		4 poles M12 connector		4 poles M12 connector	
Contacts	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**
NC (1°)	1-2	NC lever on right	1-2	NC	1-2	NC	3-4	NC	3-4	NC	3-4	NO	3-4	NC	1-2	NC	1-2
NC (2°)	3-4	NC lever on left	3-4	NO	3-4	NC	5-6	NC	5-6	NO	5-6	NC	5-6	NO	3-4	NC	3-4
						NO	7-8	NC	7-8	NO	7-8	NC	7-8				





Contact block 28 2NC+1NO		Contact block 29 3NC		Contact block 30 3NC		Contact block E1 PNP	
8 poles M12 connector		8 poles M12 connector		8 poles M12 connector		4 poles M12 connector	
Contacts	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**
NC	3-4	NC	3-4	NC	3-4	+	1
NC	5-6	NC	5-6	NC	5-6	-	4
NO	7-8	NC	7-8	NC	7-8	NC	2
						NO	3

For FG series with metal housing

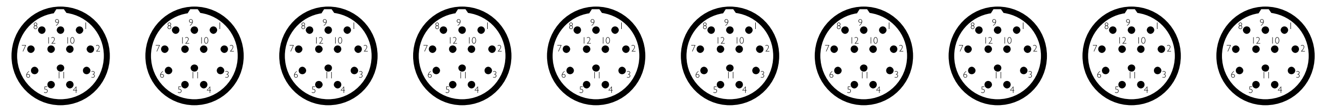


Contact block 60A 2NO+2NC		Contact block 60B 1NO+3NC		Contact block 60C 4NC		Contact block 60D 1NO+3NC		Contact block 60E 1NO+3NC		Contact block 60F 2NO+2NC		Contact block 60G 4NC		Contact block 60H 4NC		Contact block 60I 1NO+3NC		Contact block 60L 2NO+2NC	
12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector	
Contacts	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**
A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2
NC	3-4	NC	3-4	NC	3-4	NO	3-4	NC	3-4	NC	3-4	NC	3-4	NC	3-4	NC	3-4	NC	3-4
NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6
NO	7-8	NC	7-8	NC	7-8	NC	7-8	NC	7-8	NO	7-8	NC	7-8	NC	7-8	NC	7-8	NO	7-8
NO	9-10	NO	9-10	NC	9-10	NC	9-10	NO	9-10	NO	9-10	NC	9-10	NC	9-10	NO	9-10	NO	9-10
ground	11	ground	11	ground	11	ground	11	ground	11	ground	11	ground	11	ground	11	ground	11	ground	11

For FG series with metal housing

Contact block 60M 3NO+1NC		Contact block 60N 3NO+1NC		Contact block 60P 4NC		Contact block 60R 2NO+2NC		Contact block 60S 2NO+2NC	
12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector	
Contacts	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**
A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2
NO	3-4	NO	3-4	NC	3-4	NC	3-4	NC	3-4
NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6
NO	7-8	NO	7-8	NC	7-8	NO	7-8	NO	7-8
NO	9-10	NO	9-10	NC	9-10	NO	9-10	NO	9-10
ground	11	ground	11	ground	11	ground	11	ground	11

Contact block 60T 1NO+3NC		Contact block 60U 4NC		Contact block 60V 2NO+2NC		Contact block 60X 1NO+3NC		Contact block 60Y 2NO+2NC	
12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector		12 poles M23 connector	
Contacts	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**	**Contacts**	**N° pin**
A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2	A1-A2	1-2
NC	3-4	NC	3-4	NC	3-4	NO	3-4	NC	3-4
NC	5-6	NC	5-6	NC	5-6	NC	5-6	NC	5-6
NC	7-8	NC	7-8	NO	7-8	NC	7-8	NO	7-8
NO	9-10	NC	9-10	NO	9-10	NC	9-10	NO	9-10
ground	11	ground	11	ground	11	ground	11	ground	11



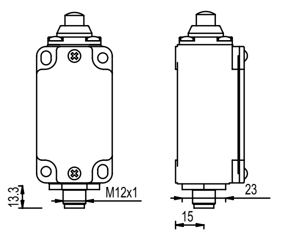
Assembled connectors outline dimension

Switch with bottom assembled, 4,5 or 8 poles, plastic or metallic connector

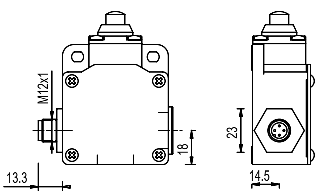
Switch with left or right assembled, 4,5 or 8 poles, plastic or metallic connector

Switch with bottom assembled, 4,5 or 8 poles, plastic or metallic connector

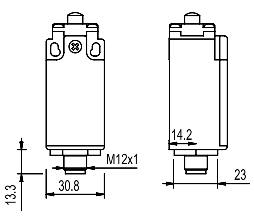
Switch with left or right assembled, 4,5 or 8 poles, plastic or metallic connector



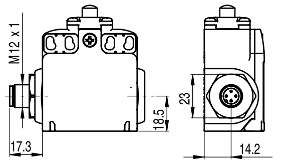
FD - FP - FC series



FL series



FR - FM - FW - FK series



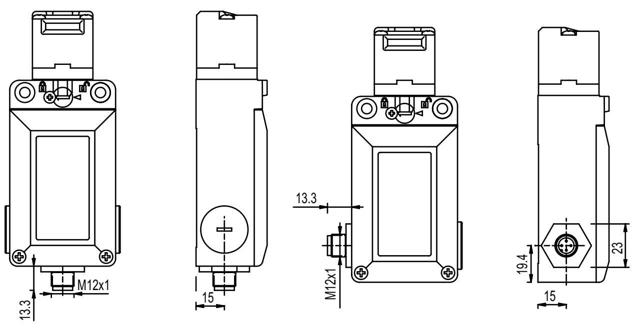
FX - FZ - FW series

Switch with bottom assembled 8 poles metallic connector

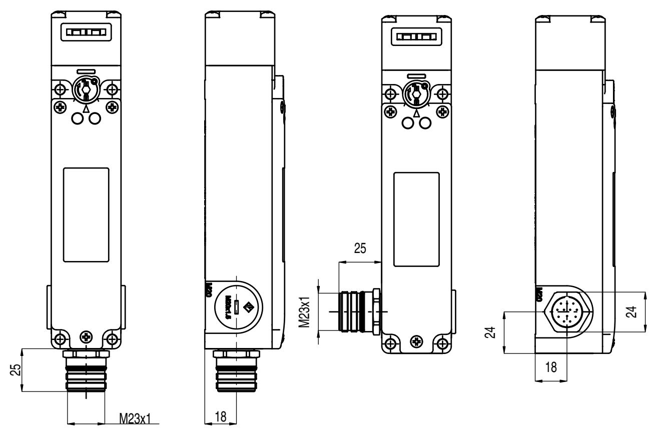
Switch with left or right assembled 8 poles metallic connector

Switch with bottom assembled 12 poles M23 metallic connector

Switch with left or right assembled 12 poles M23 metallic connector



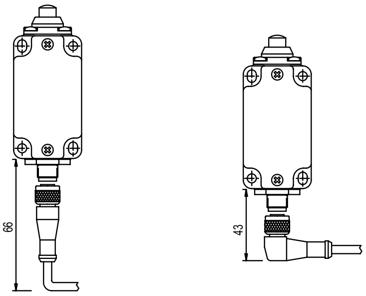
FS series

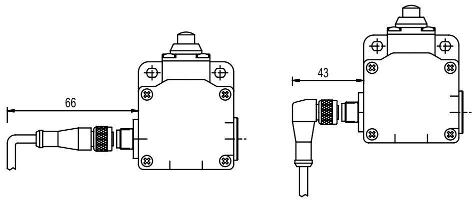


FG series

Minimal distances needed to install connectors

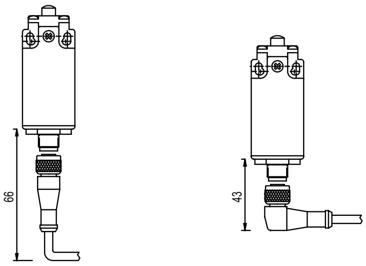
Switch with bottom assembled, 4,5 or 8 poles, plastic or metallic connector	Switch with left or right assembled, 4,5 or 8 poles, plastic or metallic connector

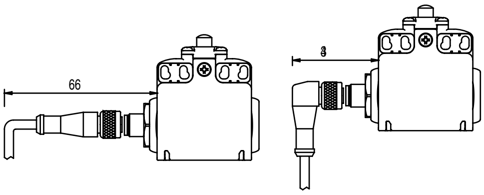




FD - FP - FC series	FL series

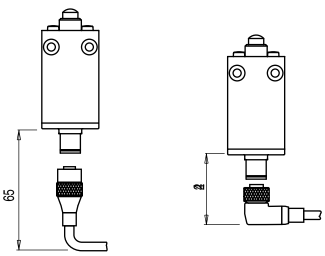
Switch with bottom assembled, 4,5 or 8 poles, plastic or metallic connector	Switch with left or right assembled, 4,5 or 8 poles, plastic or metallic connector

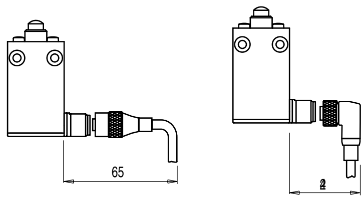




FR - FM - FW - FK series	FX - FZ - FW series

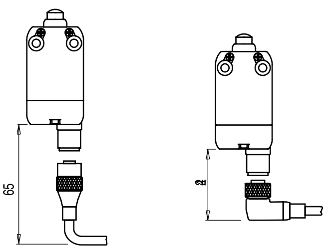
Switch with bottom 4 or 5 poles connector	Switch with right 4 or 5 poles connector

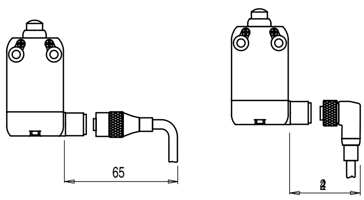




FA - FB - FF series

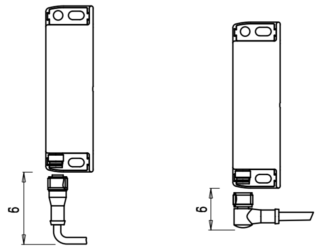
Switch with bottom 4 or 5 poles connector	Switch with right 4 or 5 poles connector



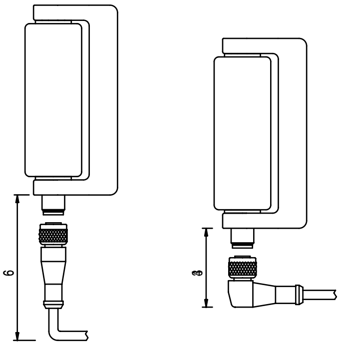


NA - NB - NF series

Sensor with 4 poles connector	Switch with 5 or 8 poles connector

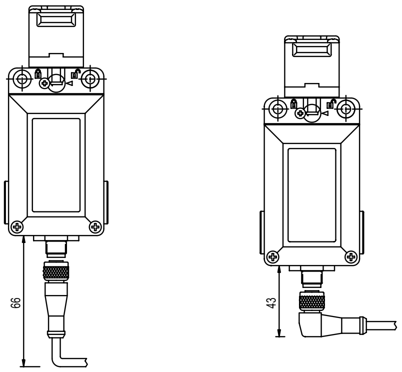


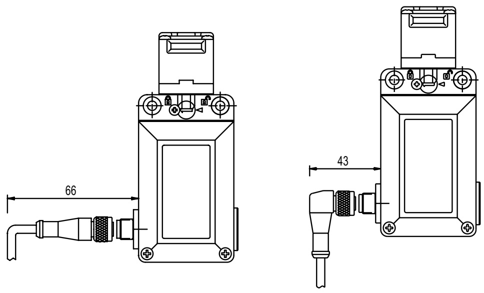
SR - SM series



HP series

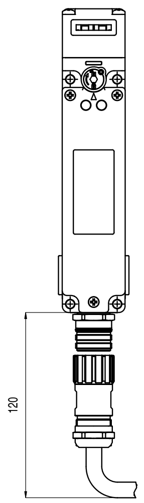
Switch with bottom assembled 8 poles metallic connector	Switch with left or right assembled 8 poles metallic connector

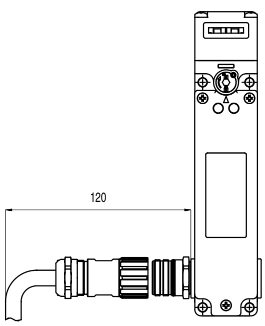




FS series

Switch with bottom assembled 12 poles M23 metallic connector	Switch with bottom assembled 12 poles M23 metallic connector





FG series

Notes

Definitions complying with the standards EN 60947-1 and EN 60947-5-1

Ambient air temperature
The air temperature determined under prescribed conditions surrounding the complete switching device.

Break-contact element (normally closed)
Contact element which opens a conducting path when the control switch is actuated.

Change-over contact elements
Contact element combination which includes one make-contact element and one break-contact element.

Contact element
The parts, fixed or movable, conducting or insulating, of a control switch necessary to close and open one single conducting path of a circuit.

Control switch
A mechanical switching device which serves the purpose of controlling the operations of switch gear or control-gear, including signalling, electrical interlocking, etc.

Conventional free air thermal current Ith
Max value of current to be used for temperature-rise tests of equipment without enclosure, in free air. Its value shall be least to equal to the maximum value of the rated operational current **Ie** of the equipment without enclosure, in eight-hour duty.

Cycle of operation
Succession of two movements, one for closure and second for opening.

Dependent action contact element (slow action)
Contact element of a manual or automatic control device, the contact motion velocity of which depends on the actuator's motion velocity.

Double gap contact element
Contact element which opens or closes the conducting path of its circuit in two locations in series.

Electrical durability
Number of on-load operating cycles, corresponding to the service conditions given in the relevant product standard, which can be made without repair or replacement.

Electrically separated contact elements
Contact elements belonging to the same control switch, but adequately insulated from each other, so they can be connected to electric circuits with different tension.

Foot-switch
Control switch having an actuator intended to be operated by the force exerted by a foot.

Independent action contact element (snap action)
Contact element of a manual or automatic control device in which the velocity of contact motion is substantially independent of the actuator's motion velocity.

Make-contact element (normally open)
Contact element which closes a conducting path when the control switch is actuated.

Mechanical durability
Number of no-load operating cycles (e.g. without current at the main contacts) which can be effected before it becomes necessary to service or replace any mechanical parts.

Minimum actuating force
The minimum force value to be applied to the actuator that will cause all contacts to reach their closed (open) position.

Position switch
Pilot switch the actuating system of which is operated by a moving part of the machine, when that part reaches a pretermined position.

Pre-travel of the actuator
The maximum travel of the actuator which does not cause any travel of the contact elements.

Rated operational current Ie
A current that takes into account the rated operational voltage, the rated frequency, the utilization category and the type of protective enclosure, if appropriate.

Rated insulation voltage Ui
Voltage to which dielectric test voltage and creepage distances are referred.

Rated operational voltage Ue
Voltage which, combined with the rated operational current Ie, determinates the application of the equipment and the referred utilization categories.

Single gap contact element
Contact element which opens or closes the conducting path of its circuit in one location only.

Unit contact
Contact element or contact elements combination which can be combined with similar units, operated by a common actuating system.

Utilization category
A combination of specified requirements related to the conditions in which the switching device fulfils its purpose.

Markings and quality marks

CE marking

The CE marking is a mandatory declaration made by the manufacturer of a product in order to indicate that the product satisfies all requirements foreseen by the directives (regulated by the European Community) on subjects of safety and quality. Its function therefore is to guarantee to the governing authorities of the various countries the fulfilment of their obligations under the law.

IMQ marking

The IMQ (Italian Institute of the Quality Mark) is the organization in Italy (third and independent) whose task is to check and certify the compliance of the materials and the equipment with the safety standards (CEI standards in the electric and electronic branch). This voluntary conformity certification is a guarantee of quality, safety and technical value.

UL marking

UL (Underwriters Laboratories Inc.) is an independent non-profit laboratory that tests materials, devices, products, equipment, constructions, methods and systems with regard to their risk for human life and goods according to the standard in force in the United States.
Regulations and testing made by UL is often taken as valid, by many governing authorities, with regard to conformity with local regulations on the subject of safety.

CCC marking

The CQC is the organization in the Chinese Popular Republic whose task is to check and certify the low voltage electrical material. This organization issue the product mark CCC which certifies the passing of electrical/mechanical conformity tests by products and the compliance of the company quality system with required standards. To obtain the mark, the Chinese organization makes preliminary company visits and periodical verification inspections. Position switches cannot be sold in the Chinese territory without this mark.

EZU markings

The EZU is the organization in Czech Republic (third and independent) whose task is to check and certify the compliance of the materials and the equipment with the safety standards. This voluntary conformity certification is a guarantee of quality, safety and technical value.

TÜV SÜD certification mark

TÜV SÜD is an international authority claiming long-standing experience in the certification of operating safety for electrical, electromechanical and electronic products. In the course of type approval, TÜV SÜD closely inspects the quality throughout all the stages concerning product development, from software design and completion, to production and to the tests conducted according to ISO/IEC standards. The operating safety certification is obtained voluntarily and has a high technical value, since it not only certifies the electrical safety of the product, but also its specific operating suitability for use in safety applications according to the IEC 61508 standard.

International, European and Italian standards

EN 50041: Industrial equipment with low voltage. Control accessories. Position switches 42,5x80 mm. Dimensions and features.
EN 50047: Industrial equipment with low voltage. Control accessories. Position switches 30x55 mm. Dimensions and features.
EN 1088: Safety of machinery. Interlocking devices associated with guards. Principles for design and selection.
EN ISO 14119: Safety of machinery. Interlocking devices associated with guards. Principles for design and selection.
EN ISO 12100-1: Safety of machinery. Basic concepts, general principles for design. Part one: Basic terminology, methodology
EN ISO 12100-2: Safety of machinery. Basic concepts, general principles for design. Part two: Technical principles
EN 1050: Safety of machinery. Principles for risk assessment.
EN ISO 13849-1: Safety of machinery. Safety-related parts of control systems. Part one: General principles for design.
EN ISO 13850: Machinery safety. Devices for the emergency stop, functional aspects. Design principles.
EN 61000-6-3 (equivalent to IEC 61000-6-3): Electromagnetic compatibility. generic emission standard. Part one: residential, commercial and light industry.
EN 61000-6-2 (equivalent to IEC 61000-6-2): Electromagnetic compatibility. generic emission standard. Part two: industrial environment.
EN 999: Safety of machinery. The positioning of protective equipment in respect of approach speeds of parts of the human body.
EN 1037: Safety of machinery. Prevention of unexpected start-up.
EN 574: Safety of machinery. Two-hand control devices. Functional aspects. Principles for design.
EN 60947-1 (equivalent to IEC 60947-1): Low voltage equipment. Section one:general standards.
EN 60947-5-1 (equivalent to IEC 60947-5-1): Low voltage equipment. Section five: devices for control and operation circuits. Section one: electromechanical devices for control circuits.
EN 60204-1 (equivalent te a IEC 60204-1): Electric equipment of industrial machines. Section one. General standards.
EN 60529 (equivalent to IEC 60529): Protection degree of the housings (IP codes).
EN 62326-1 (equivalent to IEC 62326-1): Printed boards. Part 1: Generic specification.
EN 60664-1 (equivalent to IEC 60664-1): Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
EN 61508 (equivalent to IEC 61508): Functional safety of safety-related electrical, electronic and programmable electronic systems.
EN 62061 (equivalent to IEC 62061): Functional safety of safety-related electrical, electronic and programmable electronic control systems.
EN 60079-0 (equivalent to IEC 60079-0): Electrical apparatus for potentially explosive atmospheres. General requirements.
EN 60079-11 (equivalent to IEC 60079-11): Electrical apparatus for potentially explosive atmospheres. Intrinsic safety "i".
EN 60079-31 (equivalent to IEC 60079-31): Electrical apparatus for potentially explosive atmospheres. Type of protection "n".
EN 60079-28 (equivalent to IEC 60079-28): Electrical apparatus for use in the presence of combustible dust. Electrical apparatus protected by enclosures. Part 1-1: Construction and testing
NFC 63-140: Control accessories. General prescriptions. (French standard).
BG-GS-ET-15: Prescriptions about how to test switches with forced contacts opening to be used in safety applications (German standard).
VDE 0660-200: Control and checking devices. Low voltage control and checking devices. Checking switches. General requirements. (German standard).
VDE 0113: Specifications for electrical equipment of machines for the production or the manufacturing with rated voltage up to 1000 V. (German standard).
UL 508: Standard for equipment of industrial controls. (American standard).
CSA 22-2 nr.14-95: Standard for equipment of industrial controls. (Canadian standard).

European directives

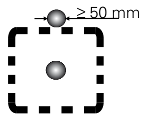
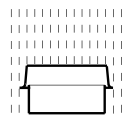
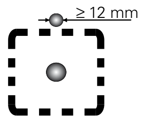
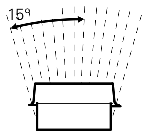
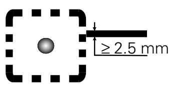
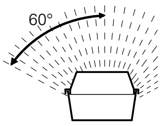
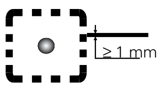
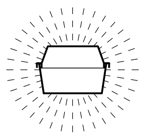
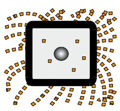
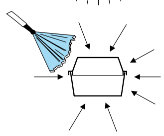
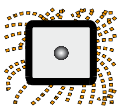
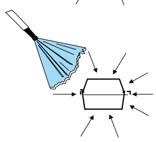
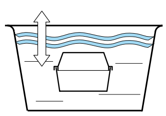
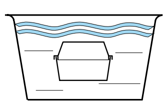
2006/95/EC	Directive on low voltage of electrical equipment
2006/42/EC	Machinery directive
2004/108/EC	Electromagnetical compatibility directive
94/9/EC	ATEX Directive

Regulation Organisation

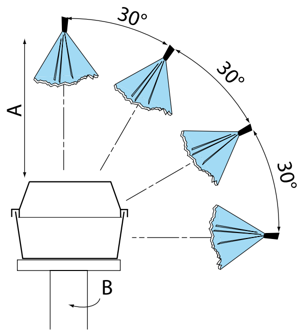
CEI	Comitato Elettrotecnico Italiano (I)	**NF**	Normes Françaises (F)
CSA	Canadian Standard Association (CAN)	**VDE**	Verband Deutscher Elektrotechniker (D)
CENELEC	Comité Européen de Normalisation Electrotechnique	**UNI**	Ente Nazionale Italiano di Unificazione (I)
IEC	International Electrotechnical Commission	**UL**	Underwriter’s Laboratories (USA)

Protection degree of the housings for electrical material according to IEC 60529 standard

This table indicates the protection degrees according to IEC 60529, EN 60529, CEI 70-1 standards.
The degrees are identified by the letters IP and two numbers. Two more letters can be added, in order to give the protection degree for people or other features. The first number means the degree of protection against penetration of external solid materials.
The second one indicates the degree of protection against penetration of water.

1° number	Description	Protection for the machine	Protection for the people	2° number	Description	Protection for the machine
0		No protection	No protection	**0**		No protection
1		Protected from solid bodies of more than 50 mm in diameter	No access to hazardous parts with back of the hands (Ø 50 mm)	**1**		Protected from drops of water that falling vertically
2		Protected from solid bodies of more than 12 mm in diameter	No access to hazardous parts with a finger (Ø 12 mm)	**2**		Protected from drops of water that falling from 15° max
3		Protected from solid bodies of more than 2.5 mm in diameter	No access to hazardous parts with tool (Ø 2.5 mm)	**3**		Protected from sprayed water that falling from 60° max
4		Protected from solid bodies of more than 1 mm in diameter	No access to hazardous parts with wire (Ø 1 mm)	**4**		Protected from splashes of water around it
5		Protected from dust	No access to hazardous parts with wire (Ø 1 mm)	**5**		Protected from jets of water discharged around it
6		Totally protected from dust	No access to hazardous parts with wire (Ø 1 mm)	**6**		Protected from strong jets of water around it
				7		Protected from temporary water immersion (30 minutes in a depth of one meter)
				8		Protected from continuous water immersion by aggrement

Protection degree IP69K according to standard DIN 40050



The standard provides that a device have to pass a particularly heavy test which simulates the conditions of pressure washing in the industrial environments with water jets having pressure between 80 and 100 bar, flow rate between 14 e 16 l/min. and temperature 80°C.

Test features:

Rotation speed (B):	5 ± 1 rpm
Distance from water jet (A):	100 +50/-0 mm
Water flow rate:	15 ± 1 l/min
Water pressure:	9000 ± 1000 kPa
Water temperature:	80 ± 5 °C
Test duration:	30 s each position

Housing features in accordance with UL approvals (standard UL 508) and CSA approvals (C22-2 nr.14)

The features required for a housing are determined by a specific environmental designation and other features like the kind of gasket or the use of solvent materials.

Type	Use guidance and description
1	Mainly for indoor utilization, supplied with protection against contact with the internal mechanism and against a limited quantity of falling dirt.
4x	Both indoor and open-air utilization, supplied with a protection degree against falling rain, sprinkling of water and direct water from the pipe. It is not damaged by the freezing of the housing and is rust-proof. It is resistant against corrosion.
12	Indoor utilization, supplied with a protection degree against dust, dirt, flying fibres, dripping water and outside condensation of non-corrosive fluids.
13	Indoor utilization, supplied with a protection degree against gauze, dust penetration, outside condensation and sprinkling of water, oil and non-corrosive fluids.

Pollution degree (of environmental conditions) according to IEC 947-1 standard

According to the standard IEC 947-1, the pollution degree is a conventional number based on the quantity of conducting hygroscopic dust, ionized gas or salt, on the relative humidity and on the frequency of occurrence, which is translated into hygroscopic absorption or humidity condensation, having the effect of reducing the dielectric rigidity and/or surface resistivity. In equipment to be used inside a housing or having an integral enclosure as part of the device, the pollution degree applies to the inner part of housing. With the purpose of evaluating the air and surface insulation distances, the following four pollution degrees are defined:

Degree	Description
1	No pollution or only dry and non-conductive pollution occurs.
2	Normally, only non-conductive pollution is present. Occasionally some temporary conductivity caused by condensation may occur.
3	Some conductive pollution is present, or some dry non-conductive pollution that becomes conductive because of condensation.
4	Pollution causes persistent conductivity, for instance because of conductive dust or rain or snow.

Where not otherwise specified by the applicable standard for the product, equipment for industrial applications are generally intended for their use in enviroment with pollution degree 3. Nevertheless, other degrees can be considered, depending on the micro-environment or on the particular applications.

Utilization categories for switching elements according to CEI EN 60947-5 and IEC 947-5 standards

Alternate current utilization

Utilization category	Description
AC12	Control of resistive loads and solid state loads with insulation by optocouplers
AC13	Control of solid state loads with transformer isolation
AC14	Control of small electromagnetic loads (≤ 72 VA)
AC15	Control of small electromagnetic loads (≥ 72 VA)

Direct current utilization

Utilization category	Description
DC12	Control of resistive loads and solid state loads with insulation by optocouplers
DC13	Control of electromagnet loads without economy resistors in circuit
DC14	Control of electromagnet loads with economy resistors in circuit