

## Presentation

### Electromechanical detection

Limit switches are used in all automated installations and also in a wide variety of applications, due to the numerous advantages inherent to their technology.

They transmit data to the logic processing system regarding:

- presence/absence,
- passing,
- positioning,
- end of travel.

### Simple to install switches, offering many advantages

#### ■ From an electrical viewpoint

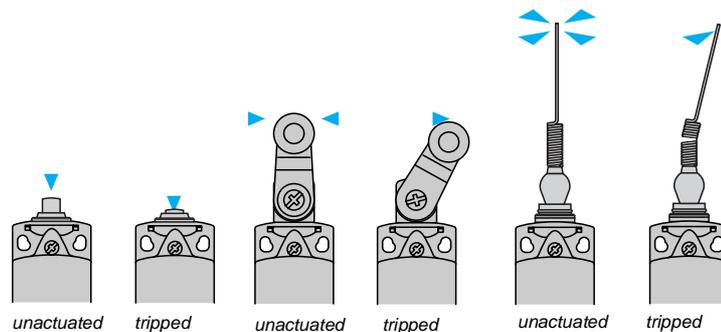
- galvanic separation of circuits,
- models suitable for low power switching, combined with good electrical durability,
- very good short-circuit withstand in coordination with appropriate fuses,
- total immunity to electromagnetic interference,
- high rated operational voltage.

#### ■ From a mechanical viewpoint

- N/C contacts with positive opening operation,
- high resistance to the different ambient conditions encountered in industry (standard tests and specific tests under laboratory conditions),
- high repeat accuracy, up to 0.01 mm on the tripping points.

### Detection movements

- Linear actuation (plunger)
- Rotary actuation (lever)
- Multi-directional actuation



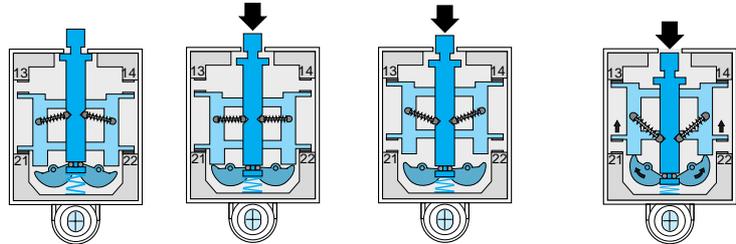
## Terminology

<b>Rated value of a quantity</b>	<ul style="list-style-type: none"> <li>■ This replaces the term "nominal value".</li> <li>■ It is the fixed value for a specific function.</li> </ul>
<b>Utilisation categories</b>	<ul style="list-style-type: none"> <li>■ AC-15 replaces AC-11: control of an electromagnet on a.c., test 10 Ie/Ie.</li> <li>■ AC-12: control of a resistive load on a.c. or static load isolated by opto-coupler.</li> <li>■ DC-13 replaces DC-11: control of an electromagnet on d.c., test Ie/Ie.</li> </ul>
<b>Positive opening travel</b>	■ Minimum travel from the initial movement of contact actuator to the position required to accomplish positive opening operation.
<b>Positive opening force</b>	■ The force required on the contact actuator to accomplish positive opening operation.
<b>Switching capacity</b>	<ul style="list-style-type: none"> <li>■ Ithe is no longer a rated value but a conventional current used for heating tests).</li> <li><b>Example:</b> for category A300 the corresponding rated current, Ie maximum, is 6 A-120 V or 3 A-240 V, the equivalent Ithe being 10 A.</li> </ul>
<b>Positive opening operation</b>	<ul style="list-style-type: none"> <li>■ A limit switch complies to this specification when all the closed contact elements of the switch can be changed, with certainty, to the open position (no flexible link between the moving contacts and the operator of the switch, to which an actuating force is applied).</li> <li>■ All limit switches incorporating either a slow break contact block or a snap action N/C + N/O (form Zb), N/C + N/O + N/O, N/C + N/C + N/O, N/C + N/C + N/O + N/O contact block are positive opening operation, in complete conformity with the standard IEC 60947-5-1 Appendix K.</li> </ul>

## Contact blocks

### Snap action contacts

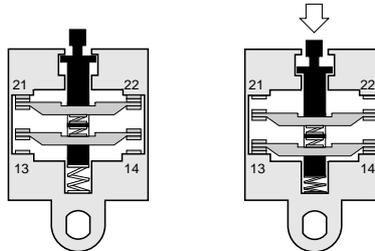
- Snap action contacts are characterised by different tripping and reset points (differential travel).
- The displacement speed of the moving contacts is independent of the speed of the operator.
- This feature ensures satisfactory electrical performance in applications involving low speed actuators.



Unactuated state    Approach travel    Contact change of state    Positive opening

### Slow break contacts

- Slow break contacts are characterised by identical tripping and resetting points.
  - The displacement speed of the moving contacts is equal, or proportional, to the speed of the operator (which must not be less than 0.001 m/s = 6 m/minute).
- The opening distance is also dependent on the distance travelled by the operator.



### Electrical durability for normal loads

- Normally, for inductive loads, the current value is less than 0.1 A (sealed) i.e. values of 3 to 40 VA sealed and 30 to 1000 VA inrush, depending on the voltage.
- For this type of application the electrical durability will exceed 10 million operating cycles.  
**Application example:** XCK J161 + LC1 D12●●●● (7 VA sealed, 70 VA inrush).  
 Electrical durability = 10 million operating cycles.

#### Range of use

Standard contacts		Gold flashed contacts on resistive load	
Continuous service (frequent switching)		Occasional service	
XE2S P2151 XE2S P3151	XE2N P●●●●	Contacts of XCM D XE3● P●●●●	Infrequent switching, ≤ 1 operating cycle/day, and/or corrosive atmosphere
			(1)

(1) Usable up to 48 V/10 mA.

### Electrical durability for small loads

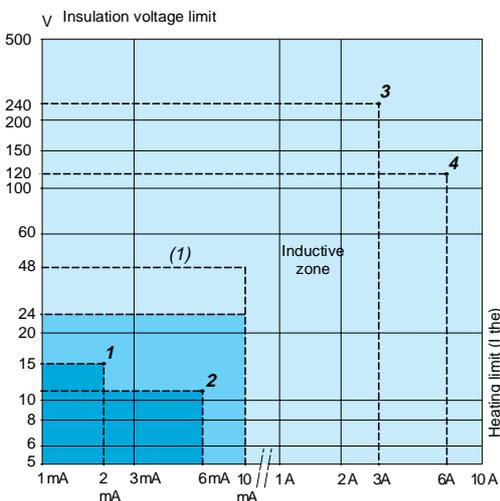
- The use of limit switches with programmable controllers is becoming more common.
- With small loads, limit switches offer the following levels of reliability:
  - failure rate of less than 1 for 100 million operating cycles using snap action contacts (XE●S P contacts and contacts of XCM D●),
  - failure rate of less than 1 for 50 million operating cycles using slow break contacts (XE●N P contacts).

### Switching capacity

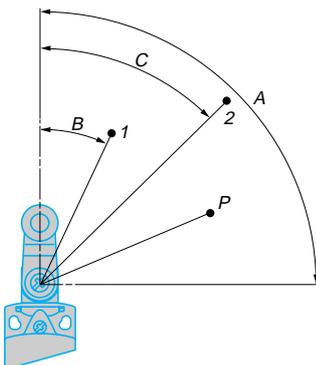
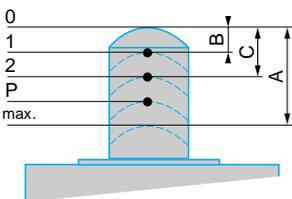
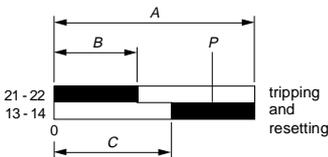
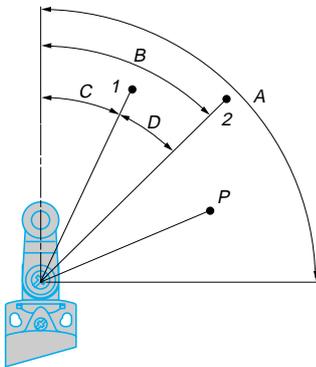
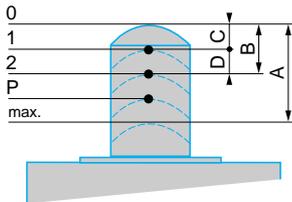
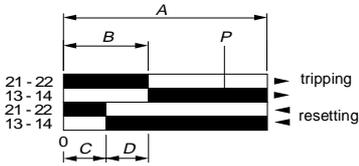
- Normal PLC input type 1
- Normal PLC input type 2
- Switching capacity conforming to IEC 60947-5-5, utilisation category AC-15, DC-13
 

A300	240 V 3 A	B300	240 V 1.5 A
Q300	250 V 0.27 A	R300	250 V 0.13 A
- Switching capacity conforming to IEC 60947-5-1, utilisation category AC-15, DC-13
 

A300	120 V 6 A	B300	120 V 3 A
Q300	125 V 0.55 A	R300	125 V 0.27 A



## Contact blocks (continued)



## Function diagrams of the snap action contacts

### ■ Example: N/C + N/O

- A - Maximum travel of the actuator in mm or degrees.
- B - Tripping travel of contact.
- C - Resetting travel of contact.
- D - Differential travel = B - C.
- P - Point from which positive opening is assured.

### □ Linear movement (plunger)

- 1 - Resetting point of contact.
- 2 - Tripping point of contact.
- A - Maximum travel of the actuator in mm.
- B - Tripping travel of contact.
- C - Resetting travel of contact.
- D - Differential travel = B - C.
- P - Point from which positive opening is assured.

### □ Rotary movement

- 1 - Resetting point of contact.
- 2 - Tripping point of contact.
- A - Maximum travel of the actuator in degrees.
- B - Tripping travel of contact.
- C - Resetting travel of contact.
- D - Differential travel = B - C.
- P - Point from which positive opening is assured.

## Function diagrams of the slow break contacts

### ■ Example: N/C + N/O break before make

- A - Maximum travel of the actuator in mm or degrees.
- B - Tripping and resetting travel of contact 21-22.
- C - Tripping and resetting travel of contact 13-14.
- P - Point from which positive opening is assured.

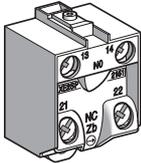
### □ Linear movement (plunger)

- 1 - Tripping and resetting points of contact 21-22.
- 2 - Tripping and resetting points of contact 13-14.
- A - Maximum travel of the actuator in mm.
- B - Tripping and resetting travel of contact 21-22.
- C - Tripping and resetting travel of contact 13-14.
- P - Positive opening point.

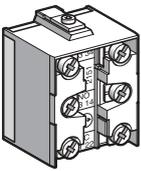
### □ Rotary movement

- 1 - Tripping and resetting points of contact 21-22.
- 2 - Tripping and resetting points of contact 13-14.
- A - Maximum travel of the actuator in degrees.
- B - Tripping and resetting travel of contact 21-22.
- C - Tripping and resetting travel of contact 13-14.
- P - Positive opening point.

## Contact blocks (continued)



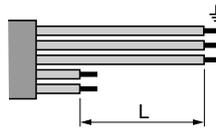
XE2●P screw clamp terminal connections



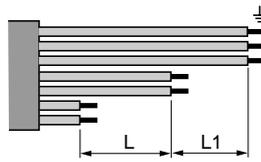
XE3●P screw clamp terminal connections

## Contact connections

- Tightening torque:
  - minimum tightening torque ensuring the nominal characteristics of the contact: 0.8 N.m,
  - maximum tightening torque without damage to the terminals: 1.2 N.m for XE2●P, 1 N.m for XE3●P.
- Connecting cable: cable preparation lengths:
  - for XE2●P, L = 22 mm,
  - for XE2●P3●●●, L = 45 mm.



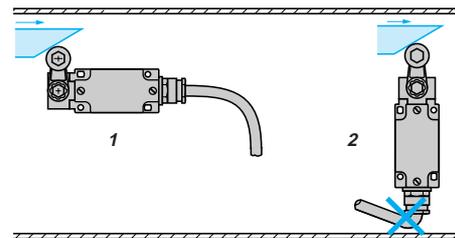
- for XE3●P, L = 14 mm, L1 = 11 mm



## Mounting

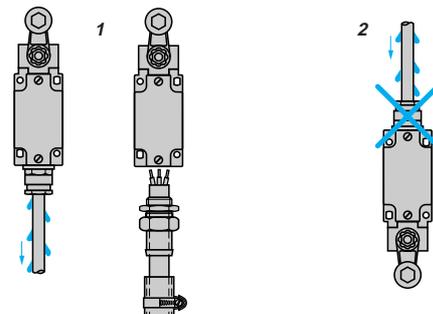
### Sweep of connecting cable

- 1 Recommended
- 2 To be avoided



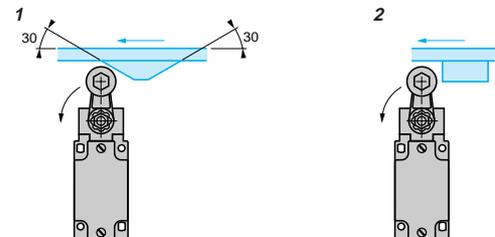
### Position of cable gland

- 1 Recommended
- 2 To be avoided



### Type of cam

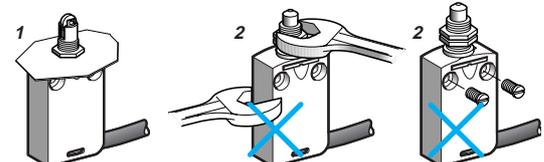
- 1 Recommended
- 2 To be avoided



### Mounting and fixing limit switches by the head

- 1 Recommended
- 2 To be avoided

Types XCK D, XCK P and XCK T, XCM D and XCM N



## Setting-up

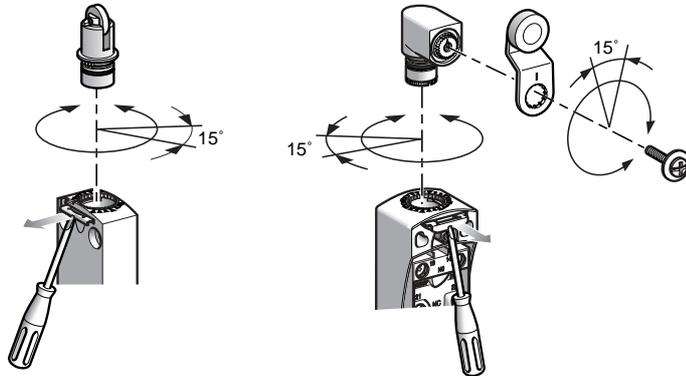
### Tightening torque

- The minimum torque is that required to ensure correct operation of the switch.
- The maximum torque is the value which, if exceeded, will damage the switch.

Range	Item	Torque (N.m)	
		Min.	Max.
Compact design XCK D, XCK P, XCK T	Cover	0.8	1.2
	Fixing screw for lever on rotary head	1	1.5
Miniature design XCM D, XCM N	–	–	–
	Fixing screw for lever on rotary head	1	1.5
Compact design XCK N	Cover	0.8	1.2
	Fixing screw for lever on rotary head	1	1.5
Classic design XCK J	Cover	1	1.5
	Fixing screw for lever on rotary head	1	1.5
Classic design XCK S	Cover	0.8	1.2
	Fixing screw for lever on rotary head	1	1.5
Classic design XCK M, XCK ML, XCK L	Cover	0.8	1.2
	Fixing screw for lever on rotary head	1	1.5

### Types XCK D, XCK P, XCK T, XCM D

- Adjustable in 3 planes:

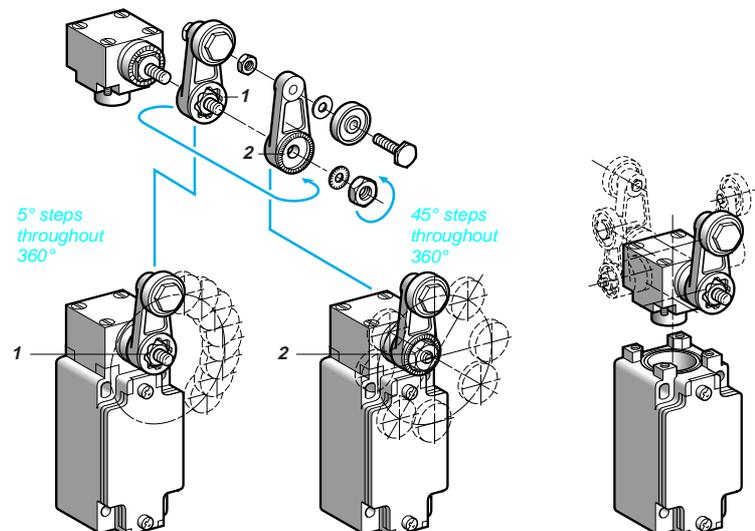


All the heads can be adjusted in 15° steps throughout 360°, in relation to the body.

All the levers can be adjusted in 15° steps throughout 360°, in relation to the horizontal axis of the head.

### Type XCK J

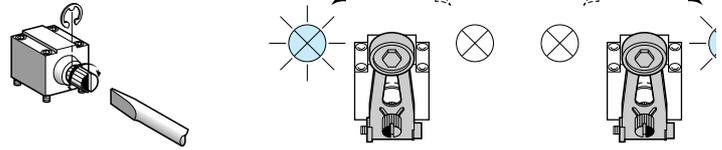
- Adjustable throughout 360° in 5° steps, or in 45° steps by reversing the lever or its mounting.
- 1 Reversed  $\alpha = 5^\circ$
  - 2 Forward  $\alpha = 45^\circ$



Setting-up (continued)

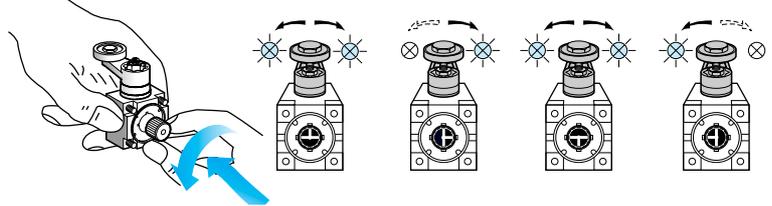
Direction of actuation programming

■ XC2 J



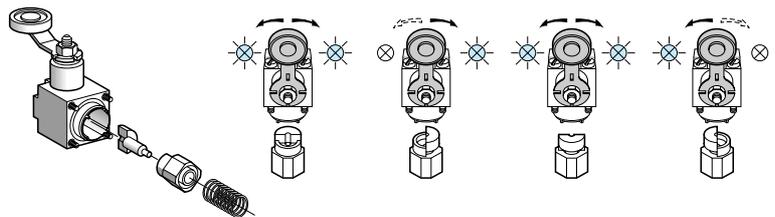
Head ZC2 JE05

■ XCK J



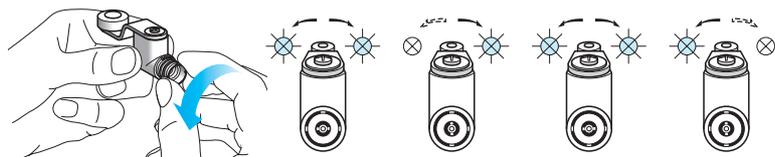
Head ZCK E05

■ XCK S



Head ZCK D05

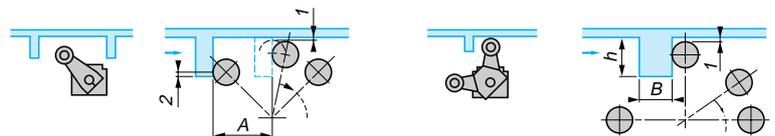
■ XCK D, XCK P, XCK T and XCM D



Head ZCE 05

Specific cams for heads ZCK E09 and ZC2 J09

- 1 0.5 mm min.
- 2 2 mm min.



A length of lever + 11 mm

ZCK E09:  $13 < h < 18$  mm and  $B = 12$  mm max.

ZC2 J09:  $14 < h < 24$  mm and  $B = 6$  mm max.

**Reminder of the standards**

The majority of Telemecanique products comply to national standards (for example French standard NF C, German standard DIN), European standards (for example CENELEC) or international standards (for example IEC). These standards rigidly stipulate the characteristic requirements of the designated products (for example IEC 60947 relating to low voltage switchgear and controlgear). These products, when correctly used, enable the production of control equipment assemblies, machine control equipment or installations conforming to their own specific standards (for example IEC 60204 for the electrical equipment of machines).

**IEC 60947-5-1**

**Insulation coordination (and dielectric strength)**

■ The standard IEC 60664 defines 4 categories of prospective transient overvoltages. It is important for the user to select control circuit components which are able to withstand these overvoltages. To these ends, the manufacturer states the rated impulse withstand voltage (U imp) applicable to the product.

**Terminal connections**

■ The cabling capacity, mechanical robustness and durability of the terminals as well as the ability to resist loosening are verified by standardised tests.  
■ Terminal reference marking conforms to the standard EN 50013.

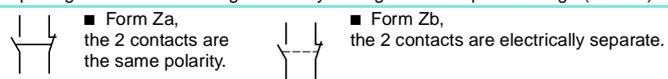
**Switching capacity**

■ With maximum electrical load. A single designation (A300 for example) enables indication of the contact block characteristics related to the utilisation category.

**Positive opening operation (IEC 60947-5-1 Appendix K)**

■ For contacts used in safety applications (end of travel, emergency stop device, etc.) the assurance of positive opening is required (see IEC 60204, EN 60204) after each test, the opening of the contact being verified by testing with an impulse voltage (2500 V).

**Electrical symbols for contacts**



**Symbol for positive opening**



**CENELEC EN 50047**

The European standards organisation CENELEC, which has 14 member countries, has defined in this standard the first type of limit switch.

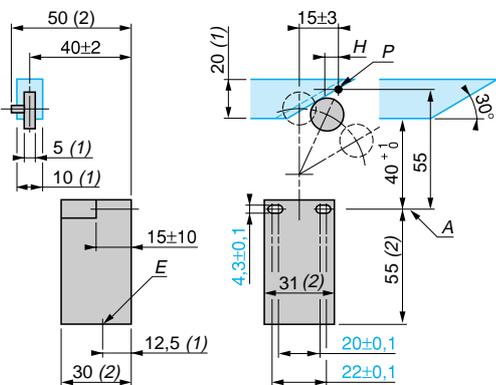
It defines 4 variants of devices (forms A, B, C, E).

Limit switches XCK P, XCK D and XCK T conform to the standard EN 50047.

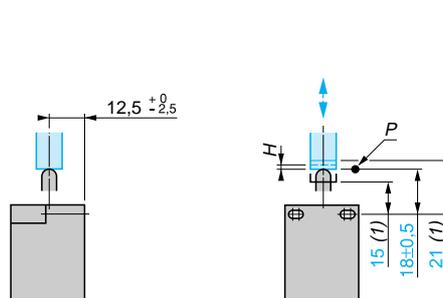
(1) Minimum value  
(2) Maximum value

A: reference axis  
H: differential travel  
P: tripping point  
E: cable entry

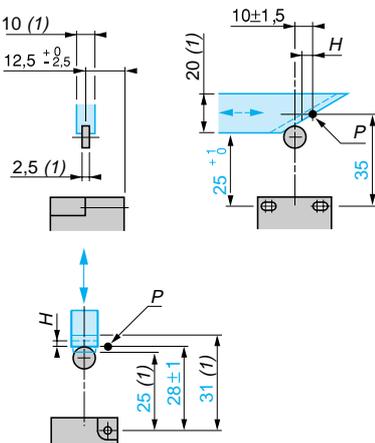
**Form A, with roller lever**



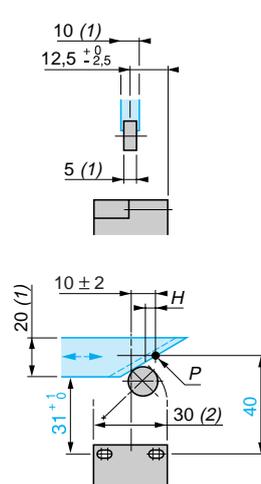
**Form B, with end plunger (rounded)**



**Form C, with end roller plunger**



**Form E, with roller lever for 1 direction of actuation**



## Reminder of the standards (continued)

### CENELEC EN 50041

The European standards organisation CENELEC, which has 14 member countries, has defined in this standard the second type of limit switch.

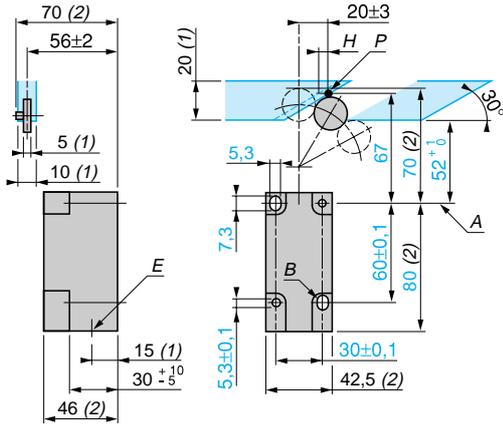
It defines 6 variants of devices (forms A, B, C, D, F, G).  
Limit switches XCK J and XCK S conform to the standard EN 50041.

(1) Minimum value  
(2) Maximum value

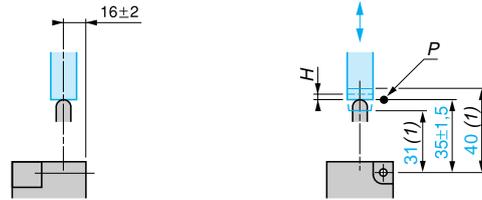
A: reference axis  
B: optional elongated holes  
H: differential travel  
P: tripping point  
E: cable entry

Za: tripping zone  
Sa: tripping threshold

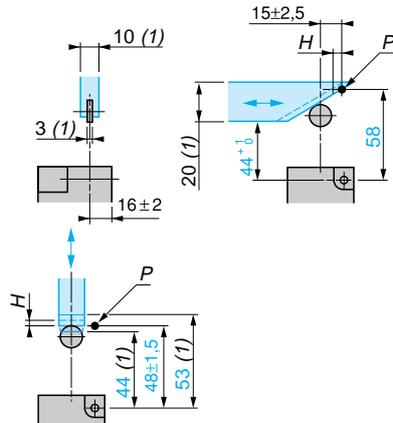
#### Form A, with roller lever



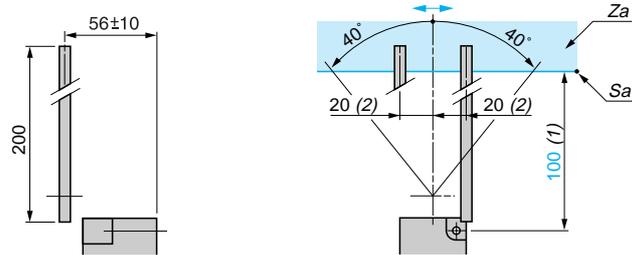
#### Form B, with end plunger (rounded)



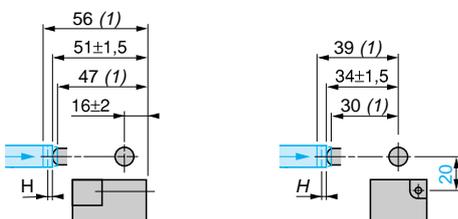
#### Form C, with end roller plunger



#### Form D, with rod lever



#### Form F, with side plunger (rounded)



#### Form G, with side roller plunger

