

Forced contact opening limit switches, AL and AL-S series

■ Description

The AL and AL-S series limit switches feature a forced contact opening mechanism. This mechanism prevents contact welding and subsequent malfunctioning. These series therefore result in extremely dependable system controls.

The AL series is available in standard sizes and the AL-S series is compact versions of the AL types.

■ Features

- The forced contact opening mechanism is provided so as to overcome contact problems.
- Gold-plated contacts and a self cleaning action ensure contact reliability.
- Sealed construction
Double oil seals prevent moving parts and contacts from being contaminated by exterior oil, grime and grease, an advantage in dirty industrial locations.
- Operational mode indicator can replace existing cover with lamp indicator cover when required. An LED or neon lamp is used depending on supply voltage.
- Contact mechanical design
Contact operating mechanisms can be selected according to the application—snap, overlap and normal actions
- Conform to IEC Standard

■ Contact ratings

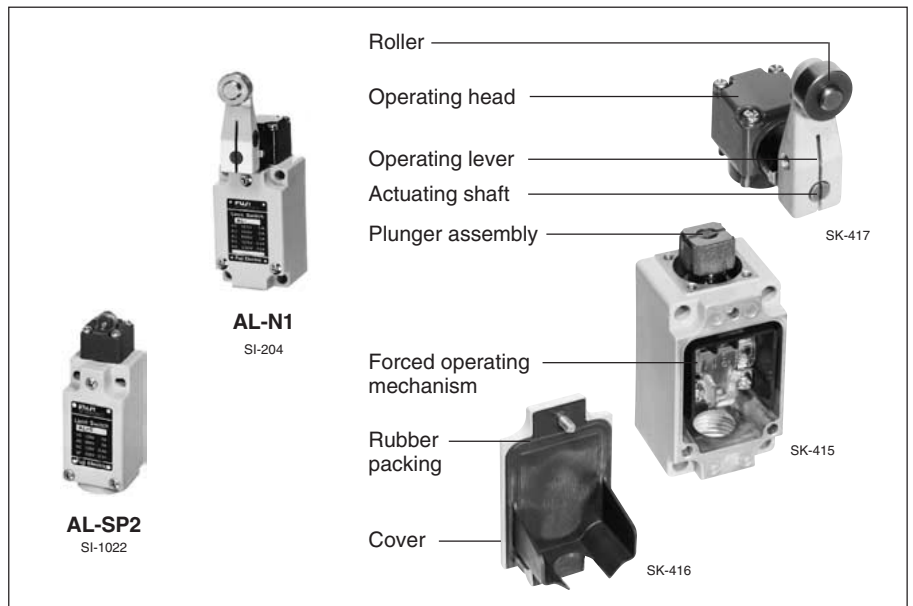
Contact action	Thermal current (A)	Make and break current *					
		AC Voltage (V)	Resistive (A)	Inductive (A)	DC Voltage (V)	Resistive (A)	Inductive (A)
Snap	5	125	5	3	30 or less	5	3
		250	3	2	125	0.4	0.05
		500	1	0.6	250	0.2	0.03
Normal Overlap	10	24	10	10	24	7	7
		110	10	10	110	1.5	0.9
		220	10	10	220	0.63	0.28
		440	5	5	440	0.28	0.14
		550	3	3	550	0.22	0.1

*: When NO and NC contacts are wired in the same potential.

■ UL listed (File No. E44592)

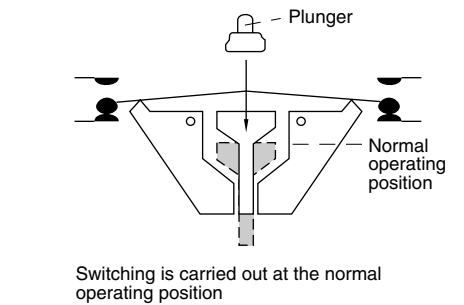
Contact ratings

AC (B300) Voltage (V)	Operational current (A)		DC Voltage (V)	Operational current (Res. load) (A)
	Make	Break		
120	30	3	30	5
240	15	1.5	125	0.4
			250	0.2

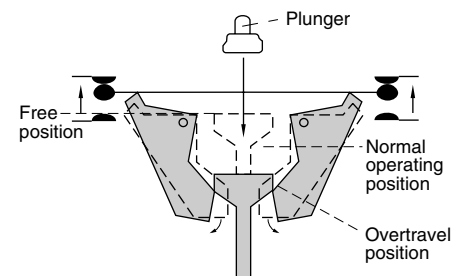


■ Forced contact opening mechanism

This mechanism does not operate under normal conditions. However, when the switch plunger overtravels under abnormal conditions the mechanism comes into operation and forcibly opens the NC contacts thus preventing contact welding. This action improves the dependability of electrical systems.



Normal operating condition



Abnormal condition

■ Technical data

Insulation resistance:

Over 100MΩ at 500V DC

Life expectancy

Mechanical: Over 10 million operations

Electrical: Snap action type

100,000 operations at

125V AC 5A res. load

Normal action type

100,000 operations at

110V AC 10A res. load

Allowable ambient temperature:

-10°C to +80°C

Degree of protection: IEC IP67

Limit Switches

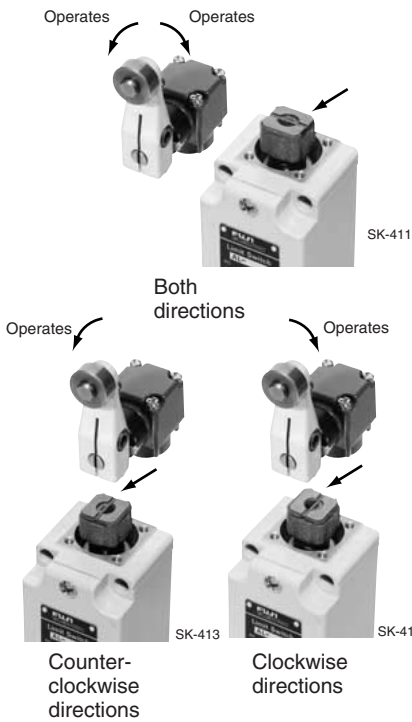
AL and AL-S

General information

Directional contact operation

AL-N1, AL-N2 and AL-N3 can be modified in their operational directions. They will switch in both directions, or in only one direction, either clockwise or counterclockwise. The adjustment is easily carried out by removing the operating head and changing the plunger as shown in the photograph. After the plunger has been reassembled, replace the head and tighten the screws. Check operation by moving the arm in the desired direction.

Standard operating position



Changing direction of operating head

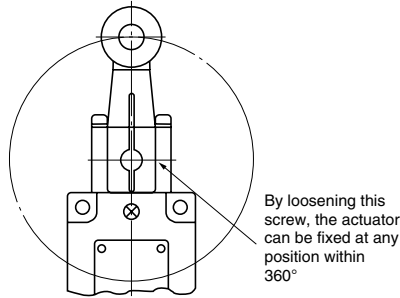
The operating head direction can be changed through 90° after having removed the screw. Care must be taken because the contact action changes according to the direction of the plunger assembly. Check for correct assembly after each step has been completed. Limit switches with adjustable head direction are AL-N1, AL-N2, AL-N3, AL-SN1, AL-SN2 and AL-SN3. In the case of AL-P2 and AL-SP2, the head direction of a top push roller plunger type can be shifted 90° in either direction.



Adjustment of operating lever

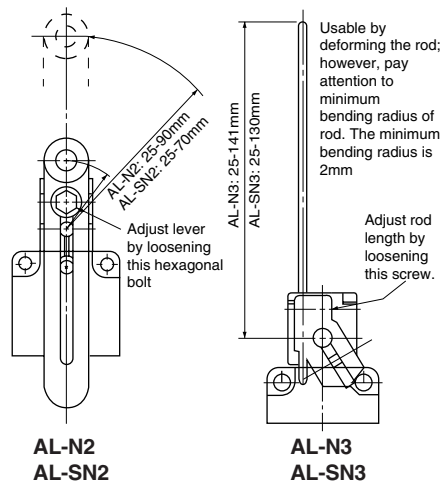
Loosen the locking screw, turn over the lever and then retighten at the required position.

Type:
AL-N1, AL-N2, AL-N3, AL-SN1,
AL-SN2, AL-SN3, AL-F1.

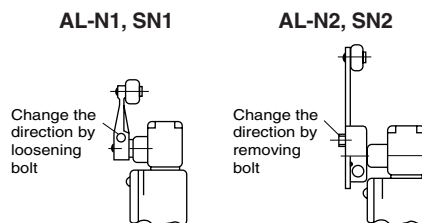


Adjustment of lever length

Loosen the adjustment screw, adjust the length and retighten.



Roller installable on inner side



Dimensions:

See pages 05/110 to 05/112.

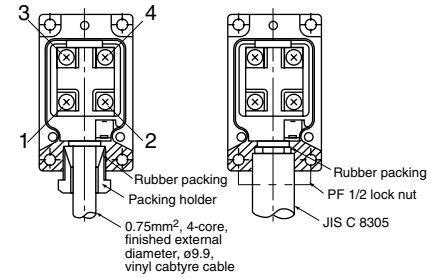
Ordering information

Specify the following:
1. Type number or ordering code

Cable connection

Refer to the wiring diagram for connection.

When connecting to conduit remove the plastic packing piece.

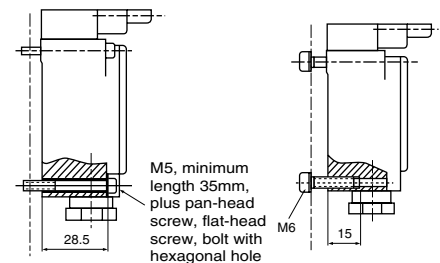


Contact: 1-2 Normally closed
3-4 Normally open

Mounting

AL type limit switches can be attached either from the front or the back. In the case of front mounting type clamp at 4 positions using M5 screws. When attaching from the back of the panel tighten at 4 positions by means of M6 screws.

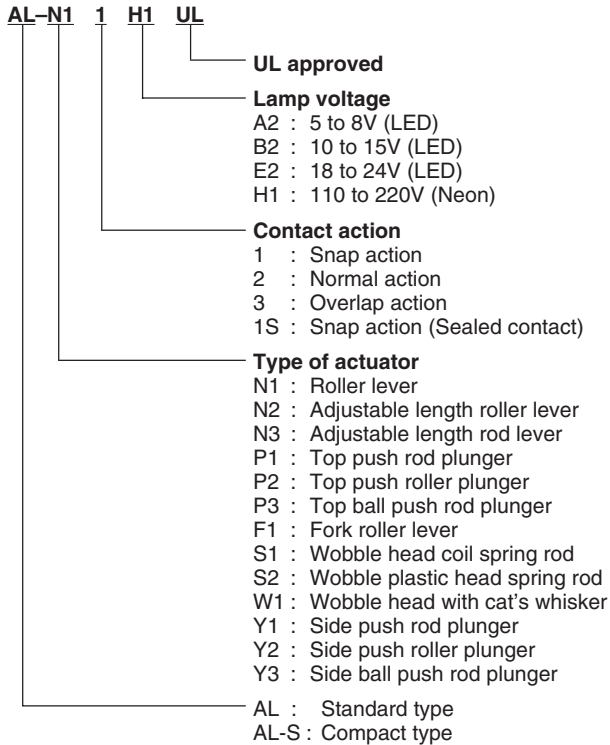
The thread depth of the switch body is 15mm.



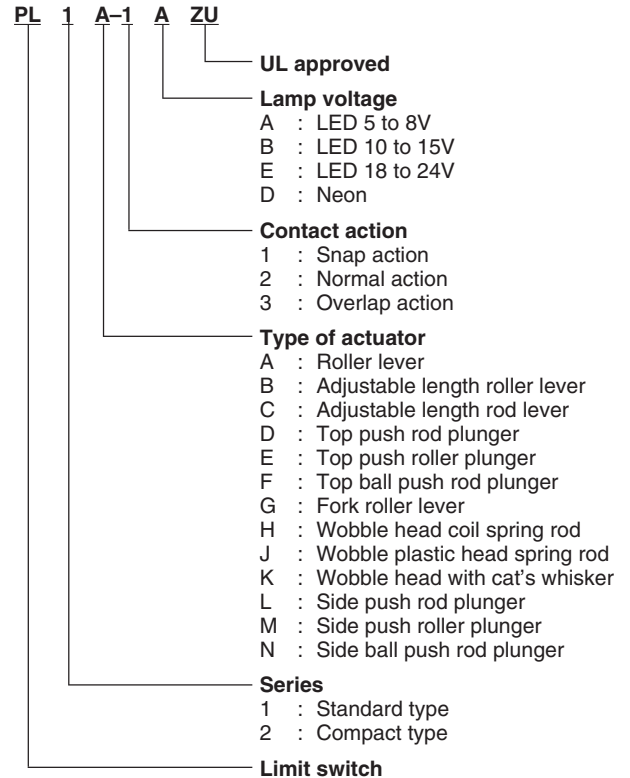
Front mounting

Rear mounting

■ Type number nomenclature

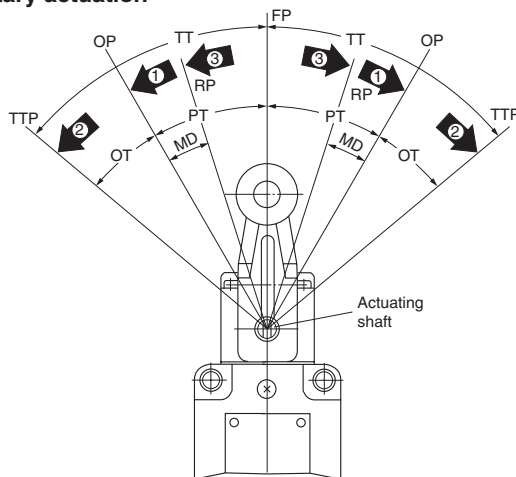


■ Ordering code



■ Operating and definitions (for snap action type)

● Rotary actuation



FP: Free Position

This is the position where there is no load on the actuator.

OP: Operating Position

This is the position where the actuator travels from the free position to NO contact closes.

TTP: Total Travel Position

This is the furthest position where the actuator can travel to after passing the OP without damage to the limit switch.

RP: Release Position

This is the position where the contact resets after the actuator has travelled from OP.

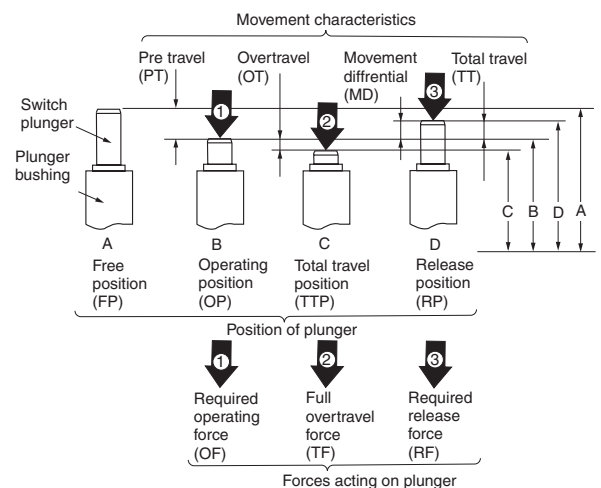
PT: Preoperating Travel

This indicates the travelling angle or distance from FP to OP.

OT: Overtravel

This indicates the travelling angle or distance from OP to TTP.

● Plunger actuation



TT: Total Travel

This indicates the travelling angle or distance from FP to TTP.

MD: Movement Differential (Travel to Reset)

This indicates the travelling angle or distance from OP to the position where the contact resets.

OF: Required Operating Force ①

This indicates the minimum operating force which is required for the contact to close.

RF: Required Resetting Force ③

This indicates the force required for the contact to reset.

TF: Full Overtravel Force ②

This indicates the force required for the actuator to travel from FP to TTP.

Limit Switches

AL and AL-S

■ Actuating slider face angle and approach speed

● Standard type

Type		AL-N1	AL-N2	AL-N3	AL-F1	AL-S1	AL-P1	AL-P2	AL-P3
Slider angle (degree)		30 45	30 45	—	45	—	—	30	30
Slider approach speed	Maximum (meter/second)	0.5	0.2	0.2	0.1	0.2	0.2	0.3	0.3
	Minimum (millimeter/second)	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1

AL-N1	AL-N2	AL-N3	AL-F1
	<p>Determine slider depth within range of these dimensions</p>	<p>Determine slider depth within range of these dimensions</p>	
AL-S1	AL-P1	AL-P2	AL-P3
<p>When actuating switch beyond this range, contact may make/break two times or more</p>	<p>Actuate AL-P1 type in direction coinciding with plunger shaft direction</p>		

● Compact type

Type		AL-SN1	AL-SN2	AL-SN3	AL-SK1	AL-SK2	AL-SS1	AL-SP1	AL-SP2	
Slider angle (degree)		30 45	30 45	—	30	45	—	—	30	
Slider approach speed	Maximum (meter/second)	0.5	0.2	0.2	0.1	0.2	ν_1 : 0.6 ν_2 : 0.2	0.2	0.2	0.3
	Minimum (millimeter/second)	0.1	0.1	0.2	0.2	0.2	ν_1 : 0.1 ν_2 : 0.1	0.2	0.1	0.1

AL-SN1	AL-SN2	AL-SN3	AL-SK1
AL-SK2	AL-SS1	AL-SP1	AL-SP2
	<p>When actuating switch beyond this range, contact may make/break two times or more</p>	<p>Actuate AL-SP1 type in direction coinciding with plunger shaft direction</p>	

■ AL series

Description



SI-204

Roller lever

- The angle from the free position to the maximum travel position is 75°
- Spring return
- The most popular limit switch which is best suited for machine tools, automatic machines, conveyor control and similar applications.

Type	Ordering code
AL-N11	PL1A-1
AL-N12	PL1A-2
AL-N13	PL1A-3
AL-N11UL	PL1A-1ZU



SI-203

Adjustable length roller lever

- The lever length can be adjusted between 25mm and 90mm.
- Spring return
- The graduated scales on the lever facilitate adjustment

Type	Ordering code
AL-N21	PL1B-1
AL-N22	PL1B-2
AL-N23	PL1B-3
AL-N21UL	PL1B-1ZU



SI-202

Adjustable length rod lever

- The $\phi 3.2$ mm stainless steel rod can be extended up to 141mm max.
- Spring return
- The rod can be used by bending. (Radial 2mm min.)

Type	Ordering code
AL-N31	PL1C-1
AL-N32	PL1C-2
AL-N33	PL1C-3
AL-N31UL	PL1C-1ZU



SI-209

Top push rod plunger

- Operated by a vertical rod plunger
- Momentary action

Type	Ordering code
AL-P11	PL1D-1
AL-P12	PL1D-2
AL-P13	PL1D-3
AL-P11UL	PL1D-1ZU



SI-207

Top push roller plunger

- This is a limit switch where the roller is attached to the plunger.
- The direction of the roller can be shifted 90°.
- This feature makes it highly suitable for the control of precision machinery.
- Momentary action

Type	Ordering code
AL-P21	PL1E-1
AL-P22	PL1E-2
AL-P23	PL1E-3
AL-P21UL	PL1E-1ZU

Description



SI-208

Top ball push rod plunger

- The ball rod can be operated from any direction.
- The ball turns smoothly at all times.
- Best suited for detecting objects which travel horizontally from left to right or right to left while turning.

Type	Ordering code
AL-P31	PL1F-1
AL-P32	PL1F-2
PL-P33	PL1F-3
AL-P31UL	PL1F-1ZU



SI-205

Fork roller lever

- The angle of the lever is 90°
- Maintained
- This limit switch is used when detecting the direction in which the lever inclines — i.e. in the right or left.

Type	Ordering code
AL-F11	PL1G-1
AL-F11UL	PL1G-1ZU



SI-211

Side push rod plunger

- Push rod is attached to the side of the operating head.
- The operating head can be changed 90° in direction.
- Momentary action
- This limit switch is used to detect the end limit of low speed transfer.

Type	Ordering code
AL-Y11	PL1H-1
AL-Y11UL	PL1H-1ZU



SI-212

Side push roller plunger

- The push roller is attached to the side of the operating head.
- Momentary action
- This is used to detect the position, speed and direction in high precision machinery and equipment.

Type	Ordering code
AL-Y21	PL1J-1
AL-Y21UL	PL1J-1ZU



SI-210

Side ball push rod plunger

- The ball rod is attached to the side of the operating head.
- The ball turns smoothly in operation.
- Momentary action
- This limit switch is used to detect objects which travel horizontally from left to right or right to left while turning.

Type	Ordering code
AL-Y31	PL1K-1
AL-Y31UL	PL1K-1ZU

Limit Switches

AL and AL-S

■ AL series

Description



SI-200

Wobble head coil spring rod

- Operates by forces from any directions.
- Used in packing and other conveyors.

Type	Ordering code
AL-S11	PL1H-1
AL-S11UL	PL1H-1ZU

Description



SI-199

Wobble head with cat's whisker

- The length of the stainless steel rod is 190mm from the head.
- Can be operated from any direction.
- Require little torque

Type	Ordering code
AL-W11	PL1N-1
AL-W11UL	PL1N-1ZU

Wobble plastic head spring rod

- The length of rod is 140mm from the head.
- Operates by forces from any directions.



SI-201

Type	Ordering code
AL-S21	PL1M-1
AL-S21UL	PL1M-1ZU

■ Operating characteristics

Standard type (Snap action)

Type	AL-N11 AL-N11S	AL-N21*1 AL-N21S*1	AL-N31*2 AL-N31S*2	AL-P11 AL-P11S	AL-P21 AL-P21S	AL-P31 AL-P31S	AL-F11 AL-F11S
Required operating force OF (max.)	9N	9N	2.9N	15N	15N	15N	9.5N
Required resetting force RF (min.)	0.5N	0.5N	0.15N	8.2N	8.2N	8.2N	—
Preoperating travel PT (min.)	12°	12°	12°	2mm	2mm	2mm	55°
Overtravel OT (min.)	65°	65°	65°	5mm	5mm	5mm	35°
Movement differential (Travel to reset) MD (max.)	7°	7°	7°	1mm	1mm	1mm	—
Total travel TT (min.)	75°	75°	75°	—	—	—	90°±10°

Notes: *1 At lever length 38mm
*2 At rod lever length 135mm

Type	AL-Y11 AL-Y11S	AL-Y21 AL-Y21S	AL-Y31 AL-Y31S	AL-S11 AL-S11S	AL-S21 AL-S21S	AL-W11 AL-W11S
Required operating force OF (max.)	40N	40N	40N	1.5N	1.5N	1.5N
Required resetting force RF (min.)	8.9N	8.9N	8.9N	—	—	—
Preoperating travel PT (min.)	2.8mm	2.8mm	2.8mm	30mm	30mm	40mm
Overtravel OT (min.)	4mm	4mm	4mm	—	—	—
Movement differential (Travel to reset) MD (max.)	1mm	1mm	1mm	—	—	—

Standard type (Normal action, overlap action)

Type	Normal action			Overlap action		
	AL-N12 *1 AL-N22	AL-N32 *2	AL-P12 AL-P22 AL-P32AL	AL-N13 *1 AL-N23	AL-N33 *2	AL-P13 AL-P23 AL-P33
Required operating force OF (max.)	11N	3.1N	18N	11N	3.1N	18N
Movement to NC contact open	28°	28°	3.5mm	45°	45°	5mm
Movement to NO contact closed	45°	45°	5mm	28°	28°	3.5mm
Total travel TT (min., max.)	75°	75°	7mm	75°	75°	7mm

Notes: *1 At lever length 38mm
*2 At rod lever length 135mm

05

Limit Switches

AL and AL-S

■ AL-S series/Compact-size

Description



SI-1023

Top push rod plunger

- Operated by a vertical rod plunger.
- Momentary action

Type	Ordering code
AL-SP11	PL2D-1
AL-SP12	PL2D-2
AL-SP13	PL2D-3
AL-SP11UL	PL2D-1ZU

Description



SI-1029

Roller lever

- The angle from the free position to the maximum travel position is 70°
- Spring return

Type	Ordering code
AL-SN11	PL2A-1
AL-SN11UL	PL2A-1ZU



SI-1022

Top push roller plunger

- This is a limit switch where the roller is attached to the plunger.
- The direction of the roller can be shifted 90°
- Momentary action

Type	Ordering code
AL-SP21	PL2E-1
AL-SP22	PL2E-2
AL-SP23	PL2E-3
AL-SP21UL	PL2E-1ZU



SI-1018

Adjustable length roller lever

- The lever length can be adjusted between 25mm and 76mm.
- Spring return
- The graduated scales on the lever facilitate adjustment

Type	Ordering code
AL-SN21	PL2B-1
AL-SN21UL	PL2B-1ZU



SI-1020

Top roller lever plunger

- This limit switch is used to detect objects which travel horizontally from left to right or right to left while turning.
- Used in packing and other conveyors.

Type	Ordering code
AL-SK11	PL2P-1
AL-SK12	PL2P-2
AL-SK13	PL2P-3
AL-SK11UL	PL2P-1ZU



SI-1027

Adjustable length rod lever

- The ø3.2mm stainless steel rod can be extended up to 130mm max.
- Spring return
- The rod can be used by bending. (Radial 2mm min.)

Type	Ordering code
AL-SN31	PL2C-1
AL-SN31UL	PL2C-1ZU



SI-1021

Reversing top roller lever plunger

- This type is designed to detect the movements in the vertical direction.

Type	Ordering code
AL-SK21	PL2Q-1
AL-SK22	PL2Q-2
AL-SK23	PL2Q-3
AL-SK21UL	PL2Q-1ZU



SI-1016

Wobble head coil spring rod

- The length of rod is 113mm from the head.
- Can be operated from any direction.
- Require little torque

Type	Ordering code
AL-SS11	PL2H-1
AL-SS11UL	PL2H-1ZU

■ Operating characteristics



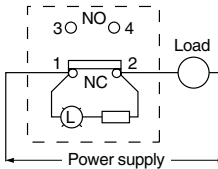
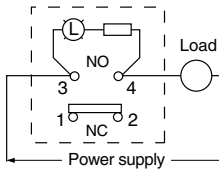
Compact type (Snap action)

Type	AL-SP11	AL-SP21	AL-SK11	AL-SK21	AL-SN11	AL-SN21 *1	AL-SN31 *1	AL-SS11
Required operating force OF (max.)	4.5N	8.5N	4N	4N	7N	7N	7N	1.5N
Required resetting force RF (min.)	2N	4.5N	1.8N	1.8N	0.5N	0.5N	0.5N	—
Preoperating travel PT (min.)	2mm	2mm	2.5mm	2.5mm	30°	30°	30°	30mm
Overtravel OT (min.)	4mm	3mm	5mm	5mm	40°	40°	40°	—
Movement differential (Travel to reset) MD (max.)	1mm	1mm	1.8mm	1.8mm	8°	8°	8°	—


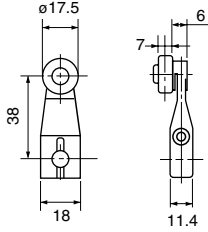
Notes: *1 At lever or rod level length 25mm


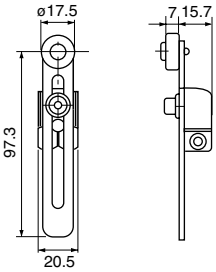
Compact type (Normal action, overlap action)


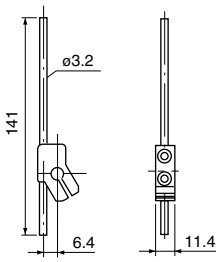
Type	Normal action			Overlap action		
	AL-SP12	AL-SP22	AL-SK□2	AL-SP13	AL-SP23	AL-SK□3
Required operating force OF (max.)	7N	10.5N	6.3N	7N	10.5N	6.3N
Movement to NC contact open	1.5mm	1.5mm	2mm	3mm	3mm	4mm
Movement to NO contact closed	3mm	3mm	4mm	1.5mm	1.5mm	2mm
Total travel TT (min., max.)	6mm	6mm	8mm	6mm	6mm	8mm


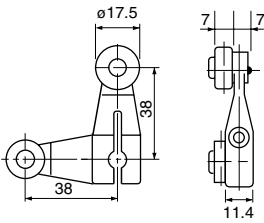
Description	Standard/Compact Type	Ordering code	UL approved		
			Type	Ordering code	
 <p>SI-314</p> <p>Standard type</p> <p>With indicating lamp</p> <ul style="list-style-type: none"> The indicating lamp can be fitted to all the AL limit switches. Neon lamp or LED, and stabilizing resistor are attached inside the housing so that the lamp lights or goes out when the switch is operating. The nylon cover makes the signal highly visible. Indicating lamps do not affect the switch dimensions or operating characteristics. The wiring connections for snap action type are shown below. 	AL-N1□■	PL1A-□■	AL-N11■UL	PL1A-1■ZU	
	AL-N2□■	PL1B-□■	AL-N21■UL	PL1B-1■ZU	
	AL-N3□■	PL1C-□■	AL-N31■UL	PL1C-1■ZU	
	AL-P1□■	PL1D-□■	AL-P11■UL	PL1D-1■ZU	
	AL-P2□■	PL1E-□■	AL-P21■UL	PL1E-1■ZU	
	AL-P3□■	PL1F-□■	AL-P31■UL	PL1F-1■ZU	
	AL-F1□■	PL1G-□■	AL-F11■UL	PL1G-1■ZU	
	AL-Y1□■	PL1L-□■	AL-Y11■UL	PL1L-1■ZU	
	AL-Y2□■	PL1M-□■	AL-Y21■UL	PL1M-1■ZU	
	AL-T3□■	PL1N-□■	AL-T31■UL	PL1N-1■ZU	
	AL-S1□■	PL1H-□■	AL-S11■UL	PL1H-1■ZU	
	AL-S2□■	PL1J-□■	AL-S21■UL	PL1J-1■ZU	
	AL-W1□■	PL1K-□■	AL-W11■UL	PL1K-1■ZU	
	 <p>SI-1078</p> <p>Compact type</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>The lamp lights when NO contact closes</p> </div> <div style="text-align: center;">  <p>The lamp lights when NO contact opens</p> </div> </div>	AL-SP1□■	PL2D-□■	AL-SP11■UL	PL2D-1■ZU
		AL-SP2□■	PL2E-□■	AL-SP11■UL	PL2E-1■ZU
		AL-SK1□■	PL2P-□■	AL-SK11■UL	PL2P-1■ZU
		AL-SK2□■	PL2Q-□■	AL-SK21■UL	PL2Q-1■ZU
AL-SN1□■		PL2A-□■	AL-SN11■UL	PL2A-1■ZU	
AL-SN2□■		PL2B-□■	AL-SN21■UL	PL2B-1■ZU	
AL-SN3□■		PL2C-□■	AL-SN31■UL	PL2C-1■ZU	
AL-SS1□■	PL2H-□■	AL-SS11■UL	PL2H-1■ZU		
		Replace the □ mark by the contact action code Replace the ■ mark by the lamp voltage code			


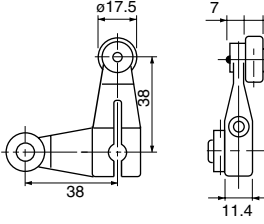
■ Actuators
● For AL series

Description	Type
Roller lever	ALX-001
 	Stainless steel roller
SI-177	


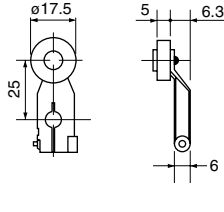
Adjustable length roller lever	ALX-003
 	Stainless steel roller
SI-173	


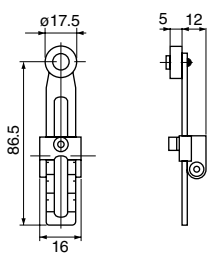
Adjustable length rod lever	ALX-005
 	Stainless steel rod
SI-171	


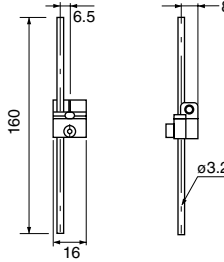
Fork roller lever	ALX-007
 	Stainless steel roller
SI-175	

Fork roller lever	ALX-009
 	Stainless steel roller
SI-176	

● For AL-S series

Description	Type
Roller lever	ALX-501
 	Stainless steel roller
SI-316	

Adjustable length roller lever	ALX-503
 	Stainless steel roller
SI-174	

Adjustable length rod lever	ALX-505
 	Stainless steel rod
SI-172	

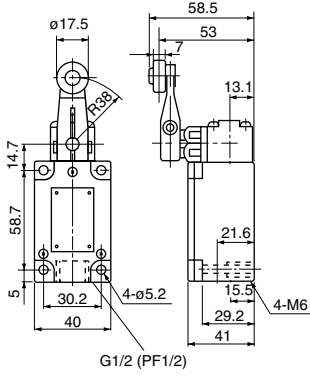
05

Limit Switches

AL and AL-S

■ Dimensions, mm (AL series)

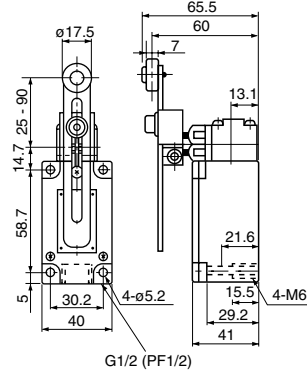
Roller lever AL-N1



Mass: 265g

Stainless steel roller

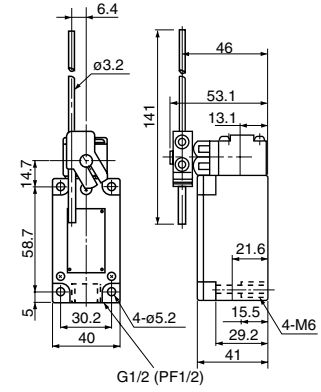
Adjustable length roller lever AL-N2



Mass: 305g

Stainless steel roller

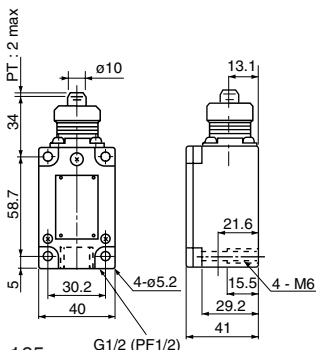
Adjustable length rod lever AL-N3



Mass: 260g

Stainless steel rod

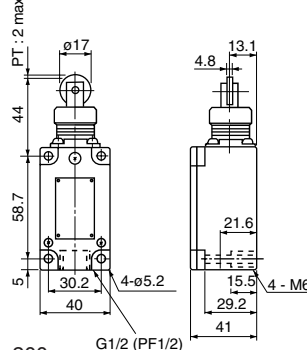
Top push rod plunger AL-P1



Mass: 165g

Stainless steel plunger

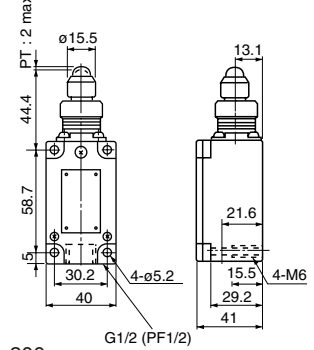
Top push roller plunger AL-P2



Mass: 200g

Stainless steel roller

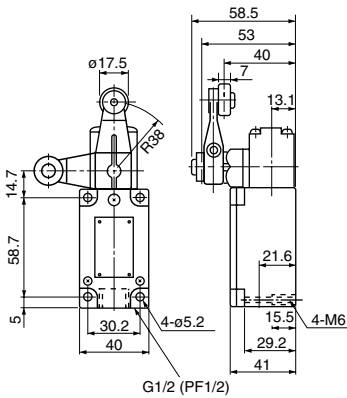
Top ball push rod plunger AL-P3



Mass: 200g

Stainless steel ball

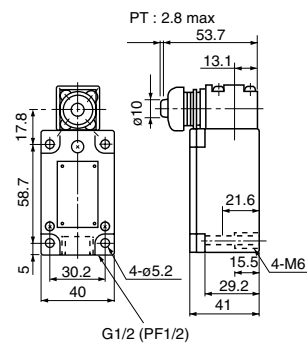
Fork roller lever AL-F1



Mass: 310g

Stainless steel roller

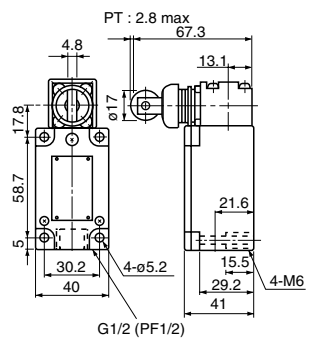
Side push rod plunger AL-Y1



Mass: 275g

Stainless steel plunger

Side push roller plunger AL-Y2

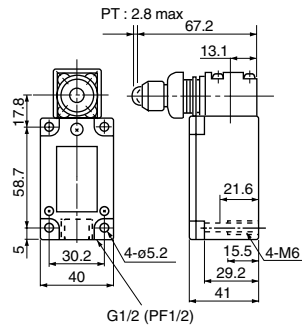


Mass: 285g

Stainless steel roller

■ Dimensions, mm (AL series)

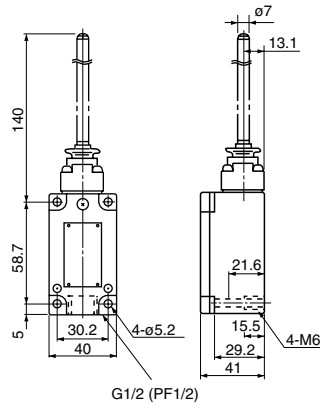
Side ball push rod plunger
AL-Y3



Mass: 285g

Stainless steel ball

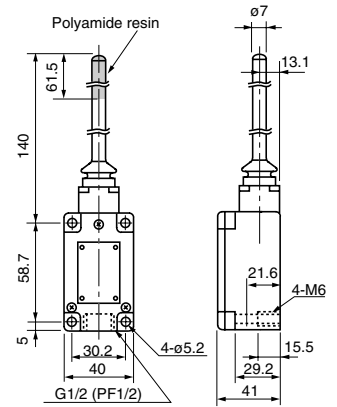
Wobble head coil spring rod
AL-S1



Mass: 220g

Stainless steel coil spring

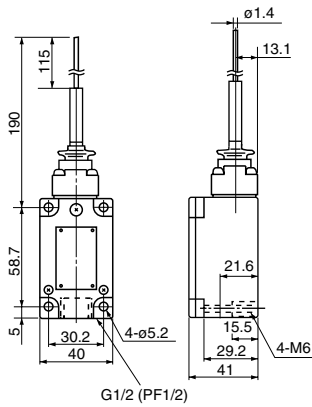
Wobble plastic head spring rod
AL-S2



Mass: 210g

Stainless steel coil spring

Wobble head with cat's whisker
AL-W1



Mass: 210g

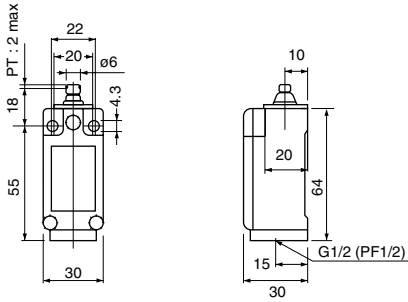
Stainless steel coil spring

Limit Switches

AL and AL-S

■ Dimensions, mm (AL-S series/Compact size)

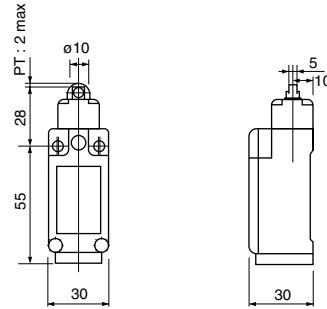
Top push rod plunger
AL-SP1



Mass: 55g

Polyamide resin plunger

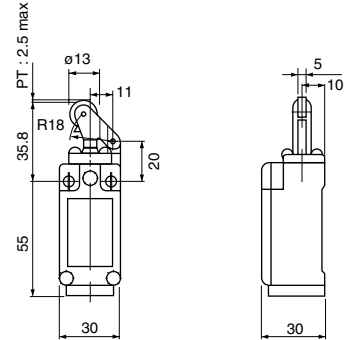
Top push roller plunger
AL-SP2



Mass: 60g

Stainless steel roller

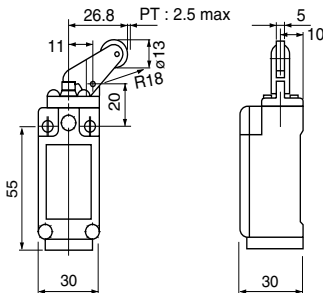
Top roller lever plunger
AL-SK1



Mass: 65g

Stainless steel roller

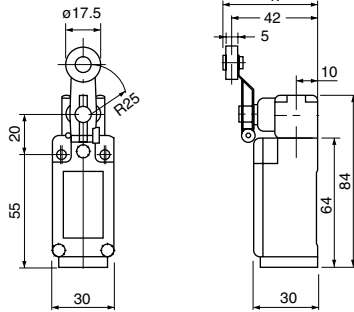
Reversing top roller lever plunger
AL-SK2



Mass: 65g

Stainless steel roller

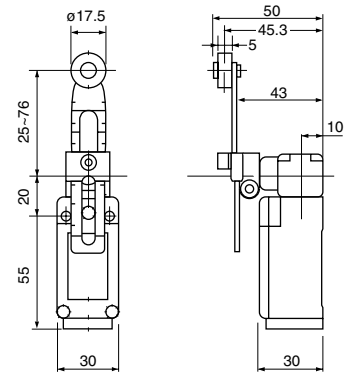
Roller lever
AL-SN1



Mass: 100g

Stainless steel roller

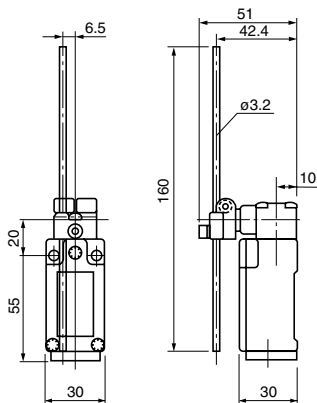
Adjustable length roller lever
AL-SN2



Mass: 120g

Stainless steel roller

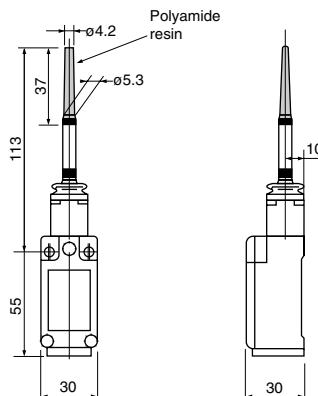
Adjustable length rod lever
AL-SN3



Mass: 105g

Stainless steel rod

Wobble plastic head spring rod
AL-SS1



Mass: 80g

Stainless steel coil spring