

Safety Limit Switch

D4B-□N

- Snap-action or slow-action contact for accurate switching with safe operation via a direct opening mechanism with metal deposition between mating contacts.
- Two sets of contacts: one (NC) for safety category circuit and the other (NO) for control circuit.
- Contacts opened by direct opening mechanism (NC contacts only), thus preventing faulty operation due to factors such as metal deposition.
- Wide standard operating temperature range:
–40°C to 80°C (standard type).
- Safety of lever settings ensured using a mechanism that engages a gear between the operating position indicator plate and the lever.
- Equipped with a mechanism that indicates the applicable operating zone, as well as push-button switching to control left and right motion.
- Conforms to EN (TÜV) standards corresponding to the CE marking.
- 3-conduit switches are available.
- Metric conduit types available.



Model Number Structure

Model Number Legend

D4B-□□□□N
1 2 3

1. Conduit

- 1: PG13.5 (1-conduit)
- 2: G1/2 (PF1/2) (1-conduit)
- 3: 1/2-14NPT (1-conduit)
- 4: M20
- 5: PG13.5 (3-conduit)
- 6: G1/2 (PF1/2) (3-conduit)
- 7: 1/2-14NPT (3-conduit)
- 8: M20 (3-conduit)

2. Built-in Switch

- 1: 1NC/1NO (snap-action)
- 3: 1NC/1NO (slow-action) gold-plated contacts
- 5: 1NC/1NO (slow-action) (see note)
- A: 2NC (slow-action)
- B: 2NC (slow-action) gold-plated contacts

Note: Excluding D4B-□□81N and D4B-□□87N models.

3. Actuator

- 00: Switch box (without head)
- 11: Roller lever (standard)
- 16: Adjustable roller lever
- 17: Adjustable rod lever
- 1R: Roller lever (conventional D4B-compatible)
- 70: Top plunger
- 71: Top roller plunger
- 81: Coil spring
- 87: Plastic rod

Ordering Information

List of Models

Safety limit switch, mechanical form lock

Switches (EN50041)

Actuator		Conduit size								
		PG13.5 (see note 2)			G1/2			M20		
		1NC/1NO (Snap- action)	1NC/1NO (Slow- action)	2NC (Slow- action)	1NC/1NO (Snap- action)	1NC/1NO (Slow- action)	2NC (Slow- action)	1NC/1NO (Snap- action)	1NC/1NO (Slow- action)	2NC (Slow- action)
Side rotary	Roller lever (form A)	D4B-1111N	D4B-1511N	D4B-1A11N	D4B-2111N	D4B-2511N	D4B-2A11N	D4B-4111N	D4B-4511N	D4B-4A11N
	Adjustable roller lever (see note 1)	D4B-1116N	D4B-1516N	D4B-1A16N	D4B-2116N	D4B-2516N	D4B-2A16N	D4B-4116N	D4B-4516N	D4B-4A16N
	Adjustable rod lever (form D) (see note 1)	D4B-1117N	D4B-1517N	D4B-1A17N	D4B-2117N	D4B-2517N	D4B-2A17N	D4B-4117N	D4B-4517N	D4B-4A17N
Top plunger	Plain (form B)	D4B-1170N	D4B-1570N	D4B-1A70N	D4B-2170N	D4B-2570N	D4B-2A70N	D4B-4170N	D4B-4570N	D4B-4A70N
	Roller (form C)	D4B-1171N	D4B-1571N	D4B-1A71N	D4B-2171N	D4B-2571N	D4B-2A71N	D4B-4171N	D4B-4571N	D4B-4A71N
Wobble lever (see note 1)	Coil spring	D4B-1181N	---	D4B-1A81N	D4B-2181N	---	D4B-2A81N	D4B-4181N	---	---
	Plastic rod	D4B-1187N	---	D4B-1A87N	D4B-2187N	---	D4B-2A87N	D4B-4187N	---	---

Note: 1. Mechanically speaking, these models are basic limit switches.

2. The D4B-□N is a Limit Switch conforming to European standards, and PG13.5 is commonly used in Europe.

3-conduit Switch

Actuator		Conduit size								
		PG13.5 (see note 2)			G1/2			M20		
		1NC/1NO (Snap- action)	1NC/1NO (Slow- action)	2NC (Slow- action)	1NC/1NO (Snap- action)	1NC/1NO (Slow- action)	2NC (Slow- action)	1NC/1NO (Snap- action)	1NC/1NO (Slow- action)	2NC (Slow- action)
Side rotary	Roller lever (form A)	D4B-5111N	D4B-5511N	D4B-5A11N	D4B-6111N	D4B-6511N	D4B-6A11N	D4B-8111N	---	---
	Adjust- able roller lever (see note 1)	D4B-5116N	D4B-5516N	D4B-5A16N	D4B-6116N	D4B-6516N	D4B-6A16N	D4B-8116N	---	---
	Adjustable rod lever (form D) (see note 1)	D4B-5117N	D4B-5517N	D4B-5A17N	D4B-6117N	D4B-6517N	D4B-6A17N	D4B-8117N	---	---
Top plunger	Plain (form B)	D4B-5170N	D4B-5570N	D4B-5A70N	D4B-6170N	D4B-6570N	D4B-6A70N	---	---	---
	Roller (form C)	D4B-5171N	D4B-5571N	D4B-5A71N	D4B-6171N	D4B-6571N	D4B-6A71N	D4B-8171N	---	D4B-8A71N
Wob- ble le- ver (see note 1)	Coil spring	D4B-5181N	---	D4B-5A81N	D4B-6181N	---	D4B-6A81N	---	---	---
	Plastic rod	D4B-5187N	---	D4B-5A87N	D4B-6187N	---	D4B-6A87N	---	---	---

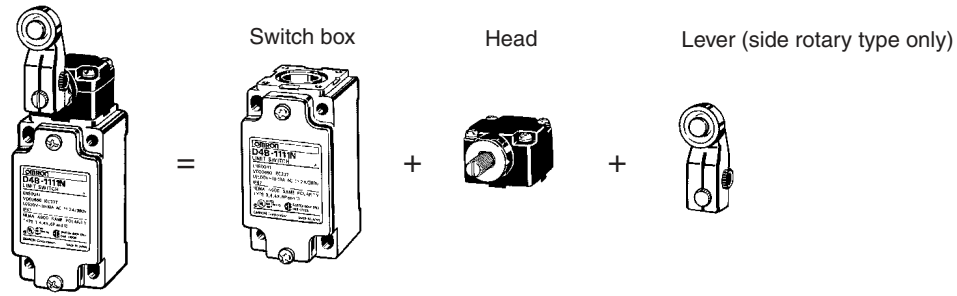
Note: 1. Mechanically speaking, these models are basic limit switches.

2. The D4B-□N is a Limit Switch conforming to European standards, and M20/PG13.5 is commonly used in Europe.

3. The wobble lever models are ordinary limit switches and are not approved under EN, GS, and SUVA's Direct Opening Certificate.

Replacement Part

Because the D4B-□N employs a block mounting construction, the switch box, operating head, and lever (side rotary type only) may be ordered as a complete assembly or individually as replacement parts. (Replacement parts are not available as a switch box and head assembly or as a head and lever assembly.)



ex. D4B-2111N = D4B-2100N + D4B-0010N + D4B-0001N

Switch Box

	EN50041			3-conduit type		
	PG13.5	G1/2	1/2-14NPT	PG13.5	G1/2	1/2-14NPT
1NC/1NO (Snap-action)	D4B-1100N	D4B-2100N	D4B-3100N	D4B-5100N	D4B-6100N	D4B-7100N
1NC/1NO (Slow-action)	D4B-1500N	D4B-2500N	D4B-3500N	D4B-5500N	D4B-6500N	D4B-7500N
2NC (Slow-action)	D4B-1A00N	D4B-2A00N	D4B-3A00N	D4B-5A00N	D4B-6A00N	D4B-7A00N

Operating Heads

Actuator	Type	Model
Side rotary	Standard	D4B-0010N
Top plunger	Plain	D4B-0070N
	Roller	D4B-0071N
Wobble lever	Coil spring	D4B-0081N
	Plastic rod	D4B-0087N

Levers (for Side Rotary Switches)


Actuator	Length	Diameter of roller	Model
Standard	31.5	17.5 dia.	D4B-0001N
Adjustable roller lever	25 to 89	19 dia.	D4B-0006N
Adjustable rod lever	145 max.	---	D4B-0007N
Interchangeable with D4B-0001	33.7	19 dia.	D4B-000RN

Note: Other types of lever are also available.

Specifications


Approved Standards

Snap-action Models

Agency	Standard	File No.
TÜV Rheinland	EN60947-5-1	R9851083  (Direct opening: approved)
		R9151372 (Direct opening: approval pending) (See note 1.)
UL	UL508	E76675
CSA	C22.2 No. 14	LR45746
BIA (See note 2.)	GS-ET-15	1-conduit: 9202158 3-conduit: 9309655

- Note:**
- Adjustable roller lever, adjustable rod lever, coil spring, and plastic rod models only.
 - Not including adjustable roller lever, adjustable rod lever, coil spring, and plastic rod models.

Slow-action Models

Agency	Standard	File No.
TÜV Rheinland	EN60947-5-1	R9151643  (Direct opening: approved) (See note)
UL	UL508	E76675
CSA	C22.2 No. 14	LR45746
BIA (See note.)	GS-ET-15	1-conduit: 9202158 3-conduit: 9309655
SUVA (See note.)	SUVA	1-conduit: E6188/ 1.d 3-conduit: E6189/ 1.d

Note: Not including adjustable roller lever, adjustable rod lever, coil spring, and plastic rod models.

Standards and EC Directives

- Conforms to the following EC Directives:
 - Machinery Directive
 - Low Voltage Directive
 - EN1088
 - EN50041

Approved Standard Ratings

TÜV Rheinland: EN60947-5-1

Utilization category	AC-15
Rated operating current (I_e)	2 A
Rated operating voltage (U_e)	400 V

Note: As protection against short-circuiting, use either a gI-type or gG-type 10-A fuse that conforms to IEC269.

UL/CSA: (UL508, CSA C22.2 No. 14)

A600

Rated voltage	Carry current	Current		Volt-amperes	
		Make	Break	Make	Break
120 VAC	10 A	60 A	6 A	7,200 VA	720 VA
240 VAC		30 A	3 A		
480 VAC		15 A	1.5 A		
600 VAC		12 A	1.2 A		

Characteristics

Item		Snap-action	Slow-action
Durability (see note 3)	Mechanical	30,000,000 operations min.	10,000,000 operations min.
	Electrical	500,000 operations min. (at a 250 VAC, 10-A resistive load)	
Operating speed		1 mm/s to 0.5 m/s	
Operating frequency		Mechanical:120 operations/min Electrical:30 operations/min	
Rated frequency		50/60 Hz	
Insulation resistance		100 MΩ min. (at 500 VDC) between terminals of the same polarity and between each terminal and non-current-carrying part	
Contact resistance		25 mΩ max. (initial value)	
Dielectric strength (U _{imp})			
	Between terminals of same polarity	U _{imp} 2.5 kV	U _{imp} 4 kV
	Between terminals of different polarity	---	U _{imp} 4 kV
	Between current-carrying metal parts and ground	U _{imp} 4 kV	U _{imp} 4 kV
	Between each terminal and non-current-carrying parts	U _{imp} 4 kV	U _{imp} 4 kV
Rated insulation voltage (U _i)		600 VAC (EN60947-5-1)	
Counter electromotive voltage at switching		1,500 VAC max. (EN60947-5-1)	
Operating environmental pollution level		3 (EN60947-5-1)	
Conditional short-circuit current		100 A (EN60947-5-1)	
Conventional enclosed thermal current (I _{the})		20 A (EN60947-5-1)	
Electric shock protection class		Class I (with ground terminal)	
Vibration resistance		Malfunction:10 to 55 Hz, 0.75 mm single amplitude	
Shock resistance		Destruction:1,000 m/s ² min. Malfunction:300 m/s ² min.	
Ambient temperature		Operating:-40°C to 80°C (with no icing) (see note 4)	
Ambient humidity		Operating:95% max.	
Degree of protection		IP67 (EN60947-5-1)	
Weight		Approx. 250 g	

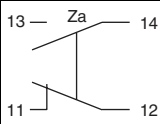
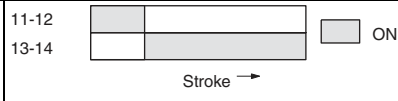

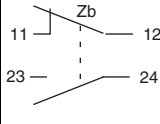
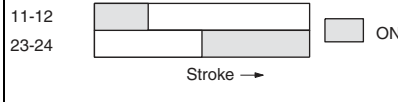

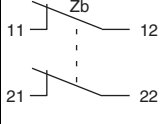
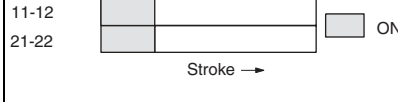

- Note:**
- The above values are initial values.
 - The above values may vary depending on the model. Consult your OMRON sales representative for details.
 - The durability is for an ambient temperature of 5°C to 35°C and ambient humidity of 40% to 70%. For further conditions, consult your OMRON sales representative.
 - 25°C to 80°C for the flexible-rod type.

Operating Characteristics

Model	D4B-□□11N	D4B-□□16N (see note 1)	D4B-□□17N (see note 2)	D4B-□□70N	D4B-□□71N	D4B-□□81N	D4B-□□87N
OF max.	9.41 N		2.12 N	18.63 N		1.47 N	
RF min.	1.47 N		0.29 N	1.96 N		---	
PT	21±3°			2.0 mm max.		15° max.	
PT (2nd) (see note 3)	(45°)			(3.0 mm)		---	
OT min.	50°			5.0 mm		---	
MD max. (see note 4)	12°			1.0 mm		---	
DOT min.	35° (Slow-action models) 55° (Snap-action models)			3.2 mm		---	
DOF min.	19.61 N			49.03 N		---	
TT	(75°)			7.0 mm		---	
FP max.	---			38 mm	51 mm	---	
OP	---			35±1 mm	48±1 mm	---	

- Note:**
- The operating characteristics of these Switches were measured with the roller lever set at 31.5 mm.
 - The operating characteristics of these Switches were measured with the rod lever set at 140 mm.
 - Only for slow-action models.
 - Only for snap-action models.

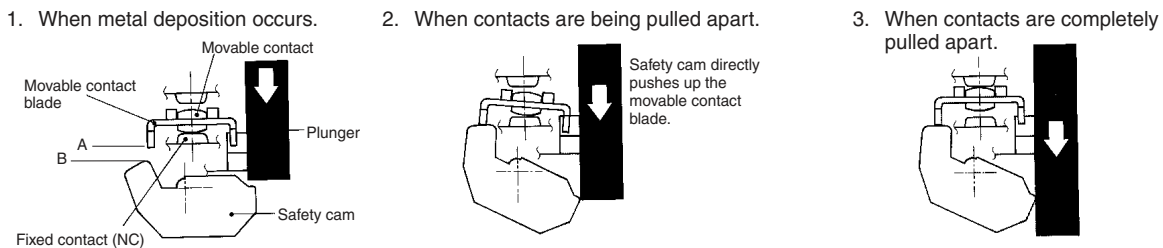
Contact Form (EN50013)

Model	Contact	Diagrams	Explanation
D4B-□1□N	1NC/1NO (Snap-action) 		Only NC contact 11-12 has an approved direct opening mechanism.  Terminal numbers 11-12 and 13-14 cannot be used as unlike poles.
D4B-□5□N	1NC/1NO (Slow-action) 		Only NC contact 11-12 has an approved direct opening mechanism.  Terminal numbers 11-12 or 23-24 can be used as unlike poles.
D4B-□A□N	2NC (Slow-action) 		Both NC contacts 11-12 and 21-22 have an approved direct opening mechanism.  Terminal numbers 11-12 and 21-22 can be used as unlike poles.

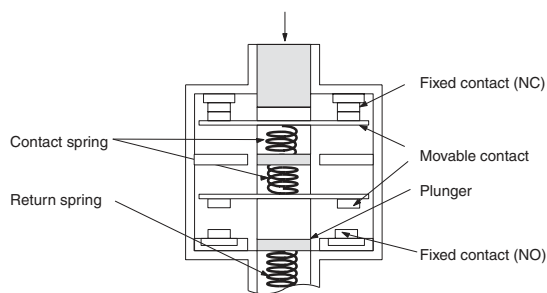
Direct Opening Mechanism


1NO/1NC Contact (Snap-action)

If metal deposition between mating contacts occurs on the NC contact side, they can be pulled apart by the shearing force and tensile force generated when part B of the safety cam or plunger engages part A of the movable contact blade. When the safety cam or plunger is moved in the direction of the arrow, the Limit Switch releases.



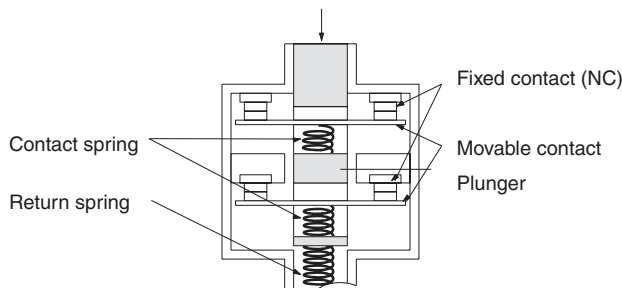
1NC/1NO Contact (Slow-action)



Conforms to EN60947-5-1 Direct Opening 


When metal deposition occurs, the contacts are separated from each other by the plunger being pushed in.

2NC Contact (Slow-action)



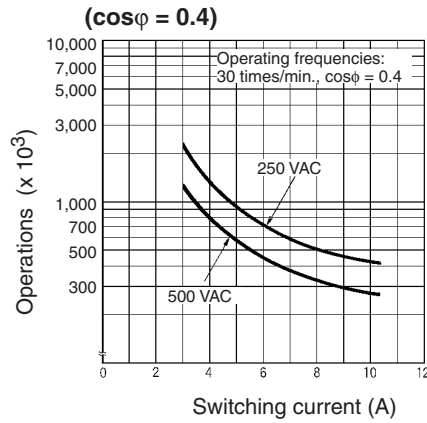
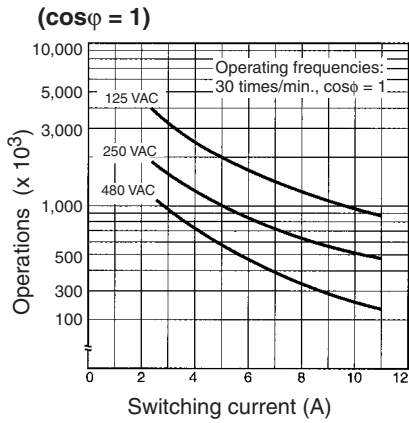
Conforms to EN60947-5-1 

When metal deposition occurs, the contacts are separated from each other by the plunger being pushed in.

 is marked on the product to indicate approval of direct opening.

Engineering Data

Electrical Durability (Snap-action)



Nomenclature

Head

With roller lever models, the direction of the switch head can be varied to any of the four directions by loosening the roller lever switch screws at the four corners of the head.

Operating Position Mark
(arrow)

The roller lever switch employs a system which allows selection of operation on only one side (left or right) or both sides without the use of any tools.

Switch Box Material
Aluminum die-cast

Conduit Opening

Available in four different types of conduit threads:
Pg 13.5, G1/2 or 1/2-14NPT, M20

Safety-oriented Lever Setting

Grooves which engage the lever every 90° are cut in the operating position indicator plate to prevent the lever from slipping against the rotary shaft.

Equipped with Operating Position Indicator Plate

An optimum overtravel (OT) value may be secured by setting a desired OT value with a projection.

Shearing Force Contact Separating Mechanism (NC Contact Section Only)

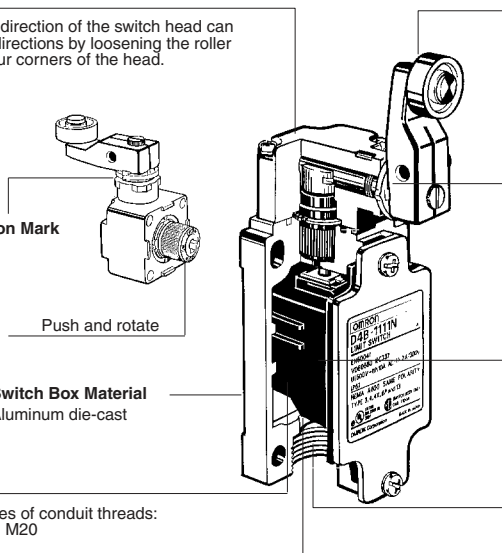
Should any abnormality occur in the contact area, the contacts are positively pulled apart from each other by shearing force.

Ground Terminal Screw

A ground terminal is provided to improve safety.

Contact Material

Ag alloy



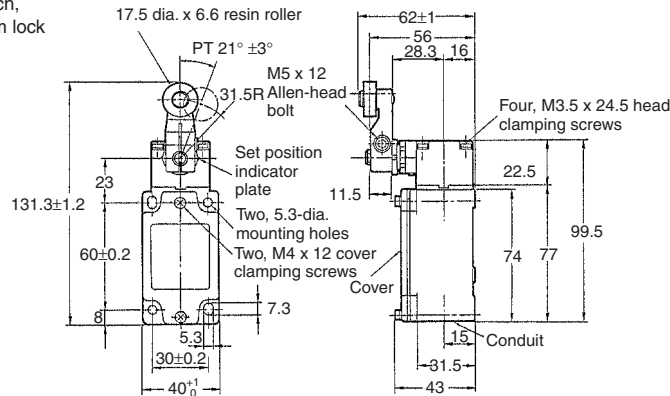
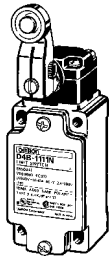
Dimensions

- Note:** 1. All units are in millimeters unless otherwise indicated.
 2. Unless otherwise specified, a tolerance of ± 0.4 mm applies to all dimensions.
 3. When placing your order, specify the conduit type by adding a code from the list below to the blank box of the following model numbers as shown below.
- | | |
|-------------------|--------------------|
| Standard Switches | 3-conduit Switches |
| 1: PG 13.5 | 5: PG 13.5 |
| 2: G 1/2 | 6: G 1/2 |
| 3: 1/2-14NPT | 7: 1/2-14NPT |
| 4: M20 | 8: M20 |

Switches

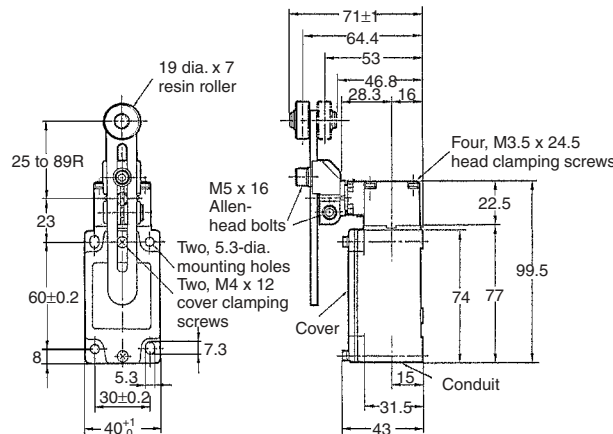
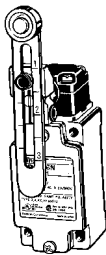
Roller Lever  safety limit switch, mechanical form lock

D4B-□□11N



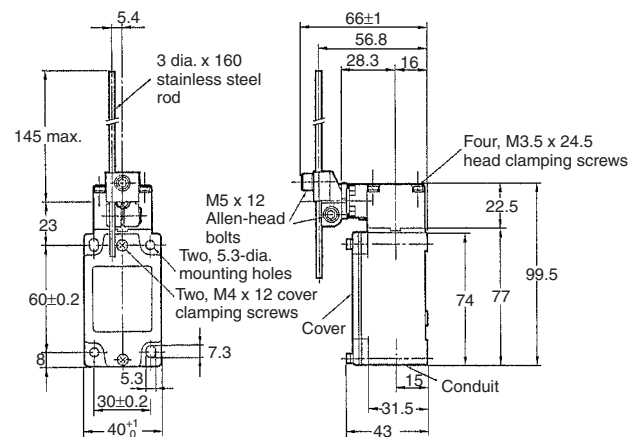
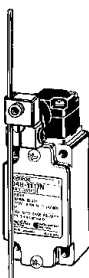
Adjustable Roller Lever

D4B-□□16N

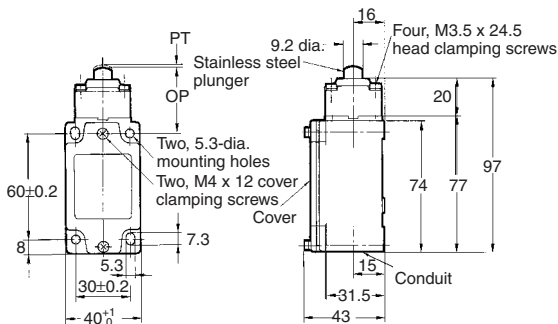


Adjustable Rod Lever

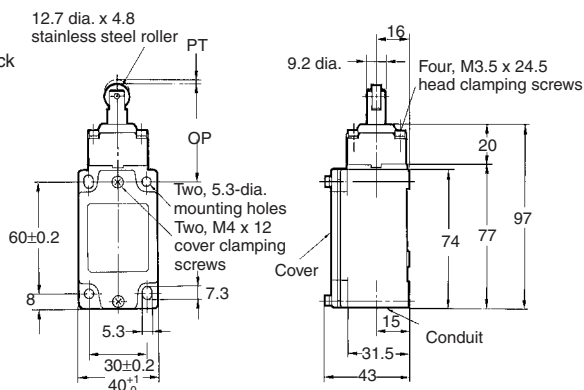
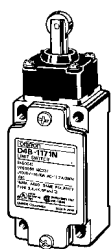
D4B-□□17N



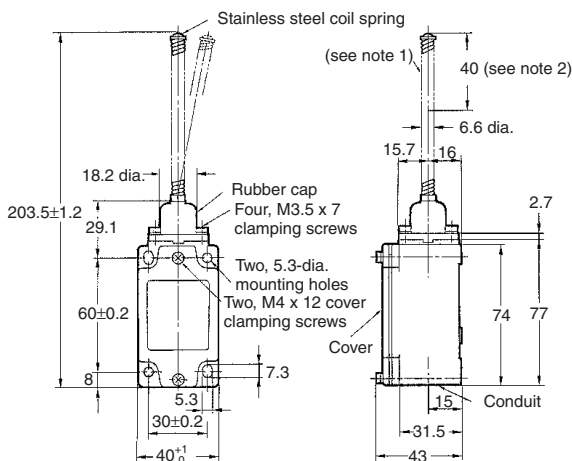
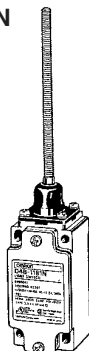
Top Plunger ■ safety limit switch,
mechanical form lock
D4B-□□70N



Top Roller Plunger ■ safety limit switch,
mechanical form lock
D4B-□□71N

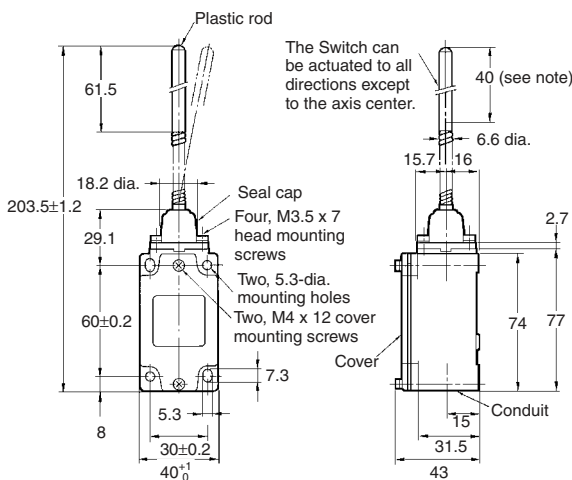


Coil Spring
D4B-□□81N



Note: 1. The coil spring may be operated from any directions except axial directions (↓).
2. Be sure to adjust the dog to within 40 mm from the top end of the coil spring.

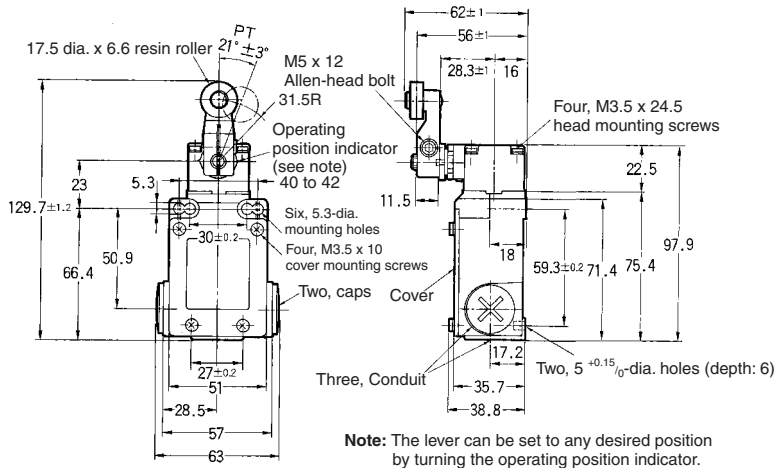
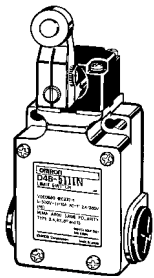
Plastic Rod
D4B-□□87N



Note: Be sure to adjust the dog to within 40 mm from the top end of the plastic rod.

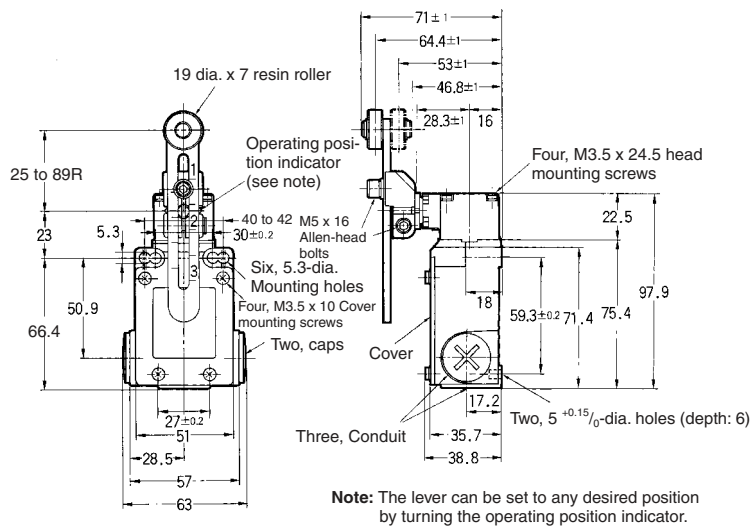
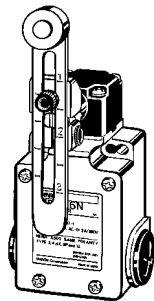
3-conduit Switches

Roller Lever ■ safety limit switch, mechanical form lock
D4B-□□11N



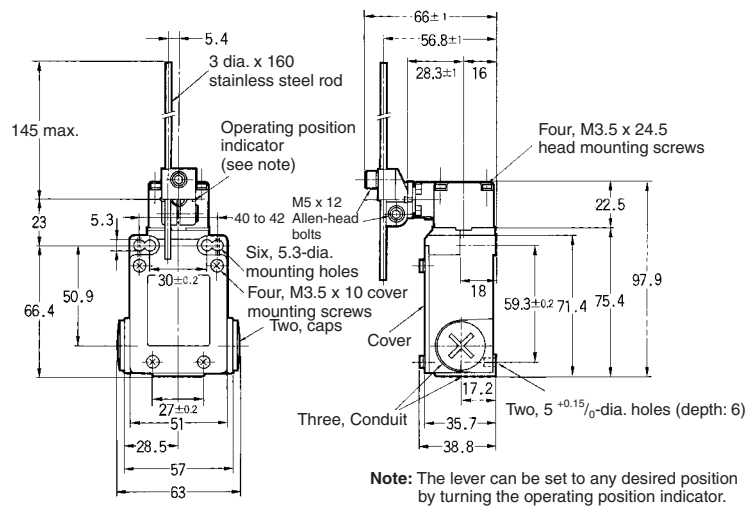
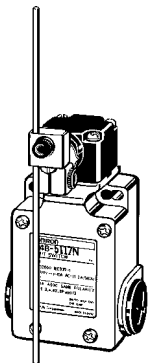
Adjustable Roller Lever

D4B-□□16N

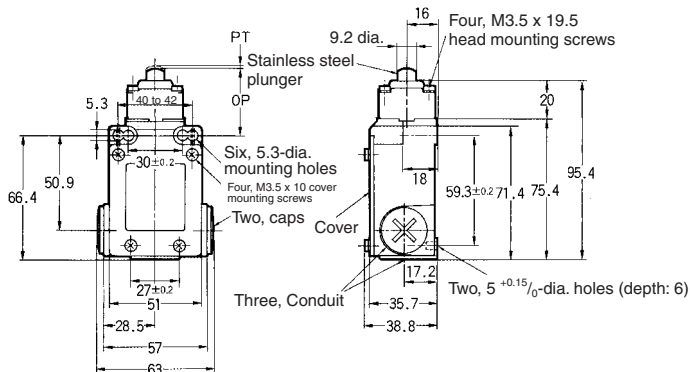
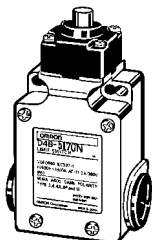


Adjustable Rod Lever

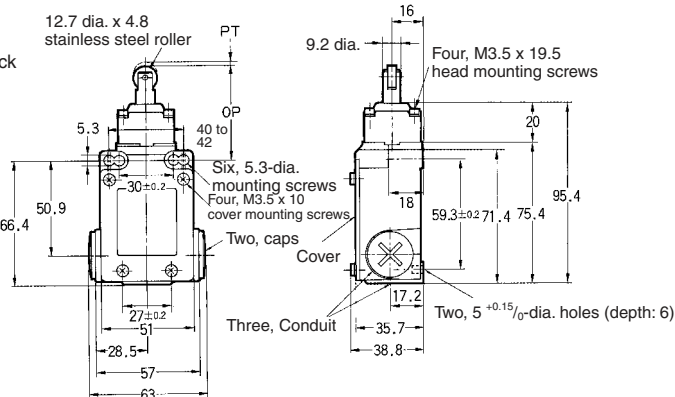
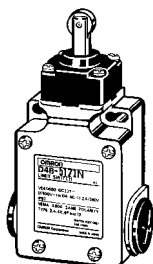
D4B-□□17N



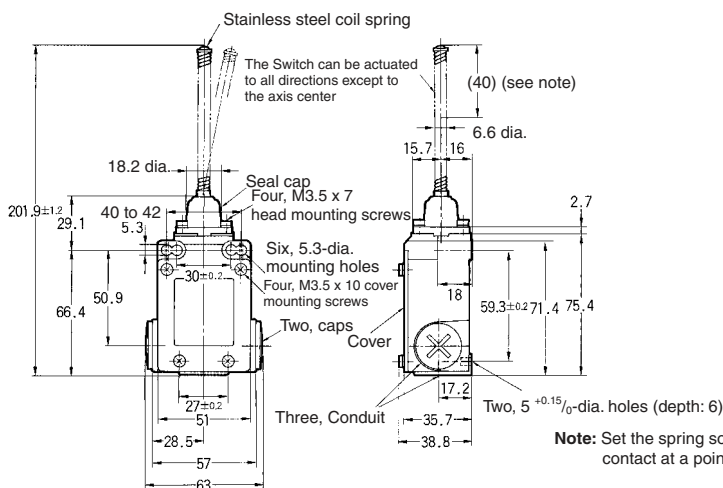
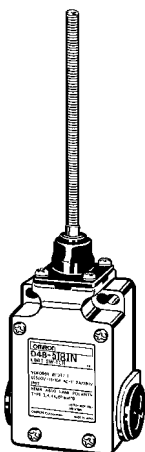
Top Plunger ■ safety limit switch, mechanical form lock
D4B-□□70N



Top Roller Plunger ■ safety limit switch, mechanical form lock
D4B-□□71N

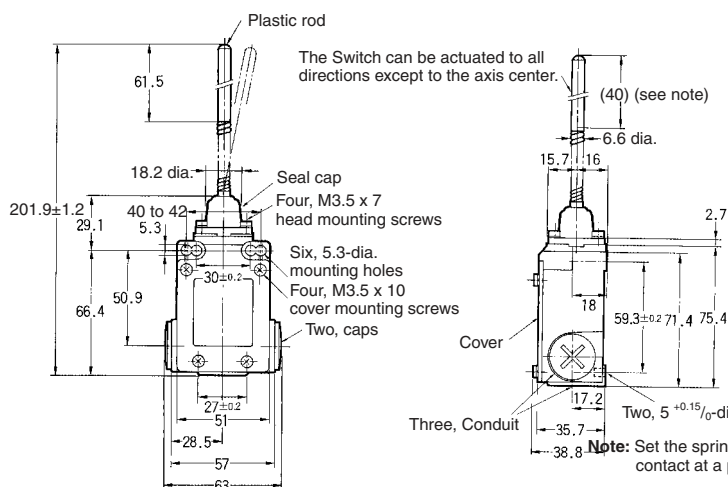
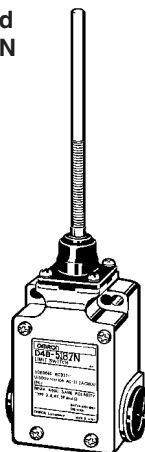


Coil Spring
D4B-□□81N



Note: Set the spring so that the dog comes in contact at a point 40 mm from the tip.

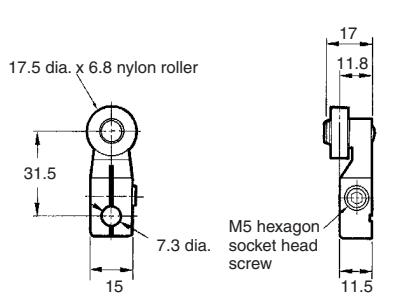
Plastic Rod
D4B-□□87N



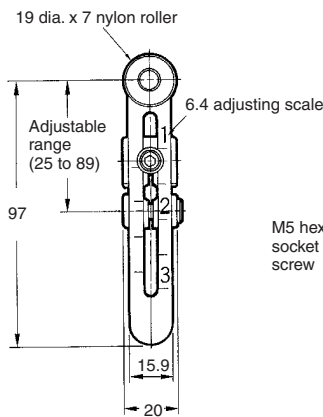
Note: Set the spring so that the dog comes in contact at a point 40 mm from the tip.

Levers

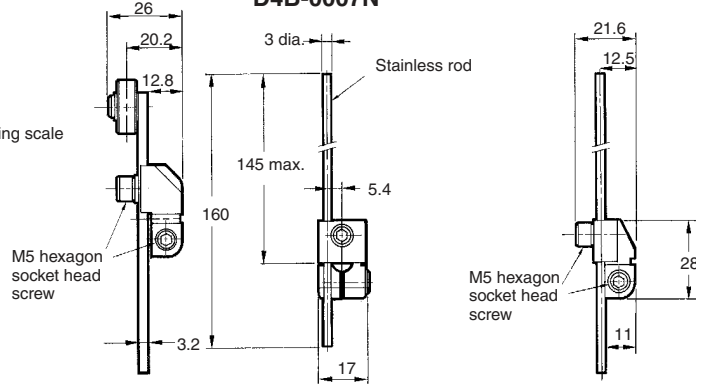
Roller Lever ■ mechanical form lock
D4B-0001N



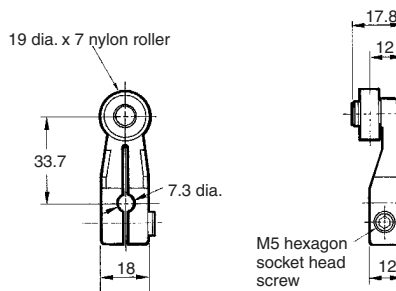
Adjustable Roller Lever
D4B-0006N



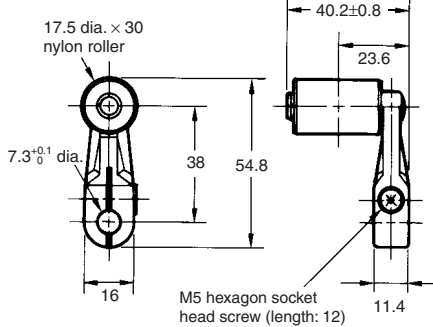
Adjustable Rod Lever
D4B-0007N



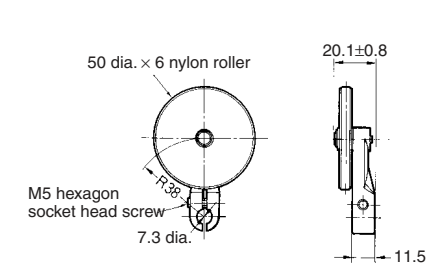
Roller Lever (compatible with previous D4B model)
D4B-000RN ■ mechanical form lock



Roller Lever
WL-1A118



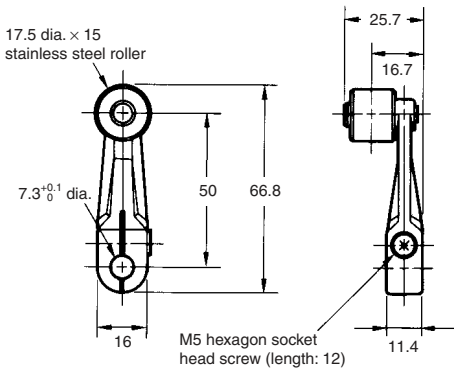
Roller Lever
WL-1A106



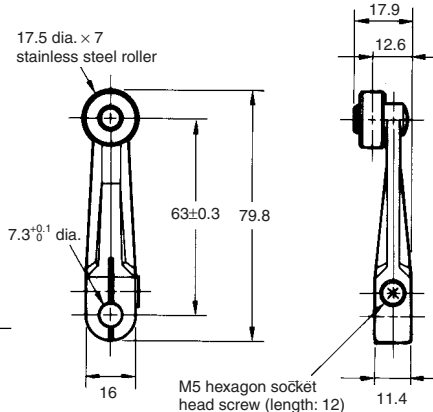
Note: Reverse the indicator plate when mounting.

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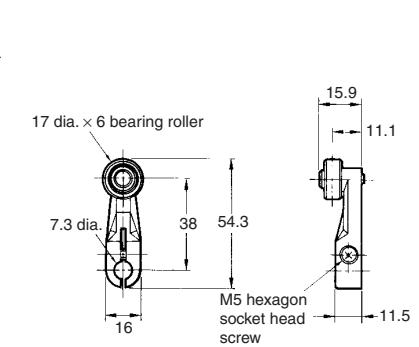
Roller Lever ■ mechanical form lock
WL-1A206



Roller Lever
WL-1A300



Roller Lever
WL-1A400

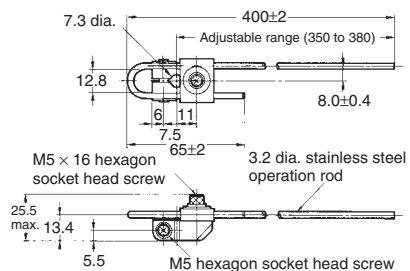


Note: Reverse the indicator plate when mounting.

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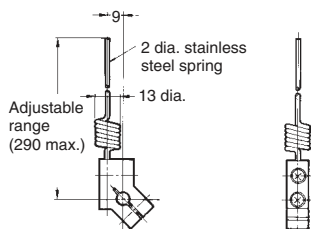
Note: Reverse the indicator plate when mounting.

**Adjustable Rod Lever
WL-3A100**



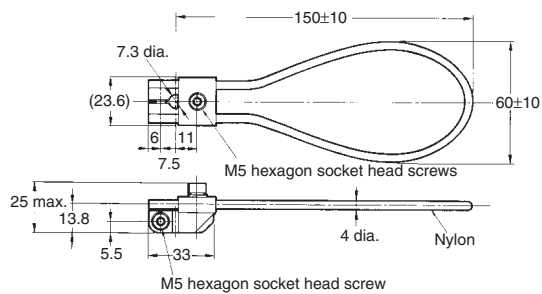
Note: Reverse the indicator plate when mounting.

**Spring Rod Lever
WL-4A201**



Note: Reverse the indicator plate when mounting.

**Resin Loop Lever
D4A-F00**



Note: Reverse the indicator plate when mounting.

- Note:** 1. Unless otherwise specified, a tolerance of ± 0.4 mm applies to all dimensions.
 2. Safety Limit Switch specifications are satisfied with D4B-□□□□AN Levers only.

Precautions

If the D4B-□N is applied to a safety category circuit for prevention of injury, use the D4B-□N model that has an NC contact equipped with a direct opening mechanism, and make sure that the D4B-□N operates in the direct opening mode. Furthermore, secure the D4B-□N with screws or equivalent parts that are tightened in a single direction so that the D4B-□N cannot be easily removed. Then provide a protection cover for the D4B-□N and post a warning label near the D4B-□N.

In order to protect the D4B-□N from damage due to short-circuiting, connect a fuse breaking a current 1.5 to 2 times higher than the rated current in parallel with the D4B-□N.

If an application satisfying EN standards is to employ the D4BL, apply the 10-A gl or gG fuse approved by IEC269.

Do not apply the D4B-□N to the door without applying a stopper to the door.

If the D4B-□N is used with the actuator normally pressed, the D4B-□N may malfunction or may soon have reset failures. Be sure to check and replace the D4B-□N regularly.

Correct Use

Operating Environment

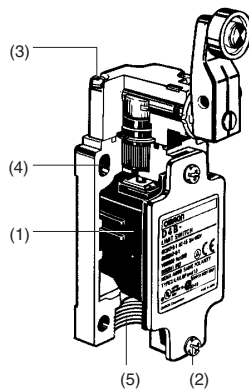
The D4B-□N is for indoor use. The D4B-□N may malfunction if the D4B-□N is used outdoors. Be sure to use a model with a lever-type actuator for outdoor use instead.

Do not use the D4B-□N in the following locations:

- Locations subject to severe temperature changes
- Locations subject to high temperatures or condensation
- Locations subject to severe vibration
- Locations where the product may come in contact with metal dust, oil, or chemicals

Tightening Torque

Be sure to tighten each screw of the D4B-□N properly, otherwise the D4B-□N may malfunction.



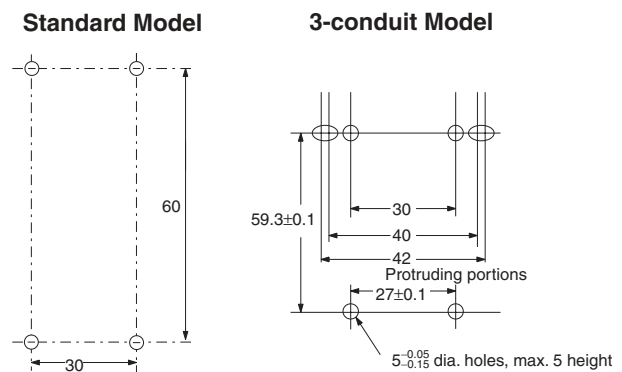
	Type	Torque
1	M3.5 terminal screw	0.59 to 0.78 N·m
2	Cover-mounting screw (see note)	1.18 to 1.37 N·m
3	Head mounting screw	0.78 to 0.98 N·m
4	M5 body mounting screw	4.90 to 5.88 N·m
5	Connector	1.77 to 2.16 N·m
6	Cap screw (for three-conduit models)	1.27 to 1.67 N·m

Note: Apply a tightening torque of 0.78 to 0.88 N·m to conduit models.

Mounting

Use four M5 screws with washers to mount the standard model. Be sure to apply the proper torque to tighten each screw. The D4B-□N can be mounted more securely by using the four screws plus two $5^{-0.05}/_{-0.15}$ -mm protruding parts, each of which has a maximum height of 4.8 mm as shown below.

Mounting Dimensions (M5)



Changes in Actuator Mounting Position

To change the angle of the lever, loosen the Allen-head bolts on the side of the lever.

The operating position indicator plate has protruding parts which engage with the lever, thus allowing changes to the lever position by 90°.

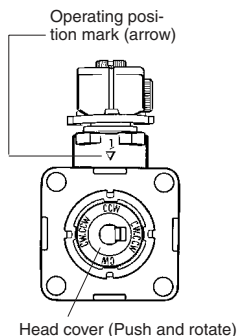
The back of the operating position indicator plate has no protruding parts. The lever can be set at any angle by attaching the operating position indicator plate to the Switch so that this side will face the lever. In this case, however, the D4B-□N will not be approved by SUVA or BIA. Make sure that the lever engages with the operating position indicator plate securely so that the lever will not slip.

Changes in Head Mounting Position

By removing the screws on the four corners of the head, the head can be reset in any of four directions. Make sure that no foreign materials will penetrate through the head.

CW, CCW or Two-way Operation

The head of Side Rotary Switches can be converted in seconds to CW, CCW, or two-way operation. The conversion procedure follows.



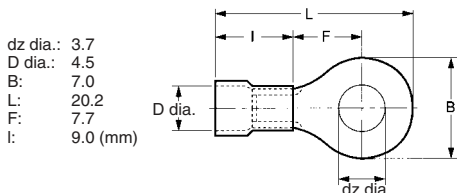
Procedure

1. Dismount the head by loosening the four screws that secure it.
2. Turn over the head to set the desired operation (CW, CCW, or both). The desired operation can be selected by setting the mode selector knob shown in the figure. This knob is factory set to the "CW + CCW" (two-way operation) position.
3. Set the CW hole on the head at the operation position mark (arrow) for clockwise operation or set the CCW hole right at the arrow for counterclockwise operation. In either case, be sure to set the hole position exactly at the arrow point.

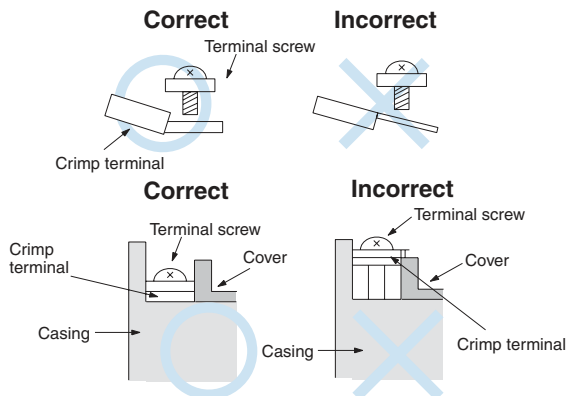
Wiring

Do not connect the bare lead wires directly to the terminals but be sure to connect each of them by using an insulation tube and M3.5 round crimp terminals and tighten each terminal screw within the specified torque range.

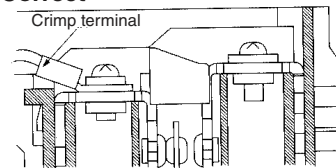
The proper lead wire is 20 to 14 AWG (0.5 to 2.5 mm²) in size.



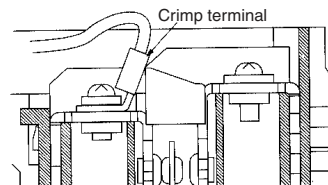
Make sure that all crimp terminals come into contact with the casing or cover as shown below, otherwise the cover may not be mounted properly or the D4B-□N may malfunction.



Correct



Incorrect



Connector

Make sure that each connector is tightened within the specified torque range. The casing may be damaged if the connector is tightened excessively.

If the 1/2-14NPT is used, cover the cable and conduit end with sealing tape in order to ensure IP67.

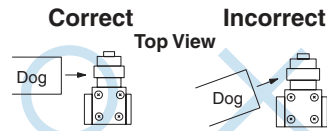
The Pg13.5 connector must be Nippon Flex's ABS-08Pg13.5 or ABS-12 Pg13.5.

Use OMRON's SC-series connector which is suited to the cable in diameter.

Properly attach the provided conduit cap to the unused conduit opening and securely tighten the cap screw within the specified torque when wiring the D4B-□N.

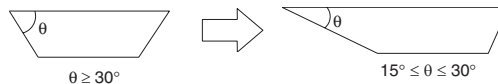
Others

The load for the actuator (roller) of the Switch must be imposed on the actuator in the horizontal direction, otherwise the actuator or the rotating axis may be deformed or damaged.



When using a long lever model like the D4B-□□16N or D4B-□□17N, the Switch may telegraph. To avoid telegraphing, take the following precautions.

1. Set the lever to operate in one direction. For details, see page G-257, CW, CCW or Two-way Operation.
2. Modify the rear end of the dog to an angle of 15° to 30° as shown below or to a secondary-degree curve.



3. Modify the circuit so as not to detect the wrong operating signals.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.