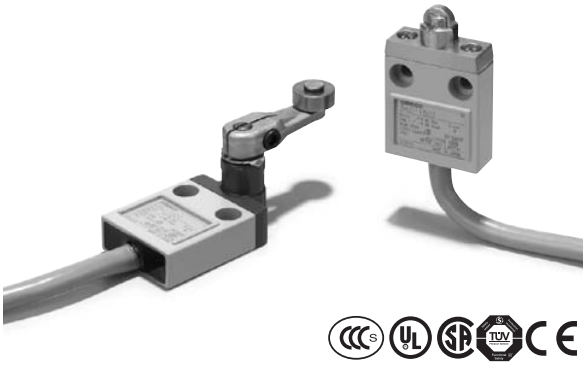
Enclosed Switch
D4C

Sealed, Compact, and Slim-bodied Switch Offers Choice of Many Actuators

- Liquid- and dust-resistance conforms to IEC IP67 standard.
- Triple-sealed construction:
  Plunger section sealed via nitrile rubber packing seal and diaphragm; switch section sealed via nitrile rubber cap; cable entrance sealed via encapsulating material.
- Standard cable (S-FLEX VCTF) in 3- or 5-meter lengths offers high flexibility with outstanding oil and extreme temperature resistance.
- Low temperature models are available.
- Approved by EN, UL, CSA, and CCC (Chinese standard).



Model Number Structure

■ Model Number Legend

Standard Models

D4C-□□□
1 2 3

1. Rated Current
- 1: 5 A at 250 VAC, 4 A at 30 VDC
- 2: 5 A at 125 VAC (with LED indicator)
- 3: 4 A 30 VDC (with LED indicator)
- 4: 0.1 A at 125 VAC, 0.1 A at 30 VDC
- 5: 0.1 A at 125 VAC (with LED indicator)
- 6: 0.1 A at 30 VDC (with LED indicator)

2. Cable Specifications
- 2: VCTF oil-resistant cable (3 m)
- 3: VCTF oil-resistant cable (5 m)
- 4: VCTF (3 m)
- 5: VCTF (5 m)
- 6: SJT(O) (3 m)
- 7: SJT(O) (5 m)

3. Actuator
- 01: Pin plunger
- 02: Roller plunger
- 03: Crossroller plunger
- 20: Roller lever
- 24: Roller lever (high-sensitivity model)
- 31: Sealed pin plunger
- 32: Sealed roller plunger
- 33: Sealed crossroller
- 50: Plastic rod
- 60: Center roller lever

Note: Some combinations of the above may not be supported.

Pre-wired Models (Use VCTF Oil-resistant Cable)

D4C-□0□□-□□□□□□
1 2 3 4

1. Operation Indicator Lamp
- 1: 1 A at 125 VAC, 1 A at 30 VDC (Without operation indicator)
- 2: 1 A at 125 VAC (with operation indicator)
- 3: 1 A at 30 VDC (with operation indicator)

2. Actuator
- 01: Pin plunger
- 02: Roller plunger
- 31: Sealed plunger
- 32: Sealed roller plunger
- 24: Roller lever (high-sensitivity model)

3. Wiring Specifications
- DK1EJ: Pre-wired models (3 conductors: DC specification, NC wiring)
- AK1EJ: Pre-wired models (3 conductors: AC specification, NC wiring)
- M1J: Connector models for ASI devices (2 conductors: NO wiring)

4. Cable length
- 03: 0.3 m

Wiring Specifications

Internal switch	Connector
COM	3
NC	2
NO	4

Note: Since the above wiring specifications are different from those for the D4CC, be careful not to mistake them.

Weather-resistant Models

D4C-□□□-P
1 2 3

1. Rated Current
- 1: 5 A at 250 VAC, 4 A at 30 VDC
- 2: 5 A at 125 VAC (with LED indicator)
- 3: 4 A at 30 VDC (with LED indicator)
- 4: 0.1 A at 125 VAC, 0.1 A at 30 VDC

2. Cable Specifications
- 2: VCTF oil-resistant cable (3 m)
- 3: VCTF oil-resistant cable (5 m)

3. Actuator
- 20: Roller lever
- 24: Roller lever (high-sensitivity model)
- 27: Variable roller lever
- 29: Variable rod lever

Ordering Information

■ List of Models

Standard Models

Switches with No Operation Indicator

Actuator	Ratings: Cable length (m)	Standard: 250 VAC, 5 A; 30 VDC 4 A — VCTF oil-resistance cable (See note 1.)	Standard: 250 VAC, 5 A; 30 VDC 4 A — VCTF cable (See note 5.)	Standard: 250 VAC, 5 A; 30 VDC 4 A — SJT(O) cable (See note 4.)	Microload: 125 VAC, 0.1 A; 30 VDC 0.1 A — VCTF oil-resistance cable (See note 1.)	Microload: 125 VAC, 0.1 A; 30 VDC 0.1 A — VCTF cable (See note 5.)
Pin plunger	3	D4C-1201	D4C-1401	D4C-1601	D4C-4201	D4C-4401
	5	D4C-1301	D4C-1501	D4C-1701	D4C-4301	D4C-4501
Roller plunger	3	D4C-1202	D4C-1402	D4C-1602	D4C-4202	D4C-4402
	5	D4C-1302	D4C-1502	D4C-1702	D4C-4302	D4C-4502
Crossroller plunger	3	D4C-1203	D4C-1403	D4C-1603	D4C-4203	D4C-4403
	5	D4C-1303	D4C-1503	D4C-1703	D4C-4303	D4C-4503
Roller lever	3	D4C-1220	D4C-1420	D4C-1620	D4C-4220	D4C-4420
	5	D4C-1320	D4C-1520	D4C-1720	D4C-4320	D4C-4520
Roller lever, high-sensitivity	3	D4C-1224	D4C-1424	D4C-1624	D4C-4224	D4C-4424
	5	D4C-1324	D4C-1524	D4C-1724	D4C-4324	D4C-4524
Sealed pin plunger	3	D4C-1231	D4C-1431	D4C-1631	D4C-4231	D4C-4431
	5	D4C-1331	D4C-1531	D4C-1731	D4C-4331	D4C-4531
Sealed roller plunger	3	D4C-1232	D4C-1432	D4C-1632	D4C-4232	D4C-4432
	5	D4C-1332	D4C-1532	D4C-1732	D4C-4332	D4C-4532
Sealed crossroller plunger	3	D4C-1233	D4C-1433	D4C-1633	D4C-4233	D4C-4433
	5	D4C-1333	D4C-1533	D4C-1733	D4C-4333	D4C-4533
Plastic rod	3	D4C-1250	D4C-1450	D4C-1650	D4C-4250	D4C-4450
	5	D4C-1350	D4C-1550	D4C-1750	D4C-4350	D4C-4550
Center roller lever	3	D4C-1260	D4C-1460	D4C-1660	D4C-4260	D4C-4460
	5	D4C-1360	D4C-1560	D4C-1760	D4C-4360	D4C-4560

Note 1. Models are available separately with resistance to viscous oils (oil drain holes are also available), but only with Plunger Models. Add "-M" to the model number (example: D4C-1202 would be D4C-1202-M).

2. Oil-resistant vinyl cabtire cables; approved by EN and IEC.

3. Ordinary vinyl cabtire cables.

4. Switches with SJT(O) Cables (cables approved by UL and CSA) are approved by UL and CSA.

5. Switches with variable roller levers are also available. Ask your nearest OMRON representative for details.

Standard Switches with Operation Indicator (Red)

Actuator	Ratings: Cable length (m)	125 VAC, 0.1 A: VCTF oil-resistance cable (See note 1.)	125 VAC, 0.1 A: VCTF cable (See note 2.)	30 VDC 0.1 A: VCTF oil-resistance cable (See note 1.)	30 VDC 0.1 A: VCTF cable (See note 2.)
Pin plunger 	3	D4C-2201	D4C-2401	D4C-3201	D4C-3401
	5	D4C-2301	D4C-2501	D4C-3301	D4C-3501
Roller plunger 	3	D4C-2202	D4C-2402	D4C-3202	D4C-3402
	5	D4C-2302	D4C-2502	D4C-3302	D4C-3502
Crossroller plunger 	3	D4C-2203	D4C-2403	D4C-3203	D4C-3403
	5	D4C-2303	D4C-2503	D4C-3303	D4C-3503
Roller lever 	3	D4C-2220	D4C-2420	D4C-3220	D4C-3420
	5	D4C-2320	D4C-2520	D4C-3320	D4C-3520
Roller lever, high-sensitivity 	3	D4C-2224	D4C-2424	D4C-3224	D4C-3424
	5	D4C-2324	D4C-2524	D4C-3324	D4C-3524
Sealed pin plunger 	3	D4C-2231	D4C-2431	D4C-3231	D4C-3431
	5	D4C-2331	D4C-2531	D4C-3331	D4C-3531
Sealed roller plunger 	3	D4C-2232	D4C-2432	D4C-3232	D4C-3432
	5	D4C-2332	D4C-2532	D4C-3332	D4C-3532
Sealed crossroller plunger 	3	D4C-2233	D4C-2433	D4C-3233	D4C-3433
	5	D4C-2333	D4C-2533	D4C-3333	D4C-3533
Plastic rod 	3	D4C-2250	D4C-2450	D4C-3250	D4C-3450
	5	D4C-2350	D4C-2550	D4C-3350	D4C-3550
Center roller lever 	3	D4C-2260	D4C-2460	D4C-3260	D4C-3460
	5	D4C-2360	D4C-2560	D4C-3360	D4C-3560

Note 1. Oil-resistant vinyl cabtire cables; approved by EN and IEC.

2. Ordinary vinyl cabtire cables.

3. Switches with SJT(O) Cables (cables approved by UL and CSA) are approved by UL and CSA.

4. Ask your nearest OMRON representative for information on Switching with approved international standards.

Micro-load Switches with Operation Indicator

Actuator	Ratings Cable Cable length (m)	125 VAC, 0.1 A VCTF oil-resistance cable (See note 1.)	30 VDC 0.1 A VCTF oil-resistance cable (See note 1.)
Pin plunger 	3	D4C-5201	D4C-6201
	5	D4C-5301	D4C-6301
Roller plunger 	3	D4C-5202	D4C-6202
	5	D4C-5302	D4C-6302
Crossroller plunger 	3	D4C-5203	D4C-6203
	5	D4C-5303	D4C-6303
Roller lever 	3	D4C-5220	D4C-6220
	5	D4C-5320	D4C-6320
Roller lever, high-sensitivity 	3	D4C-5224	D4C-6224
	5	D4C-5324	D4C-6324
Sealed pin plunger 	3	---	D4C-6231
	5	---	D4C-6331
Sealed roller plunger 	3	D4C-5232	D4C-6232
	5	D4C-5332	D4C-6332
Sealed crossroller plunger 	3	---	D4C-6233
	5	---	D4C-6333
Plastic rod 	3	D4C-5250	D4C-6250
	5	D4C-5350	D4C-6350

Note 1. Oil-resistant vinyl cabtire cables; approved by EN and IEC.

2. Ask your nearest OMRON representative for information on Switching with approved international standards.

Pre-wired Models (Use VCTF Oil-resistant Cable)

Actuator	1 A at 125 VAC without operation indicator	1 A at 125 VAC with operation indicator	1 A at 30 VDC without operation indicator	1 A at 30 VDC with operation indicator
Pin plunger 	D4C-1001-AK1EJ□	D4C-2001-AK1EJ□	D4C-1001-DK1EJ□	D4C-3001-DK1EJ□
Roller plunger 	D4C-1002-AK1EJ□	D4C-2002-AK1EJ□	D4C-1002-DK1EJ□	D4C-3002-DK1EJ□
Sealed plunger 	D4C-1031-AK1EJ□	D4C-2031-AK1EJ□	D4C-1031-DK1EJ□	D4C-3031-DK1EJ□
Sealed roller plunger 	D4C-1032-AK1EJ□	D4C-2032-AK1EJ□	D4C-1032-DK1EJ□	D4C-3032-DK1EJ□
Roller lever (high-sensitivity model) 	D4C-1024-AK1EJ□	D4C-2024-AK1EJ□	D4C-1024-DK1EJ□	D4C-3024-DK1EJ□

Note 1. The □ contains the length of the cable.
For example: 30 cm → D4C-1001-AK1EJ03

2. M1J models are also available. Contact your OMRON sales representative for further information.

3. Of the above model numbers, some with special specifications are not registered.

Weather-resistant Models

Actuator		5 A at 250 VAC 4 A at 30 VDC without operation indicator	0.1 A at 125 VAC 0.1 A at 30 VDC without operation indicator	5 A at 125 VAC with operation indicator	4 A at 30 VDC with operation indicator
Roller lever 	3 m	D4C-1220-P	D4C-4220-P	D4C-2220-P	D4C-3220-P
	5 m	D4C-1320-P	---	---	---
Roller lever (high-sensitivity model) 	3 m	D4C-1224-P	D4C-4224-P	D4C-2224-P	D4C-3224-P
	5 m	D4C-1324-P	D4C-4324-P	D4C-2324-P	D4C-3324-P
Variable roller lever 	3 m	D4C-1227-P	D4C-4227-P	D4C-2227-P	D4C-3227-P
	5 m	D4C-1327-P	D4C-4327-P	D4C-2327-P	D4C-3327-P
Variable rod lever 	3 m	D4C-1229-P	D4C-4229-P	---	D4C-3229-P
	5 m	D4C-1329-P	---	D4C-2329-P	D4C-3329-P

Note: Silicon rubber is used to increase resistance to the environment. Silicon rubber, however, can generate silicon gas. (This can occur at room temperature, but the amount of silicon gas generated increases at higher temperatures.) Silicon gas will react as a result of arc energy and form silicon oxide (SiO_2). If silicon oxide accumulates on the contacts, contact interference can occur and can interfere with the device. Before using a Switch, test it under actual application conditions (including the environment and operating frequency) to confirm that no problems will occur in actual.

Individual Parts (Head/Actuator)

Actuator type	Head (with actuator)	Actuator
Pin plunger	D4C-0001	-
Roller plunger	D4C-0002	-
Crossroller plunger	D4C-0003	-
Roller lever	D4C-0020	WL-1A100
Environment-resistant roller lever	D4C-0020-P	WL-1A100P1
Roller lever	D4C-0024	WL-1A100
Variable roller lever	D4C-0027	HL-1HPA320
Variable rod lever	D4C-0029	HL-1HPA500
Sealed pin plunger	D4C-0031	-
Sealed roller plunger	D4C-0032	-
Sealed crossroller plunger	D4C-0033	-
Plastic rod	D4C-0050	-
Center roller lever	D4C-0060	-

Note 1: The model numbers for heads are of the form D4C-00□□, with the numbers in the squares indicating the type of actuator.

2. Actuators for plunger models, plastic rod models, and center roller lever models cannot be ordered individually. They must be ordered together with the head.

3. Consult your OMRON representative for details on cold-resistant specifications.

Mounting Plates

The WL model incorporated by equipment can be replaced with the D4C together with the Mounting Plate without changing the position of the dog or cam.

List of Replaceable Models

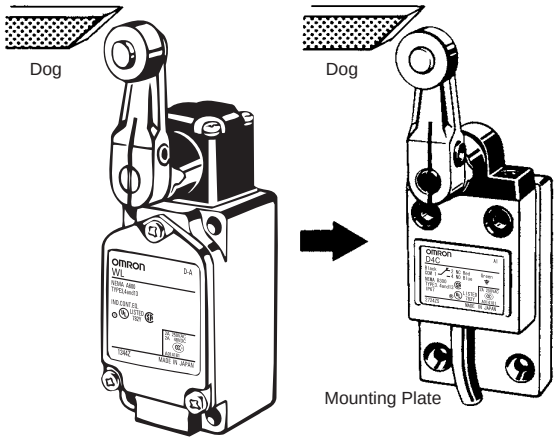
Contact your OMRON representative for the period required for delivery.

WL model (Actuator)	D4C model (Actuator)	Plate
WLD/WL01D (Top plunger)	→D4C-□□01 (Plunger)	D4C-P001
WLD2/WL01D2 (Top-roller plunger)	→D4C-□□02 (Roller plunger)	D4C-P002
WLCA2/WL01CA2 (Roller lever)	→D4C-□□20 (Roller lever)	D4C-P020

Note: The WL01□ is for micro loads.

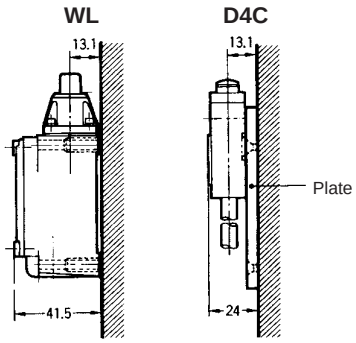
Application Example

Note: The position of the dog remains unchanged.



Remarks

There is no difference in mounting pitch between the Mounting Plate and the WL. The mounting depth of the D4C with the Mounting Plate attached is, however, shorter than that of the panel-mounted WL.



Specifications

■ Approved Standards

Agency	Standard	File No.
TÜV Product Service	EN60947-5-1	B03 08 39656 056 (see note 1) B03 08 39656 057 (see note 2)
UL	UL508	E76675 (see note 3)
CSA	CSA C22.2 No. 14	LR45746 (see note 3)
CCC (CQC)	GB14048.5	2003010305077626 (see note 4)

Note 1: Models with VCTF oil-resistant cables only.
2. Pre-wired models only.
3. SJT(0)-cable models only.
4. Ask your OMRON representative for information on approved models.

■ Approved Standard Ratings

UL/CSA

B300 (D4C-16□□, -17□□), B150 (D4C-26□□, -27□□)

NEMA B300 (D4C-16□□, -17□□)

Rated voltage	Carry current	Current		Volt-amperes	
		Make	Break	Make	Break
120 VAC	5 A	30 A	3 A	3,600 VA	360 VA
240 VAC		15 A	1.5 A	3,600 VA	360 VA

NEMA B150 (D4C-26□□, -27□□)

Rated voltage	Carry current	Current		Volt-amperes	
		Make	Break	Make	Break
120 VAC	5 A	30 A	3 A	3,600 VA	360 VA

TÜV (EN60947-5-1), CCC (GB14048.5)

Model	Applicable category and ratings	I the
D4C-1□□□	AC-15 2 A/250 VAC DC-12 2 A/30 VDC	5 A 4 A
D4C-2□□□	AC-15 2 A/125 VAC	5 A
D4C-3□□□	DC-12 2 A/30 VDC	4 A
D4C-4□□□	AC-14 0.1 A/125 VAC DC-12 0.1 A/30 VDC	0.5 A 0.5 A
D4C-5□□□	AC-14 0.1 A/125 VAC	0.5 A
D4C-6□□□	DC-12 0.1 A/30 VDC	0.5 A

■ General Ratings

Model	Rated voltage	Non-inductive load				Inductive load				Inrush current	
		Resistive load		Lamp load		Inductive load		Motor load			
		NC	NO	NC	NO	NC	NO	NC	NO	NC	NO
D4C-1□□□	125 VAC	5 A	5 A	1.5 A	0.7 A	3 A	3 A	2.5 A	1.3 A	20 A max.	10 A max.
	250 VAC	5 A	5 A	1 A	0.5 A	2 A	2 A	1.5 A	0.8 A		
	8 VDC	5 A	5 A	2 A	2 A	5 A	4 A	3 A	3 A		
	14 VDC	5 A	5 A	2 A	2 A	4 A	4 A	3 A	3 A		
	30 VDC	4 A	4 A	2 A	2 A	3 A	3 A	3 A	3 A		
	125 VDC	0.4 A	0.4 A	0.05 A	0.05 A	0.4 A	0.4 A	0.05 A	0.05 A		
	250 VDC	0.2 A	0.2 A	0.03 A	0.03 A	0.2 A	0.2 A	0.03 A	0.03 A		
D4C-2□□□	125 VAC	5 A	5 A	1.5 A	0.7 A	3 A	3 A	2.5 A	1.3 A		
	125 VDC	0.4 A	0.4 A	0.05 A	0.05 A	0.4 A	0.4 A	0.05 A	0.05 A		
D4C-3□□□	30 VDC	4 A	4 A	2 A	2 A	3 A	3 A	3 A	3 A		
D4C-4□□□	125 VAC	0.1 A	0.1 A	---		---					
	8 VDC	0.1 A	0.1 A								
	14 VDC	0.1 A	0.1 A								
	30 VDC	0.1 A	0.1 A								
D4C-5□□□	125 VAC	0.1 A	0.1 A	---		---					
D4C-6□□□	30 VDC	0.1 A	0.1 A	---		---					

Ratings for Pre-wired Models

Rated voltage	Non-inductive load				Inductive load				Inrush current	
	Resistive load		Lamp load		Inductive load		Motor load			
	NC	NO	NC	NO	NC	NO	NC	NO	NC	NO
125 VAC	1	1	1	0.7	1	1	1	1	20 A max.	10 A max.
30 VDC	1	1	1	1	1	1	1	1		

Note 1. Inductive loads have a power factor of 0.4 min. (AC) and a time constant of 7 ms max. (DC).

2. Lamp loads have an inrush current of 10 times the steady-state current.

3. Motor loads have an inrush current of 6 times the steady-state current.

■ Characteristics

Degree of protection	IP67
Durability (see note 2)	Mechanical: 10,000,000 operations min. (see note 4) Electrical: 200,000 operations min. (5A at 250 VAC, resistive load) (see note 3)
Operating speed	0.1 mm to 0.5 m/s (in case of plunger) 1 mm to 1 m/s (in case of roller lever)
Operating frequency	Mechanical: 120 operations/min Electrical: 30 operations/min
Rated frequency	50/60 Hz
Insulation resistance	100 MΩ min. (at 500 VDC)
Contact resistance (initial)	250 mΩ max. (initial value with 2-m VCTF cable) 300 mΩ max. (initial value with 3-m VCTF cable) 400 mΩ max. (initial value with 5-m VCTF cable)
Dielectric strength	1,000 VAC, 50/60 Hz for 1 min between terminals of the same polarity 1,500 VAC, 50/60 Hz for 1 min between current-carrying metal part and ground, and between each terminal and non-current-carrying metal part, Uimp: 2.5 kV (EN60947-5-1)
Rated insulation voltage (U_i)	300 V (EN60947-5-1)
Switching overvoltage	1,000 VAC, 300 VDC max. (EN60947-5-1)
Pollution degree (operating environment)	3 (IEC60947-5-1)
Short-circuit protective device (SCPD)	10 A fuse type gI or gG (IEC269)
Conditional short-circuit current	100 A (EN60947-5-1)
Conventional enclosed thermal current (I_{the})	5 A, 4 A, 0.5 A (EN60947-5-1)
Protection against electric shock	Class I (with grounding wire)
Vibration resistance	Malfunction: 10 to 55 Hz, 1.5-mm double amplitude (see note 5)
Shock resistance	Destruction: Approx. 1,000 m/s^2 min. Malfunction: Approx. 500 m/s^2 min. (see note 5)
Ambient temperature (see note)	Operating: –10°C to 70°C (with no icing)
Ambient humidity	Operating: 35% to 95%
Weight (D4C-1202)	With 3-m VCTF cable: 360 g; With 5-m VCTF cable: 540 g

Note 1. The above figures are initial values.

2. The values are calculated at an operating temperature of 5°C to 35°C, and an operating humidity of 40% to 70%. Contact your OMRON sales representative for more detailed information on other operating environments.

3. Prewired Connector Models: 1,000,000 operations min. (DC specifications, switching current: 0.1 A)

4. Outdoor specifications: 500,000 operations min.

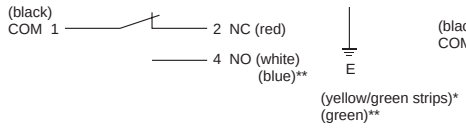
5. Excluding Plastic Rods.

Connections

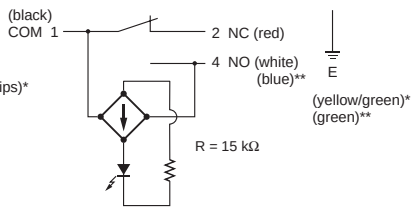
■ Contact Form

Standard Models/Weather-resistant Models

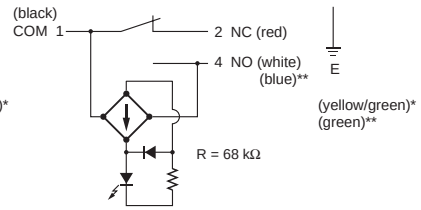
Without Operation Indicator



With 24 VDC LED Operation Indicator (Lit when Not Actuated)



With 100 VAC LED Operation Indicator (Lit when Not Actuated)



* Yellow/green: VCTF oil-resistant cable
Green: VCTF cable

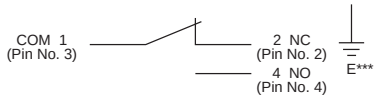
** SJT(O) cable approved by UL and CSA.

Note 1. "Lit when operated" means that when the actuator is turned or pushed and the Limit Switch contact leaves the NC side, the indicator lights.

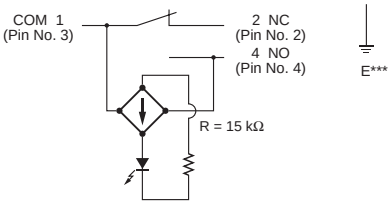
2. "Lit when not in operation" means that when the actuator is in the free position, the indicator is lit, and when the actuator is turned or pushed and the contact comes into contact with the NO side, the indicator turns OFF.

Pre-wired Models (-AK1EJ□, -DK1EJ□)

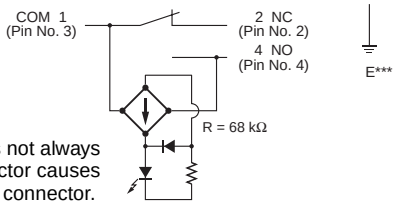
Without Operation Indicator



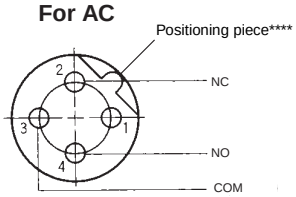
With 24 VDC LED Operation Indicator (Lit when Not Actuated)



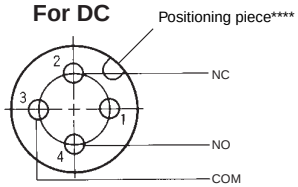
With 100 VAC LED Operation Indicator (Lit when Not Actuated)



For AC



For DC

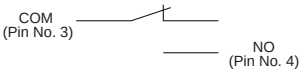


*** E (ground) is not grounded.

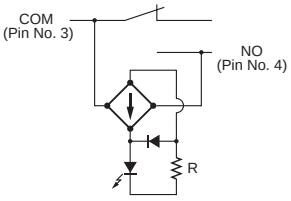
**** The position of the positioning piece is not always the same. If using an L-shaped connector causes problems in application, use a straight connector.

Connector Models for ASI Devices (-M1J)

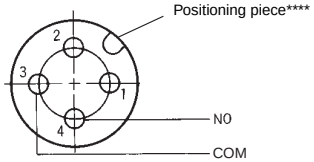
Without Operation Indicator



With Operation Indicator (Lit when Not Actuated)



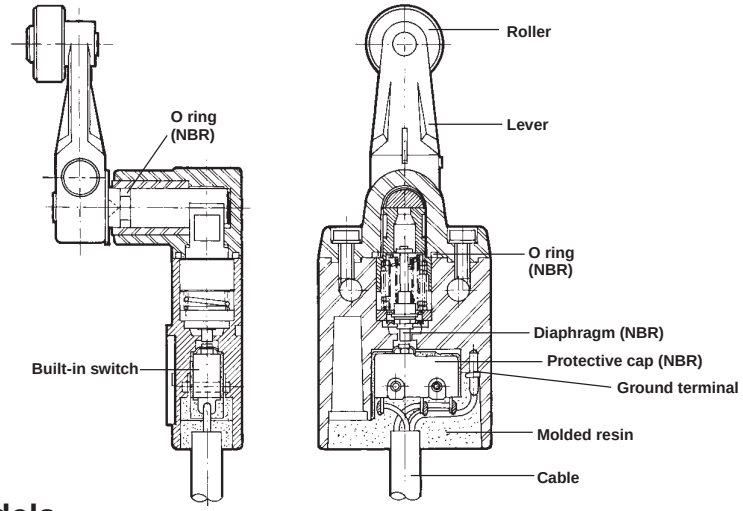
For DC



Nomenclature

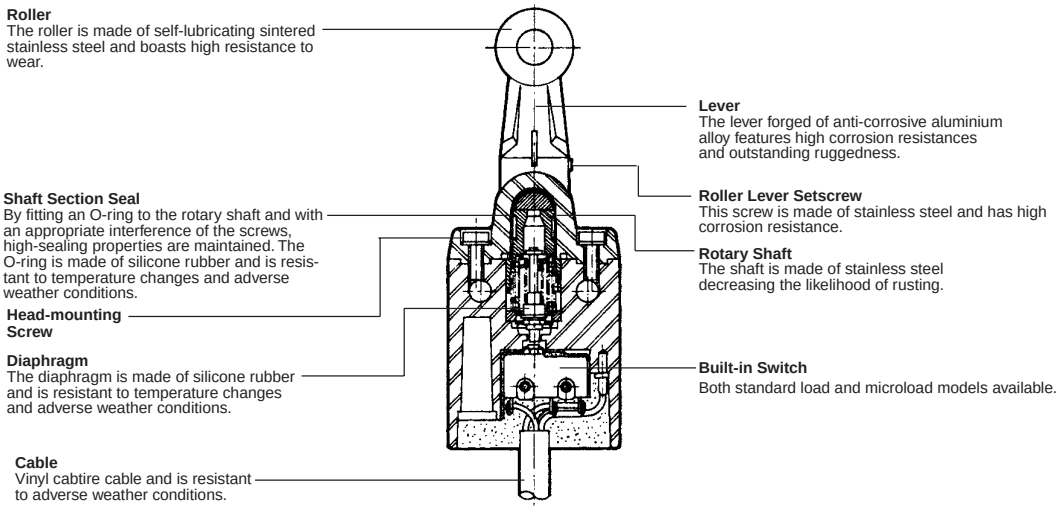
Standard Models

Roller Lever Models Without Indicator



Weather-resistant Models

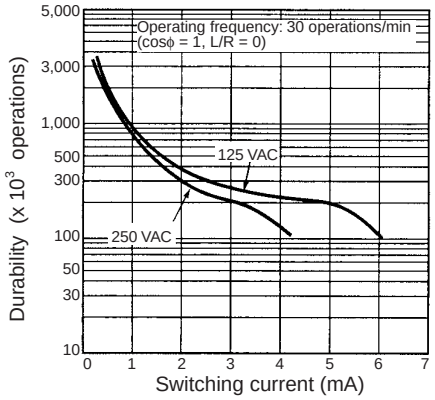
Roller Lever Models Without Indicator



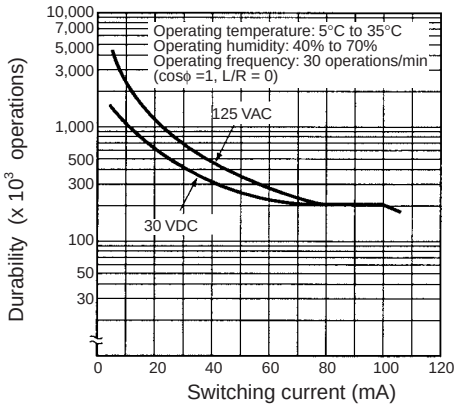
Engineering Data

■ Electrical Durability

D4C-1□□□, -2□□□, -3□□□



D4C-4□□□, -5□□□, -6□□□



■ Leakage Current for LED-indicator Models

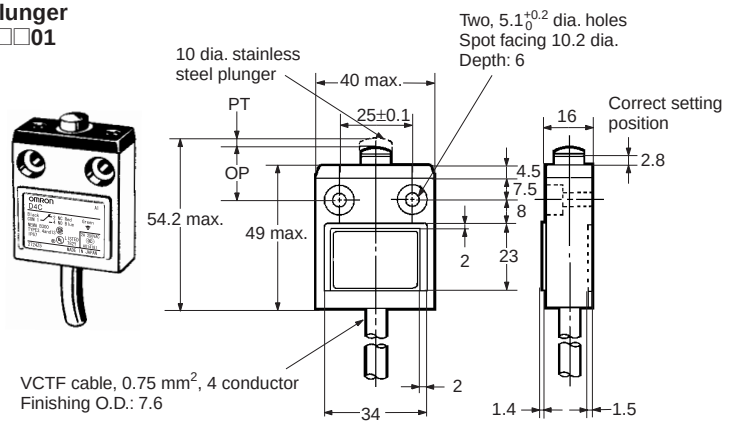
Model	Voltage	Leakage current	Resistance
D4C-2□□□	125 VAC	1.7 mA	68 kΩ
D4C-3□□□	30 VDC	1.7 mA	15 kΩ
D4C-5□□□	125 VAC	1.7 mA	68 kΩ
D4C-6□□□	30 VDC	1.7 mA	15 kΩ

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.

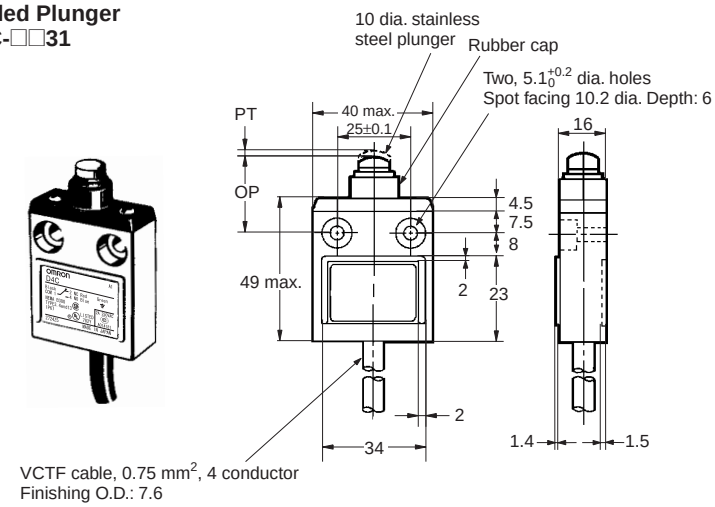
Standard Models

Pin Plunger
D4C-□□01



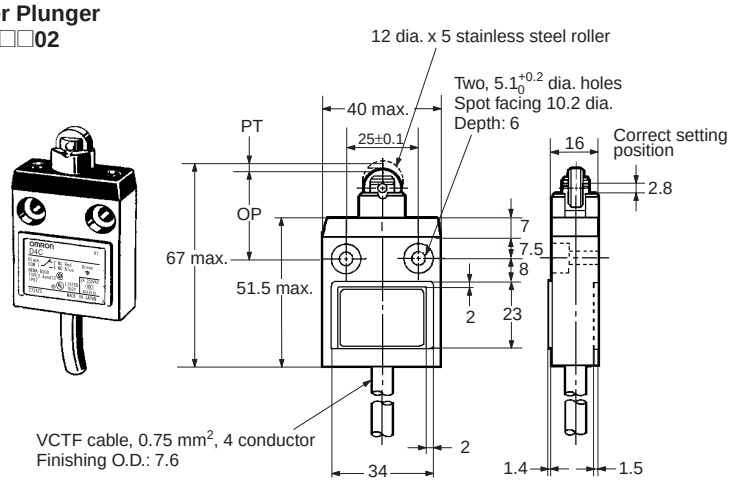
Model	D4C-□□01
OF max.	11.77 N
RF min.	4.41 N
PT max.	1.8 mm
OT min.	3 mm
MD max.	0.2 mm
OP	15.7±1 mm
TT	(5) mm

Sealed Plunger
D4C-□□31



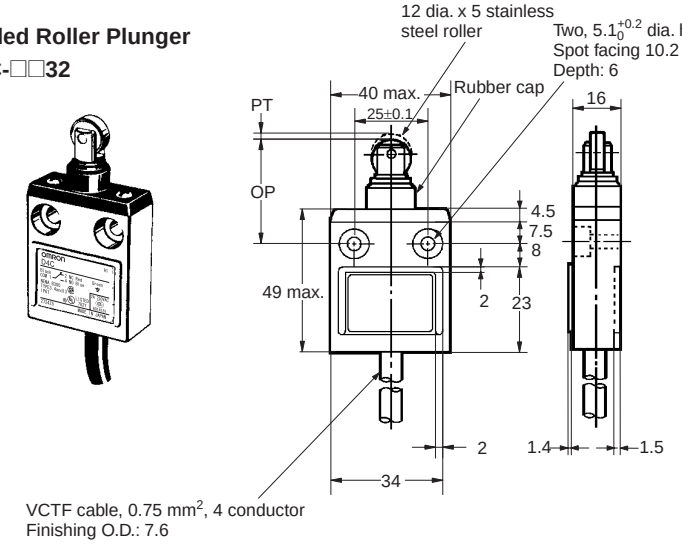
Model	D4C-□□31
OF max.	17.65 N
RF min.	4.41 N
PT max.	1.8 mm
OT min.	3 mm
MD max.	0.2 mm
OP	24.9±1 mm
TT	(5) mm

Roller Plunger
D4C-□□02



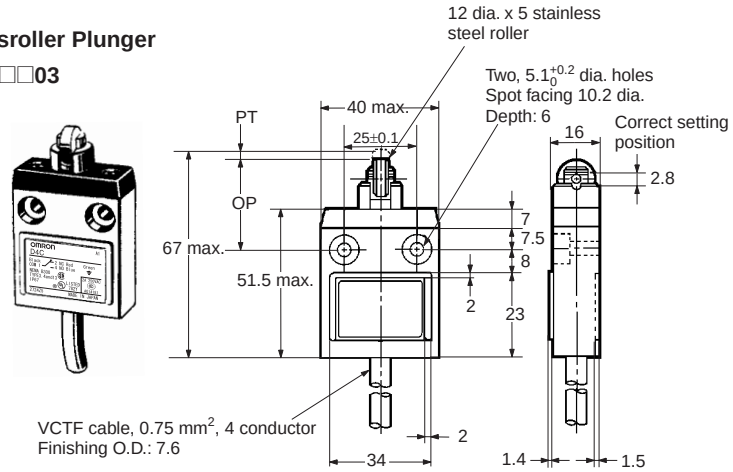
Model	D4C-□□02
OF max.	11.77 N
RF min.	4.41 N
PT max.	1.8 mm
OT min.	3 mm
MD max.	0.2 mm
OP	28.5±1 mm
TT	(5) mm

Sealed Roller Plunger
D4C-□□32



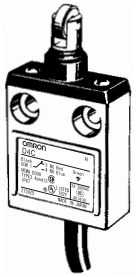
Model	D4C-□□32
OF max.	17.65 N
RF min.	4.41 N
PT max.	1.8 mm
OT min.	3 mm
MD max.	0.2 mm
OP	34.3±1 mm
TT	(5) mm

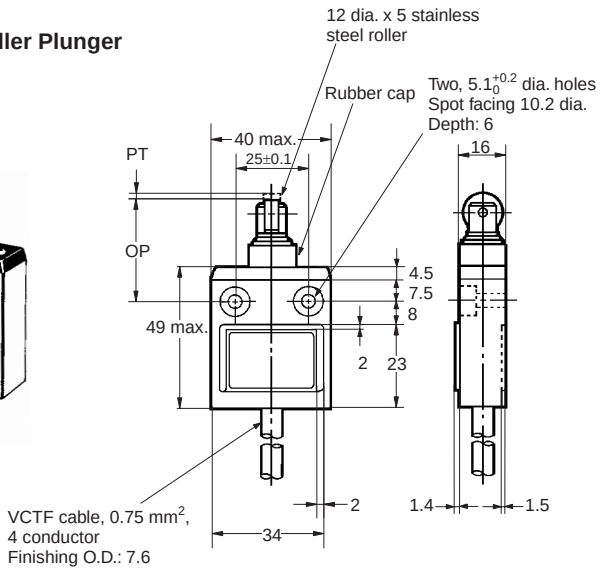
Crossroller Plunger
D4C-□□03



Model	D4C-□□03
OF max.	6.86 N
RF min.	2.45 N
PT max.	1.8 mm
OT min.	3 mm
MD max.	0.2 mm
OP	28.5±1 mm
TT	(5) mm

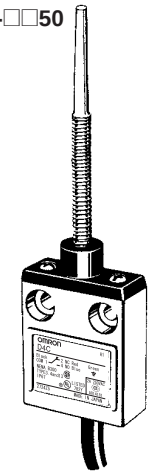
Sealed Crossroller Plunger
D4C-□□33

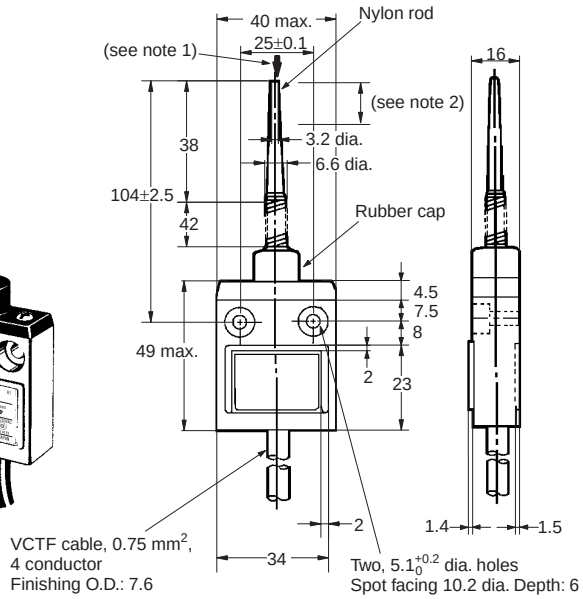




Model	D4C-□□33
OF max.	17.65 N
RF min.	4.41 N
PT max.	1.8 mm
OT min.	3 mm
MD max.	0.2 mm
OP	34.3±1 mm
TT	(5) mm

Coil Spring
D4C-□□50





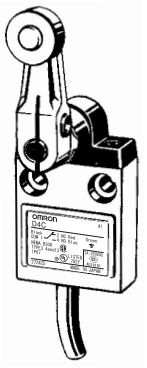
Model	D4C-□□50
OF max.	1.47 N
RF min.	---
PT max.	15°
OT min.	---
MD max.	---
OP	---
TT	---

Note 1: Operation is possible in any direction except in parallel to the axis.

2. The ideal range for operation is between the tip of the rod and 1/3 of the length of the actuator.

Roller Lever

D4C-□□20
D4C-□□20-P

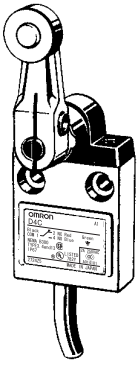


Note: S-FLEX VCTF Cables are used for weather-resistant models (D4C-P).

Model	D4C-□□20 D4C-□□20-P
OF max.	5.69 N
RF min.	1.47 N
PT max.	25°
OT min.	40°
MD max.	3°
OP	---
TT	(70°)

Roller Lever (High-Sensitivity Model)

D4C-□□24
D4C-□□24-P

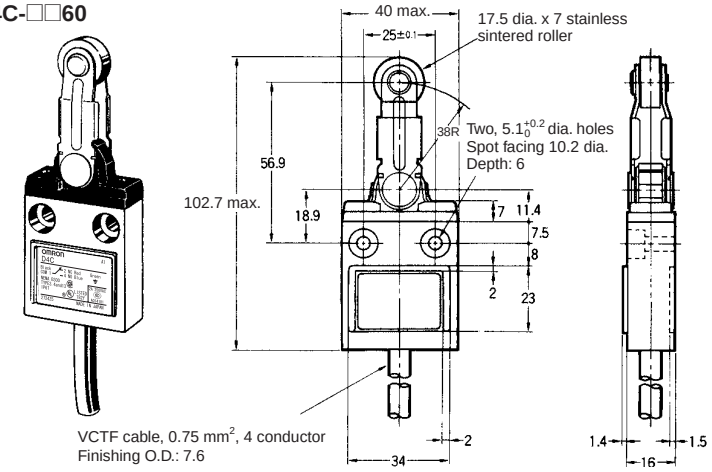


Note: S-FLEX VCTF Cables are used for weather-resistant models (D4C-P).

Model	D4C-□□24 D4C-□□24-P
OF max.	5.69 N
RF min.	1.47 N
PT max.	10±3°
OT min.	50°
MD max.	3°
OP	---
TT	(70°)

Center Roller Lever Plunger

D4C-□□60

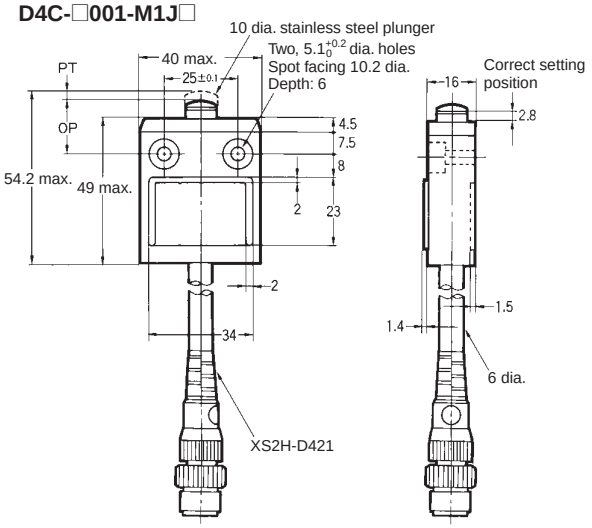


Model	D4C-□□60
OF max.	6.67 N
RF min.	1.47 N
PT max.	10±3°
OT min.	50°
MD max.	3°
OP	---
TT	---

Pre-wired Models

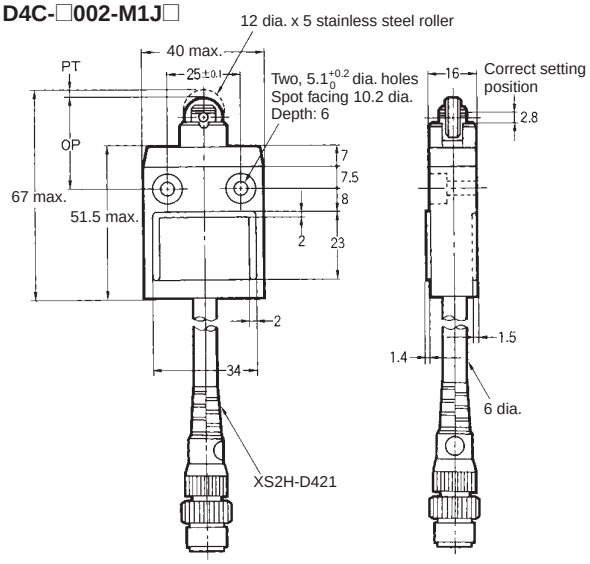
Pin Plunger

D4C-□001-□K1EJ□
D4C-□001-M1J□



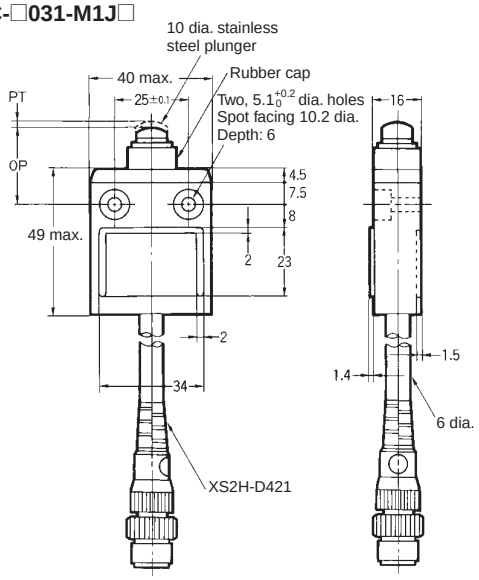
Roller Plunger

D4C-□002-□K1EJ□
D4C-□002-M1J□



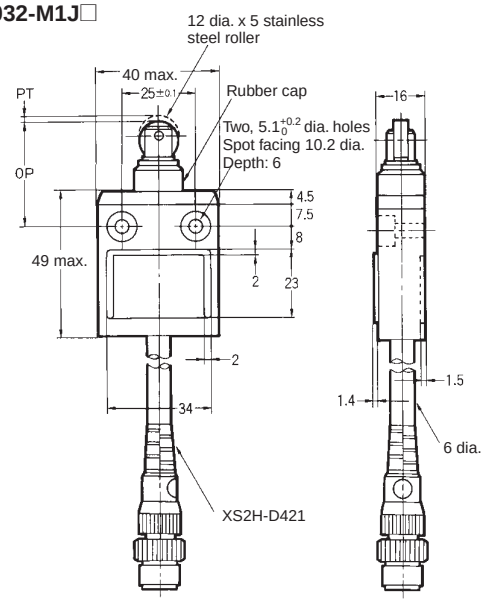
Sealed Pin Plunger

D4C-□031-□K1EJ□
D4C-□031-M1J□



Sealed Roller Plunger

D4C-□032-□K1EJ□
D4C-□032-M1J□

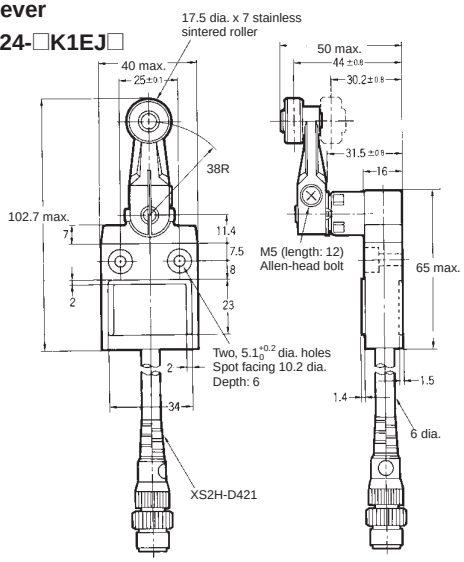


Model	D4C-□001-□K1EJ□	D4C-□002-□K1EJ□	D4C-□031-□K1EJ□	D4C-□032-□K1EJ□
OF max.	11.77 N	11.77 N	17.65 N	17.65 N
RF min.	4.41 N	4.41 N	4.41 N	4.41 N
PT max.	1.8 mm	1.8 mm	1.8 mm	1.8 mm
OT min.	3 mm	3 mm	3 mm	3 mm
MD max.	0.2 mm	0.2 mm	0.2 mm	0.2 mm
OP	15.7±1 mm	28.5±1 mm	24.9±1 mm	34.3±1 mm

Note: Specifications are the same for -M1J Switches.

Roller Lever

D4C-□024-□K1EJ□

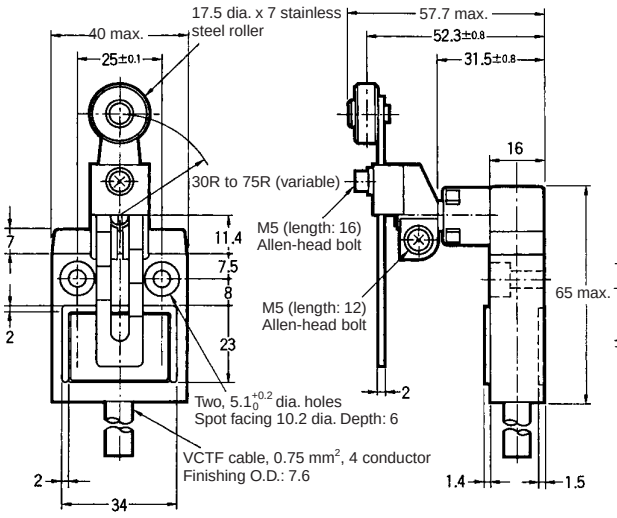


Model	D4C-□□24 -□K1EJ□
OF max.	5.69 N
RF min.	1.47 N
PT max.	10±3°
OT min.	50°
MD max.	3°
OP	---

Weather-resistant Models

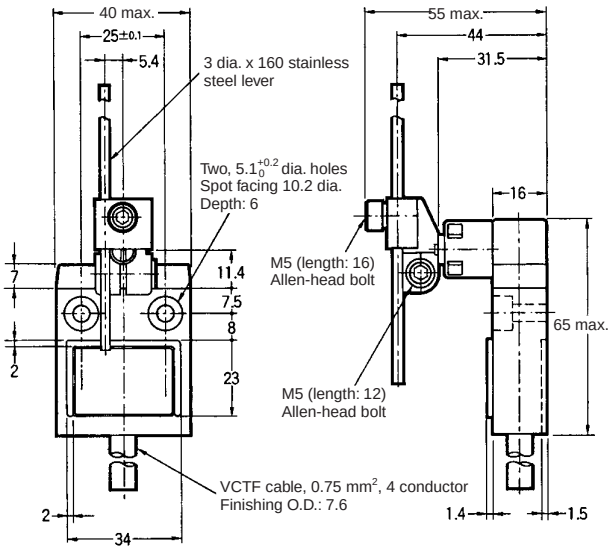
Adjustable Roller Lever

D4C-□□27-P



Adjustable Rod Lever

D4C-□□29-P

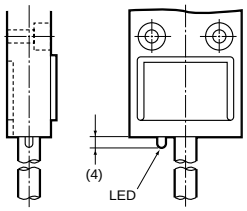


Model	D4C-□□27-P	D4C-□□29-P (see note)
OF max.	5.69 N	5.69 N
RF min.	1.47 N	1.47 N
PT max.	25°	25°
OT min.	40°	40°
MD max.	3°	3°

Note: Operation characteristics for the D4C-□□27-P and D4C-□□29-P are for a lever length of 38 mm.

Models with LED Indicator

The dimensions of the LED indicator for models equipped with one are shown below.



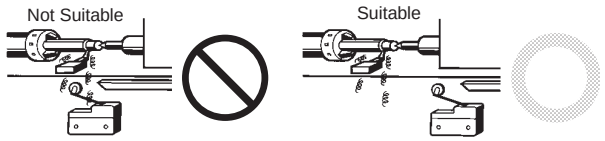
Precautions

Refer to the *"Precautions for General-purpose Limit Switches (Including Multiple Limit Switches, Mechanical Touch Switches, High-precision Switches, Touch Switches, On-site Flexible Switches; Not Including Safety Switches)" on page 17.*

■ Correct Use

Operating Environment

- Seal material may deteriorate if a Switch is used outdoor or where subject to special cutting oils, solvents, or chemicals. Always appraise performance under actual application conditions and set suitable maintenance and replacement periods.
- Install Switches where they will not be directly subject to cutting chips, dust, or dirt. The Actuator and Switch must also be protected from the accumulation of cutting chips or sludge.

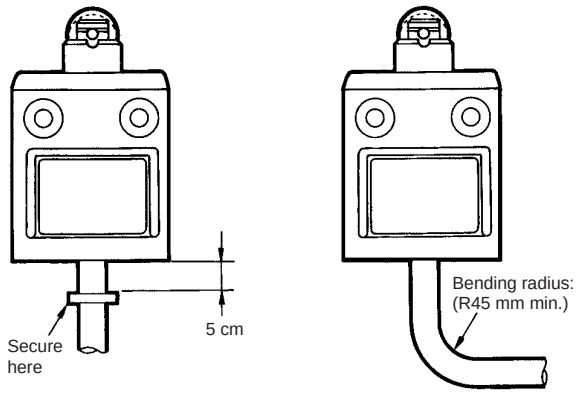


- Constantly subjecting a Switch to vibration or shock can result in wear, which can lead to contact interference with contacts, operation failure, reduced durability, and other problems. Excessive vibration or shock can lead to false contact operation or damage. Install Switches in locations not subject to shock and vibration and in orientations that will not produce resonance.
- The Switches have physical contacts. Using them in environments containing silicon gas will result in the formation of silicon oxide (SiO_2) due to arc energy. If silicon oxide accumulates on the contacts, contact interference can occur. If silicon oil, silicon filling agents, silicon cables, or other silicon products are present near the Switch, suppress arcing with contact protective circuits (surge killers) or remove the source of silicon gas.

Handling

The bottom of the Switch at the cable outlet is resin-molded. Secure the cable at a point 5 cm from the Switch bottom to prevent exertion of excess force on the cable.

When bending the cable, provide a bending radius of 45 mm min. so as not to damage the cable insulation or sheath. Excessive bending may cause fire or leakage current.



Connections

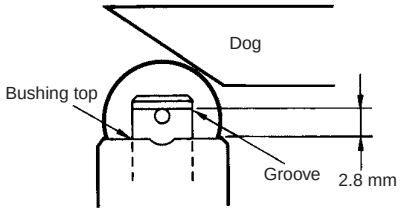
Be sure to connect a fuse with a breaking current 1.5 to 2 times larger than the rated current to the Limit Switch in series in order to protect the Limit Switch from damage due to short-circuiting.

When using the Limit Switch for the EN ratings, use the gI or gG 10-A fuse.

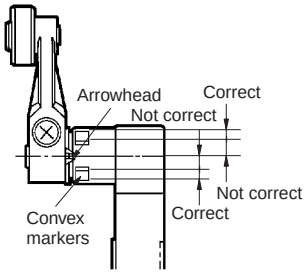
Operation

Operation method, shapes of cam and dog, operating frequency, and overtravel have a significant effect on the service life and precision of a Limit Switch. For this reason, the dog angle must be 30° max., the surface roughness of the dog must be 6.3S min. and hardness must be Hv400 to 500.

To allow the plunger-type actuator to travel properly, adjust the dog and cam to the proper setting positions. The proper position is where the plunger groove fits the bushing top.



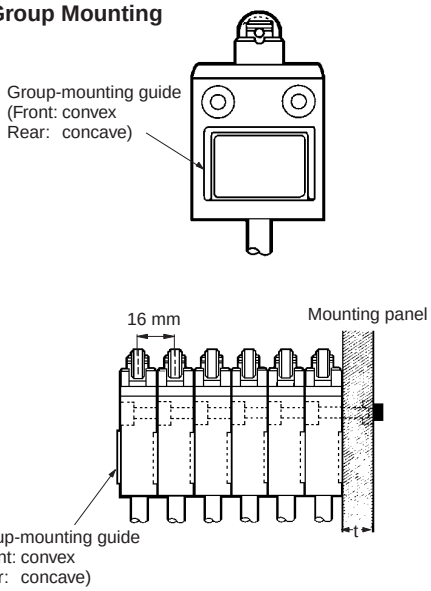
To allow the roller lever-type actuator to travel properly, adjust the dog and cam so that the arrow head is positioned between the two convex markers as shown below.



Mounting

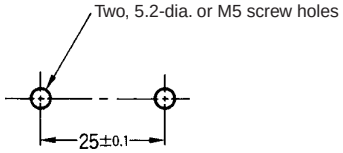
A maximum of 6 Switches may be group-mounted. In this case, pay attention to the mounting direction so that the convex part of the group-mounting guide on one Switch fits into the concave part of the guide on the other Switch as shown in the figure below. For group mounting, the mounting panel must have a thickness (t) of 6 mm min.

Group Mounting



If the mounting panel is warped or has protruding parts, a malfunction may result. Make sure that the mounting panel is not warped and has even surfaces.

Mounting Holes



Use a Switch with a rubber cap when using the plunger type in an environment where malfunction is possible due to environmental conditions such as dust or cutting chips which may not allow resetting.

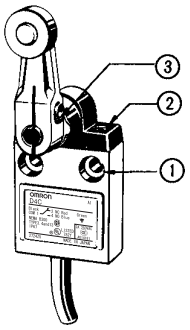
Do not expose the Switch to water exceeding 70°C or use it in steam.

When the D4C is used in a circuit of a device to be exported to Europe, classified as Overvoltage Class III as specified in IEC664, provide a contact protection circuit.

Tighten each screw to a torque according to the following table.

No.	Type	Torque
1	M5 Allen-head bolt	4.90 to 5.88 N·m
2	M3.5 head mounting screw	0.78 to 0.88 N·m
3	M5 Allen-head bolt	4.90 to 5.88 N·m

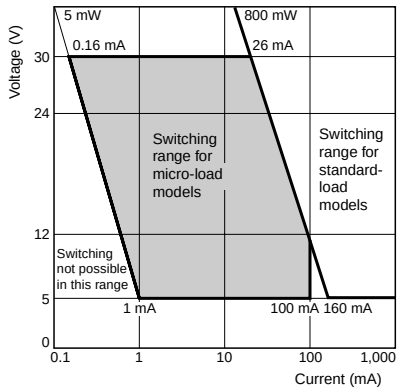
Note: By removing the two screws from the head, the head direction can be rotated 180°. After changing the head direction, re-tighten to the torque specified above. Be careful not to allow any foreign substance to enter the Switch.



Micro-load Models (D4C-4, -5, -6)

Switching Range

Micro-load models can be used for switching in the range shown below.



ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. C032-E1-10 In the interest of product improvement, specifications are subject to change without notice.

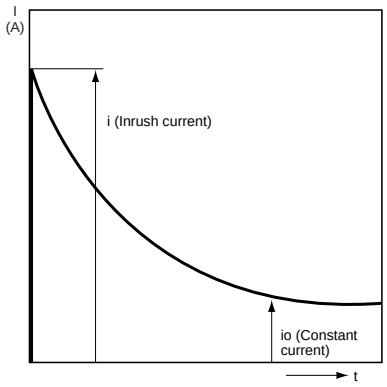
Precautions for General-purpose Limit Switches

(Including Multiple Limit Switches, Mechanical Touch Switches, High-precision Switches, Touch Switches, On-site Flexible Switches; Not Including Safety Switches)

Note: Refer to the Precautions section for each Switch for specific precautions applicable to each Switch.

Precautions for Safe Use

- If the Switch is to be used as a switch in an emergency stop circuit or in a safety circuit for preventing accidents resulting in injuries or deaths, use a Switch with a direct opening mechanism, use the NC contacts with a forced release mechanism, and set the Switch so that it will operate in direct opening mode.
  For safety, install the Switch using one-way rotational screws or other similar means to prevent it from easily being removed. Protect the Switch with an appropriate cover and post a warning sign near the Switch in order to ensure the safety.
- Do not supply electric power when wiring. Otherwise electric shock may result.
- Keep the electrical load below the rated value.
- Be sure to evaluate the Switch under actual working conditions after installation.
- Do not touch the charged switch terminals while the Switch has carry current, otherwise electric shock may result.
- If the Switch has a ground terminal, be sure to connect the ground terminal to a ground wire.
- Do not disassemble the Switch while electric power is being supply. Otherwise electric shock may result.
- The durability of the Switch greatly varies with switching conditions. Before using the Switch, be sure to test the Switch under actual conditions. Make sure that the number of switching operations is within the permissible range.
  If a deteriorated Switch is used continuously, insulation failures, contact weld, contact failures, switch damage, or switch burnout may result.
- Maintain an appropriate insulation distance between wires connected to the Switch.
- Some types of load have a great difference between normal current and inrush current. Make sure that the inrush current is within the permissible value. The greater the inrush current in the closed circuit is, the greater the contact abrasion or shift will be. Consequently, contact weld, contact separation failures, or insulation failures may result. Furthermore, the Switch may become broken or damaged.



Wiring

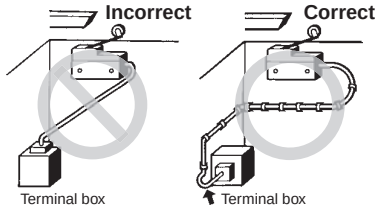
Pay the utmost attention so that each terminal is wired correctly. If the terminal is wired incorrectly, the Switch will not function. Furthermore, not only will the Switch have a bad influence on the external circuit, the Switch itself may become damaged or burnt.

Mounting

- Do not modify the actuator, otherwise the operating characteristics and performance of the actuator will change.
- Do not enlarge the mounting holes of the Switch or modify the Switch, otherwise insulation failures or housing damage may result.
- Be sure to evaluate the Switch under actual working conditions after installation.
- Do not apply oil, grease, or other lubricants to the moving parts of the actuator, otherwise the actuator may not operate correctly. Furthermore, intrusion of oil, grease, or other lubricants inside the Switch may reduce sliding characteristic or cause failures in the Switch.
- Mount the Switch and secure it with the specified screws tightened to the specified torque along with flat washers and springs.
  The actuator of a Pushbutton Limit Switch mounted to a panel with excessive tightening torque may not operate correctly.
- Be sure to wire the Switch so that the conduit opening is free of metal powder or any other impurities.
- If glue or bonding agent is applied, make sure that it does not adhere to the movable parts or intrude inside the Switch, otherwise the Switch may not work correctly or cause contact failure. Some types of glue or bonding agent may generate a gas that may have a bad influence on the Switch. Pay the utmost attention when selecting the glue or locking agent.
- Do not drop or disassemble the Switch, otherwise the Switch will not be capable of full performance. Furthermore, the Switch may become broken or burnt.
- Some models allow changes in head directions. When changing the head of such a model, make sure that the head is free of any foreign substance. Tighten each screw of the head to the rated torque.
- Be sure to take measures so that no foreign material, oil, or water will penetrate into the Switch through the conduit opening. Be sure to attach a connector suited to the cable thickness and tighten the connector securely to the rated torque.
- Do not impose shock or vibration on the actuator while it is fully pressed. Otherwise, the actuator will partially abrade and an actuation failure may result.

Wiring

- If the wiring method is incorrect, the wires may get caught on objects or the lead wires may be pulled excessively. Make sure that the lead wires are sufficiently long and secure them along the wiring path.



Pay the utmost attention so that each terminal is wired correctly. If a terminal is wired incorrectly, the Limit Switch will not function properly. Furthermore, not only will the Limit Switch have an adverse influence on external circuits, the Limit Switch itself may become damaged or burnt.

Precautions for Correct Use

Switch Operation

- The Switch in actual operation may cause accidents that cannot be foreseen from the design stage. Therefore, the Switch must be practically tested before actual use.
- When testing the Switch, be sure to apply the actual load condition together with the actual operating environment.
- All the performance ratings in this catalog are provided under the following conditions unless otherwise specified.

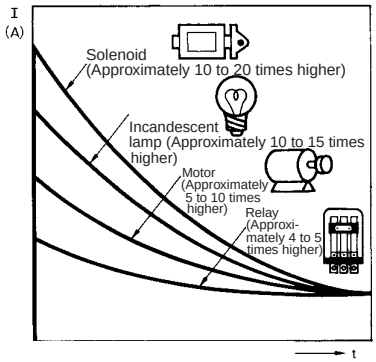
Inductive load: A minimum power factor of 0.4 (AC) or a maximum time constant of 7 ms (DC)

Lamp load: An inrush current 10 times higher than the normal current

Motor load: An inrush current 6 times higher than the normal current

1. Ambient temperature: +5°C to 35°C
2. Ambient humidity: 40% to 70%.

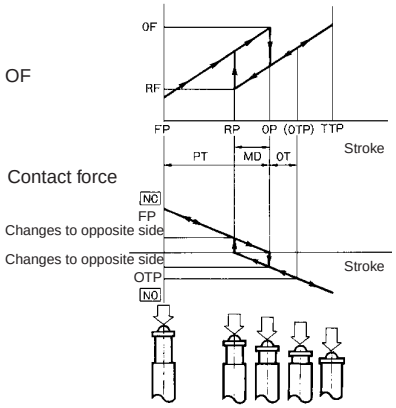
Note: An inductive load causes a problem especially in DC circuitry. Therefore, it is essential to know the time constants (L/R) of the load.



Mechanical Characteristics

Operating Force, Stroke, and Contact Characteristics

- The following graph indicates the relationship between operating force and stroke or stroke and contact force. In order to operate the Limit Switch with high reliability, it is necessary to use the Limit Switch within an appropriate contact force range. If the Limit Switch is used in a normally closed condition, the dog must be installed so that the actuator will return to the FP when the actuator is actuated by the dog. If the Limit Switch is used in a normally open condition, the actuator must be pressed to 70% to 100% of the OT (i.e., 60% to 80% of the TT) and any slight fluctuation must be absorbed by the actuator.
- If the full stroke is set close to the OP or RP, contact instability may result. If the full stroke is set to the TTP, the actuator or switch may become damaged due to the inertia of the dog. In that case, adjust the stroke with the mounting panel or the dog. Refer to page 22, *Dog Design*, page 23, *Stroke Settings vs. Dog Movement Distance*, and page 24, *Dog Surface* for details.
- The following graph shows an example of changes in contact force according to the stroke. The contact force near the OP or RP is unstable, and the Limit Switch cannot maintain high reliability. Furthermore, the Limit Switch cannot withstand strong vibration or shock.



If the Limit Switch is used so that the actuator is constantly pressed, it will fail quickly and reset faults may occur. Inspect the Limit Switch periodically and replace it as required.

Mechanical Conditions for Switch Selection

- The actuator must be selected according to the operating method.
- Check the operating speed and switching frequency.
  1. If the operating speed is extremely low, the switching of the movable contact will become unstable, thus resulting in incorrect contact or contact weld.
  2. If the operating speed is extremely high, the Switch may break due to shock. If the switching frequency is high, the switching of the contacts cannot catch up with the switching frequency. Make sure that the switching frequency is within the rated switching frequency.
- Do not impose excessive force on the actuator, otherwise the actuator may become damaged or not operate correctly.
- Make sure that the stroke is set within the suitable range specified for the model, or otherwise the Switch may break.

Electrical Characteristics

Electrical Characteristics for Switch Selection

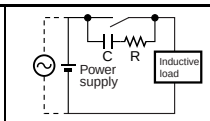
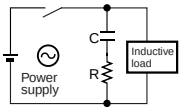
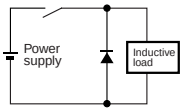
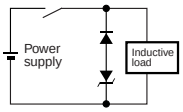
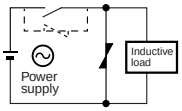
- The switching load capacity of the Switch greatly varies between AC and DC. Always be sure to apply the rated load. The control capacity will drastically drop if it is a DC load. This is because a DC load has no current zero-cross point, unlike an AC load. Therefore, if an arc is generated, it may continue comparatively for a long time. Furthermore, the current direction is always the same, which results in a contact relocation phenomena whereby the contacts easily stick to each other and do not separate when the surfaces of the contacts are uneven.
- If the load is inductive, counter-electromotive voltage will be generated. The higher the voltage is, the higher the generated energy will be, which will increase the abrasion of the contacts and contact relocation phenomena. Be sure to use the Switch within the rated conditions.
- If the load is a minute voltage or current load, use a dedicated Switch for minute loads. The reliability of silver-plated contacts, which are used by standard Switches, will be insufficient if the load is a minute voltage or current load.

Contact Protective Circuit

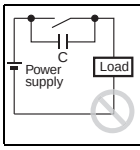
Apply a contact protective circuit to increase the contact durability, prevent noise, and suppress the generation of carbide or nitric acid. Be sure to apply the contact protective circuit correctly, otherwise an adverse effect may occur.

The following provides typical examples of contact protective circuits. If the Switch is used in an excessively humid location for switching a load that easily generates arcs, such as an inductive load, the arcs may generate NOx, which will change into HNO_3 if it reacts with moisture. Consequently, the internal metal parts may corrode and the Switch may fail. Be sure to select the ideal contact preventive circuit from the following. Also, load operating times may be delayed somewhat if a contact protective circuit (a surge killer) is used.

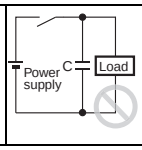
Typical Examples of Contact Protective Circuits

Circuit example		Applicable current		Feature	Element selection
		AC	DC		
CR circuit		*	Yes	*When AC is switched, the load impedance must be lower than the CR impedance.	C: 1 to 0.5 μF x switching current (A) R: 0.5 to 1 Ω x switching voltage (V) The values may change according to the characteristics of the load. The capacitor suppresses the spark discharge of current when the contacts are open. The resistor limits the inrush current when the contacts are closed again. Consider the roles of the capacitor and resistor and determine ideal capacitance and resistance values through testing. Generally, use a capacitor that with a dielectric strength of between 200 and 300 V. Use an AC capacitor for an AC circuit i.e., a capacitor that has no polarity. If, however, the arc shutoff capacity between the contacts is a problem at high DC voltages, it may be more effective to connect a capacitor and resistor across the contacts rather than the load. Performing testing to determine the most suitable method.
		Yes	Yes	The operating time will be greater if the load is a relay or solenoid. Connecting the CR circuit in parallel to the load is effective when the power supply voltage is 24 or 48 V and in parallel to the contacts when the power supply voltage is 100 to 200 V.	
Diode method		No	Yes	Energy stored in the coil is changed into current by the diode connected in parallel to the load. Then the current flowing to the coil is consumed and Joule heat is generated by the resistance of the inductive load. The reset time delay with this method is longer than that in the CR method.	The diode must withstand a peak inverse voltage 10 times higher than the circuit voltage and a forward current as high or higher than the load current.
Diode and Zener diode method		No	Yes	This method will be effective if the reset time delay caused by the diode method is too long.	If a suitable Zener voltage is not used, the load may fail to operate depending on the environment. Use a Zener diode with a Zener voltage that is about 1.2 times the power supply voltage.
Varistor method		Yes	Yes	This method makes use of constant-voltage characteristic of the varistor so that no high-voltage is imposed on the contacts. This method causes a reset time delay. Connecting a varistor in parallel to the load is effective when the supply voltage is 24 to 48 V and in parallel to the contacts when the supply voltage is 100 to 200 V.	Select a varistor with a cut voltage Vc that satisfies the following formula. For AC, the voltage must me multiplied by the square root of 2. Vc > Power supply voltage x 1.5 If Vc is set too high, effectiveness will be reduced because high voltages will not be cut.

Do not apply contact protective circuits (surge killers) as shown below.



This circuit effectively suppresses arcs when the contacts are OFF. The capacitor contacts are OFF. Consequently, when the contacts are ON again, short-circuited current from the capacitance may cause contact weld.

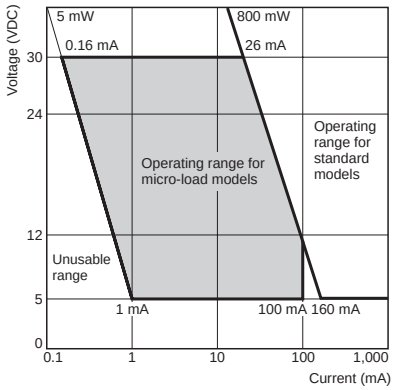


This circuit effectively suppresses arcs when the contacts are OFF. When the contacts are ON again, however, charge current will flow to the capacitor, which may result in contact weld.

Switching a DC inductive load is usually more difficult than switching a resistive load. By using an appropriate contact protective circuit, however, switching a DC inductive load will be as easy as switching a resistive load.

Using Switches for Micro Loads

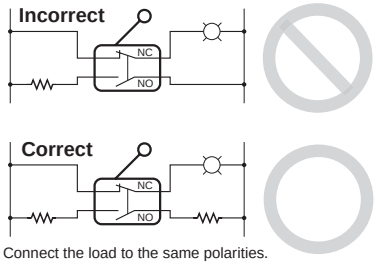
Contact faults may occur if a Switch for a general-load is used to switch a micro load circuit. Use switches in the ranges shown in the diagram on the right. However, even when using micro load models within the operating range shown here, if inrush current occurs when the contact is opened or closed, it may increase contact wear and so decrease durability. Therefore, insert a contact protection circuit where necessary. The minimum applicable load is the N-level reference value. This value indicates the malfunction reference level for the reliability level of 60% (λ60). The equation, $\lambda 60 = 0.5 \times 10^{-6}$/operations indicates that the estimated malfunction rate is less than 1/2,000,000 operations with a reliability level of 60%.



Connections

- Do not connect a Single Limit Switch to two power supplies that are different in polarity or type.

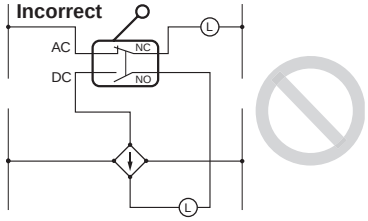
  Power Connection Examples
  (Connection of Different Polarities)



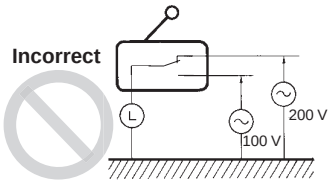
Connect the load to the same polarities.

Incorrect Power Connection Example

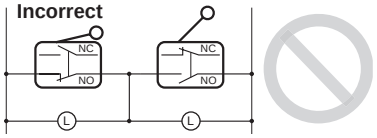
(Connection of Different Power Supplies)
There is a risk of AC and DC mixing.



- Do not design a circuit where voltage is imposed between contacts, otherwise contact welding may result.



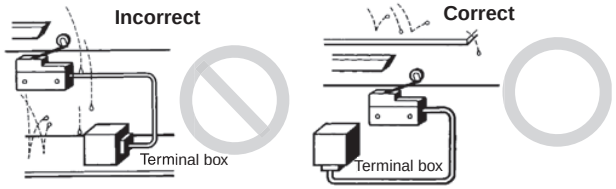
- Do not use a circuit that will short-circuit if an error occurs, otherwise the charged part may melt and break off.



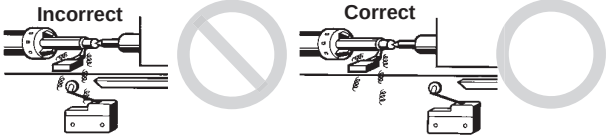
- Application of Switch to a Low-voltage, Low-current Electronic Circuit.
  1. If bouncing or chattering of the contacts results and causes problems, take the following countermeasures.
     (a) Insert an integral circuit.
     (b) Suppress the generation of pulse from the contact bouncing or chattering of the contacts so that it is less than the noise margin of the load.
  2. Conventional silver-plated contacts are not suited to this application. Use gold-plated contacts, which are ideal for handling minute voltage or current loads.
  3. The contacts of the Switch used for an emergency stop must be normally closed with a positive opening mechanism.
- In order to protect the Switch from damage due to short-circuits, be sure to connect a quick-response fuse with a breaking current 1.5 to 2 times larger than the rated current to the Switch in series. When complying with EN approved ratings, use a 10-A IEC 60269-compliant gI or gG fuse.

Operating Environment

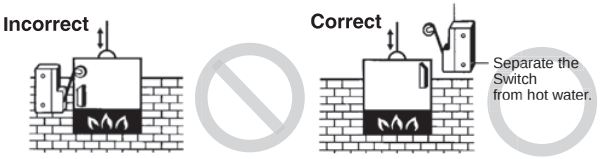
- Do not use the Switch by itself in atmospheres containing flammable or explosive gases. Arcs and heating resulting from switching may cause fire or explosion.
- Use protective covers to protect Switches that are not specified as waterproof or airtight whenever they are used in locations subject to splattering or spraying oil or water, or to accumulation of dust or dirt.



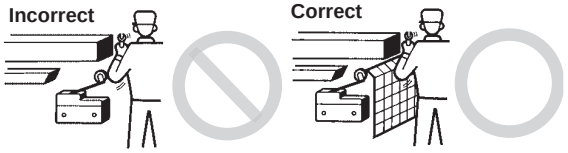
- The materials of Limit Switch may change in quality or deteriorate if the Limit Switch is used outdoors or any other location where the Limit Switch is exposed to special machining oil. Consult your OMRON representative before selecting the model.
- Be sure to install the Switch so that the Switch is free from dust or metal powder. The actuator and the switch casing must be protected from the accumulation of dust or metal powder.



- Do not use the Switch in locations where the Switch is exposed to hot water at a temperature greater than 60°C or steam.
- Do not use the Switch under temperatures or other environmental conditions not within the specified ranges. The rated permissible ambient temperature range varies with the model. Refer to the specifications in this catalog.
  If the Switch is exposed to radical temperature changes, the thermal shock may deform the Switch and the Switch may malfunction.



- Be sure to protect the Switch with a cover if the Switch is in a location where the Switch may be actuated by mistake or where the Switch is likely cause an accident.

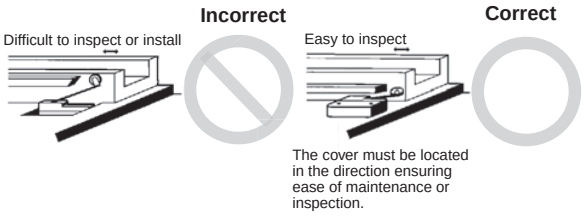


- Make sure to install the Switch in locations free of vibration, shock, or resonance. If vibration or shock is continuously imposed on the Switch, contact failure, malfunction, or decrease in service life may be caused by abrasive powder generated from the internal parts. If excessive vibration or shock is imposed on the Switch, the contacts may malfunction or become damaged.
- Do not use the Switch with silver-plated contacts for long periods if the switching frequency of the Switch is comparatively low or the load is minute. Otherwise, sulfuric film will be generated on the contacts and contact failures may result. Use the Switch with gold-plated contacts or use a dedicated Switch for minute loads instead.
- Do not use the Switch in locations with corrosive gas, such as sulfuric gas (H_2S or SO_2), ammonium gas (NH_3), nitric gas (HNO_3), or chlorine gas (Cl_2), or high temperature and humidity. Otherwise, contact failure or corrosion damage may result.

- If the Switch is used in locations with silicone gas, arc energy may create silicon dioxide (SiO_2) on the contacts and a contact failure may result. If there is silicone oil, silicone sealant, or wire covered with silicone close to the Switch, attach a contact protective circuit to suppress the arcing of the Switch or eliminate the source of silicone gas generation.

Regular Inspection and Replacement

- If the Switch is normally closed with low switching frequency (e.g., once or less than once a day), a reset failure may result due to the deterioration of the parts of the Switch. Regularly inspect the Switch and make sure that the Switch is in good working order.
- In addition to the mechanical durability or electrical durability of the Switch described previously, the durability of the Switch may decrease due to the deterioration of each part, especially rubber, resin, and metal. Regularly inspect the Switch and replace any part that has deteriorated in order to prevent accidents from occurring.
- Be sure to mount the Switch securely in a clean location to ensure ease of inspection and replacement. The Switch with operation indicator is available, which is ideal if the location is dark or does not allow easy inspection or replacement.



Storage of Switch

- When storing the Switch, make sure that the location is free of corrosive gas, such as H_2S, SO_2, NH_3, HNO_3, or Cl_2, or dust and does not have a high temperature or humidity.
- Be sure to inspect the Switch before use if it has been stored for three months or more.

Weather Resistance, Cold Resistance, and Heat Resistance

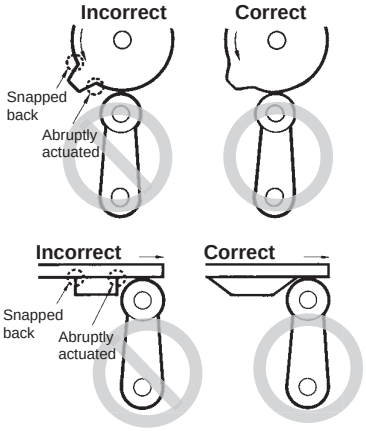
Silicon rubber is used to increase resistance to weather, cold, and heat. Silicon rubber, however, can generate silicon gas. (This can occur at room temperature, but the amount of silicon gas generated increases at higher temperatures.) Silicon gas will react as a result of arc energy and form silicon oxide (SiO_2). If silicon oxide accumulates on the contacts, contact interference can occur and can interfere with the device. Before using a Switch, test it under actual application conditions (including the environment and operating frequency) to confirm that no problems will occur in actual.

Outdoor Use

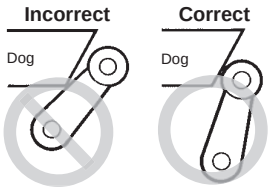
- If the Limit Switch is used in places with sludge or dust powder spray, make sure that the mechanical parts are sealed with a rubber cap.
- The rubber materials exposed to ozone may deteriorate. Check that the rubber parts are made of environment-resistive materials, such as chloroprene, silicone, or fluorine rubber.
- Due to capillary attraction, rainwater may enter the Limit Switch through the lead wires or sheath. Be sure to cover the wire connections in a terminal box so that they are not directly exposed to rainwater.
- If the Limit Switch is used outdoors, the steel parts of the Limit Switch (such as the screws and plunger parts) may corrode. Consider the use of outdoor models, such as WL-□P1 or D4C-□P.
- “Limit Switch is used outdoors” refers to an environment where the Limit Switch is exposed directly to rainwater or sunlight (e.g., multi-story parking facilities) excluding locations with corrosive gas or salty breezes. A Limit Switch used outdoors may not release due to icing and may not satisfy specified standards.

Operation

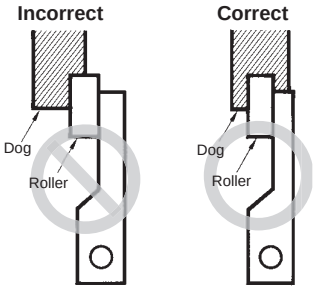
- Carefully determine the position and shape of the dog or cam so that the actuator will not abruptly snap back, thus causing shock. In order to operate the Limit Switch at a comparatively high speed, use a dog or cam that keeps the Limit Switch turned ON for a sufficient time so that the relay or valve will be sufficiently energized.
- The method of operation, the shape of the cam or dog, the operating frequency, and the travel after operation have a large influence on the durability and operating accuracy of the Limit Switch. The cam or dog must be smooth in shape.



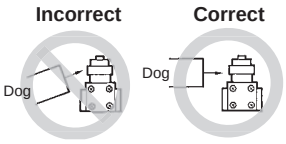
- Appropriate force must be imposed on the actuator by the cam or dog in both rotary operation and linear operation. If the dog touches the lever as shown below, the operating position will not be stable.



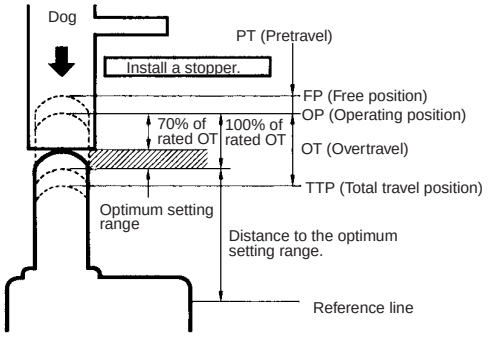
- Unbalanced force must not be imposed on the actuator. Otherwise, wear and tear on the actuator may result.



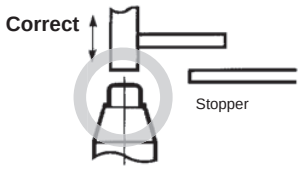
- With a roller actuator, the dog must touch the actuator at a right angle. The actuator or shaft may deform or break if the dog touches the actuator (roller) at an oblique angle.



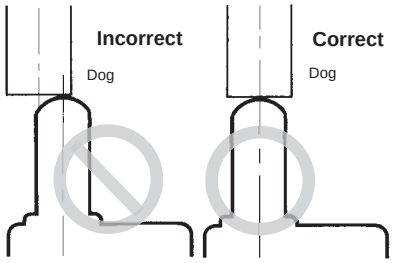
- Make sure that the actuator does not exceed the OT (overtravel) range, otherwise the Limit Switch may malfunction. When mounting the Limit Switch, be sure to adjust the Limit Switch carefully while considering the whole movement of the actuator.



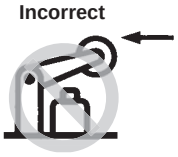
- The Limit Switch may soon malfunction if the OT is excessive. Therefore, adjustments and careful consideration of the position of the Limit Switch and the expected OT of the actuator are necessary when mounting the Limit Switch.



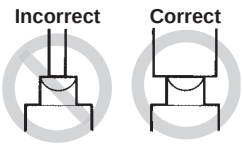
- When using a pin-plunger actuator, make sure that the stroke of the actuator and the movement of the dog are located along a single straight line.



- Be sure to use the Limit Switch according to the characteristics of the actuator. If a roller arm lever actuator is used, do not attempt to actuate the Limit Switch in the direction shown below.



- Do not modify the actuator to change the OP.
- With the long actuator of an Adjustable Roller Lever Switch, the following countermeasures against lever shaking are recommended.
  1. Make the rear edge of the dog smooth with an angle of 15° to 30° or make it in the shape of a quadratic curve.
  2. Design the circuit so that no error signal will be generated.
  3. Use or set a switch that is actuated in one direction only.
- With a bevel plunger actuator, make sure that the width of the dog is wider than that of the plunger.



Dog Design

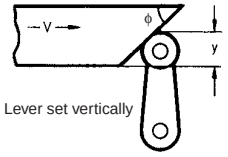
Operating Speed, Dog Angle, and Relationship with Actuator

Before designing a dog, carefully consider the operating speed and angle of the dog (ϕ) and their relationship with the shape of the actuator. The optimum operating speed (V) of a standard dog at an angle of 30° to 45° is 0.5 m/s maximum.

Roller Lever Switches

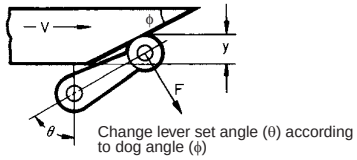
1. Non-overtravel Dog

Dog speed: 0.5 m/s max. (standard speed)



ϕ	V max. (m/s)	y
30° 45° 60° 60° to 90°	0.4 0.25 0.1 0.05 (low speed)	0.8 (TT) 80% of total travel

Dog speed: 0.5 m/s ≤ V ≤ 2 m/s (high speed)

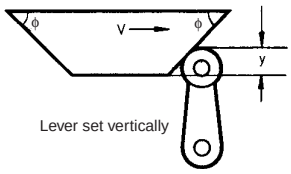


θ	ϕ	V max. (m/s)	y
45°	45°	0.5	0.5 to 0.8 (TT)
50°	40°	0.6	0.5 to 0.8 (TT)
60° to 55°	30° to 35°	1.3	0.5 to 0.7 (TT)
75° to 65°	15° to 25°	2	0.5 to 0.7 (TT)

Note: The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 50% and 80% (or 50% and 70%).

2. Overtravel Dog

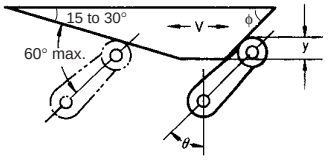
Dog speed: 0.5 m/s max.



ϕ	V max. (m/s)	y
30° 45° 60° 60° to 90°	0.4 0.25 0.1 0.05 (low speed)	0.8 (TT) 80% of total travel

Dog speed: 0.5 m/s min.

If the speed of the overtravel dog is comparatively high, make the rear edge of the dog smooth at an angle of 15° to 30° or make it in the shape of a quadratic curve. Then lever shaking will be reduced.



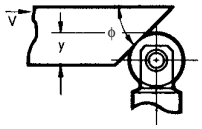
θ	ϕ	V max. (m/s)	y
45°	45°	0.5	0.5 to 0.8 (TT)
50°	40°	0.6	0.5 to 0.8 (TT)
60° to 55°	30° to 35°	1.3	0.5 to 0.7 (TT)
75° to 65°	15° to 25°	2	0.5 to 0.7 (TT)

Note: The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 50% and 80% (or 50% and 70%).

Plunger Switches

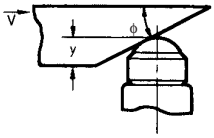
If the dog overrides the actuator, the front and rear of the dog may be the same in shape, provided that the dog is not designed to be separated from the actuator abruptly.

Roller Plunger



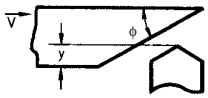
ϕ	V max. (m/s)	y
30° 20°	0.25 0.5	0.6 to 0.8 (TT) 0.5 to 0.7 (TT)

Ball Plunger



ϕ	V max. (m/s)	y
30° 20°	0.25 0.5	0.6 to 0.8 (TT) 0.5 to 0.7 (TT)

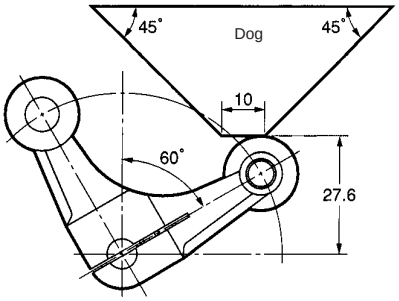
Bevel Plunger



ϕ	V max. (m/s)	y
30° 20°	0.25 0.5	0.6 to 0.8 (TT) 0.5 to 0.7 (TT)

Note: The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 60% and 80% (or 50% and 70%).

Fork Lever Lock Models

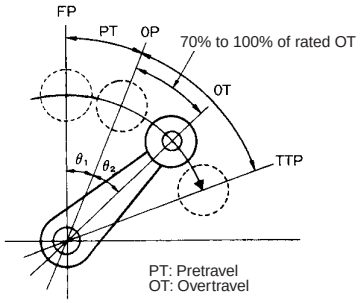


Note: Design the shape of the dog so that it does not come in contact with the other roller lever when the actuator is inverted.

Stroke Settings vs. Dog Movement Distance

- The following information on stroke settings is based on the movement distance of the dog instead of the actuator angle. The following is the optimum stroke of the Limit Switch.

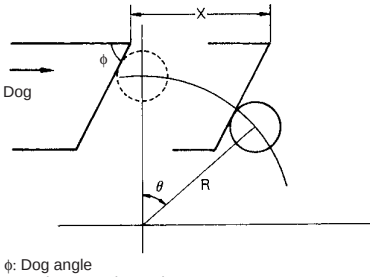
  Optimum stroke: PT + {Rated OT x (0.7 to 1.0)}
  In terms of angles, the optimum stroke is expressed as $\theta_1 + \theta_2$.



- The movement distance of the dog based on the optimum stroke is expressed by the following formula.

  Movement distance of dog

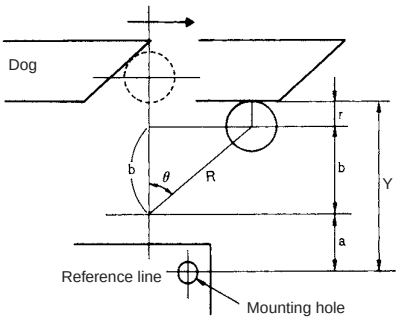
$$X = R\sin\theta + \frac{R(1-\cos\theta)}{\tan\phi} \ (\text{mm})$$



ϕ: Dog angle
θ: Optimum stroke angle
R: Actuator length
X: Dog movement distance

- The distance between the reference line and the bottom of the dog based on the optimum stroke is expressed by the following formula.

$$Y = a + b + r\,(mm)$$



a: Distance between reference line and actuator fulcrum
b: R cosθ
r: Roller radius
Y: Distance between reference line and bottom of dog

Dog Surface

- The surface of dog touching the actuator should be 6.3 S in quality and a hardness of approximately HV450.
- For smooth operation of the actuator, apply molybdenum disulfide grease to the actuator and the dog touching the actuator. This is ideal for Limit Switches of drip-proof construction and Multiple Limit Switches.

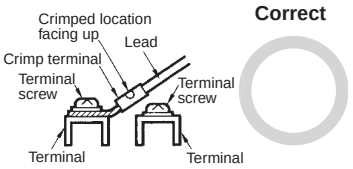
Maintenance and Repairs

- The user of the system must not attempt to perform maintenance and repairs. Contact the manufacturer of the system concerning maintenance and repairs.

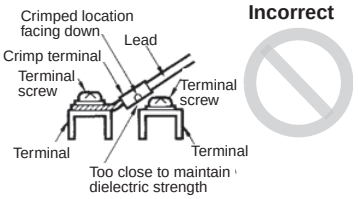
Other

- The standard material for the switch seal is nitrile rubber (NBR), which has superior resistance to oil. Depending on the type of oil or chemicals in the application environment, however, NBR may deteriorate, e.g., swell or shrink. Confirm performance in advance.
- The correct Switch must be selected for the load to ensure contact reliability. Refer to precautions for micro loads in individual product information for details.
- When using a Limit Switch with a long lever or long rod lever, make sure that the lever is in the downward direction.
- Wire the leads as shown in the following diagram.

Correct Wiring



Incorrect Wiring



Typical Problems, Probable Causes, and Remedies

Problem		Probable cause	Remedy
Mechanical failure	1. The actuator does not operate. 2. The actuator does not return. 3. The actuator has been deformed. 4. The actuator is worn. 5. The actuator has been damaged.	The shape of the dog or cam is incorrect.	• Change the design of the dog or cam and smooth the contacting surface of the cam. • Scrutinize the suitability of the actuator. Make sure that the actuator does not bounce.
		The contacting surface of the dog or cam is rough.	
		The actuator in use is not suitable.	
		The operating direction of the actuator is not correct.	
		The operation speed is excessively high.	• Attach a decelerating device or change the mounting position of the Switch.
		Excessive stroke.	• Change the stroke.
		The rubber or grease hardened due to low temperature.	• Use a cold-resistive switch.
		The accumulation of sludge, dust, or cuttings.	• Use a drip-proof model or one with high degree of protection. • Use a protection cover and change the solvent and materials.
		Dissolution, expansion, or swelling damage to the rubber parts of the driving mechanism.	
	There is a large deviation in operating position (with malfunctioning involved).	Damage to and wear and tear of the internal movable spring.	• Regularly inspect the Switch. • Use a better quality switch. • Tighten the mounting screws securely. Use a mounting board.
		Wear and tear of the internal mechanism.	
		The loosening of the mounting screws causing the position to be unstable.	
	The terminal part wobbles. (The mold part has been deformed.)	Overheating due to a long soldering time.	• Solder the Switch quickly. • Change the lead wire according to the carry current and ratings.
		The Switch has been connected to and pulled by thick lead wires with excessive force.	
		High temperature or thermal shock resulted.	• Use a temperature-resistive switch or change mounting positions.
Failures related to chemical or physical characteristics	Contact chattering	Vibration or shock is beyond the rated value.	• Attach an anti-vibration mechanism. • Attach a rubber circuit to the solenoid. • Increase the operating speed (with an accelerating mechanism).
		Shock has been generated from a device other than the Switch.	
		Too-slow operating speed.	
	Oil or water penetration	The sealing part has not been tightened sufficiently.	• Use a drip-proof or waterproof switch. • Use the correct connector and cable. (Use a sealed connector for sealed switches.)
		The wrong connector has been selected and does not conform to the cable.	
		The wrong switch has been selected.	
		The terminal part is not molded.	
		The Switch has been burnt or carbonated due to the penetration of dust or oil.	
	Deterioration of the rubber part	The expansion and dissolution of the rubber caused by solvent or lubricating oil.	• Use an oil-resistant rubber or fluororesin bellows. • Use a weather-resistant rubber or protective cover. • Use a switch with a metal bellows protective cover.
		Cracks due to direct sunlight or ozone.	
		Damage to the rubber caused by scattered or heated cuttings.	
	Corrosion (rusting or cracks)	The oxidation of metal parts resulted due to corrosive solvent or lubricating oil.	• Change the lubricating oil. • Change mounting positions. • Use a crack-resistant material.
		The Switch has been operated in a corrosive environment, near the sea, or on board a ship.	
		The electrical deterioration of metal parts of the Switch resulted due to the ionization of cooling water or lubricating oil.	
		The cracking of alloyed copper due to rapid changes in temperature.	
Failures related to electric characteristics	No actuation. No current breakage. Contact welding	Inductive interference in the DC circuit.	• Add an erasing circuit.
		Carbon generated on the surface of the contacts due to switching operations.	• Use a switch with a special alloy contact or use a sealed switch.
		A short-circuit or contact weld due to contact migration.	• Reduce the switching frequency or use a switch with a large switching capacity.
		Contact weld due to an incorrectly connected power source.	• Change the circuit design.
		Foreign materials or oil penetrated into the contact area.	• Use a protective box.

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