CKD

SM-5417-A

INSTRUCTION MANUAL

CYLINDER SWITCH

R series

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

2nd
CKD Corporation

For Safety Use

To use this product safely, basic knowledge of pneumatic equipment, including materials, piping, electrical system and mechanism, is required (to the level pursuant to JIS B 8370 Pneumatic System Rules).

We do not bear any responsibility for accidents caused by any person without such knowledge or arising from improper operation.

Our customers use this product for a very wide range of applications, and we cannot keep track of all of them. Depending on operating conditions, the product may fail to operate to maximum performance, or cause an accident. Thus, before placing an order, examine whether the product meets your application, requirements, and how to use it.

This product incorporates many functions and mechanisms to ensure safety. However, improper operation could result in an accident. To prevent such accidents, read this instruction manual carefully for proper operation.

Observe the cautions on handling described in this manual, as well as the following instructions :

⚠ Precautions

- The cylinder may malfunction depending on the mounting position or wiring of the cylinder switch. Select a proper mounting position, and connect the wires correctly.
- Do not touch electric wiring connections (exposed live parts) : this will cause an electric shock. During wiring, keep the power off. Also, do not touch these live parts with wet hands.

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CYLINDER SWITCH
R series
Manual No. SM-5417-A

NOTE: Letters & figures enclosed within Gothic style bracket (examples such as [C2-4PP07] · [V2-503-B] etc.) are editorial symbols being unrelated with contents of the book.

Dec.19.1985
Revision : Apr.13.2000

1. PRODUCT

1.1 Specifications

Type & Model / Item	Reed switch type			
	RO	R4	R5	R6
Application	PLC, relay	High capacity relay, solenoid	PLC, relay, IC circuit (w/o indicator), serial connection	Exclusively with PLC(with DC self-holding function)
Load voltage/current	12/24VDC, 5~50mA 100VAC, 7~20mA 200VAC, 7~10mA	100VAC, 20~200mA 200VAC, 10~200mA	5/12/24VDC、50mA or less 100VAC,20mA or less 200VAC, 10mA or less	24VDC, 5~50mA
Internal voltage drop	2.4V or less	2V or less	OV	5V or less
Indicator light	LED(Lights while power is ON)	Neon lamp(Lights while power is OFF)	W/o indicator	LED(Lights while power is ON)
Leak current	0	1mA or less	0	0.1mA or less
Lead wire length (Note1)	1m (Oil-proof vinyl cabtyre cord, 2-core, 0.3mm^2)			
Max. shock resistant	294 m/s^2 {30G}			
Insulation resistance	20 MΩ or more at 500V megger DC			
With standing voltage	No defection after one minute charging at 1000V AC			
Ambient temperature	−10~+60° C			
Degree of protection (Note 3)	For grommet-oil protection and water tight comformed to IEC code(IEC529), IP67 and JIS code(C0920)			

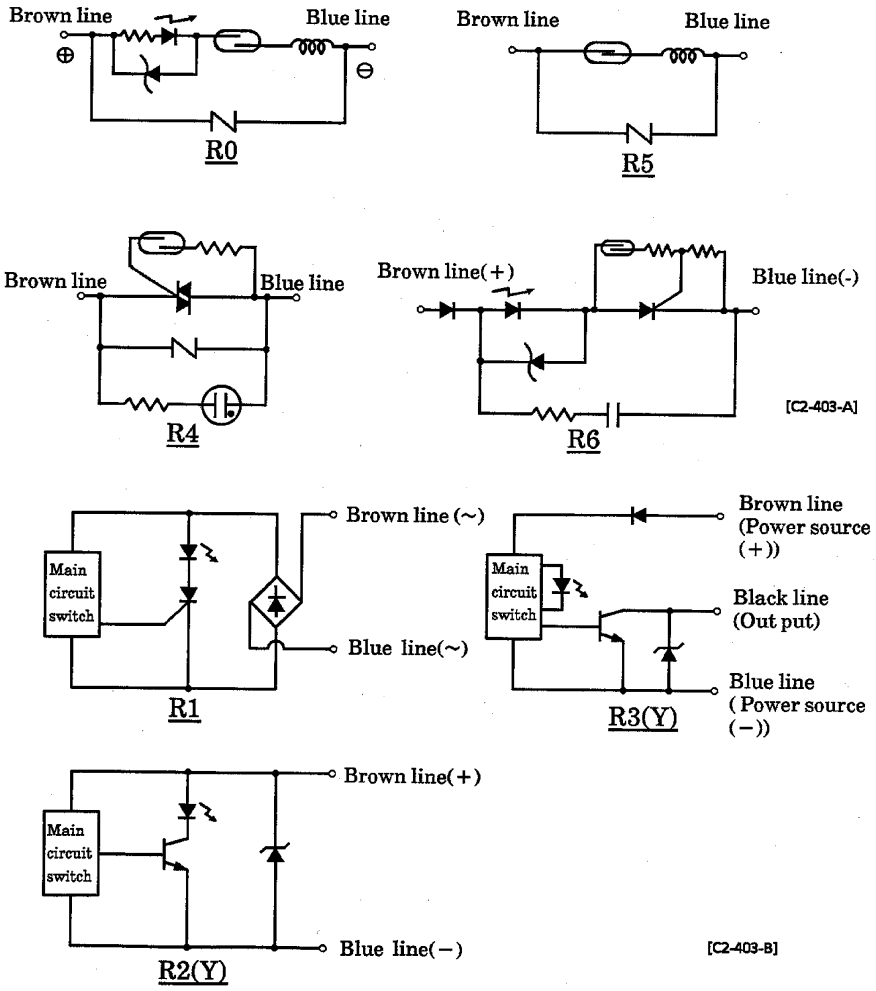
Type & Model / Item	Solid state type				
	R1(K)	R2(K)	R2Y(K) (Bi)	R3(K)	R3Y(K) (Bi)
Application	PLC, relay, compact solenoid valve	Exclusively with PLC		PLC, relay, IC circuit, compact solenoid valve	
Power supply voltage	——	——		4.5~28VDC	
Load voltage	85~265VAC	10~30VDC		30VDC or less	
Load current	5~100mA	5~30mA		200mA or less	150mA or less
Consumption current	——	——		10mA or less when it is on at 24VDC	16mA or less when Green LED is on at 24VDC
Internal voltage drop	7V or less	4V or less		0.5V or less at 150mA	0.5V or less
Indicator light	LED (Lights while power is ON.)		LED (Red/Green) (Lights while power is ON.)	LED (Lights while power is ON.)	LED (Red/Green) (Lights while power is ON.)
Leak current	1 mA or less at 100VAC 2 mA or less at 200VAC	1mA or less	1.2mA or less	10μA or less	
Lead wire length (Note 1)	Standard 1 m (Oil-proof vinyl cabtyre cord, 2-core, 0.3mm^2)			Standard 1 m (Oil-proof vinyl cabtyre cord, 3-core,0.2 mm^2)	
Max. shock resistant	980m/s^2 {100G}				
Insulation resistance	20 MΩ or more at 500V megger DC				
With standing voltage	No defection after one minute charging at 1500V AC	No defection after one minute charging at 1000V AC			
Ambient temperature	−10~+60° C				
Degree of protection (Note 3)	For grommet-oil protection and water tight comformed to IEC code(IEC529), IP67 and JIS code(C0920)				

Note 1 3m or 5m long lead wire is optionally available.
Note 2 The maximum load current (30mA) mentioned above is measured at 25°C ambient temp. If the temp. exceeds 25°C, the load current value will be lower.
Note 3 R※B terminal box is not water-proof. The water-proof R※A type box is the order made item.
Note 4. Please add "K" at the end of the model for solid state switches for SCS/JSC3 series cylinders.
(ex. R1K,R2K,R3K,R2YK,R3YK)

1.2 Table of switch applications

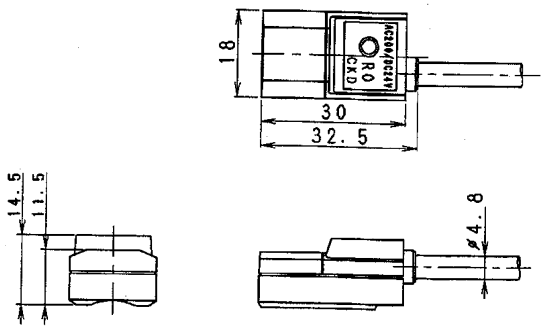
Load · Application \ Model	Reed switch type				Solid state type		
	R0	R4	R5	R6	R1	R2 R2Y	R3 R3Y
Compact relay for DC	○		○				○
Medium relay for DC							○
Compact relay for AC	○		○		○		
Medium relay for AC		○			○		
Compact solenoid valve for DC							○
Compact solenoid valve for AC		○			○		
Digital IC			○				○
PLC(Sink input)	○		○	○		○	
PLC(Source input)	○		○	○		○	○
PLC(AC input)	○		○		○		
Intermediate sensor, high speed cylinder				○			
Multiple units serial connection			○				

1.3 Internal circuit diagrams

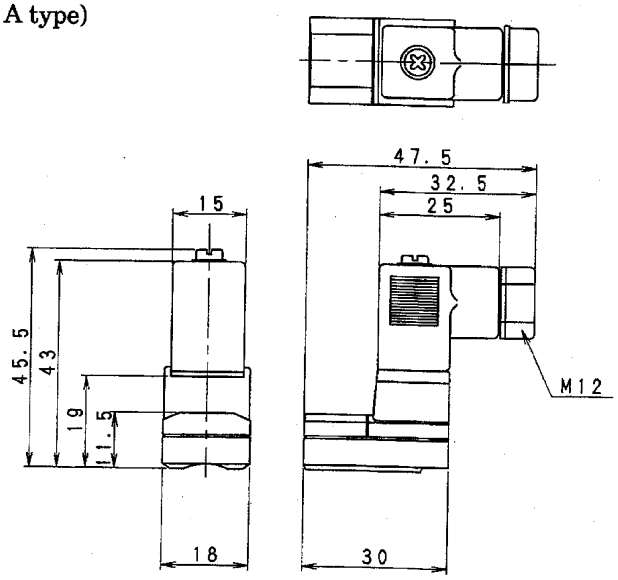


1.4 External dimension diagrams

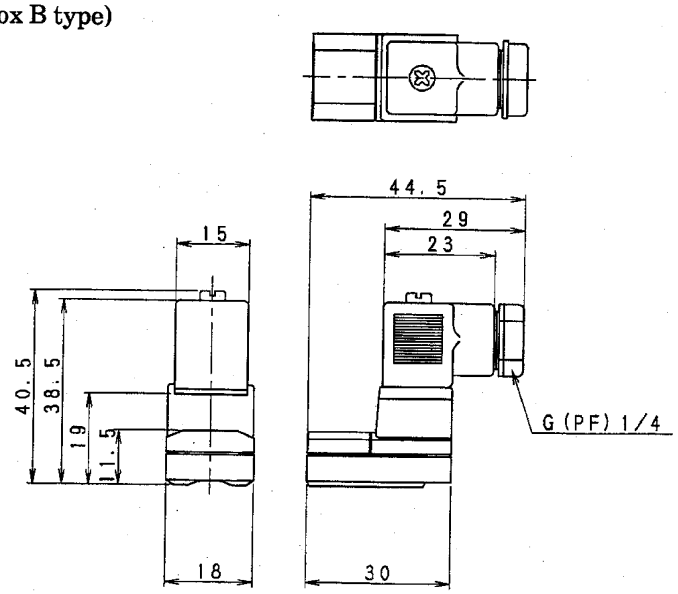
R□□(Grommet type)



R□A(Terminal box A type)



R□B(Terminal box B type)



2. CAUTION

2.1 Common subjects

1) Magnetic environment

Avoid installation of switches within the area where strong magnetic field or large current (such as large magnet or spot welding equipment) exist. There may be a certain influence over sensing accuracy due to the interference of each magnetic field in case of parallel connection of cylinders with switch or when a magnetized article very much closely passes by the cylinder switch.

2) Wiring the lead wire

Considerately lay the lead wire so as to avoid repetitive bending stress or tensile stress. Use such durable enough lead wire as for building robot to wire moving part.

3) Working temperature

Avoid an operation within such high temperature as 60°C or above. Considering the temperature characteristics of magnetic parts and electronic parts, carefully avoid operation within high temperature.

4) Intermediate position sensing

When planning to have switch actuate in an intermediate position of stroke, beware that a certain excessive piston speed makes the switch unable to respond accordingly.

Set the piston speed to 500mm/s or less when the responding time of a relay is 20 ms.

5) Shock

Carefully eliminate to give substantial vibration or strong shock during a course of cylinder transportation or the process of installation or adjusting switch.

6) Parallel connection

The total voltage will decrease when the two wire type switches connections have a leak current. Therefore, confirm the input specifications for the PLC, which are the connecting load. However, dimming or total failure of the lamp may exist.

Three wire type switches hardly ever leak current. When less than 10μA, then leakage may occur. Usually dimming and failure of the lamp do not occur.

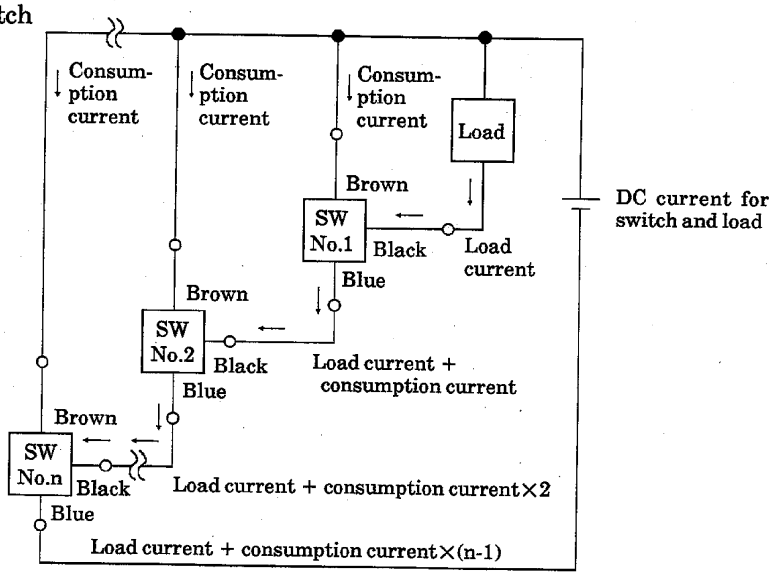
2
CAUTION

7) Serial connection

When two or more two wire type switches are connected in series, the voltage drop is equal to the sum of the voltage drops in all of the connected switches. The voltage applied to the load is the result of subtracting the total voltage drop from the power supply voltage. It is necessary to determine the number of switches to be connected based on the specifications of the load.

When two or more three wire type switches are connected in series, the voltage drop is equal to the sum of the voltage drops in all the connected switches as in the case of the two wire type switches. The current flowing through the switches is equivalent to the sum of the current consumption of the connected switches as shown in the figure below and the load current. Determine the number of switches to be connected based on the specifications of the load so that the current will not exceed the maximum load current.

Three wire type switch



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CAUTION

2.2 Solid state type

1) Connection of lead cord

Comply with the color coding specified on the illustrations. Be sure to turn the power off before starting connecting work.

An erroneous wiring or short circuiting of load causes damage to not only switches, but also load side circuit. Wiring work without shutting electricity off may cause damage to the load side circuit.

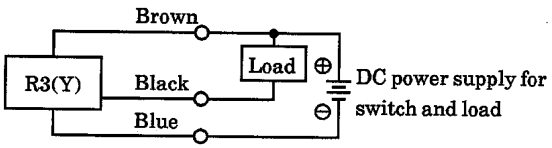

Fig.1 Basic circuit example (1)
(The same power supply is used for switch and load.)

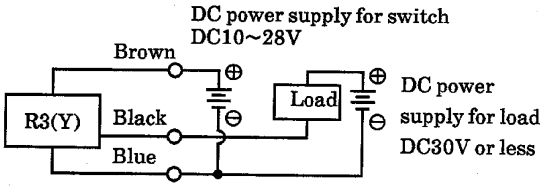

Fig.2 Basic circuit example (2)
(Different power supply are used for switch and load.)

2) Protection of output circuit

Install some protective circuit as illustrated in Fig. 3 when inducing type load (relay or solenoid valve) are to be used because those types apt to generate surge current switch off.

Install some protective circuit as illustrated in Fig. 4 when capacitor type load (Capacitor type) are to be used, because these types apt to generate a dash current when turning the switch ON.

Install some protective circuit as illustrated in Fig. 5 or 6 (in case of model R2(Y)) and Fig 7 (in case of model R3(Y))

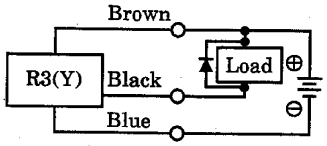

Fig.3 An example of using inducing load together with surge absorptive element (diode). (HITACHI Mfg. made diode V06C or equivalent is recommended.)

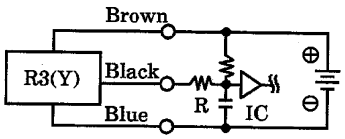

Fig.4 An example of using capacitor type load together with current regulating resister R. Comply with the following formula to figure out required R. $\frac{V}{0.15} = R(\Omega)$

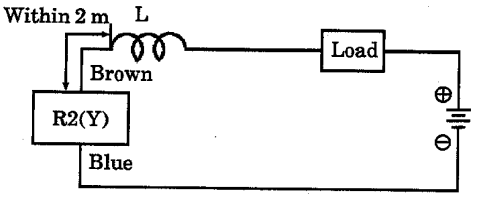

Fig.5 • Choke coil
L= a couple hundred μH ~ a couple mH surpassing high frequency characteristic
• Install it nearby the switch (within 2 m).

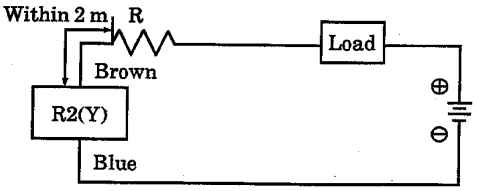

Fig.6 • Dash current restriction resister
R= As much large resister as the load circuit can afford.
• Install it nearby the switch (within 2 m).

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CAUTION

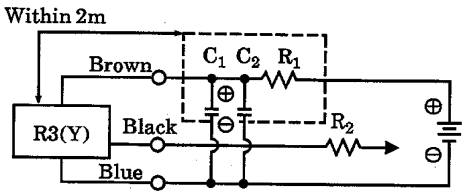


Fig.7

- Electric power noise absorptive circuit
  C_1=20~50μF electrolytic capacitor
  (withstanding 50V or more)
  C_2=0.01~0.1μF ceramic capacitor
- Dash current restriction resister
  R_1=20~30Ω
  R_2=As much large resister as the load circuit can afford.
- Install it nearby the switch (within 2 m).

3) Connection to a PLC

Type of connection varies depending upon the model of the PLC. Refer to the following Fig. 8~12 respectively.

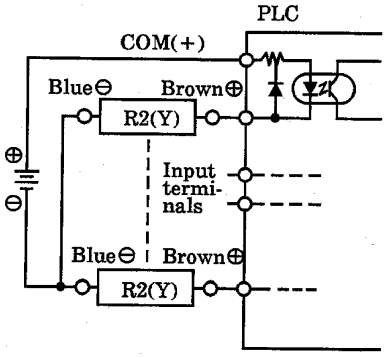


Fig.8 An example of R2(Y) connection to source input type (an external power supply)

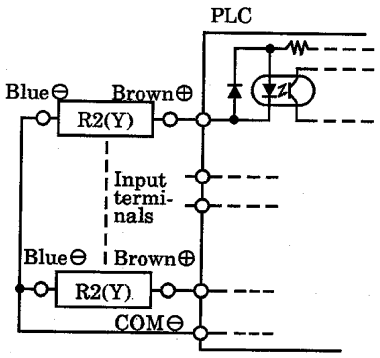


Fig.9 An example of R2(Y) connection to source input type (an internal power supply)

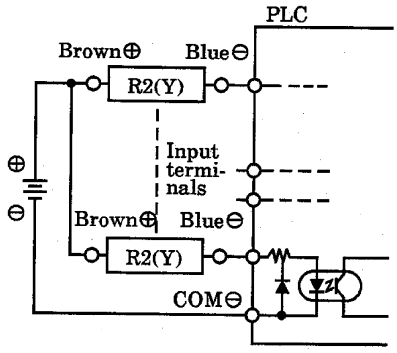


Fig.10An example of R2(Y) connection to sink input type

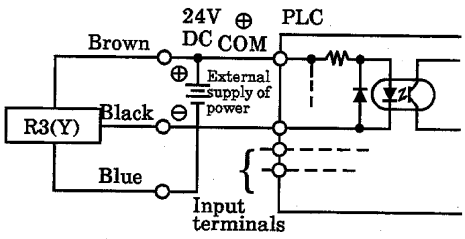


Fig.11An example of R3(Y) connection to source input type (an external power supply)

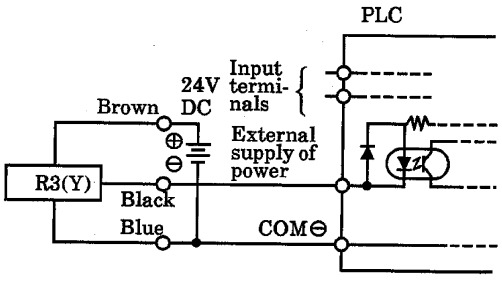


Fig.12An example of R3(Y) connection to source input type (an internal power supply)

2.3 Reed switch type

1) Connection of lead cord

Instead of connecting the cord to the power supply directly, always connect to the load in series. In case of model R0 connection, pay the following precautions.

Ⓐ For DC connection, use such polarities of cords as brown ⊕ and blue⊖. The switch still functions right with reversed polarities but lamp is not lit.

Ⓑ For AC connection to either relay or input terminal to PLC, switch lamp sometimes is not lit in case when half-wave rectification is being carried out. Lamp is lit, in this occasion, when polarities of cords for switch is reversed.

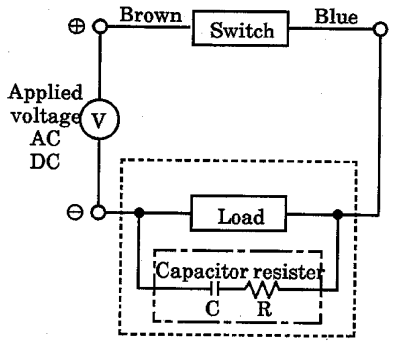
2) Capacity of contact points

Avoid using a load exceeding the max. capacity of contact points. On the other hand, in case of R0 model, switch lamp may not be lit sometimes when current is lower than the rated current.

3) Protection of contact point

Install such a protective circuit as illustrated in either Fig 1 or 2, as follows, when inducing a type load such as a relay is to be used.

If the wire for the DC voltage is longer than 50 m or the wire for the AC voltage exceeds 10 m, add a contact protective circuit as shown in Fig.1 and Fig. 2.

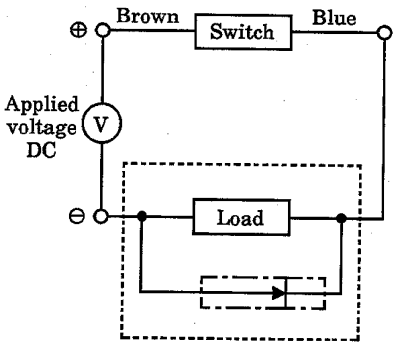


User circuit

Protective circuit (Spark absorbing circuit)

Recommended value
C (Capacitor) = 0.033~0.1μF
R (Resister) = 1~3kΩ
XEB1K1 (OKAYADENKI Mfg.) or equivalent

Fig.1 When capacitor and resister is used.



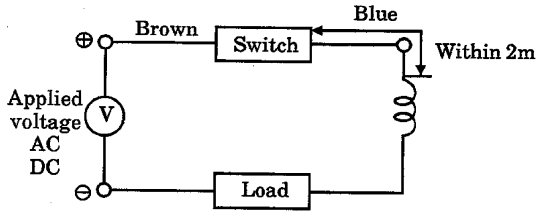
User circuit

Protective circuit

Rectifying diode, general use
V06C (HITACHI Mfg.) or equivalent

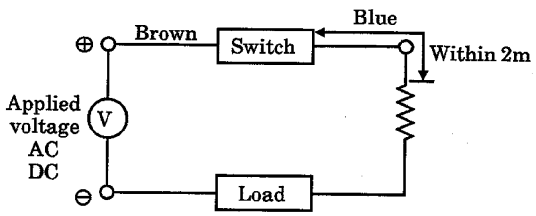
Fig.2 When diode is used.

2
CAUTION



- Choke coil
  L= A couple hundred μH ~ a couple mH surpassing high frequency characteristic
- Install it near by a switch (within 2 m).

Fig. 3



- Dash current restriction resister
  R= As much large resister as the load circuit can afford.
- Install it near by a switch (within 2 m).

Fig. 4

4) Relay

Use such products as specified below or equivalent.

○OMRON Corporation	Model MY
○FUJI ELECTRIC Corporation	Model HH5
○MATSUSHITA ELECTRIC WORKS Ltd.	Model HC

3. OPERATION

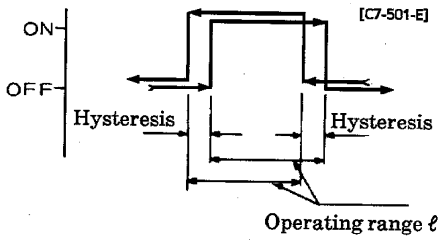
3.1 Operating range, hysteresis

1) Operating range

The operating range is the range in which the switch is turned on with the piston moved until it is turned off.

2) Hysteresis

This is the hysteresis by a piston after its activation of the cylinder switch, followed by reversal of its direction of travel, before it turns off the switch again in its backwasrd travel.



Tube bore(mm)		Solid state type(Mono)		Solid state type(Bi)		Reed switch type	
		Operating range(mm)	Hysteresis(mm)	Operating range(mm)	Hysteresis(mm)	Operating range(mm)	Hysteresis(mm)
CMK2 CKV2	ϕ20	5~9.5	1.5 or less	9~13	1 or less	8~11	3 or less
	ϕ25	6~10.5		9.5~14.5		9.5~12.5	
	ϕ32	6~10.5		9.5~14.5		8~11	
	ϕ40	6~11.5		9.5~14.5		9~13	
CMA2	ϕ20	7.5~12		12~16		10~14	
	ϕ30	7~12		12~16		10~14	
	ϕ40	7~12.5		12~16		10~14	
SCA2	ϕ40	6.5~11.5		10~14		9.5~12.5	
	ϕ50	8~12.5		12~16		10.5~14.5	
	ϕ63	7.5~12.5		12~16		10.5~14.5	
	ϕ80	8~13.5		12~16		11.5~15.5	
	ϕ100	8~14		12~17		12~16	
SCS	ϕ125	7.5~14		14~21		11~16	
	ϕ140	7.5~14		18~26		11~16	
	ϕ160	7.5~14		18~26		11~16	
	ϕ180	7.5~14		18~26		11~16	
	ϕ200	7.5~14		18~26		11~16	

Note : The fingures of operating range and hysteresis in the above Table are due to the irregularities in the characteristics of switches, with the repeated irregularities in functional range and difference of each switch being extremely small.

4. INSTALLATION

4.1 Relocation of switch and replacement

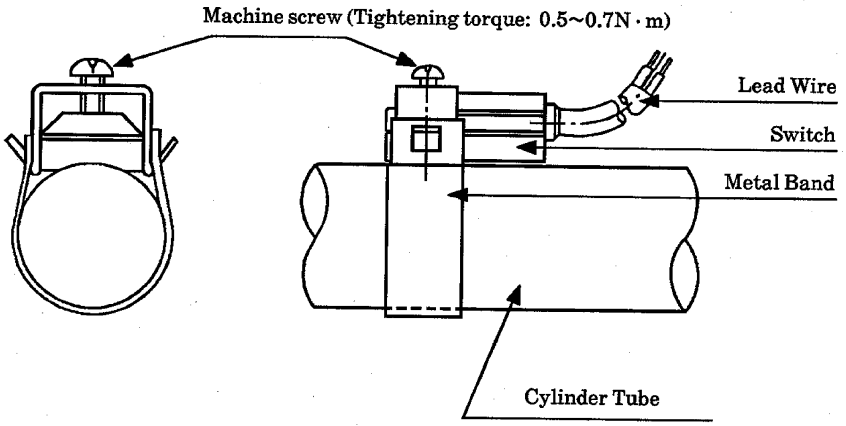
a. Band system(CMK2,CKV2,CMA2)

1) Relocation

Push switch body together with mounting band along the side of cylinder, after loosening set screw (Machine screw) and tighten set screw once required location is determined. Move switch body only while holding band in position for minor adjustment of location.

2) Replacement of switch

Take switch body out of mounting metal band after loosening set screw. Leave band and bracket in an old position on cylinder. Fix new switch to former metal band and tighten set screw upon determination of required location. It makes work easy to slightly turn switch while pushing it into bracket, when working on short stroke cylinder. (Apply tightening torque of 0.5~0.7N·m to tighten the screw.)



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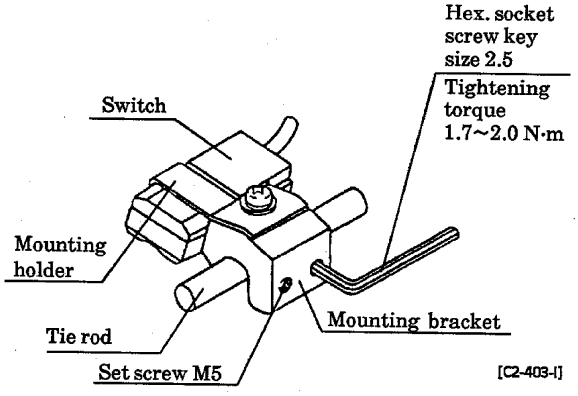
b. Tie rod system(SCA2,JSC3)

1) Relocation

Loosen the set screws (2 ea.) for approx. 1/2 ~ 3/4 turn. It enables the switch to slide along the tie rod without letting screws drop off.

After setting the new location of switch, hold switch holder against the tube surface and tighten set screws to the tie rod. Adequate torque of tightening it is 1.7~2.0N·m. It is considered to be sufficient, as a rule of thumb, when the hexagonal wrench starts bending slightly.



2) Installation of switches

Follow the procedures (1)~(3) as described below.

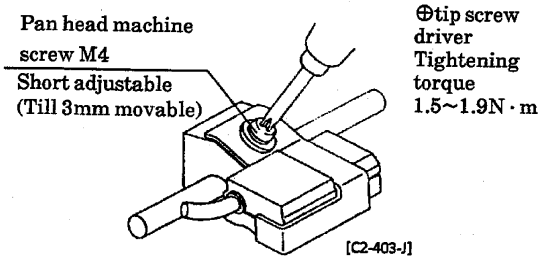
(1) While holding a switch underneath of switch holder, tighten M4×10 pan head machine screws to mount it on the bracket.

(2) Screw-in the set screws to mount the bracket on the tie rod. While letting the mounting bracket hook the tie rod, slightly screw further until it touches the rod. Thus, it eliminates the whole set of switch from falling off the rod, yet enables to slide the set along the rod.

Make use this merit when engaged in adjusting location of the switch set.

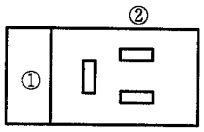
(3) To fix the mounting bracket on the tie rod, tighten screws while pressing bracket slightly against tube.

Adequate torque of tightening screw is 1.7~2.0N·m. It is considered to be sufficient, as a rule of thumb, when the hexagonal wrench starts bending slightly.



4.2 How to make connection to terminal box

1) Connection to terminal box

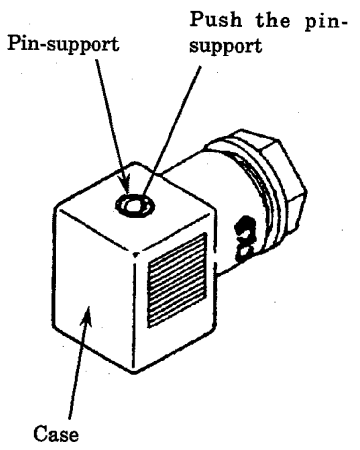


[C2-405-8]

Model \ Terminal	①	②	③
R0 (DC), R2 (Y), R6		+	−
R0 (AC), R1, R4, R5		±	±
R3 (Y)	OUT	+	−

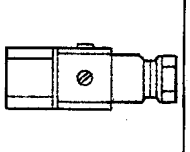
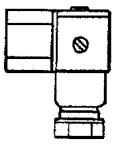
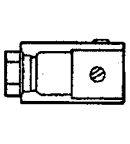
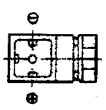
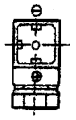
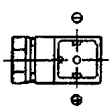
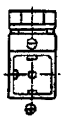
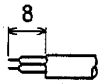
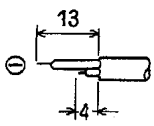
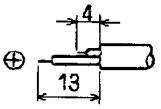
2) For wiring to the R terminal box, use a lead wire with a size of 0.5 - 0.7 mm². When using a cabtyre cord, use one with an outside diameter of 6.6 mm or less.
Follow the steps below to connect the wiring to the R terminal box.

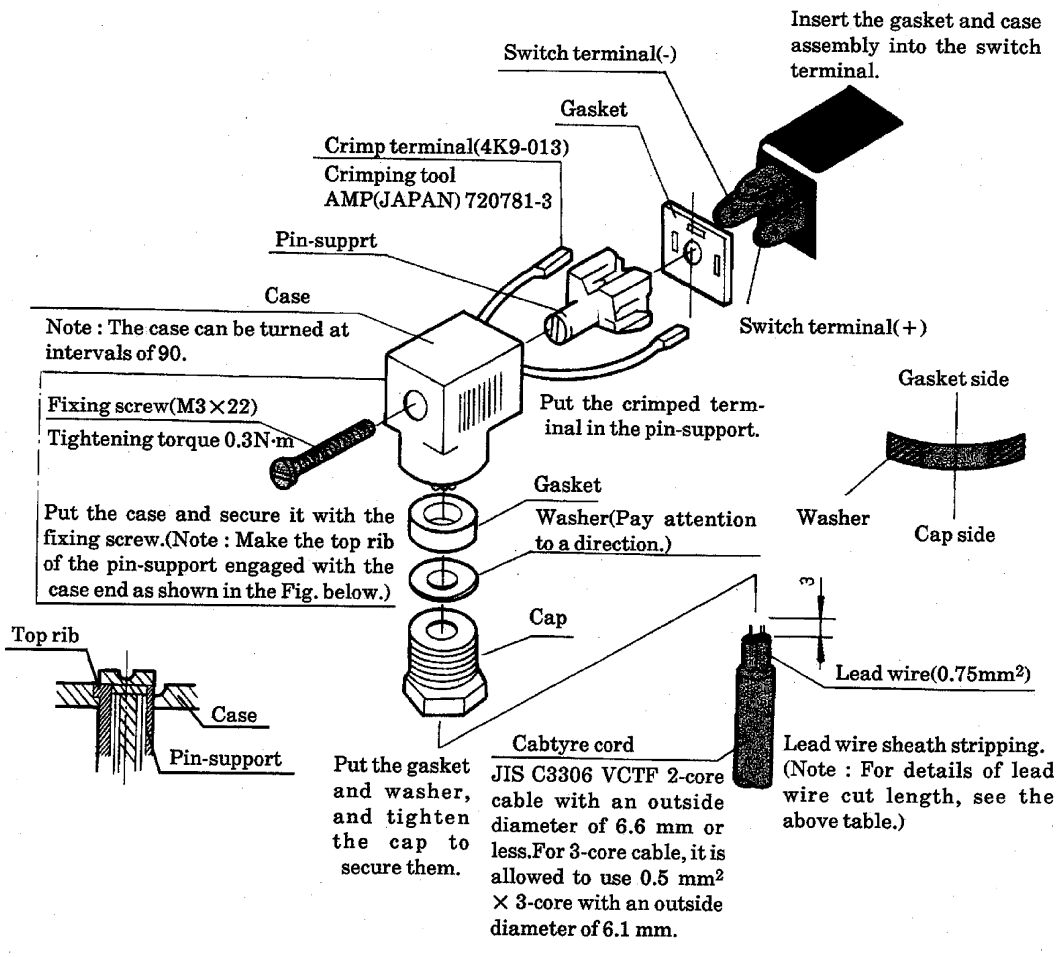
(1) Remove the fixing screw completely and pull out the terminal box from the switch.
(2) Push the pin-support from the top of the case to remove the pin-support from the case.
(3) Remove the cap, and take out the washer and gasket.
(4) Determine the lead wire take-out direction of the terminal box.
(5) Cut the lead wire and strip the wire sheath while carefully checking the case mounting direction.
(6) Crimp the terminal attached to the lead wire.



(7) Pass the lead wire through the cap, washer, gasket, and case in that order while carefully checking their orientations, and then pull it out using long-nose pliers.
(8) Put the terminal in the pin-support.
(9) Put the terminal in the pin-support and push it into the case while carefully checking their orientations. At this time, push the pin-support until the top rib of the pin-support is projected from the top of the case.
(10) Insert the fixing screw into the case and pin-support.
(11) Put the gasket and washer in the case, and tighten the cap to secure them.
(12) Insert the case into the switch terminal and secure them with the fixing screw.
When removing the terminal box to replace the switch, loosen the case fixing screw about eight turns to loosen it and pull out the terminal box with the screw put in the case. After the switch has been replaced with a new one, insert it into the terminal again and secure them with the fixing screw.

- The lead wire cut length may vary depending on the case mounting direction. For details, see the following table.

Top view of case mounting direction				
Bottom view of case mounting direction				
Lead wire length				



5. MAINTENANCE

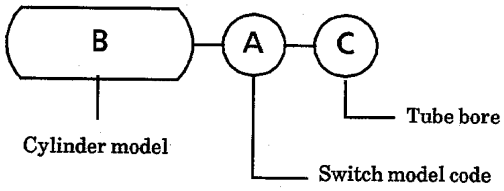
5.1 Troubles and corrective measures

Troubles	Causes	Remedies
Indicator lamp is not lit.	Deposited contact point	Replace the switch.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
	Damaged lamp	Replace the switch
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
Switch does not function right.	Broken circuit	Replace the switch.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
	Improper voltage	Correct voltage to specified.
	Incorrect location of switch	Correct its location.
	Aberrant position of switch	Set it back to original position and tighten the mounting device.
	Incorrect direction of switch mounting	Correct the direction of the switch mounting.
	Relay is unable to respond properly	Replace the relay with a recommended one.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
	Excessive speed of piston if it is to sense an intermediate point of stroke	Reduce the speed of piston. Connect switches in parallel. Use "R6" type.
Switch does not return.	Piston is not moving	Make the piston move.
	Deposited contact point	Replace the switch
	Excessive load (relay) than rated capacity	Replace the relay with a recommended one or replace the switch.
	Improper ambient temperature	Adjust the ambient temperature within the range of −10~60°C
	Existence of a foreign magnetic field	Shield the magnetic field.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.

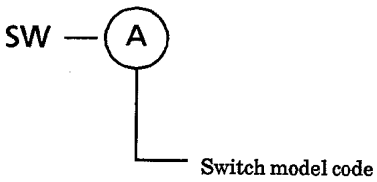
Note 1. Refer "4. INSTALLATION" as for replacing a switch and correcting its location.

6. MODEL CODING

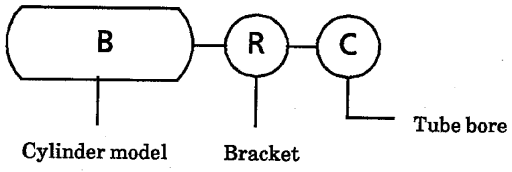
(A) Switch body + Mounting bracket



(B) Switch alone



(C) A set of mounting bracket



Ⓐ Switch model coding					
Grommet	Water-proof terminal box	Terminal box	Function		
R0 ※	R0A	R0B	Relay, PLC for AC/DC	Reed switch type	2-core
R4 ※	R4A	R4B	High capacity relay for AC		
R5 ※	R5A	R5B	Relay, PLC for AC/DC, IC circuit, w/o indicator		
R6 ※	R6A	R6B	Self holding (PLC for DC)		
R1(K) ※	R1(K)A	R1(K)B	PLC, relay, small solenoid valve for AC	Solid state type	
R2 (Y)(K) ※	R2(Y)(K) A	R2(Y)(K) B	PLC exclusively for DC		
R3 (Y)(K) ※	R3(Y)(K) A	R3(Y)(K) B	PLC, relay, IC Circuit, solenoid valve for DC		3-core

The mark ※ indicates the length of the lead wire.

Ⓑ Cylinder model	
CMK2	SCA2
CMA2	JSC3
CKV2	SCS
JSM2	HCA
CAV2	MFC
COV2	ULK

Ⓒ Tube bore (mm)			
20	ϕ20	80	ϕ80
25	ϕ25	100	ϕ100
30	ϕ30	125	ϕ125
32	ϕ32	140	ϕ140
40	ϕ40	160	ϕ160
50	ϕ50	180	ϕ180
63	ϕ63	200	ϕ200

※ Lead wire length	
No marking	1m (Standard)
3	3m (Option)
5	5m (Option)