Safety Precautions

Always read this section before use.
Refer to page 2 for general information of the cylinder, and to the body text for detailed precautions of each series.

Cylinder switch

Design & selection

⚠WARNING

■ Application, load current, voltage, temperature, impact, environment, etc., exceeding the specifications will result in damage or operation faults. Use the device as instructed in specifications.

■ Never use this product in an explosive gas atmosphere. The cylinder switch does not have an explosive-proof structure. Never use in an explosive gas atmosphere as explosions or fires could result.

⚠CAUTION

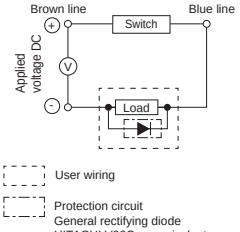
■ Check the following when you use this product for an interlock circuit.
When you use the cylinder switch for an interlock signal which requires high reliability, provide a double interlock mechanism by installing a mechanical protection device or a switch (sensor) in addition to the pressure switch as a guard against failure. Regularly inspect and confirm that the interlock activates correctly.

■ Check the contact capacity.
Do not use a load that exceeds the switch's specified voltage and current. This may lead to failure.

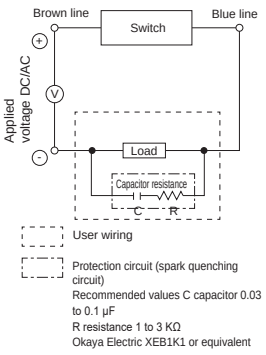
■ Check the contact protection circuit. (Reed switch)

● When an inductive load (relay or solenoid valve) is connected, a surge voltage is generated when the switch is turned OFF. Be sure to provide a contact protection circuit.

● Diode used



● Capacitor and resistance used



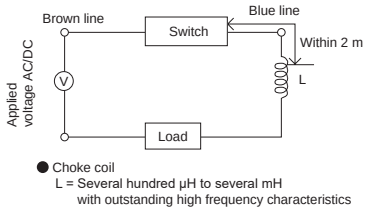
● When a capacitive load (capacitor) is connected, a rush current is generated when the switch is turned ON. Be sure to provide the contact protection circuit.

● When wiring becomes long, a rush current is generated when the switch is turned ON because of its wiring capacity, resulting in breakage or shortened service life of the switch. Be sure to provide a contact protection circuit when the wiring length exceeds the values in Table 1. When using T8 at 200 VAC, make sure that the allowable wire length is shorter than others. Consult CKD for details.

Switch	Voltage	Wire length
T, K, F	DC	50 m
T, K	AC	10 m

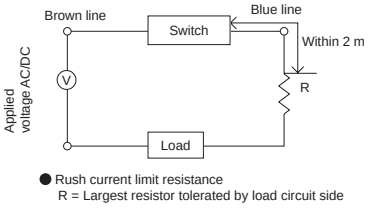
Table 1

● With Choke coil



● Choke coil
L = Several hundred μH to several mH
with outstanding high frequency characteristics

● Resistance used



● Rush current limit resistance
R = Largest resistor tolerated by load circuit side

■ Avoid using in an environment exposed to water.

● Insulation failure may cause malfunction.

■ Avoid using this product in environments where oil or chemical mist is present.

● The cylinder switch could be adversely affected (insulation fault, malfunction caused by swelling of filled plastic, hardening of lead wire sheath, etc.) if used in an environment where oil, coolant, or cleaning fluid is used. Contact CKD.

● Cutting oil proof cylinder switches are available. Refer to "Guide to pneumatic devices compatible with cutting oil" (No. CC-N-375) for details.

■ Do not use in a high impact environment.
If a significant impact (294 m/s^2 or greater) applies to a reed switch, the contacts may instantaneously (1 ms or less) close or open erroneously. It may be necessary to use a proximity switch depending on the working environment. Consult with CKD.

■ Do not use this product in surge generating areas.

If there are devices and components (solenoid lifters, high frequency induction furnace, motors, etc.) around the cylinder with proximity switch that generate a large surge, consider surge protection of the source as it may lead to deterioration or damage of the switch internal circuit element.

■ Check for any magnets in the vicinity.

If magnetic objects (materials attracted to a magnet) exist in the close vicinity of the cylinder with a cylinder switch, the magnetic force in the cylinder is lost, leading to a cylinder switch failure.

⚠ CAUTION

■ Take note of the distance between cylinders.

- When installing more than one cylinder with switches in parallel, keep sufficient distance between the cylinder tubes according to the cylinder specifications.
  Mutual magnetic interference may cause the switch to malfunction.

■ Check the magnetic environment.

- If a strong magnetic field exists around it, use a svwitch for AC magnetic field. (T2YD)
  If a magnet moves around in the vicinity of the cylinder, they may interfere with each other affecting the detection accuracy.

■ In the mid-stroke position, pay attention to the ON time of the cylinder switch.

- When setting the cylinder switch at mid-stroke and driving a load with the piston movement, if the speed is too fast, the cylinder switch will function but operation time will be too short and the load may not respond correctly.
  The maximum detectable piston speed will be:

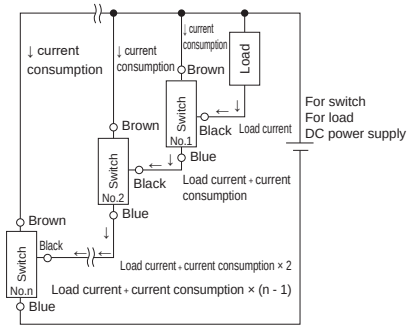
$$V\ (mm/s) = \frac{\text{Cylinder switch operation range (mm)}}{\text{Load operation time (s)}}$$

If the piston speed is too fast, use an off delay output cylinder switch T2JH/V (models are limited).

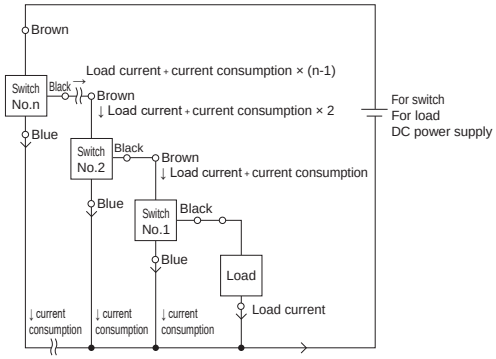
■ Pay attention to the serial connection usage method.

- When serially connecting several 2-wire switches, the switch voltage drop is the total voltage drop of all connected switches. The voltage applied to the load is the voltage obtained by subtracting the voltage drop at switches from the power supply voltage. Check load specifications and determine the number of switches.
- Connecting several 2-wire proximity switches in series may result in a malfunction. Contact CKD in advance. It is recommended to use reed switches.
- When connecting several 3-wire serial proximity switches, the switch voltage drop is the total voltage drop of all connected switches, as with the 2-wire switch. In addition, the current flowing to the switch is the sum of current consumption and load current of the switches connected as in the upper right figure. Check load specifications and determine the number of connections so as not to exceed the maximum load current of the switch.
- The indicator lamp turns ON only when all switches are ON.

Fig. 1: For T3 (Y), K3 (Y) and F3 (Y)



For T3P, K3P and F3P



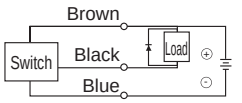
■ Pay attention to the parallel connection usage method.

- When connecting several 2-wire switches in parallel, note that leakage current increases in proportion to the number of connected units. Check load specifications and determine the number of connections.
- With the 2-wire proximity switch, when 1 switch changes from ON to OFF status, voltage at both ends of the switch connected in parallel drops to the internal voltage drop value when the switch is ON and goes below the load voltage range, so other switches will not turn ON. Therefore, check the input specifications of the programmable controller that is the connected load before use.
- Since the leakage current value of the 3-wire proximity switch is very small (10 μA or less), it should not be a problem for normal use.
- Note that switch' indicator lamp could dim or may not turn ON.

■ Output circuit protection (Proximity switch)

● When an inductive load (relay or solenoid valve) is connected, a surge voltage is generated when the switch is turned OFF. Be sure to provide the following protection circuit.

T3 (Y), K3 (Y), F3 (Y)

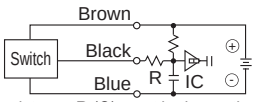


● Diode
D = Made by Hitachi
V06C or equivalent

Example of adding a surge absorption element for inductive load.

● When a capacitive load (capacitor) is connected, a rush current is generated when the switch is turned ON. Be sure to provide the protection circuit shown below in the figure.

T3 (Y), K3 (Y), F3 (Y)



Resistance R (Ω) must be larger than the following equation in this case.

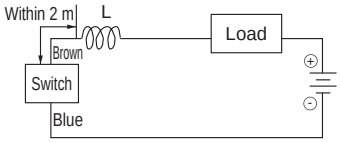
$\frac{V}{0.15}$ = R (Ω) (R3 (Y), M3 (W))

$\frac{V}{0.05}$ = R (Ω) (T3 (Y), K3 (Y), F3 (Y))

● Be sure to provide the following protective circuit when the lead wire length exceeds 10 m.

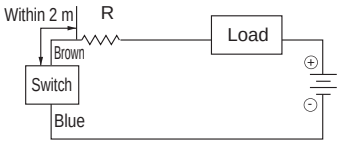
T2 (Y/J), K2 (Y), F2

● With Choke coil



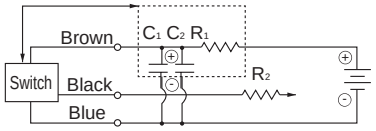
● Choke coil
L = Several hundred μH to several mH
with outstanding high frequency characteristics

● Resistance used



● Rush current limit resistance
R = Largest resistor tolerated by load circuit side

● Resistance used
Within 2 m



Power supply noise absorptive circuit
C_1 = 20 to 50 μF
Electrolytic capacitor (Withstand voltage: 50 V or greater)
C_2 = 0.01 to 0.1 μF
Ceramic capacitor
Rush current limit resistance
R_1 = 20 to 30 Ω
R_2 = Use the resistor as large as permitted by the load circuit.

■ Check the reed switch for its useful life.

● Useful life of the reed switch may vary depending on use conditions but it is generally about several million times of use. If the machine at your site needs to be put into a day and night operation or a high frequency operation, useful life of the contact will be reached in a short term; therefore using a proximity switch with no contact part is recommended.

⚠CAUTION

■ Do not drop or apply impact.

Do not drop or bump the switch or apply excessive impact (294 m/s² or greater for reed switches, 980 m/s² or greater for proximity switches) to it. Even if the switch case does not break, switch components may break leading to malfunction.

■ Do not carry the cylinder by the switch's lead wire.

This may cause disconnection of lead wire, but this also applies stress inside the switch, which may break an internal element of the switch.

■ Do not wire together with power lines or high voltage lines.

Avoid the use of parallel wiring or wiring in the same conduit as that of power lines or high voltage lines. Wire separately. The control circuit containing the cylinder switch could malfunction due to noise.

■ Do not short-circuit the load.

If turned ON in a state of load short-circuit, excess current will flow and the switch will be instantly damaged.

■ Pay attention to the lead wire connection.

Turn OFF power to the device in the electric circuit to be connected before starting wiring. If operated while the power is turned ON, it may cause accidents due to electric shock or unpredicted operation.

● Reed switch

Do not connect the switch lead wire directly to the power supply. Connect the load serially. Pay attention to the following (1), (2) for RO, MO, TO, KO, EO, FO, ETO.

(1) When used for DC, connect the brown wire on the positive (+) side and the blue wire on the negative (-) side. The switch will function when connected in reverse, but the indicator lamp will not turn ON. (There is no polarity for HO.)

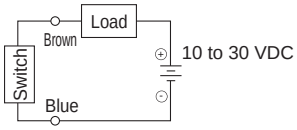
(2) When connected to an AC relay or programmable controller input, conducting half wave rectification with that circuit may prevent the indicator lamp from turning ON. The indicator lamp will come ON when the switch lead' polarity is reversed.

● Proximity switch

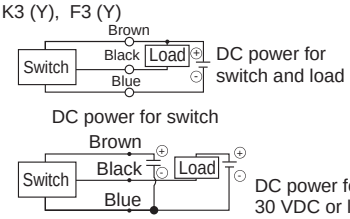
Correctly connected lead wires on the right based on color coding.

Incorrect wiring could result in damage.

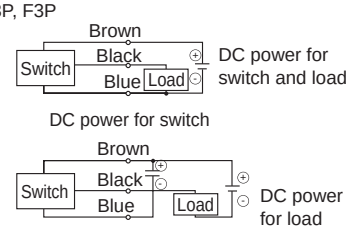
● T2 (Y), T2J, K2 (Y) and F2 (Y) (T2YD does not have polarity)



● T3 (Y), K3 (Y), F3 (Y)



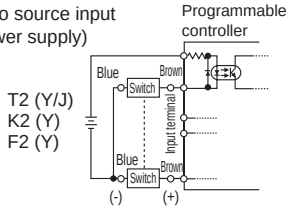
● T3P, K3P, F3P



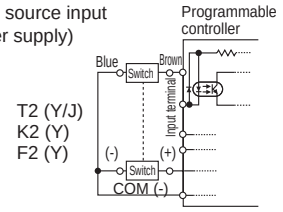
(Connection to programmable controller (PLC))

● Connecting method may vary depending on the type of programmable controller. Refer to the input specifications.

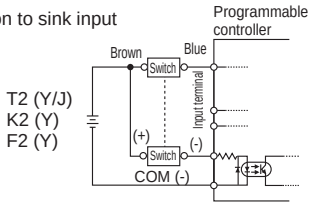
● Connection to source input (external power supply)



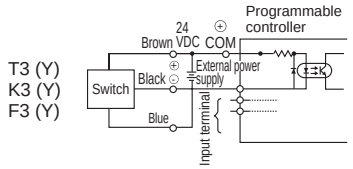
● Connection to source input (internal power supply)



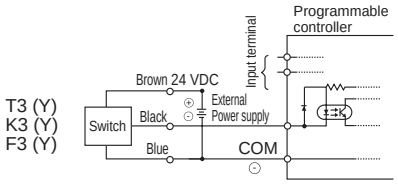
● Connection to sink input



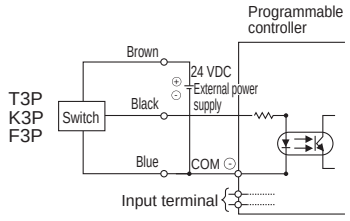
● Connection to source input (external power supply)



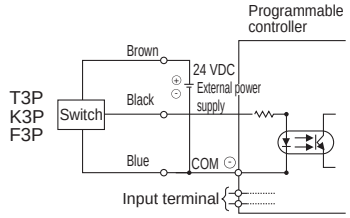
● Connection to source input (internal power supply)



● Example of connection to sink input (external power supply)



● Example of connection to sink input (internal power supply)



■ Set the switch to the center of the operation range.

The cylinder switch position should be adjusted so that the piston stops at the center of its operating range (the range where the switch is ON). (The mounting position in the catalog indicates the optimum position at the end of the stroke.) If the switch position is adjusted to be at the end of the stroke, the operation may become unstable around the boarder line of ON and OFF.

■ Observe tightening torque when mounting the switch.

If you tighten the bolts exceeding the torque range, the set screw, the bracket, or the switch may be damaged. On the other hand, if you do not tighten the screw sufficiently, the switch may be displaced.

■ Lead wire protection

The lead wire's minimum bending radius is 9 mm (when fixed). Pay attention to wiring so repeated bending and tensile strain do not apply to the lead wire. For moving part, use T2H/VR cylinder switch (restriction applies to equipped models) with bend tolerant lead wire, which has higher bend tolerance.

■ Relay

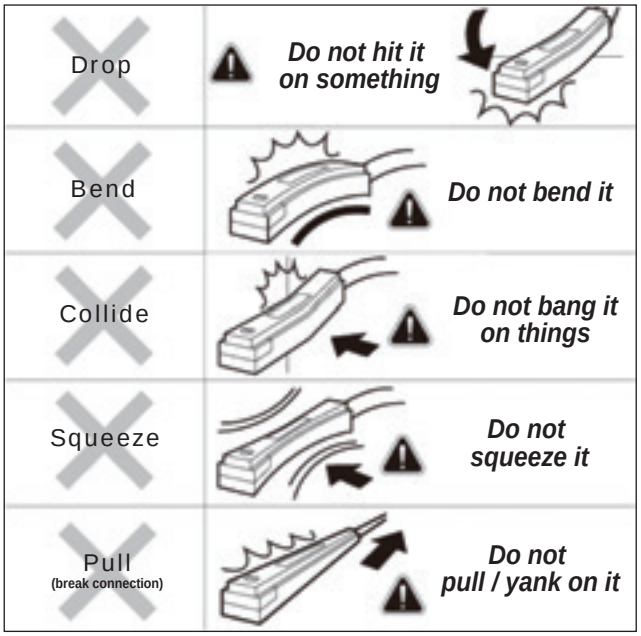
Use the following or equivalent relays.

○ Omron model …… MY
○ Fuji Electric Corporation model…… HH5
○ Tokyo Electric model …… MPM
○ Panasonic model…… HC

1. Precautions for external force

⚠CAUTION

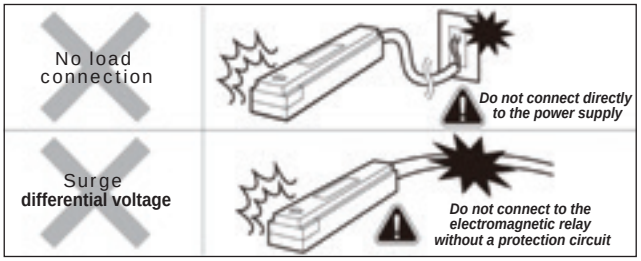
■ Especially when using the reed type, the reed switch (glass tube) could be damaged or sensitivity could decrease.
Example: T0□, T5□, T8□ types



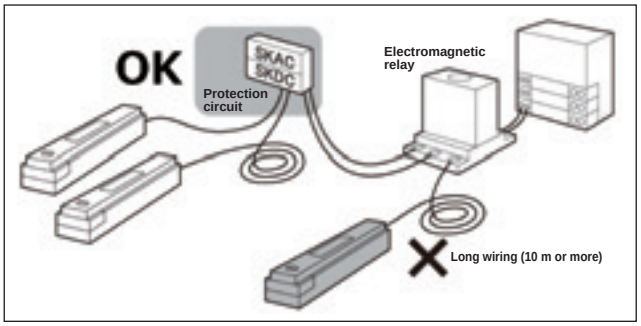
2. Precautions for "Overcurrent/Overvoltage"

■ Do not connect directly to the power supply.

■ Do not connect to the electromagnetic relay without a protection circuit.



■ Install a "protection circuit" for the electromagnetic relay/long wiring.



⚠WARNING

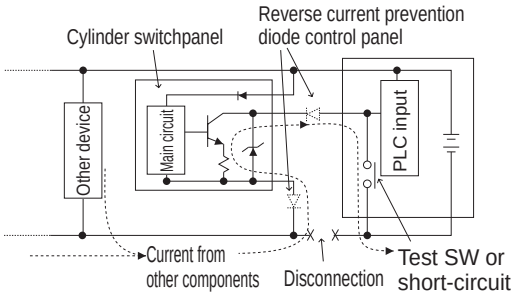
■ Do not apply overcurrent.

If overcurrent flows to the cylinder switch because of a load short-circuit, etc., the cylinder switch will be damaged with a risk of ignition.
Provide an overcurrent protection circuit, such as a fuse, for the output wire and power cable as needed.

⚠CAUTION

■ Pay attention to reverse currents caused by disconnected wires and wiring resistance.

● When other devices, including cylinder switches, are connected to the same power supply as the cylinder switch and the output cable and power cable are short-circuited or the power supply is disconnected to check operation of the input unit in the control panel, reverse current could flow to the cylinder switch's output circuit and cause damage.

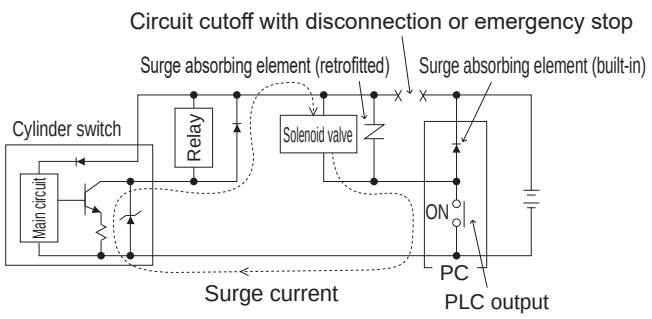


● Take countermeasures as followings to prevent damages caused by reverse current.

(1) Avoid centralizing current at the power cable, especially the negative power cable, and use as thick a cable as possible.
(2) Limit the number of devices connected to the same power supply as the cylinder switch.
(3) Place a diode in series with the cylinder switch's output cable to prevent reverse current.
(4) Place a diode in serial with the cylinder switch's negative power cable to prevent reverse current.

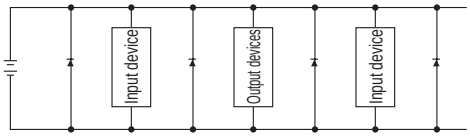
■ Care must be taken for surge current leading.

● When power is shared with inductive loads which create a surge current such as a cylinder switch, a solenoid valve or a relays, a surge current may enter the output circuit and cause damage depending on where the surge absorbing element is placed if the circuit gets closed with inductive loads activated.



● Take the measures below to prevent damage from sneak surge current.

(1) Separate the power supply for the output system which has inductive load such as a solenoid valve and a relay and for the input system such as a cylinder switch.
(2) If separate power supplies cannot be used, directly install a surge absorption element for all inductive loads. Remember that the surge absorbing element connected to a PLC protects only that device.
(3) Connect a surge absorbing element to the power wiring at the following places as shown below as a measure against disconnections in unspecific areas.



When devices are connected to a connector, the output circuit could be damaged by the above if the connector is disconnected while power is ON. Turn power OFF before connecting or disconnecting the connector.