

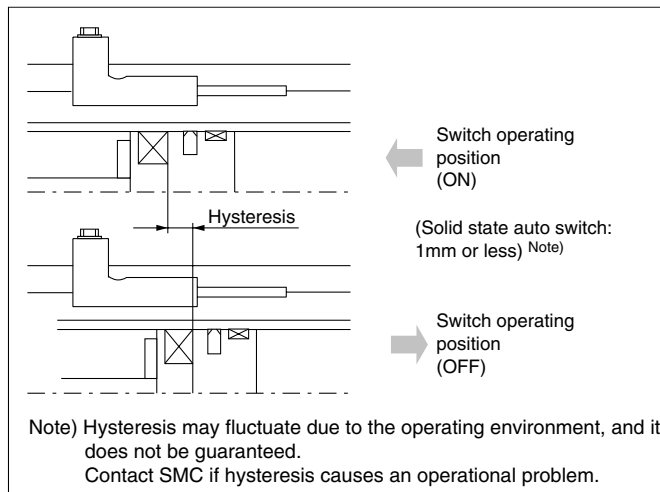
# Auto Switch Specifications

## Specifications

Type	Solid state switch
<b>Leakage current</b>	3-wire: 100 $\mu$ A or less 2-wire: 0.8 mA or less
<b>Operating time</b>	1 ms or less
<b>Impact resistance</b>	1000 m/s <sup>2</sup>
<b>Insulation resistance</b>	50 M $\Omega$ or more at 500 VDC Mega (between lead wire and case)
<b>Withstand voltage</b>	1000 VAC for 1 minute (between lead wire and case)
<b>Ambient temperature</b>	-10 to 60°C
<b>Enclosure</b>	IEC529 standard IP67, JIS C 0920 waterproof construction

## Hysteresis

Hysteresis is the distance between the position at which piston movement operates an auto switch and the position at which reverse movement turns the switch off. This hysteresis is included in a part of the operating range (one side)



## Lead Wire Length

Lead wire length indication

(Example) D-F6P **L**



Lead wire length

Nil	0.5 m
L	3 m
Z	5 m

Note 1) Applicable auto switch with 5 m lead wire "Z"

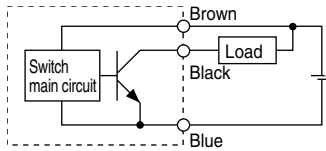
Solid state switch: All types are manufactured upon receipt of order (as standard).

Note 2) The standard lead wire length of solid state switch with water resistant 2-color indication is 3 meters. (0.5 m is not available.)

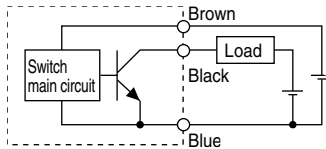
# Auto Switch Connections and Examples

## Basic Wiring

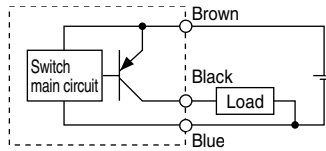
### Solid state 3-wire, NPN



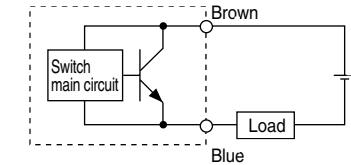
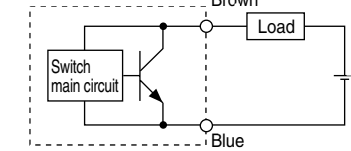
(The switch power supply and the load power supply are another cases )



### Solid state 3-wire, PNP

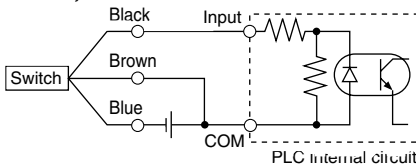


### 2-wire (Solid state)

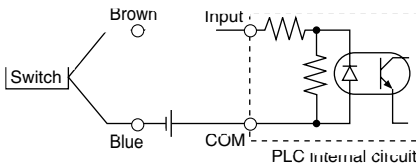


## Example of Connection to PLC

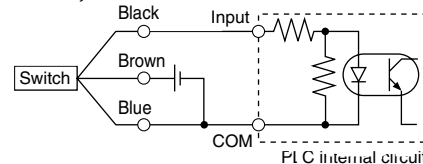
### • Sink input specifications 3-wire, NPN



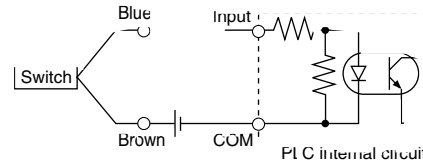
### 2-wire



### • Source input specifications 3-wire, PNP



### 2-wire

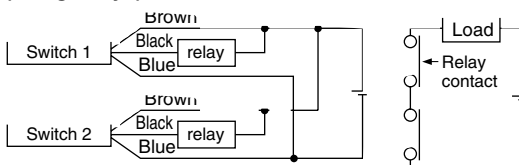


Connect according to the applicable PLC input specifications, since the connection method will vary depending on the PLC input specifications.

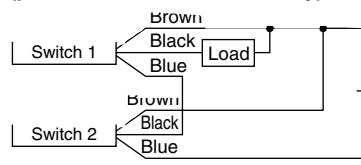
## Example of AND (Series) and OR (Parallel) Connection

### • 3-wire

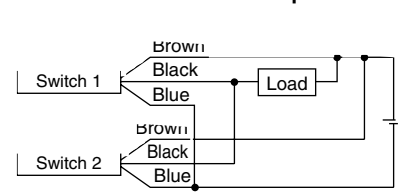
#### AND connection for NPN output (using relays)



#### AND connection for NPN output (performed with switches only)

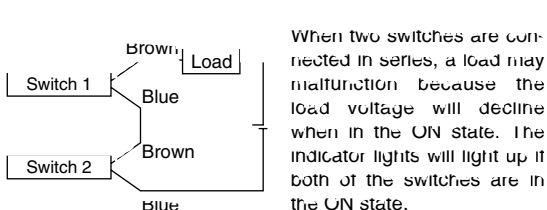


#### OR connection for NPN output



The indicator lights will illuminate when both switches are turned ON.

#### 2-wire with 2 switches AND connection

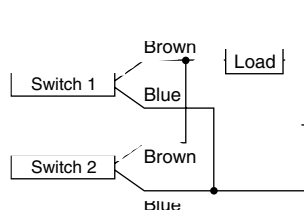


When two switches are connected in series, a load may malfunction because the load voltage will decline when in the ON state. The indicator lights will light up if both of the switches are in the ON state.

$$\begin{aligned} \text{Load voltage at ON} &= \frac{\text{Power supply voltage}}{\text{Internal voltage drop} \times 2} \\ &= \frac{24 \text{ V} - 4 \text{ V}}{2} \\ &= 10 \text{ V} \end{aligned}$$

Example : Power supply voltage is 24 V DC  
Internal voltage drop in switch is 4 V.

#### 2-wire with 2 switches OR connection



(Solid state)  
When two switches are connected in parallel, malfunction may occur because the load voltage will increase when in the OFF state.

$$\begin{aligned} \text{Load voltage at OFF} &= \text{Leakage current} \times 2 \text{ pcs.} \times \text{Load impedance} \\ &= 1 \text{ mA} \times 2 \text{ pcs.} \times 3 \text{ k}\Omega \\ &= 6 \text{ V} \end{aligned}$$

Example : Load impedance is 3 kΩ  
Leakage current from switch is 1 mA.

# Solid State Switch: Direct Mounting Style D-F6N/D-F6P/D-F6B



## Grommet

- 2-wire load current is reduced (2.5 to 40 mA)
- UL certified (style 2844) lead cable is used
- For RoHS



## Auto Switch Specifications

PLC: Programmable Logic Controller

D-F6□ (With indicator light)			
Auto switch part no.	D-F6N	D-F6P	D-F6B
Electrical entry direction	In-line		
Wiring type	3-wire		2-wire
Output type	NPN	PNP	—
Applicable load	IC circuit, relay, and PLC		24 VDC relay, PLC
Power supply voltage	5, 12, 24 VDC (4.5 to 28 V)		—
Current consumption	10 mA or less		—
Load voltage	28 VDC or less	—	24 VDC (10 to 28 VDC)
Load current	40 mA or less		2.5 to 40 mA
Internal voltage drop	0.8 V or less		4 V or less
Leakage current	100 μA or less at 24 V DC		0.8 mA or less
Indicator light	Red LED illuminates when ON.		

- Lead wires Oilproof vinyl heavy-duty cord: 2.7 x 3.2 ellipse  
D-F6B 0.15 mm<sup>2</sup> x 2 cores  
D-F6N, D-F6P: 0.15 mm<sup>2</sup> x 3 cores

Note 1) Refer to page 37 for solid state switch common specifications.

Note 2) Refer to page 37 for lead wire lengths.

## Caution

### Operating Precautions

Fix the switch with the existing screw installed on the switch body. The switch may be damaged if a screw other than the one supplied, is used.

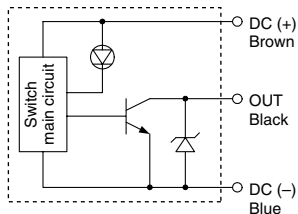
## Weight

Unit g

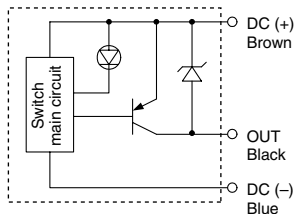
Auto switch part no.	D-F6N	D-F6P	D-F6B
Lead wire length (m)	0.5	20	19
	3	53	50
	5	80	75

## Auto Switch Internal Circuit

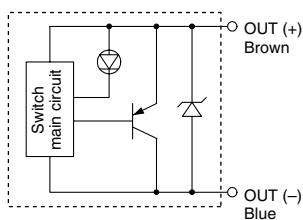
### D-F6N



### D-F6P



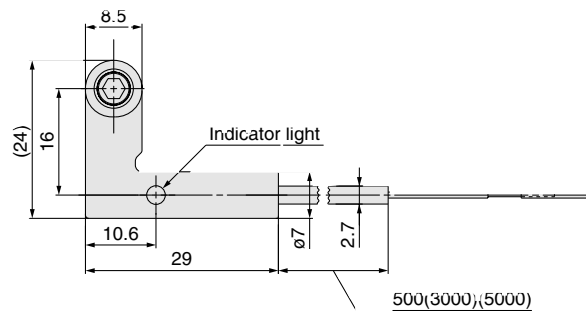
### D-F6B



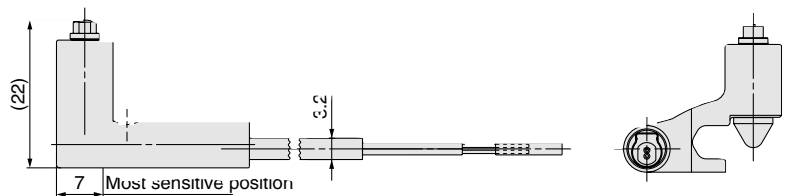
## Dimensions

Unit mm

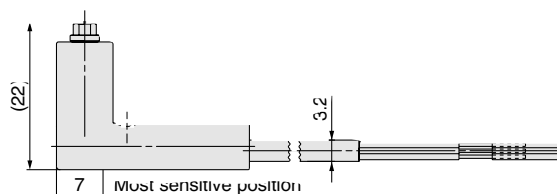
### D-F6□



### D-F6B



### D-F6N/F6P





# Auto Switch Precautions 1

Be sure to read this before handling.

## Caution on Design / Selection

### Warning

#### 1. Confirm the specifications.

Read the specifications carefully and use this product appropriately. The product may be damaged or malfunction if it is used outside the range of specifications of current load, voltage, temperature or impact. We do not guarantee any damage in any case the product is used outside of the specification range.

#### 2. Pay attention to the length of time that a switch is on at an intermediate stroke position.

When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the speed is too great, the operating time will be shortened and the load may not operate properly. The maximum detectable piston speed is:

$$V \text{ (mm/s)} = \frac{\text{Auto switch operating range (mm)}}{\text{Load operating time (ms)}} \times 1000$$

#### 3. Keep wiring as short as possible.

##### <Solid state switch>

Although wire length should not affect switch function, use a wire that is 100 m or shorter.

#### 4. Do not use a load that generates surge voltage. If a surge voltage is generated, the discharge occurs at the contact, possibly resulting in the shortening of product life.

##### <Solid state switch>

Although a zener diode for surge protection is connected at the output side of a solid state auto switch, damage may still occur if a surge is applied repeatedly. When directly driving a load which generates surge, such as a relay or solenoid valve, use a type of switch with a built-in surge absorbing element.

#### 5. Cautions for use in an interlock circuit

When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to safeguard against malfunctions by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch. Also perform periodic inspection and confirm proper operation.

#### 6. Do not repair, disassemble, or make any modifications to the product, including changes in the printed circuit board, as this may result in injury or an accident.

### Caution

#### 1. Take precautions when multiple cylinders (actuators) are used close together.

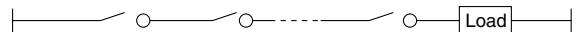
When two or more auto switch cylinders (actuators) are lined up in close proximity to each other, magnetic field interference may cause the switches to malfunction. Maintain a minimum cylinder separation of 40 mm. (When the allowable interval is specified for each cylinder series, use the indicated value.)

#### 2. Take precautions for the internal voltage drop of the switch.

- If auto switches are connected in series as shown below, take note that there will be a large voltage drop because of internal resistance in the light emitting diodes. (Refer to internal voltage drop in the auto switch specifications.)

[The voltage drop will be "n" times larger when "n" auto switches are connected.]

Even though an auto switch operates normally, the load may not operate.



- Similarly, when operating below a specified voltage, it is possible that the load may be ineffective even though the auto switch function is normal. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

$$\text{Supply voltage} - \text{Internal voltage drop of switch} > \text{Minimum operating voltage of load}$$

##### <Solid state switch>

Generally, the internal voltage drop will be great with a 2-wire solid state auto switch.

Also, note that a 12 VDC relay is not applicable.

#### 3. Pay attention to leakage current.

##### <Solid state switch>

With a 2-wire solid state auto switch, current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

$$\text{Current to operate load (OFF condition)} > \text{Leakage current}$$

If the condition given in the above formula is not met, it will not reset correctly (stays ON). Use a 3-wire switch if this specification cannot be satisfied.

Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

#### 4. Ensure sufficient clearance for maintenance activities.

When designing an application, be sure to allow sufficient clearance for maintenance and inspections.



# Auto Switch Precautions 2

Be sure to read this before handling.

## Mounting and Adjustment

### Warning

#### 1. Instruction manual.

Install the products and operate them only after reading the instruction manual carefully and understanding its contents. Also keep the manual where it can be referred to as necessary.

#### 2. Do not drop or bump.

Do not drop, bump or apply excessive impacts (1000 m/s<sup>2</sup> or greater for solid state switches) while handling. Although the body of the switch may not be damaged, the inside of the switch could be damaged and cause a malfunction.

#### 3. Mount switches using the proper tightening torque.

When a switch is tightened above the torque specification, the mounting screws, or switch may be damaged. On the other hand, tightening below the torque specification may allow the switch to slip out of position. (Refer to switch mounting for each series regarding switch mounting, moving, and fastening torque, etc.)

#### 4. Mount a switch at the center of the operating range.

Adjust the mounting position of an auto switch so that the piston stops at the center of the operating range (the range in which a switch is ON). (The mounting positions shown in the catalog indicate the optimum position at the stroke end.) If mounted at the end of the operating range (around the borderline of ON and OFF), operation will be unstable.

#### 5. Secure the space for maintenance.

When installing the products, please allow access for maintenance.

### Caution

#### 1. Do not carry an actuator by the auto switch lead wires.

Never carry a cylinder by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.

#### 2. Fix the switch with the appropriate screw installed on the switch body. If using other screws, switch may be damaged.

## Wiring

### Warning

#### 1. Confirm proper insulation of wiring.

Be certain that there is no faulty wiring insulation (such as contact with other circuits, ground fault, improper insulation between terminals, etc.). Damage may occur due to excess current flow into a switch.

#### 2. Do not wire in conjunction with power lines or high voltage lines.

Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits containing auto switches may malfunction due to noise from these lines.

## Wiring

### Caution

#### 1. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from repeatedly applying bending stress or stretching force to the lead wires.

#### 2. Be sure to connect the load before power is applied.

##### <2-wire type>

If the power is turned ON when an auto switch is not connected to a load, the switch will be instantly damaged because of excess current.

#### 3. Do not allow short circuit of loads.

##### <Solid state switch>

F6□ does not have built-in short circuit protection circuits. If loads are short circuited, the switches will be instantly damaged, as in the case of reed switches.

Take special care to avoid reverse wiring with the brown power supply line and the black output line on 3-wire type switches.

#### 4. Avoid incorrect wiring.

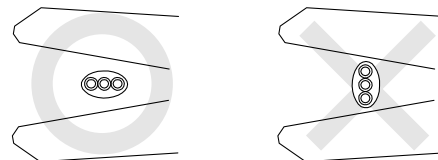
##### <Solid state switch>

If connections are reversed on a 2-wire type switch, the switch will not be damaged if protected by a protection circuit, but the switch will always stay in an ON state. However, it is still necessary to avoid reversed connections, since the switch could be damaged by a load short circuit in this condition.

##### <F6□>

D-F6□ does not have built-in short circuit protection circuit. Be aware that if the power supply connection is reversed (e.g. (+) power supply wire and (-) power supply wire connection is reversed), the switch will be damaged.

#### 5. When the cable sheath is stripped, confirm the stripping direction. The insulator may be split or damaged depending on the direction. (D-F6□)



#### Recommended Tool

Model name	Model no.
Wire stripper	D-M9N-SWY

\* Stripper for a round cable (ø2.0) can be used for a 2-wire type cable.



# Auto Switch Precautions 3

Be sure to read this before handling.

## Operating Environment

### Warning

- 1. Never use in an atmosphere of explosive gases.**

The construction of the auto switch is not intended to prevent explosion. Never use in an atmosphere with an explosive gas since this may cause a serious explosion.
- 2. Do not use in an area where a magnetic field is generated.**

The auto switch will malfunction or the magnets inside of an actuator will become demagnetized if used in such an environment.
- 3. Do not use in an environment where the auto switch will be continually exposed to water.**

The switch satisfies the IEC standard IP67 construction (JIS C 0920: waterproof construction). Nevertheless, it should not be used in applications where it is continually exposed to water splash or spray. This may cause deterioration of the insulation or swelling of the potting resin inside switch causing a malfunction.
- 4. Do not use in an environment with oil or chemicals.**

Consult with SMC if the auto switch will be used in an environment with coolant, cleaning solvent, various oils or chemicals. If the auto switch is used under these conditions for even a short time, it may be adversely effected by a deterioration of the insulation, a malfunction due to swelling of the potting resin, or hardening of the lead wires.
- 5. Do not use in an environment with temperature cycles.**

Consult with SMC if the switch is used where there are temperature cycles other than normal temperature changes, as they may adversely affected the switch internally.
- 6. Do not use in an area where surges are generated.**

<Solid state switch>

When there are units (such as solenoid type lifters, high frequency induction furnaces, motors, etc.) that generate a large amount of surge in the area around an actuator with a solid state auto switch, their proximity or pressure may cause deterioration or damage to the internal circuit of the switch. Avoid sources of surge generation and crossed lines.

### Caution

- 1. Avoid accumulation of iron debris or close contact with magnetic substances.**

When a large accumulated amount of ferrous waste such as machining chips or welding spatter, or a magnetic substance (something attracted by a magnet) is brought into close proximity to a cylinder with auto switches, this may cause the auto switches to malfunction due to a loss of the magnetic force inside the cylinder.
- 2. Contact SMC for the water resistance ability, the elasticity ability of the lead wire, and the welding site etc.**
- 3. Do not expose the product to direct sunlight for an extended period of time.**
- 4. Do not use the product in locations where it is exposed to radiant heat.**

## Maintenance

### Warning

- 1. Perform the following maintenance periodically in order to prevent possible danger due to unexpected auto switch malfunction.**
  - 1) Securely tighten switch mounting screws.

If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.
  - 2) Confirm that there is no damage to the lead wires.

To prevent faulty insulation, replace switches or repair lead wires, etc., if damage is discovered.
- 2. Perform the maintenance procedures outlined in the instruction manual.**

If the maintenance procedures are performed improperly, malfunction or damage to the machinery or equipment may occur.
- 3. Removal of equipment, and supply/exhaust of compressed air.**

When an equipment is serviced, first confirm that measures are in place to prevent workpieces from dropping run-away equipment, etc. Then cut the supply pressure and power, and exhaust all compressed air from the system using the residual pressure release function.

When the equipment is operated after remounting or replacement, first confirm that measures are in place to prevent lurching of actuators, etc. Then confirm that the equipment is operating normally.