



# Auto Switches Precautions 1

Be sure to read this before handling products.

## Design/Selection

There are many different kinds of cylinders, or actuators, including cylinders, air grippers, rotary actuators, and electrical actuators/cylinders.

### Warning

#### 1. Confirm the specifications.

If the product is used with excess load applied or beyond the specification range, this may cause the product to break or malfunction. We do not guarantee against any damage if the product is used outside of the specification range.

#### 2. Use caution when using in an interlock circuit.

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

#### 3. Do not attempt to disassemble, modify (including exchanging the printed circuit boards), or repair the product.

Doing so can result in injury or accident.

### Caution

#### 1. 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 the operating time will be short if the speed is too fast. As a result, the load may not operate completely. The maximum detectable piston speed is:

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

In cases of high piston speed, the use of an auto switch (D-F5NT, F7NT, G5NT, M5NT, M5PT) with a built-in OFF delay timer ( $\approx 200$  ms) makes it possible to extend the load operating time.

Please consult with SMC for information on other models.

#### 2. Take precautions when multiple cylinders/actuators are used close together.

When multiple auto switch cylinders/actuators are used in close proximity, magnetic field interference may cause the auto 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.)

The auto switches may malfunction due to the interference from the magnetic fields.

Use of a magnetic screen plate (MU-S025) or commercially available magnetic screen tape can reduce the interference of magnetic forces.

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

When designing an application, be certain to allow sufficient clearance for maintenance and inspection.

### Caution

#### 4. Do not mount the cylinder or actuator with the auto switch on a footing.

If work personnel gets on or puts their foot on the footing accidentally, an excessive load is applied to the cylinder or actuator, causing the cylinder or actuator to break.

#### 5. Design the circuit to prevent backflow in the event of short-circuit problems or when forced operation is performed to check the operation.

If backflow occurs, this may cause the switch to malfunction or break.

#### 6. When multiple auto switches are required

"n" indicates the number of auto switches which can be physically mounted on a cylinder/actuator. Detection intervals depend on the auto switch mounting structure and set position, therefore some required intervals and set positions may not be available.

#### 7. Limitations on detectable position

There are positions and surfaces (bottom surface of the foot bracket, etc.) where the auto switch cannot be mounted due to physical interference depending on the cylinder or actuator mounting status or mounting bracket. Select an appropriate auto switch setting position where the auto switch does not interfere with the cylinder or actuator mounting bracket (trunnion or reinforcing ring) after checking it sufficiently.



# Auto Switches Precautions 2

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## Mounting/Adjustment

### ⚠ Caution

#### 1. Do not drop or bump.

Do not drop, bump, or apply excessive impact (300 m/s<sup>2</sup> or more for reed auto switches, 1000 m/s<sup>2</sup> or more for solid state auto switches) while handling the auto switch. It may cause the auto switch to break or malfunction.

#### 2. Observe the proper tightening torque for mounting an auto switch.

When an auto switch is tightened beyond the range of tightening torque, auto switch mounting screws, auto switch mounting brackets, or the auto switch itself may be damaged. On the other hand, tightening below the range of tightening torque may allow the auto switch to slip out of position.

#### 3. Do not carry a cylinder or actuator by the auto switch lead wires.

This may cause the disconnection of the lead wire or the internal element to break.

#### 4. Do not use screws other than the set screws installed on the auto switch body to secure the auto switch.

If other screws are used, the auto switch may be damaged.

#### 5. Mount an auto switch at the center of the operating range.

In the case of a 2-color indicator auto switch, mount it at the center of the green LED illuminating range. Adjust the mounting position of the auto switch so that the piston stops at the center of the operating range. (The mounting position shown in the catalog indicates the optimum position at stroke end.)

If mounted at the end of the operating range (around the borderline of ON and OFF), operation may be unstable depending on the operating environment. Also, there are some cylinders or actuators with specific setting methods for auto switches. If so, mount it in accordance with the indicated method.

**Even if 2-color indicator solid state auto switches are secured within the proper operating range (the green light lights up), the operation may become unstable depending on the installation environment or magnetic field disturbance.**

(Magnetic body, external magnetic field, installation near cylinders or actuators with built-in magnets, temperature change, other factors causing magnetic force fluctuation during operation, etc.)

#### 6. Check the actual actuation status and adjust the auto switch mounting position.

According to the installation environment, the cylinder or actuator may not operate even at its proper mounting position. Even when setting at the middle of the stroke, check the actuation status and make adjustments accordingly.

#### 7. Be very careful when handling the auto switch mounting band, as it has a thin structure.

## Wiring

### ⚠ Caution

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

If there is any improper insulation (mixed contact with other circuits, grounding faults, improper insulation between terminals, etc.) in the wiring, an over-current may flow in, causing the auto switch to break.

#### 2. Wire separately from power lines or high-voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines.

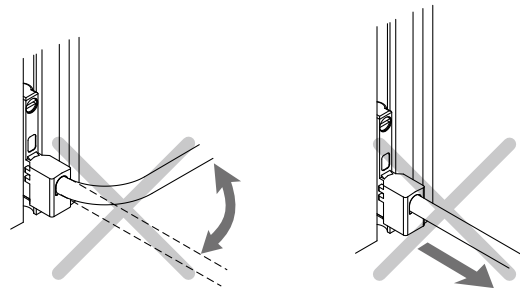
If an inrush current is generated, the noise may cause the auto switch to malfunction.

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

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

Stress and tensile force applied to the connection between the lead wire and the auto switch increases the possibility of disconnection.

Keep the lead wire from moving, especially in the area where it connects with the auto switch.



#### 4. Be certain 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 auto switch will be instantly damaged because of excess current (short circuit).

The same goes for when the 2-wire brown lead wire (+, output) is directly connected to the (+) power supply terminal.

#### 5. Perform wiring only after shutting down the power.

If wiring is performed with the power turned ON, this may cause electric shock, malfunction, or damage to the auto switch.



# Auto Switches Precautions 3

Be sure to read this before handling products.

## Operating Environment

### ⚠ Warning

#### 1. Never use in an atmosphere containing explosive gases.

Auto switches are not designed to prevent explosion. This may cause an explosion hazard.  
Please contact SMC concerning ATEX compliant products.

### ⚠ Caution

#### 1. Do not use in an area where a magnetic field is generated.

Auto switches will malfunction or magnets inside cylinders/actuators will become demagnetized. (Please consult with SMC to see if a magnetic field resistant auto switch can be used.)

#### 2. Do not use in an environment where the auto switch will be continually exposed to water.

Although auto switches satisfy IEC Standard IP67 construction, with the exception of some models (D-A3□, A44□, G39□, K39□, RNK, RPK), do not use auto switches in applications where they will be continually exposed to water splash or spray. This may cause improper insulation or malfunction.

#### 3. Do not use in an environment with oil or chemicals.

If auto switches are used in an environment containing coolant, cleaning solvent, various oils, or chemicals, even for a short period of time, this may adversely affect the auto switches, resulting in improper insulation, malfunction due to the swelling of potting resin, or hardening of the lead wires.

#### 4. Do not use in an environment with temperature cycles.

If temperature cycles other than normal temperature changes are applied, this may adversely affect the insides of the auto switches.

#### 5. Avoid the accumulation of iron waste or close contact with magnetic substances.

If too many iron particles, such as cutting chips or spatters, accumulate around a cylinder or actuator with auto switches, or if a magnetic substance (attracted by a magnet) is put close to a cylinder or actuator with auto switches, the magnetic force inside the cylinder or actuator may weaken, causing the auto switch to malfunction.

#### 6. Please contact SMC concerning water resistance, elasticity of lead wires, usage at welding sites, etc.

#### 7. Do not use in direct sunlight.

#### 8. Do not mount the product in locations where it is exposed to radiant heat.

#### 9. Take appropriate measures against lightning surges on the equipment side, as the auto switches do not have any lightning surge resistance specified in the CE marking.

## Maintenance

### ⚠ Warning

#### 1. Removal of equipment, and supply/exhaust of compressed air

Before any machinery or equipment is removed, first ensure that the appropriate measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the electric power and reduce the pressure in the system to zero. Only then should you proceed with the removal of any machinery or equipment.

When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent sudden movement.

#### 2. Do not touch a terminal during energizing.

Touching a terminal during energizing may cause electric shock, malfunction, or auto switch breakage.

### ⚠ Caution

#### 1. Perform the following maintenance and inspection periodically in order to prevent possible danger due to unexpected auto switch malfunction.

##### 1) Secure and tighten auto 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 auto switches or repair lead wires if damage is discovered.

##### 3) Confirm the detection setting position.

###### • Red light on 1-color indicator auto switch

Confirm that the set position stops at the center of the operating range (red indication area).

###### • Confirm the green light and position of the 2-color indicator auto switch.

Confirm that the set position stops at the center of the appropriate operating range (green indication area). If stopped with the red LED lit, the operation may become unstable due to effects of the equipment environment or external disturbance. So, set the mounting position at the center of the appropriate operating range again.

Some cylinders or actuators indicate a specific setting procedure for the auto switch. If so, set the mounting position according to the specific setting procedure.

#### 2. Do not use solvents, such as benzene, thinner, etc., to clean the product.

They could damage the surface of the body and erase the markings on the body. For heavy stains, use a cloth lightly dampened with diluted neutral detergent, then wipe up any residue with a dry cloth.



# Solid State Auto Switches Precautions

Be sure to read this before handling products.

## Design/Selection

### ⚠ Caution

#### 1. Keep wiring as short as possible.

Be sure to use a wire length of 100 m or less.  
When a long wire is required, we recommend attaching ferrite cores to both ends of the cable to prevent excess noise. A contact protection box is not necessary for solid state auto switches due to the nature of this product's construction.

#### 2. Do not use a load that generates surge voltage.

If driving a load, such as a relay, that generates a surge voltage, use a built-in surge-absorbing element type device.

#### 3. Pay attention to the internal voltage drop of the auto switch.

Generally, the internal voltage drop of the solid state auto switch is larger than that of the reed auto switch. When the auto switches ("n" pcs.) are connected in series, the voltage drop is multiplied by "n". In this case, even if the auto switches operate correctly, the loads may not operate. Additionally, note that the 12 VDC relay does not apply to the auto switch.

#### 4. Pay attention to leakage current.

<2-wire type>

Current (leakage current) flows to the load to operate the internal circuit when in the OFF state.

Operating current of load (OFF condition) > Leakage current

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

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

#### 5. Output operation of the solid state auto switch is not stable for 50 [ms] after being powered ON.

In the output operation immediately after being powered ON or when using an AND connection operation, the input device (PLC, relay, etc.) may judge the ON position as OFF output or the OFF position as ON output. So, please set the equipment so that the input judgement signal is disabled for 50 [ms] immediately after being powered ON or when using an AND connection. When using SMC's AHC System (Auto Hand Changing System) MA Series, please also adjust this setting.

## Wiring

### ⚠ Caution

#### 1. Do not allow the short-circuit of loads.

All models of D-J51, and PNP output type auto switches do not have built-in short-circuit protection circuits.

Handle carefully as the auto switch may be damaged.

## Wiring

### ⚠ Caution

#### 2. Avoid incorrect wiring.

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

2) If connections are reversed (power supply line + and power supply line -) on a 3-wire type auto switch, the auto switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue wire and the power supply line (-) is connected to the black wire, the auto switch will be damaged.

#### 3. Do not disconnect the cable between the sensor and amplifier of the heat resistant 2-color indicator solid state auto switch.

Even when the sensor and amplifier are connected again, a contact resistance is produced, causing the auto switch to malfunction. Additionally, the sensor and amplifier are paired and they do not operate correctly in different combinations.

## Operating Environment

### ⚠ Caution

#### 1. Do not use in an area where surges are generated.

If there is an equipment unit (electromagnetic lifter, high-frequency induction furnace, motor, radio, etc.) that generates large surges or electromagnetic waves around cylinders or actuators with solid state auto switches, this may cause the circuit element inside the auto switch to break.

#### 2. The AC magnetic field resistant solid state auto switch has no immunity against DC magnetic fields.

So it is not suitable for use in applications where welding takes place using a DC inverter/rectified source. If using in conjunction with a DC welding application, use it at a distance from the conductor, as with ordinary switches.

Approximate required distance from conductor to prevent malfunction (10,000 A: 30 cm or more)

Additionally, as for the effects of magnetization and demagnetization, in areas exceeding 10,000 A, detection performance may occasionally become unstable due to the demagnetization of the detection magnet (weakening of magnetic field) or the magnetization (temporary magnetization) of materials around the cylinders and actuators.

If green and red indicators are not lit or if multi-point operation occurs, contact SMC.



# Reed Auto Switches Precautions

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## Design/Selection

### ⚠ Caution

#### 1. Keep wiring as short as possible.

As the length of the wiring to a load gets longer, the rush current when switching ON becomes greater, and this may shorten the product's life. (The switch will stay ON all the time.)

- 1) For an auto switch without contact protection circuit, use a contact protection box when the wire length is 5 m or longer.
- 2) Even if an auto switch has a built-in contact protection circuit, when the wiring is more than 30 m long, it is not able to adequately absorb the rush current and its life may be reduced. It is again necessary to connect a contact protection box in order to extend its life. Please consult with SMC in this case.

#### 2. Do not use a load that generates surge voltage.

If a surge voltage is generated, the discharge occurs at the point of contact, possibly resulting in the shortening of the product's life.

If driving a load, such as a relay, that generates a surge voltage, use an auto switch with a built-in contact protection circuit or use a contact protection box.

#### 3. Pay attention to the internal voltage drop of the auto switch.

- 1) Auto switch with an indicator light (Exceptions: D-A56, A76H, A96, A96V, C76, E76A, Z76)

- 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 the internal voltage drop in the auto switch specifications.) [The voltage drop will be "n" times larger when "n" auto switches are connected.]

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



- In the same way, when operating under a specified voltage, even if the auto switch operates normally, the load may not operate. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

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

- 2) If the internal resistance of a light emitting diode causes a problem, select an auto switch without an indicator light (D-A6□, A80, A80H, A90, A90V, C80, R80, 90, 90A, E80A, Z80).

## Wiring

### ⚠ Caution

#### 1. Do not allow the short-circuit of loads.

If the power is turned ON with a load in a short-circuited condition, the auto switch will be instantly damaged because of excess current flow into the switch.

#### 2. Avoid incorrect wiring.

A 24 VDC auto switch with indicator light has polarity. The brown lead wire, or terminal No. 1, is (+), and the blue lead wire, or terminal No. 2, is (-).

[For D-97, (+) is on the non-display side, and (-) is on the black line side.]

- 1) If connections are reversed, the auto switch will operate, but the light emitting diode will not light up. Also, take note that a current greater than that specified will damage a light emitting diode and it will no longer operate. Applicable models: D-A73, A73H, A73C, A93, A93V, A53, A54, B53, B54, C73, C73C, E73A, Z73 D-R73, R73C, 97, 93A, A33, A34, A33A, A34A, A44, A44A
- 2) When using a 2-color indicator type auto switch (D-A79W, A59W, and B59W), the auto switch will constantly remain ON if the connections are reversed.

## Operating Environment

### ⚠ Caution

#### 1. Do not use in an environment where there is excessive impact shock.

When excessive impact (300 m/s<sup>2</sup> or more) is applied to a reed auto switch during operation, the contact point will malfunction and generate or cut off the signal momentarily (1 ms or less). If further excessive impact is applied, the reed auto switch may break. Depending on the environment, a solid state auto switch may be required. Please consult with SMC for details.

## Handling Precautions

### ⚠ Caution

1. The protective cover supplied with the product (D-A9□, A9□V, Z7□, or Z80) when it is shipped from the factory is intended to absorb the impact generated by handling and prevent the auto switch holding screw from falling out. Do not remove this cover until immediately before installing the auto switch on the cylinder or actuator.

# Prior to Use

## Auto Switches Common Specifications 1

Refer to the Auto Switch Precautions on pages 15 to 19 before using auto switches.

### Auto Switches Common Specifications

Type	Reed auto switch	Solid state auto switch
Leakage current	None	3-wire: 100 $\mu$ A or less, 2-wire: 0.8 mA or less
Operating time	1.2 ms	1 ms or less *3
Impact resistance	300 m/s <sup>2</sup>	1000 m/s <sup>2</sup> *4
Insulation resistance	50 M $\Omega$ or more (500 VDC measured via megohmmeter) (Between lead wire and case)	
Withstand voltage	1500 VAC for 1 minute *1 (Between lead wire and case)	1000 VAC for 1 minute (Between lead wire and case)
Ambient temperature	-10 to 60°C	
Enclosure	IEC60529 Standard IP67 *2	

- \*1 Electrical entry: Connector type (A73C/A80C/C73C/C80C): 1000 VAC/min. (Between lead wire and case)
- \*2 The terminal conduit type (D-A3/A3□A/A3□C/G39/G39A/G39C/K39/K39A/K39C), DIN terminal type (D-A44/A44A/A44C), and heat-resistant auto switch (D-F7NJ) are IEC60529 Standard IP63 compliant.  
The trimmer type amplifier section (D-R□K) is compliant with IP40.
- \*3 Excludes solid state auto switches with a timer (D-M5□T/G5NT/F7NT/F5NT types) and the magnetic field resistant 2-color indicator solid state auto switch (D-P3DW□/P4DW).  
The operating time for the D-J51 is 2 ms or less and is 40 ms or less for the D-P3DW□/P4DW.
- \*4 980 m/s<sup>2</sup> for the trimmer type sensor section, 98 m/s<sup>2</sup> for the amplifier section

### Lead Wire

#### Lead wire length indication

(Example)

**D-M9BW L**

Auto switch model

Lead wire length

Symbol	Length	Tolerance	Connector specifications	Solid state	Reed
Nil	0.5 m	$\pm$ 15 mm		●	●
M	1 m	$\pm$ 30 mm		●*2	●*2
L	3 m	$\pm$ 90 mm		●	●
Z	5 m	$\pm$ 150 mm		●	●*3
N *1	None	—		●	●
SAPC	0.5 m	$\pm$ 15 mm	M8-3 pin Plug connector	○	—
MAPC	1 m	$\pm$ 30 mm	M8-3 pin Plug connector	○	—
SBPC	0.5 m	$\pm$ 15 mm	M8-4 pin Plug connector	○	—
MBPC	1 m	$\pm$ 30 mm	M8-4 pin Plug connector	○	—
SDPC	0.5 m	$\pm$ 15 mm	M12-4 pin A code (Normal key) Plug connector	○	—
MDPC	1 m	$\pm$ 30 mm		○	—
LDPC	3 m	$\pm$ 90 mm		○	—

●: Standard ○: Produced upon receipt of order (Standard)

- \*1 Applicable to the connector type (D-□□C) only
- \*2 Applicable to the D-M9□(V), D-M9□W(V), D-M9□A(V), and D-A93 only
- \*3 Applicable to the D-B53/B54, D-C73(C)/C80C, D-A93(V), D-A73(C)/A80C, D-A53/A54, D-Z73, and D-90/97/90A/93A only
- \*4 For reed auto switches M8 and M12 type with connector, please contact SMC.
- \*5 The standard lead wire length of the trimmer auto switch is 3 m.
- \*6 The standard lead wire length of the solid state auto switch with a timer (with the exception of the D-P3DW and D-M9□A(V)□), water-resistant 2-color indicator solid state auto switch, wide range detection auto switch, heat-resistant 2-color indicator solid state auto switch, and strong magnetic field resistant 2-color indicator solid state auto switch is 3 m or 5 m. (Product with a lead wire length of 0.5 m is not available.)

#### Lead wires with a connector indication

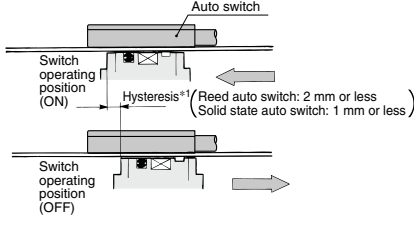
Part No. of Lead Wires with Connectors  
(Applicable only for connector type)

Model	Lead wire length
D-LC05	0.5 m
D-LC30	3 m
D-LC50	5 m

# Prior to Use

## Auto Switches Common Specifications 2

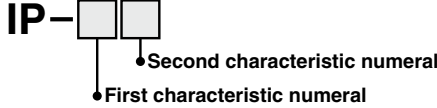
Refer to the Auto Switch Precautions on pages 15 to 19 before using auto switches.

Term	Meaning
<b>Hysteresis</b>	 <p>A deviation amount between the ON position and OFF position caused by auto switch characteristics (difference in sensitivity between ON and OFF). When the switch is turned ON once and the switch (or piston) is moved in the opposite direction, a symptom occurs that causes the switch's OFF position to deviate to a position where it is further returned from the ON position. This deviation amount is called "hysteresis."</p> <p>*1 Hysteresis may fluctuate due to the operating environment. Please contact SMC if hysteresis causes an operational problem.</p>
<b>Most sensitive position</b>	A position (sensor layout position) where the sensitivity on the detection surface of the auto switch enclosure is highest. When the center of the magnet is aligned with this position, it is basically at the center of the operating range and stable operation can be obtained.
<b>Programmable Logic Controller (PLC)</b>	One of the elements that makes up the sequence control. The PLC is designed so that it can receive signals, such as the auto switch output signal, and output them to other devices in order to perform the electrical control according to the preset program.
<b>Operating temperature range</b>	A temperature range in which the auto switch can be used. If significant temperature change or freezing occurs even within this temperature range, it may cause the auto switch to malfunction.
<b>Operating voltage</b>	A voltage at which the auto switch can be used. The operating voltage is indicated using generally used voltages (24 VDC, 100 VAC, etc.). For the 2-wire type, the operating voltage has the same meaning as the power supply voltage or load voltage.
<b>Operating current range</b>	A range of the current value that can be flowed to the output of the auto switch. If the operating current is lower than this range, the auto switch may not operate correctly. Conversely, if the operating current is higher than this range, the auto switch may break.
<b>Current consumption</b>	This current value is necessary for the 3-wire type auto switch to operate the circuit through the power cable. For the 2-wire type, as the current consumption is a part of the load current, it is not defined.
<b>Insulation resistance</b>	A resistance between the electric circuit and enclosure. Unless otherwise specified, 50 MΩ (Min) is used for auto switches.
<b>Magnetic field resistant auto switch</b>	An auto switch with protection against the effects of external (welding) magnetic fields generated in the spot welding process, etc. The solid state auto switch is able to function as it detects the frequency of the applied magnetic field. If an external magnetic field (AC) is applied, the last signal is retained and the product remains unaffected by the external magnetic field. This system can be used with cylinders with normal magnetic force. The reed auto switch features a built-in magnetic field shielded sensor with low sensitivity that reduces the effects of external magnetic fields (DC or AC magnetic fields). Therefore, a dedicated cylinder with a strong built-in magnet needs to be selected, and the operable range (conditions) need to be considered.
<b>Impact resistance value</b>	A minimum acceleration that may cause the auto switch to malfunction or break when the standard impact is applied.
<b>Water-resistant auto switch</b>	In contrast with the general (general purpose) product, structural measures have been taken in order to provide this model with long-term water resistance.
<b>Withstand voltage</b>	A tolerated dose of voltage that can be applied to the portion between the electrical circuit and enclosure. The withstand voltage shows the strength level of the product against the voltage. If a voltage exceeding the withstand voltage is applied, it may cause the product to break. (The voltage described here is different from the power supply voltage necessary to operate the product.)
<b>Proper mounting position</b>	A dimension that shows the mounting position when the position is detected at the stroke end of the cylinder. When this position is set, the maximum sensitivity position is aligned with the center of the magnet. However, make the necessary adjustments to the actual machine by considering the characteristic differences of the actual setting. When an adjustment allowance is needed for the detection before the stroke, set a value with an adjustment allowance added to the proper mounting position.
<b>Applicable load</b>	A device that is assumed as a target load of the auto switch.
<b>Operating time</b>	A period of time until the auto switch output becomes stable after the magnetic force to operate the auto switch has been received.
<b>Operating range</b>	An auto switch operating range in response to the cylinder piston movement (ON length in response to the stroke). The operating range is determined by the magnetic force of the magnet (range in which the magnetic force acts) and switch sensitivity. So, the operating range may vary as these conditions can change according to the ambient environment, etc. The operating range in the standard status (normal temperature, single cylinder, magnetic force, sensitivity, etc.) is described in the catalog.

# Prior to Use

## Auto Switches Common Specifications 3

Refer to the Auto Switch Precautions on pages 15 to 19 before using auto switches.

Term	Meaning																																
<b>Minimum stroke for auto switch mounting</b>	A minimum stroke value of the auto switch that can be mounted on the cylinder. The minimum stroke is determined by the specification limit (auto switch operation, position setting ability, etc.) and physical limit (mechanical interference associated with the auto switch mounting). Note that the catalog shows the value assuming that the position detection is performed at the stroke end and that this value does not consider the adjustment allowance. When an adjustment allowance is needed, such as for detection before the stroke, set the value so that this adjustment allowance is added to the minimum stroke.																																
<b>Internal voltage drop</b>	A voltage that is applied to the portion between the COM and signal line when the auto switch is ON. As only the value of the power supply voltage subtracted by the internal voltage drop is applied to the input side of the PLC, a detection fault (incorrect input) may occur if this value is lower than the minimum operating voltage. So, take great care when selecting a device.																																
<b>2-color indicator</b>	As the end part of the auto switch operating range (boundary between ON and OFF) is an area that is susceptible to external disturbances or stroke changes during cylinder operation, this function is intended to quickly and properly make the setting at the center of the operating range where stable operation can be obtained by changing the operation indication color of the auto switch.																																
<b>Load</b>	A device that is connected to the output of the auto switch in order to do any work is called a "load." For example, the load may be a relay, PLC, etc. To check the operation of the auto switch, a device equivalent to a load (such as a resistor, etc.) must be connected.																																
<b>Load current</b>	A current that flows to the load when the ON-OFF output is ON.																																
<b>Enclosure</b>	A class of protection against the entry of water or solids for electrical machinery and apparatus as specified in the IEC60529 Standard.   <p>IP—  <span style="margin-left: 100px;">•</span> Second characteristic numeral  <span style="margin-left: 50px;">•</span> First characteristic numeral</p> <p>●<b>First Characteristic:</b>  <b>Degree of protection against solid foreign objects</b></p> <table border="1" data-bbox="370 1167 1082 1352"> <tbody> <tr><td>0</td><td>Non-protected</td></tr> <tr><td>1</td><td>Protected against solid foreign objects of 50 mm <math>\phi</math> and greater</td></tr> <tr><td>2</td><td>Protected against solid foreign objects of 12 mm <math>\phi</math> and greater</td></tr> <tr><td>3</td><td>Protected against solid foreign objects of 2.5 mm <math>\phi</math> and greater</td></tr> <tr><td>4</td><td>Protected against solid foreign objects of 1.0 mm <math>\phi</math> and greater</td></tr> <tr><td>5</td><td>Dust-protected</td></tr> <tr><td>6</td><td>Dust-tight</td></tr> </tbody> </table> <p>●<b>Second Characteristic:</b>  <b>Degree of protection against water</b></p> <table border="1" data-bbox="370 1424 1082 1688"> <tbody> <tr><td>0</td><td>Non-protected</td></tr> <tr><td>1</td><td>Protected against vertically falling water drops</td></tr> <tr><td>2</td><td>Protected against vertically falling water drops when enclosure is tilted 15°</td></tr> <tr><td>3</td><td>Protected against rainfall when enclosure is tilted up to 60°</td></tr> <tr><td>4</td><td>Protected against splashing water</td></tr> <tr><td>5</td><td>Protected against water jets</td></tr> <tr><td>6</td><td>Protected against powerful water jets</td></tr> <tr><td>7</td><td>Protected against the effects of temporary immersion in water</td></tr> <tr><td>8</td><td>Protected against the effects of continuous immersion in water</td></tr> </tbody> </table> <p>Example) In the case of products stipulated as IP65, we can know the degree of protection is dust-tight and water jetproof on the grounds that the first characteristic numeral is 6 and the second characteristic numeral is 5. Therefore, we can assume it will not be adversely affected by direct water jets from any direction.</p>	0	Non-protected	1	Protected against solid foreign objects of 50 mm $\phi$ and greater	2	Protected against solid foreign objects of 12 mm $\phi$ and greater	3	Protected against solid foreign objects of 2.5 mm $\phi$ and greater	4	Protected against solid foreign objects of 1.0 mm $\phi$ and greater	5	Dust-protected	6	Dust-tight	0	Non-protected	1	Protected against vertically falling water drops	2	Protected against vertically falling water drops when enclosure is tilted 15°	3	Protected against rainfall when enclosure is tilted up to 60°	4	Protected against splashing water	5	Protected against water jets	6	Protected against powerful water jets	7	Protected against the effects of temporary immersion in water	8	Protected against the effects of continuous immersion in water
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7	Protected against the effects of temporary immersion in water																																
8	Protected against the effects of continuous immersion in water																																
<b>Solid state auto switch</b>	A switch that uses an MR element to detect magnetic fields and possesses an internal judgement circuit that is able to output an ON/OFF signal like a transistor regardless of mechanical contact or non-contact (such as when there is no point of contact).																																
<b>Leak current</b>	A current that flows to operate the internal circuit when the ON-OFF output is OFF. In particular, if the leak current exceeds the detection current in the 2-wire type auto switch or PLC, it may cause a reset failure. So, take great care when selecting a device.																																
<b>Reed auto switch</b>	A switch that uses a reed switch to detect magnetic fields and output an ON/OFF signal when there is mechanical contact or non-contact (when there is a point of contact, such as with a relay or limit switch).																																
<b>Induction load</b>	A load that has a coil. The connection target of the auto switch is a relay.																																
<b>Recommended lead wire bending radius</b>	A minimum bending radius (reference value) of the lead wire when the lead wire is secured and constructed (oscillation or rotation is not considered). (As the temperature and current value conforms to the auto switch specifications, this lead wire bending radius differs from the value disclosed by the electric wire manufacturer.)																																
<b>Electrical entry</b>	A structure in which the lead wire of the auto switch is taken out in the horizontal direction when the cylinder is laid out horizontally (cylinder rod is horizontal) is called an "in-line entry." A structure in which the lead wire is taken out in a direction perpendicular to the cylinder axis center is called a "perpendicular entry."																																

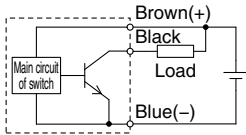


# Prior to Use

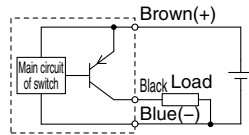
## Auto Switches/Internal Circuits

### Solid State Auto Switches

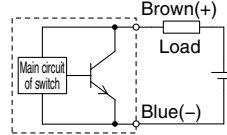
Solid state 3-wire, NPN



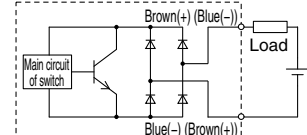
Solid state 3-wire, PNP



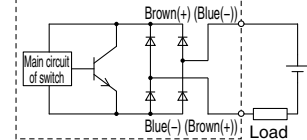
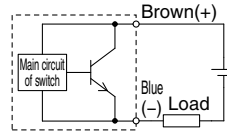
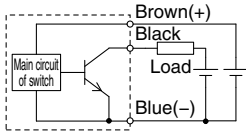
Solid state 2-wire



Solid state 2-wire, Non-polar type



(Power supply for switch and load are separate)



### Reed Auto Switches

No.	①	②	③	④
Circuit diagram	<p><b>2-wire (Reed switch)</b></p>	<p><b>2-wire (Reed switch)</b></p>	<p><b>2-wire (Reed switch)</b></p>	<p><b>2-wire (Reed switch)</b></p>
	<p><b>3-wire (Reed switch, NPN)</b></p>	<p><b>2-wire (Reed switch)</b></p>	<p><b>2-wire (Reed switch)</b></p>	

### Contact Protection Box/CD-P11, CD-P12

#### <Applicable switch models>

D-A7/A8, D-A7□H/A80H, D-A73C, A80C, D-C7/C8, D-C73C/C80C, D-E7□A, E80A, D-Z7/Z8, D-9/9□A, D-A9/A9□V, D-A79W

The auto switches above do not have a built-in contact protection circuit.

A contact protection box is not required for solid state auto switches due to their construction.

- Where the operation load is an inductive load
- Where the wiring length to the load is 5 m or more
- Where the load voltage is 100/200 VAC  
Use a contact protection box with the switch for any of the above cases.

The contact life may be shortened (due to permanent energizing conditions).

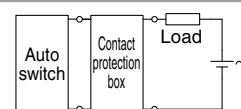
**D-A72(H) must be used with the contact protection box regardless of load types and lead wire length since it is greatly affected by loads. (Where the load voltage is 110 VAC)**

When the load voltage is increased by more than 10% of the rating of the applicable auto switches (Exceptions: D-A73C/A80C/C73C/C80C/90/97/A79W) above, use a contact protection box (CD-P11) to reduce the upper limit of the load current by 10% so that it can be set within the range of the load current range, 110 VAC.

Even for the built-in contact protection circuit type (D-A34[A][C], D-A44[A][C], D-A54/A64, D-A59W, D-B59W), use the contact protection box when the wiring length to the load is very long (30 m or more) and when a PLC (Programmable Logic Controller) with a large inrush current is used.

### Contact Protection Box Connection

To connect a switch unit to a contact protection box, connect the lead wire from the side of the contact protection box marked SWITCH to the lead wire coming out of the switch unit. Keep the switch as close as possible to the contact protection box, with a lead wire length of no more than 1 meter.



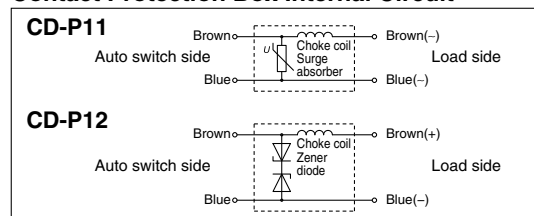
#### Contact Protection Box Specifications

Part no.	CD-P11	CD-P12
Load voltage	100 VAC or less	200 VAC 24 VDC
Max. load current	25 mA	12.5 mA 50 mA

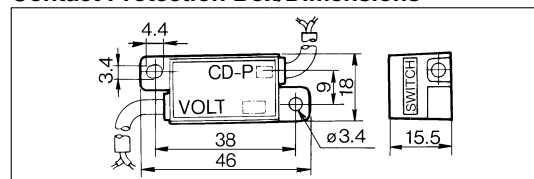
\* Lead wire length — Auto switch connection side 0.5 m  
Load connection side 0.5 m



#### Contact Protection Box Internal Circuit



#### Contact Protection Box/Dimensions

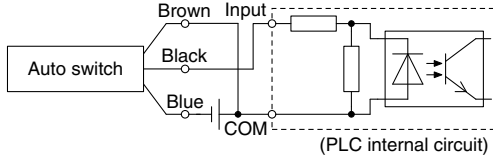


# Prior to Use

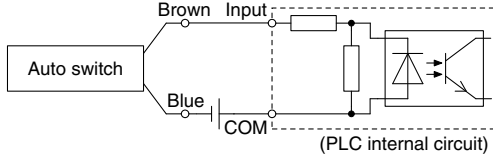
## Auto Switch Connections and Examples

### Sink Input Specifications

#### 3-wire, NPN

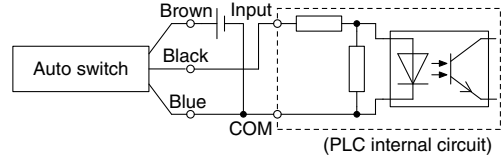


#### 2-wire

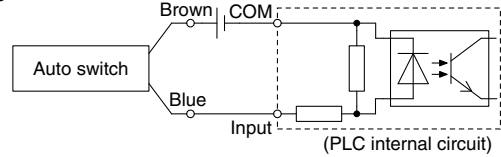


### Source Input Specifications

#### 3-wire, PNP



#### 2-wire

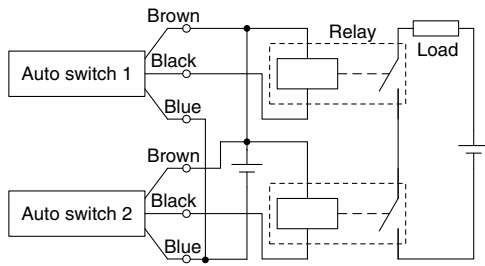


Connect according to the applicable PLC input specifications, as the connection method will vary depending on the PLC input specifications.

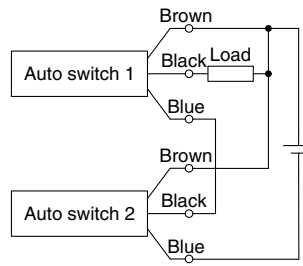
### Examples of AND (Series) and OR (Parallel) Connections

\* When using solid state auto switches, ensure the application is set up so the signals for the first 50 ms are invalid. Depending on the operating environment, the product may not operate properly.

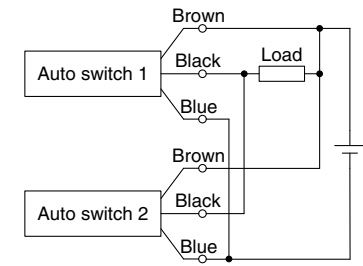
#### 3-wire AND connection for NPN output (Using relays)



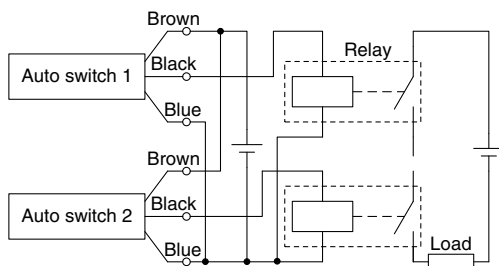
#### (Performed with auto switches only)



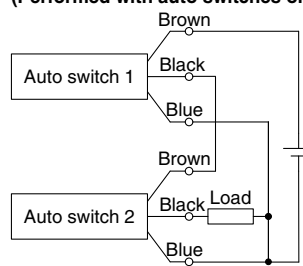
#### 3-wire OR connection for NPN output



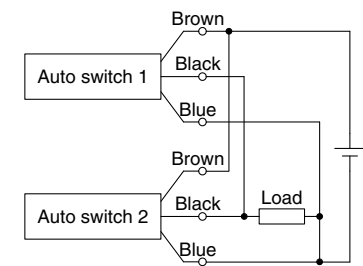
#### 3-wire AND connection for PNP output (Using relays)



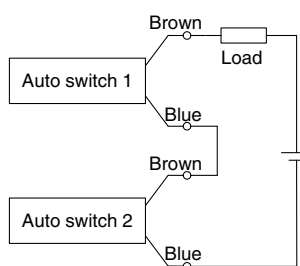
#### (Performed with auto switches only)



#### 3-wire OR connection for PNP output



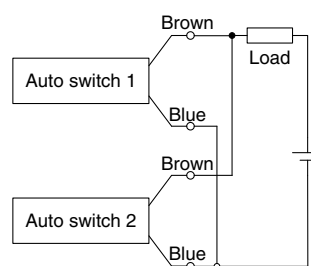
#### 2-wire AND connection



When two auto 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 when both of the auto switches are in the ON state. Auto switches with a load voltage less than 20 V cannot be used. Please contact SMC if using AND connection for a heat-resistant solid state auto switch or a trimmer switch.

Example) Load voltage at ON  
 Power supply voltage: 24 VDC  
 Internal voltage drop: 4 V  
 Load voltage at ON = Power supply voltage –  
 Internal voltage drop x 2 pcs.  
 = 24 V – 4 V x 2 pcs.  
 = 16 V

#### 2-wire OR connection



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

(Reed)  
 Because there is no current leakage, the load voltage will not increase when turned OFF. However, depending on the number of auto switches in the ON state, the indicator lights may sometimes grow dim or not light up, due to the dispersion and reduction of the current flowing to the auto switches.

Example) Load voltage at OFF  
 Leakage current: 1 mA  
 Load impedance: 3 kΩ  
 Load voltage at OFF = Leakage current x 2 pcs. x  
 Load impedance  
 = 1 mA x 2 pcs. X 3 kΩ  
 = 6 V