For Hygienic Design Cylinders
Solid State Auto Switch: Direct Mounting Style
D-F6N/D-F6P/D-F6B

Grommet

- **2-wire load current is reduced (2.5 to 40 mA)**
- **Using flexible cable as standard spec.**

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 at 10 mA (2V or less at 40 mA)		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 turned ON.		
Standard	CE marking, RoHS		

Oilproof Flexible Heavy-duty Lead Wire Specifications

Auto switch model		D-F6N□	D-F6P□	D-F6B□
Sheath	Outside diameter [mm]	2.7 x 3.2 (ellipse)		
Insulator	Number of cores	3 cores (Brown/Blue/Black)		2 cores (Brown/Blue)
	Outside diameter [mm]	ø0.9		
Conductor	Effective area [mm²]	0.15		
	Strand diameter [mm]	ø0.05		
Minimum bending radius [mm] (Reference values)		20		

Note 1) Refer to page 1568 for solid state auto switch common specifications.
Note 2) Refer to page 1568 for lead wire lengths.

⚠Caution

Precautions

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

Weight

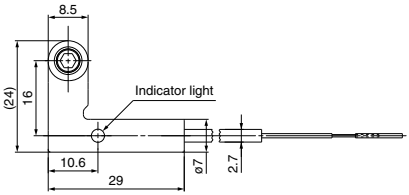
(g)

Auto switch model		D-F6N	D-F6P	D-F6B
Lead wire length	0.5 m (**Nil**)	20		19
	3 m (**L**)	53		50
	5 m (**Z**)	80		75

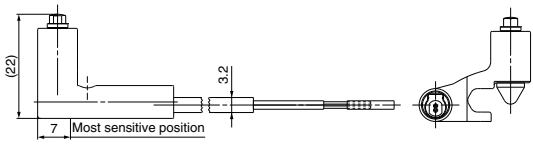
Dimensions

(mm)

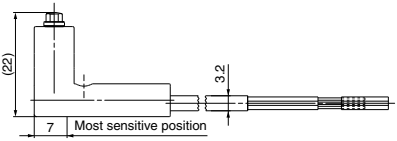
D-F6□



D-F6B



D-F6N/F6P



D-□

Auto Switches Precautions 1

Be sure to read this before handling.

Design/Selection

Cylinders or actuators include 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. 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 avoid trouble by providing a mechanical protection function, or by also 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.

An injury or failure can result.

⚠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:

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

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 (≈ 200 ms) makes it possible to extend the load operating time.

The wide-range detection type D-G5NB (operating range 35 to 50 mm) may also be useful, depending on the application. Please consult with SMC for 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 force.

3. Ensure sufficient clearance for maintenance activities.

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

⚠Caution

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

If work personnel gets on or puts the work personnel's 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 so that any back-flow current does not flow in if a short-circuit trouble occurs or forced operation is performed to check the operation.

If a back-flow current 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 the cylinders/actuators. Detection intervals depends on the auto switch mounting structure and set position, therefore some required interval and set positions may not be available.

7. Limitations on detectable position

There are positions or surfaces (bottom surface of the foot bracket, etc.) where the auto switch cannot be mounted due to the 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

Be sure to read this before handling.

Mounting/Adjustment

⚠Caution

1. Do not drop or bump.

Do not drop, bump, or apply an excessive impact (300m/s^2 or more for reed auto switches, 1000m/s^2 or more for solid state auto switches) while handing 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 auto switch 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 by the auto switch lead wires.

This may cause 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 using other screws, auto switch may be damaged.

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

In the case of 2-color display 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 will be unstable depending on the operating environment. Also there are some cylinders or actuators with individual setting methods for auto switches. If so, mount it in accordance with the indicated method.

Even if 2-color indication solid state auto switches are fixed at a 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, proximal installation of cylinders with built-in magnet and actuators, temperature change, other factors for 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 a midpoint of the stroke, check the actuation status and make the adjustment in the same manner.

Wiring

⚠Caution

1. Confirm proper insulation of wiring.

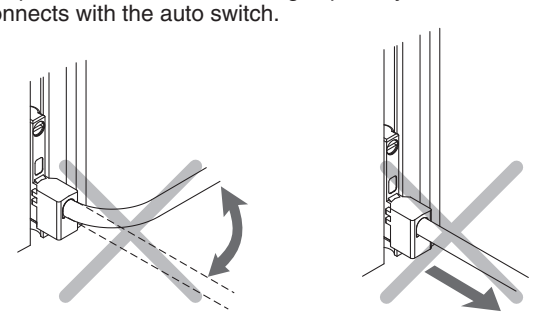
If there is any improper insulation (mixed contact with other circuit, grounding fault, or improper insulation between terminals, etc.) in the wiring, an over-current flows in, causing the auto switch to break.

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

Auto Switches Precautions 4

Be sure to read this before handling.

Operating Environment

⚠Warning

1. Never use in an atmosphere of explosive gases.

The structure of auto switches is not intended to prevent explosion. This may lead to 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 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 except some models (D-A3□, A44□, G39□, K39□, RNK, RPK) do not use auto switches in applications where 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 swelling of the 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 accumulation of iron waste or close contact with magnetic substances.

If many iron particles, such as cutting chips or spatters accumulate around a cylinder with the auto switches or an actuator or if a magnetic substance (attracted by a magnet) is put close to a cylinder with the auto switch or an actuator, the magnetic force inside the cylinder or actuator loses, 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 the lightning surge 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 the fall or erratic movement of driven objects and equipment, 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 and equipment.
When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent actuators from moving suddenly.

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 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 lead wires.
To prevent faulty insulation, replace auto switches or repair lead wires, etc., if damage is discovered.

3) Confirm the detection setting position.
- Red light of 1-color display auto switch
  Confirm that the set position stops at the center of the operating range (red display area).
- Confirm the green light and position of the 2-color display auto switch.
  Confirm that the set position stops at the center of the appropriate operating range (green display 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 the individual setting procedures for the auto switch. If so, set the mounting position using the individual setting procedures.

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.

Design/Selection

⚠Caution

1. Keep wiring as short as possible.

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

2. Do not exceed the trimmer switch sensor cable length 3 m.

If the sensor cable length exceeds 3 m, the CE marking does not apply to the auto switch.

3. 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.

4. 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, the auto switches operate correctly, but the loads may not operate. Additionally, note that the 12 VDC relay does not apply to the auto switch.

5. 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 will not be satisfied.
Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

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

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

Wiring

⚠Caution

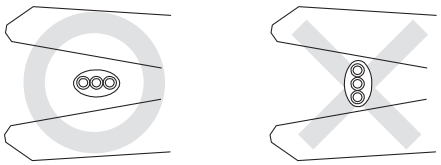
1. Do not allow short-circuit of loads.

All models of D-J51, G5NB and PNP output type auto switches do not have built-in short circuit protection circuits.
Carefully handle as the auto switch may be damaged.

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 always stay 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.

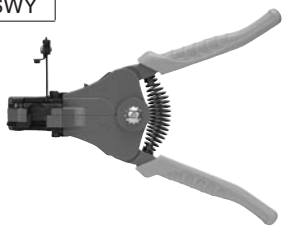
3. When the lead wire sheath is stripped, confirm the stripping direction. The insulator may be split or damaged depending on the direction. (D-M9□ only)



Recommended Tool

Description	Model
Wire stripper	D-M9N-SWY

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



4. Do not disconnect the cable between the sensor and amplifier of the heat resistant 2-color display solid state auto switch by the customer.

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, or radio, etc.) that generates large surges or electromagnetic waves around cylinders with solid state auto switches or actuators, this may cause the circuit element inside the auto switch to break.

Reed Auto Switches Precautions

Be sure to read this before handling.

Design/Selection

⚠Caution

1. Keep wiring as short as possible.

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

1) 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.

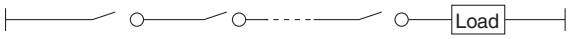
2. Do not use a load that generates surge voltage.

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

If driving a load such as a relay that generates a surge voltage, use an auto switch with 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 (Except 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 though an auto switch operates normally, the load may not operate.



   - In the same way, when operating under a specified voltage, although an auto switch may operate 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, E80A, Z80).

Wiring

⚠Caution

1. Do not allow 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 no-displayed side, (–) is on the black line side.]

1) If connections are reversed, an auto switch will operate, however, 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 model:
   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^2 or more) is applied to a reed auto switch during operation, the contact point will malfunction and generate or cut off a signal momentarily (1 ms or less). Please consult with SMC if a solid state auto switch can be used according to the environment.

Prior to Use
Auto Switches Common Specifications 1

Refer to the Auto Switch Precautions on pages 8 to 11 before using auto switches.

Auto Switches Common Specifications

Type	Reed auto switch	Solid state auto switch
Leakage current	None	3-wire: 100 μA or less, 2-wire: 0.8 mA or less
Operating time	1.2 ms	1ms or less*3)
Impact resistance	300 m/s²	1000 m/s² *4)
Insulation resistance	50 MΩ 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 the 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) conform to IEC60529 Standard IP63.
The trimmer type amplifier section (D-R□K) conforms to IP40.
∗ 3) Excluding the solid state auto switches with a timer (D-M5□T/G5NT/F7NT/F5NT types) and magnetic field resistant 2-color indication solid state auto switch (D-P3DW□/P4DW).
The operating time for D-J51 is 2 ms or less and for D-P3DW□/P4DW are 40 ms or less.
∗ 4) 980 m/s² for the trimmer type sensor section, 98 m/s² 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	±15 mm		●	●
M	1 m	±30 mm		●*2)	–
L	3 m	±90 mm		●	●
Z	5 m	±150 mm		●	●*3)
N∗1)	None	–		●	●
SAPC	0.5 m	±15 mm	M8-3 pin Plug connector	○	–
MAPC	1 m	±30 mm		○	–
SBPC	0.5 m	±15 mm	M8-4 pin Plug connector	○	–
MBPC	1 m	±30 mm		○	–
SDPC	0.5 m	±15 mm	M12-4 pin A code (Normal key) Plug connector	○	–
MDPC	1 m	±30 mm		○	–
LDPC	3 m	±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), and D-M9□A (V) 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 the timer except for the D-P3DW and D-M9□A (V)□, water-resistant 2-color display solid state auto switch, wide range detection auto switch, heat resistant 2-color display solid state auto switch, and strong magnetic field resistant 2-color display solid state auto switch is 3 m or 5 m. (Product with a lead wire length of 0.5 m is not available.)

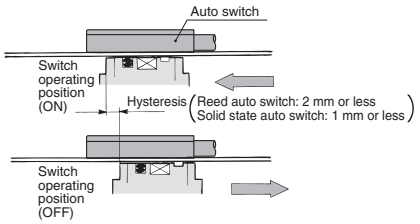
Lead wires with a connector indication

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

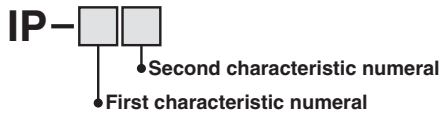
Prior to Use
Auto Switches Common Specifications 2

Refer to the Auto Switch Precautions on pages 8 to 11 before using auto switches.

Term	Meaning
Hysteresis	 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 the position where the switch turns OFF deviates to a position where it is further returned from the ON position. This deviation amount is called “hysteresis”. Note) Hysteresis may fluctuate due to the operating environment. Please contact SMC if hysteresis causes an operational problem.
Most sensitive position	A position (sensor layout position) where the sensitivity is highest on the detection surface of the auto switch enclosure. When the center of the magnet is aligned with this position, this becomes almost the center of the operating range and stable operation can be obtained.
Programmable Logic Controller (PLC)	One of elements making up the sequence control. The PLC is so designed that it receives signals, such as auto switch output and outputs them to other devices so as to perform the electrical control according to the preset program.
Operating temperature range	A temperature range, in which the auto switch can be used. If significant temperature change or freezing occurs even in this temperature range, this may cause the auto switch to malfunction.
Operating voltage	A voltage, at which the auto switch can be used. The operating voltage is indicated using generally used voltage (24 VDC or 100 VAC, etc.). For 2-wire type, the operating voltage has the same meaning as the power supply voltage or load voltage.
Operating current range	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 does not operate correctly. Conversely, if the operating current is higher than this range, this may cause the auto switch to break.
Current consumption	This current value is necessary for the 3-wire type auto switch to operate the circuit through the power cable. For 2-wire type, as the current consumption is a part of the load current, it is not defined.
Insulation resistance	A resistance between the electric circuit and enclosure. Unless otherwise described particularly, 50MΩ (Min) is used for auto switch.
Magnetic field resistant auto switch	An auto switch, for which measures against effects arising from external (welding) magnetic field generated in the spot welding process, etc. are taken. The solid state auto switch functions as it detects the frequency of the applied magnetic field. If the external magnetic field (AC) is applied, the last signal is retained not to be affected by the external magnetic field. This system can be used by the cylinder with normal magnetic force. The reed auto switch built-in a magnetic field shielded sensor with a low sensitivity to make the effect of the external magnetic field (DC or AC magnetic field) insusceptible. Therefore, a dedicated cylinder built-in the strong magnet needs to be selected and there is also an operable range (conditions).
Impact resistance value	A minimum acceleration that may cause the auto switch to malfunction or break when the standard impact is applied.
Water-resistant type auto switch	A model, long-term water resistance of which is improved by taking structural measures for the general (general purpose) product.
Withstand voltage	A tolerance dose when the voltage is applied to the portion between the electrical circuit and enclosure. The withstand voltage shows a strength level of the product against the voltage. If a voltage exceeding the withstand voltage is applied, this may cause the product to break. (The voltage described here is different from the power supply voltage necessary to operate the product.)
Proper mounting position	A dimension that shows the mounting position when the position is detected at the stroke end of the cylinder. As this position is set, the maximum sensitivity position is aligned with the center of the magnet. However, make the adjustment with the actual machine by considering the characteristic difference during 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.
Applicable load	A device that is assumed as a target load of the auto switch.
Operating time	A period of time until the auto switch output becomes stable after the magnetic force to operate the auto switch has been received.
Operating range	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 are changed by the ambient environment, etc. The operating range in the standard status (normal temperature, single cylinder, magnetic force, and sensitivity, etc.) is described in the catalog.

Prior to Use
Auto Switches Common Specifications 3

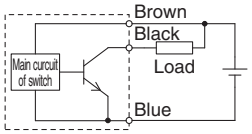
Refer to the Auto Switch Precautions on pages 8 to 11 before using auto switches.

Term	Meaning
Minimum Stroke for Auto Switch Mounting	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 or 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 this value does not consider the adjustment allowance. When an adjustment allowance is needed, such as detection before the stroke, a value is set that this adjustment allowance is added to the minimum stroke.
Internal voltage drop	A voltage that is applied to the portion between the COM and signal line when the auto switch is ON. As only a value that the internal voltage drop is subtracted from the power supply voltage is applied to the input side of the PLC, the detection fault (incorrect input) may occur if this value is lower than the minimum operating voltage. So, take great care when selecting a device.
2-Color Indication	As the end part of the auto switch operating range (boundary between ON and OFF) is an area where is susceptible to the external disturbance or stroke change during cylinder operation, this function is intended to quickly and properly make the setting at the center of the operating range where the stable operation can be obtained by changing the operation indication color of the auto switch.
Load	A device that is connected to the output of the auto switch so as to do any work is called “load”. For example, the load is a relay or PLC, etc. To check the operation of the auto switch, a device equivalent to the load (such as resistor, etc.) is connected.
Load current	A current that flows to the load when the ON-OFF output is ON.
Enclosure	A class of protection against solid or water entry of the electrical machinery and apparatus specified in IEC60529.  **●First Characteristics:** **Degrees of protection against solid foreign objects** **0** Non-protected **1** Protected against solid foreign objects of 50 mm ø and greater **2** Protected against solid foreign objects of 12 mm ø and greater **3** Protected against solid foreign objects of 2.5 mm ø and greater **4** Protected against solid foreign objects of 1.0 mm ø and greater **5** Dust-protected **6** Dusttight **●Second Characteristics:** **Degrees of protection against water** **0** Non-protected **1** Protected against vertically falling water drops **2** Protected against vertically falling water drops when enclosure tilted up to 15° **3** Protected against rainfall when enclosure 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 Example) In the case of stipulated as IP65, we can know the degrees of protection is dusttight and water jet-proof on the grounds that the first characteristic numeral is 6 and the second characteristic numeral is 5 respectively, that gives it will not be adversely affected by direct water jets from any direction.
Solid state auto switch	A switch that detects the magnetic field by the MR element and incorporates the judgement circuit to turn ON or OFF the output regardless of the contact or non-contact of the mechanical contact like transistor (non-contact part).
Leak current	A current that flows to operate the internal circuit when the ON-OFF output is OFF. In particular, if this leak current exceeds the detection current in the 2-wire type auto switch or PLC, this may cause reset fault. So, take great care when selecting a device.
Reed auto switch	A switch that uses the reed switch to detect the magnetic field and turn ON or OFF the output by the contact or non-contact of the mechanical contact (contact part is provided like relay or limit switch).
Induction load	A load that has the coil. The connection target of the auto switch is a relay.
Recommended lead wire bending radius	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 or current value conforms to the auto switch specifications, this lead wire bending radius differs from the value disclosed by the electric wire manufacturer.)
Electrical entry	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 “in-line entry”. A structure, in which the lead wire is taken out in a direction perpendicular to the cylinder axis center, is called “perpendicular entry”.

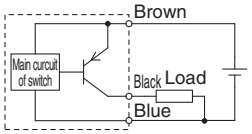
Prior to Use
Auto Switches/Internal Circuit

Solid State Auto Switches

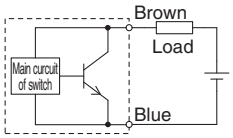
Solid state 3-wire, NPN



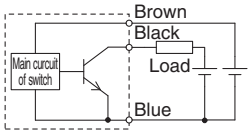
Solid state 3-wire, PNP

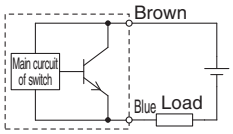


2-wire (Solid state)

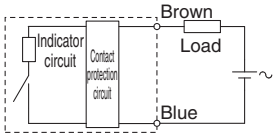
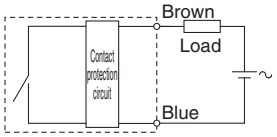
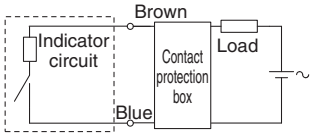
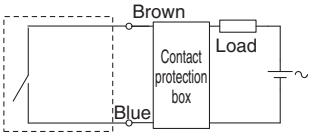


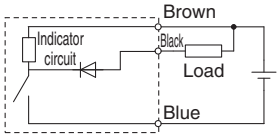
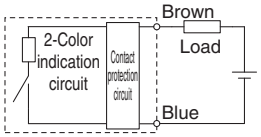
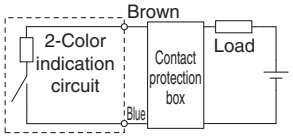
(Power supply for switch and load are separate)





Reed Auto Switches

No.	①	②	③	④
Circuit diagram	**2-wire (Reed switch)**	**2-wire (Reed switch)**	**2-wire (Reed switch)**	**2-wire (Reed switch)**
				

No.	⑤	⑥	⑦
Circuit diagram	**3-wire (Reed switch, NPN)**	**2-wire (Reed switch)**	**2-wire (Reed switch)**
			

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.

1. Where the operation load is an inductive load.

2. Where the wiring length to load is greater than 5 m.

3. Where the load voltage is 100/200 VAC.

Therefore, 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% to the rating of applicable auto switches (except 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.

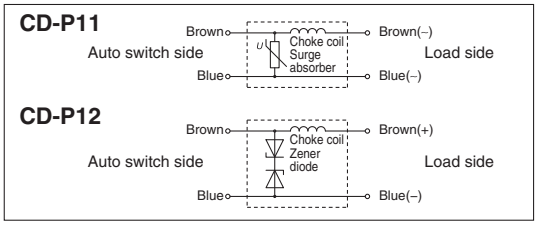
Even for the built-in contact protection circuit type (D-A34[A][C], DA44[A][C], D-A54/A64, D-A59W, D-B59W), **use the contact protection box when the wiring length to load is very long (over 30 m) and PLC (Programmable Logic Controller) with a large inrush current is used.**

Contact Protection Box Specifications

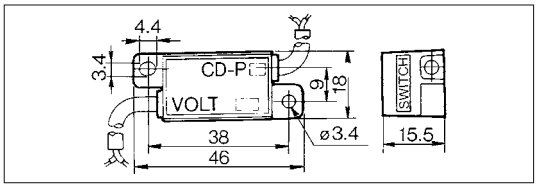
Part no.	CD-P11		CD-P12
Load voltage	100 VAC or less	200 VAC	24 VDC
Max. load current	25 mA	12.5 mA	50 mA

∗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



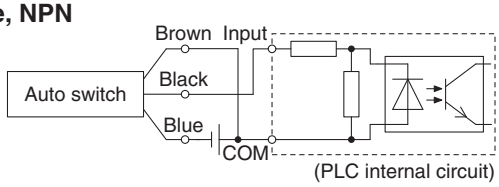
Contact Protection Box Connection

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.

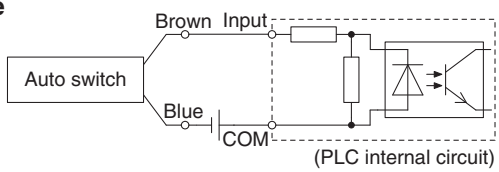
Prior to Use
Auto Switch Connection and Example

Sink Input Specifications

3-wire, NPN

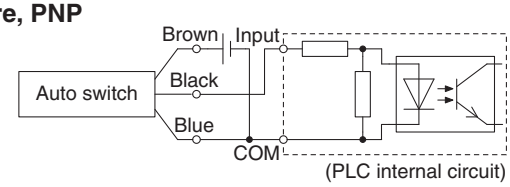


2-wire

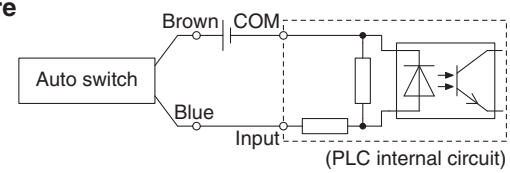


Source Input Specifications

3-wire, PNP



2-wire



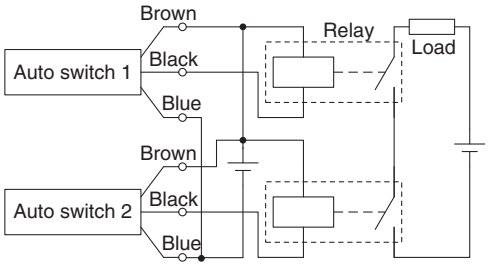
Connect according to the applicable PLC input specifications, as the connection method will vary depending on the PLC input specifications.

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

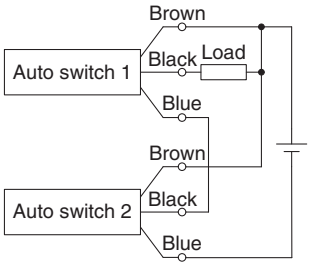
∗ When using solid state auto switches, ensure the application is setup so the signals for the first 50 ms are invalid.

3-wire AND connection for NPN output

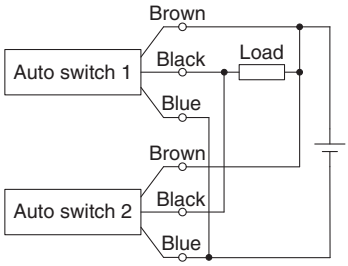
(Using relays)



(Performed with auto switches only)

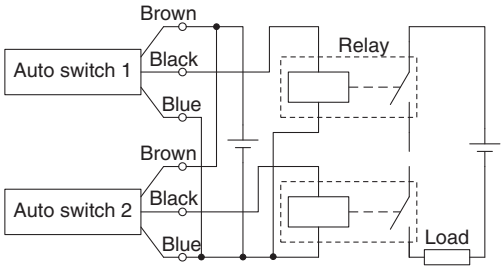


3-wire OR connection for NPN output

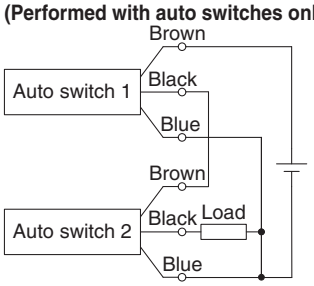


3-wire AND connection for PNP output

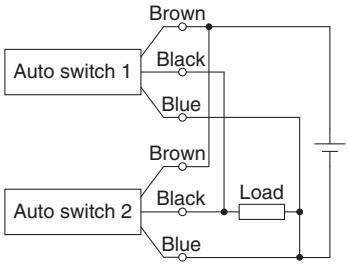
(Using relays)



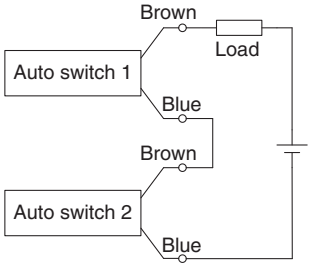
(Performed with auto switches only)



3-wire OR connection for PNP output



2-wire AND connection

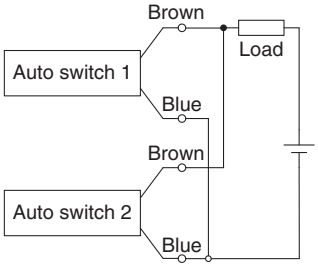


When two auto switches are connected in series, a load may malfunction because the load voltage will decline when in the ON state. The indicator lights will light up when both of the auto switches are in the ON state. Auto switches with load voltage less than 20V cannot be used.

Load voltage at ON = Power supply voltage – Residual voltage x 2 pcs.
= 24 V – 4 V x 2 pcs.
= 16 V

Example: Power supply is 24 VDC
Internal voltage drop in auto switch is 4 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 auto switch)
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.

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

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