



ORIGINAL INSTRUCTIONS

## Installation and Maintenance Manual

### [Auto Switch (Solid State)]

Series **D-M9N□, D-M9P□, D-M9B□**

(Complies with the basic safety principles in accordance with ISO 13849)



The intended use of this product is to detect a position of a magnet in a pneumatic cylinder.

#### Validated D-M9 components according to ISO 13849:

For the part numbers of validated D-M9 products refer to Doc. No. D-\*S-SMQ0018.

### Safety Instructions

This manual contains essential information for the protection of users and others from possible injury and/or equipment damage.

- Read this manual before using the product, to ensure correct handling, and read the manuals of related apparatus before use.
- Keep this manual in a safe place for future reference.
- These instructions indicate the level of potential hazard by label of "Caution", "Warning" or "Danger", followed by important safety information which must be carefully followed.
- To ensure safety of personnel and equipment the safety instructions in this manual and the product catalogue must be observed, along with other relevant safety practices.
- Always ensure compliance with relevant safety laws and standards.

	<b>Caution</b>	Indicates a hazard with a low level of risk, which if not avoided, could result in minor or moderate injury.
	<b>Warning</b>	Indicates a hazard with a medium level of risk, which if not avoided, could result in death or serious injury.
	<b>Danger</b>	Indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury.

This product is class A, group 1 equipment that is only intended for use in an industrial environment as described by EN55011.

#### Common Auto Switch Precautions Design and Selection

#### Warning

- (1) Check the specifications.  
If the auto switch is used with an excessive load or used outside of the specifications, it may cause damage or malfunction.  
The product cannot be guaranteed if it is used outside of the specification range.
- (2) Caution for use in an interlock system.  
When an auto switch is used in an interlock system which requires high reliability, provide a double interlock system, for example a mechanical protection system, for extra safety, or by also using another switch (sensor) together with the auto switch.  
Check the product regularly in order to confirm normal operation.
- (3) Do not disassemble, modify (including changing the printed circuit board) or repair.  
An injury or failure can result.

#### Caution

- (1) Pay attention to the length of time the auto switch will operate at an intermediate stroke position.  
When an auto switch is placed at an intermediate stroke position, and a load is driven during the time when the piston passes, the auto switch will operate, but if the piston speed is too great, the operating time will be shortened, and the load may not operate correctly.  
The maximum piston speed is:

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

- (2) Take precautions when multiple actuators are used close together.  
When using two or more actuators with auto switches in close proximity to each other, maintain a minimum separation distance of at least 40 mm. (If the separation distance is specified for the actuator series, then use that value).  
The auto switches may malfunction due to magnetic field interference.  
Use of a magnetic screen plate (MU-S025) or commercially available magnetic screening tape can reduce the interference of magnetic fields.
- (3) Provide sufficient space for maintenance.  
When designing an application, allow sufficient clearance for maintenance and inspection.
- (4) Never mount the actuator with auto switch in a location that will be used as a footrest.  
The product may be damaged if excessive force is applied by stepping or climbing onto it.
- (5) Design the circuit to prevent reverse current during open circuit conditions or when the product is forced to operate for functional checks.  
Reverse current can cause product damage or malfunction.
- (6) Precautions for mounting an auto switch  
When n number of auto switches is specified for mounting, this indicates the maximum number of auto switches based on the physical dimensions of the actuator.  
The detection distance varies depending on the auto switch mounting structure and the auto switch body dimensions. For this reason, the switch may not always be mounted at the required detection distance or at the required position.
- (7) Limitations of the detection position.  
There will be mounting positions or surfaces where the auto switch cannot be mounted due to physical interference (e.g. rear side of the foot bracket), depending on the mounting conditions of the actuator.  
Select an auto switch after confirming that the switch mounting position does not interfere with the mounting bracket (e.g. trunnion, reinforcement ring).

#### Mounting and Adjustment

#### Caution

- (1) Do not drop or apply impact.  
The auto switch may be damaged or malfunction if it is dropped, bumped or applied with excessive impact (1000 m/s<sup>2</sup> or more).
- (2) Observe the required tightening torque for mounting an auto switch.  
If an auto switch is tightened beyond the specified tightening torque, the auto switch, mounting screws, or mounting bracket may be damaged.  
Tightening below the specified tightening torque will allow the auto switch to move out of position.
- (3) Do not carry an actuator by the auto switch lead wire.  
This may cause a broken lead wire or damage to the auto switch internal elements.
- (4) Use only the screws installed in the auto switch body for mounting the auto switch.  
If other screws are used, the auto switch may be damaged.
- (5) Mount the auto switch at the centre of its operating range.  
Auto switches should be mounted so that the most sensitive position is at the centre of the operating range.  
Mounting the auto switch close to the edge of its operating range (close to the border of ON/OFF operation) may cause unstable operation.  
(The auto switch mounting positions shown in the actuator catalogue indicate the optimum position at the end of stroke).  
Some actuator and cylinder series have their own setting methods. In such cases, follow the instructions given.
- (6) Check and adjust the actual auto switch operation during installation.  
The auto switch may not operate in the correct actuator mounting position due to the installation environment.  
Also check and adjust the auto switch operation when used in intermediate stroke positions, according to the operating environment.

#### Wiring

#### Caution

- (1) Check the insulation of the wiring.  
Check that there is no faulty wiring insulation (short circuits, faulty ground connections, improper insulation between terminals, etc.), as this may damage the auto switch due to over current.
- (2) Do not route the auto switch wiring in the same place as power cables or high voltage cables.  
Otherwise auto switch malfunction may result due to noise and inrush current.

- (3) Avoid repeatedly bending or stretching the lead wire.  
Broken lead wires will result if bending stresses or tensile forces are applied to the lead wires.  
Stress and tensile forces applied to the connection between the lead wire and auto switch increases the possibility of disconnection.  
Secure the lead wire to reduce any movement in the area where the lead wire connects with the auto switch.  
The standard of bending radius becomes R20 to 40 mm.
- (4) Be sure to confirm the load condition (e.g. connection and current value) before power is supplied.

#### Operating Environment

#### Warning

- (1) Do not use the auto switch in the presence of explosive gases.  
Auto switches are not designed with an explosion proof construction. Fire or an explosion may result.  
Contact SMC for information regarding ATEX compliant products.

#### Caution

- (1) Do not use in a location where magnetic fields are generated.  
Auto switches will malfunction or the magnets inside actuators will become demagnetized.
- (2) Do not use in an environment where the auto switch will be continually exposed to water.  
Although auto switches satisfy the IEC standard IP67 construction, do not use in applications continually exposed to water splashes or spray. Otherwise, insulation failure or malfunction may result.
- (3) Do not use in an environment where oil or chemical splashes can occur.  
If auto switches are used in an environment with coolants, cleaning solvents, oils or chemicals for even a short time, they may be adversely affected by insulation failure, malfunction due to swelling of the potting resin, or hardening of the lead wires.
- (4) Do not use in an environment where there are cyclic temperature changes.  
Temperature cycles other than normal temperature changes can adversely affect the auto switch internally.
- (5) Avoid accumulation of iron debris or close contact with magnetic substances.  
When a large amount of iron waste such as machining chips or spatter has accumulated, or a magnetic substance (something attracted by a magnet) is brought into close proximity with the actuator, it may cause the auto switch to

- malfunction due to a weakening of the magnetic force inside the actuator.
- (6) Contact SMC for information regarding auto switch water resistance, elasticity of lead wires, applications in welding sites, etc.
  - (7) Do not use in direct sunlight.
  - (8) Do not mount the auto switch in locations where it is exposed to radiant heat.
  - (9) The auto switch is CE marked, but not immune to lightning strikes. Take measures against lightning strikes in the system.

#### Maintenance

#### Warning

- (1) Removal of equipment, and exhausting the compressed air.  
When equipment is to be removed, first confirm that measures are in place to prevent losing control of the equipment or workpieces from falling, etc. Turn off the power supply, stop the air supply and exhaust all compressed air from the system. Before restarting the equipment, confirm that measures are taken to prevent sudden movement.
- (2) Never touch the terminals while the power is on.  
Otherwise electric shock, malfunction and damage to the product can result.

#### Caution

- (1) Perform the following maintenance regularly to avoid possible danger due to unexpected auto switch malfunction.
  - 1) Securely tighten the auto switch mounting screws.  
If the screws have become loose and the required mounting position has been lost, re-adjust the auto switch to the correct mounting position and re-tighten the screws.
  - 2) The mounting screw is not tamper proof therefore it is foreseeable that misuse could result in system malfunction.
  - 3) Check that there is no damage to the lead wire.  
If damage to the lead wire is found, replace the auto switch, or repair the lead wire, to avoid faulty insulation.
  - 4) Check the detecting position setting.  
Confirm that the auto switch most sensitive position is at the centre of the operating range (red LED range).  
Some actuator and cylinder series have their own setting methods. In such cases, follow the instructions given.
- (2) Do not use solvents such as benzene, thinner, alcohol etc. to clean the auto switch.  
This may damage the surface of the body or erase the markings on the body.

For heavy stains, use a cloth soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

#### Solid state Auto switch Design and Selection

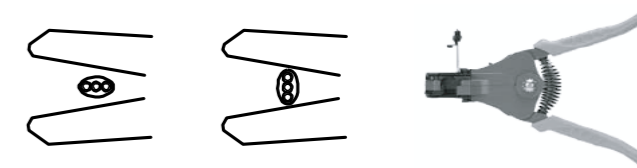
#### Caution

- (1) Wiring should be kept as short as possible.  
Do not use a cable longer than 100 m.  
For long wire lengths, we recommend a ferrite core should be attached to both ends of the cable, to reduce noise.
- (2) Do not use a load which generates a surge voltage.  
When a load which generates a surge voltage is to be directly driven, operate such as a relay or solenoid, use an auto switch with built-in surge protection.
- (3) Pay attention to the internal voltage drop of the switch.  
In general, the internal voltage drop will be greater with a 2-wire solid state auto switch than with a reed type auto switch.  
When auto switches are connected in series, the voltage drop will be "n" times larger when "n" auto switches are connected.  
Even though an auto switch may operate normally, the load may not operate.  
Note that a 12 VDC relay is not applicable.
- (4) Pay attention to the leakage current.  
<2-wire type>  
With a 2 wire solid state auto switch, current (leakage current) flows to the load to operate the internal circuit even when the switch is in the OFF state.  
Current to operate load (OFF condition) > Leakage current  
If the criteria given in the above formula are not met, the auto switch will not reset correctly (stays ON).  
Use a 3 wire type auto switch if this specification cannot be satisfied.  
In addition, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.
- (5) The solid state auto switch output will be unstable for 50 ms after power is supplied.  
During the time after supplying power, the input device (e.g. PLC, relay) may consider the ON position as OFF output or the OFF position as ON output.  
Please set up the application to consider the signals will be invalid within 50 ms after power is supplied.  
Perform a similar setting when using the SMC AHC system (Auto Hand Changing system) MA series.

#### Wiring

#### Caution

- (1) Do not short-circuit the load.  
The auto switch will be damaged if the load is short-circuited.
- (2) Avoid incorrect wiring.
  - 1) If connections are reversed on a 2-wire type auto switch, the switch will not be damaged if protected by a protection circuit, but the switch will always stay in an ON state.  
However, it is still necessary to avoid reversed connections, since the switch could be damaged by a load short circuit in this condition.
  - 2) If connections are reversed (power supply wire + and -) on a 3-wire type auto switch, the switch will be protected by a protection circuit. However, if the blue wire is connected to the power supply (+) and the black wire is connected to the power supply (-), the auto switch will be damaged.
- (3) Please note the correct stripping direction when removing the cable sheath. The insulator may be split or damaged depending on the direction used.



Recommended tool:

Description	Part number
Wire stripper	D-M9N-SWY

\*: For 2-wire type auto switches, a round wire stripper (φ2.0) can be used.

Operating Environment

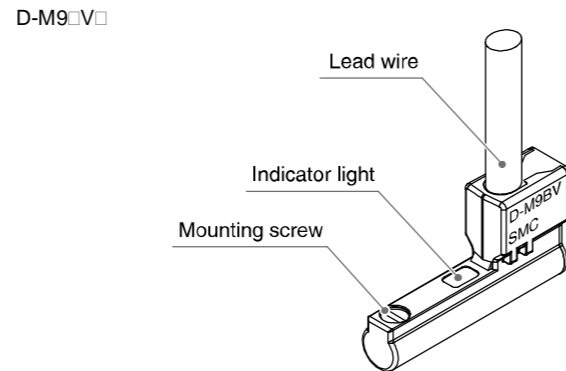
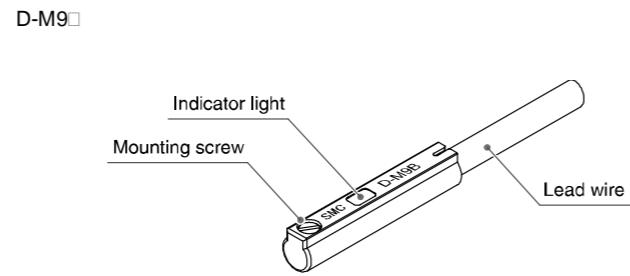
**Caution**

(1) Do not use in a location where surges are generated. When there are units (solenoid lifter, high frequency induction furnace, motor, etc.) which generate a large amount of surge in the area around the actuator with solid state auto switches, this may cause damage to the auto switch internal circuit.

Model Indication and How to Order

Switch No.		Output		Lead wire length	
N	3 wire NPN output	Nil	500 mm (Half strip)	M	1000 mm (Half strip)
P	3 wire PNP output	L	3000 mm (Half strip)	Z	5000 mm (Half strip)
B	2 wire	SAPC	500 mm (M8 3-pin pre-wired)	SBPC	500 mm (M8 4-pin pre-wired)
Display		SDPC	500 mm (M12 4-pin pre-wired)	MAPC	1000 mm (M8 3-pin pre-wired)
Nil	One colour	MBPC	1000 mm (M8 4-pin pre-wired)	MDPC	1000 mm (M12 4-pin pre-wired)
W	Two colour				
Electrical entry					
Nil	In-line				
V	Perpendicular				

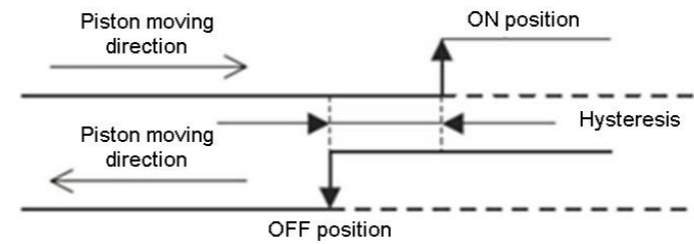
Product Elements



Setting the detecting position

- 1) Set the actuator at the end of stroke.
- 2) Mount the auto switch in the position where the red LED is ON (detecting position for the actuator end of stroke).
- 3) Based on the A and B dimensions in the actuator catalogue, set the switch.

Hysteresis

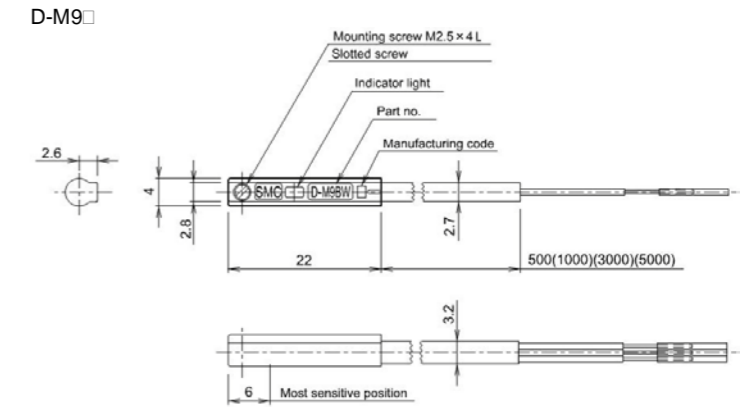


Environment

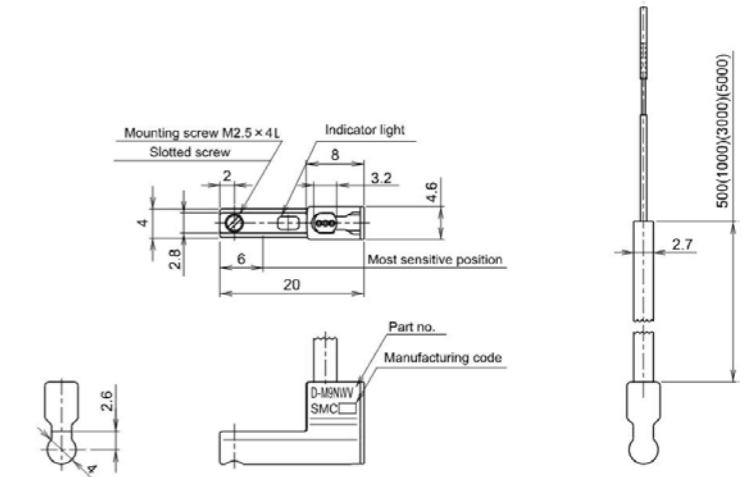
**Warning**

- Do not use in an environment where corrosive gases, chemicals, salt water or steam are present.
- Do not install in a location subject to vibration or impact. Check the product specifications.

Outline Dimensions (mm)



D-M9□V□



Specifications

Switch model No.	D-M9N□	D-M9P□	D-M9B□
Wiring	3 wire		2 wire
Output	NPN	PNP	-
Application	IC circuit / Relay / PLC		24 VDC Relay / PLC
Power voltage	5/12/24 VDC (4.5 to 28 VDC)		-
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 load current (2 V or less at 40 mA)		4 V or less
Current leakage	100 μA or less at 24 VDC		0.8 mA or less
Operating time	1 ms or less		
Indicator light	Operating position: Red LED lights up Optimum position: Green LED lights up (D-M9□W only)		
Electrical entry system	Grommet		
Lead wire	Oil-proof heavy-duty vinyl cord 2.7 x 3.2 oval, 0.15 mm <sup>2</sup> , 2 wire (D-M9B), 3 wire (D-M9N/D-M9P)		
Impact resistance	1000 m/s <sup>2</sup>		
Vibration resistance	10 to 150 Hz, at the smaller amplitude, 1.5 mm or 20 m/s <sup>2</sup> in X, Y, Z directions for 2 hours each (De-energized)		
Insulation resistance	50 MΩ or more at 500 VDC mega		
Withstand voltage	1000 VAC for 1 minute (between terminals and housing)		
Ambient temperature	-10°C to 60°C		
Protection structure	IEC60529 standard IP67, JISC0920		

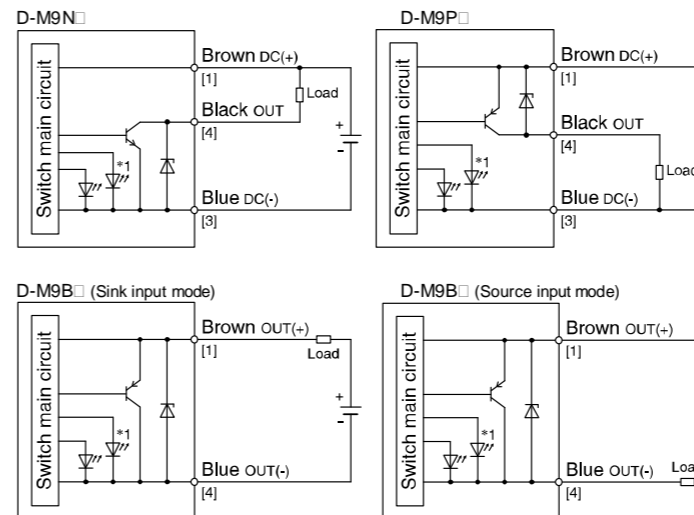
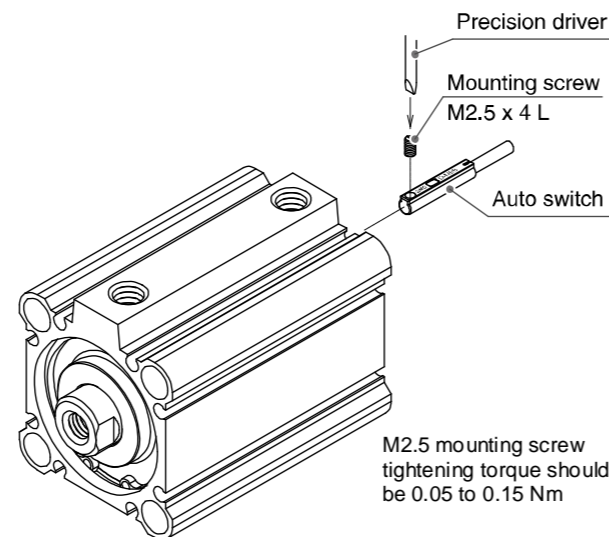
Installation

**Warning**

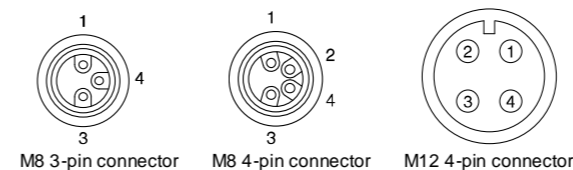
- Do not install the product unless the safety instructions have been read and understood.

Mounting

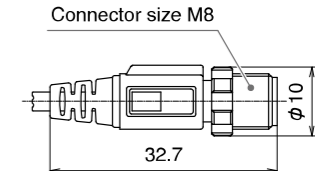
Each actuator has a specified mounting bracket for mounting the auto switch. "How to mount / Mounting bracket" depends on the actuator type and the tube I.D. Please refer to the actuator catalogue. When an auto switch is mounted for the first time, ensure that the actuator is a type including a built in magnet, and select a bracket corresponding to the actuator.



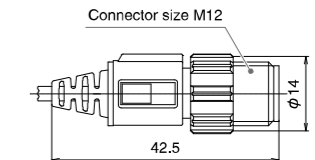
\*1: For the D-M9□(V) single colour auto switch the green LED is removed. The number shown in brackets [ ] indicates the connector pin number.



External dimensions of Pre-wired connector

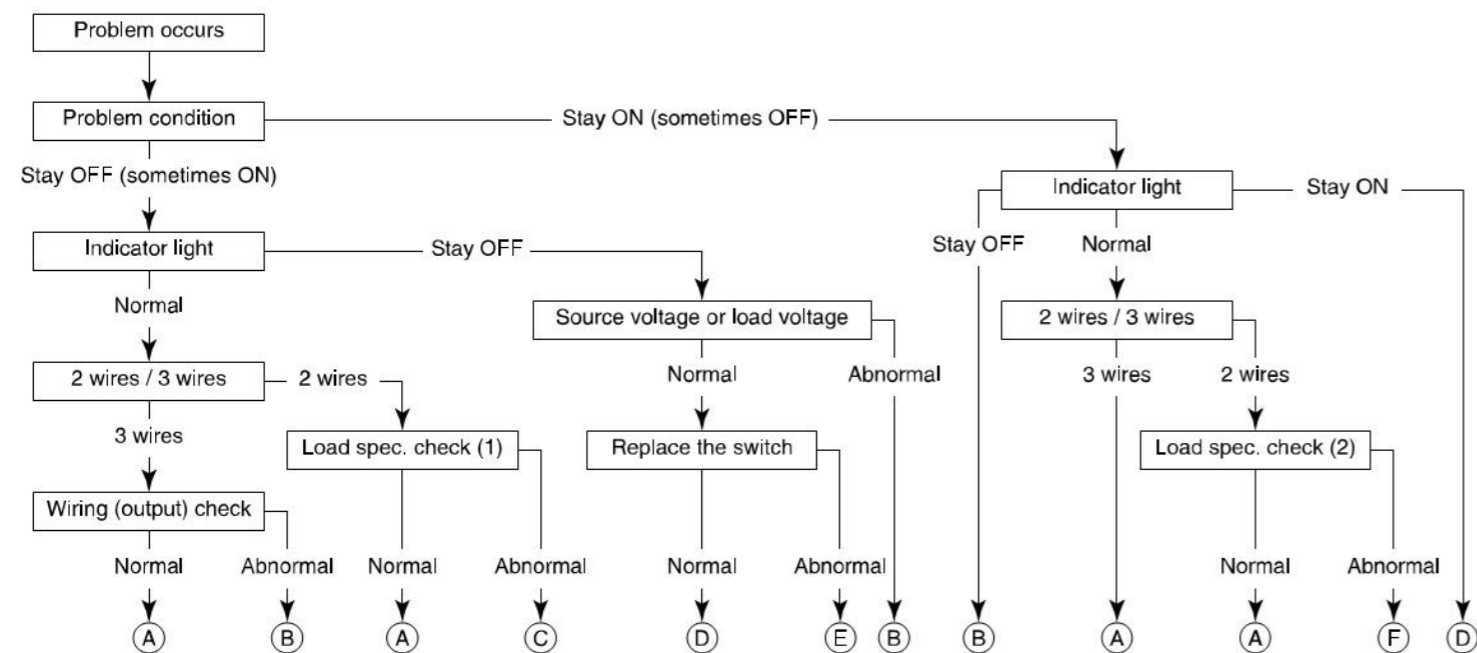


D-M9□□□□ DPC



## Troubleshooting

When detection failure occurs (stay ON/OFF), please follow the flow chart below.



- A: Switch output parts failure (replace)
- B: Check wiring and correct fault
- C: Replace switch 2 wires --> 3 wires
- D: Switch failure
- E: Replace cylinder. Detectable magnet field inadequate (No magnet)
- F: Replace PLC input board or replace switch 2 wires --> 3 wires

### Load specification checks

- 1) On voltage > Load voltage – Internal voltage drop
- 2) Off current > Leak current

## Limitations of use

Any use in an EN ISO 13849 system must be within the specified limits and application condition. The user is responsible for the specification, design, implementation, validation and maintenance of the safety system (SRP/CS)

## Contacts

<b>AUSTRIA</b>	(43) 2262 62280-0	<b>LATVIA</b>	(371) 781 77 00
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