No.D-※S-OMK0010-A

Operation Manual

Solid State Auto Switch

PRODUCT NAME

*D-M9*A(V) Series*

MODEL/ Series

SMC Corporation

Contents

Safety Instructions

The Solid-state Auto Switch and this manual contain essential information for the protection of users and others from possible injury and damage to property and to ensure correct handling.
Please check that you fully understand the definition of the following messages (signs) before going on to read the text, and always follow the instructions.
Also read carefully the instruction manual of relevant equipment or apparatus before use.

Indications

IMPORTANT MESSAGES	
Read this manual and follow its instructions. Signal words such as WARNING, CAUTION and NOTE, will be followed by important safety information that must be carefully reviewed.	
⚠WARNING	Indicates a potentially hazardous situation which could result in death or serious injury if you do not follow instructions.
⚠CAUTION	Indicates a potentially hazardous situation which if not avoided, may result in minor injury or moderate injury.
NOTE	Gives you helpful information.

Usage Restrictions

♦This product is designed for use in general equipment for factory automation. Never use this product with equipment or apparatus that directly concerns human lives*1, or which malfunction or failure can cause a huge loss.

*1: Equipment or apparatus that directly matters human lives means the following:
- Medical equipment such as life support systems or equipment used in operating rooms
- Compulsory equipment required by law such as the Fire Prevention Law, Construction Law and etc.
- Equipment or apparatus that conforms with those mentioned above.

♦Contact our sales department when plans are made for the product to be used for the system*2 including equipment that concerns itself with the safety of persons or that seriously affects the public. This usage needs special consideration*3.

*2: The system including equipment that concerns itself with the safety of persons or that seriously affects the public means the following:
- Nuclear reactor control systems in nuclear power plants, safety protection systems or other systems important for safety in nuclear power facilities
- Driving control systems of mass transportation systems, and flight control systems
- Equipment or apparatus that comes into contact with foods or beverages

*3: Special consideration means discussing usage with our engineers to establish a safe system designed as fool-proof, fail-safe, redundant and etc.

♦ Special consideration*4 should be taken regarding the safety or maintainability of the product to prevent a failure or malfunction. Such occurrence can be hazardous or cause a loss. This is likely to occur under certain environmental stresses (deterioration).

*4: Special consideration means to fully review the equipment or apparatus during the design stage and to establish a backup system in advance, such as a redundant system or fail-safe system.

♦Use for an interlocking circuit

When using the pressure switch as a sensor for interlock, adopt a double interlocking method such as equipping the mechanical protection function in order to deal with a auto switch failure. Check the pressure switch regularly to ensure proper operation.

Operator

- ♦This operation manual has been written for those who have knowledge of machinery and apparatus that use pneumatic equipment and have full knowledge of assembly, operation and maintenance of such equipment.
- ♦Please read this operation manual carefully and understand it before assembling, operating or providing maintenance to the Auto switch.

⚠WARNING
• Do not disassemble, modify (including change of printed circuit board) or repair. An injury or failure can result.
• Do not operate the Auto switch beyond specification range. Operation at a range that exceeds the specifications can cause a fire, malfunction, or damage to the Auto switch. Verify the specifications before use.
• Do not use the Auto switch in an atmosphere containing combustible or explosive gas. A fire or explosion can result. This Auto switch is not an explosion-proof type.
• These instructions must be followed when using the Auto switch in an interlocking circuit:
• Provide double interlocking by another system such as mechanical protection
• Check the Auto switch regularly to ensure proper operation Otherwise malfunction can cause an accident.
⚠CAUTION
• Do not touch terminals and printed circuit board inside the switch Otherwise it can cause electric shock, malfunction or damage to the unit.
• After maintenance, perform the appropriate functional inspection. Stop operation when the equipment or component does not function properly. Safety may not be guaranteed when an unintended malfunction occurs.
• Be sure to confirm the wiring condition. This series, including this product, is not equipped with excessive current protection. Therefore, incorrect wiring and or a short-circuited load could damage and or burn this product.

NOTE

• Follow the instructions given below when designing, selecting and handling your Auto switch.
 • The instructions on design and selection (installation, wiring, environment of use, adjustment, operation, maintenance and etc.) described below must also be followed.
 • Do not place two or more actuators close together.
 When using more than two Auto switches mounted parallel with each other, keep 40 mm or more between actuator tubes to prevent influence (malfunction) due to magnetic interference. (Keep the allowable displacement for each Auto switch if specified)
 • Detection of a piston by Auto switch mounted in the middle part of a cylinder stroke depends on the speed of the piston. Satisfy the conditional equation below.
 Where the maximum detectable piston speed =V[mm/s]

$$V[mm/s] = \frac{\text{Travel of auto switch [mm]}}{\text{Change over time of load [ms]}} \times 1000$$

 • Reserve a space for maintenance.
 Remember to leave space for maintenance when installing the product.

• Product handling
 • Installation
 • Follow the specified tightening torque. (0.05 to 0.15N▪m)
 Excessive tightening torque can break the mounting screws, mounting bracket or Auto switch. Insufficient tightening torque can displace the Auto switch from the original position. (Refer to the installation manual)
 • Connect frame-ground terminal (FG terminal) to the ground when using a switching power supply.
 • Do not drop, hit or apply excessive shock (larger than 1000 m/s2) to the Auto switch. Otherwise it can result in damage to the Auto switch causing failure or malfunction.

• Wiring
 • Do not pull the lead wires.
 Especially never lift actuator equipped with Auto switch by holding the lead wires. It can result in damage to inside of Auto switch causing malfunction.
 • Do not bend or apply tensile stress to lead wires repeatedly.
 Wiring with repetitive bending stress or tensile stress can cause peel of a sheath. If the lead wire can move, fix it near the body of the Auto switch.
 A bend radius of about 40 to 80 mm is recommended. Contact us for the details.
 • Connect wires and cables correctly.
 Miswiring can break the Auto switch depending on the miswired circuit.
 • Do not connect wires while the power is on.
 Otherwise it can break the circuit inside the Auto switch causing malfunction.
 • Do not lay wires or cables with power cable or high-voltage cable in the same wiring route.
 Lay the wires to the Auto switch to a wire duct or in a protective tube other than those for power cables or high-voltage cables to prevent contamination with noise or induced surge voltage from power lines or high-voltage lines.
 • Verify the insulation of wiring.
 Poor insulation (interference with other circuit, poor insulation between terminals and etc.) can introduce excess voltage or current to the Auto switch causing damage.

• Keep wiring as short as possible to prevent contamination from noise and induced surge voltage.
  Do not use a cable longer than 100 m.
• When stripping the cable envelope, please pay attention to the stripping direction.
  Insulator might be split or hurt depending on the directions.

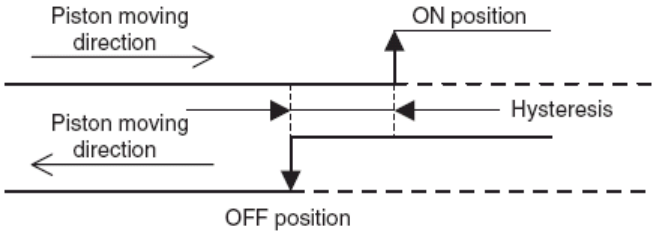
• Environment
  • Never use the product for a corrosive gas or liquid.
    It can cause failure or malfunction.
  • Do not use the product in a place where strong magnetic field exists.
    It can cause a malfunction of the Auto switch, or demagnetization of a magnet inside actuator.
  • Do not use the Auto switch in an environment where the Auto switch is always splashed with water drips.
    It can cause poor insulation or malfunction due to swelling of a resin filled inside the Auto switch.
  • Do not use the product in an atmosphere containing oils or chemicals.
    Use of the Auto switch in an atmosphere containing various oils or chemicals such as coolant or detergent can result in giving bad influence (poor insulation, malfunction die to swelling of a resin filled inside the Auto switch, or hardening of lead wires) even if in a short operating period.
  • Do not use the product in an atmosphere where steel dusts accumulate or magnetic bodies are gathered closely.
    When an amount of steel chips or steel dusts such as sputters of welding accumulate around an actuator equipped with Auto switch, or magnetic bodies (those attracted by magnet) are gathered closely to the actuator, they can weaken a magnet inside the actuator causing inoperativeness of the Auto switch.
  • Do not use the product in an environment where heat cycle exists.
    Heat cycles other than ordinary change of the temperature can affect the inside of Auto switch.
  • Do not use the Auto switch nearby a place where electric surges are generated.
    Internal circuit elements of Auto switch can deteriorate or break when equipment generating a large surge (electromagnetic lifter, high frequency induction furnace, motor, etc.) is located near the Auto switch. Provide surge preventives, and avoid interference.
  • Do not use a load generating surge voltage.
    Use Auto switch equipped with surge absorber when a surge-generating load such as a relay or solenoid valve is driven directly.

• Adjustment and Operation
  • Adjust an Auto switch in the middle of operating area and then fix it.
    Adjust the position of Auto switch in a way that a piston stops at about the middle of operating area (where switch is in ON status).
    Mounting the Auto switch close to the end of operating area can cause instability of operation.
    Air grippers and rotary actuators have their own setting method. Follow their instructions.
  • Turn the power on after connecting a load.
    Otherwise it can cause excess current causing instantaneous breakage of the Auto switch.

• Maintenance
  • Perform maintenance and check regularly.
    Otherwise safety is not assured due to an unexpected malfunction or incorrect operation.
  • Do not touch terminals or printed circuit board inside the switch while the power is on.

Otherwise it can cause in malfunction or damage to AUTO switch.

• Others
  • Contact SMC for water-proof capability, endurance of wire bending or use at welding shop.
  • Contact SMC when there is a problem of switch's ON/OFF positions (hysteresis).



How to Order

D-M9□A□□

Output type

Symbol	Spec.
N	3-wire, PNP
P	3-wire, NPN
B	2-wire

Electric entry

Symbol	Spec.
NIL	In line
V	Perpendicular

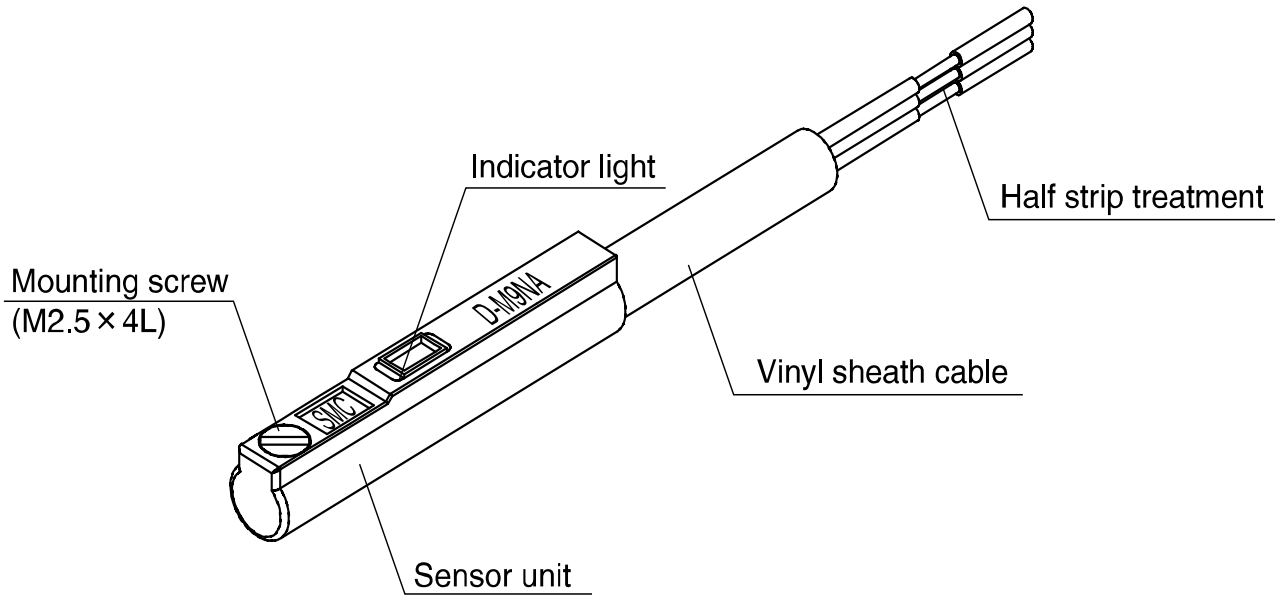
Lead wire length

Symbol	Spec.
NIL	500mm (Half strip)
M	1000mm (Half strip)
L	3000mm (Half strip)
Z	5000mm (Half strip)
SAPC	500mm (M8 3 pin pre-wire)
SBPC	500mm (M8 4 pin pre-wire)
SDPC	500mm (M12 4 pin pre-wire)
MAPC	1000mm (M8 3 pin pre-wire)
MBPC	1000mm (M8 4 pin pre-wire)
MDPC	1000mm (M12 4 pin pre-wire)

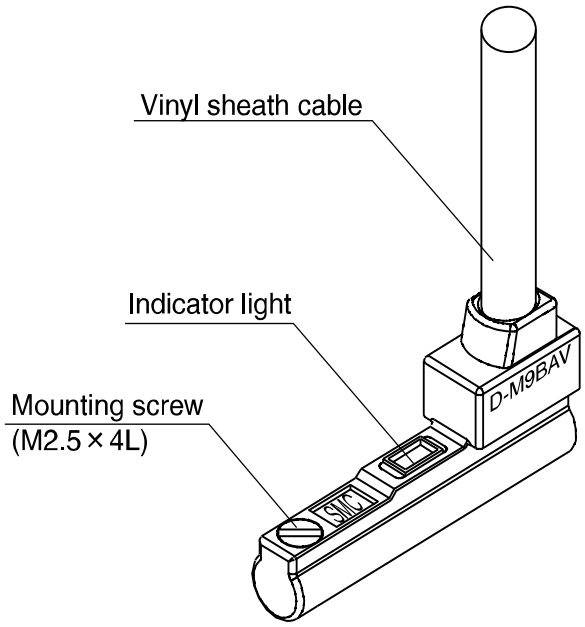
Description and Functions of Individual Part

♦Description and functions of individual part

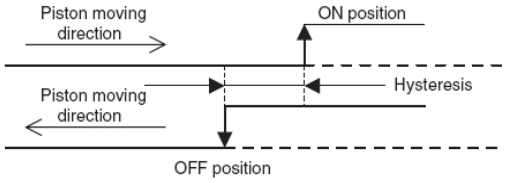
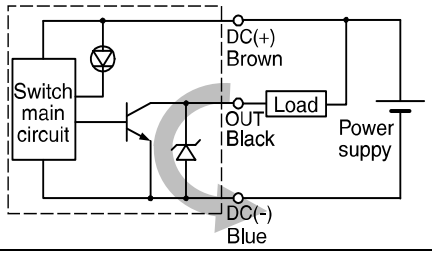
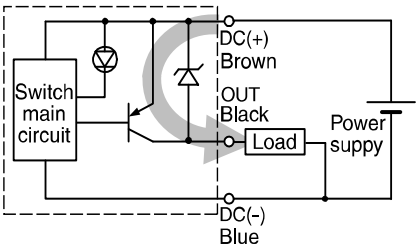
D-M9BA/M9NA/M9PA



D-M9BAV/M9NAV/M9PAV



♦Definition of terms and terminology

Term	Meaning and definition
Hysteresis	The difference between the points when the Auto switch turns on and off, which is provided to prevent chattering. 
Most sensitive position	The center position of the sensor unit (which gets the strongest reaction of the sensor unit), which means the center position of an operating range as well.
Sequence controller (PLC)	The device to perform sequence control, which performs controlling such as receipt of inputs from the Auto switch along with programming and sending of the output to other machines.
Internal voltage drop	The voltage applied between the COM and signal line when the Auto switch turns on.
Current leakage	The current flowing to the load when the Auto switch turns off.
Load current	The current flowing to the load when the Auto switch turns on.
Solid state auto switch	Auto switch which generates on and off outputs with or without mechanical contact such as a transistor.
Reed auto switch	Auto switch which generates on and off outputs with a mechanical contact.
2-wire auto switch	Auto switch which has only signal line and COM line.
NPN output	Auto switch which sinks current from the signal line when turning on. 
PNP output	Auto switch which sources current from the signal line when turning on. 
2-color indication	A type of indicating methods which lights up the red LED light up when the Auto switch comes to the operating position, and lights up the green LED when the Auto switch comes to the optimum operating position. 

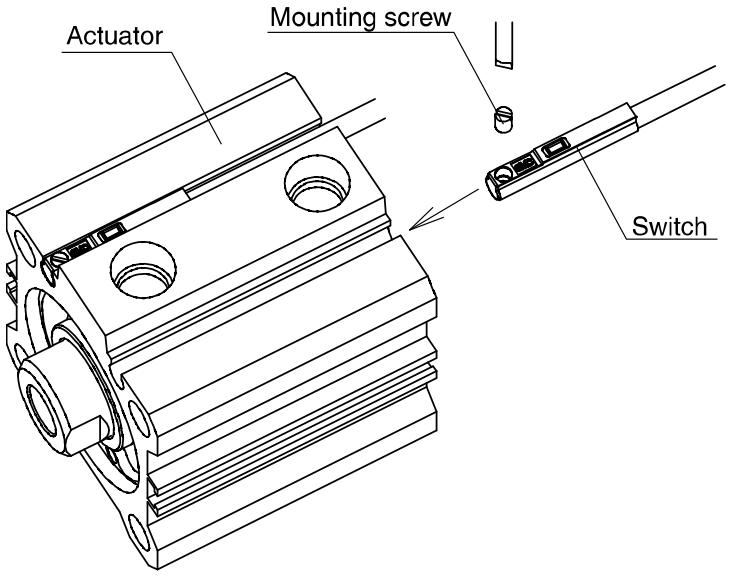
Mounting and Installation

♦How to install

When mounting the Auto switch to actuator it should be done with clamp for actuator.
“How to mount” depends on actuator type and tube I.D. Please refer the actuator catalogue.
When the Auto switch is mounted newly, please prepare the clamp for actuator after confirms that the actuator built in magnet.

• Proper tightening torque

Use a watchmaker driver whose grip diameter is 5 to 6mm when tightening the mounting screw.
M2.5 mount screw tightening torque range shall be 0.05 to 0.15N•m (0.5 to 1.5kgf•cm)



• Setting the detecting position

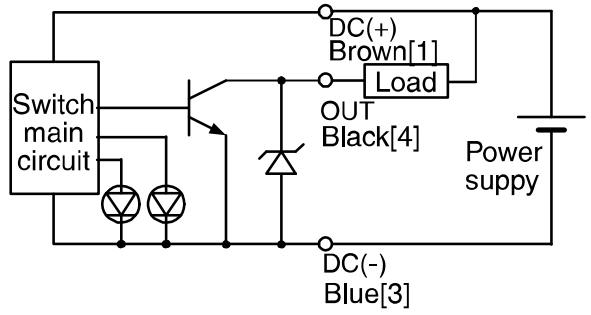
Set the actuator at the stroke end. Set the switch in the area to where the auto switch red lamp light.

(Detecting actuator end)

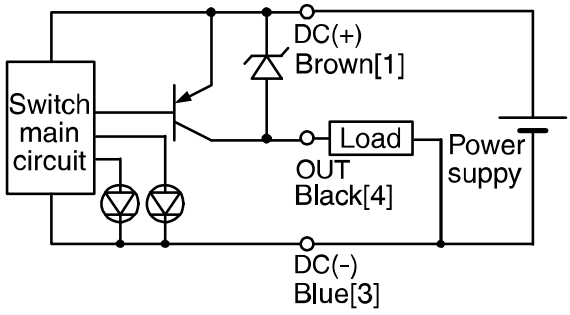
Based on A and B dimensions in the actuator catalogue, set the switch.
For actual installation works, perform adjustment with checking the operating conditions of the Auto switch.
Air grippers and rotary actuators have their own setting method. Follow their instructions.

♦Circuit diagram

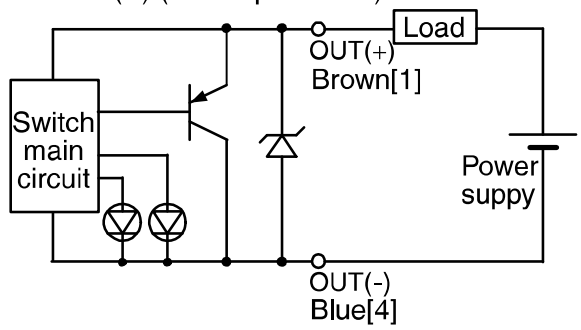
D-M9NA(V)



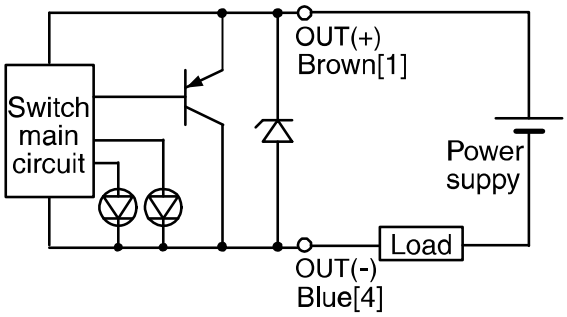
D-M9PA(V)



D-M9BA(V) (Sink input mode)



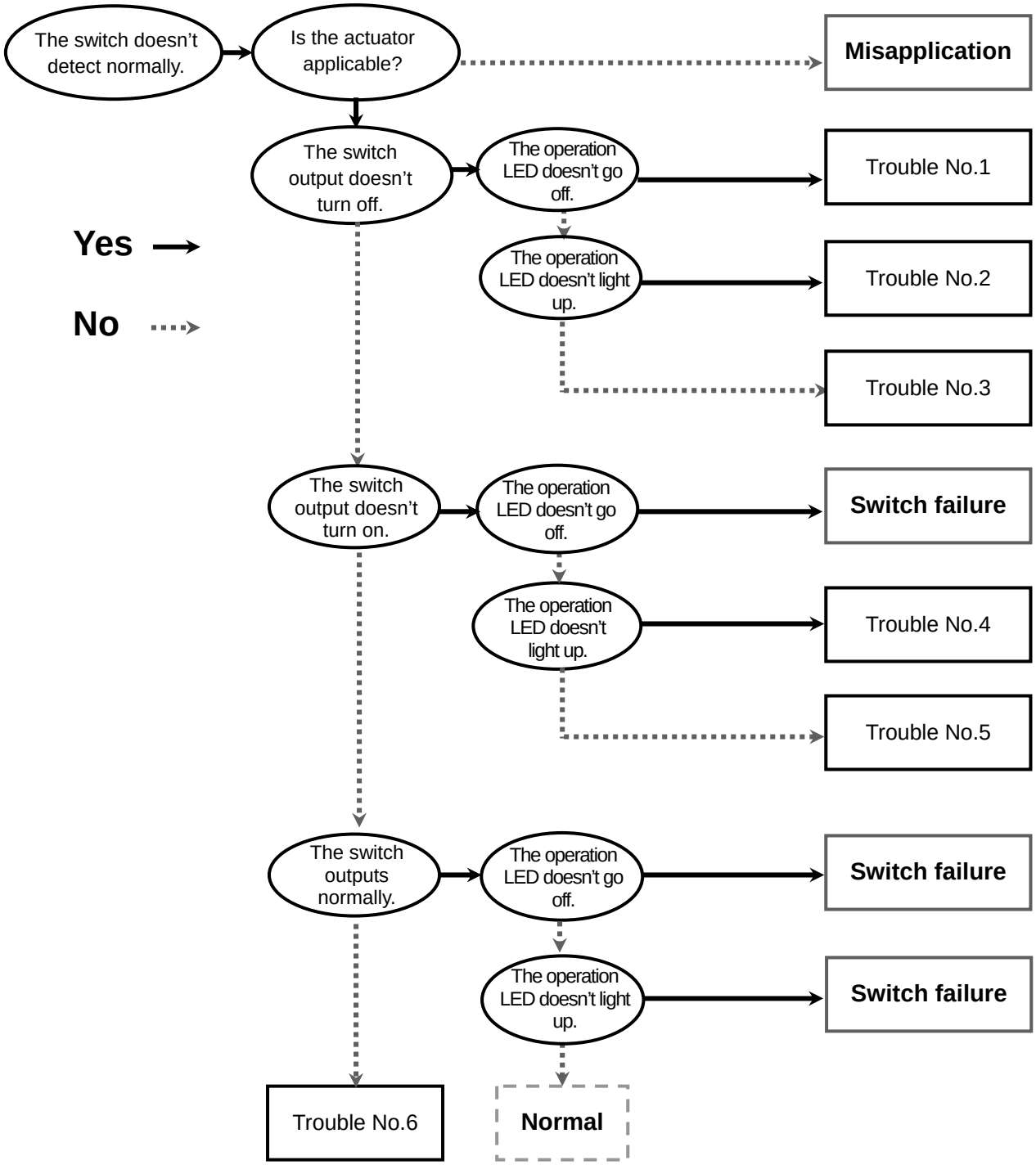
D-M9BA(V) (Source input mode)



Note) The number marked on each lead wire color shows the pin number of pre-wired connector.

Troubleshooting

When the auto switch falls in operation failure, identify the trouble with the following flow chart.
A failure of the auto switch might depend on operating environment (application etc.) and needs to be given a measure by contacting to us separately.



♦Trouble list

Trouble No.	Trouble	Possible cause	Investigation to find possible cause	Countermeasure
1	The switch output doesn't turn off. The operation LED doesn't go off.	Malfunction due to disturbance magnetic field	The effect of magnetic field generated by adjacent actuator	Place a magnetic shield plate to the actuator.
		Improper setting (mounting) position *Narrow angle	The presence of the following conditions - Switch operating angle - Actuator operating angle	Displace the switch set position from the center of the actuator operating range.
2	The switch output doesn't turn off. The operation LED doesn't light up.	Switch failure (2-wire type)	Check the switch wiring for any converse connection (brown, blue).	Correct wiring (refer to the circuit diagram on p11).
		Switch failure (3-wire type)		Replace the switch.
3	The switch output doesn't turn off. The operation LED operates properly.	Incorrect wiring	Reverse connection of switch wiring (blue and black)	Correct wiring.
		Wiring failure (3-wire type)	Check switch wiring for any converse connection (brown, blue)	Correct wiring (refer to the circuit diagram on p11).
4	The switch output doesn't turn on. The operation LED doesn't light up.	Power supply failure	Power supply voltage (zero or extremely low)	Adjust power supply voltage to a given value (refer to power voltage and load voltage on p15).
		Incorrect wiring	Voltage (load) applied to the switch	Correct wiring (refer to the circuit diagram on p11).
		Improper setting (mounting) position	Detection close to the limit of switch operating angle	Move the switch to proper position (near the center of the switch operating angle).
		Displacement from set position	Looseness of the switch unit or switch mounting screw	Fix to proper position at appropriate torque Tightening torque range: 0.05 to 0.15N•m
		Displacement of the actuator stopping angle	Deviation of the actuator stopping angle (position)	Stabilize stop position. (Correct decentrality and cushion.)
		Lowering of magnetic force for detection (demagnetization)	The presence of magnetic filed source near the actuator (electric welding machine conductor and strong magnet, etc.)	Place a magnetic shield plate between magnetic filed source and the actuator.
			The effect of magnetic field generated by adjacent actuator (placed within 20mm)	Separate the actuator (by 40mm or more). Place a magnetic shield plate.
			The presence of deposit of magnetic material (cutting chip) on the actuator.	Remove the magnetic deposit.
		Breakage of lead wire	The presence of repeated bending stress to a part of lead wire. (Bending radius, tensile force to the lead wire)	Correct wiring. (Adjust tensile force and enlarge bending radius)

Trouble No.	Trouble	Possible cause	Investigation to find possible cause	Countermeasure
5	The switch output doesn't turn on. The operation LED operates properly.	Non-conformity to load specification (2-wire type)	Check whether load spec. satisfies the following equation. Load voltage-(switch internal voltage drop x n) n: # of switch connected in series	Change the switch to 3-wire type or reed switch. Decrease the number of switch connected in series until the equation is satisfied.
		Incorrect wiring (output line) (3-wire type)	Condition of connected part (connector contact pin and crimping terminal)	Correct wiring. (Perform wiring of connected part again.)
		Breakage of lead wire (black) (3-wire type)	The presence of repeated bending stress to a part of lead wire. (Bending radius, tensile force to the lead wire)	Correct wiring. (Adjust tensile force and enlarge bending radius)
6	The operation is unstable. (chattering)	Improper setting (mounting) position	Detection close to the limit of switch operating angle	Move the switch to proper position (near the center of the switch operating angle).
		Displacement from set position	Looseness of the switch unit or switch mounting screw	Fix to proper position at appropriate torque. Tightening torque range: 0.05 to 0.15N•m
		Incorrect wiring	Condition of connected part (connector contact pin and crimping terminal)	Correct wiring. (Perform wiring of connected part again)
		Breakage of lead wire	The presence of repeated bending stress to a part of lead wire. (Bending radius, tensile force to the lead wire)	Correct wiring. (Adjust tensile force and enlarge bending radius)
		Malfunction due to disturbance magnetic field	The presence of magnetic field source near the actuator. (Cylinder, electric welding machine conductor, motor, magnet etc.)	Place a magnetic shield plate between magnetic field source and the actuator, or separate magnetic field source from the actuator.
	The switch operates at multiple points.	Malfunction due to disturbance magnetic field	The effect of magnetic field generated by adjacent actuator	Place a magnetic shield plate to the actuator.
	The load doesn't work.	Operating angle range Detection at intermediate position	Satisfaction of the following relations by the actuator rotation speed. Load operating time [s] < Auto switch operating angle range [mm] / Actuation operating speed [mm/s]	Decrease the actuating driving speed until specified relations can be satisfied.

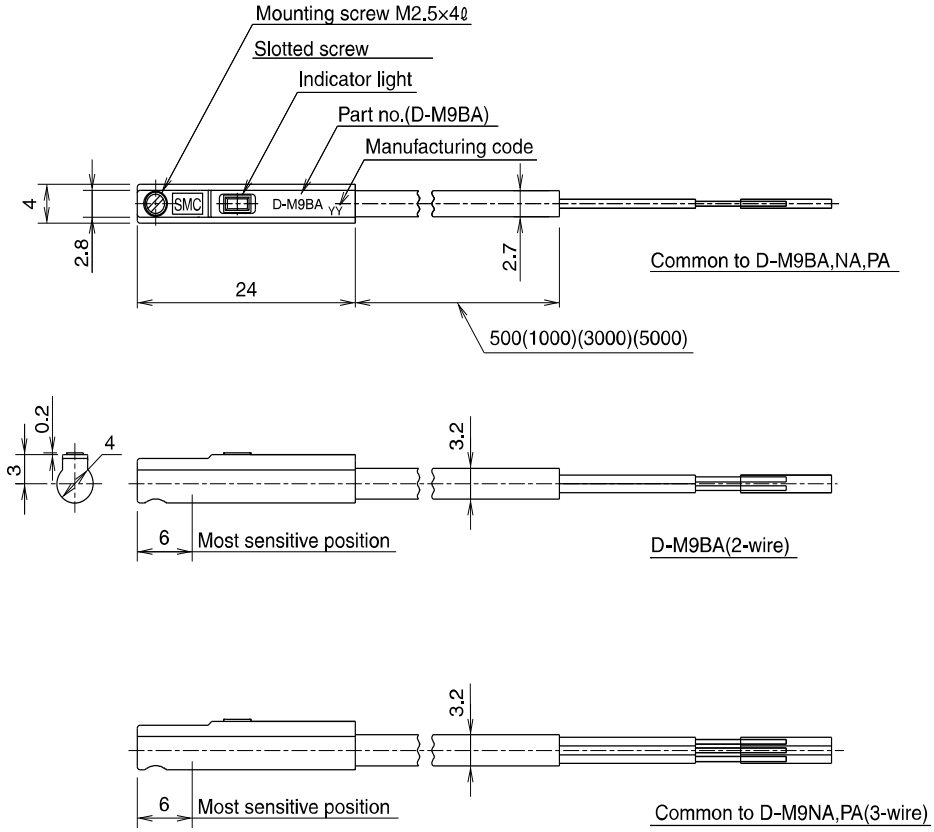
Specifications

♦Specifications

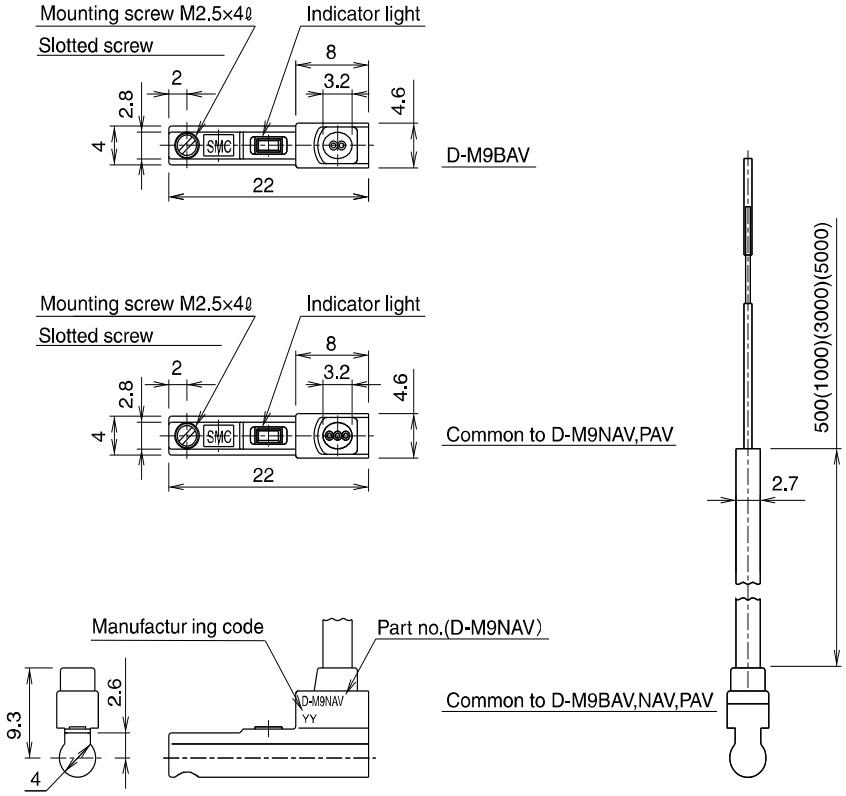
Switch part no.	D-M9NA	D-M9NAV	D-M9PA	D-M9PAV	D-M9BA	D-M9BAV
Wiring	3-wire				2-wire	
Output	NPN		PNP		-	
Lead wire orientation	In line	Perpendicular	In line	Perpendicular	In line	Perpendicular
Applicable load	IC circuit/Relay/PLC				24V DC Relay/PLC	
Power supply voltage	5/12/24V DC (4.5 to 28V DC)				-	
Current consumption	10mA or less				-	
Load voltage	28V DC or less		-		24V DC (10 to 28VDC)	
Load current	40mA or less				2.5 to 40mA	
Internal voltage drop	0.8V or less at load current of 10Ma (2V or less at load current of 40mA)				4.0V or less	
Current leakage	100μA or less at 24V DC				0.8mA or less	
Operating time	1ms or less					
Indication light	Operating position: The red LED lights up. Optimum operating position: The Green LED lights up.					
Electrical entry	Grommet					
Lead wire	Vinyl sheath cable 2.7 × 3.2 oval, 0.15mm^2, 2-wire (D-M9BA(V)), 3-wire (D-M9NA(V),D-M9PA(V))					
Impact proof	1000m/s^2					
Insulation resistance	50MΩ or more under the test voltage 500V DC (between case and cable)					
Withstand voltage	1000V AC 1min (between case and cable)					
Ambient temperature	-10 to 60°C					
Enclosure	IEC 60529 criteria IP67, JISC0920 watertight construction					

♦Dimensions

○D-M9BA,NA,PA



○D-M9BAV,NAV,PAV



♦Operating range

Unit: Operating range [mm]

Air cylinder Unit: Operating range [mm]

Series / Bore size	4	6	8	10	12	15	16	20	25	32	40	50	63	80	100	200
CQS	—	—	—	—	2.5	—	3	4.5	4.5	—	—	—	—	—	—	—
CQ2	—	—	—	—	—	—	—	—	—	5.5	4.5	4	5.5	5	5.5	—
RQ	—	—	—	—	—	—	—	4.5	4.5	5.5	4.5	5	6	8	7.5	—
CXT	—	—	—	—	2.5	—	3	4.5	4.5	5	4.5	—	—	—	—	—
CLQ	—	—	—	—	2.5	—	3	4.5	4.5	—	—	—	—	—	—	—
MK	—	—	—	—	2	—	3	—	—	5	4.5	5	5	—	—	—
MK2	—	—	—	—	—	—	—	—	—	5	5	5	5	—	—	—
RSQ	—	—	—	—	2.5	—	—	—	—	5.5	4.5	4	—	—	—	—
CEP1	—	—	—	—	2.5	—	—	3.5	—	—	—	—	—	—	—	—
CE1	—	—	—	—	—	—	—	—	—	5	5	5.5	5.5	—	—	—
CXSJ	—	2.5	—	3	—	3.5	—	4	4	4.5	—	—	—	—	—	—
RZQ	—	—	—	—	—	—	—	—	—	4.5	4.5	5	5	—	—	—
CY1R	—	3.5	—	5	—	5	—	4	—	—	—	—	—	—	—	—
RLQ	—	—	—	—	—	—	—	—	—	5.5	4.5	5	6	—	—	—

Coolant valve /series	200	300	400
SGC	3	3.5	3.5

Series / Bore size		Section	6	8	10	12	15	16	20	25	30	32	40	50	63	80
MHZJ2	M9W	Hysteresis	0.5	—	0.5	—	—	0.3	0.8	0.5	—	0.7	1	—	—	—
MHK2	M9W	Hysteresis	—	—	—	0.3	—	0.4	0.4	0.4	—	—	—	—	—	—
MHSJ3	M9W	Hysteresis	—	—	—	—	—	0.3	0.3	0.4	—	0.6	0.6	0.6	0.6	0.6
MHT2	M9W	Hysteresis	—	—	—	—	—	—	—	—	—	3	3	3	3	—
MHQJ2	M9W	Hysteresis	—	—	0.5	—	—	0.5	0.5	0.5	—	—	—	—	—	—

Revision history
A: Modify the contents.

SMC Corporation

URL http://www.smcworld.com

No.D-※S-OMK0010-A