ORIGINAL INSTRUCTIONS

Refer to Declaration of Conformity for relevant Directives

Instruction Manual

5 Port Solenoid Valve with Spool Detection
SY5100-X30 / -X31 Series New SY



The intended use of this valve is to supply and relieve air to a pneumatic component.

1 Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “Caution”, “Warning” or “Danger”.
They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC) *1), and other safety regulations.

*1) ISO 4414: Pneumatic fluid power - - General rules relating to systems.
ISO 4413: Hydraulic fluid power - - General rules relating to systems.
IEC 60204-1: Safety of machinery - -Electrical equipment of machines. (Part 1: General requirements)
ISO 10218-1: Manipulating industrial robots -Safety.etc.

- Refer to product catalogues, Operation Manual and Handling Precautions for SMC Products for additional information.
- Keep this manual in a safe place for future reference.

⚠ **Caution**	Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
⚠ **Warning**	Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
⚠ **Danger**	Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

⚠ Warning

- **Always ensure compliance with relevant safety laws and standards.**
  All work must be carried out in a safe manner by a qualified person in compliance with applicable national regulations.

2 Specifications

2.1 Valve specifications

Valve type		Rubber seal
Type of actuation Note 1)		2-position single / spring and air return type
Spool detection		Auto switch signal output is active when valve is de-energized
Fluid		Air
Internal pilot operating pressure range [MPa]		0.15 to 0.7
External pilot operating pressure range [MPa]	Operating pressure range	-100 kPa to 0.7
	2 position single	0.25 to 0.7
Ambient and fluid temperature [°C]		-10 to +50 (no freezing)
Min. operating frequency		1 cycle every 30 days
Max. operating frequency [Hz]		5
Pilot exhaust type	Internal pilot	Main/pilot valve common exhaust
	External pilot	Pilot valve individual exhaust
Lubrication		Not required (Refer also to 3.3)

2 Specifications – continued

Mounting orientation	Unrestricted
Impact/vibration resistance Note 2) [m/s^2]	150/30
Manual override	Non-locking push type
Flow	Refer to catalogue
Response time	Refer to catalogue
Duty cycle	Contact SMC
Enclosure	IP67 (Based on IEC60529)
Filtration	5 µm filtration or smaller

Table 1

Notes:

Note 1) When the air supply is cut, the main valve returns to the original (de-energized) position. See section 8.6 of Limitations of Use for more details on return of the spool to the safe position.

Note 2) Impact resistance: No malfunction occurred when it was tested with a drop tester in the axial direction and at right angles to the main valve and armature; in both energized and de-energized states and for every time in each condition (values at the initial period).
Vibration resistance: No malfunction occurred in a one-sweep test between 45 and 2000 Hz. Tests were performed at both energized and de-energized states in the axial direction and at right angles to the main valve and armature (values at the initial period).

2.2 Solenoid specifications

Coil rated voltage [DC]		24
Allowable voltage fluctuation		±10% of rated voltage Note 1, 2)
Power consumption [W]	X30	0.35 (with indicator light: 0.4)
	X31	0.1 (Inrush 0.35, holding 0.1)
Surge voltage suppressor		Diode (varistor for non-polar type)
Indicator light		LED

Table 2

Note 1) Since voltage drops due to the internal circuit in S/Z type, the allowable voltage fluctuation should be within the following:
24 VDC: -7% to +10%

Note 2) Valve state is not defined if electrical input is outside the specified operating range.

2.3 Special requirements of valve

Auto switch spool detection (auto switch signal output is active when valve is de-energized).
Refer to drawings for other special requirements.

2.4 Auto switch specifications

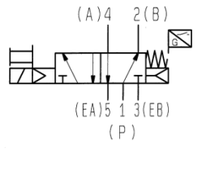
Auto switch model	D-M9NW	D-M9PW	D-M9BW
Wiring type	3-wire		2-wire
Output type	NPN	PNP	–
Applicable load	IC circuit, Relay, PLC		24 VDC relay, PLC
Power supply voltage	5, 12, 24 VDC (4.5 to 28 V)		–
Current consumption	10 mA or less		–
Load voltage	28 VDC or less	–	24 VDC (10 to 28 VDC)
Load current	40 mA or less		2.5 to 40 mA
Internal voltage drop	0.8 V or less at 10 mA load current (2 V or less at 40 mA)		4 V or less
Leakage current	100 µA or less at 24 VDC		0.8 mA or less
Operating time	1 ms or less		
Indicator light	Green LED illuminates when turned on (Red LED illuminates when within operating range)		
Standard	CE marking, RoHS		
Electrical entry system	Grommet		
Lead wire	Oil-proof heavy-duty vinyl cord 2.7 x 3.2 oval, 0.15 mm^2, 2 wire (D-M9BW), 3 wire (D-M9NW/D-M9PW)		
Withstand voltage	1000 VAC for 1 minute (between terminals and housing)		
Insulation resistance	50 MΩ or more at 500 VDC mega		
Ambient temperature	-10 to +60°C		
Enclosure	IEC529 standard IP67, JISC0920 water-proof construction		

Table 3

2.5 Symbols

2 Specifications – continued

X30: Internal pilot



External pilot

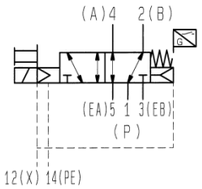
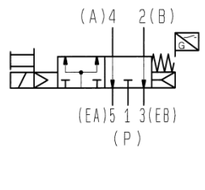


Figure 1

X31: Internal pilot



External pilot

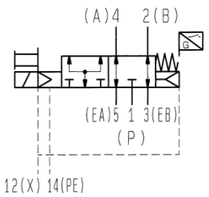


Figure 2

Note) Refer to section "8 Limitations of Use” for valves with combined air/spring return spool.

2.6 Light indication

Light
A side: Orange

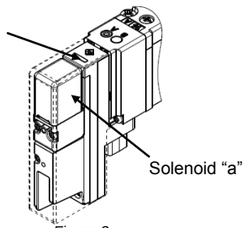


Figure 3

When equipped with indicator light and surge voltage suppressor, the light window turns orange when solenoid “a” is energized.

2.7 Manual Override

⚠ Warning

The manual override is used to switch the main valve without an electric signal.
Since connected equipment will operate when the manual override is activated, confirm that conditions are safe prior to activation.

2.7.1 Non-locking push type

Push down on the manual override button with a small screwdriver until it stops. Release the screwdriver and the manual override will return.

3 Installation

3.1 Installation

⚠ Warning

- Do not install the product unless the safety instructions have been read and understood.
- Warnings or specifications printed or affixed to the product should not be erased, removed or covered up.
- Provide sufficient space for inspection.
- Do not carry a valve by the auto switch lead wire. This may cause a broken lead wire or damage to the auto switch internal elements.
- Do not paint this product.
- The solenoid valve is an electrical product. For safety, install an appropriate fuse and circuit breaker before use.

3.2 Environment

⚠ Warning

- Do not use in an environment where corrosive gases, chemicals, coolant, cleaning solvent, various oils, salt water or steam are present.
- Do not use in an explosive atmosphere.
- Do not expose to direct sunlight. Use a suitable protective cover.
  Note that the valve is not for outdoor use.

3 Installation – continued

- Do not install in a location subject to vibration or impact. Check the product specifications.
- Do not mount in a location exposed to radiant heat.
- Products with IP67 enclosures (based on IEC60529) are protected against dust and water; however, these products cannot be used in water.
- Products compliant to IP67 satisfy the specifications through mounting.
- If using in an atmosphere where there is possible contact with water drop-lets, oil, weld spatter, etc., take suitable preventive measures.
- When the solenoid valve is mounted in a control panel or it is energized for a long time, make sure that the ambient temperature is within the specification of the valve.
- Incorrect mounting of the product violates the IP67 rating. Be sure to read the precautions of mounting for each product.
- Do not use in an area where a magnetic field is generated.
  Auto switches can malfunction or magnets inside valve can become demagnetized.
- 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.
- 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 valve, it may cause the auto switch to malfunction due to a weakening of the magnetic force inside the valve.
- Do not use in high humidity environments where condensation can occur.
- Contact SMC for altitude limitations.

⚠ Caution

- Temperature of ambient environment
  Use the valve within the range of the ambient temperature specification of each valve. In addition, pay attention when using the valve in environments where the temperature changes drastically.

3.3 Lubrication

⚠ Caution

- SMC products have been lubricated for life at manufacture, and do not require lubrication in service.
- If a lubricant is used in the system, refer to catalogue for details.

3.4 Wiring

⚠ Warning

- 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.

⚠ Caution

- 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. If damage to the lead wire is found, replace the valve.
- 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.
- Do not short-circuit the load.
  The auto switch will be damaged if the load is short-circuited.
- Confirm the load condition (e.g. connection and current value) before power is supplied.
- **External force applied to lead wire**
  If an excessive force is applied to the lead wire, this may cause faulty wiring. Take appropriate measures so that a force of 30 N or more is not applied to the lead wire. When instructions are given to the Specific Product Precautions, follow these specifications.
- 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 bending radius should be R20 to 40 mm.

3 Installation – continued

- **Polarity**
  When connecting power to a solenoid valve with a DC specification and equipped with a light or surge voltage suppressor, check for polarity. If there is polarity, take note of the following:
  - No diode to protect polarity: If a mistake is made regarding the polarity, damage may occur to the diode in the valve, the switching element in a control device or power supply equipment, etc.
  - With diode to protect polarity: If polarity connection is wrong, the valve does not operate.
- **Applied voltage**
  When electric power is connected to the solenoid valve, be careful to apply the proper voltage. Improper voltage may cause malfunction or coil damage.
- **Confirm the connections**
  Check if the connections are correct after completing all wiring.

3.5 Auto switch connector pin arrangement

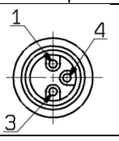
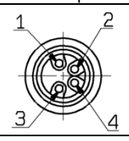
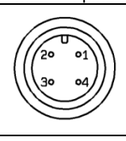
M8 – 3 pins	M8 – 4 pins	M12 – 4 pins
		

Table 4

Pin no.	1	2	3	4
DC 2-wire type	OUT (+) Brown	-	-	OUT (-) Blue
DC 3-wire type	DC (+) Brown	-	DC (-) Blue	OUT Black

Table 5

3.6 Connector circuit

Refer to Auto Switch catalogue.

3.7 Light/surge voltage suppressor – only for solenoid valve

Caution

Surge suppression for the solenoid valve should be specified by using the appropriate part number.

■ **Non-polar type**

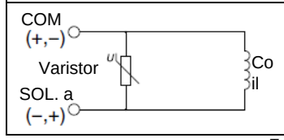
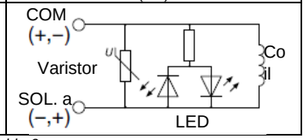
Single solenoid	Single solenoid
With surge voltage suppressor (□R)	With light/surge voltage suppressor (□U)
	

Table 6

■ **Polar type**

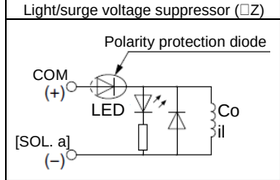
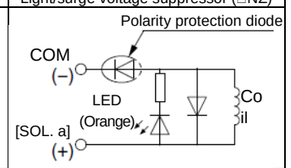
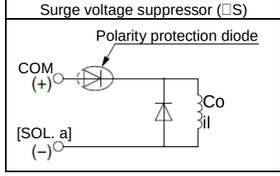
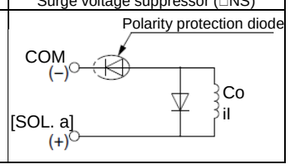
Positive common	Negative common
Single solenoid	**Single solenoid**
Light/surge voltage suppressor (□Z)	Light/surge voltage suppressor (□NZ)
	
Surge voltage suppressor (□S)	Surge voltage suppressor (□NS)
	

Table 7

3.7.1 Residual voltage of the surge suppressor

If a varistor or diode surge voltage suppressor is used, there is some residual voltage to the protection element and rated voltage. Therefore, refer to the below table and pay attention to the surge voltage protection on the controller side.

3 Installation – continued

Residual voltage

Surge voltage suppressor for solenoid valve	24 V DC
S, Z	Approx. 1 V
R, U	Approx. 47 V

Table 8

• The switch does not have voltage suppressor. Do not use a load which generates a surge voltage.

3.8 With power saving circuit

Power consumption is decreased by approximately 1/3rd by reducing the wattage required to hold the valve in an energized state.
(Effective energizing time is over 67 ms at 24 VDC).

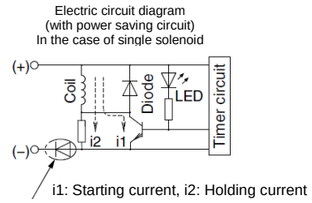


Figure 4

The above circuit reduces the power consumption for holding in order to save energy. Refer to the catalogue for details.

• The 12 VDC specification with power saving circuit (standard specification) does not have the polarity protection diode. Do not make a mistake with the polarity.

• Since the voltage will drop by approx. 0.5 V due to the transistor, pay attention to the allowable voltage fluctuation. (For details, refer to the solenoid specifications of each type of valve.)

3.9 Auto switch precautions

3.9.1 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.

3.9.2 Auto switch leakage current

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.

3.9.3 Solid state auto switch output

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.

3.10 Extended periods of continuous energization

Caution

If valves are energized continuously for a long period of time, the rise in temperature due to heat-up of the coil assembly may cause a decline in solenoid valve performance, reduce service life, or have adverse effects on peripheral equipment. In particular, if three or more adjacent stations on the manifold are energized simultaneously for extended periods of time, take special care as the temperature rise will be greater.
Refer to SMC for more information.

3.11 Valve mounting

Warning

- Stop operation if air leakage increases and the equipment does not operate properly:
  Check mounting conditions after air and power supplies are connected.

3 Installation – continued

Initial function and leakage tests should be performed after installation.

Caution

Mount the valve so that there is no slippage or deformation in gaskets, and tighten with the tightening torque as shown below.

Model	Thread size	Tightening torque
SY5000	M3	0.8 N·m

Table 9

3.12 Reverse flow

Caution

Only the external pilot variants are suitable for reverse flow with pressure supplied on ports 3 and 5 provided the pressure is less than 0.7 MPa.

3.13 External pilot exhausts

Caution

The external pilot variants use the manifold PE connection for pilot exhaust. Ensure that this connection is always vented to atmosphere and not subject to any pressure pulses from other devices.

3.14 Valve and manifold combination

The SY series plug-in valve has the common configuration of the valve mounting surface. Therefore it can be mounted to all manifolds of the side ported type (type 50 and type 10), the bottom ported type (type 51 and type 11) and the top ported type (type 52 and type 12).
For example, air output can be obtained from both sides of the A and B ports of the manifold and the valve by mounting a top ported valve to a side ported or bottom ported manifold, and a pressure switch can be connected to the output port on one side.

3.15 Air supply

Warning

- **Use clean air**
  Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.

Caution

- **Install an air filter**
  Install an air filter upstream of the valve. Select an air filter with a filtration size of 5 µm or smaller.

3.16 Effect of back pressure when using a manifold

Use caution when valves are used on a manifold, because an actuator may malfunction due to back-pressure.

4 Settings

4.1 Manual Override

Warning

Since connected equipment will operate when the manual override is activated, confirm that conditions are safe prior to activation.

5 How to Order

Refer to drawings and catalogue.

6 Outline Dimensions (mm)

Refer to drawings.

7 Maintenance

7.1 General Maintenance

Caution

- Not following proper maintenance procedures could cause the product to malfunction and lead to equipment damage.
- If handled improperly, compressed air can be dangerous. Maintenance of pneumatic systems should be performed only by qualified personnel.
- Before performing maintenance, turn off the power supply and be sure to cut off the supply pressure. Confirm that the air is released to atmosphere.
- After installation and maintenance, apply operating pressure and power to the equipment and perform appropriate functional and leakage tests to make sure the equipment is installed correctly.
- If any electrical connections are disturbed during maintenance, ensure they are reconnected correctly and safety checks are carried out as required to ensure continued compliance with applicable national regulations.
- Do not make any modification to the product.

7 Maintenance – continued

- Do not disassemble the product, unless required by installation or maintenance instructions.
- When the equipment is operated after remounting or replacement, first confirm that measures are in place to prevent lurching of actuators, etc. Then, confirm that the equipment is operating normally.
- If the volume of air leakage increases or the valve does not operate normally, do not use the valve.
  Perform periodic maintenance of the valve to confirm the operating condition, and if there is any air leakage.

8 Limitations of Use

8.1 Limited warranty and Disclaimer/Compliance Requirements

Refer to Handling Precautions for SMC Products.

Caution

8.2 Leakage voltage

Ensure that any leakage current when the switching element is OFF causes < 3% of the rated voltage across the valve.

8.3 Low temperature operation

Unless otherwise indicated in the specifications for each valve, operation is possible to -10 °C, but appropriate measures should be taken to avoid solidification or freezing of drainage and moisture, etc.

8.4 Safety relay or PLC

Warning

If a safe output from a safety relay or PLC is used to operate this valve, ensure that any output test pulse duration is shorter than 1 ms to avoid the valve solenoid responding.

8.5 Countermeasure for Surge Voltage

At times of sudden interruption of the power supply, the energy stored in a large inductive device may cause non-polar type valves in a de-energised state to switch.
When installing a breaker circuit to isolate the power, consider a valve with polarity (with polarity protection diode), or install a surge absorption diode across the output of the breaker.

Caution

8.6 Return of the spool to the safe position

8.6.1 Internal pilot type

For internal pilot type, the main valve returns to the original (de-energized) position by means of the spring when the air supply is cut.
When only the electrical power is cut, the return is by means of the pilot pressure itself.

8.6.2 External pilot type

For external pilot type, the main valve returns to the original (de-energized) position by means of the spring when the main air supply, and the external pilot supply, is cut.
When only the electrical power is cut, the return is by means of the external pilot pressure itself.

8.7 Light/surge voltage suppressor

Caution

If a valve type without suppression is used, suppression must be provided by the host controller.

9 Contacts

Refer to Declaration of Conformity or www.smcworld.com for contacts.

SMC Corporation

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