ORIGINAL INSTRUCTIONS

Instruction Manual
5 Port Pilot Operated Solenoid Valve
VFS2000 and VF2-4

The intended use of this valve is to control the movement of an actuator.

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: Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots.

- Refer to product catalogue, 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.
- If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

⚠ Caution

- The product is provided for use in manufacturing industries only. Do not use in residential premises.

2 Specifications

2.1 Valve specifications

Type		Body ported	Base mounted 2 position	Base mounted 3 position
Fluid		Air		
Operating pressure range [MPa]	For internal pilot	0.1 to 1		0.15 to 1
	For external pilot	0 to 1		
Internal / External pilot operating pressure range [MPa]		0.1 to 1		0.15 to 1
Proof pressure		1.5 MPa		
Ambient and fluid temperature [°C] Note 1)		-10 to 60		
Flow characteristics		Refer to catalogue		
Response time		Refer to catalogue		
Duty cycle		Contact SMC		

2 Specification - continued

Type		Body ported	Base mounted 2 position	Base mounted 3 position
Min. operating frequency		1 cycle / 30 days		
Max. operating frequency [cycles/min]	2 position	1200		
	3 position	600		
Manual override		Non-locking push type (Flush/Extended), Locking type (Tool required)	Non-locking push type (Flush/Extended), Locking type (Tool required/Lever)	
Lubrication		Not required		
Impact/Vibration resistance [m/s^2] Note 2)		150 / 50		
Enclosure (based on JIS C 0920)		IP50 equivalent	Type G, E: IP50 Equivalent, Type F, T, D: IP54 Equivalent	
Mounting orientation Note 3)		Unrestricted		
Weight		Refer to catalogue		

Table 1.

Note 1) Use dry air at low temperatures.
Note 2) Impact resistance: No malfunction occurred when it is tested with a drop tester in the axial direction and at the right angles to the main valve and armature in both energized and deenergized states every once for each condition. (Values at the initial period)
Vibration resistance: No malfunction occurred in a one-sweep test between 45 and 2000 Hz. Test was performed at both energized and de-energized states in the axial direction and at the right angles to the main valve and armature. (Values at the initial period)
Note 3) In the case of double solenoid, mount the valve so that the spool is horizontal.

2.2 Solenoid specifications

Pilot valve part number			SF4-###-#
Coil rated voltage	AC (50/60 Hz) [VAC]		100, 110 to 120, 200, 220, 240
	DC [VDC]		12, 24, 100
Electrical entry	Base mounted		Grommet, Grommet terminal, Conduit terminal, Conduit terminal (Plug-in), DIN terminal
	Body ported		Grommet, Grommet terminal, Conduit terminal, DIN terminal
Coil insulation class (Based on JIS C 4003)			Class B or equivalent
Allowable voltage fluctuation Note)			–15 to +10% of rated voltage
Apparent power [VA]		Inrush	5.6 (50 Hz), 5.0 (60 Hz)
		Holding	3.4 (2.1 W)/50 Hz, 2.3 (1.5 W)/60 Hz
Power consumption [W]			1.8 (2.04 with light/surge voltage suppressor)
Surge voltage suppressor			Varistor, Diode (DC Grommet)
Indicator light		AC, 100 VDC	Neon light
		12, 24 VDC	LED

Table 2.

Note) Valve state is not defined if electrical input is outside of specified operating ranges.

2.3 Manifold specifications

2.3.1 Body ported type (VV5FS2-20 / VV5FS2-30)

Symbol	Passage		Porting specifications		
			Base	Valve	Base
	1(P)	5(R1), 3(R2)	1(P)	2(B), 4(A)	3(R2), 5(R1)
1	Common	Common	Side 3/8	Top: 1/8, 1/4	Side: 3/8

Table 3.

2 Specification - continued

2.3.2 Base mounted type (VV5FS2-01# / VV5FS2-10)

Base model	Port specification	Port size Rc		Stations	Applicable valve model
	A, B port	P, EA, EB	A, B		
Plug-in type VV5FS2-01#	Side/ Bottom	1/4	1/8, 1/4	2 to 15 stations	VFS2#00-#F
Non plug-in type VV5FS2-10					VFS2#10-#G VFS2#10-#E VFS2#10-#T VFS2#10-#D

Table 4.

2.4 Pneumatic symbol

Refer to catalogue for pneumatic symbol.

2.5 Indicator light

Refer to catalogue for indicator light locations.

2.6 Special products

⚠ Warning

Special products (-X) might have specifications different from those shown in this section. Contact SMC for specific drawings.

3 Installation

3.1 Installation

⚠ Warning

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

3.2 Environment

⚠ Warning

- Do not use in an environment where corrosive gases, chemicals, salt water or steam are present.
- Do not use in an explosive atmosphere.
- Do not expose to direct sunlight. Use a suitable protective cover.
- Do not install in a location subject to vibration or impact in excess of the product's specifications.
- Do not mount in a location exposed to radiant heat that would result in temperatures in excess of the product's specifications.
- Products compliant with IP50 and IP54 have limited protection against dust.
- Products compliant with IP54 are protected against water splashes. However, these products cannot be used in water.
- Do not use in high humidity environment where condensation can occur.
- Contact SMC for altitude limitations.

3.3 Piping

⚠ Caution

- Before connecting piping make sure to clean up chips, cutting oil, dust etc.
- When installing piping or fittings, ensure sealant material does not enter inside the port. When using seal tape, leave 1 thread exposed on the end of the pipe/fitting.
- Tighten fittings to the tightening torque specified in table 5.

Port	Thread	Tightening torque [N·m]
External pilot	M5	1 to 1.5
Pilot exhaust		
1 (P), 2 (B), 3 (R2/EB), 4 (A), 5 (R1/EA)	1/8	3 to 5
	1/4	8 to 12
1 (P), 3 (R2/EB), 5 (R1/EA)	3/8	15 to 20

Table 5.

3.4 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 Installation - continued

3.5 Air Supply

⚠ Warning

- Use clean air. If the compressed air supply includes chemicals, synthetic materials (including organic solvents), salinity, corrosive gas etc., it can lead to damage or malfunction.

⚠ Caution

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

3.6 Manual override

⚠ Warning

- Regardless of an electric signal for the valve, the manual override is used for switching the main valve. Since connected equipment will operate when the manual override is activated, confirm that conditions are safe prior to activation.
- Locked manual overrides might prevent the valve responding to being electrically de-energised or cause unexpected movement in the equipment.
- Refer to the catalogue for manual override location.
- To operate the non-locking manual override, push the manual override until it stops.
- To operate the locking manual override, use a tool (not required for lever type) to turn the manual override 90° in the "1" direction, the valve will turn on and lock. To cancel the ON state, turn it 90° in the display "0" direction and check that it is in the OFF state.

OFF State ON State

Figure 1. Locking manual override (Tool required type shown)

3.7 Mounting

⚠ Caution

- Ensure gaskets are in good condition, not deformed and are dust and debris free.
- When mounting valves to a manifold or sub-plate ensure gaskets are present, aligned and securely in place and tighten the M3 mounting screws to a torque of 0.8 to 1.2 N·m.
- Refer specific product precautions for how to exchange solenoid valve.

Figure 2. Mounting valve to base (Plug-in type)

- Attach/remove solenoid valve vertically, parallel to sub-plate, otherwise it may cause damage to the solenoid valve. Never remove a valve at an angle.

3.8 Electrical circuits

⚠ Caution

Surge suppression should be specified by using the appropriate part number. If a valve type without suppression (Type 'Nil') is used, suppression must be provided by the host controller as close as possible to the valve.

3 Installation - continued

3.8.1 AC and 100 VDC (All types other than Grommet 'G')

Figure 3. Circuit diagrams - AC and 100 VDC

3.8.2 24 VDC or less (All types other than Grommet 'G')

Figure 4. Circuit diagram - 24 VDC or less

3.8.3 Grommet (Type G)

Note) DC Grommet with surge voltage suppressor has polarity

Figure 5. Circuit diagrams – Grommet

3.9 Electrical connections

3.9.1 DIN terminal, Grommet terminal, Conduit Terminal

Caution

Applicable terminal: 1.25-3, 1.25-3S, 1.25Y-3N, 1.25Y-3S, but in the case of with DIN terminal block, is not a terminal structure.

Note: There is no polarity (+, –).

1	(-)(+) (no polarity)
2	(+)(-) (no polarity)
3	Ground

Figure 6. Internal wiring of DIN terminal and terminal block

- Refer to specific product precautions in catalogue for how to change direction of DIN terminal.
- Applicable heavy-duty cord O.D. ø6 mm to ø8 mm.
- Tightening torque for terminal: 0.6 N·m

3.9.2 Grommet

Refer to 3.8.3 for Grommet wiring

3 Installation - continued

3.9.3 Plug-in type sub-plate Conduit terminal (With terminal block)

Caution

Refer to figure 7: Removing junction cover (1) allows access to plug-in terminal block (2). Connect with power side corresponding to markings.

Figure 7. Plug-in (conduit terminal) electrical connection

	Solenoid A side	Solenoid B side
Terminal block marking	A A + -	B B + -

Table 6.

- Applicable terminal: 1.25-3, 1.25-3S, 1.25Y-3N, 1.25Y-3S.
- There is no polarity.
- When ground wiring and COM wiring are required, please specify separately.
- Tightening torque for terminal: 0.6 N·m.

3.9.4 Plug-in type manifold

Caution

Refer to specific product precautions in catalogue for how to wire plug-in manifold (lead wire, terminal, circular connector or D-Sub connector types).

3.10 Residual voltage

Caution

- If a varistor voltage suppressor is used, the suppressor arrests the back EMF voltage from the coil to a level in proportion to the rated voltage.
- Ensure the transient voltage is within the specification of the host controller.
- Contact SMC for the varistor residual voltage.
- In the case of a diode, the residual voltage is approximately 1 V.
- Valve response time is dependent on surge suppression method selected.

3.11 Countermeasure for surge voltage

Caution

- 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.

3.12 Extended period of continuous energization

Warning

- If a valve will be continuously energized for an extended period of time, the temperature of the valve will increase due to the heat generated by the coil assembly. This will likely adversely affect the performance of the valve and any nearby peripheral equipment. Therefore, if the valve is to be energized for periods of longer than 30 minutes at a time or if during the hours of operation the energized period per day is longer than the de-energized period, we advise using a valve with specifications of 0.4 W or lower valve, such as the SY series, or a valve with a power-saving circuit.

3.13 Effect of back pressure when using a manifold

Warning

- Use caution when valves are used on a manifold, because an actuator may malfunction due to back-pressure.
- Special caution must be taken when using 3 position exhaust centre valve or when driving a single acting cylinder. To prevent a malfunction, implement counter measures such as using a single EXH spacer assembly or an individual exhaust manifold.

4 How to Order

Refer to catalogue for 'How to Order'.

5 Outline Dimensions

Refer to catalogue for outline dimensions.

6 Maintenance

6.1 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.
- Do not disassemble the product, unless required by installation or maintenance instructions.

6.2 Mounting

Caution

Refer to 3.7 Mounting for information on mounting valves to a base.

6.3 Maintainable parts

Caution

- Refer to specific product precautions in catalogue for how to order and exchange pilot valve.

Figure 8. Attachment/removal of pilot valve

- Refer to catalogue for how to order sub-plate assemblies, manifolds, manifold accessory parts and mounting bolts and gasket.

7 Limitations of Use

Warning

The system designer should determine the effect of the possible failure modes of the product on the system.

7.1 Limited warranty and disclaimer/compliance requirements

Caution

Refer to Handling Precautions for SMC Products.

7.2 Effect of energy loss on valve switching

Warning

- The use of 2-position single valves with combined air and spring returned spools has to be carefully considered.
- The return of the valve spool into the de-energized position depends on the pilot pressure. If the pilot pressure drops below the specified operating pressure the position of the spool cannot be defined.
- The design of the system must take into account such behaviour.
- Additional measures might be necessary. For example, the installation of an additional air tank to maintain the pilot pressure.

7 Limitations of Use - continued

	Single solenoid	Double solenoid	3 Position
Air supply present, electrical supply cut	Valve spool returns to the OFF position by air and spring force.	Valve spool holds position.	Valve spool returns to the OFF position by spring force.
Electrical supply present, air supply cut	Valve spool position cannot be defined.	Valve spool holds position.	Valve spool returns to the OFF position by spring force.

Table 7.

7.3 Intermediate stopping

Warning

Refer to Handling Precautions for 3/4/5 port Solenoid Valves.

7.4 Holding of pressure

Warning

Since valves are subject to air leakage, they cannot be used for applications such as holding pressure (including vacuum) in a system.

7.5 Cannot be used as an emergency shut-off valve

Warning

This product is not designed for safety applications such as an emergency shut-off valve. If the valves are used in this type of system, other reliable safety assurance measures should be adopted.

7.6 Safety relays 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.

7.7 Leakage voltage

Caution

Ensure that any leakage voltage caused by the leakage current when the switching element is OFF causes ≤3% (for DC coils) or ≤20% (for AC coils) of the rated voltage across the valve.

7.8 Low temperature operation

Caution

Unless otherwise indicated in the specifications for each valve, operation is possible to -10˚C (-5˚C for VF2-4), but appropriate measures should be taken to avoid solidification or freezing of drainage and moisture, etc.

7.9 Momentary energization

Caution

If a double solenoid valve is operated with momentary energization, it should be energized for at least 0.1 second. However, depending on the secondary load conditions, it should be energized until the cylinder reaches the stroke end position, as there is a possibility of malfunction otherwise.

8 Product Disposal

This product shall not be disposed of as municipal waste. Check your local regulations and guidelines to dispose this product correctly, in order to reduce the impact on human health and the environment.

9 Contacts

Refer to www.smcworld.com or www.smc.eu for your local distributor/importer.

SMC Corporation

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