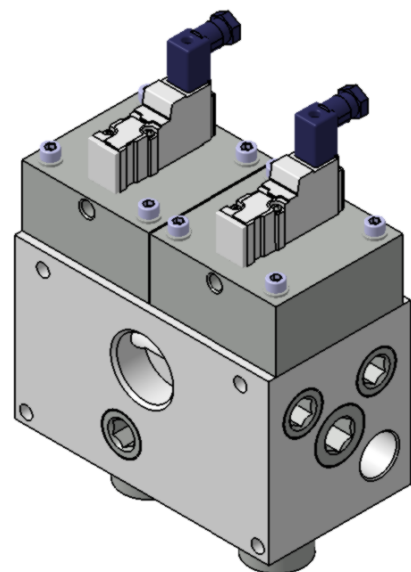




Installation and Maintenance Manual
Monitored valve for use in safety related systems
Product Name: VV3CH5R-5D-06G-X66A



Safety component as defined by the Machinery Directive 2006/42/EC article 2c



The intended use of this valve is to vent a protected system to atmosphere when it is de-energised. When properly integrated into a suitable safety system the valve is compatible for use in Category 4 PL e systems as defined by EN ISO 13849-1:2008.

1 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.

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

1 Safety Instructions (Continued)

Warning

- The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications. Since the products specified here can be used in various operating conditions, their compatibility with the specific pneumatic system must be based on specifications or after analysis and/or tests to meet specific requirements.
- **Only trained personnel should operate pneumatically operated machinery and equipment.**
Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced personnel.
- **Do not service machinery/equipment or attempt to remove components until safety is confirmed.**
 - 1) Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
 - 2) When equipment is to be removed, confirm the safety process as mentioned above. Switch off air and electrical supplies and exhaust all residual compressed air in the system.
 - 3) Before machinery/equipment is re-started, ensure all safety measures to prevent sudden movement of cylinders etc. (Supply air into the system gradually to create back pressure, i.e. incorporate a soft-start valve).
- **Do not use this product outside of the specifications. Contact SMC if it is to be used in any of the following conditions:**
 - 1) Conditions and environments beyond the given specifications.
 - 2) Installations in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, press applications, or safety equipment.
 - 3) An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

- This product is intended for use in a safety related part of a control system and is capable of providing the stated safety function to the category stated in the Declaration of Conformity, when correctly used. Any system using this product must be designed and validated by a properly qualified and responsible person, to meet the requirements of the relevant standards, laws and regulations applicable to the equipment in which it is installed.
- **Extended periods of continuous energisation**
For applications such as mounting a valve on a control panel, incorporate measure to limit the heat radiation so that it is within the operating temperature range.
- **Do not disassemble the product or make any modifications, including additional machining. It may cause human injury and/or an accident.**

Caution

- Ensure that the air supply system is filtered to 5µm or better.

2 Specifications

2.1 Manifold specification

Model	VV3CH5R-5D-06G-X66A
Structure	External pilot operated poppet valve
Type of actuation	Normally closed
Return method	Spring return with balanced poppet
Fluid	Air
Proof pressure	6.0 MPa
Operation pressure	0 to 4.0 MPa
External pilot pressure	0.6-0.7 MPa
Ambient & operating Fluid temp.	5 to 50°C ⁽¹⁾
Lubrication	Not required ⁽²⁾
Operating frequency Max	0.5Hz
Operating frequency Min	1 per week ⁽³⁾
Response time – on/off	See 2.8.3.1 ⁽⁷⁾
Vibration / Impact resistance	300/50 m/s ² ^(4,5)
Ambient humidity	95% RH or less
Air quality	5 µm filtration or better
Environment	Indoor use only
Enclosure	IP 40 ⁽⁶⁾
B10 _d for calculation of MTTF _d	14,900,000 cycles ⁽⁶⁾
Mission time	14,900,000 cycles ⁽⁶⁾
Orifice diameter	Ø 23
Effective area when both valves are working (1-2)	170mm ²
Effective area when exhausting from V2 valve (normal) (2-3)	280mm ²
Effective area when exhausting from V1 valve (V2 fails) (2-3)	200mm ²
Body material	Aluminium
Seal material	Polyurethane elastomer
Mounting orientation	Free

2.1.1 Notes

Maximum allowable back pressure on port 2 to be 1.0MPa.

- 1) Ensure moisture does not freeze.
- 2) If lubrication is used, use turbine oil Class 1 ISO VG32.
- 3) The valve must be energised/de-energised at least once per week.
- 4) Shock resistance:
 - No malfunction resulted from the impact test using a drop impact tester.
 - The test was performed on the axis and right angle direction of the main valve and armature, for both energised and de-energised states.
- 5) Vibration resistance:
 - No malfunction occurred in a one-sweep test between 45 and 2000Hz.
 - Test was performed at both energised and de-energised state to the axis and right angles direction of the main valve and armature (valve in the initial stage).
- 6) According to the Safety Standard. See Note in Section 2.8.5 and 2.8.6. Manifold body is IP30

2 Specifications (Continued)

2.2 Flow specifications (indicative values)

Inlet pressure 4MPa Outlet pressure 3.8MPa	1→2 (P→A) (When both valves work)	
	Flow L/min (ANR) 30676*	
Inlet pressure 4MPa Outlet pressure 0MPa	2→3 (A→R) When exhausting from V2	2→3 (A→R) (When exhausting from V1)
	Flow L/min (ANR) 137760*	Flow L/min (ANR) 98400*

*Values obtained from calculation

Note that the air supply flow is from port 1 to port 2 and the exhaust from port 2 to 3. The ports on the valve are clearly identified with the corresponding numbers.

2 Specifications (Continued)

2.3 Pilot valve specification

Model	VKF334E-5D-X76
Electrical entry	DIN EN 175301-803 Industry Standard C "Micro" 9.4 mm pitch terminals (SMC "D" type connector)
Coil rated voltage	24 VDC
Coil insulation type	Type B
Allowable voltage fluctuation	±10%
Power consumption	2W per valve
Surge voltage suppressor	None

2.4 Auto switch D-M9PVS DPC specification

Wiring	3 wire
Output	PNP
Application	IC circuit/Relay/PLC
Power voltage	4.5 to 28 VDC
Current consumption	10 mA or less
Maximum permitted load current	20 mA or less ⁽¹⁾
Internal voltage drop	0.8V or less
Current leakage	100 µA or less at 24V DC
Operating time	1 ms or less
Indication light	ON: Red light emitting diode
Electrical entry	M12 connector
Lead wire	Oil proof heavy-duty vinyl cable 2.7 3.2 oval, 0.15 mm ² , 3 wire
Impact resistance	1000 m/s ²
Insulation resistance	50 mΩ or more at 500V DC mega
Withstand voltage	1000V AC for 1 minute (lead wire, between cases)
Ambient temperature	5 to 50 °C
Protection structure	IEC529 standard IP67, JISC0920

2.4.1 Notes

1) For the purposes of EN ISO 13849-2:2008 table D.2 the switch is de-rated from the figures specified by the switch manufacturer. The switch load must be limited in the application in order to maintain the specified safety performance, including the B10d and mission time.

2.5 Safety specification

Safety function: When the valve is de-energised the protected circuit is vented to atmosphere. The product is compatible with Category 4 architecture according to the Safety Standard when integrated into a suitable safety system.

In this section, 'the Safety Standard' refers to EN ISO 13849-1 and 'the Validation Safety Standard' refers to EN ISO 13849-2 as referenced in the Declaration of Conformity.

Information about compatibility with the Safety Standard is given in section 2.9.

2 Specifications (Continued)

2.6 Declaration of Conformity

Below is a sample Declaration of Conformity (DoC) used for this product. The actual DoC will be supplied with each product.

Doc. No. DoC_VV3CH5R-5D-06G-X66A

EC DECLARATION OF CONFORMITY

SMC Corporation
4-14-1 Soto-Kanda, Chiyoda-ku, Tokyo 101-0021, Japan
declares under sole responsibility that the following equipment:
3 PORT SPECIAL MANIFOLD VV3CH5R-5D-06G-X66A
Batch codes: Ro, RP, RQ, RR, RS, RT, RU, RV, RW, RX, Ry, RZ
conforms with the following directive(s) and harmonized standards:

Directive	Harmonized standards
Machinery Directive 2006/42/EC	EN ISO 13849-1:2008, EN ISO 13849-2:2008 EN ISO 4414:2010
EMC Directive 2004/108/EC	EN 61000-6-2:2005 EN 55011:2007+A2:2007

Name and address of the person authorised to compile the technical file:
Mr O. Berakotoba, Director & General Manager, SMC European Zone,
SMC España, Zuazobidea 14, 01015 Vitoria, Spain

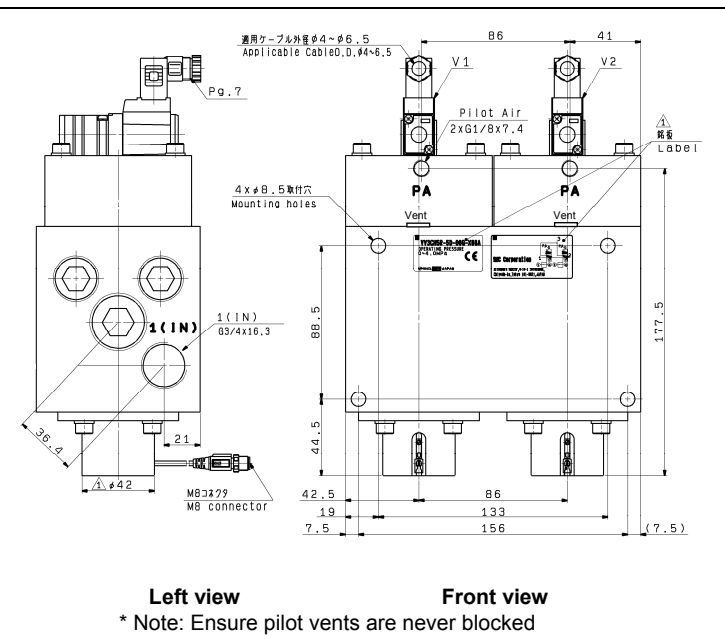
Importer/Distributor in EU and EFTA:

Country	Company Name	Address
Austria	SMC Pneumatik GmbH	Waldviertelstr. 10, 3430 Sankt Pölten, Austria
Belgium	SMC Pneumatik B.V.	Willemsdreef 20, 2700 Breda, Belgium
Bulgaria	SMC Pneumatik Bulgaria EOOD	1100 Sofia, Bulgaria
Czech Republic	SMC Pneumatik s.r.o.	150 00 Praha 5, Czech Republic
Denmark	SMC Pneumatik A/S	2500 Roskilde, Denmark
Estonia	SMC Pneumatik Eesti OÜ	10110 Tallinn, Estonia
Finland	SMC Pneumatik Oy	00420 Espoo, Finland
France	SMC Pneumatique S.A.	14410 Vitoria, France
Germany	SMC Pneumatik GmbH	42699 Solingen, Germany
Greece	SMC Pneumatik S.A.	11527 Athens, Greece
Hungary	SMC Pneumatik Hungary Ltd.	1046 Budapest, Hungary
Italy	SMC Pneumatik S.p.A.	20139 Milan, Italy
Latvia	SMC Pneumatik SIA	1000 Riga, Latvia
Lithuania	SMC Pneumatik UAB	01103 Vilnius, Lithuania
Netherlands	SMC Pneumatik B.V.	2700 Breda, Netherlands
Poland	SMC Pneumatik Sp. z o.o.	01-651 Warszawa, Poland
Portugal	SMC Pneumatik Lda	1449-015 Vitoria, Portugal
Romania	SMC Pneumatik S.R.L.	14001 Bucharest, Romania
Slovakia	SMC Pneumatik s.r.o.	821 01 Bratislava, Slovakia
Slovenia	SMC Pneumatik d.o.o.	1000 Ljubljana, Slovenia
Spain	SMC España S.A.	01015 Vitoria, Spain
Sweden	SMC Pneumatik AB	141 86 Vitoria, Sweden
Switzerland	SMC Pneumatik AG	141 86 Vitoria, Switzerland
Turkey	SMC Pneumatik A.Ş.	141 86 Vitoria, Turkey

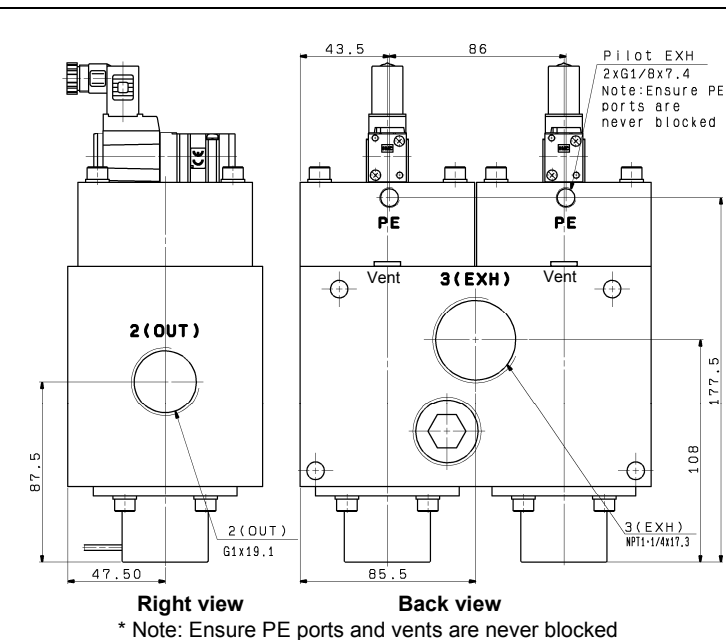
Tokyo, DD MMM YYYY

xxx - name - xxx
General Manager
Product Development Division - 8

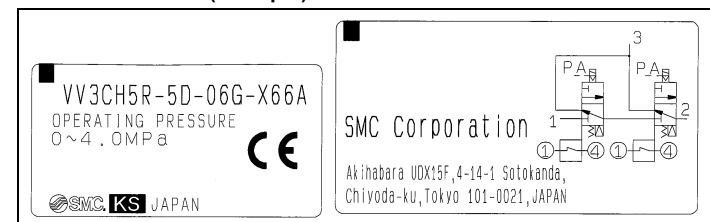
2.7 Parts and connections



2 Specifications (Continued)



2.8 Product Label (example)



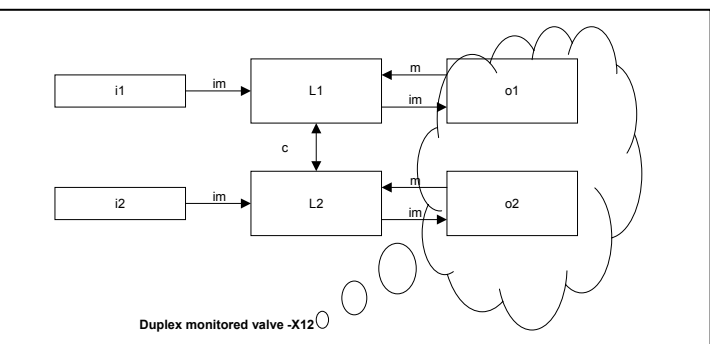
Batch code in the above label translates to the construction year / month according to the following table (eg. 'QQ' = Mar 2012)

Construction Year / Month	Production batch codes											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	Qo	Qp	Qq	Qr	Qs	Qt	Qu	Qv	Qw	Qx	Qy	Qz
2013	Ro	Rp	Rq	Rr	Rs	Rt	Ru	Rv	Rw	Rx	Ry	Rz
...
2017	Vo	Vp	Vq	Vr	Vs	Vt	Vu	Vv	Vw	Vx	Vy	Vz

2.9 Safety System - information for the system designer

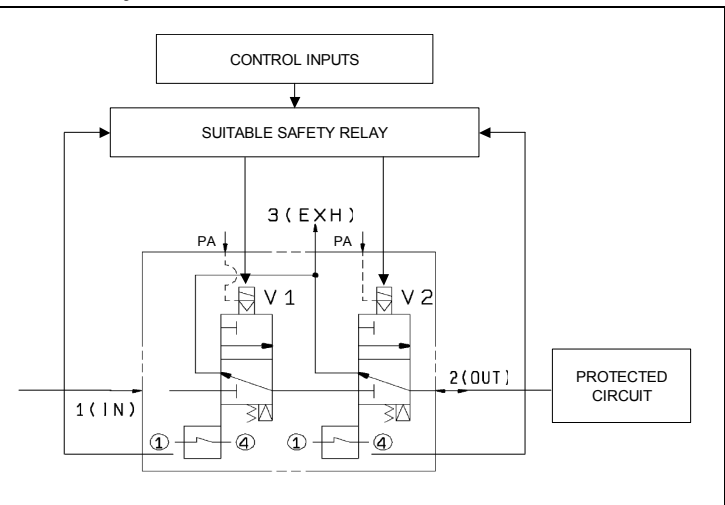
2.9.1 System Block Model according to the Safety Standard

2 channels: 1 and 2
Input 'i' and output 'o' controlled by logic element 'L'.
Input 'i' is an initiation that will result in output 'o' (the valve solenoid) becoming active if permitted by the logic element.
When output 'o' is active the protected system operates and the potentially hazardous condition is allowed as long as input 'i' is active and the logic element is satisfied.
The logic element monitors the state of the output 'o' via input 'm' (the valve switch).
The logic element for each channel also monitors the fault state of the other channel via cross-monitor connection 'c'.



2 Specifications (Continued)

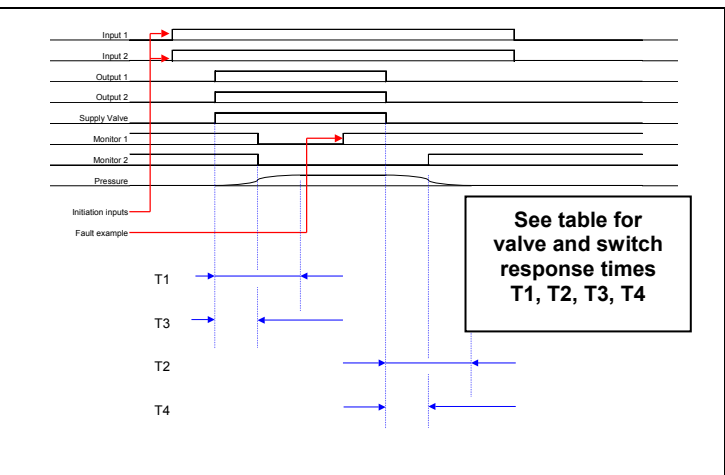
2.9.2 The System Interface



The diagram shows the valve in the dotted line box connected to a safety relay in dual channel mode following the principles of the Safety Standard.

2.9.3 Timing Diagram

Note: The monitor switches are Normally Closed, i.e. closed when indicating the protected system is in the vented state. The monitor signals are therefore shown 'High' when the protected system is in this state. When the solenoids of both channels are energised by the output signals air is supplied to the protected system, the monitoring switch contacts open and the monitor signals go 'Low'.



2 Specifications (Continued)

2.9.3.1 Valve Response

T1 values given in the table are indicative and depend on the valve and the design of the protected system. They are based on the pressure rising to 3.6MPa

T2 values given in the table are indicative and based on the pressure falling from 4.0MPa to 0.05MPa (see note 2.8.4).

2.9.3.2 Switch Response

T3 Refer to table
T4 Refer to table

Volume V, dm ³	Valve response		Switch response	
	T1, ms	T2, ms	T3, ms	T4, ms
0	115	100	90	40
2	165	210	90	40

Caution

Exhaust times experienced on systems will be increased in the fault condition when only 1 channel is functioning.
Exhaust times are based on tests under SMC conditions and are not guaranteed. Always observe the terms of 2.9.4.

2.9.4 Relationship of flow and response performance to safety function

The time taken for the air to vent and remove the hazard is a function of:

- The flow capacity of the valve.
- The flow restriction of silencers fitted to the valve
- The volume of the protected system
- The pressure of the air in the protected system

The flow restrictions in air supply and the protected system
The end user is expected to establish the time taken to vent the application system by testing and ensure that this time is consistent with the requirement of the overall safety system. This includes the selection of suitable silencers.

The performance of the system should be validated by test after each installation to ensure that the actual performance of the valve is consistent with the safety function.

2.9.5 Mission time according to the Safety Standard

The operational life of the product should be limited to the mission time stated in section 2.1. The mission time is given in cycles, the user is expected to calculate an equivalent figure in time units based on the duty cycle of the application. After the mission time has expired for the component it should be replaced with a completely new unit.

2.9.6 MTTFd according to the Safety Standard

The B10d for the component given in section 2.1 is derived from product knowledge and based on specific life tests. The system integrator should use this data to determine MTTFd and the Performance Level (PL) of the system using the methods described in the Safety Standard.

2.9.7 Diagnostic Coverage according to the Safety Standard

This valve is fitted with 'indirect monitoring' according to Table E1 of the Safety Standard. When properly integrated this valve contributes to a minimum DC value of 90% for the safety function.

2.9.8 Common Cause Failures according to the Safety Standard

CCF analysis is the responsibility of the system integrator. This valve has 2 channels made of identical valves. The use of this valve might not allow the system calculation to include CCF points for diversity.

3 Installation (Continued)

- Loosen the terminal screws in the terminal block and insert the cores of the wire into the terminals according to the connection method. Tighten the terminal screws securely with a torque range of 0.5 Nm +/-15%.
- Reassemble the housing in the required direction, pressing the housing and terminal block together until they click into place.
- Fasten the cable by screwing in the gland nut and tightening it to a torque of 1.65 to 2.5 Nm

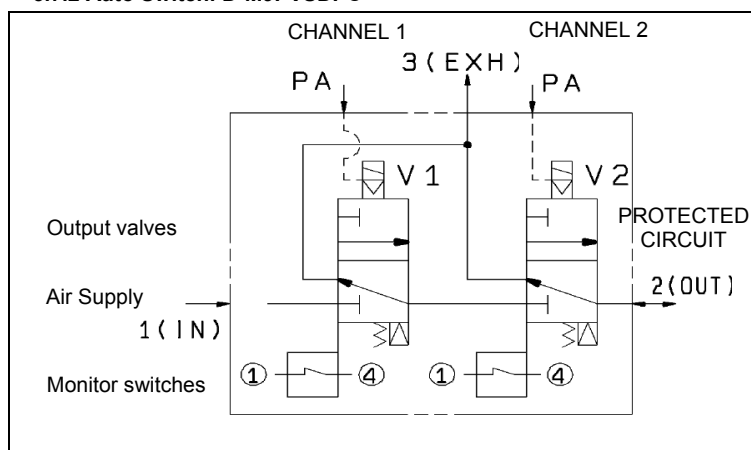
Cable entry direction changing procedure

- After separating the terminal block and housing, the cable entry direction can be changed by re-attaching the housing in the desired direction (4 directions in 90° increments). When adjusting the direction do not put any strain the wires.

Compatible cables

- Cable outside diameter: $\phi 4$ to $\phi 6.5$ (Reference) 0.5mm² equivalent to JISC3306, 2 wire or 3 wire

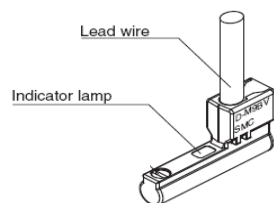
3.7.2 Auto Switch: D-M9PVSDPC



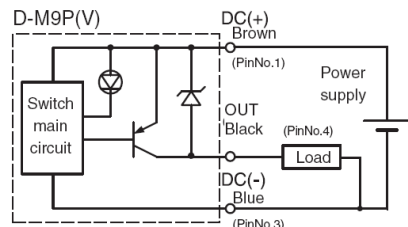
- Avoid repeatedly bending or stretching lead wires. Broken lead wires can result from wiring patterns, which repeatedly apply bending stress or stretching force to the lead wires.
- Confirm proper insulation of wiring. Be certain that there is no faulty wiring insulation (contact with other circuits, ground fault, improper insulation between terminals, etc.) Damage may occur due to excess current flow into a switch.
- Do not wire with power lines or high voltage lines. Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits containing auto switches may malfunction due to electrical noise from these other lines.
- Do not allow short circuit of loads. The switches do not have built-in short circuit protection circuits. Note that if a load is short circuited, the switch will be instantly damaged because of excess current flow into the switch.
- Avoid incorrect wiring. If wiring is incorrect, the switches will be damaged.

Warning

The auto switches are permanently fitted during manufacture and must not be removed or adjusted.

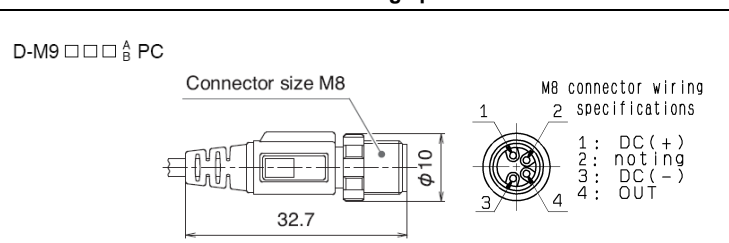


3.7.2.1 Basic wiring

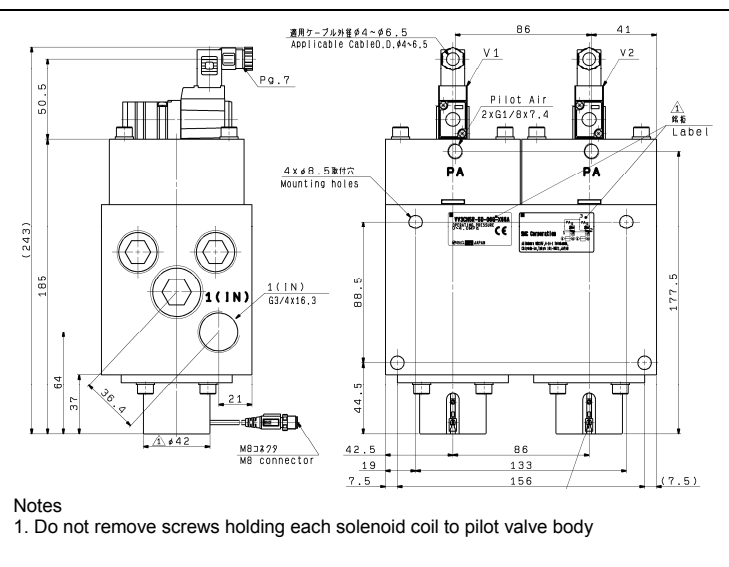


3 Installation (Continued)

3.7.2.2 Exterior dimensions and wiring specifications



4 Outline Dimensions (mm)



4.1 Mounting

- Installation orientation: free.
- The valve can be mounted using 4 x M8 bolts.
- Tighten bolts to achieve a secure mounting. Maximum torque 12 Nm.
- Do not carry the valve by the auto switch lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.

5 Maintenance

5.1 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.
- Do not make any modification to the product.
- Do not disassemble the product, unless required by installation or maintenance instructions.
- Replacement parts. The only component, which can be replaced by the user, is the pilot valve. (See below)

5.2 Auto switch

- Periodically confirm that there is no damage to the lead wires, body or permanent location of the switches.

5 Maintenance (Continued)

5.3 Pilot Valve

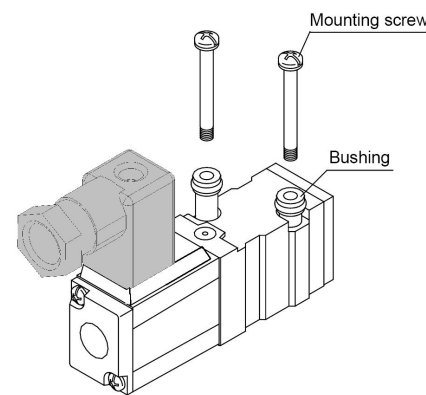
Warning

- Under no circumstances attempt to change the solenoid of the pilot valve as this is an integral part of the valve and doing so will negate any SMC warranty.
- Do not remove screws securing each solenoid coil to pilot valve body.

5.3.1 Replacement pilot valve VKF334E-5D-X76-Q

Caution

- Ensure that no contamination is introduced when the pilot valve is replaced.
- Only replace pilot valve with VKF334E-5D-X76-Q supplied by SMC for the purpose. Do not attempt to replace pilot valve with any other component that appears to provide the same function.
- Remove screws securing pilot valve to valve and carefully remove, ensuring gasket is not misplaced.



- Replace pilot valve ensuring gasket is correctly positioned. After confirming the installation of the gaskets, securely tighten the screws to the tightening torque of 0.6 to 0.8 Nm.
- The bushing might be damaged if the tightening torque of 0.8Nm is exceeded. In the event that damaged does occur, be sure to replace the bushing. (2 sets per unit are required)

Bushing assembly	VKF300-6A-1
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Warning

Replacing a pilot valve does not change the mission time restriction of the main valve assembly. When the pilot valve is replaced it is the end user's responsibility to ensure that the life history of the main valve assembly remains under control to ensure that the main valve assembly is not used beyond its mission time.

5.4 Periodic testing

The product should be tested for proper operation of the safety function once per month or whenever considered necessary for the purposes of the end user. The test should consist of operation of the safety system and observation of the following:

- When the connected control system is energising the solenoids:
- Check that the solenoid indicator lamps are illuminated.
 - Check that the connected downstream system is properly pressurised.
 - Check that the switch contacts are open.
 - Check that when only one channel (solenoid) is energised the protected system does not become pressurised. Check this for both channels.
- When the connected control system is not energising the solenoids:
- Check that the solenoid indicator lamps are not illuminated.

5 Maintenance (Continued)

- Check that the connected downstream system is properly vented to atmosphere and ensure that the condition of the silencers is not causing an extension of the vent time.
- Check that the switch contacts are closed.
- Check that when only one channel (solenoid) is de-energised the protected system is vented to atmosphere. Check this for both channels.

Warning

The specification of the valve requires the valve to be cycled (energised and de-energised) at least once per week.

5.1 Silencers

Warning

Ensure that silencers fitted to the valve remain clean and uncontaminated in operation because blockage will affect the safety function. These silencers to be fitted by the end user during installation.

Examine all the silencers at least once per month and more frequently if necessary due to the nature of the application environment.

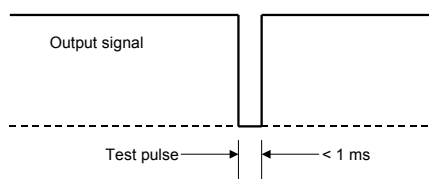
5.2 Troubleshooting guide

Symptom	Possible fault	Action
Valve does not open	Pilot valve is not energised	Check pilot solenoid indicator
	Supply pressure is too low	Check supply pressure
	Pilot valve has failed	Replace individual pilot valve(s)
Valve does not close	Pilot valve remains energised	Check pilot solenoid indicator
	Pilot valve is jammed	Replace individual pilot valve(s)
	Main valve is jammed	Replace whole valve
Switch contacts do not open	Switch has failed	Replace whole valve
Switch contacts do not close	Switch has failed	Replace whole valve
Valve operation is noisy or erratic	Supply flow is inadequate	Increase supply pressure and/or flow.
Valve is slow to pressurise protected system	Supply flow is inadequate	Increase supply pressure and/or flow.
	One channel of valve is not functioning	Check 'Valve does not open' symptoms above
Valve is slow to vent protected system	Inadequate flow area in protected system	Revise flow in protected system
	One channel of valve is not functioning	Check 'Valve does not close' symptoms above

NOTE: If any fault is found, the valve should be replaced if the safety function is not maintained.

6 Limitations of Use

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.



Caution

This product is CE marked as a safety component as defined under the Machinery Directive 2006/42/EC. For details please refer to the Declaration of Conformity supplied with the product.

The valve may only be used to provide the stated safety function for the removal of pressure from all or part of a pneumatic system, under the total control of a supervisory device. The valve can only perform as a safety component when properly installed in a system conforming to the appropriate safety standards. Any such use must be within the specified limits and application conditions for the product.

In order to meet a required performance level as defined by the appropriate safety standards, the user must provide all the other necessary components to complete the function of the safety system.

The user is responsible for the specification, design, implementation, validation and maintenance of the safety system.

7 Contacts

Europe:

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BELGIUM	(32) 3-355-1464	LITHUANIA	(370) 5 264 8126
BULGARIA	(359) 2 9744492	NETHERLANDS	(31) 20 531 8888
CZECH REP.	(420) 541-424-611	NORWAY	(47) 67 12 90 20
DENMARK	(45) 7025 2900	POLAND	(48) 22 211 9600
ESTONIA	(372) 651 0370	PORTUGAL	(351) 21 471 1880
FINLAND	(358) 207 513513	ROMANIA	(40) 21 320 5111
FRANCE	(33) 1-6476-1199	SLOVAKIA	(421) 2 444 56725
GERMANY	(49) 6103-402-0	SLOVENIA	(386) 73 885 412
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SMC Corporation

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SMC Corporation, Akihabara UDX15F, 4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021 JAPAN

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