



ORIGINAL INSTRUCTIONS

Instruction Manual
Two Hand Control Valve
Series VR51



The intended use of this product is a logic unit for use in two-hand control circuits according to ISO 13851 type IIIA. When properly integrated into a suitable safety system VR51 is compatible for use in systems up to Category 1 as defined by EN ISO 13849-1:2015.

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.

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

- Refer to product catalogue, Operation Manual and Handling Precautions for SMC Products for additional information.
- 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.
- To ensure safety of personnel and equipment the safety instructions in this manual must be observed, along with other relevant safety practices.

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

- **The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.**
Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalogue information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.
- **Only personnel with appropriate training should operate machinery and equipment.**
The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.
- **Do not service or attempt to remove product and machinery/equipment until safety is confirmed.**
1) The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

1 Safety Instructions - continued

- 2) When the product is to be removed, confirm the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
- 3) Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

• **Do not use this product outside of the specifications. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.**

- 1) Conditions and environments outside of the given specifications or use outdoors or in a place exposed to direct sunlight.
- 2) Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustions and recreation, or equipment in contact with food or beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the specification described in this document.
- 3) An application which could have negative effects on people, property or animals requiring special safety analysis outside the scope of ISO 13851 described in this document.
- 4) Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

• **Always ensure compliance with relevant safety laws and standards.**

- All electrical work must be carried out in a safe manner by a qualified person in compliance with applicable national regulations.

Caution

• **The product is provided for use in manufacturing industries.** The product herein described is basically provided for peaceful use in manufacturing industries.

- If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary. If anything is unclear, contact your nearest sales branch.

2 Specifications

Warning

Special products (-X) might have specifications different from those

shown in this Instruction Manual. Contact SMC for specific drawings.

2.1 Valve specifications

Fluid		Air		
Operating pressure [MPa]		0.25 to 1.0		
Proof pressure [MPa]		1.5		
Ambient and fluid temperature [°C]		-5 to 60 (with no freezing)		
Flow characteristics	C[dm ³ /(s·bar)]	b	Cv	
	P(1+2) to A(2)	0.3	-	-
	A(2) to R(4)	1.0	0.12	0.25
Maximum operating frequency [cpm]		10		
Minimum operating frequency		Once every 30 days		
Impact / vibration resistance [m/s ²] Note 1)		1000 / 50		
Mounting orientation		Unrestricted		
Air quality		5 μm filtration or smaller		
Environment		Indoor use only		
Port size	Metric	Ø6		
	Inch	Ø1/4		
Applicable tube material Note 2)		Nylon, Soft nylon, Polyurethane, Flame resistant (FR) soft nylon, FR double layer, FR double layer polyurethane		
Weight [g]		340		
Accessory option	Silencer	Part No.: AN101-01		
	Bracket	Part No.: VR51B		
B _{10D} [cycles]		1,000,000 Note 3)		
Mission time [years or cycles]		Maximum 20 years or when the number of cycles = B _{10D} , whichever occurs first Note 4)		

Table 1.

- Note 1) Impact resistance: No malfunction occurred when tested in the axial direction and right angle to the valve. Vibration resistance: No malfunction occurred in a round sweep test between 10 to 150 Hz. The test was performed in the axial direction and right angles to the valve axis, 20 times for each condition.
- Note 2) In the case of soft nylon or polyurethane tubing, use caution when the maximum operating pressure of the tubing is used.
- Note 3) The B_{10D} figure is estimated from SMC life test.

2 Specifications - continued

Note 4) The period of intended use of the product shall not exceed the mission time (T_M). The user is expected to calculate the product T_{10D} according to ISO 13849 based on the stated B_{10D} and operating cycles (n_{op}) of the application. The period of intended use of the product shall be the shorter of T_M or T_{10D} and neither is a guarantee of the actual life of the product. After the period of intended use has expired the product shall be replaced with a new unit.

2.2 Pneumatic symbol

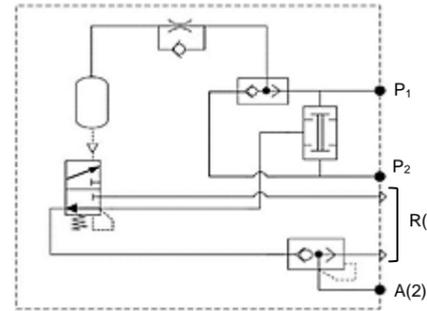


Figure 1.

2.3 Typical circuit

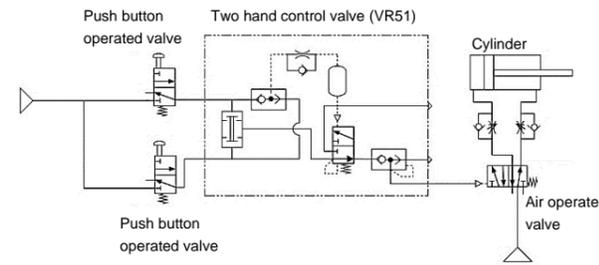


Figure 2.

2.4 Circuit functional description / timing

- When there is a time delay of less than 0.5 seconds between the two air signal inputs, the VR51 provides an output signal.
- VR51 output stops when one of the two air signal inputs stops.
- Two simultaneous air signals reset the output.

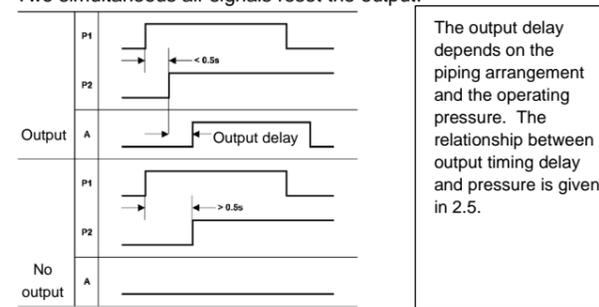


Figure 3. Output time delay

2.5 Output timing delay

- Example for typical piping, the exact delay will depend on the application.

Conditions

- 1, Piping: Tube: T0604 with I.D. Ø4mm
- 2, Piping length: Primary side 1m, Secondary side 3m
- 3, Connected equipment: 1 Air operated valve

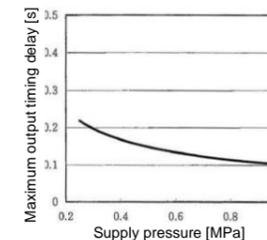


Figure 4. Output timing delay from supply pressure

2 Specifications - continued

2.6 Declaration of conformity

Original declaration Doc. No. VR51-TF122-142EU

EU DECLARATION OF CONFORMITY

SMC Corporation, 4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021, JAPAN, declares under its sole responsibility, that the following equipment:

Two Hand Control Valve VR51 series
Batch No. : AW onwards Marked H

is in conformity with the relevant Union harmonisation legislation and has been demonstrated to fulfil the requirements with reference to the harmonised standard(s) or applied standard(s) as listed below:

Directive	Requirements	Harmonised/applied standards
2006/42/EC [Machinery Directive]	Annex I	EN ISO 13851:2019 EN ISO 13849-1:2015 EN ISO 13849-2:2012

Classification: Type IIIA

Name and address of the person authorised to compile the technical file⁽¹⁾ :
Mr Lucio Moriggi, General Manager, SMC Italia S.p.A.
Via delle Donne Lavoratrici, 21 - 20861 BRUGHERIO (MB), ITALY

Importer/Distributor contact details www.SMC.eu, www.SMCworld.com

Tokyo, Date: 01. Sep. 2022

M. Araki
Mitsutoshi Araki
General Manager
Product Development Division - 3

Figure 5.

(BG) SMC Corporation декларира на своя отговорност, че оборудването и в съответствие със съответното законодателство на Съюза за хармонизиране и установяване на техническите или действащите (целте) стандарти, посочени(и) на страницата 1.

(DE) Name und Anschrift der Person, die bevollmächtigt ist, die relevanten technischen Unterlagen zusammenzustellen

(ES) Nombre y dirección de la persona autorizada para recopilar el archivo técnico

(FR) Nom et adresse de la personne autorisée à constituer le dossier technique

(IT) Nome e indirizzo della persona autorizzata a compilare la documentazione tecnica

(UK) SMC Corporation declares, under its sole responsibility, that the equipment is in conformity with the relevant harmonised EU-legislation and that it has been demonstrated to fulfil the requirements with reference to the harmonised standard(s) or applied standard(s) as listed below:

(1) The person authorised to compile the technical file

(2) Name and address of the person authorised to compile the technical file

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Figure 6.

2 Specifications - continued

UK DECLARATION OF CONFORMITY

SMC Corporation, 4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021, JAPAN, declares under its sole responsibility, that the following equipment:

Two Hand Control Valve
VR51 series
Batch No. : AW onwards Marked H

is in conformity with relevant statutory regulations (including amendments) and has been demonstrated to fulfil the requirements with reference to the designated standards as listed below:

Statutory Instrument	Requirements	Designated Standards/ Technical Specifications
Supply of Machinery (Safety) Regulations 2008	Schedule 2	EN ISO 13851:2019 EN ISO 13849-1:2015 EN ISO 13849-2:2012

Classification: Type IIA

Importer/Distributor contact details:
SMC
Vincent Avenue
Milton Keynes
MK8 0AN
www.smc.eu, www.smcworld.com

The person authorised to compile the technical file is the person named at the address below:

Tokyo, Date: 01. Sep. 2022

M. Araki
Mitsutoshi Araki
General Manager
Product Development Division - 3
4-2-2, Kinunodai, Tsukubamirai-shi,
Ibaraki 300-2436, JAPAN

Figure 7.

2.7 Batch code

The batch code indicated in the product label translates to construction year / month according to the following table (eg. BQ = Mar 2023):

Construction Year / Month	Production batch codes											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2023	Bo	BP	BQ	BR	BS	BT	BU	BV	BW	BX	By	BZ
2024	Co	CP	CQ	CR	CS	CT	CU	CV	CW	CX	Cy	CZ
...
2026	Eo	EP	EQ	ER	ES	ET	EU	EV	EW	EX	Ey	EZ

Table 2.

3 Installation

3.1 Installation

Warning

- Do not install the product unless the safety instructions have been read and understood.
- Do not install the product if it appears to have been damaged during transport.
- Do not paint the product.
- Do not remove or cover up warnings or specifications printed or affixed to the product.
- Ensure sufficient space for maintenance activities. When installing the products, allow access for maintenance.
- Ensure that the connections of pipework to the unit do not result in a residual trip hazard to system operators or maintainers.
- If air leakage increases or equipment does not operate to specification, stop operation.
- Check mounting conditions when air supplies are connected. Initial function and leakage tests should be performed after installation.

3.2 Environment

Warning

- Do not use in an environment where corrosive gases, chemicals, salt water or steam are present.

3 Installation - continued

- 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.
- Employ suitable protective measures in locations where there is contact with oil or welding spatter etc.
- Ambient humidity
When using the valve in environments with low humidity, take measures to prevent static.
If the humidity rises, take measures to prevent the adhesion of water droplets on the valve.
- Do not use in high humidity environment where condensation occurs.
- Altitude limitation is 1000 m above sea level.

Caution

Avoid using in places where there is splashing oil, coolant or water. In addition, avoid using where dust may adhere.

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 specified tightening torque.
- Connect tubing with a longer length than required to prevent torsion, stretching or moment loads. Damage of the fittings or flattening, as well as bursting or releasing of the tubing may occur if the instructions are not followed.
- Tubing connected to the VR51 should be used at more than its minimum bend radius. If used under the minimum bend radius, bending or flattening of the tubing may occur. Refer to catalogue for additional information.

3.3.1 Piping length for secondary side

To help avoid output timing delay;

- Use the same tubing length and diameter between the VR51 and each control actuating device: L1=L2, L1'=L2'.
- Use the same control valve type for each input port: V1=V2
- Operate the control valves with the same pressure: P1=P2

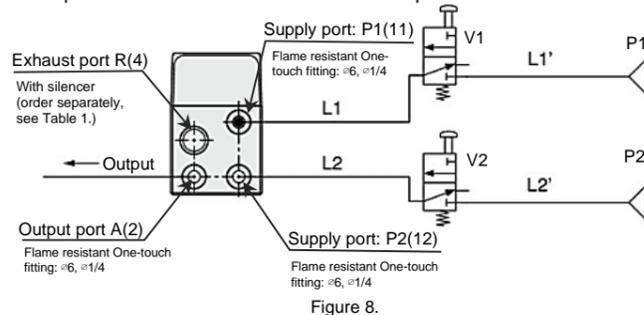


Figure 8.

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, use turbine oil Class 1 (no additive), ISO VG32. Once lubricant is used in the system, lubrication must be continued because the original lubricant applied during manufacturing will be washed away.

3.5 Air supply

Warning

- When there is a large amount of condensate. Compressed air containing a large amount of water vapour can cause malfunction of pneumatic equipment such as valves. An air dryer or water separator should be installed upstream from filters.
- Drain flushing
If condensation in the drain bowl is not emptied on a regular basis, the bowl will overflow and allow the condensation to enter the compressed air lines. It causes malfunction of pneumatic equipment.

3 Installation - continued

If the drain bowl is difficult to check and remove, installation of a drain bowl with an auto drain option is recommended.

- Type of 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

- When extremely dry air is used as the fluid, degradation of the lubrication properties inside the equipment may occur, resulting in reduced reliability (or reduced service life) of the equipment. Please consult with SMC.
- Install an air filter upstream near the valve. Select an air filter with a filtration size of 5 µm or smaller.
- Take measures to ensure air quality, such as by installing an aftercooler, air dryer, or water separator.
- If excessive carbon powder is seen, install a mist separator on the upstream side of the valve.
If excessive carbon dust is generated by the compressor it may adhere to the inside of a valve and cause it to malfunction.

Warning

- Minimise the distance between the valve and the air supply and between the valve and the protected system.
- Do not place any devices between the valve and the protected system that might interfere with the safety function.
- The exhaust ports of the valve should not be left unconnected.
- The exhaust ports of the valves should never be blocked and must be protected from ingress of contamination by a suitable silencer or device which does not affect the valve function.

3.6 Mounting

- The valve can be mounted using 2 x M5 x 0.8 bolts (thread depth: 5 mm) or using a bracket with 2 x ∅6.5 mm diameter holes. Tightening torque for M5 thread is 1.5 to 3 N·m.
- Refer to catalogue for more details.

3.7 One-touch fittings

Caution

Refer to catalogue for specific precautions.

4 Settings

4.1 Operating button setup

Caution

- Design and prepare the buttons in accordance with instruction manuals. Install the buttons according to ISO 13851 Safety of machinery - Two-hand control devices - Functional aspects - Principles for design and other applicable standards.
- If the operating buttons are incorrectly arranged, an unexpected motion is likely to occur and safety cannot be maintained.
- Principle precautions (reference only):
 - Configure the buttons so only 2 hand operation is possible, ensure it is not possible to operate by 1 hand only.
 - Configure the buttons so only 2 hand operation is possible, ensure it is not possible to operate by forearm(s) or elbow(s).
 - Configure the buttons so only 2 hand operation is possible, ensure it is not possible to operate by 1 hand and any other part of the body (knee or hip for example).
- Example of button setup:
 - Ensure a safe spacing of the buttons so they cannot be operated by 1 hand.

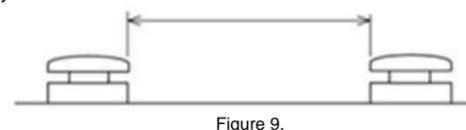


Figure 9.

- Install an isolating object between the buttons so they cannot be operated by 1 hand.



Figure 10.

- Place a cover over both buttons so they cannot be operated by 1 hand.

4 Settings - continued



Figure 11.

5 How to Order

Refer to catalogue for 'How to Order'.

6 Outline Dimensions

Refer to catalogue for outline dimensions.

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

7.2 Periodic testing

- The product should be tested regularly for proper operation of the safety functions.

- Testing should be conducted at start-up and then at regular intervals determined by the end user depending on complete system requirements. The test should consist of operation of the safety system and observation of the following, replace product if necessary:

- There are no scratches, dents, corrosion, loose screws, or damage to the valve body.
- The one-touch fitting is not damaged.
- The tube should not be kinked, crushed or damaged.
- The tube should not be hardened, deteriorated or softened.
- No air leaks.
- The air pressure is in the range of 0.25 MPa to 1 MPa.
- Operate the two operating devices installed on the 'Input' side at the same time and ensure that there is output from port A of VR51.
- The operation timings of the two operating devices installed on the 'Input' side are shifted by 0.5 seconds or more, and there is no output from port A of VR51.
- When one of the operating devices is cancelled while there is output from port A of VR51, there is no output from port A.

7.3 Maintainable parts

Warning

There are no replaceable parts.

8 Limitations of Use

Warning

- The system designer should determine the effect of the possible failure modes of the product on the system.
- VR51 only offers protection for the person operating it.

8.1 Limited warranty and disclaimer/compliance requirements

Refer to Handling Precautions for SMC Products.

8.2 Type of fluid and pneumatic pressure

- Do not use fluids other than those specified. The only fluid that can be used is air.

8 Limitations of Use - continued

- Do not use the product with a pressure under 0.25 MPa. The time lag for operating the VR51 is different depending on the operating pressure. The higher the operating pressure, the shorter the time lag, and vice versa. If used under 0.25 MPa, an output will be produced; however, safety is not likely to be maintained, even though the time lag may exceed 0.5 seconds.

⚠ Caution

8.3 Low temperature operation

In the case of using in low temperature, take measures not to freeze the drainage or moisture.

8.4 Trouble shooting

Symptom	Possible fault	Action ^{Note)}
Cylinder does not operate	Supply pressure is too low	Check supply pressure
	Time difference between P1 and P2 is more than 0.5 s.	Check & ensure P1 and P2 is supplied within 0.5 s time difference.
	Start-up valves (push button operated) malfunction.	Check if valves are operating correctly.
	Control valve faulty	Refer to 9 Product Failure Modes.
	Start-up valve is 2 port	Replace 2 port with 3 port valve
Output does not turn off	Piping lengths P1 & P2 are not same	Ensure P1 and P2 are same length
	Start-up valve is 2 port	Replace 2 port with 3 port valve

Table 3.

Note: If there are doubts about the performance of the unit, replace the whole unit.

8.5 Limitations

⚠ Caution

- This product is CE/UKCA marked as a safety component as defined under the Machinery Directive 2006/42/EC / The Supply of Machinery (safety) Regulations 2008. 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 as a logic unit for use in two-hand control circuits. 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 standard, the user must provide all the other necessary components to complete function of the safety system.
- The user is responsible for the specification, design, implementation, validation and maintenance of the safety system.

9 Product Failure Modes

⚠ Warning

Failure mode	Cause	Action
Malfunction allowing output by one-handed operation.	Ingress of foreign matter	Please replace the product.
Malfunction allowing output 0.5 seconds or longer after operation.	Ingress of foreign matter	
	Loss of lubrication	
	Sticking after long period of inactivity	
Leakage to exhaust port preventing output.	Ingress of foreign matter	
	Loss of lubrication	
Malfunction delaying exhaust.	Ingress of foreign matter	

Table 4.

10 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.

11 Contacts

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

SMC Corporation

URL : <https://www.smcworld.com> (Global) <https://www.smc.eu> (Europe)
 SMC Corporation, 4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021, Japan
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