



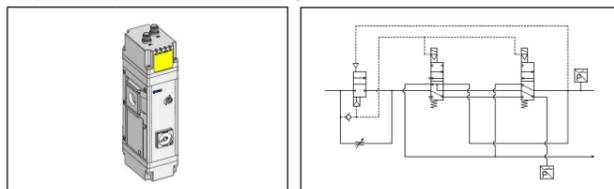
ORIGINAL INSTRUCTIONS

Instruction Manual

Safety exhaust valve

Series VPX400(-XA###)

Note) '###' represent numerical digits.



Safety component as defined by the Machinery Directive 2006/42/EC Article 2 (c) and The Supply of Machinery (Safety) Regulations 2008 PART 2 4. (2) (c)

The intended use of this valve is to vent a protected system to atmosphere when it is de-energised. In addition, the valve is intended to prevent unexpected pressurisation of the protected system when in a de-energised state. When properly integrated into a suitable safety control system the valves are compatible for use in systems up to Category 4 PL e, as defined by EN ISO 13849-1.

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 shall be followed in addition to International Standards (ISO/IEC) (1), and other safety regulations.

(1) ISO 4414: Pneumatic fluid power - General rules and safety requirements for systems and their components.

ISO 4413: Hydraulic fluid power - General rules and safety requirements for systems and their components.

IEC 60204-1: Safety of machinery - Electrical equipment of machines. Part 1: General requirements.

ISO 10218-1: Robotics — Safety requirements — Part 1: Industrial 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.

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

Warning

- Always ensure compliance with relevant safety laws and standards.
- All work shall 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 only. This product shall not be used in residential areas.

2 Specifications

2.1 Functional description

This product consists of a dual channel valve assembly connected to a main air supply, via an integrated soft-start valve. The product is capable of performing the safety function described in this document. The soft start valve is intended to allow the end user to perform machine operational start up procedures with reduced flow potential until an operational pressure is achieved. At this pressure the soft start valve allows full flow. The soft start function is intended for machine operational purposes and not for the performance of a safety function.

2 Specifications – continued

2.2 Valve specifications

Type of actuation	N.C. (Spring return) ^{Note 1)}	
Fluid	Air	
Operating pressure range [MPa] ^{Note 2)}	Standard	0.25 to 0.7
	High pressure	0.25 to 1.0
Proof pressure [MPa]	Standard	1.05
	High pressure	1.5
Ambient and fluid temperature [°C]	0 to 50 (No freezing)	
Ambient humidity (Operation / Storage)	35 to 85% RH (No condensation)	
Manual override	None	
Pilot exhaust	Individual exhaust	
Flow characteristics	See section 2.3	
Response time [ms]	See Section 2.12.2	
Max. duty cycle [%]	100	
Min. operating frequency	1 cycle / 7 days	
Max. operating frequency [Hz]	1	
Lubrication	Not allowed	
Impact/Vibration resistance [m/s ²] ^{Note 3)}	150/30	
Enclosure (based on IEC60529)	IP40 (E1/E2/E3/E4)	
	IP65 (Ni/G/M/E)	
Mounting orientation	Unrestricted ^{Note 4)}	
Operating environment	Indoor use only	
Weight [kg]	A3 (Size 30)	1.71
	A4 (Size 40)	1.71
	A6 (Size 60)	1.81
B ₁₀₀ [cycles] ^{Note 5)}	1,083,893	
Mission time [years or cycles]	Maximum 20 years or when the number of cycles = B ₁₀₀ , whichever occurs first. ^{Note 6)}	

Table 1.

Note 1) Except soft start spool.

Note 2) This valve is a large flow rate pilot-operated solenoid valve. If the air supply is not sufficient to ensure a minimum operating pressure of 0.25MPa at the inlet, the valve may not be able to switch properly.

Note 3) 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-energised states and for every time in each condition. (Values quoted are for a new valve.)

Vibration resistance: No malfunction occurred in a one-sweep test between 45 and 2000 Hz. Tests are performed at both energized and de-energized states in the axial direction and at right angles to the main valve and armature. (Values quoted are for a new valve.)

Note 4) Mounting with the silencer upwards will cause drainage to spatter onto the valve and surroundings.

Note 5) The B₁₀₀ figure is estimated from SMC life tests under SMC test conditions.

Note 6) See section 2.12.5 for details.

2.3 Flow characteristics

Type	Flow direction	C	b
A3	1 → 2	16.2	0.40
	2 → 3	25.0	0.20
A4	1 → 2	20.0	0.30
	2 → 3	31.0	0.15
A6	1 → 2	22.6	0.25
	2 → 3	35.8	0.10

Table 2.

2.4 Solenoid specifications

Coil rated voltage	DC [VDC]	24
Electrical entry		M12
Allowable voltage fluctuation ^{Note 1)}		-8% to +10% of the rated voltage
Power consumption [W] (per solenoid)		Inrush:0.45 Holding: 0.2
Surge voltage suppressor		Diode
Indicator light	SOL.1 / SOL. 2	LED (green)

Table 3

Note 1) Valve state is not defined if electrical input is outside of specified operating ranges.

2.5 Detection functions

Pressure sensor	Sensor E	For fault detection ^{Note 1)}
	Sensor 2	For output port 2
Rated voltage [VDC]		24
Electrical entry		M12
Allowable voltage fluctuations		±10% of the rated voltage (including ripple)
Power consumption [W] (per sensor)		0.3

2 Specifications - continued

Output type	PNP open collector output	
Output mode	Hysteresis mode	
Maximum load current [mA]	80	
Internal voltage drop [V]	≤1 (at load current of 80mA)	
Indicator light	SEN/PWR	LED (green)
	ERR	LED (red)

Table 4.

Note 1) Sensor E outputs a signal when SOL.1 and SOL.2 are in the same switching position.

2.6 Indicator light

LED	LED colour	LED is ON	LED is OFF
SOL.1	Green	SOL.1 is ON	SOL.1 is OFF
SOL.2		SOL.2 is ON	SOL.2 is OFF
SEN/PWR	Green	SEN.E and SEN.2 powered	SEN.E and/or SEN.2 not powered
ERR		Red	SEN.E output is OFF

Table 5.

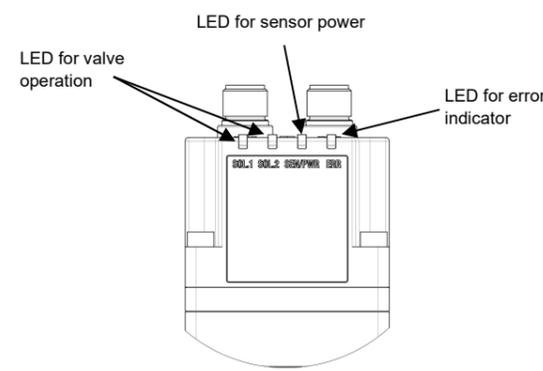


Figure 1.

2.7 Safety specifications

- Safety function:
 - Safe De-Energisation (SDE): When the valves are de-energised the spools return to the venting position by spring force.
 - Protection against Unexpected Start-up (PUS): In the venting position, a single fault cannot cause both spools to switch to the ON position.
- The valve assembly is compatible for use in systems up to Category 4 PL e according to the Safety Standard when integrated into a suitable safety system.
- The double common type is only compatible for use in systems up to Category 3 PL e 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 2.12.

2.8 Pneumatic symbol

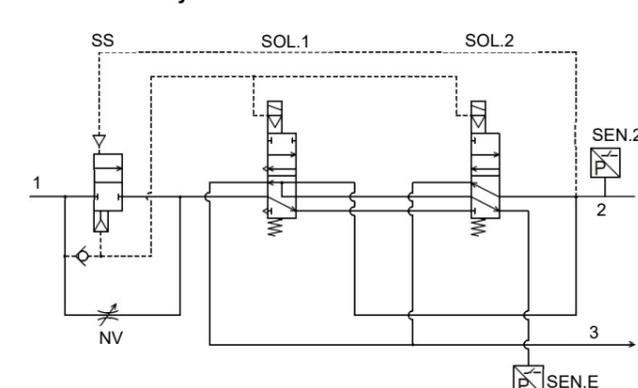


Figure 2.

2 Specifications - continued

2.9 Soft start specification and operating principle

2.9.1 Operating principle

- In a safety related application, the machine safety system will energise the safety valves (SOL.1 and SOL.2 in Figure 2) when the machine is safe to operate. When both valves are energised air will flow into the protected system via Port 2. The flow is initially limited by needle valve (NV) (see Figure 4) and pressure in the protected system will remain low as the system fills or actuators move slowly. The pressure will begin to rise as the system becomes full or the actuators stop moving. As Port 2 pressure increases soft start-up (SS) valve switches on and valve NV is by-passed.
- The soft start function switching pressure depends on the outlet and inlet pressure as shown in Figure 3.
- When either of the valves SOL.1 or SOL.2 are de-energised, the protected system is vented to atmosphere. When the protected system pressure drops below Port 2 pressure (Figure 3), valve SS returns to its OFF state with NV limiting the flow to SOL.1 and SOL.2.

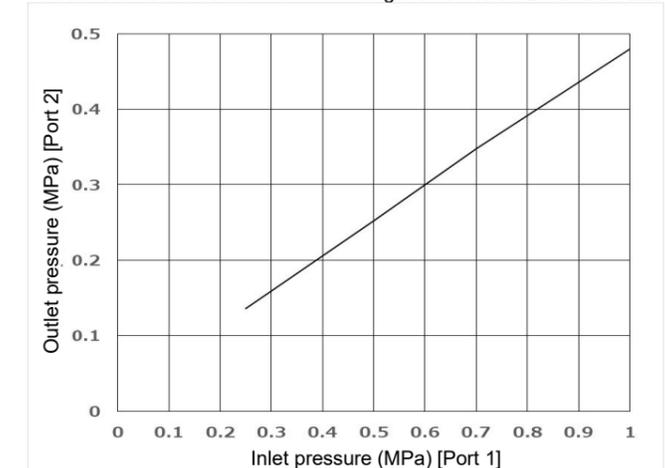


Figure 3. Switching pressure (Close → Open) of soft start-up (SS) valve

2.9.2 Soft start flow

The restricted flow is set by NV. This can be adjusted.

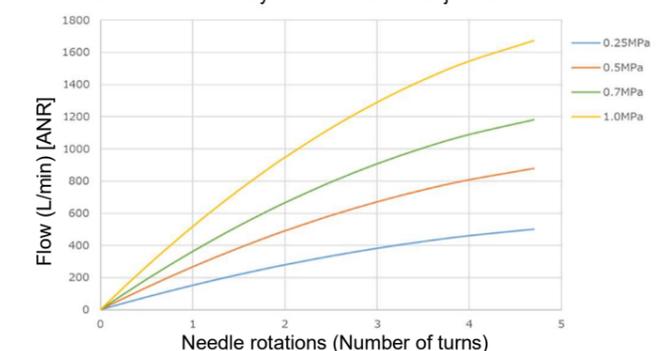


Figure 4. Needle valve flow characteristics (Use this graph as a guide only)

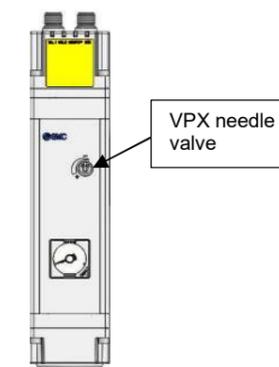


Figure 5.

2 Specifications - continued

2.10 Declaration of conformity

EU DECLARATION OF CONFORMITY

SMC Corporation, 1-5-5, Kyobashi, Chuo-ku, Tokyo 104-0031, JAPAN, declares under its sole responsibility, that the following equipment:

Safety Exhaust valve
VPX406(-XA###)
Batch No. CT 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:

EU legislation	Requirements	Harmonised/applied standards
2006/42/EC [Machinery Directive]	Annex I	EN ISO 13849-1:2023 EN ISO 13849-2:2012 EN 61508-1,2 4-7:2010 EN ISO 4414:2010
2014/30/EU [EMC Directive]	Annex I	EN IEC 61326-1:2021 EN IEC 61326-2-3:2021 EN 61326-3-1:2017
2011/65/EU [RoHS Directive]	Annex II	EN IEC 63000:2018

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: 28th Mar 2025

Shinichi Yoshimura
General Manager
Product Development Division - 1

Figure 6.

2 Specifications - continued

UK DECLARATION OF CONFORMITY

SMC Corporation, 1-5-5, Kyobashi, Chuo-ku, Tokyo 104-0031, JAPAN, declares under its sole responsibility, that the following equipment:

Safety Exhaust valve
VPX406(-XA###)
Batch No. CT 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:

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2014/30/EU [EMC Directive]	Annex I	EN IEC 61326-1:2021 EN IEC 61326-2-3:2021 EN 61326-3-1:2017
2011/65/EU [RoHS Directive]	Annex II	EN IEC 63000:2018

Name and address of the person authorised to compile the technical file:
Mr D Westbury, Director of Operations, SMC Corporation (U.K.) Ltd.
Vincent Avenue, Crownhill, Milton Keynes, MK8 0AN

Importer/Distributor contact details:
SMC Corporation (U.K.) Ltd.
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Tokyo, Date: 28th Mar 2025

Shinichi Yoshimura
General Manager
Product Development Division - 1

Figure 8.

2 Specifications - continued

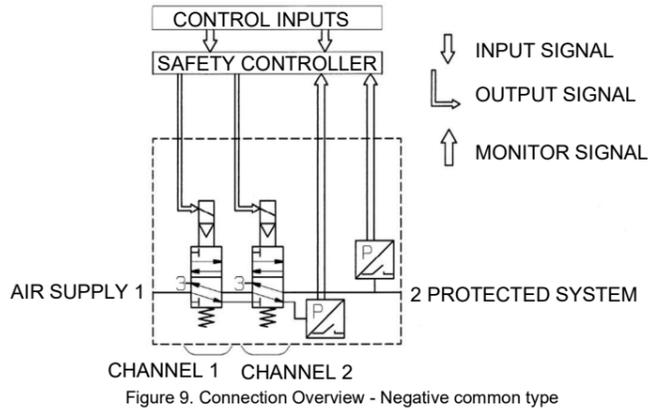


Figure 9. Connection Overview - Negative common type

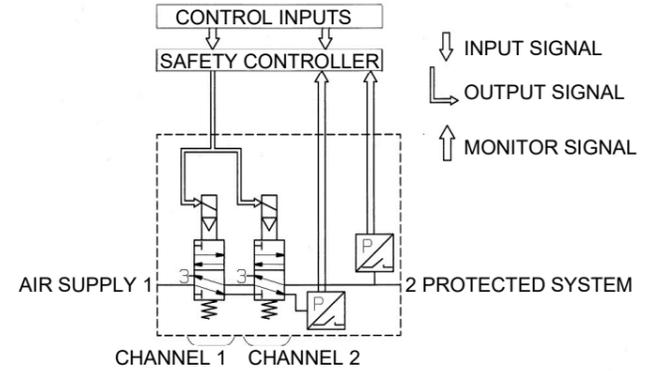


Figure 10. Connection Overview - Double common type

- SEN.E and SEN.2 provide monitoring signals to be used as a diagnostic measure to confirm the correct operation of the safety exhaust valve.
- They are not safety outputs and shall not be used to confirm the safe state of the valve or connected system.

2 Specifications - continued

- The response time of the pressure sensor 2 from valve ON (T3) depends on the setting of soft start-up valve and the sensor threshold.
- The response time of the pressure sensor 2 (T4) from valve OFF depends on the system volume to be vented and the sensor threshold.

Caution

- Response time values are for reference only and it is the system integrator's responsibility to determine the actual values.
- Response time calculation under normal conditions:
Formula for T2 calculation: $T2 (ms) = 60 \times \text{Volume (L)} + 800$
Formula for T4 calculation: $T4 (ms) = 50 \times \text{Volume (L)} + 800$
- Response time calculation under fault condition where only one channel is functioning:
Formula for T2 calculation: $T2 (ms) = 90 \times \text{Volume (L)} + 800$
Formula for T4 calculation: $T4 (ms) = 80 \times \text{Volume (L)} + 800$
- Response times are based on tests under SMC conditions and are not guaranteed. Always observe the terms of 2.12.4.
- Exhaust times will increase when only one channel is functioning in a fault condition.

2.12.3 SEN.E signal characteristic

2.12.3.1 SOL.1,2 ON

- T5 = Maximum time for stable SEN.E ON output after SOL.1 and 2 are energised (Starting from SOL. signal).

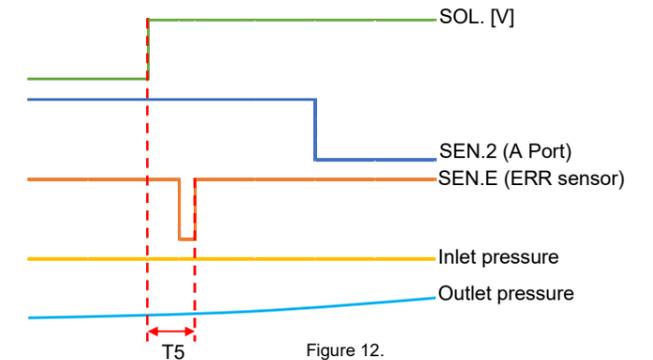


Figure 12.

2.12.3.2 SOL.1,2 OFF

- T6 = Maximum time for stable SEN.E output when SOL.1 and 2 are de-energised. (Starting from SEN.2 signal).

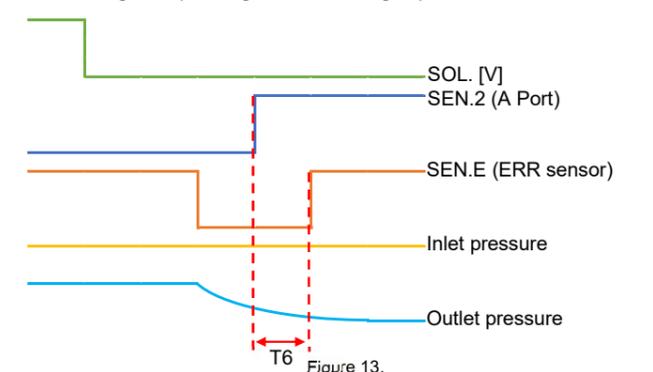


Figure 13.

- Maximum detection times for T5 and T6 are shown in the table below. If T5 or T6 exceed the values in Table 6 the valve has failed.

T5 [ms]	T6 [ms]
500	500

Table 7.

2.12.4 Relationship of flow and response performance to safety function

- The safety function is to exhaust the compressed air in the protected system when required to do so by the system safety controller.
- The time taken for the air to vent 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 the protected system
- The end user is expected to establish the time taken to vent the application system and ensure that this time is consistent with the requirement of the overall safety system. This includes the selection of suitable silencers.

2.11 Batch code

The batch code indicated in the product label translates to construction year month / day according to the following table (eg. "CQI = 9 Mar 2024):

Year		Month		Day			
2020	y	Jan	o	1	A	18	R
2021	Z	Feb	P	2	B	19	S
2022	A	Mar	Q	3	C	20	T
2023	B	Apr	R	4	D	21	U
2024	C	May	S	5	E	22	V
2025	D	Jun	T	6	F	23	W
2026	E	Jul	U	7	G	24	X
2027	F	Aug	V	8	H	25	y
2028	G	Sep	W	9	i	26	Z
2029	H	Oct	X	10	J	27	d
2030	i	Nov	y	11	K	28	e
2031	J	Dec	Z	12	L	29	f
2032	K			13	M	30	g
2033	L			14	N	31	h
2034	M			15	o		
2035	N			16	P		
2036	o			17	Q		

Table 6.

2.12 Safety system

2.12.1 System interface

- The diagram shows the valve in the dotted line box connected to a safety controller in dual channel mode following the principles of the Safety Standard.
- Safety integrity level of the safety controller shall match the required SIL or PL determined by the control system safety analysis. When the monitoring safety controller detects a possible failure of one of the valves, the safety controller shall use the remaining channel to maintain the safe state.

(BG) SMC Corporation декларира на свои отговорности, че оборудването е в съответствие със съответното законодателство на Съюза за хармонизация и изпълнение на техническите стандарти (цели) стандарти(е), посочен(и) на страницата 1.

(CS) Společnost SMC Corporation prohlašuje, že své výrobky odpovídají, že zařazené v souladu s příslušnou harmonizační legislativou Unie a bylo dokázáno, že plní požadavky s odkazem na harmonizované normy, jak je uvedeno na straně 1.

(DA) SMC Corporation erklærer under eget ansvar, at udstyret er i overensstemmelse med den relevante, harmoniserede EU-lovgivning og at det er blevet påvist, at det opfylder kravene med henvisning til de(i) harmoniserede standard(er), der er anført på side 1.

(DE) SMC Corporation erklärt in alleiniger Verantwortung, dass das Produkt die einschlägigen Harmonisierungsrechtsvorschriften der Union sowie nachweislich die Anforderungen in Bezug auf die auf Seite 1 aufgeführten harmonisierten oder angewandten Normen erfüllt.

(EL) Η SMC Corporation δηλώνει με αποκλειστική της ευθύνη ότι ο εξοπλισμός είναι σύμφωνα με τη σχετική νομοθεσία αρμόδιας της Ένωσης και έχει αποδειχθεί ότι πληροί τις απαιτήσεις σχετικά με το εφαρμοζόμενο πρότυπο (πρότυπα), όπως αναφέρονται στη σελίδα 1.

(ES) SMC Corporation declara, bajo su responsabilidad, que el equipo es conforme con la legislación vigente de la Unión Europea y ha demostrado que cumple los requisitos referentes a las normas armonizadas o aplicadas (enumeradas) en la página 1.

(ET) SMC Corporation deklareerib olma ainuvastutusega, et seadmed vastavad ajakohastele liidu ühtlustamisaktidele ja on tõestatud, et nad vastavad viidetega nõuetele harmoniseeritud või rakendatud standardi (te) le, mis on loetletud 1. lehel.

(FI) SMC Corporation vakuuttaa yksinomaanella vastuullaan, että laite on asiaa koskevan unionin yhdenmukaistamislaissäännön vaatimusten mukainen ja on osoitettu täyttävän sivulla 1 lueteltujen yhdenmukaistettujen standardien vaatimukset.

(FR) SMC Corporation déclare sous sa seule responsabilité, que l'équipement est conforme à la législation de l'Union relative à l'harmonisation et a démontré qu'il répond aux exigences en référence à la ou aux norme(s) harmonisé(s) ou appliqué(s) comme indiqué à la page 1.

(HR) SMC Corporation izjavuje na svojoj isključivoj odgovornosti da je oprema u skladu s zakonskim propisima Unije za usklađivanje i da dokazano ispunjava zahtjeve u vezi s usklađenim normama ili primjenjenim normama, navedenim na stranici 1.

(HU) Az SMC Corporation kijelentés felelősségére, kijelenti, hogy a berendezés megfelel az alkalmazandó EU harmonizációs jogszabályoknak, és kimutatták, hogy megfelel az 1. oldalon felsorolt harmonizált szabvány (ok) követelményeinek.

(IT) SMC Corporation dichiara, sotto la sua esclusiva responsabilità, che l'apparecchio è conforme alla pertinente normativa di armonizzazione dell'Unione e ha dimostrato di soddisfare i requisiti nell'ambito delle norme armonizzate o applicate indicate a pagina 1.

(LT) SMC Corporation, deklaruojama, prisiimama visą atsakomybę, kad gaminyvis atitinka Sąjungos teisės aktus, bandymai atitiki naudojamų darnųjų standartų ir standartus pateiktus pirmame puslapyje.

(LV) SMC Corporation paziņo, ka ir pilnībā atbildīga par to, ka iekārta atbilst attiecīgajam Eiropas Savienības saskaņotiem tiesību aktiem un ir pierādīts, ka tā atbilst prasībām ar attāci uz saskaņotajiem vai piemērotajiem standartiem, kas uzskaitēti 1. lapas pusē.

(NL) SMC Corporation verklaart onder eigen verantwoordelijkheid dat haar apparaat voldoet aan de betreffende harmonisatiewetgeving van de Europese Unie en veldtoet aan de voorschriften van de onderstaande geharmoniseerde norm(en) zoals vermeld op pagina 1.

(PL) SMC Corporation deklaruje na swojej wyłącznej odpowiedzialności, że urządzenie jest zgodne z odpowiednimi harmonizowanymi przepisami prawa Unii i wykazało, że spełnia wymagania harmonizowanych lub stosowanych norm wymienionych na stronie 1.

(PT) SMC Corporation declara sob sua responsabilidade que o equipamento está em conformidade com a legislação vigente da UE e foi demonstrado que cumpre os requisitos definidos nas normas harmonizadas ou aplicáveis, tal como indicado na página 1.

(RO) SMC Corporation declară sub responsabilitatea sa exclusivă că echipamentul sunt în conformitate cu legislația relevantă de armonizare a Uniunii și a demonstrat că îndeplinește cerințele cu referință la standardele armonizate sau aplicate, așa cum sunt enumerate la pagina 1.

(SK) Korporácia SMC s iškľučivo odgovornosťou izjavlja, da je oprema skladna z ustrežno usklajevalno zakonodajo Evropske unije ter, da je bilo dokazano, da izpolnjuje zahteve iz harmonizirane ali drugih uporabljeneh standardov, navedenih na strani 1.

(SV) SMC Corporation försäkras på eget ansvar att utrustningen överensstämmer med relevant EU-lagstiftning om harmonisering och har uppvisat att den uppfyller kraven avseende harmoniserade standard(er) enligt vad som anges på sidan 1.

(UK) SMC Corporation declares under its sole responsibility that the equipment 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.

Figure 7.

2 Specifications - continued

- The performance of the system shall be validated by test after each installation to ensure that the actual performance of the valve is consistent with the safety function. Validate the performance of the system under all foreseeable operating conditions of pressure, flow and volume.

2.12.5 Mission time according to the Safety Standard

The operational life of the product shall be limited to the mission time stated in section 2.2. The user is expected to calculate an equivalent figure in time units from the B₁₀₀ value based on the operating cycles of the application. In no circumstances can the mission time exceed 20 years. After the mission time has expired for the component, it shall be replaced with a new unit.

2.12.6 MTTFD according to the Safety Standard

The B₁₀₀ for the component given in section 2.2 is derived from product knowledge and based on specific life tests. The system integrator shall use this data to determine MTTFD and the Performance Level (PL) of the system using the methods described in the Safety Standard.

2.12.7 Diagnostic coverage according to the Safety Standard

The Diagnostic Coverage of this product has been evaluated by FMEDA and has been determined to be 99% when properly integrated with a safety controller.

2.12.8 Common cause failures according to the Safety Standard

- This product has been designed to meet the minimum requirement for CCF score (as required for Cat 3 and 4) when installed and used in accordance with the product specifications.
- The system's CCF analysis remains the responsibility of the system integrator.

2.13 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.
- Do not install the product if it appears to have been damaged during transport.
- The valve shall be protected from contamination from the downstream system when air is vented through the valve.
- 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 and cables 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 and power 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.
- 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.
- Do not install in a location subject to strong magnetic fields.
- Do not use in an area where surges are generated. If the product is used in an environment where surges are generated (solenoid lifter, high frequency induction furnace, motor, etc.) malfunction or failure may occur. Take the appropriate measures before using the product.

3 Installation - continued

- Use appropriate countermeasures against surges when using a load which generates a surge voltage. If surge voltages are repeatedly applied, this may cause malfunction or failure.
- Do not install in an EMC environment other than 'industrial' according to the scope of standard listed on the Declaration of Conformity.
- If it is used in an environment where there is possible contact with oil, weld spatter, etc., exercise preventive measures.
- Products compliant with IP65 or more enclosures are protected against dust and water, however, these products cannot be used in water.
- Products compliant with IP65 or more enclosures satisfy the specifications by mounting each product properly. Be sure to read the Specific Product Precautions for each product.
- When the solenoid valve is mounted in a control panel or is energised for a long time, make sure ambient temperature is within the specification of the valve.
- 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 2000 m above sea level.

3.3 Piping

Caution

- Before connecting piping make sure to clean up chips, cutting oil, dust etc.
- When installing fittings, ensure sealant material does not enter inside the port. When using seal tape, leave 1.5 to 2 threads exposed on the end of the pipe/fitting.
- Tighten fittings to the specified tightening torque.

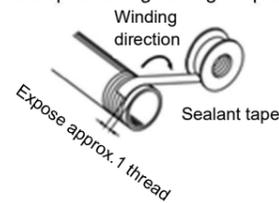


Figure 14.

- Exhaust port tightening torque: Hold the tip of the main body with your hand and screw it in tightly.

Exhaust port 3(R)	
Size	Silencer
G1	INA-25-100

Table 8.

- The valve shall be protected from contamination from the downstream system when air is vented through the valve.

3.4 Lubrication

Caution

The VPX products have been lubricated for life at manufacture. Additional lubrication shall not be used.

3 Installation - continued

3.5 Air supply

Warning

- Compressed air containing a large amount of water vapour can cause malfunction of pneumatic equipment. An air dryer or water separator should be installed upstream from filters.
- 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 causing malfunction of pneumatic equipment.
- If the drain bowl is difficult to check and remove, installation of a drain bowl with an auto drain option is recommended.
- 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

- Ensure a constant pressure of 0.25 MPa to 1.0 MPa.
- 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.
- 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. Compressed air that contains a large amount of drainage can cause malfunction of pneumatic equipment such as valves.
- 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

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

3.6 Mounting

Caution

The valves are compatible with the modular FRL unit AC-D series, please observe the AC-D precautions for mounting orientation.

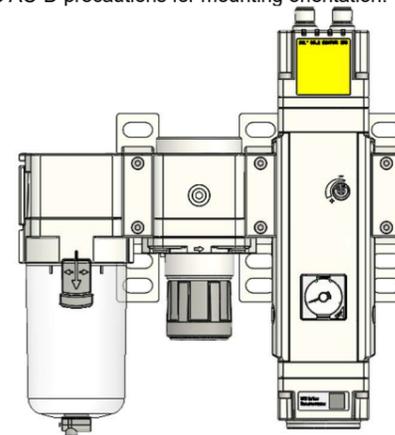


Figure 15.

Caution

- The valves require the use of Y#00T-D spacers with brackets.
- Ensure gaskets are in good condition, not deformed and are dust and debris free.
- When mounting the spacers ensure gaskets are present, aligned and securely in place and tighten the 2 holding screws evenly as per the values shown below.

Size	Spacer with bracket	Tightening torque [N·m]
AC30-D	Y300T-D	1.2 ± 0.05
AC40-D	Y400T-D	1.2 ± 0.05
AC50-D/AC60-D	Y600T-D	2.0 ± 0.1

Table 9.

3 Installation - continued



Figure 16. Y#00T-D

- If a threaded inlet/outlet port is required, a piping adapter E300-###-D, E400-###-D and E600-###-D is required. Refer to catalogue "Modular F.R.L. Units AC-D" for details.

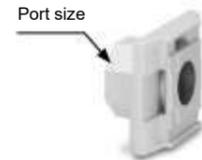


Figure 17. E#00-###-D

3.7 Noise

Caution

- It is recommended that silencers or noise reduction devices are fitted to protect personnel from transient noise when the valves are de-energised.
- The pressure drop of silencers or devices shall be taken into account during the design and testing of the application system to ensure that the safety function is maintained.

3.8 Electrical circuits

3.8.1 Valves (with power saving circuit)

- Power consumption is decreased to 56% by reducing the wattage required to hold the valve in an energized state. (Effective energizing time is over 62ms at 24 VDC.)

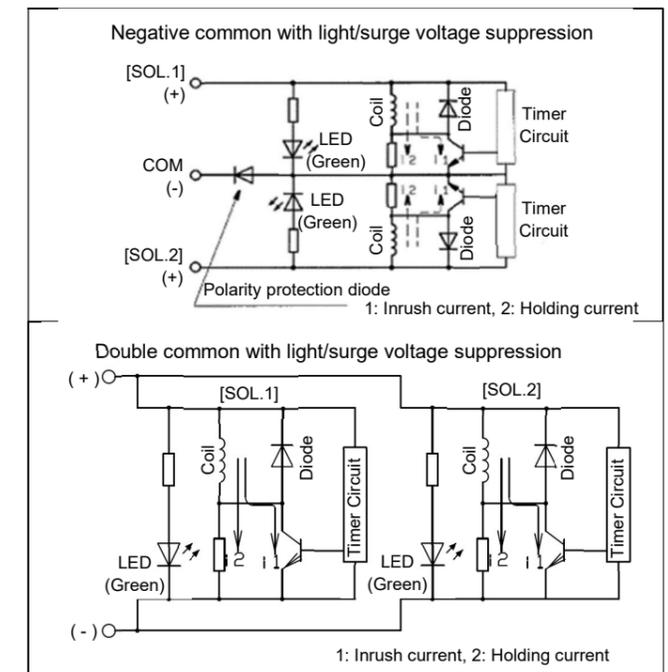


Table 10.

- The above circuits reduce the power consumption for holding to save energy. Refer to the catalogue for details.
- 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 Installation - continued

3.8.2 Pressure sensors

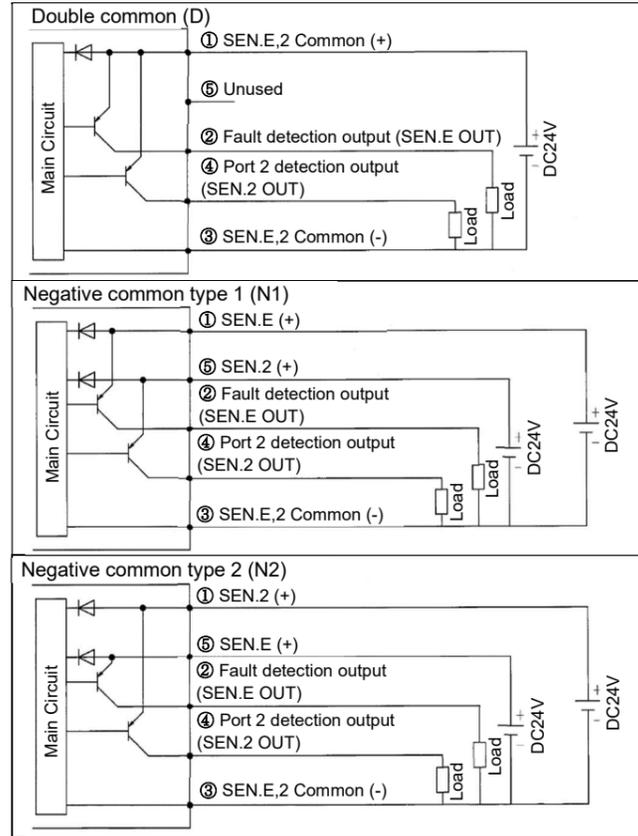


Table 11.

- Pay attention to the allowable voltage fluctuation, since a voltage drop of approx. 1 V occurs due to a transistor.

3.9 Electrical connection

Caution

- When electric power is connected to a solenoid valve, be careful to apply the proper voltage. Improper voltage may cause malfunction or coil damage.
- Check if the connections are correct after completing all wiring.

3.9.1 M12 wire colour

Pins	Colour
1	Brown
2	White
3	Blue
4	Black
5	Grey

Table 12.

Note) When using SMC M12 connector cables.

3.9.2 M12 connector pin wiring for pilot valve

M12 connector type – A-coded

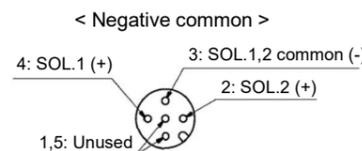


Figure 18.

3 Installation - continued

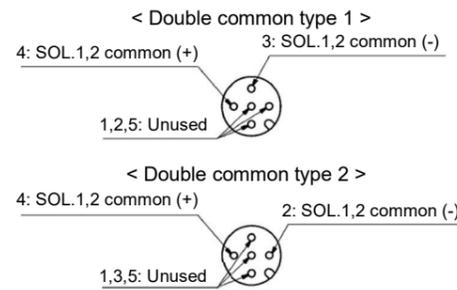


Figure 19.

3.9.3 M12 connector pin wiring for pressure sensor

M12 connector type – A-coded

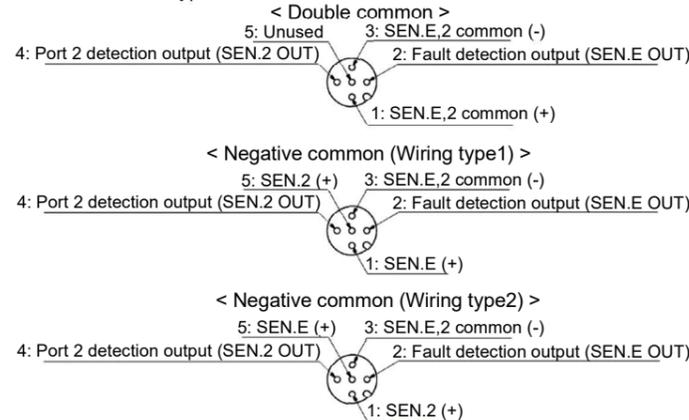


Figure 20.

3.10 Residual voltage

Caution

- The suppressor arrests the back EMF from the coil to a level in proportion to the rated voltage.
- Ensure the transient voltage is within the specification of the host controller.
- In the case of a diode, the residual voltage is approximately 1 V.

4 Operational tests

4.1 On demand test (Cat. 3 and Cat. 4)

- On every switch ON or switch OFF of the valve the data of the pressure sensors shall be confirmed as per the table below. This on demand test shall be performed automatically by a safety controller.
- When the monitoring safety controller detects a possible failure of one of the two channels of the VPX, the safety controller shall use the remaining channel to maintain the safe state.

Input	Pilot valve		Main valve		Pressure sensor				Diagnostics
	CH1	CH2	CH1	CH2	SEN.E		SEN.2		
CH1	CH2	CH1	CH2	ERR LED	OUTPUT	LED	OUTPUT		
0	0	OFF	OFF	OFF	OFF	OFF	ON	ON	Normal
		ON	OFF	ON	OFF	ON	OFF	ON	Failure →
		OFF	ON	OFF	ON	OFF	ON	ON	Safe/Detectable
		(ON)	(ON)	(ON)	(ON)	(OFF)	(ON)	(OFF)	(OFF)
1	1	ON	ON	ON	ON	OFF	ON	OFF	Normal
		OFF	ON	OFF	ON	ON	OFF	ON	Failure →
		ON	OFF	ON	OFF	ON	OFF	ON	Safe/Detectable
		(OFF)	(OFF)	(OFF)	(OFF)	(OFF)	(ON)	(ON)	(ON)

Table 13.

Note) Terms in brackets are with more than a single failure or caused by a failure of the diagnostics. If these cases occur the product shall be discarded and replaced.

Note) Refer to timing diagrams in section 2.12 for details.

Warning

- If the machine is not in operation, the product shall have the diagnostic test applied at least once per week.

4 Operational tests - continued

4.2 Diagnostic test (Cat. 4 only)

- In order to declare Cat.4, the following diagnostics test shall be performed at least once per day. This diagnostics test shall be performed automatically by a safety controller.

4.2.1 PUS

Diagnostic Test Step	Valve		Pressure Sensor		LED				Diagnostics
	SOL.1	SOL.2	SEN.E output	SEN.2 output	SOL.1	SOL.2	SEN/PWR	ERR	
A	OFF	OFF	ON	ON	OFF	OFF	ON (green)	OFF	Normal
B	ON	OFF	OFF	ON	ON (green)	OFF	ON (green)	ON (RED)	Failure
C	OFF	ON	OFF	ON	OFF	ON (green)	ON (green)	ON (RED)	Failure

Table 14.

4.2.2 SDE

Diagnostic Test Step	Valve		Pressure Sensor		LED				Diagnostics
	SOL.1	SOL.2	SEN.E output	SEN.2 output	SOL.1	SOL.2	SEN/PWR	ERR	
A	OFF	OFF	ON	ON	OFF	OFF	ON (green)	OFF	Normal
B	ON	OFF	OFF	ON	ON (green)	OFF	ON (green)	ON (RED)	Failure
C	OFF	ON	OFF	ON	OFF	ON (green)	ON (green)	ON (RED)	Failure
D	ON	ON	ON	OFF	ON (green)	ON (green)	ON (green)	OFF	Normal

Table 15.

Note) Refer to timing diagrams in section 2.12 for details.

- Sensor E:
In case of normal operation, SEN.E output ON.
In case of failure, SEN.E output OFF.
- Sensor 2:
In case of no pressure in port 2, SEN.2 output ON.
In case of pressure in port 2, SEN.2 output OFF.

Warning

- The supply pressure shall be greater than 0.25MPa for the diagnostics to function correctly.

5 How to Order

Refer to catalogue or drawings for 'How to Order'.

Note) The 25A- variants are compatible for use in the secondary battery manufacturing environment. These variants are copper and zinc free and suitable for use with low dew point air supplies (-70°C). Contact SMC for more information.

6 Outline Dimensions

Refer to catalogue or drawings 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 Maintenance - continued

7.2 Replacement parts

Warning

There are no replaceable parts on these products other than the pressure gauge, digital pressure switch or plug.

7.2.1 Pressure gauge replacement (E type)

- 1) Remove the pressure gauge cover. Turn it anticlockwise by 15 degrees and pull it out.

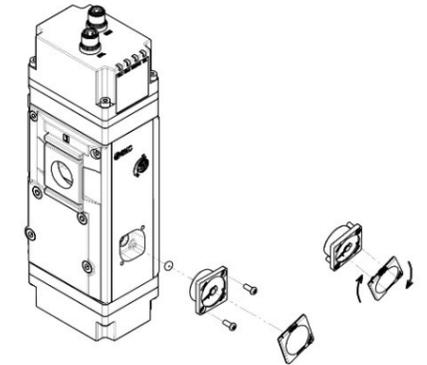


Figure 21.

- 2) Remove the pressure gauge by removing the 2 mounting screws and remove the pressure gauge.
- 3) Confirm that the O-ring is in good condition, not deformed and is dust and debris free, and that it is mounted onto the pressure gauge correctly.
- 4) Mount the pressure gauge to the body with the mounting screws and tighten the screws to a tightening torque of 0.85±0.05 N·m.
- 5) Set the pressure gauge cover with its arrow on the lower right corner. Mate the 2 fingers of the pressure gauge cover with the 2 finger slits of the pressure gauge and rotate the pressure gauge cover 15 degrees clockwise.

7.2.2 Pressure gauge replacement (round type)

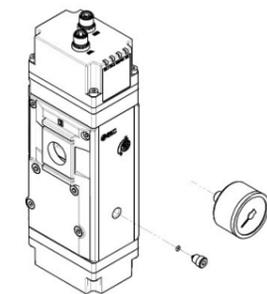


Figure 22.

- 1) Remove the gauge using a hexagon wrench size 14.
- 2) Assemble the gauge using a hexagon wrench size 14.
- 3) Tightening torque: 3 to 5 N·m.

7 Maintenance - continued

7.2.3 Digital pressure switch replacement (type E1, E2, E3, E4)

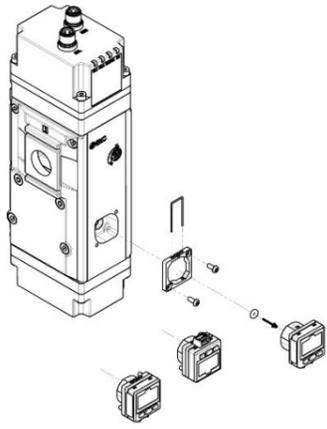


Figure 23.

- 1) Remove the pressure switch by removing the lock pin with a flat blade screwdriver and pulling it out from the adapter.
- 2) Remove the 2 mounting screws and pull the adapter of the body.
- 3) Mount the pressure switch to the product with the mounting screws and tighten them to a tightening torque of 0.85 ± 0.05 N·m.
- 4) Apply grease to the supplied O-ring and confirm that it is in good condition, not deformed and is dust and debris free, and that it is mounted onto the pressure switch correctly.
- 5) Assemble the pressure switch to the body.
- 6) Secure the pressure gauge with the lock pin.

7.2.4 Plug replacement

- 1) Remove the plug (with O-ring) using a hexagon wrench size 4.
- 2) Assemble the plug (with O-ring) using a hexagon wrench size 4.
- 3) Tightening torque: 0.6 ± 0.05 N·m.

7.3 Silencers

Warning

- Ensure that any silencers fitted to the valve remain clean and uncontaminated in operation because blockage will affect the safety function.
- These silencers are to be fitted by the end user during installation.
- Examine any silencers at least once per month and more frequently if necessary due to the nature of the application environment.

7.4 Troubleshooting guide

Symptom	Possible fault	Action
Valve does not open	Pilot valve is not energised	Check pilot solenoid indicator (light) is illuminated and that voltage is within specification
	Supply pressure is too low	Check supply pressure Check pressure regulator
	Pilot valve has failed	Replace the entire unit
Valve does not close	Pilot valve remains energised	Check pilot solenoid indicator (light)
	Pilot valve is jammed	Replace the entire unit
	Main valve is jammed	Replace the entire unit
	Supply pressure is too high	Check supply pressure
No sensor output signal	Sensor is not energised	Check the sensor power indicator light is illuminated, and that voltage is within specifications
Valve operation is noisy or erratic	Supply flow is inadequate	Increase supply pressure and/or flow
		Check tubing and fitting size is applicable for required 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 correctly	Check 'Valve does not open' symptoms above

7 Maintenance - continued

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 correctly	Check 'Valve does not close' symptoms above
	Exhaust silencer is contaminated or blocked	Inspect and replace as necessary, confirm air quality and operating environment

Table 16.

Note) If any fault is found, the valve shall be replaced if the safety function is not maintained. If one channel fails, replace the entire unit.

8 Limitations of Use

Danger

- The machine designer is responsible for ensuring that the operation of this device is compatible with relevant safety regulations.
- Having a soft start device does not contribute to human risk reduction.
- The limited flow phase and the transition to full flow might cause unpredictable machine movements.

Warning

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

8.1 Limited warranty and disclaimer/compliance requirements

Refer to Handling Precautions for SMC Products.

Warning

8.2 Effect of energy loss on valve switching

- Since there is a check valve in the pilot flow path, the pilot flow path remains pressurized even if the main air supply is cut off.
- Due to the trapped air in the pilot flow path, the main valve spool will move to the ON position if the solenoid is energised, even in the case that there is no supply to port 1.
- To relieve the air from the pilot flow path, energise and de-energise the solenoid valve several times with no air supply to port 1.

8.3 Holding of pressure

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

8.4 Machinery safety use only

This product shall only be used in machinery safety stop functions within the scope of EN ISO 13849 & EN ISO 13850. The use for any other emergency related shut down application is not allowed.

8.5 Safety relays or PLC

- 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.
- The diagnostic sensors shall be wired to the safety input of the PLC which can apply test pulses providing the duration is less than 1 ms.

Caution

8.6 Leakage voltage

Ensure that any leakage voltage caused by the leakage current when the switching element is OFF causes $\leq 3\%$ of the rated voltage across the valve.

8.7 Low temperature operation

Unless otherwise indicated in the specifications for each valve, operation is possible to 0°C , but appropriate measures should be taken to avoid solidification or freezing of drainage and moisture, etc.

8.8 EMC restrictions

8.8.1 Class and group description

- This product is group 1, class A equipment according to EN 55011.
- Group 1 equipment does not intentionally generate radio-frequency energy in the range 9kHz to 400 GHz.
- Class A equipment is equipment suitable for use in all locations other than those allocated in residential environments and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.
- This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

8 Limitations of Use - continued

8.8.2 Cable length to connect

The cable to connect the product shall be less than or equal to 30m.

8.8.3 Connecting the power supply

This product is not intended to be directly connected to any DC Distribution network.

8.9 Safety standard

8.9.1 Mission time according to ISO13849

After the mission time has expired for the component, it shall be replaced with a new unit.

8.9.2 Specifications according to IEC61508

HFT (Hardware fault tolerance)	1
Product classification	Type A
Mode of operation	High demand mode
Safety integrity level	SIL3
Systematic capability	SC3
B10D	1,083,893 (per 1 valve)
MTTF _D	1,237 years (per 1 valve)
λ D	93 FIT (per 1 valve)
λ DU	0.93 FIT (per 1 valve)
DC	99%
PFH _{1oo2}	9.24E-11/h
dop	365
hop	24
tcycle	3,600
Route of assessment	2H/1S

Table 17.

- When there is a change to the hardware version, it will be shown in the product label.
- Changes are made on the batch code basis, and in the case of changes that affect the specifications the batch code indicates when changes were made.

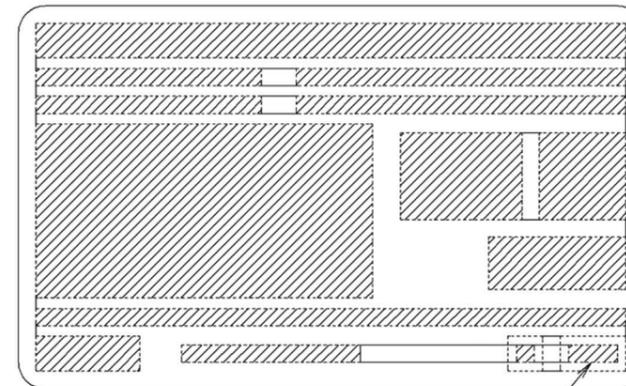


Figure 24.

8.10 Limitations

- Even when the inlet pressure is within the operating pressure range, restricted piping, etc., may cause reduced flow on the inlet side, leading to the valve not operating properly.
- Please note that if the operating pressure falls below 0.25 MPa due to the pressure drop caused by insufficient air supply capacity, it may not switch properly.
- 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 for the supply and 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.

8 Limitations of Use - continued

- Any such use shall 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 shall 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 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.

10 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, 1-5-5, Kyobashi, Chuo-ku, Tokyo 104-0031, JAPAN
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