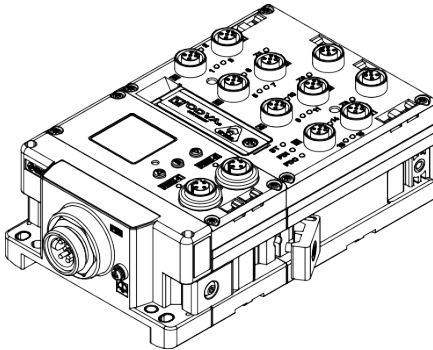




Instruction Manual

Fieldbus device – Safety I/O module for CIP Safety over EtherNet/IP™

EX600-FVC1 / -FVC2



IMPORTANT

When supplied in the European Union or the United Kingdom this document does not contain the necessary safety instructions as required by the Machinery Directive 2006/42/EC or the UK Machinery Safety Regulations 2008.

It is mandatory to refer to the Operation Manual, Document No. DOC1114013 supplied with the product by your local SMC subsidiary for such Safety Instructions before using this product.

The EU or UKCA Declaration of Conformity is supplied by your local subsidiary with the product.

For other territories the Operation Manual and Declaration of Conformity may be downloaded from the SMC website (URL: <https://www.smcworld.com>).

The intended use of this product is for CIP Functional Safety system control over the EtherNet/IP™ protocol of pneumatic valves and I/O.

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 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 must be carried out in a safe manner by a qualified person in compliance with applicable national regulations.
- Refer to the operation manual on the SMC website (URL: <https://www.smcworld.com>) for further Safety Instructions.

2 Specifications

The EX600-FVC# Safety I/O module implements CIP Safety over EtherNet/IP for SMC pneumatic valves.

The module can be used to implement a Safety function for the directly connected valves and I/O.

One Safety I/O module can be connected to manifold valves with up to 128 solenoid valve outputs, and connected to 16 safe inputs, 3 safe outputs.

2.1 Safety specifications

Item	Specification
Safety Function	
Safety Function	Safety Input Safety Output
Safety Integrity Level (SIL)	Up to SIL3 (EN 61508 / EN 62061)
Performance Level (PL), Category (Cat)	Up to PLe, Cat.3 (EN ISO 13849)
DCavg	High (≥ 99 %)
MTTFd	Safety Input 1oo1: High (590 years) 1oo2: High (741 years) Safety Output: High (316 years)
PFHd	Safety Input 1oo1: 2.56E-10 1/h 1oo2: 2.52E-10 1/h Safety Output: 2.53E-10 1/h
HFT	1
Classification	Type B
Mission time	20 years
Safety Inputs	
Number of safety inputs	1oo1: 16 inputs max. 1oo2: 8 inputs max.
Clock pulse width	1 ms max.
Clock pulse interval	160 ms max.
Response time to switch ON/OFF	21 ms max.
Response time to channel fault	500 ms max.
Safety Outputs	
Number of safety outputs	3 safety outputs
Clock pulse width	1 ms max.
Clock pulse interval	160 ms max.
Response time to switch ON/OFF	21 ms max.
Response time to channel fault	500 ms max.

2.2 General specifications

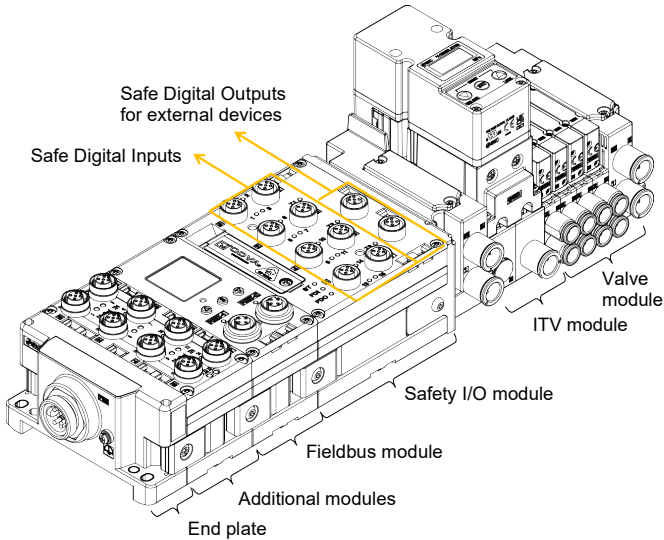
Item		Specification
Enclosure rating		IP65, IP67
Operating temperature		-10 to +50 °C
Storage temperature		-20 to +60 °C
Ambient humidity		35 to 85%RH (no condensation or freezing)
Altitude		2,000 m max.
Withstand voltage		500 VAC applied for 1 minute
Insulation resistance		500 VDC, 10 MΩ or more
Weight		540 g max.
Standards		CE, UKCA, UL (CSA), EN 61508, EN 62061, ISO 13849-1
Cable length	Sensor cable	20 m max. with shield
	Actuator cable	20 m max. with shield
Solenoid valve		
Applicable valve series		SY, JSY and VQC series
Output type of Solenoid		PNP
Short circuit protection		Yes

2 Specifications (continued)

2.3 Electrical specifications

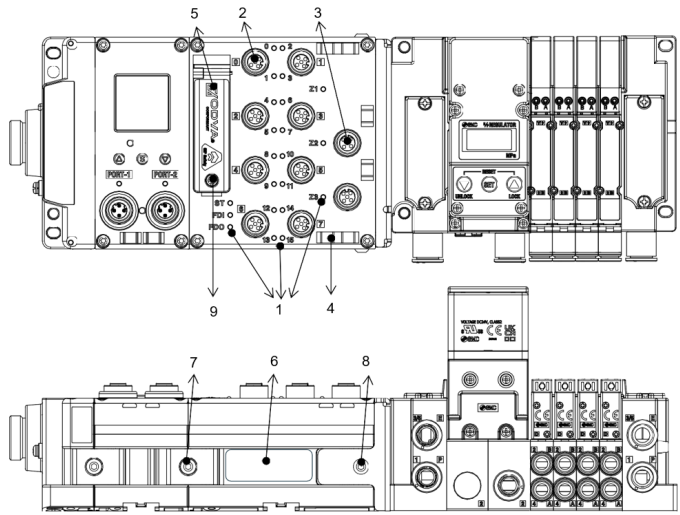
Item	Specification
Electrical	
Power supply for Control/Inputs (US1)	24 VDC +20%, -15%
Power supply for Outputs (US2)	24 VDC +20%, -15%
Internal current consumption	100 mA max. (24V_US1) 100 mA max. (24V_US2)
Galvanic isolation	Yes, between US1 and US2
Safety Inputs	
Power source	US1
Power supply for sensor	Yes, via UT1-5
Max supply current	Module: 2 A max. UT1-5: 0.6 A max.
Operating voltage	24 VDC +20%, -15%
Input type	PNP, M12 5-pin socket
Input characteristics	IEC 61131-2 Type3
Input current	Typ. 3.62 mA
ON voltage	11 V to 30 V
OFF voltage	-3 V to 5 V
Short circuit protection	Yes
Cross circuit detection	Yes
Voltage drops to sensor supply	1.2 V max.
Safety Outputs	
Power source	US2
Max supplied current	Module: 2.5 A max. Zone1: 2 A max. / zone Zone2 and 3: 0.25 A max. / zone
Operating voltage	24 VDC +20%, -15%
Short circuit protection	Yes
Voltage drop to valve supply	1.2 V max.
Communication Protocol	
Prototol	CIP Safety
Electro-pneumatic Regulator (ITV) module	
Number of ITV connections	4 modules max.
Short circuit protection	Yes

3 Product Structure



Item	Function
Safety I/O module	Control safe input, safe output, valves and ITV modules (ITV module only with EX600-FVC2)
Fieldbus module	Communicate with upper controller (EtherNet/IP).
Additional module	Digital input/output, analog input/output, IO-link module. See SMC website for further details.
ITV module	Electro-pneumatic regulator ITV module (can be controlled by EX600-FVC2 only).
Valve module	To operate pneumatic devices.
End plate	To supply power to the valve manifold.

4 Name and function of parts



No	Part	Description
1	Status LED	LED for displaying the module status.
2	Safety Input connector	Connectors for Safety input
3	Safety Output connector	Connectors for Safety output
4	Marker groove	Groove for identification marker.
5	Display window	Display window.
6	Product label	Label to provide product information.
7	Joint bracket	Bracket for joining the next module.
8	Screw for attaching the valve module	Screw hole for attaching the valve plate.
9	Screw for display window	This screw is not used for the EX600-FVC#. If the screw is loosened by mistake, the module may not satisfy the protection rating (IP65/IP67). The tightening torque is 0.7 - 0.8 N•m.

5 Installation

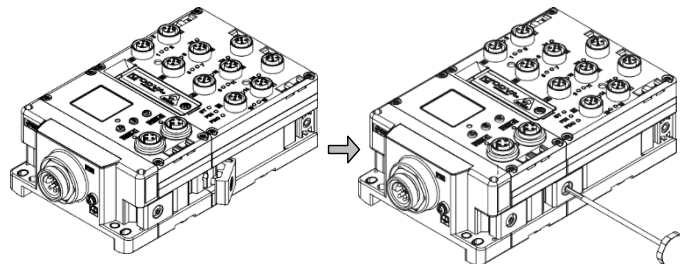
5.1 Assembling the modules

Warning

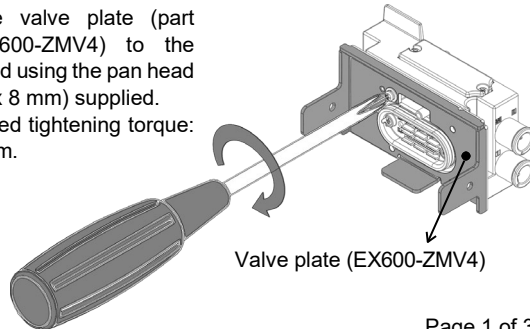
Do not install the product unless the safety instructions have been read and understood.

1. Assemble the Safety I/O module to the adjacent modules as required using the hexagon socket head screws (width across flats 2.5 mm). Recommended tightening torque: 1.5 to 1.6 N•m.

Refer to the Fieldbus module instruction manual available on the SMC website (URL: <https://www.smcworld.com>) for information on how to install the valve manifold assembly.

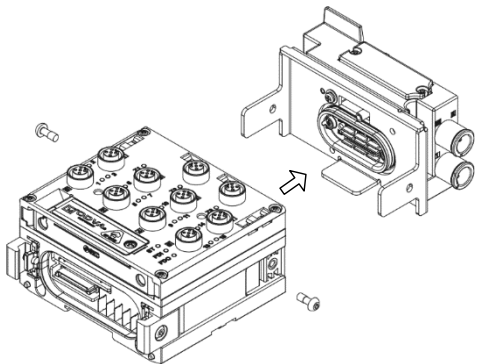


2. Connect the valve plate (part number EX600-ZMV4) to the valve manifold using the pan head screws (M3 x 8 mm) supplied. Recommended tightening torque: 0.6 to 0.7 N•m.



5 Installation (continued)

3. Connect the Safety I/O module assembly to the valve manifold module using the hexagon socket head cap screws supplied (width across flats 2.5 mm).
Recommended tightening torque: 0.7 to 0.8 N•m).



Warning

- All power to the modules must be turned OFF (de-energized) before the modules are assembled or removed, to prevent damage.
- All screws should be tightened to the recommended torque. Insufficient tightening may lead to equipment malfunction, injury, or equipment damage.

5.2 Environment

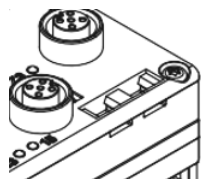
Warning

- Do not use in an environment where corrosive gases, chemicals, salt water or steam are present.
- Do not use in a place where the product could be splashed by oil or chemicals.
- Do not use in an area where electrical surges are generated. If there is equipment which generates large surges (solenoid type lifter, high frequency induction furnace, motor, etc.) near to the Fieldbus

- system, this may cause deterioration or internal circuit damage.
- The product is CE marked, but not immune to lightning strikes. Take measures against lightning strikes in the system.
 - Prevent foreign matter such as remnants of wires from entering the product during assembly to avoid failure or malfunction.
 - Do not mount the product in a location exposed to excessive vibration or impact.
 - Do not use the product in an environment exposed to temperature cycles. Heat cycles other than ordinary changes in temperature can adversely affect the product.
 - Do not expose the product to direct sunlight or UV light. Use a suitable protective cover.
 - Do not mount in a location exposed to radiant heat that would result in temperatures in excess of the product specifications.
 - Keep within the specified ambient temperature range.
 - Do not operate close to a heat source, or in a location exposed to radiant heat.

5.3 Identification marker

The signal name of the Input or Output devices can be written on the marker and can be installed on each unit.
Mount a marker (EX600-ZT1) into the marker groove as required.



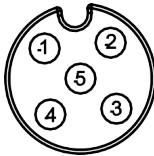
6 Wiring

6.1 Wiring connections

- Do not perform wiring while the power is ON. Otherwise damage to the product can result, causing malfunction.
- Wire correctly. Incorrect wiring can damage the module.
- Avoid repeatedly bending or stretching the cables or placing heavy loads on them. Repetitive bending stress or tensile stress can cause damage to the cable.
- Do not route wires or cables together with power or high voltage cables. Otherwise the product can malfunction due to interference of noise and surge voltages. Route the wires to the product separately from power or high voltage cables.
- Confirm proper insulation of wiring. Poor insulation (interference from another circuit, poor insulation between terminals, etc.) can lead to excess voltage or current being applied to the module, causing damage.
- Take appropriate measures against noise, such as using a noise filter, when the product is incorporated into equipment.

6.2 Safety Digital Input Connectors

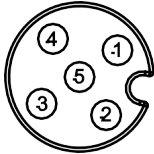
- M12 5-pin A-coded socket



Pin No.	Allocation							
	CN0	CN1	CN2	CN3	CN4	CN5	CN6	CN7
1	UT1	UT1	UT2	UT2	UT3	UT3	UT4	UT4
2	IN1	IN3	IN5	IN7	IN9	IN11	IN13	IN15
3	0V (US1)							
4	IN0	IN2	IN4	IN6	IN8	IN10	IN12	IN14
5	UT5							
Outer shell	FE (Functional Earth)							

6.3 Safety Digital Output Connectors

- M12 5-pin A-coded socket



Pin No.	Allocation	
	Zone 2	Zone 3
1	N.C.	N.C.
2	N.C.	N.C.
3	Safety Output (0 V)	Safety Output (0 V)
4	Safety Output2 (24 V)	Safety Output3 (24 V)
5	FE (Functional Earth)	

Warning

- All unused M12 connectors must be fitted with an M12 seal cap (part number EX9-AWTS), screwed down correctly after wiring and settings have been performed, for a protection rating of IP65/IP67 to be maintained.
- Users must take all necessary precautions to avoid any external short circuits on the cable. Refer to the relevant standards and apply fault exclusion where necessary.
- For an overview of Safety inputs and Safety outputs, refer to the operation manual section [2.2.1 Safety inputs](#) and [2.2.2 Safety outputs](#). Failure to comply with the information in the relevant chapters may cause the product to operate in an unintended operation.
- **These connectors may become hot when energized. Do not touch the connectors while it is energized.**

6 Wiring (continued)

6.4 Power Supply connection

The system is operated using power supplied from the End plate unit (EX600-ED#).
Refer to the End plate instruction manual and operation manual available on the SMC website (URL: <https://www.smcworld.com>) for the power supply connection details.

7 Settings

7.1 Configuration

Configure the Safety I/O module according to the procedure in the operation manual available on the SMC website (URL: <https://www.smcworld.com>).

7.2 Safety Communication

- Refer to the operation manual for the respective Safety controller (PLC) for the procedure to establish Safety communication (e.g. CIP Safety).
- Refer to the Safety I/O module operation manual available on the SMC website (URL: <https://www.smcworld.com>) for parameters required to establish Safety communication.

Items	Specification
Vendor	7
Product type	12
Product code	271
Product revision	1.001
Data format	SINT
Input size and Assembly Instance	See operation manual Table 4.2-2
Output size and Assembly Instance	See operation manual Table 4.2-2
CIP safety connection	Type 2
SCCRC	ID: 59757269
SCTS	Date: 2024/06/12 Time: 7:48:46, 579ms (UTC)

8 LED Display

Caution

- LED's are not a Safety function and it cannot be guaranteed to provide accurate information. They should only be used for general diagnostics during commissioning or troubleshooting. Do not refer to LED's as operational indicators.

8.1 ST LED indication

LED	Status	Description
	OFF	Power supply is not present.
	Green ON	Non-safety function is running.
	Green/Red Flashing (0.5 Hz)	Detects low priority non-safety function fault. Request removing cause of fault.
	Red ON	Detects high priority function fault. Restart power supply to module.

8.2 FDI LED indication

LED	Status	Description
	OFF	Power supply is not present.
	Green ON	Safety Input function is running.
	Green Flashing (0.5 Hz)	Request to set Safety parameter in module.
	Green/Red Flashing (0.5 Hz)	Detects setting parameter is invalid. Request to set parameters again.
	Red Flashing (0.5 Hz)	Detects low priority fault in Safety input. Request error reset using "Error reset bit" after removing the cause of the fault.
	Red Flashing (2.0 Hz)	Detects high priority fault in Safety Input. Restart power supply to module, OR Reset if supported by Fieldbus protocol.
	Red ON	Detect high priority fault in Safety input. Restart power supply to module.

10 LED Display (continued)

8.3 FDO LED indication

LED	Status	Description
	OFF	Power supply is not present.
	Green ON	Safety Output function is running.
	Green Flashing (0.5 Hz)	Request to set Safety parameter in module.
	Green/Red Flashing (0.5 Hz)	Detects setting parameter is invalid. Request to set parameters again.
	Red Flashing (0.5 Hz)	Detects low priority fault in Safety Output. Request error reset using "Error reset bit" after removing the cause of the fault.
	Red Flashing (2.0 Hz)	Detects high priority fault in Safety Output. Restart power supply to module, OR Reset if supported by Fieldbus protocol.
	Red ON	Detect high priority fault in Safety Output. Restart power supply to module.

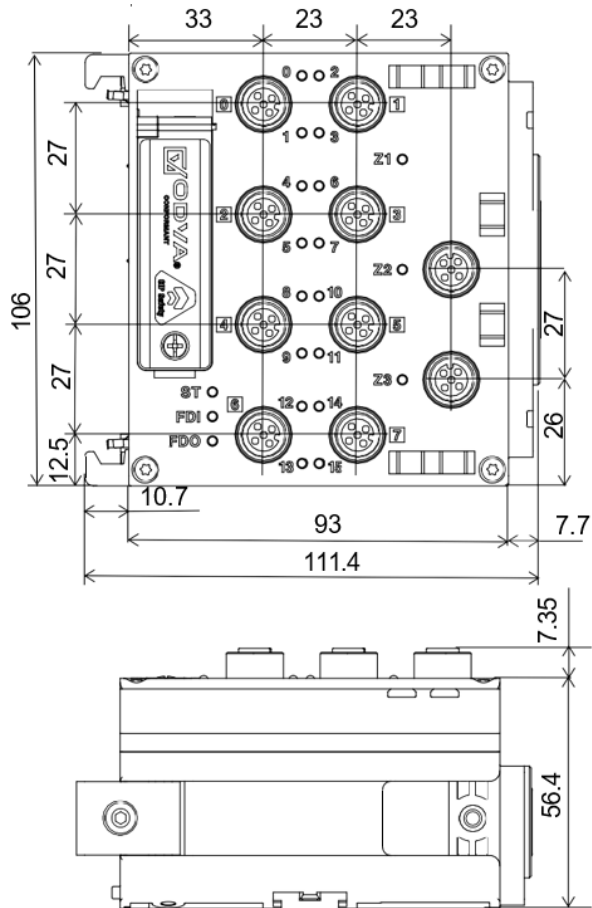
8.4 IN0-15 LED indication

LED	Status	Description
	OFF	Power supply is not present, or related Safety Input is OFF.
	Green ON	Related Safety Input is ON.
	Red ON	Detects fault on the related Safety Input. Reset error according to the status of the FDI LED.

8.5 Z1-3 LED indication

LED	Status	Description
	OFF	Power supply is not present, or related Safety Output is OFF.
	Green ON	Related Safety Output is ON.
	Red ON	Detects fault on the related Safety Output. Reset error according to the status of the FDO LED.

9 Outline Dimensions (mm)

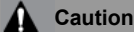


10 How to Order

Refer to the Safety I/O module operation manual available on the SMC website (URL: <https://www.smcworld.com>) for How to order information.

11 Maintenance

11.1 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
- Perform regular maintenance and inspections.
There is a risk of unexpected malfunction.
- After maintenance is complete, perform appropriate functional inspections.
Stop operation if the equipment does not function properly.
Otherwise Safety is not assured due to an unexpected malfunction or incorrect operation.
- Do not use solvents such as benzene, thinner etc. to clean the module.
They could damage the surface of the product and erase the markings on the body. Use a soft cloth to remove stains.
For heavy stains, use a cloth soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

11.2 Maintenance and Repairs

To prevent accumulation of malfunctions, perform malfunction checks at regular intervals (otherwise known as the diagnostic test interval) based on the risk assessments of the machine or the system.

With the exception of these periodic diagnostic tests, there is no other specific maintenance agenda for the EX600-FV## while it is in service. The module does not contain any components requiring maintenance.



Warning

- With the exception of periodic diagnostic tests, there is no other specific maintenance agenda for the Safety I/O module while it is in service. The module does not contain any components requiring maintenance. Repairs are prohibited. Do not carry out any repairs or modifications.

12 Limitations of Use

12.1 Limited warranty and Disclaimer/Compliance Requirements

Refer to Handling Precautions for SMC Products.

Operate the Safety I/O module exclusively for the intended activities defined in the operation manual, taking into account the prescribed values.

Safety products are designed for machine Safety functions and directly associated industrial automation tasks.

This product is intended for use in applications requiring safe disconnection of electrical power of pneumatic valves mounted to manifolds. It is the user's responsibility to determine if this product is suitable for the intended application and to specify the pneumatic valve arrangement accordingly to achieve the required safety function.

13 Product disposal

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

14 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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