

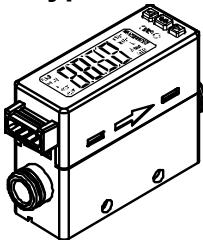


ORIGINAL INSTRUCTIONS

Instruction Manual

Digital Flow Switch – Integrated type

PF2M7## series



The intended use of the digital flow switch is to monitor and display flow information.

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 the product catalogue, Operation Manual and Handling Precautions for SMC Products for additional information.

• Keep this manual in a safe place for future reference.

• This product is class A equipment intended for use in an industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted or radiated disturbances.

⚠ 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.

- Do not disassemble, modify (including changing the printed circuit board) or repair.

An injury or failure can result.

- Do not operate the product outside of the specifications.

Fire, malfunction or damage to the product can result.

- Do not operate in an atmosphere containing flammable, explosive or corrosive gas.

Fire or an explosion can result.

- Do not use the product for flammable fluids.

Fire, explosion, damage or corrosion can result.

- If using the product in an interlocking circuit:

Provide a double interlocking system, for example a mechanical system.

- Check the product for correct operation.

Otherwise malfunction can result, causing an accident.

- Do not use the product in a place where static electricity is a problem.

Product failure or system malfunction may result.

Otherwise electric shock, malfunction or product damage can result.

- Refer to the operation manual on the SMC website (URL: <https://www.smeworld.com>) for more safety instructions.

2 Specifications

Model	701	702	705	710	725	750	711	721	
Fluid	Applicable fluid	Dry air, N ₂ , Ar, CO ₂ (ISO8573-1 1.1.2 to 1.6.2)							
	Fluid temperature range	0 to 50 °C							
	Detection method	Thermal (main flow)	Thermal (branch flow)						
Flow rate	Rated flow range [L/min]	Dry air, N ₂ , Ar 0.01 to 1 0.02 to 2	0.05 to 5 0.1 to 10	0.3 to 25 0.5 to 50	1 to 100 2 to 200				
	CO ₂	0.01 to 0.5 0.02 to 1	0.05 to 2.5 0.1 to 5	0.3 to 12.5 0.5 to 25	1 to 50 2 to 100				
	Instantaneous flow [L/min]	-0.05 to 1.05 -0.1 to 2.1	-0.25 to 5.25 -0.5 to 10.5	-1.3 to 26.3 -2.5 to 52.5	-5 to 105 -10 to 210				
	Accumulated flow [L]	0.00 to 999999.99	0.0 to 9999999.9	0 to 99999999					
Min. setting unit	Set flow range	Instantaneous flow [L/min]	0.001	0.01	0.1	1			
	Accumulated flow [L]	0.01	0.1	1					
	Accumulated volume [L/pulse]	0.01	0.1	1					
	Accumulated value hold	Select from 2 and 5 minutes							
Pressure	Operating pressure range	-0.1 to 0.75 MPa							
	Rated pressure range	-0.07 to 0.75 MPa							
	Proof pressure	1.0 MPa							
	Pressure loss	Refer to the pressure loss graph.							
	Pressure characteristics	±5% F.S. ±1 digit (0.35 MPa standard)							
Electrical	Power supply voltage	Switch output device	12 to 24 VDC ±10%						
	IO-Link device		18 to 30 VDC ±10%						
	Current consumption	35 mA or less							
	Protection	Polarity protection							
Accuracy	Display accuracy	±3% F.S. ±1 digit							
	Analogue output accuracy	±3% F.S.							
	Repeatability	±1% F.S. ±1 digit (±2% F.S. ±1 digit when digital filter is set to 0.05 s)							
	Temperature characteristics	±3% F.S. ±1 digit (15 to 35 °C: 25 °C standard) ±5% F.S. ±1 digit (0 to 50 °C: 25 °C standard)							
Switch output	Output type	NPN or PNP open collector							
	Output mode	Select from hysteresis mode, window comparator mode, accumulated output mode, accumulated pulse output mode, error output and switch output OFF							
	Switch operation	Select from normal output and reversed output							
	Maximum load current	80 mA							
	Maximum applied voltage	28 VDC (NPN only)							
	Internal voltage drop	Standard value	NPN: 1 V or less (Load current 80 mA) PNP: 1.5 V or less (Load current 80 mA)						
	IO-Link compatible product		1.5 V or less (Load current 80 mA)						
	Response time	50 ms or less							
	Delay time	0 to 0.10 s (0.01 s increment), 0.1 to 1.0 s (0.1 s increment), 1 to 10 s (1 s increment) Select from 20 s, 30 s, 40 s, 50 s, 60 s							
	Hysteresis	Variable							
	Protection	Short circuit protection							

2 Specifications (continued)

Model	701	702	705	710	725	750	711	721	
Output type	Voltage output: 1 to 5 V (or 0 to 10 V), Current output 4 to 20 mA								
Analogue output	Voltage output	Output impedance approx.1 kΩ							
Impedance	Current output	Max. load impedance Power supply voltage 24 V: 600 Ω Power supply voltage 12 V: 300 Ω							
Response time		50 ms ±40%							
Reference condition		Select from normal condition (NOR) and standard condition (STD)							
Display mode		Select from instantaneous flow and accumulated flow							
Unit	Instantaneous flow	L/min, cfm							
Display	Accumulated flow	L, ft ³							
Displayable range	Instantaneous flow [L/min]	-0.05 to 1.05 -0.1 to 2.1	-0.25 to 5.25 -0.5 to 10.5	-1.3 to 26.3 -2.5 to 52.5	-5 to 105 -10 to 210				
	Zero cut-off range	0 to ±10% F.S. (selected for every 1% F.S. of max. rated flow rate)							
	Accumulated flow [L]	0.00 to 999999.99	0.0 to 999999.9	0 to 99999999					
Display		Display type: LCD, Display colour: Red, green, Display digit: 7-segment, 4 digits							
Operation LED		LED is ON when switch output is ON, OUT1/OUT2: Orange							
Digital filter		Select from 0.05 s, 0.1 s, 0.5 s, 1 s, 2 s and 5 s							
Enclosure		IP40							
Withstand voltage		1000 VAC, 1 min. between terminals and housing							
Insulation resistance		50 MΩ or longer (with 500 VDC) between terminals and housing							
Operating temperature range		Operation: 0 to 50 °C, Storage: -10 to 60 °C (no freezing or condensation)							
Operating humidity range		Operation, Storage: 35 to 85% R.H. (no freezing or condensation)							
Piping	Piping specification	One-touch fitting	C4 (φ4) / C6 (φ6)	C6 (φ6) / N7 (φ1/4")	C8 (φ8) / N7 (φ1/4")				
		Screw fitting (Rc/NPT/G)	01 (Rc1/8) N1 (NPT1/8) F1 (G1/8)	02 (Rc1/4) N2 (NPT1/4) F2 (G1/4)					
	Port direction		Straight, Rear						
Material fluid contact parts		PPS, PBT, FKM, SUS304, brass (electroless nickel plating), Si, Au, GE4F							
Body	One-touch fitting		Straight: 40 g Rear: 55 g						
	Screw fitting		Straight: 60 g Rear: 75 g						
Weight	Flow adjustment valve		-	+34 g					
	Lead wire			+35 g					
	Bracket			+20 g					
	Panel mount adapter			+15 g					
	DIN rail mounting bracket			+65 g					

⚠ Warning

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

3 Names of Individual parts

3.1 PF2M7## (with flow adjustment valve)

Item	Description
</tbl_info

4 Installation

4.1 Installation

Warning

- Do not install the product unless the safety instructions have been read and understood.
- Use the product within the specified operating pressure and temperature range.
- Proof pressure could vary according to the fluid temperature. Check the characteristics data for operating pressure and proof pressure.

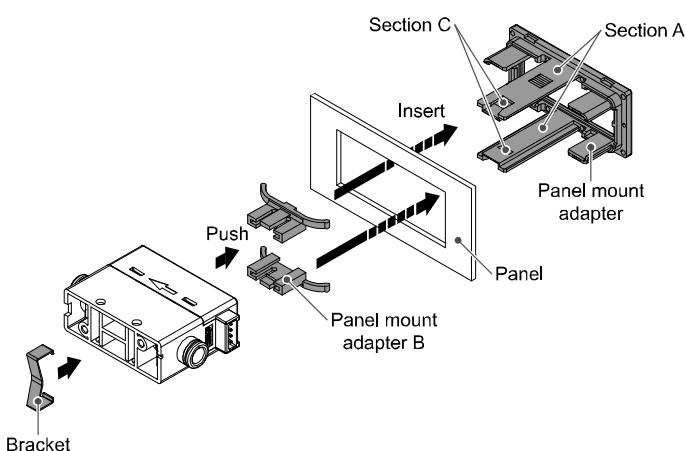
4.2 Environment

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.
- Refer to the flow direction of the fluid indicated on the product for installation and piping.
- Do not mount the body with the bottom facing upwards. Retention of air can cause inability to measure accurately.
- Do not insert metal wires or other foreign matter into the piping port. This can damage the sensor causing failure or malfunction.
- Never mount a product in a location that will be used as a foothold. The product may be damaged if excessive force is applied by stepping or climbing onto it.
- If there is a risk of foreign matter entering the fluid, install and pipe a filter or mist separator at the inlet to avoid failure and malfunction. Otherwise damage or malfunction can result.

4.3 Panel mounting

- Insert panel mount adapter B (supplied as an accessory) into section A of the panel mount adapter. Push panel mount adapter B from behind until the display is fixed onto the panel. The bracket pin engages the notched part of panel adapter section C to fix the display.
- The switch can be mounted on a panel with a thickness of 1 to 3.2 mm.

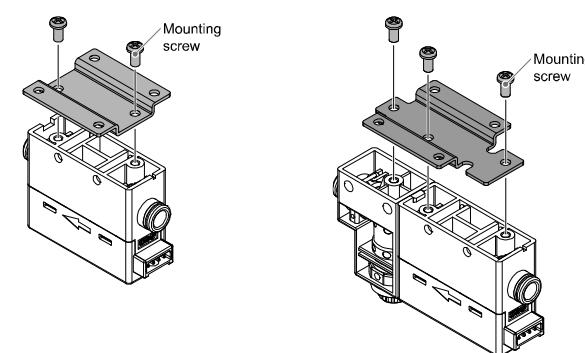


4 Installation (continued)

4.4 Bracket mounting

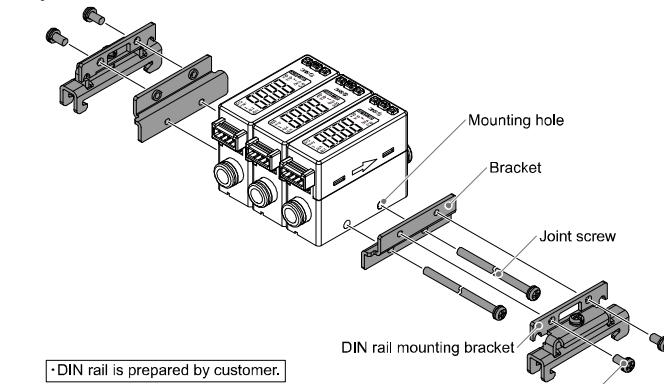
- Mount the bracket using the mounting screws supplied.
- The required tightening torque is $0.42 \pm 0.04 \text{ N}\cdot\text{m}$.
- Install the product (with bracket) using the M3 screws (4 pcs.).
- Bracket thickness is approximately 1.2 mm.

Without flow adjustment valve (using ZS-33-M) With flow adjustment valve (using ZS-33-MS)



4.5 DIN rail mounting (using ZS-33-R#)

- Mount the DIN rail mounting parts using the mounting screws and joint screws supplied.
- The required tightening torque of the DIN rail mounting screws and joint screws is $0.4 \pm 0.05 \text{ N}\cdot\text{m}$.



Refer to the operation manual on the SMC website (URL: <https://www.smeworld.com>) for all mounting dimensions.

4.6 Piping

Caution

- Before connecting piping make sure to clean up chips, cutting oil, dust etc.
- Ensure there is no leakage after piping.
- Any dust left in the piping should be flushed out by air blow before connecting piping to the product. Otherwise damage or malfunction can result.
- For piping of the product, hold the piping with a wrench on the metal part of the product. Holding other parts of the product with a wrench may damage the product.

4 Installation (continued)

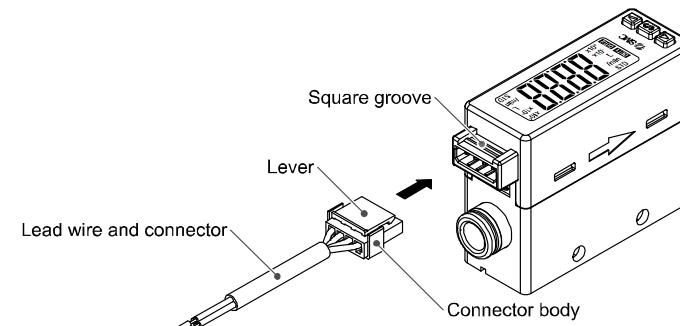
4.7 Wiring

Caution

- Do not perform wiring while the power is on.
- Confirm proper insulation of wiring.
- Do not route wires and cables together with power or high voltage cables. Otherwise the product can malfunction due to interference of noise and surge voltage from power and high voltage cables to the signal line.
- Keep wiring as short as possible to prevent interference from electromagnetic noise and surge voltage. Do not use a cable longer than 30 m. When using it as an IO-Link device, do not use a cable longer than 20 m.
- Ensure that the FG terminal is connected to ground when using a commercially available switch-mode power supply.
- When the analogue output is used, install a noise filter (line noise filter, ferrite element, etc.) between the switch-mode power supply and this product.

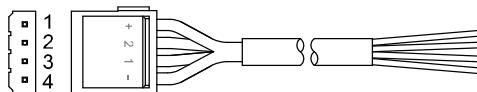
Connecting / Disconnecting

- When mounting the connector, insert it straight into the socket, holding the lever and connector body, and push the connector until the lever hooks into the housing, and locks.
- When removing the connector, press down the lever to release the hook from the housing and pull the connector straight out.



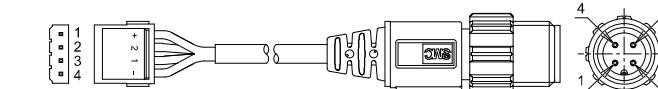
Connector pin numbers (on the lead wire)

- Lead wire and connector (ZS-33-D)



No.	Signal name	Lead wire colour
1	DC(+)	Brown
2	OUT2	White
3	OUT1	Black
4	DC(-)	Blue

M12 conversion lead wire (ZS-33-DM)



Used as switch output device

No.	Signal name	Lead wire colour
1	DC(+)	Brown
2	N.C./OUT2	White
3	DC(-)	Blue
4	OUT1	Black

Used as IO-Link device

No.	Signal name	Lead wire colour
1	L+	Brown
2	N.C./OUT2	White
3	L-	Blue
4	C/Q	Black

5 Outline of Settings

Power is supplied

The product code is displayed for approximately 3 seconds after power is supplied. Then measurement mode will be displayed and the switch operation will start.

[Measurement mode]

Measurement mode is the condition where the flow is detected and displayed, and the switch function is operating. This is the basic mode; other modes should be selected for set-point changes and other function settings.

Current flow rate value or peak/bottom value



Press the SET button once

Press the SET button between 2 to 5 seconds

Press the SET button for 5 seconds or longer

Flow Setting and Hysteresis (Simple setting mode)

Function Setting (Function selection mode)

Other Settings

- Snap shot
- Key-lock
- Zero clear

*: The outputs will continue to operate during setting.

*: Simple setting mode and function selection mode settings are reflected each other.

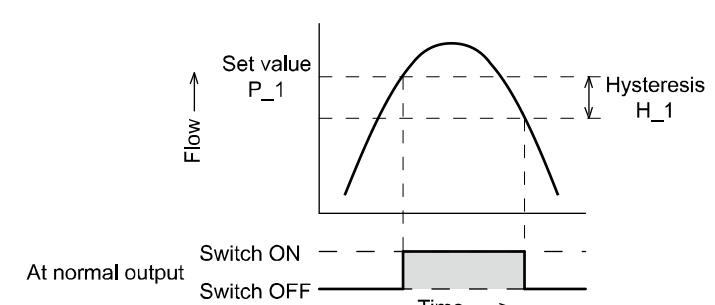
6 Flow Setting

6.1 Switch operation

When the flow exceeds the set value, the switch will be turned ON. When the flow falls below the set value by the amount of hysteresis or more, the switch will be turned OFF.

The default setting is to turn on the flow switch when the flow reaches the centre of the upper limit of the rated flow range.

If the operation shown below is acceptable, keep this setting.



*: For hysteresis refer to [F 1] Setting of OUT1 and [F 2] Setting of OUT2.

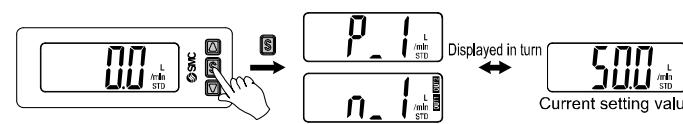
7 Simple Setting mode

[Simple setting mode (Hysteresis mode)]

In the Simple setting mode, the set value and hysteresis can be changed.

(1) Press the SET button once in measurement mode.

[P_1] or [n_1] and the [current set value] are displayed alternately.

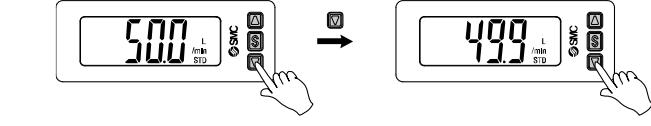


(2) Change the set value using the UP or DOWN button and press the SET button to set the value. Then, the setting moves to hysteresis setting (The snap shot function can be used).

• Press the UP button continuously to keep increasing the set value.



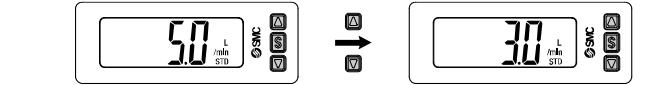
• Press the DOWN button continuously to keep decreasing the set value.



(3) [H_1] and the current set value are displayed in turn.



(4) Change the hysteresis by pressing the UP or DOWN button and press the SET button. Setting is completed and the product returns to measurement mode (The snap shot function can be used).



* For models with switch outputs for both OUT1 and OUT2, [P_2] or [n_2] will be displayed. These are set simultaneously.

* After enabling the setting by pressing the SET button, it is possible to return to measurement mode by pressing the SET button for 2 seconds or longer.

* When hysteresis mode is not used, "Input set value" is displayed.

* The set value and hysteresis settings limit each other.

* For more detailed setting, set each function in function selection mode.

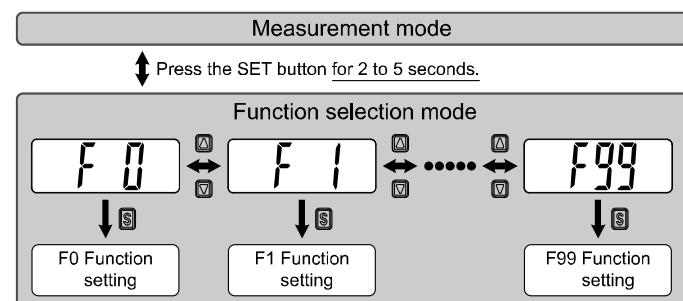
8 Function Setting

8.1 Function selection mode

In measurement mode, press the SET button for 2 to 5 seconds to display [F 0] on the display.

Select to display the function to be change [F 0-F99].

Press the SET button for 2 seconds or longer in function selection mode to return to measurement mode.



*: Some products do not have all the functions. If a function is not available or selected due to configuration of other functions, [- -] is displayed.

8 Function Setting (continued)

8.2 Default settings

Item	Default setting
[F 0] [FLU]	[FLU] Select the flow rate [Air] Dry air, N ₂
	[rEF] Setting the units criteria [Std] Standard condition
	[Unit] Measurement unit setting [L] L/min (L)
	[norP] Switch output PNP/NPN setting [PnP] PNP output
	[i_o] SW / external input setting [oUt] SW output
	[oUt1] Setting of OUT1 [HYS] Hysteresis mode
	[1ot] OUT1 output configuration setting [1_P] Normal output
	[] 50% of maximum rated flow PF2M701: 0.5 L/min, PF2M702: 1.0 L/min PF2M705: 2.5 L/min, PF2M710: 5 L/min PF2M725: 12.5 L/min PF2M750: 25 L/min PF2M711: 50 L/min PF2M721: 100 L/min
	[P_1] Set value
	[H_1] Hysteresis
[F 1] [oUt1]	[] 5% of maximum rated flow PF2M701: 0.05 L/min, PF2M702: 0.1 L/min PF2M705: 0.25 L/min, PF2M710: 0.5 L/min PF2M725: 1.3 L/min PF2M750: 2.5 L/min PF2M711: 5 L/min PF2M721: 10 L/min
	[dt1] Delay time setting [0.00] 0.00 s
	[CoL] Display colour setting [1SoG] ON: Green OFF: Red
	[oUt2] Setting of OUT2 [HYS] Hysteresis mode
	[2ot] OUT2 output configuration setting [2_P] Normal output
	[] 50% of maximum rated flow PF2M701: 0.5 L/min, PF2M702: 1.0 L/min PF2M705: 2.5 L/min, PF2M710: 5 L/min PF2M725: 12.5 L/min PF2M750: 25 L/min PF2M711: 50 L/min PF2M721: 100 L/min
	[P_2] Set value
	[H_2] Hysteresis
	[] 5% of maximum rated flow PF2M701: 0.05 L/min, PF2M702: 0.1 L/min PF2M705: 0.25 L/min, PF2M710: 0.5 L/min PF2M725: 1.3 L/min PF2M750: 2.5 L/min PF2M711: 5 L/min PF2M721: 10 L/min
	[dt2] Delay time setting [0.00] 0.00 s
[F 2] [oUt2]	[CoL] Display colour setting [1SoG] ON: Green OFF: Red
	[F 3] [FiL] Digital filter setting [1.0] 1.0 s
	[F 4] [PrS] Auto-preset function setting [oFF] Manual

8 Function Setting (continued)

Item	Default setting
[F10] [FLo]	[FLo] Display mode [inS] Instantaneous flow
[F11] [drE]	[drE] Display resolution setting [1000] 1000-split
[F13] [rEv]	[rEv] Reverse display [oFF] Not reverse
[F14] [CuT]	[1.0] 1% of maximum rated flow PF2M701: 0.01 L/min, PF2M702: 0.02 L/min PF2M705: 0.05 L/min, PF2M710: 0.1 L/min PF2M725: 0.3 L/min, PF2M750: 0.5 L/min PF2M711: 1 L/min PF2M721: 2 L/min
	[CuT] Zero cut-off setting
[F20] [inP]	[inP] External input setting [rAC] Accumulated value reset
[F22] [AoUt]	[AoUt] Analogue output setting [1-5] 1 to 5 V Voltage output (when voltage is output) [---] Analogue output is not selectable (for current type output)
[F30] [SAvE]	[SAvE] Accumulated flow value hold setting [oF] Not held
[F80] [disp]	[disp] Display OFF mode setting [on] Normal display
[F81] [Pin]	[Pin] Security code [oFF] Unused
[F90] [ALL]	[ALL] Setting of all functions [oFF] Unused
[F96] [S_in]	[S_in] External input signal check No setting due to input signal setting
[F98] [tESt]	[tESt] Output checking [n] Normal output
[F99] [ini]	[ini] Reset to the default settings [oFF] Not recover

*: Setting is only possible for models with the units selection function.

*: Only available for models with switch outputs for both OUT1 and OUT2.

*: This function is available for models with analogue output.

Analogue free span function can be selected.

*: This function is available in IO-Link compatible products.

*: This function is available for models with external input.

10 Maintenance

10.1 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.

How to reset the product after a power cut or when the power has been unexpectedly removed

The settings of the product are retained from before the power cut or de-energizing. The output condition also recovers to that before the power cut or de-energizing, but may change depending on the operating environment. Therefore, check the safety of the whole system before operating the product.

11 How to Order

Refer to drawings/catalogue on the SMC website (URL: <https://www.smcworld.com>) for 'How to Order' information.

12 Outline Dimensions (mm)

Refer to the operation manual on the SMC website (URL: <https://www.smcworld.com>) for outline dimensions.

9 Other Settings

- Snap shot function
- Peak/bottom value indication
- Reset
- Key-lock function
- Zero clear function

Refer to the operation manual on the SMC website (URL: <https://www.smcworld.com>) for setting these functions.

13 Troubleshooting

13.1 Error indication

Error name	Error display	Description	Measures
Instantaneous flow error		Flow exceeding the upper limit of the set flow range is applied.	Reduce the flow.
		Flow exceeding the lower limit of the set flow range is applied.	Ensure the flow is in the correct direction.
OUT1 over current error		The load current applied to the switch output has exceeded the maximum value. (OUT1)	Turn the power off and remove the cause of the over current. Then turn the power on again.
OUT2 over current error		The load current applied to the switch output has exceeded the maximum value. (OUT2)	
Zero clear error		During zero clear operation, pressure greater than $\pm 5\%$ F.S. is applied. (The mode is returned to measurement mode automatically 1 second later).	Retry the zero clear operation without applying fluid.
System error			
			
			
		An internal data error has occurred.	Turn the power off and turn it on again.
			
			
			
			
Accumulated flow error		Accumulated flow is displayed (flashing)	The accumulated flow has exceeded the accumulated flow range. (For accumulated increment) Reset the accumulated flow. (Press the UP and DOWN buttons simultaneously for <u>1 second or longer</u>)
		Accumulated flow is displayed (flashing)	The accumulated flow has reached the set accumulated flow. (For accumulated decrement)
Version does not match		Version of master and IO-Link does not match. Mismatch because master version is 1.0.	Align the master IO-Link version to the device.

If the error cannot be reset after the above measures are taken, or errors other than above are displayed, please contact SMC.

Refer to the operation manual on the SMC website
(URL: <https://www.smeworld.com>) for more detailed information about troubleshooting.

14 Limitations of Use

14.1 Limited warranty and Disclaimer/Compliance Requirements

Refer to Handling Precautions for SMC Products.

15 Product disposal

This product should 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.

16 Support / Importer / Manufacturer

Support: Please contact your distributor or importer in the country of purchase if you need assistance.

Importer: Address of importer in the country of purchase is listed at <https://www.smeworld.com/en-eu/worldwide-addresses>

Manufacturer:

SMC Corporation

URL: <https://www.smeworld.com> (Global) <https://www.smeworld.com> (Europe)
SMC Corporation, 1-5-5, Kyobashi, Chuo-ku, Tokyo 104-0031, Japan
Specifications are subject to change without prior notice from the manufacturer.
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