



ORIGINAL INSTRUCTIONS

Instruction Manual

Electromagnetic Digital Flow Switch

LFE* Series



The intended use of the electromagnetic digital flow switch is to monitor the flow of fluids and provide an output signal.

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^{*)}, and other safety regulations.
*) ISO 4414: Pneumatic fluid power - General rules relating to systems.
ISO 4413: Hydraulic fluid power - General rules relating to systems.
IEC 60204-1: Safety of machinery - Electrical equipment of machines. (Part 1: General requirements)
ISO 10218-1: Manipulating industrial robots -Safety. etc.
• 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.

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

Warning

- **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 use the product outside of the specifications.** Do not use for flammable or harmful fluids. Fire, malfunction or damage to the product can result. Check the specifications before use.
- **Do not use with flammable or highly permeable 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 regularly for correct operation.
- **Do not touch the terminals or connectors while the power is on.** Electric shock, malfunction or damage to the product can result.
- **Do not touch the piping or connected parts when the fluid is at high temperature.** Ensure the piping cools sufficiently before touching.

2 Specifications

2.1 General Specifications

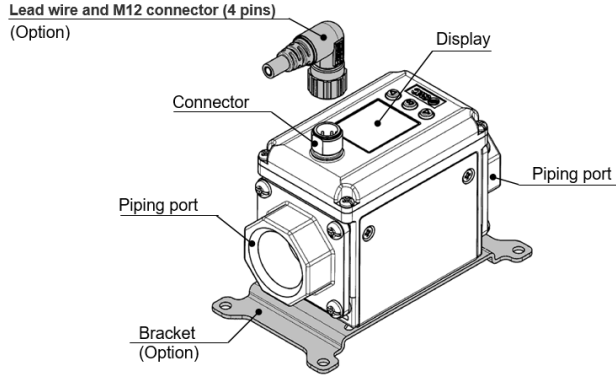
| Model | | LFE1* | LFE2* | LFE3* |
|-------------------------------------|------------------------------------|--|------------|-------------------|
| Applicable fluid | | Water, Conductive liquids which do not corrode the fluid contact materials | | |
| Fluid conductivity | | 5µS/cm or more | | |
| Detection method | | Electrostatic capacity | | |
| Rated flow range (L/min) | | 0.5 to 20 | 2.5 to 100 | 5 to 200 |
| Fluid temperature | | 0 to 85°C (with no freezing or condensation) | | |
| Repeatability | | Analogue output ±1.5% F.S. | | |
| Ambient temperature characteristics | | ±5% F.S. (25°C reference) | | |
| Fluid temperature characteristics | | ±5% F.S. (25°C reference) | | |
| Operating pressure range | | 0 to 1 MPa | | |
| Proof pressure | | 2 MPa | | |
| Analogue | Voltage output | 1 to 5 V Output impedance: 1 kΩ | | |
| | Current output | 4 to 20 mA max. load impedance 600 | | |
| Electrical | Power supply voltage | 24 VDC ±10% | | |
| | Current consumption | 45 mA maximum (Load current not included) | | |
| Environment | Enclosure | IP65 | | |
| | Operating temperature range | 0 to 50°C (with no freezing or condensation) | | |
| | Operating / storage humidity range | 35 to 85% R.H. (with no condensation) | | |
| Fluid contact material | | PPS, FKM, Brass | | |
| Port size | | 3/8 (10A) | 1/2 (15A) | 3/4 (20A) 1 (25A) |
| Weight (approx.) | | 340 g | 400 g | 520 g 680 g |

2.2 Integrated Display type Specifications

| Model | | LFE1* | LFE2* | LFE3* |
|--|-----------------------|---|---|-----------|
| Display range (L/min) | | 0.4 to 24 | 2.0 to 120 | 4 to 240 |
| Set flow range (L/min) | | 0.4 to 24 | 2.0 to 120 | 4 to 240 |
| Zero-cut flow | | 0.4 L/min | 2.0 L/min | 4 L/min |
| Smallest increment | | 0.1 L/min | 0.5 L/min | 1 L/min |
| Accumulated volume per pulse (pulse = 50 ms) | | 0.1 L/pulse | 0.5 L/pulse | 1 L/pulse |
| Display units | | Instantaneous flow: L/min Accumulated flow: L | | |
| Repeatability | | Display value ±2% F.S. Analogue output ±1.5% F.S. | | |
| Accumulated flow range | | 99999999.9 L by 0.1 L | 999999999 L by 1L | |
| Switch output | Output type | NPN or PNP open collector | | |
| | Max. Load current | 80 mA | | |
| | Max. applied voltage | 28 VDC | | |
| | Internal voltage drop | NPN = 1 V max (at 80 mA load) PNP = 1.5 V max (at 80 mA load) | | |
| | Response time | Selectable from 0.25 s / 0.5 s / 1 s / 2 s / 5 s | | |
| | Output Protection | Short circuit protection | | |
| | Output mode | Hysteresis mode, Window comparator, Accumulated output or pulse output | | |
| | Display method | | 2 screen display Main screen: 4 digit, Red/Green Sub screen: 6 digit, White | |
| Operation LED | | Output 1, Output 2: Orange | | |

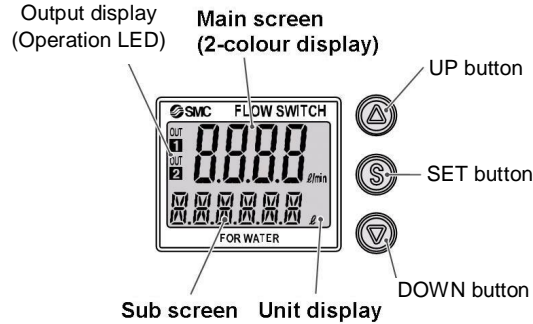
Refer to the SMC website (URL <https://www.smcworld.com>) for more detailed information about the product specifications.

3 Name and Function of Individual parts



| Item | Description |
|-----------------------------|--|
| Connector | Connector for electrical connections. |
| Lead wire and M12 connector | Cable to supply power and transmit output signals. Enclosure:IP65 is with the lead wire and M12 connector installed. |
| Piping port | For piping connections. |
| Bracket | Mounting bracket used to install the product. |
| Display | Displays the flow value, setting values and error indication. |

3.1 Display (integrated display type)



| Item | Description |
|--------------------------------|---|
| Main screen (2-colour display) | Displays the flow value, setting mode, and error indication. |
| Sub screen | Displays the accumulated flow, set value, peak/bottom value flow direction, line names, and close proximity setting values. In setting mode, the set status is displayed. |
| Output display (Operation LED) | Displays the output status of OUT1 and OUT2.(When ON: Orange light turns on) |
| Units display | Indicates the unit currently selected. |
| UP / DOWN button | Select and change the various modes and increase or decrease the setting values. |
| SET button | Press this button to select mode and to confirm a set value. |

4 Installation

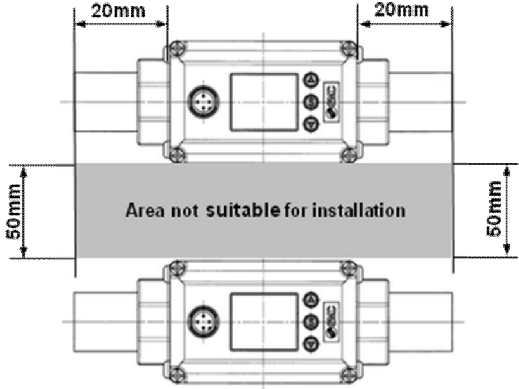
4.1 Installation

Warning

- Do not install the product unless the safety instructions have been read and understood.
- Never mount the product in a location where it will be used as a support.
- Mount the product so that the fluid flows in the direction indicated by the arrow on the side of the body.
- Check the flow characteristics data for pressure loss and the straight inlet pipe length effect on accuracy, to determine inlet piping requirements.
- Do not sharply reduce the piping size.
- Piping port is grounded to DC(-)/blue. Power supply with positive ground cannot be used.

4 Installation (continued)

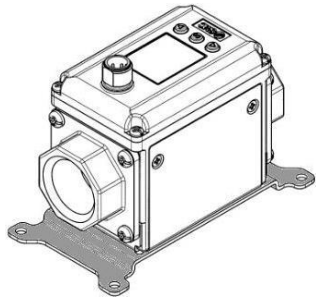
- When several sensors are mounted in parallel, do not mount them within the 50 mm area where installation is prohibited as shown below.
- When using the **Close proximity setting** the sensors can be installed closer than 50 mm to each other (integrated display type). Refer to the product catalogue or SMC website (URL <https://www.smcworld.com>) for more details of Function setting.



- Use the product within the specified operating pressure and temperature range.
- The withstand pressure is 2 MPa. This could vary according to the fluid temperature. Check the characteristics data before applying pressure.

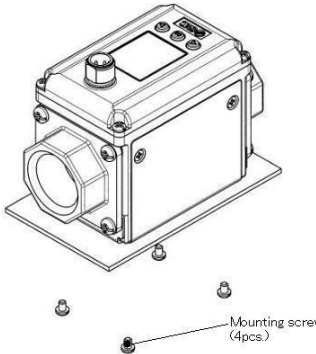
Bracket mounting

Mount the product (with bracket) using the mounting screws (M4 x 4 pcs). Bracket thickness is approx. 1.6 mm. Refer to the outline dimensions for the bracket thickness and mounting hole dimensions.



Direct mounting

Mount the product using self tapping screws.(Nominal thread size 3). Recommended tightening torque is 0.75 ±0.05 Nm. Refer to the dimension drawing in the operation manual for mounting hole dimensions. When a self tapping screw is used, it should not be re-used several times.



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.
- Do not use the product in a location subject to static electricity.

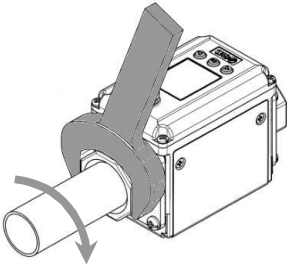
4.3 Piping

Caution

- Before connecting piping make sure to clean up chips, cutting oil, dust etc.
- When installing piping or fittings, ensure sealant material does not enter inside the port. When using seal tape, leave 1 thread exposed on the end of the pipe/fitting.
- Tighten fittings to the specified tightening torque.
- Ensure there is no leakage from loose piping.
- When connecting piping to the product, a spanner should be used on the metal piping attachment only.

4 Installation (continued)

- Using a spanner on other parts may damage the product. In particular do not let the spanner come into contact with the M12 connector. The connector can be easily damaged.



| Port | Width |
|------|-------|
| 3/8 | 24 mm |
| 1/2 | 28 mm |
| 3/4 | 35 mm |
| 1 | 41 mm |

- Tighten piping according to the specified torque. The tightening torque for connection threads is shown below.

| Nominal thread size | Tightening torque |
|---------------------|-------------------|
| Rc(NPT) 3/8 | 22 to 24 Nm |
| Rc(NPT) 1/2 | 28 to 30 Nm |
| Rc(NPT) 3/4 | 28 to 30 Nm |
| Rc(NPT) 1 | 36 to 38 Nm |

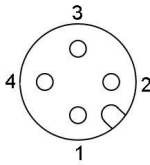
- If the tightening torque is exceeded, the product can be damaged. If the correct tightening torque is not applied, the fittings may become loose.

4.4 Wiring

- Connections should only be made with the power supply turned off.
- Use separate routes for the Flow switch wiring and any power or high voltage wiring. Otherwise, malfunction may result due to noise.
- Ensure that the FG terminal is connected to ground when using a commercially available switch-mode power supply. When a switch-mode power supply is connected to the product, switching noise will be superimposed and the product specification can no longer be met.

Wiring of Connector

Pin number of the connector (on the product)

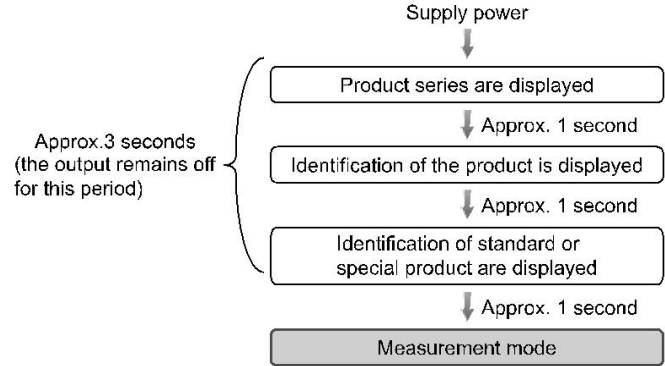


| Pin | Signal |
|-----|--------|
| 1 | DC(+) |
| 2 | OUT2 |
| 3 | DC(-) |
| 4 | OUT1 |

5 Flow Setting

5.1 Measurement mode

The mode in which flow is detected and displayed, and the switch function is operating. This is the basic operating mode; other modes should be selected for set-point and other function setting changes.

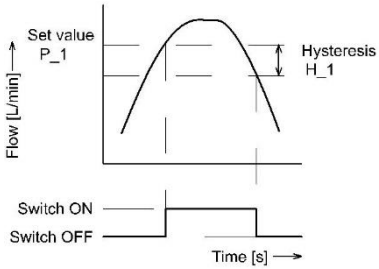


Set the ON and OFF points of the switch output. (with display).

5 Flow Setting (continued)

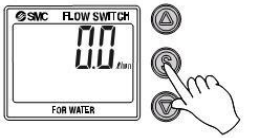
5.2 Switch Operation

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



<Operation>

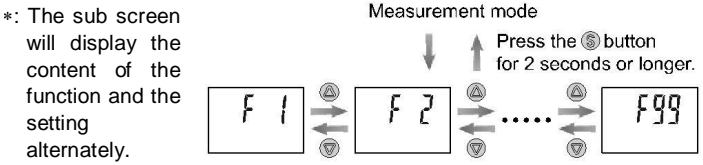
- Press the SET button in measurement mode to display the set values.
- [P_1] or [n_1] and the set value are displayed alternately.
- Press the UP or DOWN button to change the set value. The UP button is to increase and the DOWN button is to decrease the set value.
 - Press the UP button once to increase by one digit, press and hold to continuously increase.
 - Press the DOWN button once to decrease by one digit, press and hold to continuously increase.
- Press the SET button to finish the setting. During window comparator mode the switch turns on within a set flow range (from P1L to P1H). Set P1L (switch lower limit) and P1H (switch upper limit) using the setting procedure above. When reversed output is selected, the main screen displays [n1L] and [n1H]. For models with 2 outputs, [P_2] or [n_2] will be displayed. Set as above.
 - If a button operation is not performed for 30 seconds during the setting changes, the set value will start flashing.



6 Function Setting

6.1 Function selection mode (integrated display type)

In measurement mode, press the SET button for 2 seconds or longer to display [F 1]. [F□□] indicates the mode for changing each function setting. Press the SET button for 2 seconds or longer to return to measurement mode.



The function number is increased and decreased by the UP and DOWN buttons. Display the required function number and press the SET button.

6.2 Default settings

If the default settings are acceptable, retain for use. To change a setting, refer to the SMC website (URL <https://www.smcworld.com>).

[F 1] Setting of OUT1

| Item | Content | Default setting |
|-----------------|---|-------------------------------------|
| Output mode | Selects the switch output type from: Instantaneous flow (hysteresis or window comparator mode), accumulated flow or accumulated pulse output. | Hysteresis mode |
| Reversed output | Selects which type of switch output is used, normal or reversed. | Normal output |
| Set value | Sets the ON / OFF point of the switch output. | 50% of rated flow |
| Hysteresis | Setting of hysteresis can prevent chattering. | 5% of rated flow |
| Display colour | The display colour can be selected. | Output ON: Green Output OFF: Red |

6 Function Setting (continued)

[F 2] Setting of OUT2

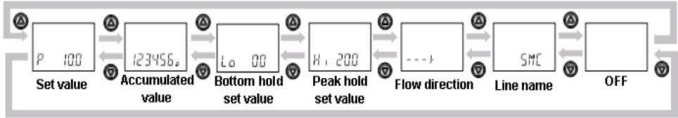
| Item | Content | Default setting |
|-----------------|--|-------------------|
| Output mode | Selects the switch output type from: Instantaneous flow (either hysteresis or window comparator mode), accumulated flow or accumulated pulse output. | Hysteresis mode |
| Reversed output | Selects which type of switch output is used, normal or reversed. | Normal output |
| Set value | Sets the ON / OFF point of the switch output. | 50% of rated flow |
| Hysteresis | Setting of hysteresis can prevent chattering. | 5% of rated flow |

*: The display colour is linked to OUT1, and cannot be set for OUT2.

6.3 Sub screen display

In measurement mode, the sub screen display can be temporarily changed by pressing the UP or DOWN buttons.

*: After 30 seconds, it will automatically return to the display selected in [F10].



The set values and accumulated output of OUT2 cannot be displayed. (example shown is for 20 L/min type)

7 Other Settings

Refer to the SMC website (URL <https://www.smcworld.com>) to obtain more detailed information about default settings and all other settings.

8 Outline Dimensions (mm)

Refer to the SMC website (URL <https://www.smcworld.com>) for Outline dimensions.

9 Maintenance

9.1 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.
- 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.
- After maintenance is complete, perform appropriate functional inspections and leak tests.
- Stop operation if the equipment does not function properly or there is a leakage of fluid.
- When leaks occur from parts other than the piping, the product may be faulty. Cut off the power supply and stop supplying fluid. Do not apply fluid under leaking conditions.

10 Troubleshooting

10.1 Error Indication (With display)

| Error Name | Display | Content | Remedy |
|------------------------------|--|--|--|
| OUT1 over current error | Er 1 | The switch output load current has exceeded 80 mA (OUT1). | Turn the power OFF and remove the cause of the over current. Then turn the power ON again. |
| OUT2 over current error | Er 2 | The switch output load current has exceeded 80 mA (OUT2). | |
| Zero-reset error | Er 3 | Detection passage is not filled or the flow rate exceeds $\pm 20\%$ F.S. | Check detection passage status, and retry the zero reset operation. |
| Excessive instantaneous flow | HHH | The flow rate has exceeded the display range. | Reduce the flow rate to within the display range. |
| Reverse flow error | LLL | Flow in the reverse direction of the setting. | Connect flow in the direction of the setting. |
| Excessive accumulated flow | 999999999 (Displays 「999」 and 「999999」 alternately) | The accumulated flow range has been exceeded. | Reset the accumulated flow. (applicable only if accumulated flow is used) |
| System error | Er 0 Er 4 Er 6 Er 8 | Internal data error has occurred. | Turn the power OFF and ON again. |
| Power supply voltage error | Er 10 | The power supply voltage exceeds $24\text{ V} \pm 10\%$. | Adjust the power supply voltage and then turn the power on again. |

10.2 Cross reference for troubleshooting

| Problem | Probable cause | Recommended error handling | Recommended action |
|--------------|---------------------------|--|---------------------|
| Output error | Insufficient fluid supply | Confirm whether the fluid path is full | Fill the fluid path |

11 Limitations of Use

11.1 Limited warranty and Disclaimer/Compliance Requirements

Refer to Handling Precautions for SMC Products.

12 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.

13 Contacts

Refer to www.smcworld.com or www.smc.eu for contacts.

SMC Corporation

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