



# Operation Manual

Product Name

Electromagnetic Digital Flow Switch  
Remote Type

Model/ Series/ Product Number

*LFE#####(Z)*

## SMC Corporation

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# Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger." They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)\*1), and other safety regulations.

\*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems.

ISO 4413: Hydraulic fluid power -- General rules relating to systems.

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

ISO 10218: Manipulating industrial robots -Safety.

etc.



## 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

### 1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### 2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### 3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### 4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3. An application which could have negative effects on people, property, or animals requiring special safety analysis.

4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



# Safety Instructions

## Caution

### **The product is provided for use in manufacturing industries.**

The product herein described is basically provided for peaceful use in manufacturing industries. If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.  
If anything is unclear, contact your nearest sales branch.

## **Limited Warranty and Disclaimer/ Compliance Requirements**

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.

Read and accept them before using the product.

### **Limited Warranty and Disclaimer**

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*2)

Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.

This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

\*2) Vacuum pads are excluded from this 1 year warranty.

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

### **Compliance Requirements**

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction(WMD) or any other weapon is strictly prohibited.

2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

## Caution

### **SMC products are not intended for use as instruments for legal metrology.**

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.

Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

## ■ Explanation of Symbols

Symbol	Definition
	Things you must not do. Actual instructions are provided as a drawing or sentence close to this mark.
	Things you must do Actual instructions are provided as a drawing or sentence close to this mark.




## ■ Operator

<p>(1) This Operation Manual is intended for those who have knowledge of machinery using pneumatic equipment, and have sufficient knowledge of assembly, operation and maintenance of such equipment. Only those persons are allowed to perform assembly, operation and maintenance.</p> <p>(2) Read and understand this Operation Manual carefully before assembling, operating or providing maintenance to the product.</p>
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## ■ Safety Instructions

<b>Warning</b>	
 Disassembly prohibited	Do not disassemble, modify (including the replacement of board) or repair. Otherwise, an injury or failure can result.
 Do not	Do not operate the product outside of the specifications. Do not use for flammable or harmful fluids. Fire, malfunction, or damage to the product can result. Please check the specifications before use.
 Do not	Do not use in an atmosphere containing flammable or explosive gases. Fire or an explosion can result. The product is not designed to be explosion proof.
 Do not	Do not use the product for flammable or highly permeable fluids. Fire, explosion, breakage or corrosion can result.
 Do not	Do not use the product in a place where static electricity is a problem. Otherwise failure or malfunction of the system can result.
 Instruction	If using the product in an interlocking circuit: - Provide a double interlocking system, for example a mechanical system. - Check the product for proper operation. Otherwise malfunction can result, causing an accident.
 Instruction	The following instructions must be followed during maintenance: - Turn off the power supply - Stop supplying fluid before maintenance. It may cause an injury.

## ⚠ Caution

 Do not touch	<p>Do not touch the terminals and connectors while the power is on. Otherwise electric shock, malfunction or damage to the switch can result.</p>
 Do not touch	<p>Do not touch the piping joint or piping when hot fluid is used. It may lead to burn. Check that the piping is cooled down before touching it.</p>
 Instruction	<p>■ After maintenance is complete, perform appropriate functional inspections and leak test. Stop operation if the equipment does not function properly or there is leakage of fluid. When leakage occurs from parts other than the piping, the product itself may be damaged. Cut off the power supply and stop the fluid supply. Do not apply fluid if the system is leaking. Safety cannot be assured in the case of unexpected malfunction.</p>

### ■ Handling Precautions

- Follow the instructions given below for selecting and handling.

- The instructions on design and selection (installation, wiring, environment, adjustment, operation, maintenance, etc.) described below must be followed.

#### \*Product specifications

- Use the specified voltage.

Otherwise failure or malfunction can result.

Insufficient supply voltage may not drive a load due to a voltage drop inside the product.

Check the operating voltage of the load before use.

- Do not exceed the specified maximum allowable load.

This may cause damage or shorten the lifetime of the product.

- Confirm the pressure loss at the sensor according to the flow rate characteristics (pressure loss) graph before designing piping.

Confirm pressure loss of the sensor from the flow characteristics chart.

- Take care that pressure exceeding the specified range will not be applied due to water hammer.

<Examples of measures for reducing water hammer>

(1) Use a water hammer resistant valve.

(2) Use elastic piping material such as rubber hose etc. and an accumulator to absorb impact pressure.

(3) Shorten the length of piping as much as possible.

- Use the product within the specified operating pressure and temperature range.

- Proof pressure is 2MPa. Proof pressure depends on fluid temperature. Refer to the chart of the operating pressure range.

- Reserve a space for maintenance.

When designing an application, allow sufficient clearance for maintenance and inspection.

- Product handling

- \* Mounting

- Tighten to the specified tightening torque.

- If the tightening torque is exceeded, the mounting screws, brackets and product may be damaged. Insufficient torque can cause displacement of the product from its proper position and the looseness of the mounting screws.

- If a commercially available switching power supply is used, be sure to ground the frame ground (FG) terminal.

- Do not use where the product is subjected to vibration or impact.

- Otherwise damage to the internal components may result, causing malfunction.

- When multiple sensors are mounted together in parallel on an installation within the area not suitable for mounting next to the product, a detected flow rate to fluctuate.

- Products should be mounted with a suitable distance between each sensor.

- When piping the product, apply a spanner on the metal part of the piping port to turn the fitting.

- Holding other parts of the product with a tool may damage the product.

- Specifically, make sure that the spanner does not damage the M12 connector.

- This will damage the connector.

- Any dust left in the piping should be flushed out by air before connecting the piping to the product.

- Otherwise it can cause damage or malfunction.

- Refer to the flow direction of the fluid indicated on the product label for installation and piping.

- Avoid piping in which the piping size of the IN side of the switch changes suddenly.

- If the piping size is reduced suddenly, or there is a restrictor such as a valve on the IN side, the fluid velocity distribution in the piping will be disturbed, leading to improper measurement. Therefore, the above mentioned piping reduction or restrictor should be connected on the OUT side.

- If the OUT side is opened, or the flow rate is excessive, cavitations may be generated, which may result in improper measurement. As a measure against this, it is possible to reduce the cavitations by increasing the fluid pressure.

- Take action such as mounting an orifice on the OUT side of the switch, and confirm that there is no malfunction before handling.

- If the orifice of the OUT side is fully closed to operate the pump, the switch may malfunction due to the effect of pulsation (pressure fluctuation). Ensure that there is no malfunction before use.

- Do not insert metal wires or other foreign matter into the flow path.

- This can damage the sensor causing failure or malfunction.

- Never mount the product in a place that will be used as a scaffold during piping.

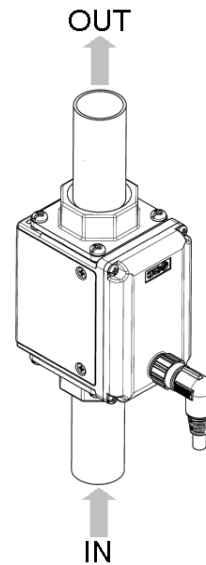
- The product may be damaged if excessive force is applied by stepping or climbing onto it.

## **- Design and install the product so that fluid always fills the detection passage.**

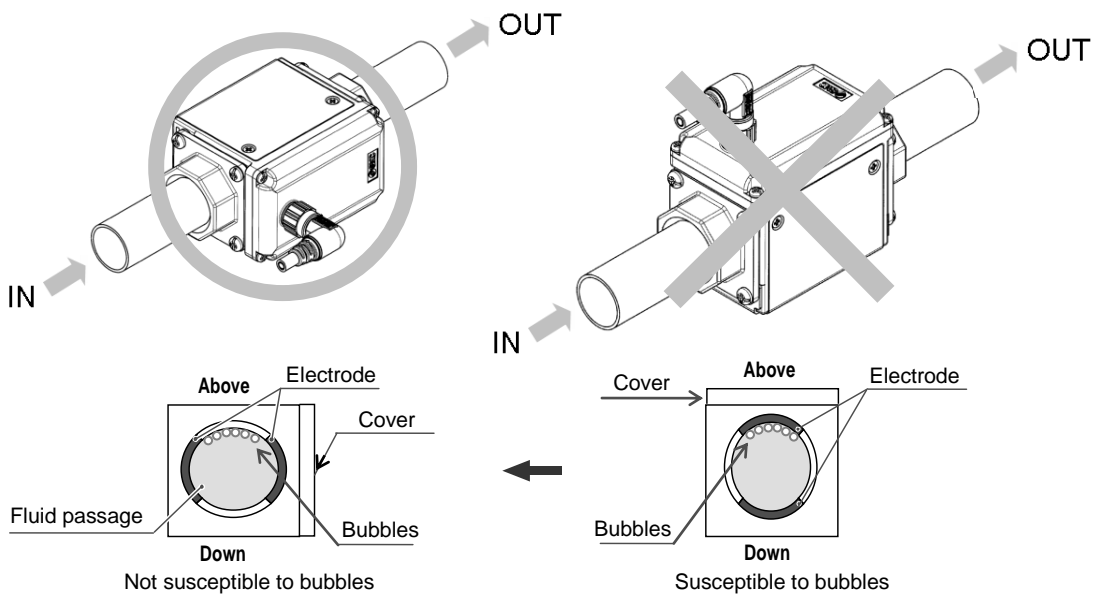
1. If the detection passage does not become fully filled with fluid during the use of the product, an incorrect detection signal can be generated in the electrodes, prohibiting correct measurement. Be sure to install the product so that fluid will remain in the detection passage even after the fluid flow is stopped.

For vertical mounting, apply fluid from the bottom to the top. Bubbles may be generated when applying fluid from the top to the bottom, leading to operation failure.

(There should not be a problem as long as the fluid passage is completely filled with fluid)



2. When the product is mounted horizontally, place the cover perpendicular to the floor (to place the electrodes on the right and the left) to unaffected bubbles.





- \* Wiring (Including connecting/disconnecting of the connectors)
  - Do not pull the lead wire forcefully, or lift the product by the lead wire (Tensile strength 49 N or less).
    - Hold the product body when handling.
    - The lead wire will be damaged, leading to failure and malfunction.
    - Damage to the connector, cover or internal components may result, causing failure or malfunction.
  - Avoid repeatedly bending, stretching or applying a heavy object or force to the lead wire.
    - Repetitive bending stress or tensile stress can cause the sheath of the wire to peel off, or breakage of the wire.
    - If the lead wire can move, fix it near the body of the product.
    - The recommended bend radius of the lead wire is 6 times the outside diameter of the sheath, or 33 times the outside diameter of the insulation material, whichever is larger.
    - Replace the damaged lead wire with a new one.
  - Wire correctly.
    - Incorrect wiring can cause malfunction or damage the product.
  - Do not perform wiring while the power is on.
    - Otherwise damage to the internal components may result, causing malfunction.
  - Do not route wires and cables together with power or high voltage cables.
    - Route the wires of the product separately from power or high voltage cables to prevent noise and surge from entering the product.
  - Confirm proper insulation of wiring.
    - Poor insulation (interference with other circuits, poor insulation between terminals etc.) can apply excessive voltage or current to the product causing damage.
  - Design the system to prevent reverse current when the product is performing an operational check.
    - Depending on the circuit used, which can cause malfunction and damage to the product.
  - Keep wiring as short as possible to prevent interference from electromagnetic noise and surge voltage.
    - Do not use a cable longer than 10 m.
    - Wire the DC (-) line (blue) as close as possible to the power supply.
  - When analogue output is used, install a noise filter (line noise filter, ferrite element, etc.) between the switch-mode power supply and the product.

## Operating environment

- Do not use the product in an environment where the product is constantly exposed to water splashes.  
Otherwise failure or malfunction can result. Take measures such as using a cover.
- Do not use in an environment where the product could be exposed to corrosive gas or liquids.  
Otherwise damage to the internal parts can result, causing malfunction.
- Do not use the product in a place where the product could be splashed by oil or chemicals.  
If the product is to be used in an environment containing oils or chemicals such as oily coolant or cleaning solvent, even for a short time, it may be adversely affected (damage, malfunction, or hardening of the lead wires).
- Do not use the product with a corrosive fluid or a fluid with an electric conductivity of less than 5 $\mu$ S/cm.  
Do not use the product with a fluid which may corrode the fluid contact part or a fluid with a low electric conductivity, such as pure water or oil.
- Make sure that foreign matter is not allowed in the detection passage.  
If a large amount of insulating substances are adhered to the passage, incorrect detection may occur.  
If electrically conductive substances are adhered to the internal surface of the detection passage, it may lead to incorrect detection.
- Do not use in an area where surges are generated.  
When there are machines or equipment that generate large surges near the product (magnetic type lifter, high frequency inductive furnace, motor, etc.), this can result in deterioration and damage of the internal elements. Take measures against the surge sources, and prevent the lines from coming into close contact.
- Do not use a load which generates surge voltage.  
When a surge-generating load such as a relay or solenoid is directly driven, use the product with a surge absorbing element built-in.
- The product is CE marked, but not immune to lightning strikes. Take measures against lightning strikes in the system.
- Mount the product in a location that is not affected by vibration or impact.  
Failure or malfunction may result.
- Do not use the product in the presence of a magnetic field.  
Malfunction can result.
- Do not let foreign matter, such as wire debris, get inside the product.  
Failure or malfunction may result.
- Do not use the product in an environment that is exposed to temperature cycle.  
Heat cycles other than ordinary changes in temperature can adversely affect the internal components of the product.
- Do not expose the product to direct sunlight.  
If using in a location directly exposed to sunlight, protect the product from the sunlight.  
Failure or malfunction may result.
- Keep within the specified operating fluid temperature range and operating temperature range.  
The operating fluid temperature range is 0 to 85 °C, and operating temperature range is 0 to 50°C.  
If the fluid freezes, it may cause damage and malfunction of the product.  
Protection against freezing is necessary.  
If the temperature of the fluid is lower than the ambient temperature, condensation will be generated which may damage the product or cause malfunction.  
Avoid abrupt temperature changes even within the specified temperature range.  
Failure or malfunction may result.
- Do not use close to a heat source, or in a location exposed to radiant heat.  
The heat may cause operation failure.

\* Adjustment and Operation

- Check the load status before turning the power supply on.
- Do not short-circuit the load.
  - Over current may lead to the damage of the product.
- Supply the power when there is no flow.
- There will be a drift on the analogue output for 5 minutes after the power supply is turned on.
- The product doesn't produce and output signal for 3 seconds after the power is supplied.

\* Maintenance

- Confirm safety by turning off the power supply and stopping the flow before performing maintenance.
  - There is a risk of unexpected malfunction.
- Perform regular maintenance and inspections.
  - There is a risk of unexpected failure of components due to the malfunction of equipment and machinery.
- Do not use solvents such as benzene, thinner etc. to clean the product.
  - This may damage the surface of the body or 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.

# Model Indication and How to Order

LFE □ □ □ □ □ Z

Rated flow range

Symbol	Content
1	0.5~ 20L/min
2	2.5~100L/min
3	5~200L/min

Isolation Specifications

Symbol	OUT2
Nil	Not isolated
Z	Isolated

Output Specifications

Symbol	OUT2
J	Analogue 1 to 5V
K	Analogue 4 to 20mA

Options

Symbol	Lead wire and M12 connector	Bracket
Nil	Yes	-
1	-	-
2	Yes	Yes
3	-	Yes

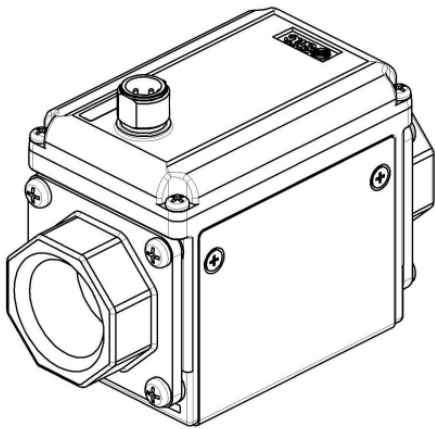
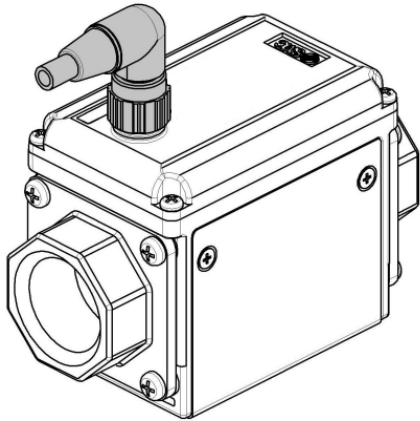
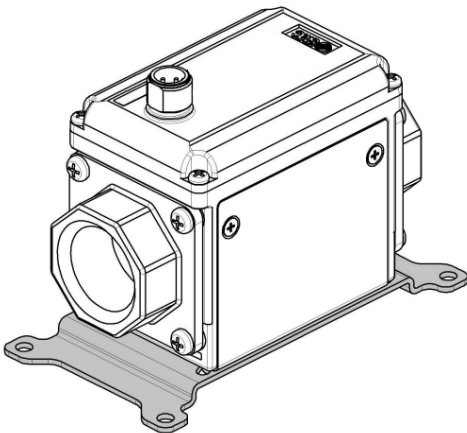
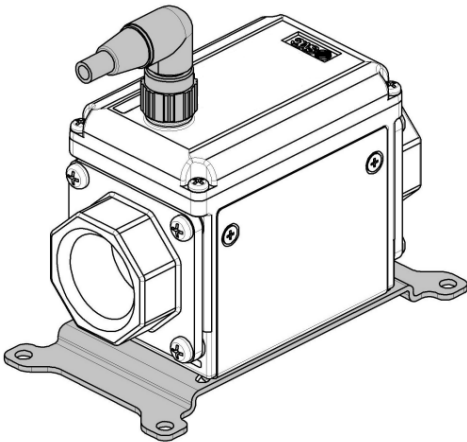
Port size

Symbol	Port size	Rated flow range		
		1	2	3
3	3/8	Yes	-	-
4	1/2	Yes	-	-
6	3/4	-	Yes	-
8	1	-	-	Yes

Thread type

Symbol	Content
Nil	Rc
N	NPT
F	G

### Combination of options

Options available		Without Lead wire and M12 connector	With Lead wire and M12 connector
Bracket	No		
	Yes		

### Accessories/ Part number

If an accessory is required, order using the following part number.

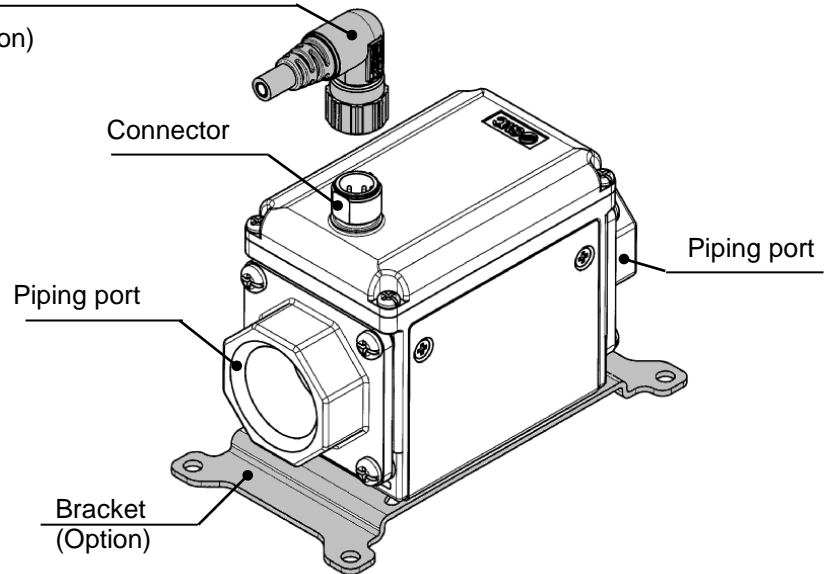
Option	Part No.	Remarks	Weight
Lead wire and M12 connector	LFE-1-A3	Lead wire length: 3 m	Approx. 175 g
Bracket	LFE-1-D	Tapping screw 3 x 10, 4 pcs.	Approx. 45 g
	LFE-2-D	Tapping screw 3 x 10, 4 pcs.	Approx. 70 g
	LFE-3-D	Tapping screw 3 x 10, 4 pcs.	Approx. 70 g

## Summary of Product Parts

### Body

Lead wire and M12 connector (4 pins)

(Option)



Description	Function
Connector	The part to which "Lead wire and M12 connector" are connected.
Lead wire and M12 connector	This is a cable that supplies power to the product and receives output.
Piping port	For piping connections.
Bracket	This is a mounting bracket used to install the product.

■ Definition and terminology

	Term	Meaning
A	Analogue output	Outputs a value proportional to the flow rate. When the analogue output is in the range 1 to 5V, it will vary between 1 to 5V according to the rate of flow. The same for analogue output of 4 to -20 mA.
	Applicable fluids	The fluid(s) that the product can measure.
	Attachment	The metal part of both sides of the product to which piping is connected.
C	Cavitation	A phenomenon that may occur in a fluid moving at high speed. In the parts of the fluid where the pressure is low, vapor bubbles form and then rapidly collapse.
E	Electric conductivity	The electric conductivity is a ratio which shows how easily the electricity flows. The unit is [S/cm] (siemens/centimeter). The lower the electric conductivity, the more difficult the electricity flows in the fluid. On the contrary, the higher the electric conductivity, the easier the electricity flows in the fluid. Conductivity of tap water is 100 to 200 $\mu$ S/cm.
F	F.S. (full span / full scale)	This means "full span" or "full scale", and indicates maximum variation width at rated value. For example, when analogue output is 1 to 5 V, F.S.=5[V] – 1[V]=4[V]. (Reference: 1%F.S. = 4[V] $\times$ 1% = 0.04[V])
	Fluid contact part	A part that comes into physical contact with the fluid.
I	Instantaneous flow	The flow passing per unit of time. If it is 10 L/min, there is a flow of 10 L passing through the device in 1 minute.
	Internal voltage drop	Voltage reduction across an internal device when the switch output is in the ON condition.
O	Operating fluid temperature	Range of fluid temperature that can be used by the product.
	Operating pressure range	The pressure range in which the product can be used.
	Operating temperature range	Ambient temperature range in which the product can operate.
P	Pressure characteristics	Indicates the change in the display value and analogue output when fluid pressure changes.
	Proof pressure	Pressure limit that if exceeded will result in mechanical and/or electrical damage to the product.
R	Rated flow range	The flow range within which the product will meet all published specifications.
	Rated pressure range	The pressure range that satisfies the specifications.
	Repeatability	Reproducibility of the display or analogue output value, when the measured quantity is repeatedly increased and decreased.
	Response time	The delay time until the set value reaches 63% in relation to the step input.
T	Temperature characteristics	Indicates the change in the display value and analogue output caused by ambient temperature or fluid temperature changes.
W	Water hammer	Water hammer or impact pressure is a pressure surge due to pressure spread when a fluid in motion is forced to stop or change direction when equipment such as valve, is opened/closed.

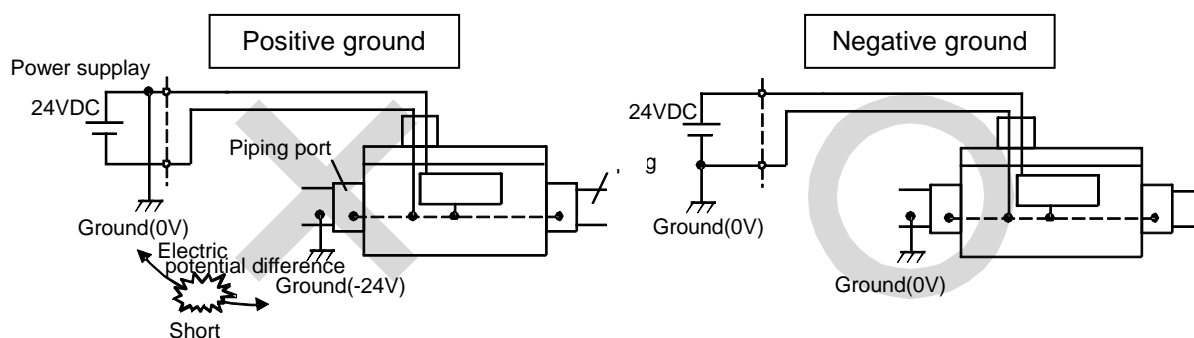
# Mounting and Installation

## Installation

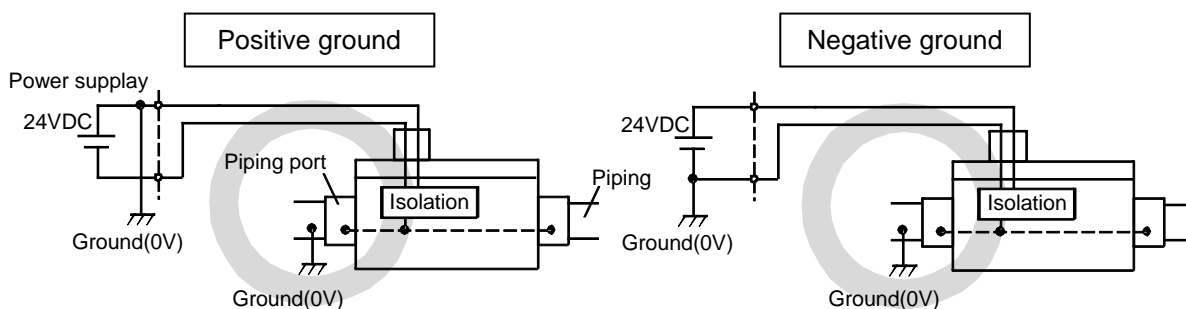
- Be sure to use the product within the specified operating pressure and temperature range.
- Proof pressure is 2MPa.  
Proof pressure depends on fluid temperature. Refer to the chart of the operating pressure range (page 28).

## Mounting

- Never mount the switch in a place that will be used as a scaffold.
- 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 (page 26) and the straight inlet pipe length effect on accuracy (page 27), to determine inlet piping requirements.
- Do not suddenly reduce the piping diameter.
- In the non-isolated type, the piping port is connected to the negative terminal of the power supply, and this product is usable in the negative ground system only. The positive ground system is not accepted.
- In the isolated type, the piping port is isolated from the power supply, and this product is usable in wiring connections from the negative and positive ground systems.



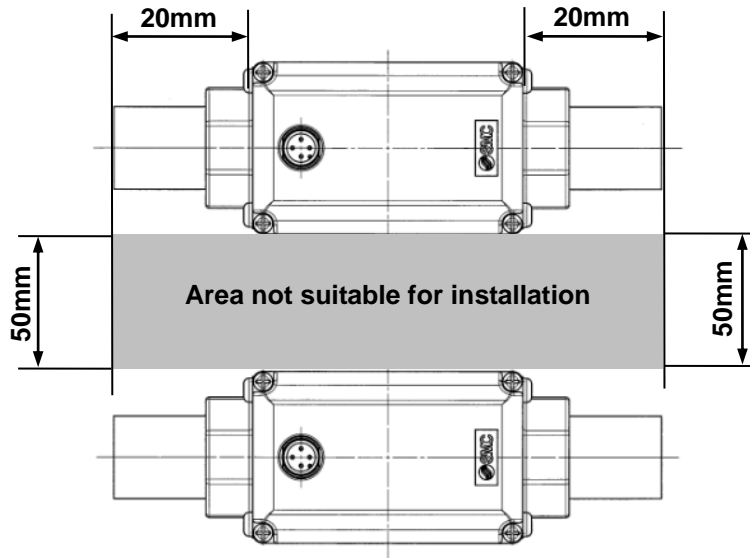
Ground connection and wiring method for the non-isolated type (LFE□)



Ground connection and wiring method for the isolated type (LFE□Z)



- When multiple sensors are used in parallel, install them at a distance as shown below.  
When multiple sensors are mounted in parallel within the area not suitable for installation, the detected flow rate may fluctuate.



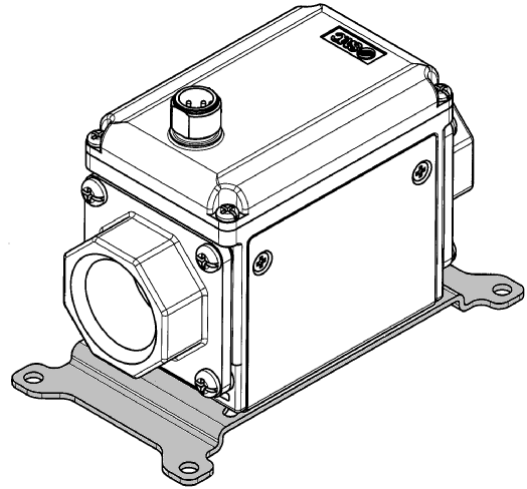
## ■ Installation

### Bracket mounting

Fix the bracket using the mounting screws (Equivalent to M4: 4 pcs.).

Bracket thickness is approx. 1.6mm

Refer to the dimensions (page 30) for mounting hole sizes.



### Direct mounting

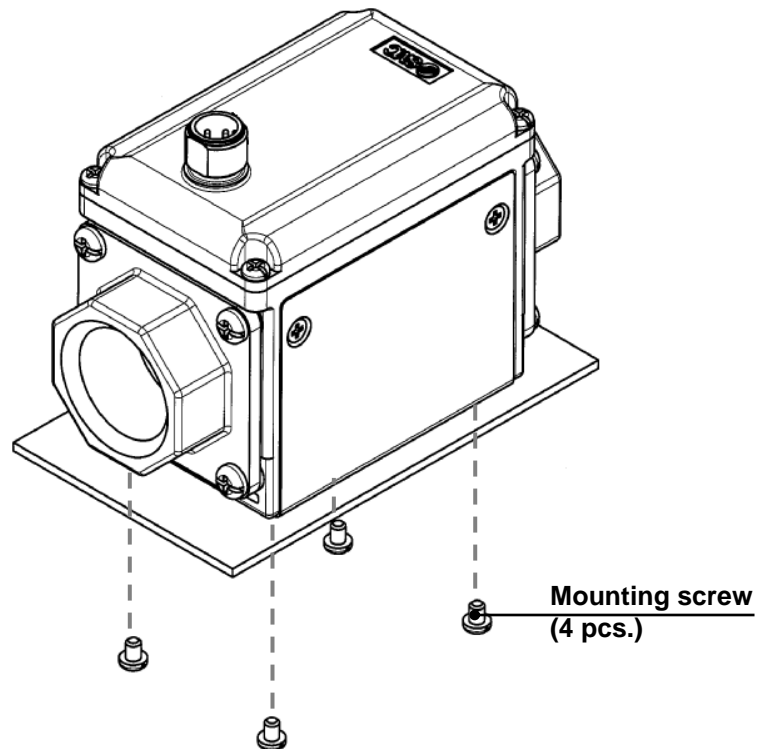
Mount the product with the screw stated below.

Thread type	Nominal thread size	Tightening torque
Tapping screw	3	0.7 to 0.8 Nm

Refer to the dimensions (page 30) for the diameter and depth of the mounting screw holes.

If you are installing directly, choose the self tapping screw in depth is to 8mm.

The self tapping screws cannot be reused.



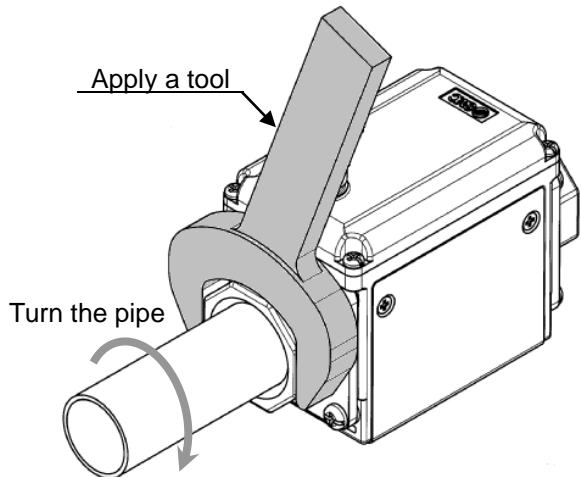
■ Piping Method

When connecting the piping to the product, do not rotate the switch. Apply a spanner to the metal part of the piping port to turn the fitting.”

Using a spanner on other parts may damage the product.

Specifically, make sure that the spanner does not damage the M12 connector.

This will damage the connector.



Width across flats of attachment

Port size	Width across flats
3/8	24 mm
1/2	28 mm
3/4	35 mm
1	41 mm

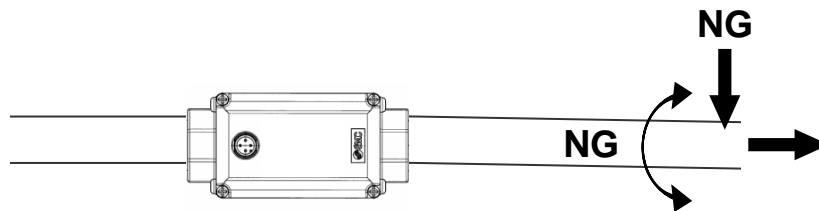
Ensure that the piping is tightened to the required torque.

The tightening torque for connection threads is shown in the table below.

Nominal thread size	Appropriate 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

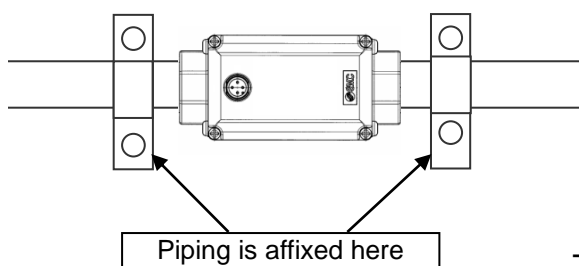
If the tightening torque is exceeded, the product can be damaged. If the tightening torque is insufficient, the piping may become loose.

The product body is made of resin. Do not apply direct stress, vibration or impact during piping to avoid malfunction, damage or water leakage. Never mount the product in a location that will be used as a scaffold.

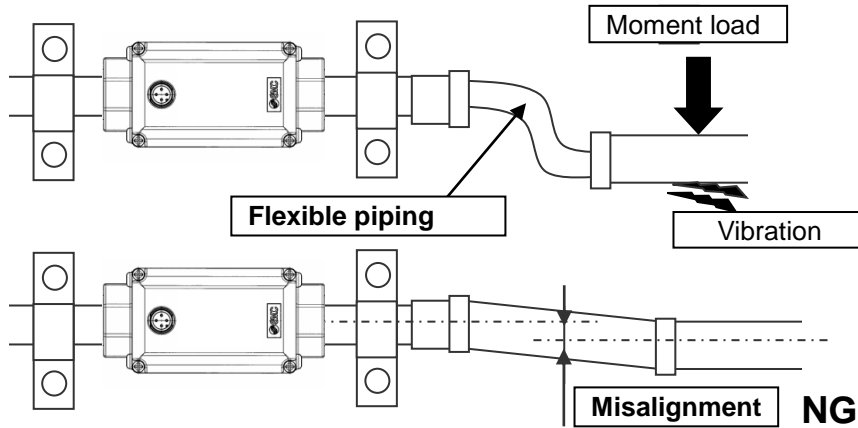


Affix the piping as close to the product as possible (both before and after the product) to avoid direct stress, vibration or impact.

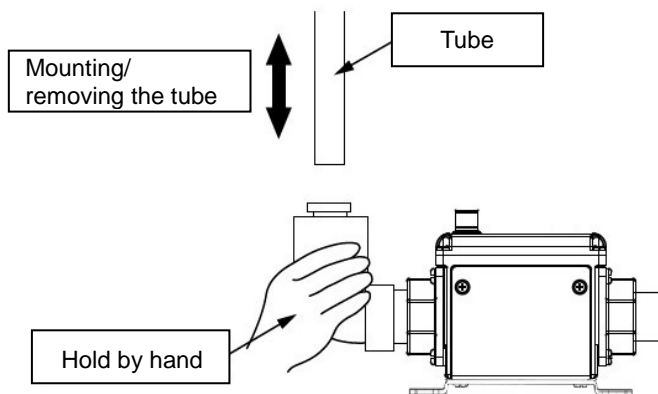
If the stress, vibration or impact cannot be reduced, affix the product at multiple locations.



Non-flexible piping materials such as steel piping will be subject to excessive moment load, vibration and impact from the piping side, so use a flexible tube for intermediate connection. Misaligned piping may apply long-term load after piping, causing malfunction, damage, or water leakage.



If one-touch fitting is used, hold the fitting by hand so that the load for mounting and removing the tube will not be applied to the product.



The IN side straight piping length shall be a minimum of 5 times (5D) the piping size to achieve a stable measurement.

For details, refer to straight piping length and accuracy (page 27).

Avoid any sealing tape getting inside the piping.

Ensure that there is no leakage from loose piping.

■ Wiring

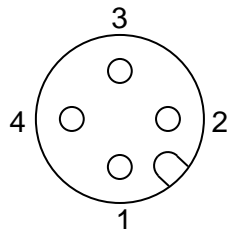
**Connector**

Attaching/detaching of the connector should be done while the power supply is turned off. Power lines and high-voltage lines can cause noise. Keep the wiring away from them.

Otherwise, malfunction may result due to noise.

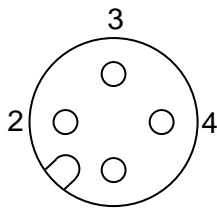
Ensure that the FG terminal is connected to ground when using a commercially available switch-mode power supply.

If you have problems with the switch-mode power supply, consider using a noise filter.

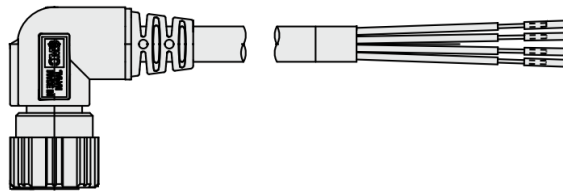


Connector on the body  
Connector pin numbers  
(male connector)

No.	Pin description
1	DC(+)
2	OUT2
3	DC (-)
4	OUT1



Cable connector  
Connector pin numbers  
(female connector)

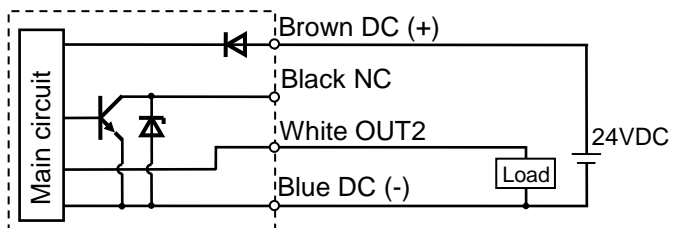


No.	Pin description	Wire color
1	DC (+)	Brown
2	OUT2	White
3	DC (-)	Blue
4	OUT1	Black

\*: When using the lead wire and M12 connector included with the LFE series.

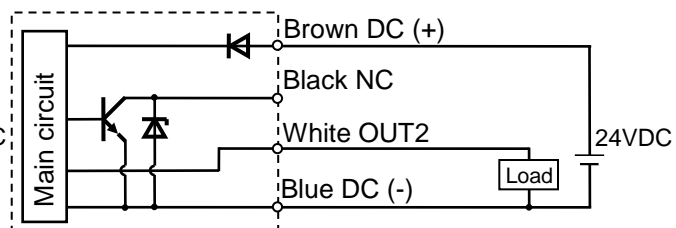
## Internal Circuit and Wiring examples

Analogue voltage output type  
LFE□J□□□(Z)



Analogue output 1 to 5 V  
Output impedance 1kΩ

Analogue current output type  
LFE□K□□□(Z)



Analogue output 4 to 20mA  
Load impedance 50 to 600 Ω

In the isolated type, the output section has been isolated from the main circuit.

## Maintenance and Inspection

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

The settings for the product are retained in memory prior to the power loss or de-energizing of the product. The output condition is also recoverable to that prior to the power loss or de-energizing. However, this may change depending on the operating environment. Therefore, check the safety of the whole installation before operating the product.

## Troubleshooting

Applicable products: LFE series

If an operation failure occurs with the product, use the chart below to find out the cause of problem.

If a cause applicable to the failure cannot be identified and normal operation can be recovered by replacement with a new product, this indicates that the product itself was faulty. The damage to the product may have been caused by operating environment (installation location, etc.). Consult with SMC separately to obtain countermeasures.

### Troubleshooting list

Fault	Detail	Possible cause	Item to check / Recommended action
Output signal abnormal	No output	Incorrect wiring / Disconnection	Check to see that the brown wire DC(+), blue wire DC(-), black wire (OUT1), and white wire (OUT2) are correctly connected to the product and that there are no broken wires.
		Loose connector	Check the M12 connectors for correct engagement.
	Unstable output	Foreign matter in the sensor fluid passage	Check the fluid passage for any foreign matter. Remove foreign matter if necessary.
		Water supply shortage	Check to see if the fluid passage is completely filled with fluid.
		There are bubbles in the fluid path.	Place the piping in the correct position for helping discharge air bubbles. (See page 7.)
		Pulsation in the flow.	It is recommended to place a component to reduce pulsating flow or a tank to reduce pressure fluctuation or replace the piping with elastic tubing, such as a rubber hose.
		Installed in area not suitable for mounting.	Check the products installed close together for sufficient clearance and keep a distance of 50 mm or more between them.
		Noise	Keep the wiring route away from any power or high voltage cables which may be a source of noise.
		The piping is connected in the wrong direction	Check the mounting direction of the product. Align the direction of the mounting (flow mark) and flow.
		Output load is not appropriate	Check to see if a load is correctly connected, and especially for the analogue output type, check it for correct impedance.
Leakage occurs	Check the piping connections for insufficient torque or defective sealing which has caused the leakage.		



## Specifications

### ■ Specifications

Model		LFE1	LFE2	LFE3
Applicable Fluids *1		Water, Conductive fluids which do not corrode the fluid contact materials *1		
Applicable fluid conductivity *1		5 $\mu$ S/cm or more (micro Siemens/cm)		
Detecting method		Electro static capacity		
Rated flow range		0.5 to 20 L/min	2.5 to 100 L/min	5 to 200 L/min
Operating Fluid temperature *2		0 to 85°C (No condensation or freezing)		
Repeatability		Analogue output: +/-1.5%F.S.		
Temperature characteristics	Ambient temperature characteristics	+/-5%F.S. (25°C reference)		
	Fluid temperature characteristics	+/-5%F.S. (25°C reference)		
Operating pressure range *2		0 to 1 MPa		
Proof pressure *2		2 MPa		
Analogue output	Response time *3	0.5s		
	Voltage output	Output voltage: 1 to 5V Output impedance: 1k $\Omega$		
	Current output	Output current: 4 to 20 mA Max. load impedance: 600 $\Omega$		
Power supply voltage		24VDC +/-10%		
Current consumption		45mA (LFE□) / 60mA (LFE□Z) or less (Both not including output load current)		
Environmental resistance	Enclosure *4	IP65		
	Operating temperature range	0 to 50°C (No condensation or freezing)		
	Operating humidity range	Operation, Storage: 35 to 85%RH (No condensation)		
Standards and regulations		CE/UKCA marking (EMC directive, RoHS directive)		
Material of fluid contact parts		PPS, FKM, Brass		
Port size		3/8(10 A)	1/2(15 A)	3/4(20 A) 1(25 A)
Weight(Body) *5		Approx. 340 g	Approx. 400 g	Approx. 520 g Approx. 680 g

\*1: Refer to page 25 [Applicable fluids list].

\*2: When fluids with high temperature are used, the available pressure range will be reduced. (See [operating pressure range] on page 28 for details.)

\*3: The response time is when the set value reaches 63% in relation to the step input. There might be a 0.05 seconds delay at response time of 0.25s or 0.5s due to the timing of internal processing.

\*4: The enclosure rating includes the digital flow switch with a lead wire with M12 connector.

\*5: When options are used, add the weight of the option parts.

## ■ Applicable Fluids and Precautions

### Applicable fluid list

Substance description	Judgment	Remarks
Water	O	Conductivity of tap water: 100 to 200 $\mu$ S/cm
Deionized water	X	The electric conductivity is too low.
Water base coolant	O	When the ratio of water is 50% or more.
Oil	X	The electric conductivity is too low.
Oil base coolant	X	The electric conductivity is too low.
Sea water	X	Corrosive to the product.
Ethylene glycol	X	The electric conductivity is too low.
Ethanol	X	The electric conductivity is too low.
Methanol	X	The electric conductivity is too low.
Chloride water (Hypochlorous acid)	X	Corrosive to the product.

\*: The table is for reference only. O: Acceptable X: Not acceptable

(1) Operate fluids with electric conductivity of 5 $\mu$ S/cm or more.

The electric conductivity is a ratio which shows how easily the electricity flows.

Note that this product can not be used for fluids with low conductivity.

This product cannot be used for fluids that do not conduct electricity such as De-ionized water and oil.

(2) If insulating material gets stuck inside of the piping, it may cause an error.

Remove the foreign material stuck inside of the piping with a brush for washing test tubes so that internal resin piping will not be damaged.

(3) If conductive materials such as metal get stuck to the interior surface in the piping, the switch may malfunction.

Remove the foreign material as mentioned above.

(4) If stray electrical currents are flowing through the fluid to be measured, the switch may malfunction.

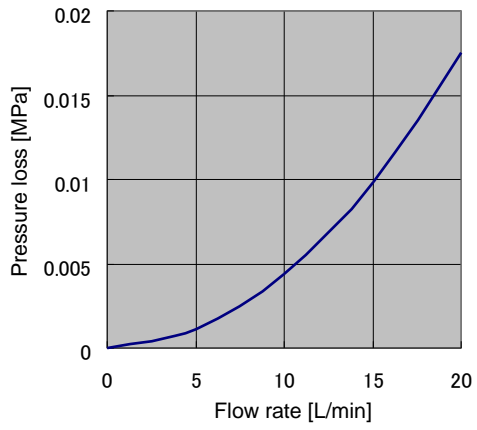
Beware that electrical leakage currents may be generated by equipment around the flow sensor such as pumps, valves and metal piping when this equipment is at different electrical potentials in relation to earth ground.

(5) Any fluid which corrodes the internal fluid contact parts cannot be used.

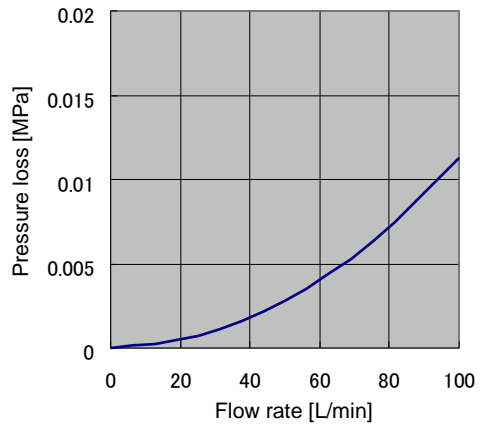
■ Characteristics Chart

**Flow rate characteristics (pressure loss)**

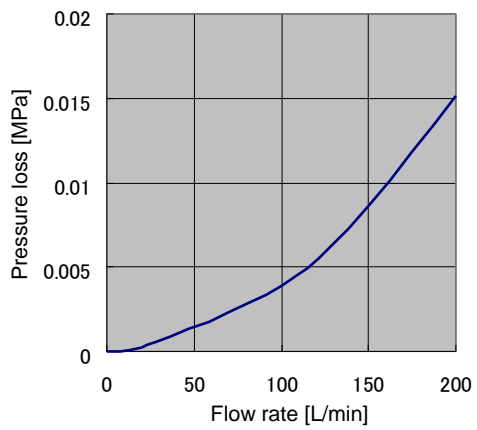
LFE1



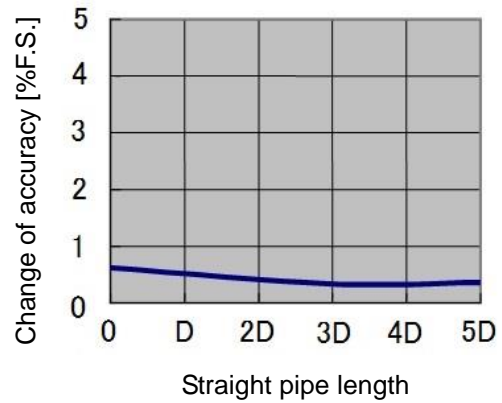
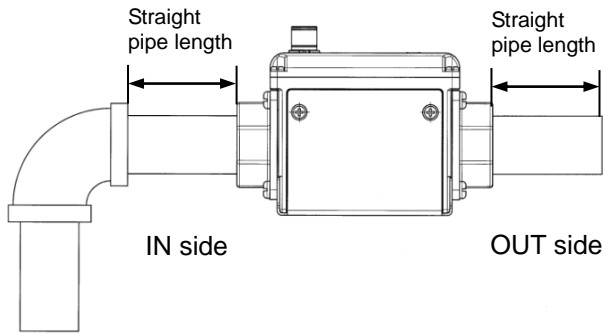
LFE2



LFE3



### Straight pipe length (reference value)



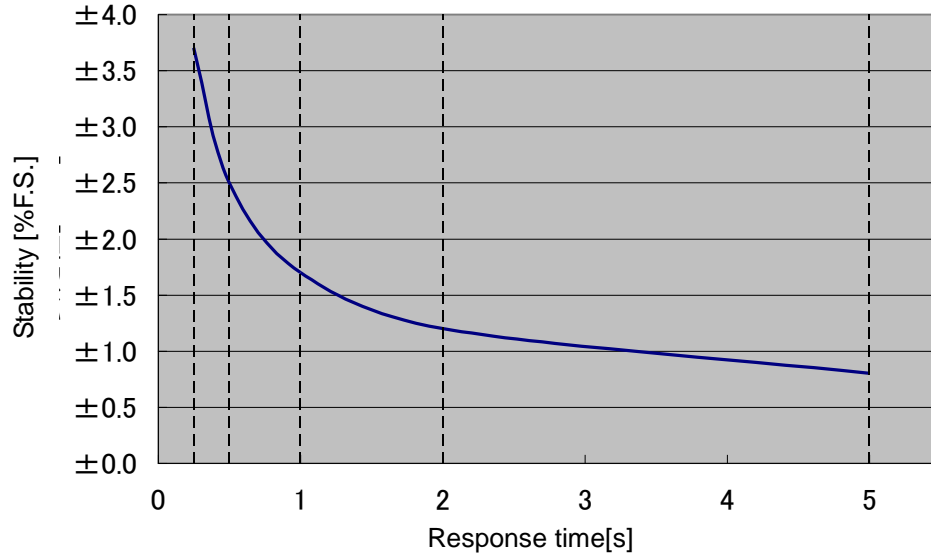
[Measurement condition]	[Port size]
Fluid: Tap water	LFE1 : 3/8 inch
Pressure: 0.2 MPa	LFE2 : 3/4 inch
	LFE3 : 1 inch

The smaller the piping size, the more the product is affected by the straight piping length. The straight piping length shall be 5 times (5D) or more of the piping size to satisfy and achieve the stable measurement.

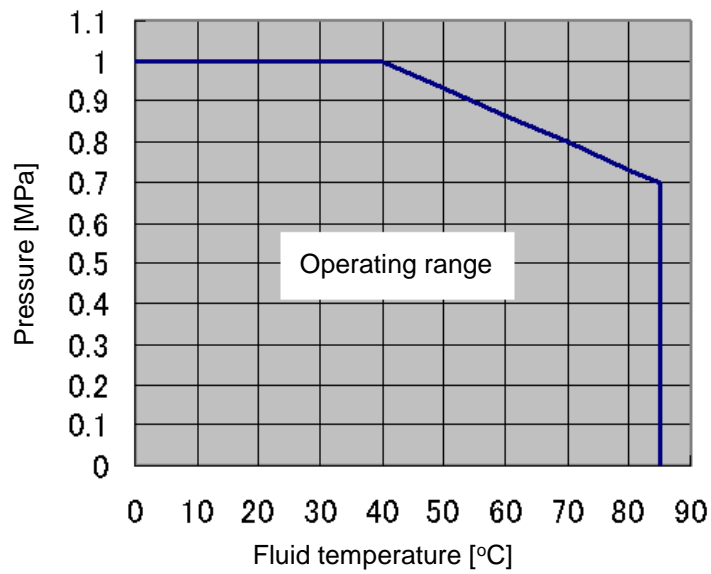
Model	Straight pipe length (mm)	
	D	5 D
LFE1	11	55
LFE2	21	105
LFE3	27	135

### ■ Stability

Fluctuation of the display and the analogue output can be reduced by lengthening the response time setting.



### ■ Operating pressure range



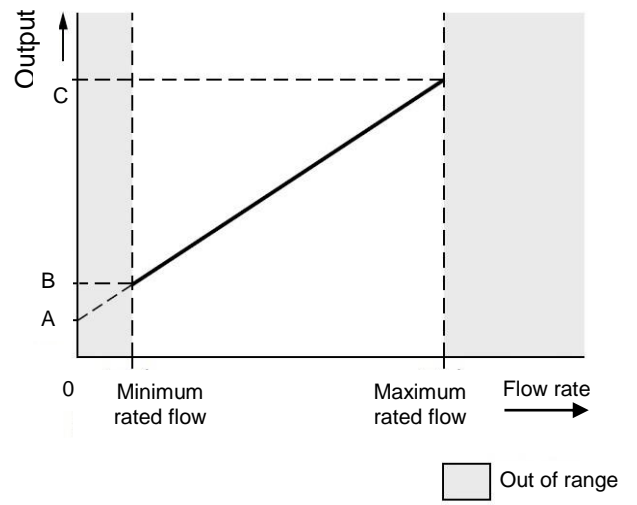
When fluids with high temperature are used, the operating pressure range will be reduced. Operate within the range mentioned above. The proof pressure is double the operating pressure range.

■ Analogue output

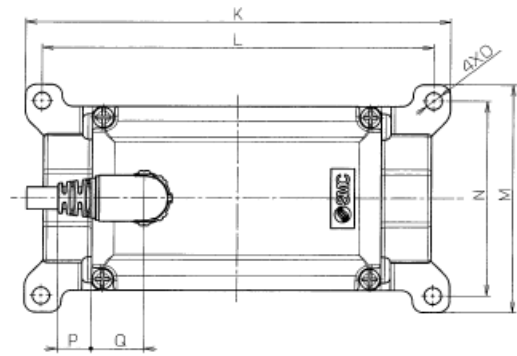
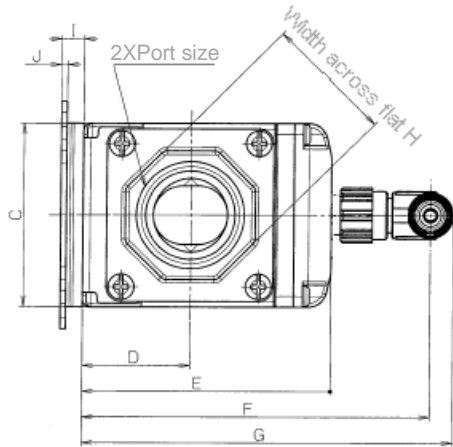
**Flow/Analogue output**

	A	B	C
Voltage output	1 V	1.1 V	5 V
Current output	4 mA	4.4 mA	20 mA

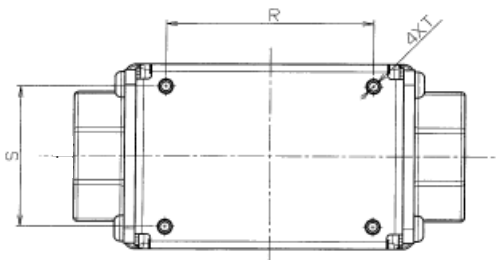
Model	Rated flow [L/min]	
	Minimum	Maximum
LFE1	0.5	20
LFE2	2.5	100
LFE3	5	200



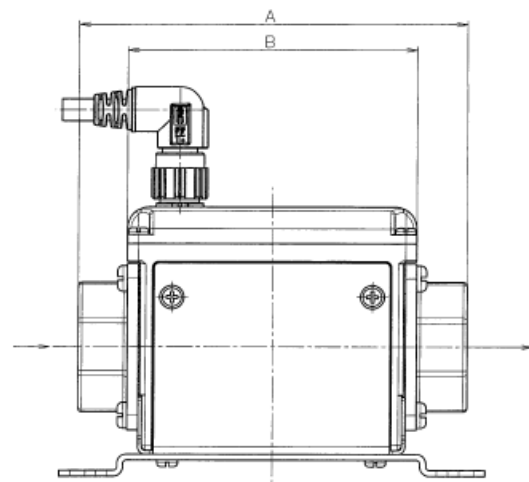
■ Dimensions



Note) The electrical entry for lead wire with M12 connector does not rotate and is limited to only one entry direction.



Without bracket (Bottom view)



Bracket thickness is approx. 1.6mm

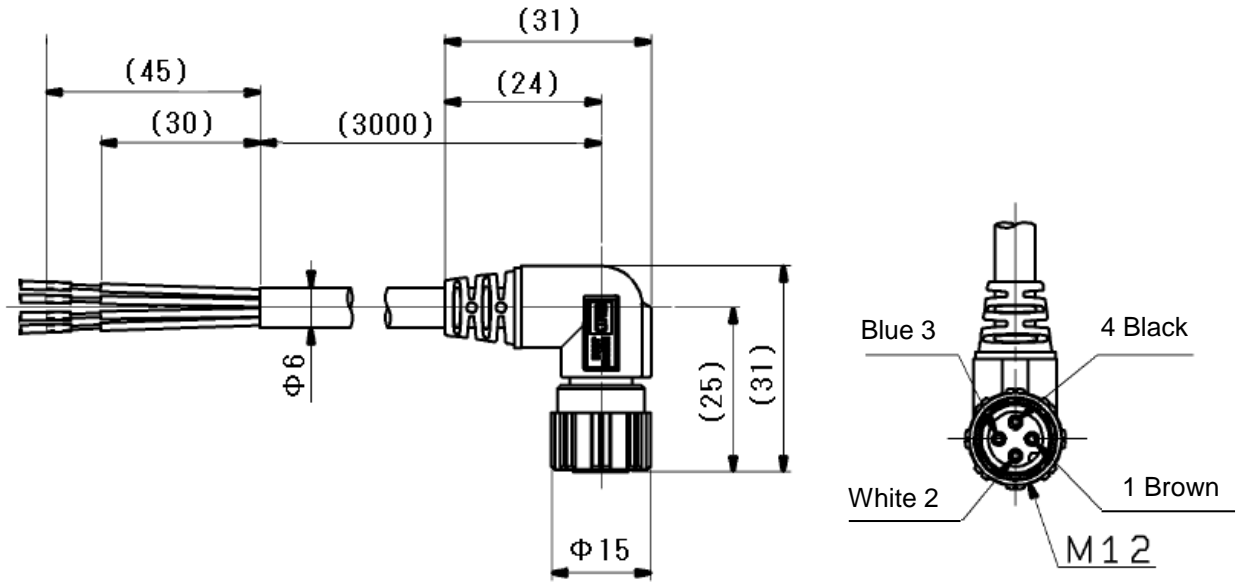
Model	Piping port size	A	B	C	D	E	F	G	H	I	J	K	L
LFE1□3□□(Z)	3/8	90	73	40	23.5	56	83	89	24	6	1.6	96	87
LFE1□4□□(Z)	1/2	104	73	40	23.5	56	83	89	28	6	1.6	96	87
LFE2□6□□(Z)	3/4	105	78	50	29	67	94	100	35	6	1.6	115	106
LFE3□8□□(Z)	1	120	90	55	32	73	100	106	41	6	1.6	115	106

Model	M	N	O	P	Q	R	S	T	U	Bracket weight
LFE1□3□□(Z)	48	39	4.6	12	11.5	52	28	2.5 depth 8.5	2	Approx. 45g
LFE1□4□□(Z)	48	39	4.6	12	11.5	52	28	2.5 depth 8.5	2	Approx. 45g
LFE2□6□□(Z)	62	53	4.6	9.5	14	56	38	2.5 depth 8.5	2.6	Approx. 70g
LFE3□8□□(Z)	62	53	4.6	3.5	20	68	43	2.5 depth 8.5	2.6	Approx. 70g

NOTE) If you are installing directly, choose the self tapping screw in depth is to 8mm. Tighten the screws with a torque of 0.7 to 0.8 Nm.

■ Lead wire and M12 connector (LFE-1-A3)

Dimensions



Cable specifications

Item		Specifications
Conductor	Nominal cross section	AWG21
	Outside diameter	Approx. 0.9 mm
Insulator	Material	Lead free heat resistant PVC
	Outside diameter	Approx. 1.7 mm
	Colours	Brown, White, Black, Blue
Sheath	Material	Lead free heat and oil resistant PVC
Finished outside diameter		ø6



Revision

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