3-Color Display

Electromagnetic Digital Flow Switch

CE RoHS IP65

Compact

Actual size
(LFE1)

Weight: 340 g (LFE1□3)

Pressure loss: 0.02 MPa or less

Applicable fluids:
Water, Water-soluble coolant

Current consumption: 45 mA
Reduced by up to **10%** when the display is off

Operating fluid temperature: 0 to 85°C

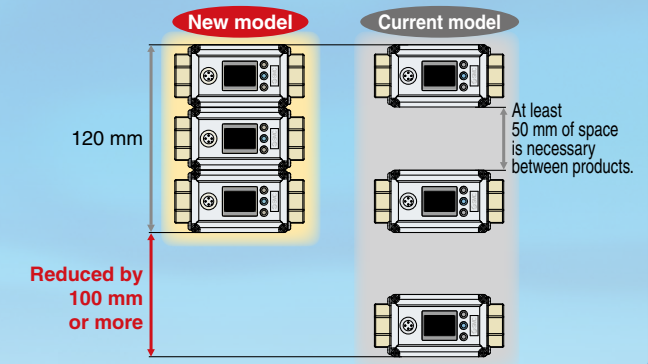
New Close proximity setting allows for space saving. (p. 16)

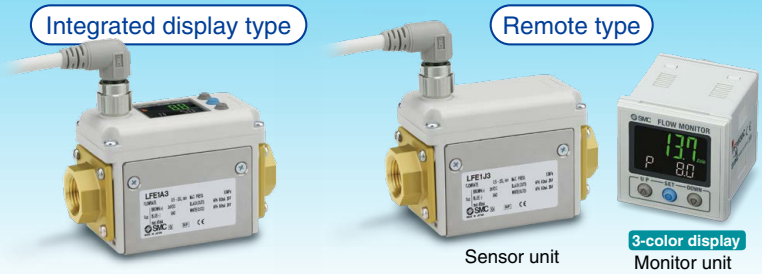
- Fluctuation of the displayed value can be reduced when the close proximity setting function is used.
- Reduced setting time

Simple setting can be made in the close proximity setting mode.

* Integrated display type only
Not available for the remote type

* For 3 LFE1 flow switches





Variations

Integrated display type/ Remote type	Flow range: 0.5 L/min, 2 L/min, 5 L/min, 10 L/min, 20 L/min, 50 L/min, 100 L/min, 200 L/min
LFE1	Rated flow range; Display flow range
LFE2	Rated flow range; Display flow range
LFE3	Display flow range; Rated flow range

New Piping connection parts: Stainless steel 304 (p. 17)

LFE□ Series

SMC

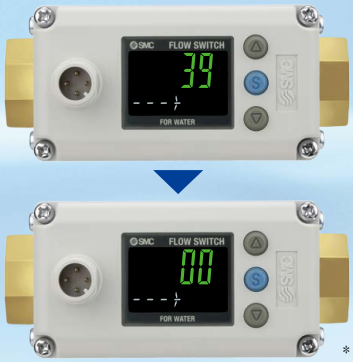
CAT.ES100-107C

Reverse flow can be detected.

Reverse flow error display

New A zero-reset setting is available.

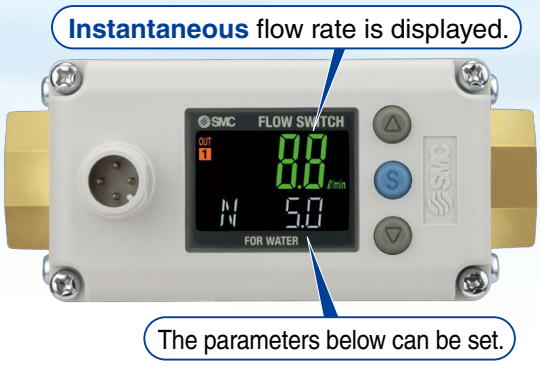
The display can be adjusted to zero.



＊ Integrated display type only

Repeatability: ±1.5 % F.S. (Analog output)

3-color/2-screen display

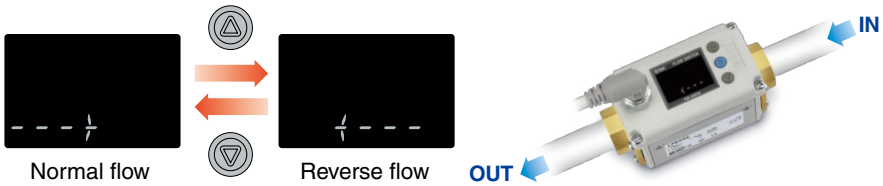


- Set value
- Flow direction
- Accumulated value
- Line name
- Peak/Bottom value

Flow direction can be changed after installation.

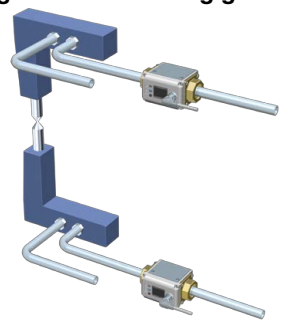
Default flow direction (Normal flow)

Flow direction can be changed after installation.

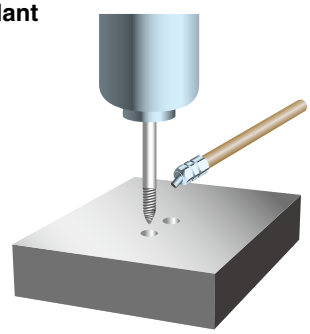


Application Examples

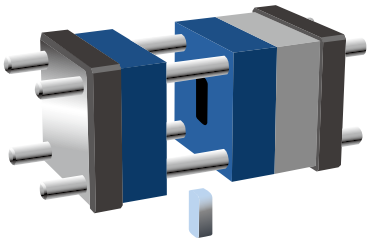
Flow control for pressurized cooling water for welding guns



Flow control for water-soluble coolant



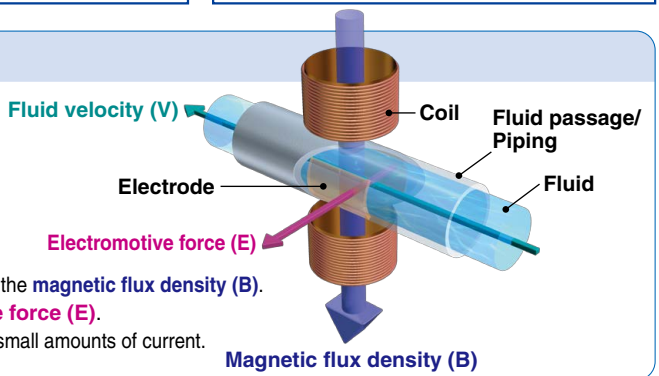
Flow control for cooling water for metal molds



Principle

Faraday's law of induction

Measure the volume flow of inductive liquids by applying Faraday's law of induction: "when a conductive object is moved through a magnetic field, an electromotive force will be generated."



The electromotive force (E) is proportional to the **fluid velocity (V)** multiplied by the **magnetic flux density (B)**.
The volume flow is calculated by converting the measured **electromotive force (E)**.
An oval fluid passage is used to improve the **magnetic flux density** generated by small amounts of current.

Flow Switch for Fluid Variations

Series	Applicable fluid	Detection method	Smallest settable increment	Enclosure*1	Display	Rated flow range [L/min]
LFE 	Water, Water-soluble coolant	Electro-magnetic	0.1 L/min	IP65	3-color display	0.5 – 20
			0.5 L/min			2.5 – 100
			1 L/min			5 – 200
PF3W 	Water, Ethylene glycol aqueous solution	Karman vortex	0.01 L/min	IP65	3-color display	0.5 – 4
			0.1 L/min			2 – 16
			0.1 L/min			5 – 40
			1 L/min			10 – 100
			2 L/min			50 – 250
PVC piping type 	Water, Ethylene glycol aqueous solution	Karman vortex	1 L/min	IP65	3-color display	10 – 100
			2 L/min			30 – 250
PF2D 	Deionized water (pure water), Liquids which do not corrode nor erode fluoropolymer	Karman vortex	0.05 L/min	IP65	1-color display	0.4 – 4
			0.1 L/min			1.8 – 20
			0.5 L/min			4 – 40

*1 For the remote type monitor unit, only the front side is IP65 compliant. The other parts are IP40 compliant.

CONTENTS

3-Color Display

Electromagnetic Digital Flow Switch

LFE Series

Integrated display type

Remote type sensor unit

Remote type monitor unit

(For details, refer to p. 10.)

How to Order

Output specifications

Symbol	OUT
J	Analog 1 to 5 V
K	Analog 4 to 20 mA

∗ When using this switch in combination with an LFE0, select output specification J.

Remote type sensor unit **LFE 1 J 3 □ □ – □**

Integrated display type **LFE 1 A 3 □ □ – □**

Rated flow range

Symbol	Rated flow range
1	0.5 to 20 L/min
2	2.5 to 100 L/min
3	5 to 200 L/min

Made to Order (Refer to p. 17.)

Symbol	Description
X8	Piping connection parts: Stainless steel 304

Output specifications

Symbol	OUT1	OUT2
A	NPN	NPN
B	PNP	PNP
C	NPN	Analog 1 to 5 V
D	NPN	Analog 4 to 20 mA

Option

Symbol	Lead wire and M12 connector (Length 3 m)	Bracket	Display unit
Nil	●	—	L/min
1	—	—	L/min
2	●	●	L/min
3	—	●	L/min
4∗1∗2	●	—	gal/min
5∗1∗2	—	—	gal/min
6∗1∗2	●	●	gal/min
7∗1∗2	—	●	gal/min

∗1 Options 4, 5, 6, and 7, which are not in SI units, are not for use in Japan due to the New Measurement Law.

∗2 Options 4, 5, 6, and 7 cannot be selected when the output specification is J or K.

Reference: 1 [L/min] = 0.2642 [gal/min]

1 [gal/min] = 3.785 [L/min]

Port size

Symbol	Port size	Applicable model		
		LFE1	**LFE2**	**LFE3**
3	3/8	●	—	—
4	1/2	●	—	—
6	3/4	—	●	—
8	1	—	—	●

Thread type

Symbol	Type
Nil	Rc
N	NPT
F	G

The close proximity setting and zero-reset setting functions are only available for the integrated display type.
For the remote type sensor unit, the close proximity setting and zero-reset setting functions cannot be used.

Option/Part No.

When only optional parts are required, order with the part numbers listed below.

Option	Part no.	Note	Weight
Lead wire and M12 connector	**LFE-1-A3**	Lead wire length 3 m	Approx. 175 g

Option	Part no.	Note	Weight
Bracket	**LFE-1-D**	Tapping screw for LFE1 (3 x 10), 4 pcs.	Approx. 45 g
	LFE-2-D	Tapping screw for LFE2 (3 x 10), 4 pcs.	Approx. 70 g
	LFE-3-D	Tapping screw for LFE3 (3 x 10), 4 pcs.	Approx. 70 g

For the flow switch precautions, refer to the Operation Manual on the SMC website. Click here for details.

Specifications (Integrated Display Type)

Model		LFE1		LFE2	LFE3
Applicable fluid∗1		Water, Conductive fluids which do not corrode the fluid contact materials.∗1			
Applicable fluid conductivity∗1		5 μS/cm or more (micro siemens)			
Detection method		Electrostatic capacity			
Ground∗10		Negative ground			
Rated flow range∗11		0.5 to 20 L/min		2.5 to 100 L/min	5 to 200 L/min
Display flow range		0.4 to 24.0 L/min		2.0 to 120.0 L/min	4 to 240 L/min
Set flow range		0.4 to 24.0 L/min		2.0 to 120.0 L/min	4 to 240 L/min
Zero-cut flow∗2		0.4 L/min		2.0 L/min	4 L/min
Smallest settable increment		0.1 L/min		0.5 L/min	1 L/min
Accumulated volume per pulse (Pulse width: 50 ms)		0.1 L/pulse		0.5 L/pulse	1 L/pulse
Operating fluid temperature ∗3		0 to 85°C (with no freezing and condensation)			
Display units		Instantaneous flow rate L/min, Accumulated flow L			
Repeatability		Displayed values: ±2% F.S. Analog output: ±1.5% F.S.			
Temperature characteristics	**Ambient temperature**	±5% F.S. (25°C reference)			
	Fluid temperature	±5% F.S. (25°C reference)			
Operating pressure range∗3		0 to 1 MPa			
Proof pressure∗3		2 MPa			
Accumulated flow range∗4		99999999.9 L		999999999 L	
		by 0.1 L		by 1 L	
Switch output		NPN or PNP open collector output			
	Maximum load current	80 mA			
	Maximum applied voltage	28 VDC			
	Internal voltage drop	NPN: 1 V or less (at load current of 80 mA) PNP: 1.5 V or less (at load current of 80 mA)			
	Response time∗5∗7	0.25 s/0.5 s/1 s/2 s/5 s			
	Output protection	Short-circuit protection			
	Output mode	Select from hysteresis mode, window comparator mode, accumulated output mode, or accumulated pulse output mode.			
Analog output	**Response time**∗6∗7	0.25 s/0.5 s/1 s/2 s/5 s			
	Voltage output	Output voltage: 1 to 5 V Output impedance: 1 kΩ			
	Current output	Output current: 4 to 20 mA Max. load impedance: 600 Ω			
Hysteresis		Variable			
Display method		2-screen (Main screen: 4-digit, 7-segment, 2-color, Red/Green; Sub screen: 6-digit, 11-segment, White) Display values updated 5 times per second			
Status LED's		Output 1, Output 2: Orange			
Power supply voltage		24 VDC ±10%			
Current consumption		45 mA or less (Load current is not included.)			
Environmental resistance	**Enclosure**∗9	IP65			
	Operating temperature range	0 to 50°C (with no freezing and condensation)			
	Operating humidity range	Operating, Storage: 35 to 85% R.H. (with no condensation)			
Standards and regulations		CE marking, RoHS			
Fluid contact materials		PPS, FKM, Brass			
Port size		3/8 (10A)	1/2 (15A)	3/4 (20A)	1 (25A)
Weight (Body)∗8		Approx. 340 g	Approx. 400 g	Approx. 520 g	Approx. 680 g

∗1 Refer to the Applicable Fluids List on p. 20.
∗2 0 L/min is displayed when the flow is less than zero-cut flow.
∗3 When fluids with high temperature are used, the operating pressure range and proof pressure will be reduced. (For details, refer to the Operating Pressure Range on p. 6.)
∗4 Cleared when the power supply is turned off. Hold function can be selected. (Interval of 2 or 5 minutes can be selected.) If the 5 minutes interval is selected, the life of the memory element (electronic parts) is limited to 1 million times. (If energized for 24 hours, life is calculated as 5 minutes x 1 million = 5 million minutes = about 9.5 years.) Therefore, if using the hold function, calculate the memory life for your operating conditions, and use within this life.
∗5 The response time when the set value is 63% in relation to the step input.
∗6 The response time until the set value reaches 63% in relation to the step input. There might be a 0.05 seconds delay at response time of 0.25 s or 0.5 s due to the timing of internal processing.
∗7 The stability of display and analog output is improved by increasing the response time setting. (For details, refer to the Stability on p. 6.)
∗8 When options are used, add the weight of the optional parts.
∗9 Enclosure is for digital flow switch with lead wire and M12 connector.
∗10 Piping port is grounded to DC(–)/blue line. Power supply with positive ground cannot be used. (Refer to Figure 1.)
Please consult SMC if the product is used for positive ground environment.
∗11 The rated flow range is a flow range in which the product specifications (accuracy and repeatability) of the sensor are satisfied. The correct flow value may not be indicated outside the flow range.

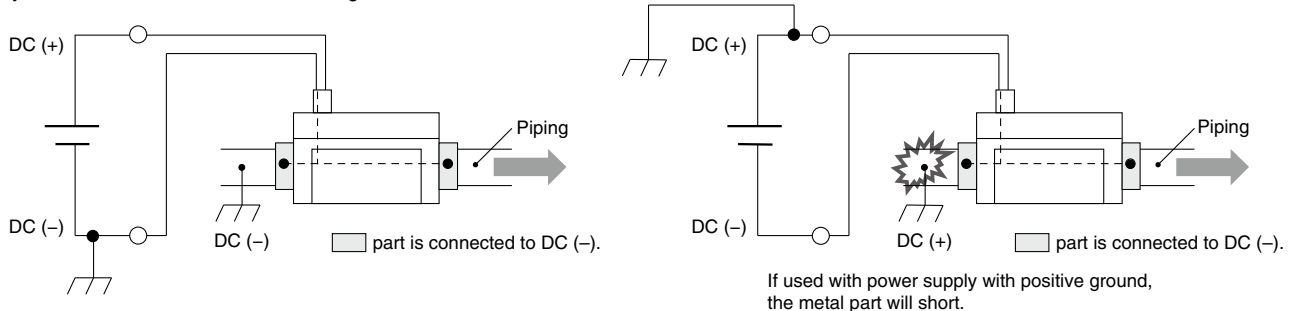


Figure 1

For the flow switch precautions, refer to the Operation Manual on the SMC website. Click here for details.

Specifications (Remote Type Sensor Unit/Body)

∗ Refer to p. 10 for the monitor unit specifications.

Model		LFE1		LFE2	LFE3
Applicable fluid∗1		Water, Conductive fluids which do not corrode the fluid contact materials.∗1			
Applicable fluid conductivity∗1		5 μS/cm or more (micro siemens)			
Detection method		Electrostatic capacity			
Ground∗5		Negative ground			
Rated flow range∗6		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 (with no freezing and condensation)			
Repeatability		Analog output: ±1.5% F.S.			
Temperature characteristics	**Ambient temperature**	±5% F.S. (25°C reference)			
	Fluid temperature	±5% F.S. (25°C reference)			
Operating pressure range∗2		0 to 1 MPa			
Proof pressure∗2		2 MPa			
Analog output	**Response time**∗3	0.5 s			
	Voltage output	Output voltage: 1 to 5 V Output impedance: 1 kΩ			
	Current output	Output current: 4 to 20 mA Max. load impedance: 600 Ω			
Power supply voltage		24 VDC ±10%			
Current consumption		42 mA or less (Load current is not included.)			
Environmental resistance	**Enclosure**	IP65			
	Operating temperature range	0 to 50°C (with no freezing and condensation)			
	Operating humidity range	Operating, Storage: 35 to 85% R.H. (with no condensation)			
Standards and regulations		CE marking, RoHS			
Fluid contact materials		PPS, FKM, Brass			
Port size		3/8 (10A)	1/2 (15A)	3/4 (20A)	1 (25A)
Weight (Body)∗4		Approx. 335 g	Approx. 395 g	Approx. 515 g	Approx. 675 g

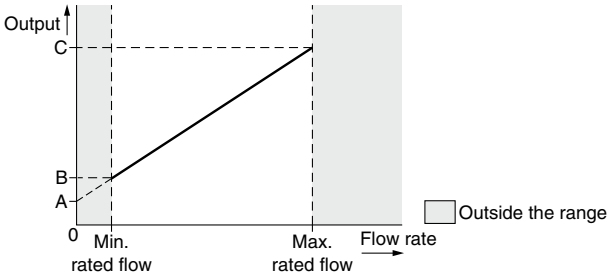
∗1 Refer to the Applicable Fluids List on p. 20.
∗2 When fluids with high temperature are used, the available pressure range will be reduced. (For details, refer to the Operating Pressure Range on p. 6.)
∗3 The response time until the set value reaches 63% in relation to the step input.
∗4 When options are used, add the weight of the optional parts.
∗5 Piping port and the metal part of the body are grounded to DC(–)/blue line. Power supply with positive ground cannot be used. Please consult SMC if the product is used for positive ground environment.
∗6 The rated flow range is a flow range in which the product specifications (accuracy and repeatability) of the sensor are satisfied. The correct flow value may not be indicated outside the flow range.

Analog Output

Flow/Analog output

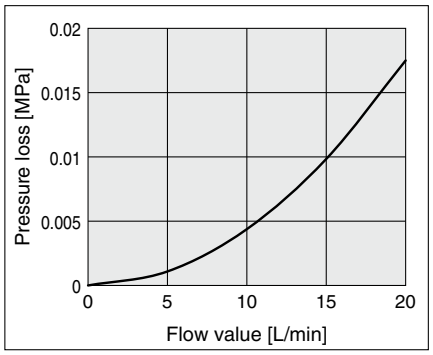
	A	B	C
Voltage output	1 V	1.1 V	5 V
Current output	4 mA	4.4 mA	20 mA

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

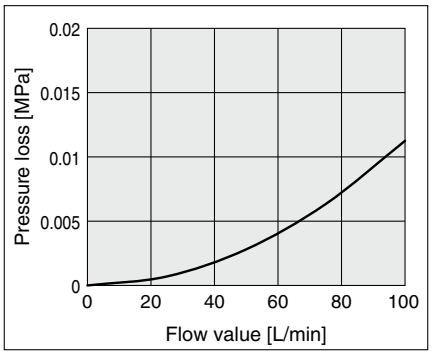


Flow Rate Characteristics (Pressure Loss)

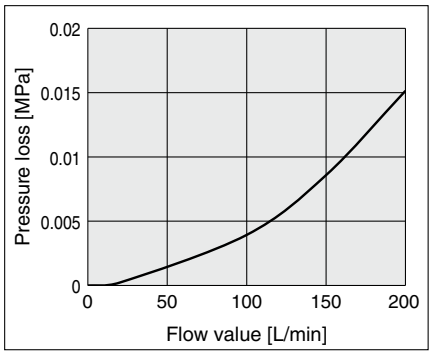
LFE1



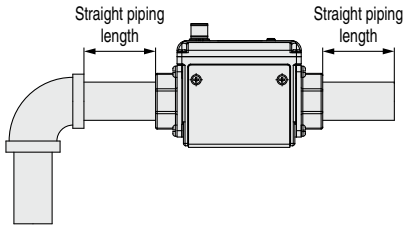
LFE2



LFE3



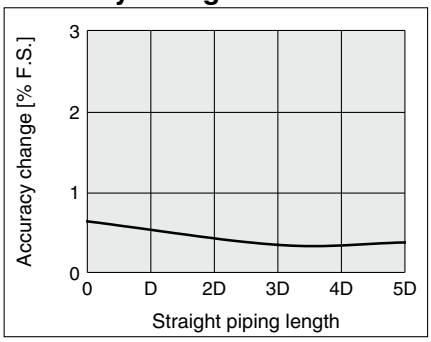
Straight Piping Length and Accuracy (Reference Value)



[Measurement conditions]
Fluid: Tap water
Pressure: 0.2 MPa

[Port size]
LFE1: 3/8 inch
LFE2: 3/4 inch
LFE3: 1 inch

Accuracy change



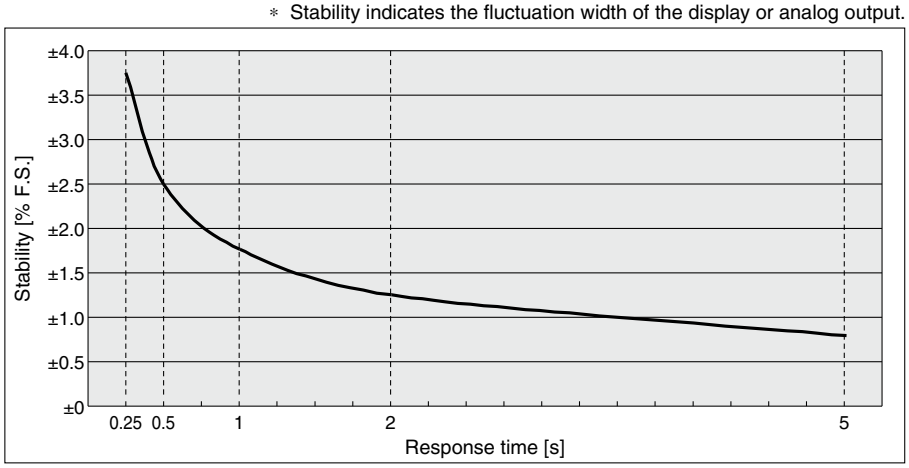
- The smaller the piping size, the more the product is affected by the straight piping length.
  The straight piping length shall be 5 times (5D) or more of the piping size to achieve the stable measurement.

[mm]

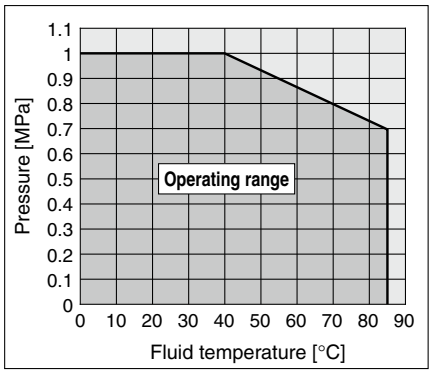
Model	Straight piping length	
	D	**5D**
LFE1	11	55
LFE2	21	105
LFE3	27	135

Stability

* Stability is improved by increasing the response time setting.
* Stability indicates the fluctuation width of the display or analog output.



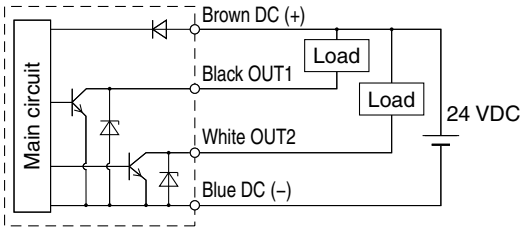
Operating Pressure Range



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.

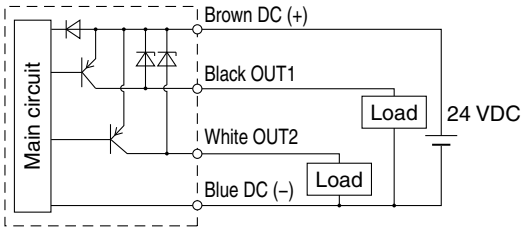
Internal Circuits and Wiring Examples (Integrated Display Type)

NPN 2 output type
LFE□A□□□



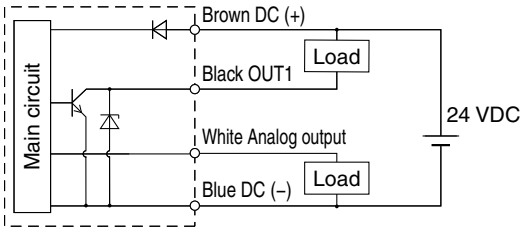
Max. 28 V, 80 mA
Internal voltage drop 1 V or less

PNP 2 output type
LFE□B□□□



Max. 80 mA
Internal voltage drop 1.5 V or less

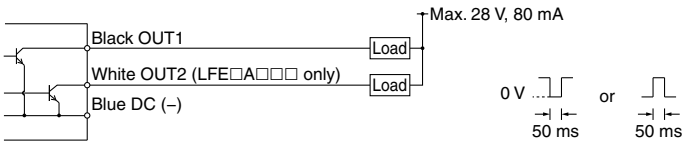
NPN + Analog output type
LFE□C□□□
NPN + Analog output type
LFE□D□□□



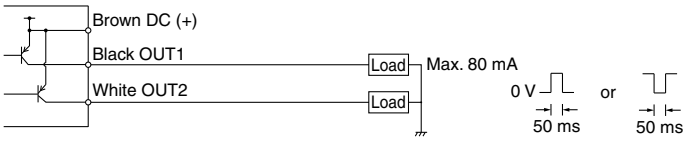
Max. 28 V, 80 mA
Internal voltage drop 1 V or less
C: Analog output 1 to 5 V
Output impedance 1 kΩ
D: Analog output 4 to 20 mA
Load impedance 50 to 600 Ω

Accumulated pulse output wiring examples

NPN 2 output type
LFE□A□□□
NPN + Analog output type
LFE□C□□□/LFE□D□□□



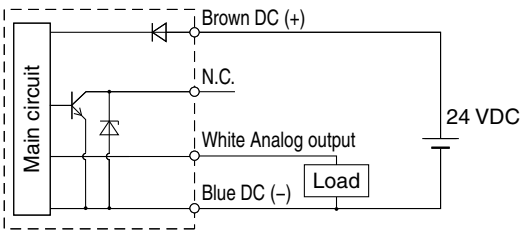
PNP 2 output type
LFE□B□□□



∗ When accumulated pulse output is selected, the indicator light is turned off.

Internal Circuits and Wiring Examples (Remote Type Sensor Unit)

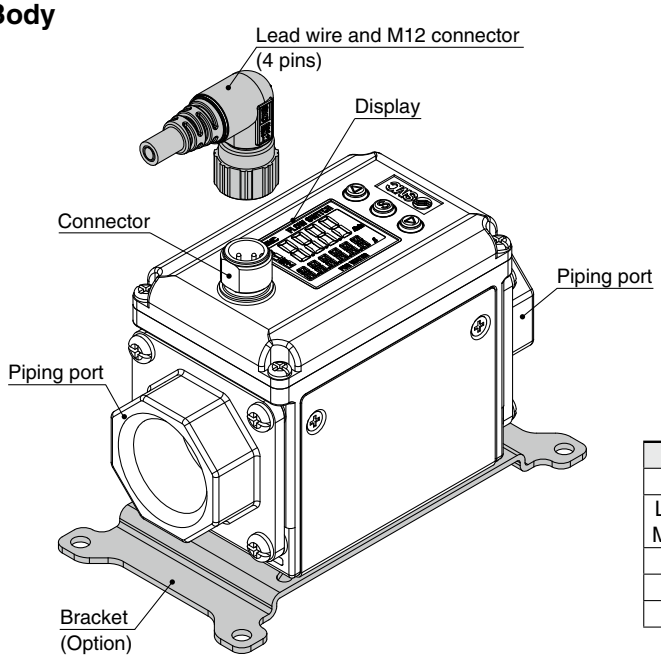
Analog output type
LFE□J□□□ (Voltage output type)
LFE□K□□□ (Current output type)



∗ Do not connect N.C.

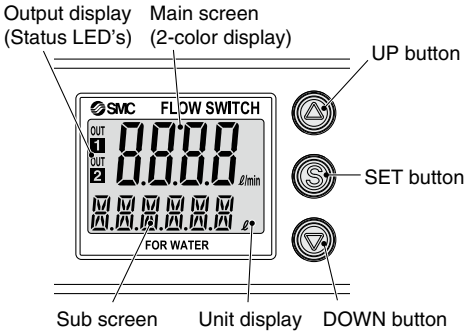
Parts Description

Body



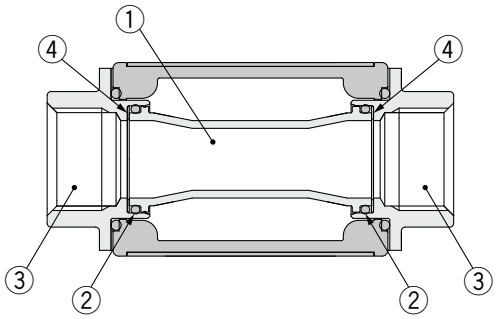
Description	Function
Connector	M12 connector for electrical connections
Lead wire and M12 connector	Cable for supplying power to the product and for receiving output
Piping port	For piping connections
Display	Displays the flow, set values, and error information
Bracket	Mounting bracket for installing the product

Display



Description	Function
Main screen (2-color display)	Displays the flow value, setting mode, and error codes
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. (For details, refer to p. 15.)
Output display (Status LED's)	Displays the output condition of OUT1 and OUT2 (When ON: Orange light turns on)
UP button	Selects the mode and the display shown on the sub screen or increases the ON/OFF set value
SET button	Used to make changes in each mode and to enter the set value
DOWN button	Selects the mode and the display shown on the sub screen or decreases the ON/OFF set value
Unit display	Indicates the unit currently selected

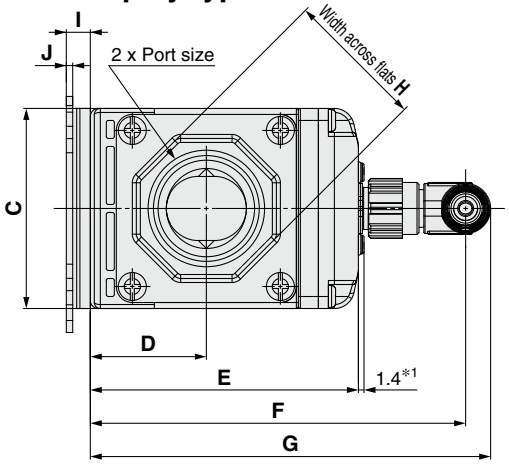
Fluid Passage Structure



No.	Description	Material
1	**Pipe**	PPS
2	**O-ring**	FKM
3	**Attachment**	Brass
4	**Spacer**	FKM

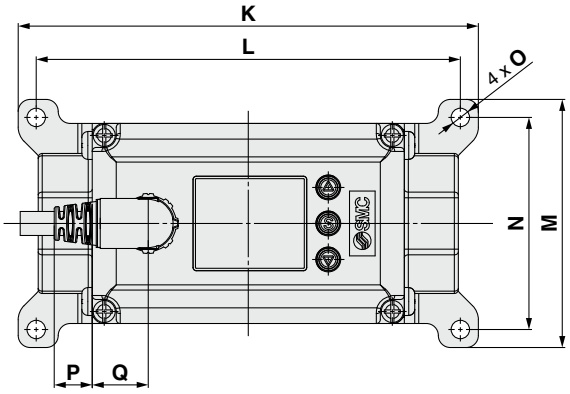
Dimensions

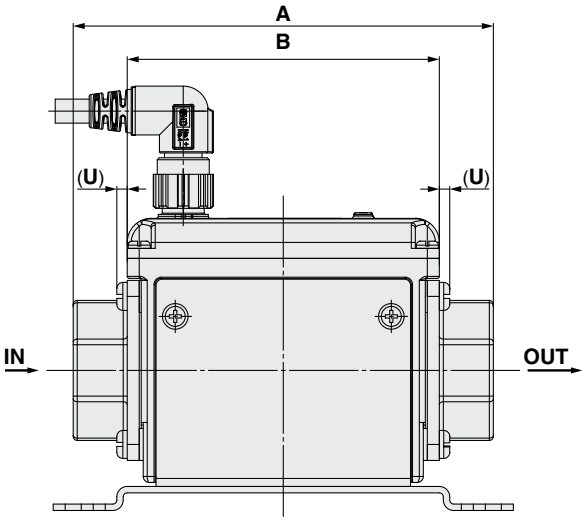
Integrated display type LFE1/2/3



*1 For integrated display type

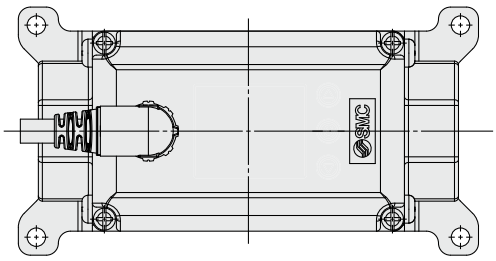
* The electrical entry for lead wire and M12 connector does not rotate and is limited to only one entry direction.



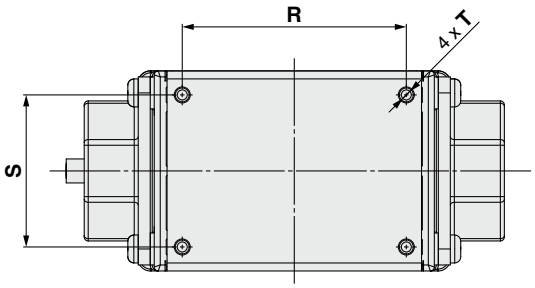


Bracket thickness is approx. 1.6 mm

Remote type sensor unit LFE1/2/3



* Dimensions are the same as those of the integrated display type.



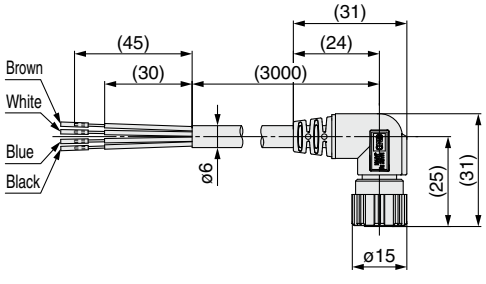
Without bracket (Bottom view)

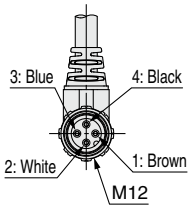
Model	Port size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
LFE1□3□	3/8	90	73	40	23.5	56	83	89	24	6	1.6	96	87	48	39	4.6	12	11.5	52	28	ø2.5 depth 8.5	2
LFE1□4□	1/2	104	73	40	23.5	56	83	89	28	6	1.6	96	87	48	39	4.6	12	11.5	52	28	ø2.5 depth 8.5	2
LFE2□	3/4	105	78	50	29	67	94	100	35	6	1.6	115	106	62	53	4.6	9.5	14	56	38	ø2.5 depth 8.5	2.6
LFE3□	1	120	90	55	32	73	100	106	41	6	1.6	115	106	62	53	4.6	3.5	20	68	43	ø2.5 depth 8.5	2.6

* If you are installing directly, choose the self tapping screw screw-in depth is to 8 mm. Tighten the screw with a torque of 0.7 to 0.8 N·m.

Lead wire and M12 connector

Pin no.	Pin description	Wire color
1	DC (+)	Brown
2	OUT 2	White
3	DC (–)	Blue
4	OUT 1	Black





Cable Specifications

Conductor	Nominal cross section area	AWG21
	External diameter	Approx. 0.9 mm
Insulator	**Material**	Non-lead heat resistant PVC
	External diameter	Approx. 1.7 mm
	Colors	Brown, White, Black, Blue
Sheath	**Material**	Non-lead heat and oil resistant PVC
Finished external diameter		ø6

3-Color Display

Digital Flow Monitor
LFE0 Series

How to Order

LFE 0 A □ – M V C

Type

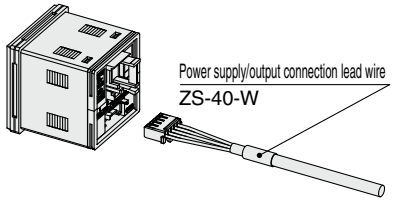
0	Remote type monitor unit

* For the remote type sensor unit, select the analog output 1 to 5 V type. Applicable sensors: LFE□J□□□
* Does not support the close proximity setting/zero-reset setting functions

Output specifications

Symbol	OUT1	OUT2
A	NPN	NPN
B	PNP	PNP
C	NPN	Analog 1 to 5 V
D	NPN	Analog 4 to 20 mA

Lead wire

Nil	With power supply/output connection lead wire (2 m) 
N	Without power supply/output connection lead wire

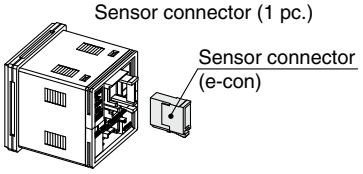
The lead wire does not come connected, but it is shipped together with the product.

Remote type monitor unit/Display unit

Symbol	Instantaneous flow rate	Accumulated flow
M	L/min	L
G	gal/min	gal

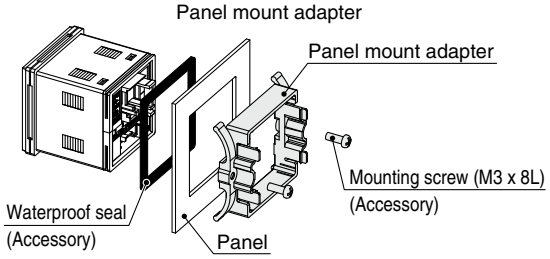
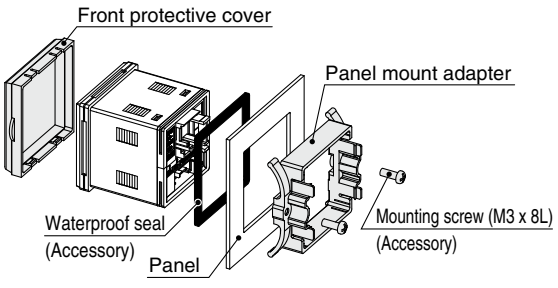
* Under the New Measurement Law, units other than SI (symbol "M") cannot be used in Japan.
* G: Made to order
  Reference: 1 [L/min] ↔ 0.2642 [gal/min]
  1 [gal/min] ↔ 3.785 [L/min]

Option 2

Nil	Without connector
C	Sensor connector (1 pc.) 

The connector does not come connected, but it is shipped together with the product.

Option 1

Nil	None
T	Panel mount adapter 
V	Front protective cover + Panel mount adapter 

Option/Part No.

When only optional parts are required, order with the part numbers listed below.

Description	Part no.	Note
Panel mount adapter	**ZS-26-B**	With waterproof seal, mounting screw
Front protective cover + Panel mount adapter	**ZS-26-C**	With waterproof seal, mounting screw
Front protective cover only	**ZS-26-01**	Separately order panel mount adapter, etc.
Power supply/output connection lead wire	**ZS-40-W**	Lead wire length 2 m
Sensor connector (e-con)	**ZS-28-C-5**	1 pc.
Lead wire with connector for copying	**ZS-40-Y**	Connect up to 10 slave units

For the flow switch precautions, refer to the Operation Manual on the SMC website. Click here for details.

Specifications (Remote Type Monitor Unit)

Model			LFE0		
Display flow range			0.4 to 24.0 L/min (Flow under 0.4 L/min is displayed as "0.00")	2.0 to 120.0 L/min (Flow under 2.0 L/min is displayed as "0.0")	4 to 240 L/min (Flow under 4 L/min is displayed as "0.0")
Set flow range			0.4 to 24.0 L/min	2.0 to 120.0 L/min	4 to 240 L/min
Smallest settable increment			0.1 L/min	0.5 L/min	1 L/min
Accumulated volume per pulse			0.1 L/pulse	0.5 L/pulse	1 L/pulse
Display units			Instantaneous flow rate L/min, Accumulated flow L		
Accuracy			Displayed values: ±0.5% F.S., Analog output: ±0.5% F.S.		
Repeatability			±0.5% F.S.		
Temperature characteristics			±0.5% F.S. (25°C reference)		
Accumulated flow range∗1			99999999.9 L by 0.1 L	999999999 L by 1 L	
Switch output			NPN or PNP open collector output		
	Maximum load current		80 mA		
	Maximum applied voltage		28 VDC		
	Internal voltage drop		NPN: 1 V or less (at load current of 80 mA) PNP: 1.5 V or less (at load current of 80 mA)		
	Response time∗2		0.5 s/1 s/2 s/5 s		
	Output protection		Short-circuit protection		
	Output mode	**Flow rate**	Select from hysteresis mode, window comparator mode, accumulated output mode, or accumulated pulse output mode.		
		Temperature	Select from hysteresis mode or window comparator mode.		
Analog output	**Response time**∗3		0.5 s/1 s/2 s/5 s (linked with the switch output)		
	Voltage output		Output voltage: 1 to 5 V Output impedance: 1 kΩ		
	Current output		Output current: 4 to 20 mA Max. load impedance: 600 Ω		
Hysteresis			Variable		
Input/output			Input for copy mode		
Display method			2-screen (Main screen: 4-digit, 7-segment, 2-color, Red/Green; Sub screen: 6-digit, 11-segment, White) Display values updated 5 times per second		
Status LED's			Output 1, Output 2: Orange		
Power supply voltage			24 VDC ±10%		
Current consumption			50 mA or less		
Connection			Power supply output 5P connector, sensor connection 4P connector (e-con)		
Environmental resistance	**Enclosure**		IP40 (Only front face of the panel is IP65 when panel mount adapter and waterproof seal of optional parts are used.)		
	Operating temperature range		0 to 50°C (with no freezing and condensation)		
	Operating humidity range		Operating, Storage: 35 to 85% R.H. (with no condensation)		
	Withstand voltage		1000 VAC for 1 minute between terminals and housing		
	Insulation resistance		50 MΩ or more (500 VDC measured via megohmmeter) between terminals and housing		
Standards and regulations			CE marking, RoHS		
Weight	**Without power supply/output connection lead wire**		50 g		
	With power supply/output connection lead wire		100 g		

∗1 Cleared when the power supply is turned off. Hold function can be selected. (Interval of 2 or 5 minutes can be selected.) If the 5 minutes interval is selected, the life of the memory element (electronic parts) is limited to 1 million times. (If energized for 24 hours, life is calculated as 5 minutes x 1 million = 5 million minutes = about 9.5 years.) Therefore, if using the hold function, calculate the memory life for your operating conditions, and use within this life.

∗2 The response time when the set value is 63% in relation to the step input.

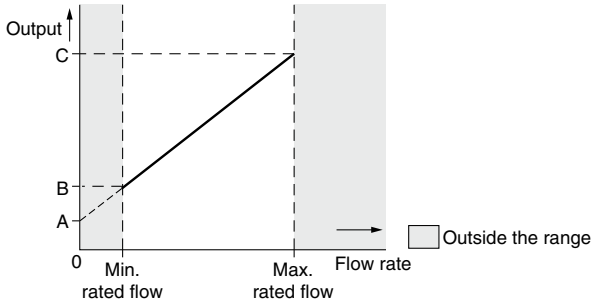
∗3 The response time until the set value reaches 63% in relation to the step input.

Analog Output

Flow/Analog output

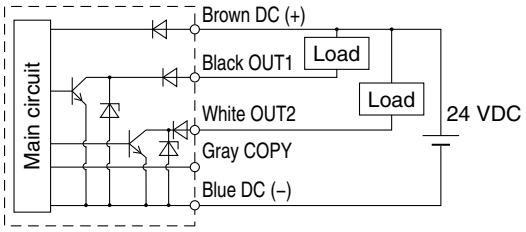
	A	B	C
Voltage output	1 V	1.1 V	5 V
Current output	4 mA	4.4 mA	20 mA

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

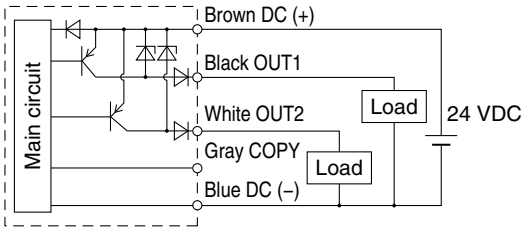


Internal Circuits and Wiring Examples

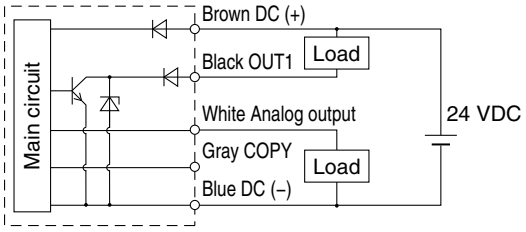
NPN 2 output type
LFE0A



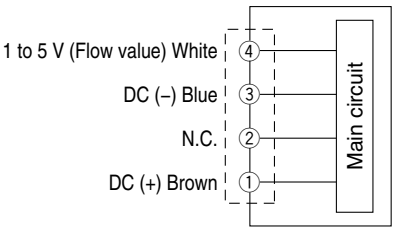
PNP 2 output type
LFE0B



NPN + Analog output type
LFE0C
NPN + Analog output type
LFE0D



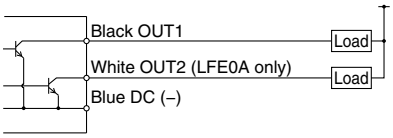
Sensor input circuit

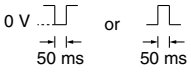


∗ Do not connect N.C.

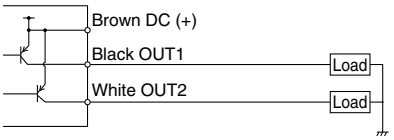
Accumulated pulse output wiring examples

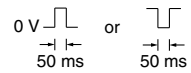
NPN 2 output type
LFE0A
NPN + Analog output type
LFE0C/LFE0D





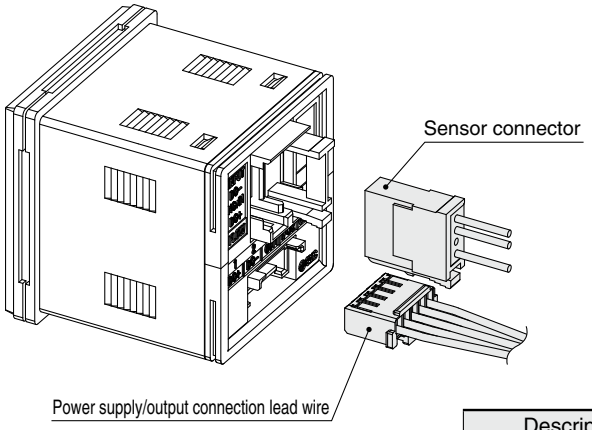
PNP 2 output type
LFE0B

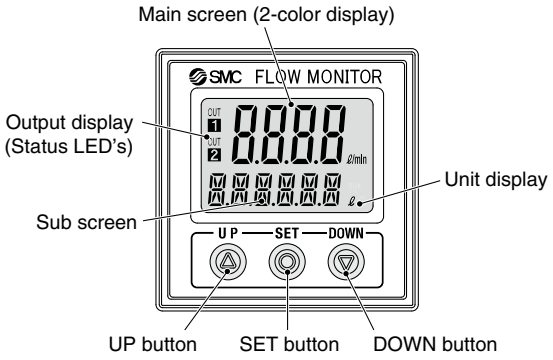




∗ When accumulated pulse output is selected, the indicator light is turned off.

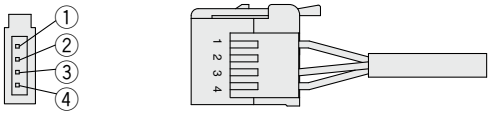
Parts Description (Remote Type Monitor Unit)





Description	Function
Main screen (2-color display)	Displays the flow value, setting mode, and error codes
Sub screen	Displays the accumulated flow, set value, peak/bottom value, fluid temperature, and line names. In setting mode, the set status is displayed. (For details, refer to p. 15.)
Output display (Status LED's)	Displays the output condition of OUT1 and OUT2. (When ON: Orange light turns on)
Unit display	Indicates the unit currently selected
UP button	Selects the mode and the display shown on the sub screen or increases the ON/OFF set value
SET button	Used to make changes in each mode and to enter the set value
DOWN button	Selects the mode and the display shown on the sub screen or decreases the ON/OFF set value

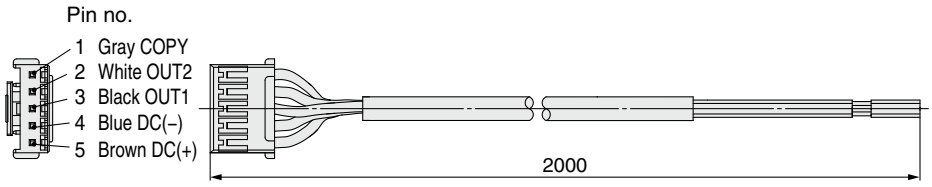
Sensor connector



Pin no.	Terminal	Connector no.	Lead wire color *1
①	DC (+)	1	Brown
②	N.C./IN	2	Not used
③	DC (–)	3	Blue
④	INPUT	4	White (Flow sensor 1 to 5 V input)

*1 When using the lead wire and M12 connector included with the LFE□J series. Do not connect black.

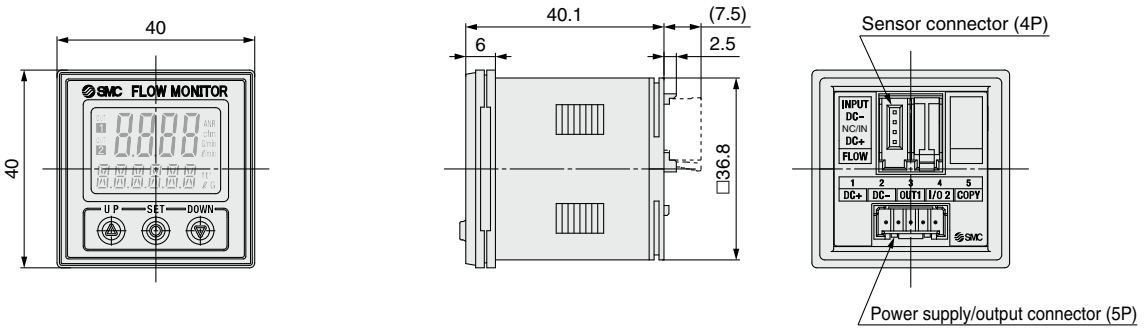
Power supply/output connection lead wire



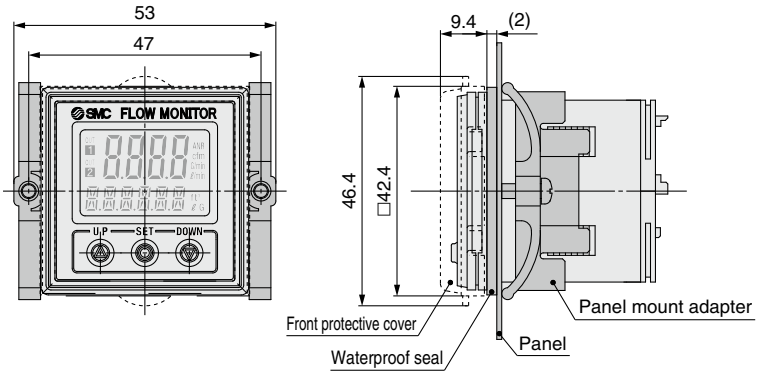
Cable Specifications

Conductor	**Nominal cross section area**	AWG26
	External diameter	Approx. 0.5 mm
Insulator	**Material**	Cross-linked vinyl
	External diameter	Approx. 1.0 mm
	Colors	Brown, Blue, Black, White, Gray
Sheath	**Material**	Oil and heat resistant vinyl
Finished external diameter		ø3.5

Dimensions

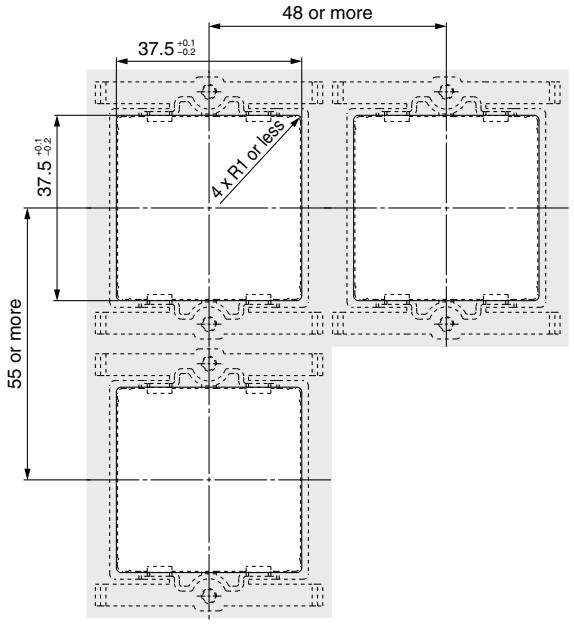


Front protective cover + Panel mount adapter



Panel fitting dimensions

Applicable panel thickness:
0.5 to 8 mm (Without waterproof seal)
0.5 to 6 mm (With waterproof seal)



LFE Series
Function Details

■ Output operation

The output operation can be selected from the following:
Output (hysteresis mode and window comparator mode) corresponding to instantaneous flow rate, output corresponding to accumulated flow, or accumulated pulse output.

∗ At the time of shipment from the factory, it is set to hysteresis mode and normal output.

■ Display color

The display color can be selected for each output condition. The selection of the display color provides visual identification of abnormal values. (The display color depends on OUT1 settings.)

ON: Green, OFF: Red
ON: Red, OFF: Green
Normally: Red
Normally: Green

■ Setting of response time

The response time can be selected according to the application. (The default setting is 1 second.) The fluctuation of the displayed value can be reduced by setting a slower response time. If you need faster detection of problems such as leakage of tip cooling water for welding guns, switch output or analog output can be made faster by setting a faster response time. In this case, widen the hysteresis to prevent the chattering of the switch output.

Response time	Stability
0.25 seconds	±3.7% F.S.
0.5 seconds	±2.5% F.S.
1 second	±1.7% F.S.
2 seconds	±1.2% F.S.
5 seconds	±0.8% F.S.

■ Forced output function

The output is turned ON/OFF compulsorily when starting the system or during maintenance. This enables the confirmation of the wiring and prevents system errors due to unexpected output.
For the analog output type, the output will be 5 V or 20 mA for ON and 1 V or 4 mA for OFF.

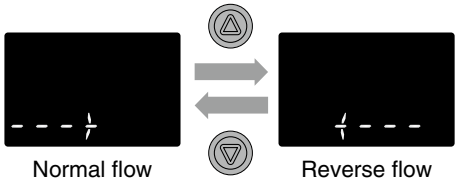
∗ Also, the increase or decrease of the flow will not change the on/off status of the output while the forced output function is activated.

■ Accumulated value hold function

The accumulated value is not cleared even when the power supply is turned off. The accumulated value is memorized every 2 or 5 minutes during measurement and continues from the last memorized value when the power supply is turned on again.
The life time of the memory element is 1 million access times. Take this into consideration before using this function.

■ Switching of flow direction (∗ Integrated display type only)

The flow direction can be changed after installation.

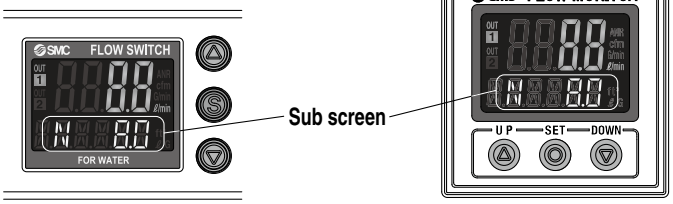


Normal flow
(Left to right)

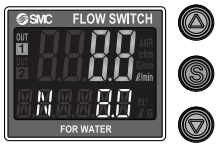
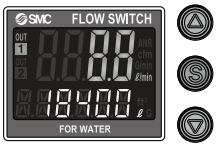
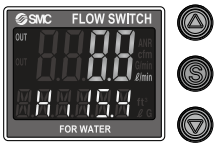
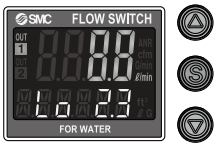
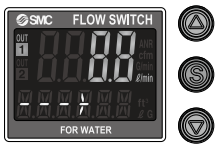
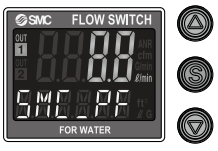
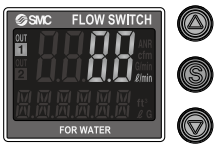
Reverse flow
(Right to left)

■ Selection of sub screen display

The display on the sub screen in measuring mode can be set.



Integrated display type **Remote type monitor unit**

Set value display	Accumulated value display	Peak value display	Bottom value display
Displays the set value (The set value of OUT2 cannot be displayed.)	Displays the accumulated value (The accumulated value of OUT2 cannot be displayed.)	Displays the peak value	Displays the bottom value
			
Flow direction display (∗ Integrated display type only)	**Line name display**	**Off**	
Displays the flow direction (When the close proximity setting function is being used, the set value is also displayed.)	Displays the line name (Up to 6 alphanumeric characters can be input.)	Displays nothing	
			

■ Selection of power-saving mode

The display can be turned off to reduce power consumption (by approx.10%). In power-saving mode, only decimal points blink. If any button is pressed during power-saving mode, the display is recovered for 30 seconds to check the flow, etc.

■ Setting of security code

The user can select whether a security code must be entered to release the key lock. At the time of shipment from the factory, it is set such that a security code is not required.

■ Peak/Bottom value display

The maximum (minimum) flow rate is detected and updated from when the power supply is turned on. In peak (bottom) value display mode, this maximum (minimum) flow rate is displayed.

■ Keylock function

Prevents operation errors such as accidentally changing setting values

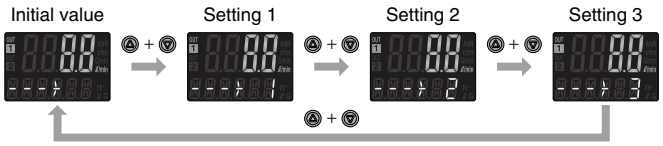
■ [F22] Setting of analog output

This function can be used only when the optional analog output is present. The flow value that generates the output voltage (= 5 V) or output current (= 20 mA) at the span side of the analog output is changeable.

■ Close proximity setting (∗ Integrated display type only)

By activating the close proximity setting function, flickering of the display in the uninstallable area is reduced.
In cases where “Flow direction display” is displayed on the sub screen, the close proximity setting function can be activated by pressing the ▲ and ▼ buttons simultaneously for at least one second.

Forward direction flow



■ Zero-reset setting (∗ Integrated display type only)

Enables the display to be adjusted to zero

■ Error display function

When an error or abnormality arises, the location and contents are displayed.

Display	Error name	Description	Action
Er 1	OUT1 over current error	A load current of 80 mA or more is applied to the switch output (OUT1).	Eliminate the cause of the over current by turning off the power supply and then turning it on again.
Er2	OUT2 over current error	A load current of 80 mA or more is applied to the switch output (OUT2).	
Er3	Zero-reset error	The detection passage is not filled or the flow rate exceeds ±20% F.S. of the rated flow rate during zero-reset setting.	When there is no flow, and the detection passage is full, wait until an adequate amount of time has passed before operating the unit.
HHH	Instantaneous flow error	The flow rate has exceeded the display flow range.	Decrease the flow rate.
LLL	Reverse flow error	Flow is flowing in the reverse direction of the setting.	Change the setting of the flow direction.
999999999 (Alternately displays [999] and [999999])	Accumulated flow error	The flow rate exceeds the accumulated flow rate range.	Clear the accumulated flow rate. (This error is irrelevant when accumulated flow is not being used.)
Er0	System error	Internal data error	Turn the power off and then on again. If the error cannot be rectified, please contact SMC for investigation.
Er4			
Er6			
Er8			
Er10	Sensor error	The power supply voltage exceeds 24 V ±10%.	Check the power supply voltage, turn off the power supply, and then turn it on again.

LFE Series
Made to Order

Please consult with SMC for detailed specifications, delivery times, and prices.

Made to Order

1 Piping connection parts: Stainless steel 304

Symbol
-X8

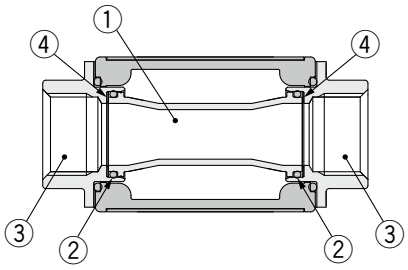
Specifications

Model		LFE1-X8		LFE2-X8	LFE3-X8
Fluid contact materials		PPS, FKM, Stainless steel 304			
Weight (Body)∗1	**Integrated display type**	Approx. 380 g	Approx. 430 g	Approx. 620 g	Approx. 800 g
	Remote type sensor unit	Approx. 375 g	Approx. 425 g	Approx. 615 g	Approx. 795 g

∗1 When options are used, add the weight of the optional parts.

Other specifications that are not indicated are the same as those of the standard product.

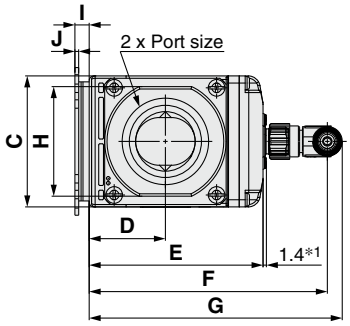
Fluid Passage Structure



No.	Description	Material
1	**Pipe**	PPS
2	**O-ring**	FKM
3	**Attachment**	Stainless steel 304
4	**Spacer**	FKM

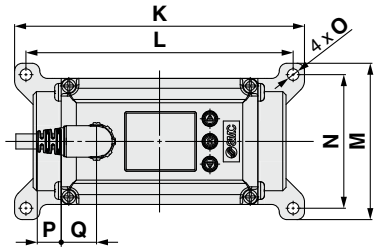
Dimensions

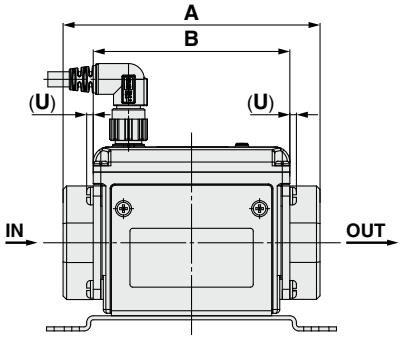
Integrated display type LFE1/2/3-X8



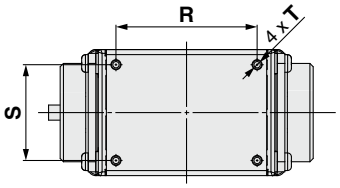
∗1 For the integrated display type

∗ The electrical entry for the lead wire and M12 connector does not rotate and is limited to only one entry direction.



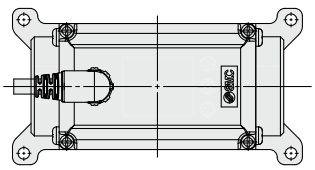


Bracket thickness is approx. 1.6 mm



Without bracket (Bottom view)

Remote type sensor unit LFE1/2/3-X8



∗ Dimensions are the same as those of the integrated display type.

Model	Port size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
LFE1□3□	3/8	90	73	40	23.5	56	83	89	30	6	1.6	96	87	48	39	4.6	12	11.5	52	28	ø2.5 depth 8.5	2
LFE1□4□	1/2	104	73	40	23.5	56	83	89	30	6	1.6	96	87	48	39	4.6	12	11.5	52	28	ø2.5 depth 8.5	2
LFE2□	3/4	105	78	50	29	67	94	100	41	6	1.6	115	106	62	53	4.6	9.5	14	56	38	ø2.5 depth 8.5	2.6
LFE3□	1	120	90	55	32	73	100	106	46	6	1.6	115	106	62	53	4.6	3.5	20	68	43	ø2.5 depth 8.5	2.6

∗ If you are installing directly, choose a self-tapping screw with a screw-in depth of 8 mm. Tighten the screw with a torque of 0.7 to 0.8 N·m.

SMC

LFE Series
Specific Product Precautions 1

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For flow switch precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on the SMC website: http://www.smcworld.com

Installation

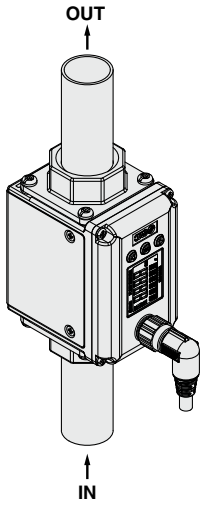
⚠ Warning

1. Since the type of fluid varies depending on the product, be sure to verify the specifications.

The switches do not have an explosion proof rating. To prevent any possible fire hazards, do not use with inflammable gases or fluids.

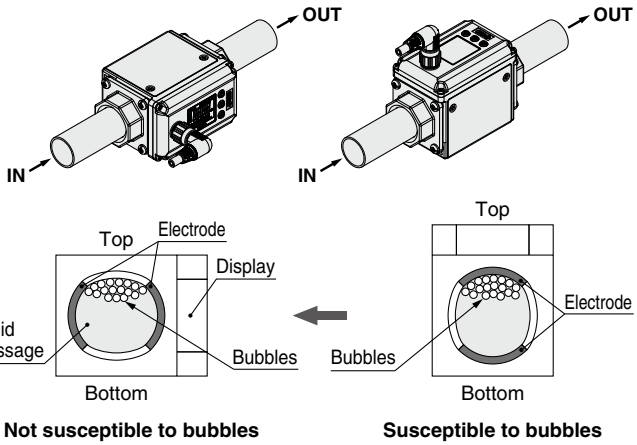
2. Install the system so that the fluid always fills the detection passage.

If the product is used when the detection passage is not filled or when it is in a condition such that air bubbles are liable to be emitted, the correct detection signal will fail to be output from the electrodes, making correct measurement impossible. When the detection passage is empty, the display may become unstable. Therefore, install the system so that fluid remains in the detection passage even when the fluid flow is stopped. For vertical mounting, introduce the fluid from the bottom because bubbles may be generated when fluid is introduced from the top, which may lead to operation failure.



When the product is mounted horizontally, place the display vertical to the floor to prevent bubbles from occurring.

Mounting orientation: ○ **Mounting orientation: ×**



Not susceptible to bubbles **Susceptible to bubbles**

Mounting

⚠ Warning

1. The piping port is grounded to DC(-)/blue line.

Do not use the power supply with a positive ground.

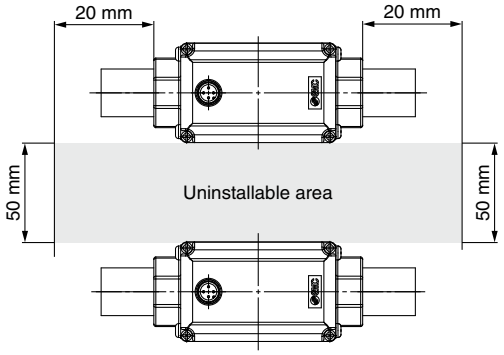
2. Avoid using piping which changes size suddenly on the IN side of the switch.

If the piping size is reduced sharply or there is a restrictor such as a valve on the IN side, fluid velocity distribution in the piping will be disturbed, leading to improper measurement. Therefore, the above-mentioned piping 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 a restrictor on the OUT side of the switch, and confirm that there is no malfunction before handling. If the orifice on the OUT side is fully closed when operating the pump, the switch may malfunction due to the effects of pulsation (pressure fluctuation). Ensure that there is no malfunction before usage.

3. For remote type products, when multiple switches are to be used in parallel, install them outside the area shown in the figure below.
When multiple switches are installed in parallel inside the uninstallable area, the display may fluctuate.

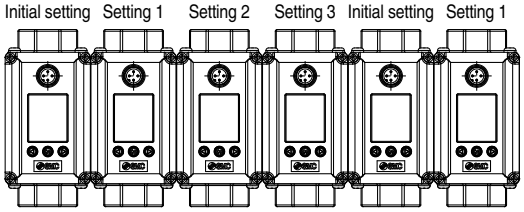
Uninstallable area



Integrated display type

In cases where multiple switches are to be installed in parallel inside the uninstallable area, fluctuation of the display can be reduced by using the close proximity setting function.

Example of close proximity setting (∗ Integrated display type only)



4. Use caution so that the electrical entry for the lead wire and M12 connector does not rotate and is limited to only one direction.

LFE Series
Specific Product Precautions 2

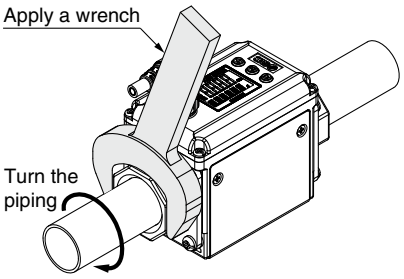
Be sure to read this before handling the products. Refer to the back cover for safety instructions. For flow switch precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on the SMC website: http://www.smcworld.com

Mounting

⚠ Caution

1. When connecting the piping to the switch, do not rotate the switch. Apply a wrench to the metal part of the piping port to turn the fitting.

Using a wrench on other parts may damage the product.
Specifically, make sure that the wrench does not damage the M12 connector. This will damage the connector.



Width across flats of attachment

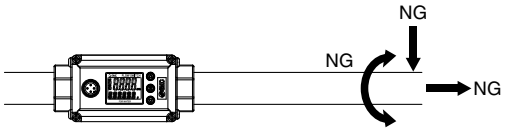
3/8	24 mm
1/2	28 mm
3/4	35 mm
1	41 mm

Refer to the tightening torque in the right table for connecting steel piping.
Torque lower than the value in the table leads to fluid leakage.
For mounting the fittings on the market, refer to the torque specified for each.

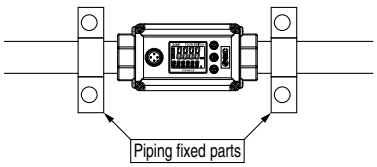
Nominal thread size	Proper tightening torque [N·m]
Rc (NPT) 3/8	22 to 24
Rc (NPT) 1/2	28 to 30
Rc (NPT) 3/4	28 to 30
Rc (NPT) 1	36 to 38

2. The product body is made of resin. Do not impose stress, vibration or impact directly on the product during piping work in order to prevent failure, damage and water leakage.

In particular, never mount a product in a location that will be used as a foothold.



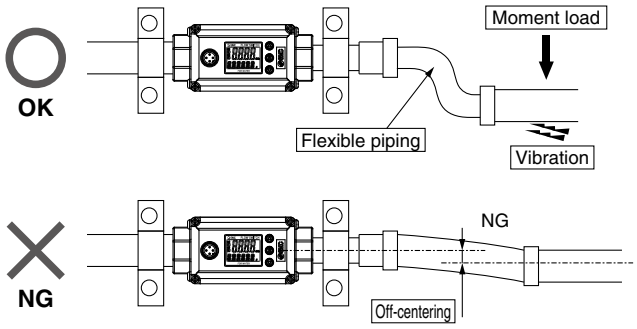
3. Secure the front and rear pipes as close to the product as possible in order to prevent stress, vibration and impact from being imposed directly on the product.



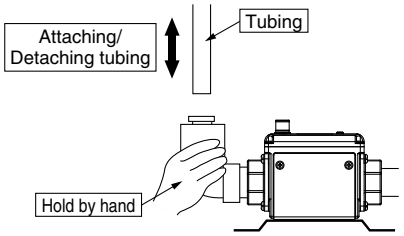
4. If stress, vibration and impact imposed on the product cannot be reduced, secure each pipe at multiple positions.

5. Inflexible piping such as steel piping tends to be affected by spread of excessive moment load or vibration from the piping side. Lay flexible tubing between the steel pipe and the product to prevent such effects.

In particular, if the piping is off center with the product, load will be imposed on the piping for a long period even after the piping work, possibly resulting in failure, damage or water leakage.



6. When using a One-touch fitting, hold the fitting by hand to prevent the load required for connecting or disconnecting the tube from being imposed directly on the product.



7. The straight piping length on the primary side of the product shall be 5 times (5D) or more of the piping size to achieve stable measurement. (Refer to p. 6.)

8. The operating pressure range and operating temperature range of the product vary depending on the operating conditions. The fluid pressure and temperature should fall within their respective allowable ranges during operation. (Refer to p. 6.)

LFE Series
Specific Product Precautions 3

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For flow switch precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on the SMC website: http://www.smcworld.com

Operating Precautions

⚠ Warning

1. Product temperature becomes high when hot fluid is used. Use caution, as there is a danger of being burned if a valve is touched directly.

2. Enclosure is for this product with lead wire and M12 connector. Be careful when handling the product without connector.

Operating Environment

⚠ Warning

1. Never use in the presence of explosive gases.

The switch does not have an explosion proof construction.
If it is used in an environment where explosive gases are used, it may cause an explosive disaster. Therefore, never use it in such an environment.

2. Observe the specified fluid and ambient temperature range.

The operating fluid temperature range is 0 to 85°C, and ambient temperature range is 0 to 50°C. Take measures to prevent moisture from freezing in a piping circuit when using at 5°C or less, since this may cause damage to the product and lead to malfunction. Even when the ambient temperature range is within the specifications, do not use in locations where there are rapid temperature changes.

3. If the temperature of the fluid is lower than the ambient temperature, condensation will be generated which may damage the product or cause malfunction.

Maintenance

⚠ Warning

1. Take precautions when using the switch for an interlock circuit.

When a pressure switch is used for the interlock circuit, devise a multiple interlock system to prevent trouble or malfunction, and verify the operation of the switch and interlock function on a regular basis.

Fluid

⚠ Warning

1. Check regulators and flow adjustment valves before introducing the fluid.

If pressure or flow rate beyond the specified range are applied to the switch, the sensor unit may be damaged.

Fluid

⚠ Caution

1. Operate fluids with electric conductivity of 5 μS/cm or more.

Note that this product cannot be used for fluids with low conductivity. This product cannot be used for fluids that do not conduct electricity such as deionized water (pure water) and oil.

Applicable Fluids List

Substance description	Judgement	Note
Water	○	Electric conductivity of tap water: 100 to 200 μS/cm
Deionized water (pure water)	×	Electric conductivity is too low.
Water-soluble coolant	○	When the ratio of water is 50% or more
Oil	×	Electric conductivity is too low.
Oil-based coolant	×	Electric conductivity is too low.
Sea water	×	Corrosive to the product
Ethylene glycol	×	Electric conductivity is too low.
Ethanol	×	Electric conductivity is too low.
Methanol	×	Electric conductivity is too low.
Chloride water (Hypochlorous acid)	×	Corrosive to the product

∗ Use the applicable fluids list as a guide. ○: Acceptable ×: Not acceptable

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

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 rubber piping will not be damaged.

3. If conductive material such as metal gets stuck to the whole surface in the piping, the switch may malfunction.

Remove the foreign material as mentioned above.

4. If the fluid with stray current running inside is measured, the switch may malfunction.

Beware that earth leakage from the equipment around the switch such as pump and stray current caused by ground fault should not flow into the fluid to be measured.

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

Specific Product Precautions 4

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For flow switch precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on the SMC website: http://www.smcworld.com

Others

⚠ Warning

1. **After the power is turned on, the switch's output remains off while a message is displayed. (Approx. 3 sec.) Therefore, start the measurement after a value is displayed.**
2. **Perform settings after stopping control systems.**
3. **Keep the switch away from the strong magnet and magnetic field to prevent the switch from malfunctioning.**

Set Flow Range and Rated Flow Range

⚠ Caution

Set the flow rate within the rated flow range.

The set flow range is the range of flow rate that is possible in setting.

The rated flow range is the range of flow rate that satisfies the sensor product specifications (such as accuracy, repeatability).

It is possible to set a value outside of the rated flow range if it is within the set flow range, however, the specification is not be guaranteed.

⚠ 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.

⚠ 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.

*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 10218-1: Manipulating industrial robots – Safety.
etc.

⚠ 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.

⚠ Caution

1. 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 regulations 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.

Revision History

Edition B
* The length of the bracket mounting hole has been changed.
* Cautions on installation and mounting have been added to the specific product precautions. SZ

Edition C
* Stainless steel 304 has been added to the piping connection parts material.
* Functions (close proximity setting and zero-reset setting) have been added. WR