New

3-colour display Electromagnetic Type Digital Flow Switch

RoHS IP65

●Compact/Lightweight

●Weight: 340 g (LFE1□3)

●Reverse flow can be detected.

Reverse flow error display

●Operating fluid temperature: 0 to 85°C

(Refer to page 4.)

●Current consumption: 45 mA

Reduced by up to 10% when the display is off.

Integrated display type

●Applicable fluids: Water, Water-soluble coolant

(Refer to page 17.)

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

Remote type

Sensor unit

3-colour display Monitor unit

Series LFE□

SMC

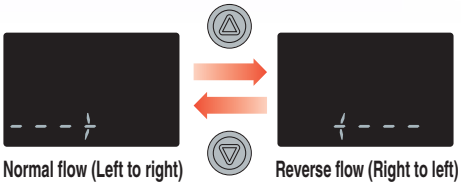
●Pressure loss: 0.02 MPa or less

●Repeatability: ±1.5 % F.S. (Analogue output)

●Flow direction can be changed after installation.

■Default flow direction (Normal flow)

■Flow direction can be changed after installation.



●3-colour/2-screen display

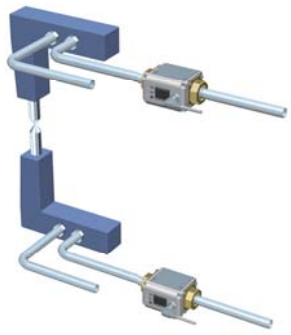
Instantaneous flow rate is displayed.

Parameters below can be set.

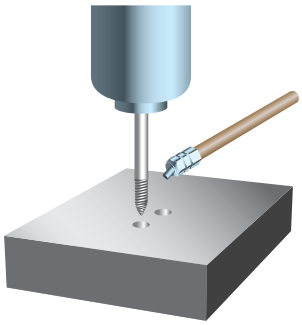
- Set value
- Flow direction
- Accumulated value
- Line name
- Peak/Bottom value

Application Examples

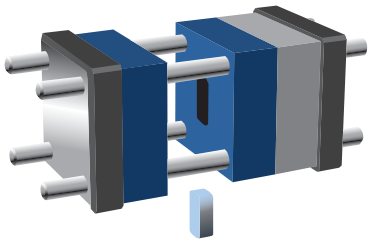
Flow control for pressurized cooling water for welding gun



Flow control for water-soluble coolant



Flow control for cooling water for metal mold

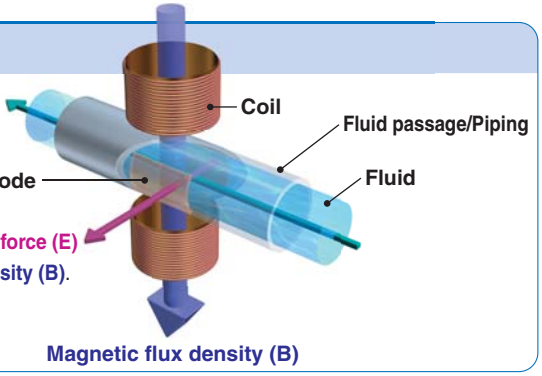


Principle

Faraday's law of induction

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

Electromotive force (E) is proportional to **fluid velocity (V)** multiplied by **magnetic flux density (B)**.
Volume flow is calculated by converting measured **electromotive force (E)**.
Oval fluid passage is used to improve the **magnetic flux density** by small amount of current.



Flow Switch for Liquid Variations

Series	Applicable fluid	Detection method	Minimum setting unit	Enclosure*	Display	Rated flow range [L/min]
LFE New	Water/ Water-soluble coolant	Electromagnetic type	0.1 L/min	IP65	3-colour 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-colour 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-colour display	10 – 100
			2 L/min			30 – 250
PF2D	Deionised water and Chemicals	Karman vortex	0.05 L/min	IP65	1-colour display	0.4 – 4
			0.1 L/min			1.8 – 20
			0.5 L/min			4 – 40

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

INDEX

3-colour display

Electromagnetic Type Digital Flow Switch

Series LFE

Integrated display type

Remote type sensor unit

Remote type monitor unit

(For details, refer to page 8.)

How to Order

Output specifications

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

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

Integrated display type **LFE 1 B 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

Output specifications

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

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
—	Rc
N	NPT
F	G

Option

Symbol	Lead wire with M12 connector (Length 3 m)	Bracket	Unit specifications
—	●	—	L/min
1	—	—	L/min
2	●	●	L/min
3	—	●	L/min
4*	●	—	gal/min
5*	—	—	gal/min
6*	●	●	gal/min
7*	—	●	gal/min

* Option 4, 5, 6, 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]

Option/Part No.

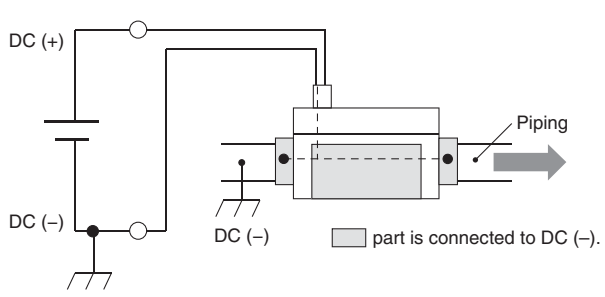
When only optional parts are required, order with the part number listed below.

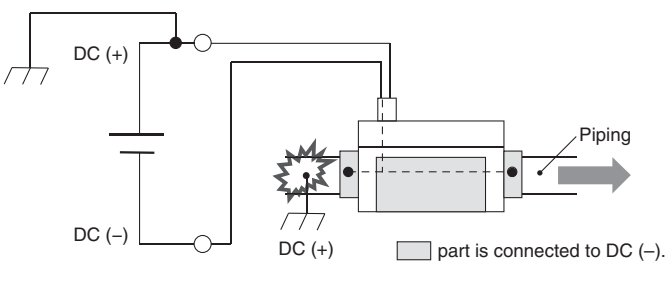
Option	Part no.	Note	Weight
Lead wire with M12 connector	**LFE-1-A3**	Lead wire length 3 m	175 g

Specifications (Integrated Display Type)

Model		LFE1		LFE2	LFE3
Applicable fluid Note 1)		Water, Conductive fluids which do not corrode the fluid contact materials. Note 1)			
Applicable fluid conductivity Note 1)		5 μS/cm or more (micro siemens)			
Detection method		Electrostatic capacity type			
Ground Note 10)		Negative ground			
Rated flow range		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 Note 2)		0.4 L/min		2.0 L/min	4 L/min
Minimum setting unit		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 Note 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. Analogue 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 Note 3)		0 to 1 MPa			
Proof pressure		2 MPa			
Accumulated flow range Note 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 80 mA) PNP: 1.5 V or less (at load current 80 mA)			
	Response time Note 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.			
Analogue output	Response time Note 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-colour, 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 Note 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			
Parts material in contact with fluid		PPS, FKM, C37 (Brass)			
Port size		3/8 (10A)	1/2 (15A)	3/4 (20A)	1 (25A)
Weight (Body) Note 8)		Approx. 340 g	Approx. 400 g	Approx. 520 g	Approx. 680 g

Note 1) Refer to "Applicable Fluids List" on page 17.
Note 2) 0 L/min is displayed when the flow is less than zero-cut flow.
Note 3) When fluids with high temperature are used, the available pressure range will be reduced. (For details, refer to "Operating Pressure Range" on page 4.)
Note 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 cycles. (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.
Note 5) The response time when the set value is 63% in relation to the step input.
Note 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.
Note 7) The stability of display and Analogue output improves by increasing the response time. (For details, refer to "Stability" on page 4.)
Note 8) When options are used, add the weight of the optional parts.
Note 9) Enclosure is for digital flow switch with lead wire and M12 connector. With no lead wire and M12 connector, enclosure is IP40.
Note 10) 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.





If used with power supply with positive ground, the metal part shorts.

Specifications (Remote Type Sensor Unit)

Refer to page 9 for the monitor unit specifications.

Model		LFE1		LFE2	LFE3
Applicable fluid Note 1)		Water, Conductive fluids which do not corrode the fluid contact materials. Note 1)			
Applicable fluid conductivity Note 1)		5 μS/cm or more (micro siemens)			
Detection method		Electrostatic capacity type			
Ground Note 5)		Negative ground			
Rated flow range		0.5 to 20 L/min		2.5 to 100 L/min	5 to 200 L/min
Operating fluid temperature Note 2)		0 to 85°C (with no freezing and condensation)			
Repeatability		Analogue 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 Note 2)		0 to 1 MPa			
Proof pressure Note 2)		2 MPa			
Analogue output	**Response time** Note 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			
Parts material in contact with fluid		PPS, FKM, C37 (Brass)			
Port size		3/8 (10A)	1/2 (15A)	3/4 (20A)	1 (25A)
Weight (Body) Note 4)		Approx. 335 g	Approx. 395 g	Approx. 515 g	Approx. 675 g

Note 1) Refer to “Applicable Fluids List” on page 17.
Note 2) When fluids with high temperature are used, the available pressure range will be reduced. (For details, refer to “Operating Pressure Range” on page 4.)
Note 3) The response time until the set value reaches 63% in relation to the step input.
Note 4) When options are used, add the weight of the optional parts.
Note 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.

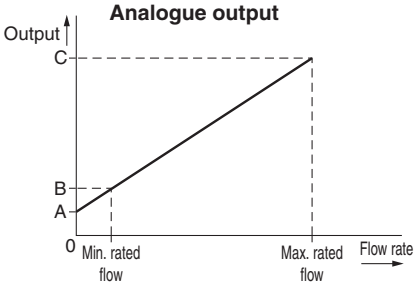
Analogue Output

Flow/Analogue output

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

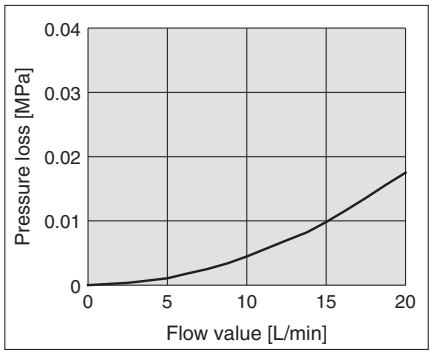
Model	Rated flow [L/min]	
	Minimum	Maximum
LFE1	0.5	20
LFE2	2.5	100
LFE3	5	200

Analogue output

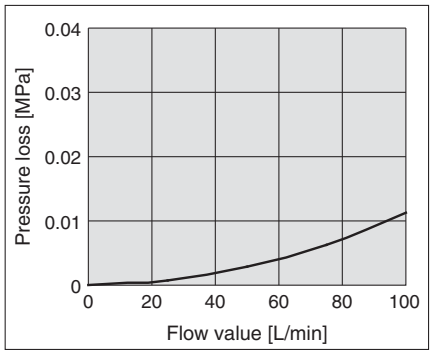


Flow-rate Characteristics (Pressure Loss)

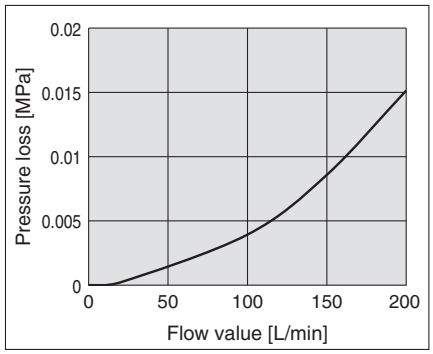
LFE1



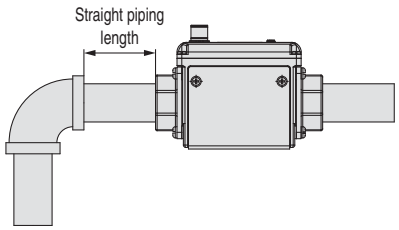
LFE2



LFE3



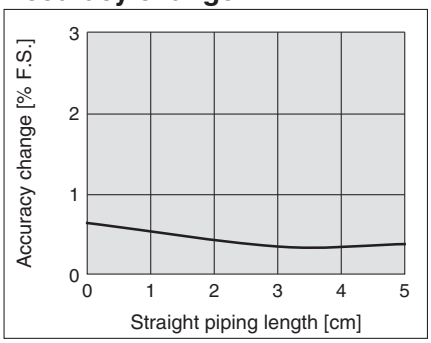
Straight Piping Length and Accuracy (Reference Value)



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

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

Accuracy change



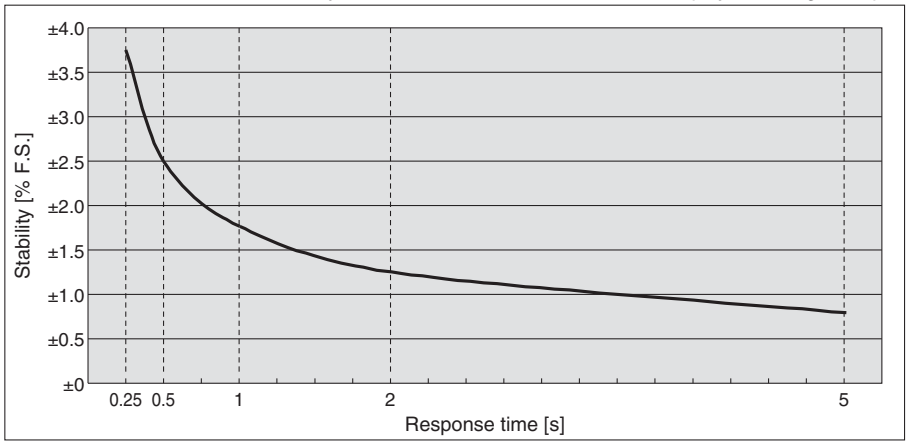
- The smaller the piping size, the more the product is affected by the straight piping length. The straight piping length shall be 5 times (5D) or more of the piping size to achieve the stable measurement.

[mm]

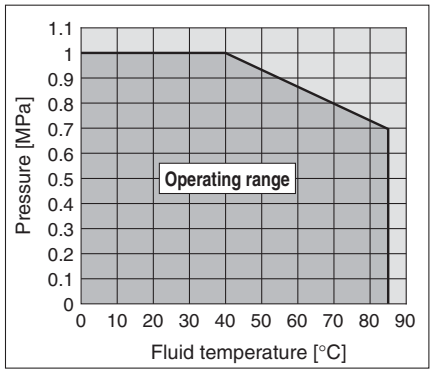
Model	Straight piping length	
	D	5D
LFE1	11	55
LFE2	21	105
LFE3	27	135

Stability

∗ Stability indicates the fluctuation width of the display or analogue output.



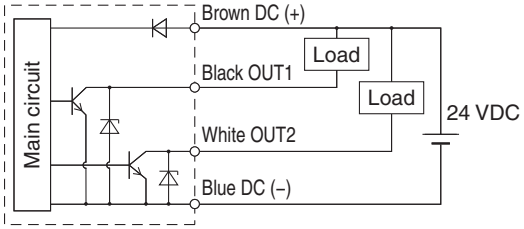
Operating Pressure Range



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.

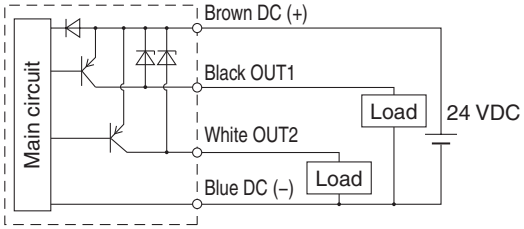
Internal Circuits and Wiring Examples (Integrated Display Type)

NPN 2 outputs type
LFE□A□□□



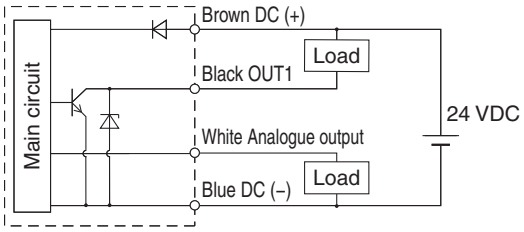
Max. 28 V, 80 mA
Internal voltage drop 1 V or less

PNP 2 outputs type
LFE□B□□□



Max. 80 mA
Internal voltage drop 1.5 V or less

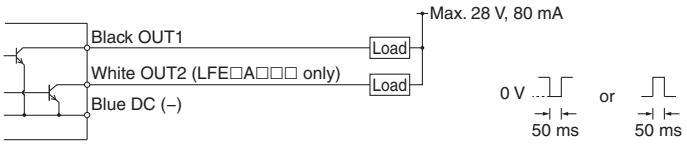
NPN + Analogue output type
LFE□C□□□
NPN + Analogue output type
LFE□D□□□



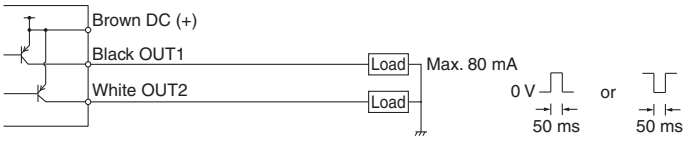
Max. 28 V, 80 mA
Internal voltage drop 1 V or less
C: Analogue output 1 to 5 V
Output impedance 1 kΩ
D: Analogue output 4 to 20 mA
Load impedance 50 to 600 Ω

Accumulated pulse output wiring examples

NPN 2 outputs type
LFE□A□□□
NPN + Analogue output type
LFE□C□□□/LFE□D□□□



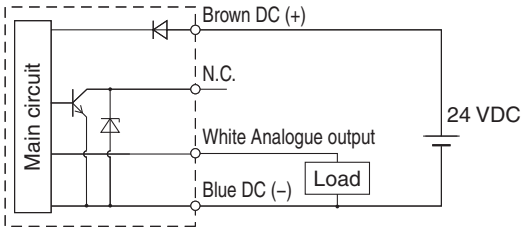
PNP 2 outputs type
LFE□B□□□



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

Internal Circuits and Wiring Examples (Remote Type Sensor Unit)

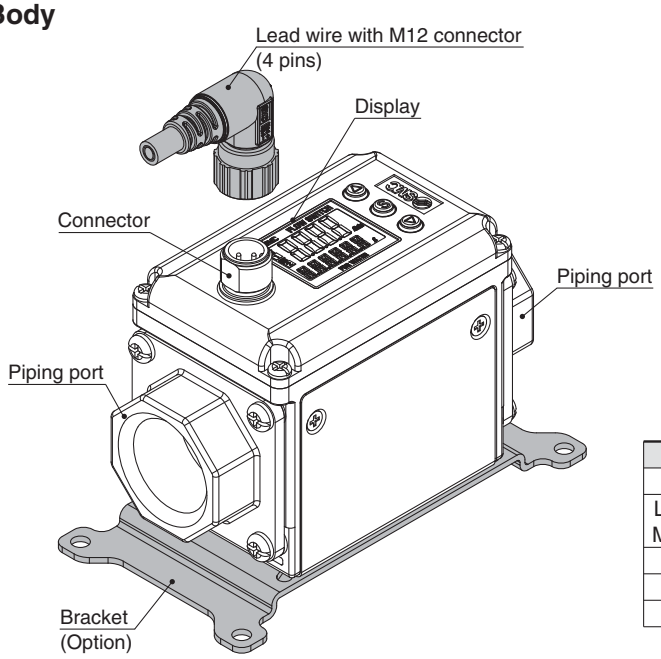
Analogue output type
LFE□J□□□ (Voltage output type)
LFE□K□□□ (Current output type)



∗ Do not connect N.C.

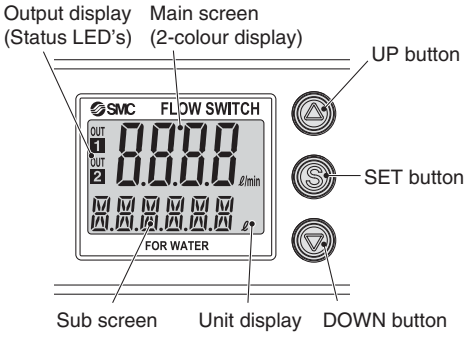
Parts Description

Body



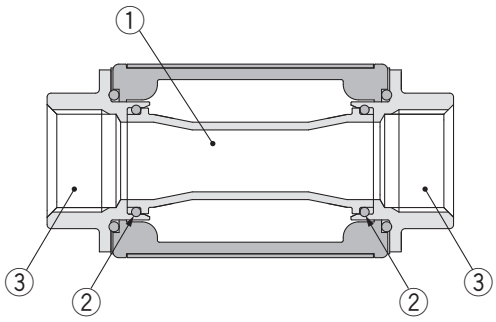
Description	Function
Connector	M12 connector for electrical connections
Lead wire with M12 connector	Cable for supplying power to the product and for receiving output
Piping port	For piping connections
Display	Displays the flow, set values and error information.
Bracket	Mounting bracket for installing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

Display



Description	Function
Main screen (2-colour display)	Displays the flow value, setting mode and error codes.
Sub screen	Displays the accumulated flow, set value, peak/bottom value, flow direction and line names. In setting mode, the set status is displayed. (For details, refer to page 13.)
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.

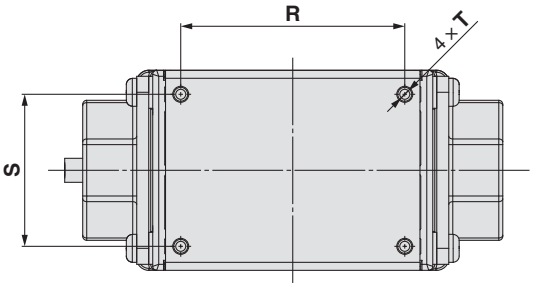
Fluid Passage Structure



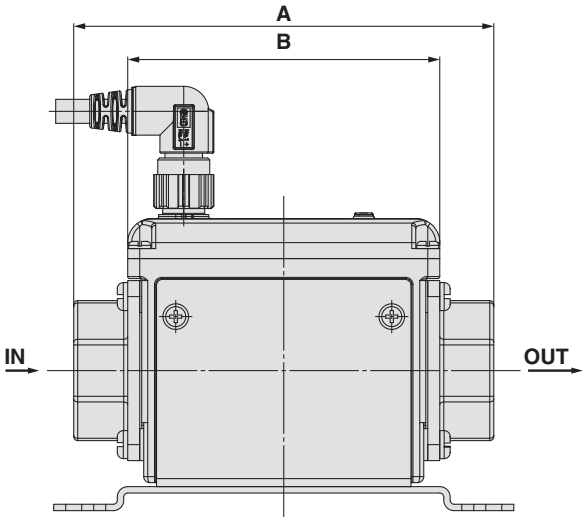
No.	Description	Material
1	**Pipe**	PPS
2	**O-ring**	FKM
3	**Attachment**	C37 (Brass)

Dimensions

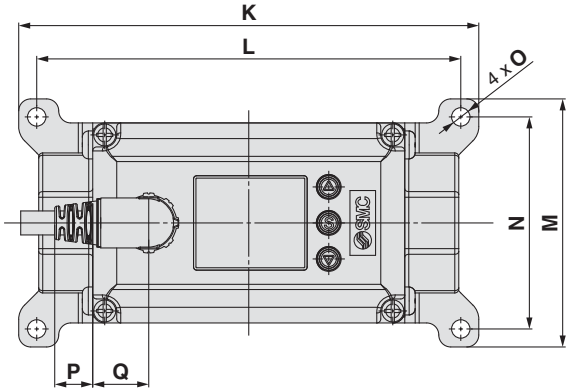
Integrated display type LFE1/2/3



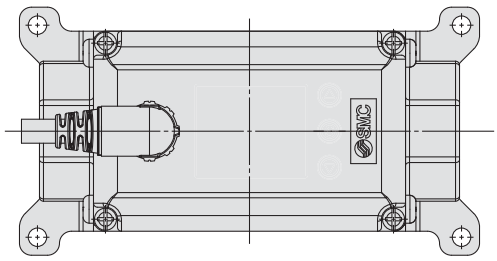
Without bracket (Bottom view)



Bracket thickness is approx. 1.6 mm.



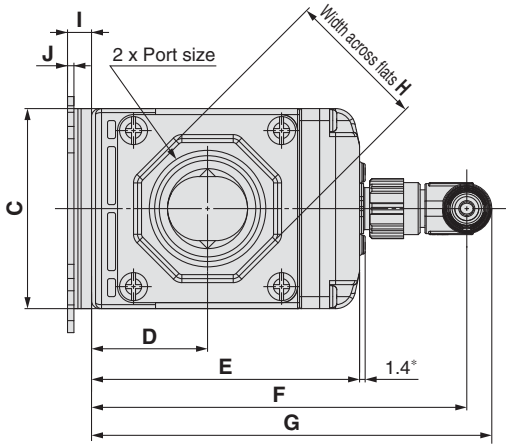
Remote type sensor unit LFE1/2/3



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

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

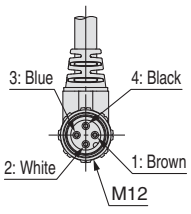
∗ For integrated display type

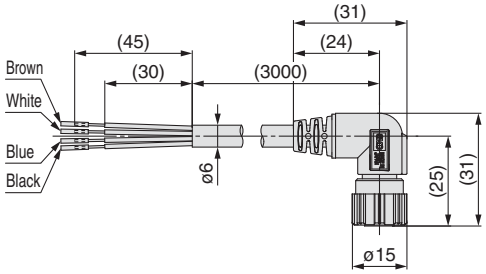


Model	Port size	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
LFE1□3□	3/8	90	73	40	23.5	56	83	89	24	6	1.6	96	87	48	39	4.6	12	11.5	52	28	ø2.5 depth 5.5	2
LFE1□4□	1/2	104	73	40	23.5	56	83	89	28	6	1.6	96	87	48	39	4.6	12	11.5	52	28	ø2.5 depth 5.5	2
LFE2□	3/4	105	78	50	29	67	94	100	35	6	1.6	115	106	62	53	4.6	9.5	14	56	38	ø2.5 depth 5.5	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 6.5	2.6

Lead wire with M12 connector

Pin no.	Pin description	Wire colour
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
	Colours	Brown, White, Black, Blue
Sheath	**Material**	Non-lead heat and oil resistant PVC
Finished external diameter		ø6

3-colour display

Digital Flow Monitor

Series LFE0

How to Order

LFE 0 B □ – M V C

Type

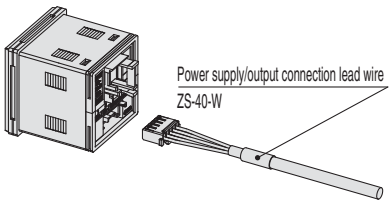
0	Remote type monitor unit

For remote type sensor unit, select the analogue output 1 to 5 V type.
Applicable sensors: LFE□J□□□

Output specifications

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

Lead wire

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

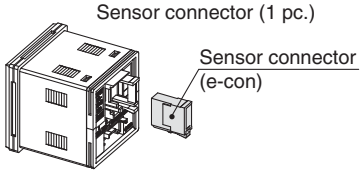
Lead wire is not connected, but shipped together.

Remote type monitor unit/Unit specifications

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

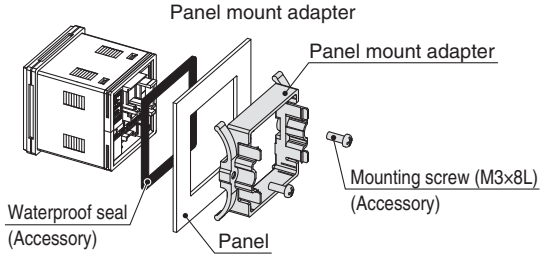
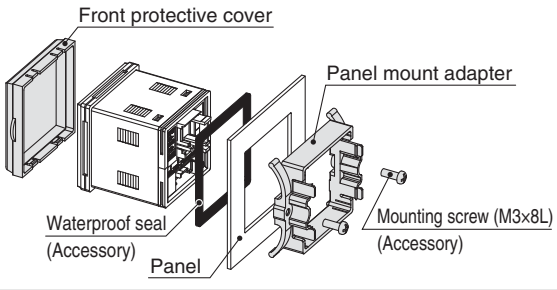
Note) G: Made to Order
Reference: 1 [L/min] ↔ 0.2642 [gal/min]
1 [gal/min] ↔ 3.785 [L/min]

Option 2

—	Without connector
C	Sensor connector (1 pc.) 

Connector is not connected, but shipped together.

Option 1

—	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

Specifications

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
Minimum setting unit			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., Analogue output: ±0.5% F.S.		
Repeatability			±0.5% F.S.		
Temperature characteristics			±0.5% F.S. (25°C reference)		
Accumulated flow range Note 1)			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 80 mA) PNP: 1.5 V or less (at load current 80 mA)		
	Response time Note 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.		
Analogue output	**Response time** Note 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: 300 Ω for 12 VDC, 600 Ω for 24 VDC		
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		

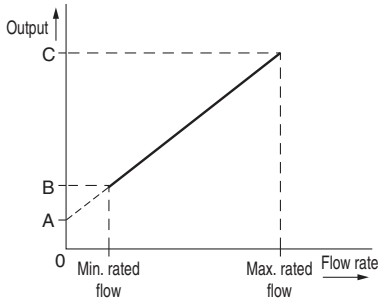
Note 1) Cleared when the power supply is turned off. Hold function can be selected. (Interval of 2 or 5 minutes can be selected.) If the 5 minutes interval is selected, the life of the memory element (electronic parts) is limited to 1 million cycles. (If energized for 24 hours, life is calculated as 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.
Note 2) The response time when the set value is 63% in relation to the step input.
Note 3) The response time until the set value reaches 63% in relation to the step input.

Analogue Output

Flow/Analogue output

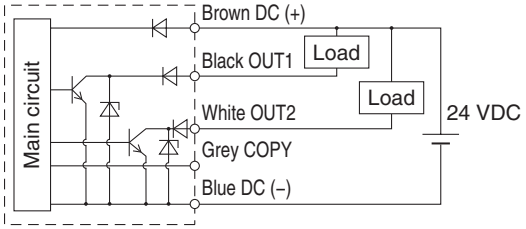
	A	B	C
Voltage output	1 V	1.1 V	5 V
Current output	4 mA	4.4 mA	20 mA

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

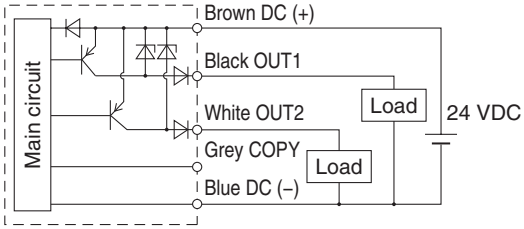


Internal Circuits and Wiring Examples

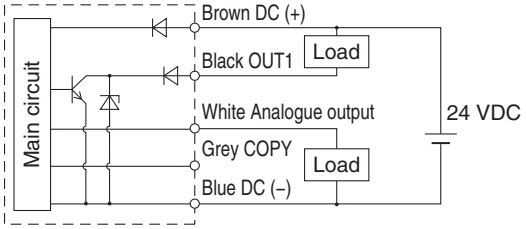
NPN 2 outputs type
LFE0A



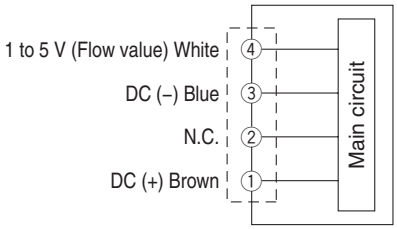
PNP 2 outputs type
LFE0B



NPN + Analogue output type
LFE0C
NPN + Analogue output type
LFE0D



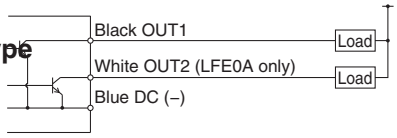
Sensor input circuit

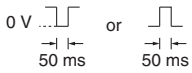


∗ Do not connect N.C.

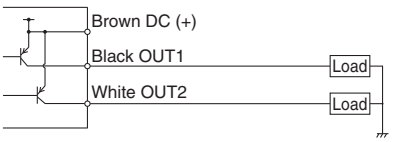
Accumulated pulse output wiring examples

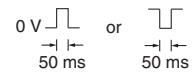
NPN 2 outputs type
LFE0A
NPN + Analogue output type
LFE0C/LFE0D





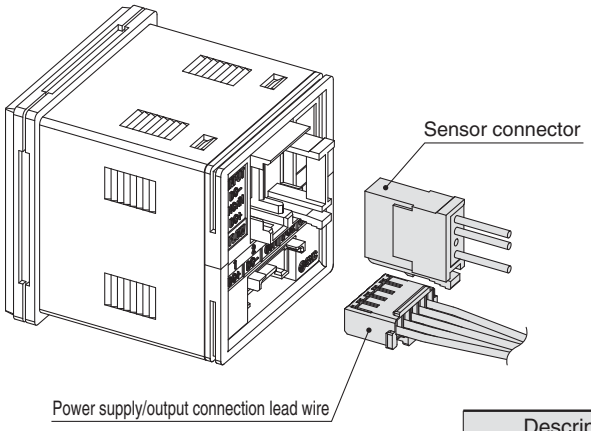
PNP 2 outputs type
LFE0B

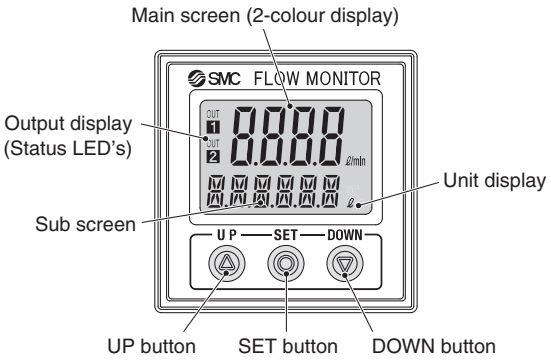




∗ When accumulated pulse output is selected, the indicator light is turned off.

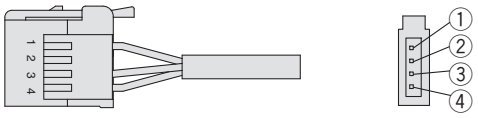
Parts Description (Remote Type Monitor Unit)





Description	Function
Main screen (2-colour 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 the setting mode, the set status is displayed. (For details, refer to page 13.)
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	Press this button to change the mode and to set a value.
DOWN button	Selects the mode and the display shown on the sub screen, or decreases the ON/OFF set value.

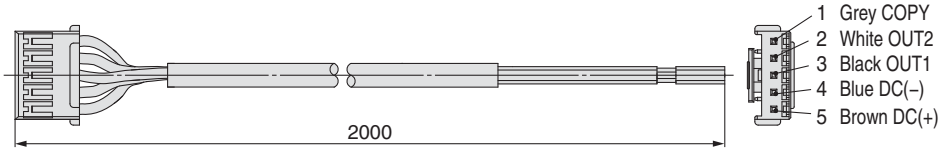
Sensor connector



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

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

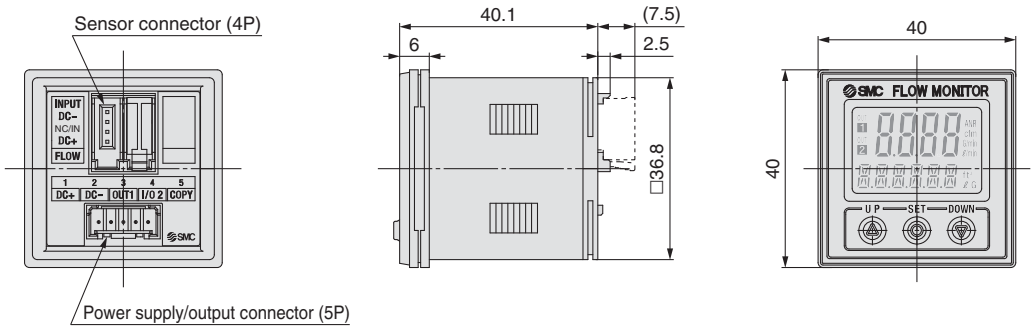
Power supply/output connection lead wire



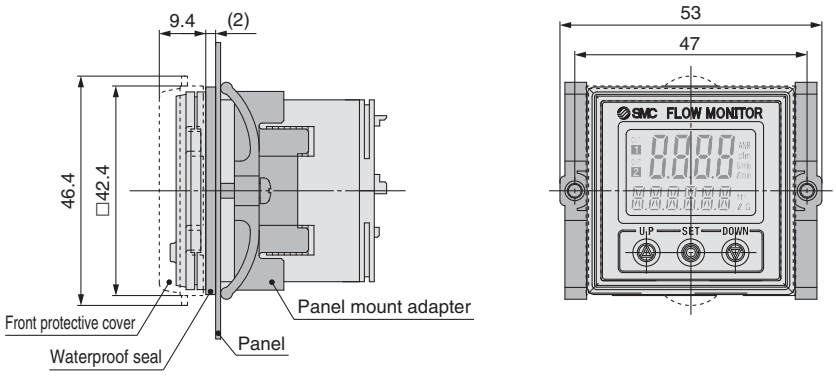
Cable Specifications

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

Dimensions

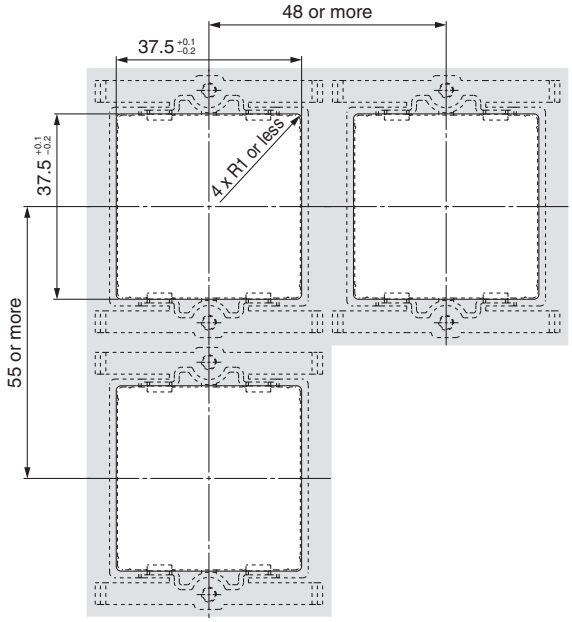


Front protective cover + Panel mount adapter



Panel fitting dimensions

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



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

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

■ Display colour

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

ON: Green, OFF: Red
ON: Red, OFF: Green
Always: Red
Always: Green

■ Setting of response time

The response time can be selected depending on the application. (1 second for default setting)
The flickering of the display can be reduced by setting the response time slower. If you need faster detection of the problem such as leakage of tip cooling water for welding gun, switch output or analogue output can be faster by setting the response time faster. In this case, widen the hysteresis to prevent 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

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

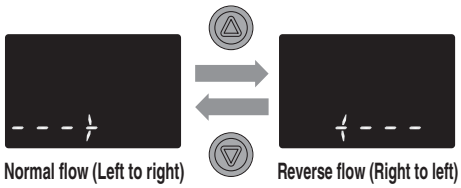
∗ Also, the increase or decrease of the flow will not change the on/off status of the output while the forced output function is activated.

■ Accumulated value hold function

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 cycles. Take this into consideration before using this function.

■ Switching of flow direction

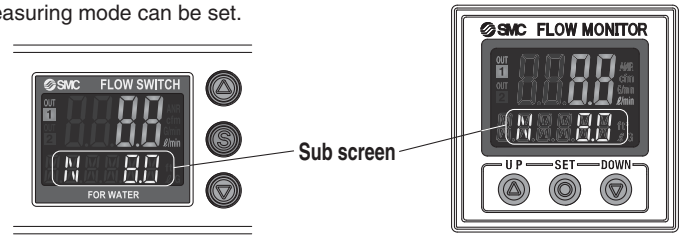
Flow direction can be changed after installation.



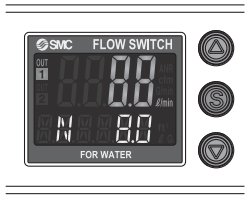
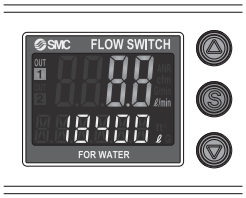
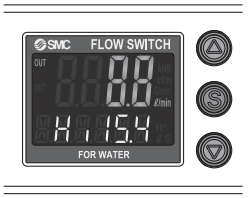
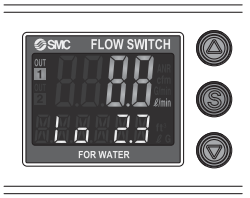
Normal flow (Left to right) Reverse flow (Right to left)

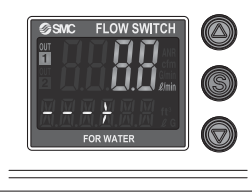
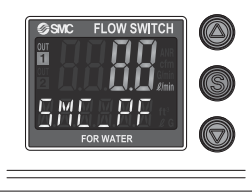
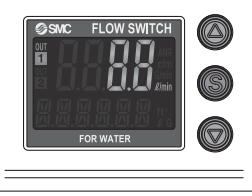
■ Selection of display on sub screen

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	Line name display	Off
Displays the flow direction.	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 the power consumption (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

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

■ Peak/Bottom value display

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

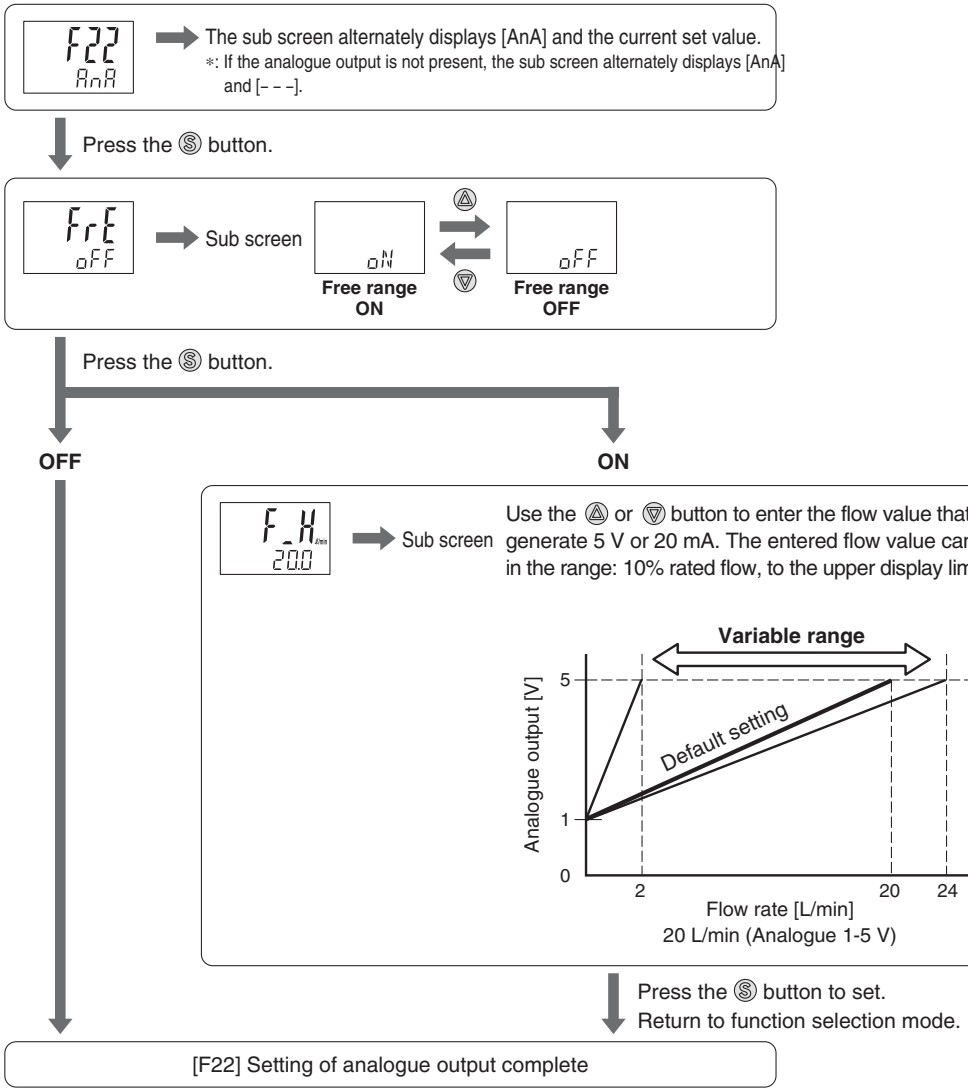
■ Keylock function

Prevents operation errors such as accidentally changing set values.

■ [F22] Setting of analogue output

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

<Operation>
Press the ▲ or ▼ button in function selection mode to display [F22] on the main screen.



■ Error display function

When a failure or abnormality occurs, the location and contents are displayed.

Display	Description	Contents	Action
Er 1	OUT1 over current error	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 turn it on again.
Er2	OUT2 over current error	Load current of 80 mA or more is applied to the switch output (OUT2).	
HHH	Excessive instantaneous flow rate error	Flow has exceeded the display flow range.	Decrease the flow.
LLL	Reverse flow error	Flow is flowing in the reverse direction of the setting.	Change the setting for the flow direction.
999999999 (alternately displays [999] and [999999])	Excessive accumulated flow error	Flow has exceeded the accumulated flow range.	Clear the accumulated flow. (This error does not matter when the accumulated flow is not used.)
Er0	System error	Displayed if an internal error has occurred.	Turn off the power supply and then turn it on again. If the failure cannot be solved, please contact SMC for investigation.
Er4			
Er6			
Er8			
Er10	Sensor error	Power supply voltage exceeds 24 V ±10%.	Check the power supply voltage, and turn off the power supply and then turn it on again.

Specific Product Precautions 1

Be sure to read before handling. Refer to back cover for Safety Instructions, "Handling Precautions for SMC Products" (M-E03-3) and Operation Manual for Flow Switch Precautions. Please download it via our website, http://www.smcworld.com

Design and Selection

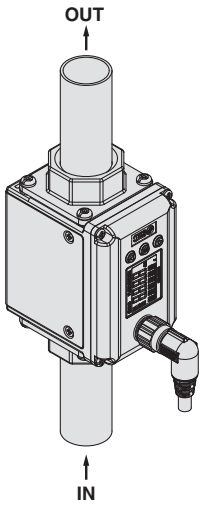
⚠ Warning

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

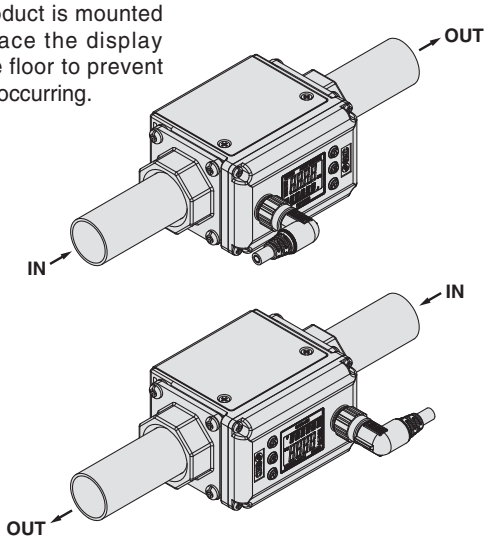
The switches do not have an explosion proof rating. To prevent a possible fire hazard, do not use with inflammable gases or fluids.

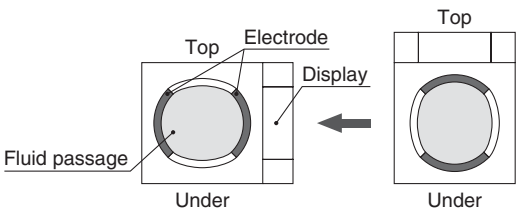
2. Design the system, so that the fluid always fills the detection passage.

If the product is used when the detection passage is not filled, correct detection signal is not output from the electrodes, making correct measurement impossible. Especially for vertical mounting, introduce the fluid from the bottom to the top because bubbles may be generated when applying fluid from the top to the bottom, leading to operation failure.



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





Not susceptible to bubbles **Susceptible to bubbles**

Mounting

⚠ Warning

1. Piping port and the metal part of the body are grounded to DC(-)/blue line.

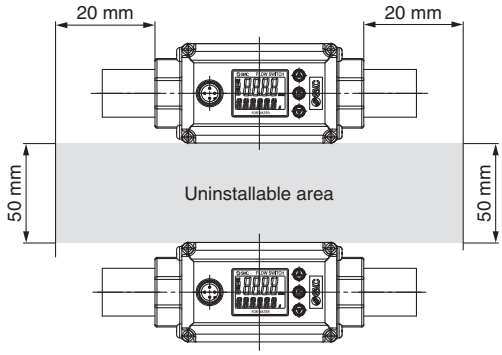
Do not use the power supply with positive ground.

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

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 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 usage.

3. When multiple sensors are used in parallel, install them outside of the area as shown below. (Uninstallable area) If the product is mounted in the area where installation is prohibited, the accuracy will decrease.



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

Specific Product Precautions 2

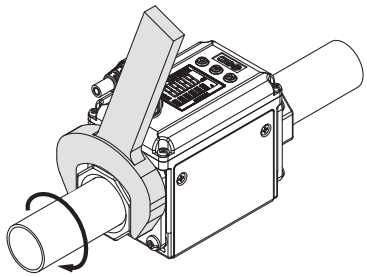
Be sure to read before handling. Refer to back cover for Safety Instructions, "Handling Precautions for SMC Products" (M-E03-3) and Operation Manual for Flow Switch Precautions. Please download it via our website, http://www.smcworld.com

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

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 with 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 explosiion 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.

⚠ 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 deionised water (pure water) and oil.

Applicable Fluids List

Substance description	Judgement	Note
Water	○	Electric conductivity of tap water: 100 to 200 μS/cm
Deionised 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.
GALDEN®	×	Electric conductivity is too low.
Fluorinert™	×	Electric conductivity is too low.

∗ 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.

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Specific Product Precautions 3

Be sure to read before handling. Refer to back cover for Safety Instructions, "Handling Precautions for SMC Products" (M-E03-3) and Operation Manual for Flow Switch Precautions. Please download it via our 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

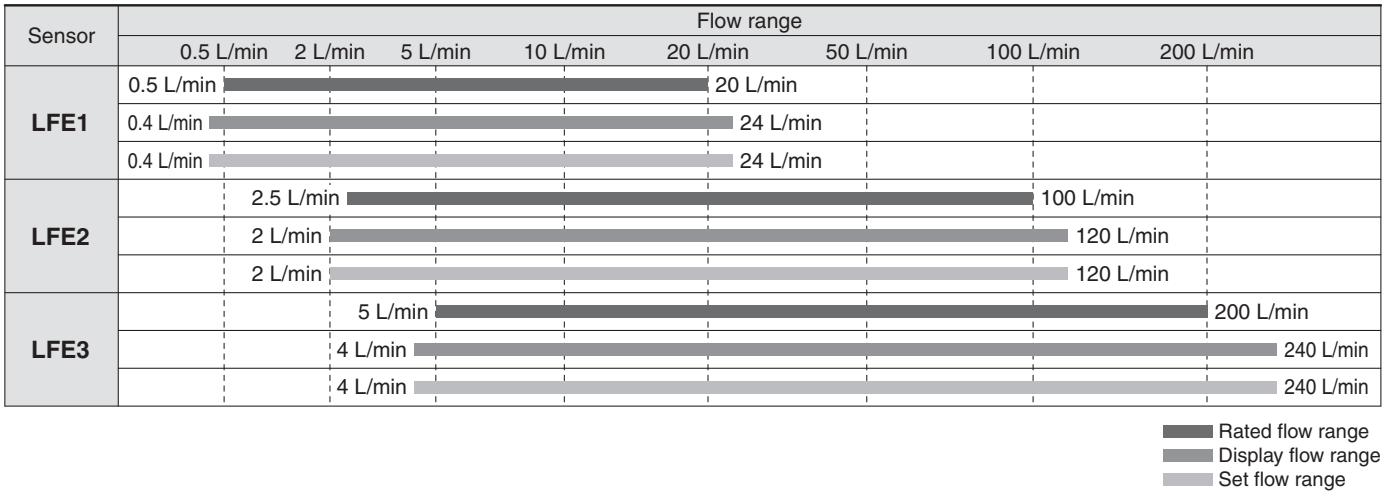
⚠ Caution

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 catalogue 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 catalogue.
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.*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 catalogue 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.

⚠ Safety Instructions Be sure to read "Handling Precautions for SMC Products" (M-E03-3) before using.

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