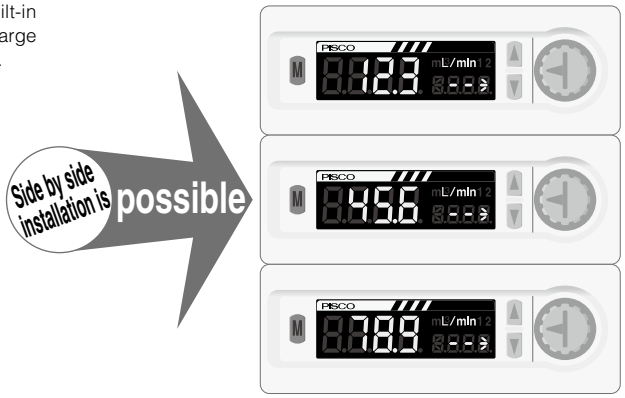
Best suitable for flow management and suction lift verification of small work piece

Flow Sensor FUS20

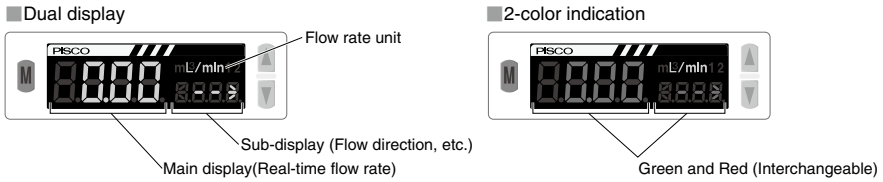
Characteristics

- Built-in needle valve model. Flow adjustable needle valve and sensor are integrated into one unit. Fuss-free plumbing and minimized installation space are realized.

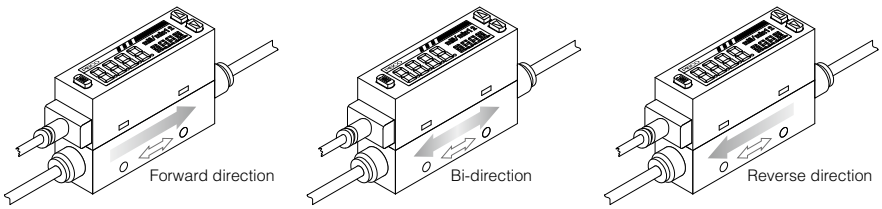
- Panel mount is possible. Bracket for panel mount is available. Sensor as well as built-in needle valve sensor can be panel mounted. Since coherent installation is possible, one large panel cut make possible for mounting multiple sensors with minimum space and process.



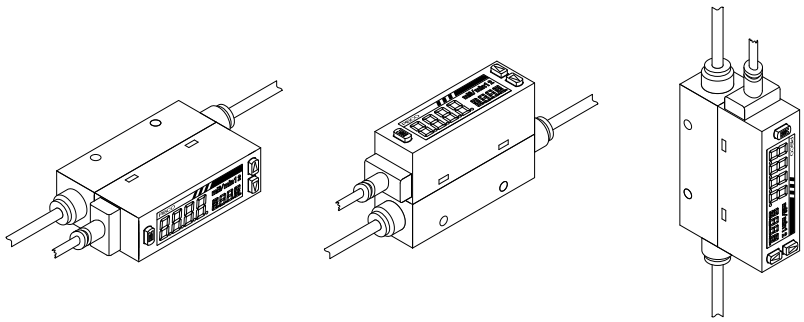
- Dual display / 2 color indication feature. Introduction of main and sub display improve operability. Additionally, 2 colors indication makes easy cognition of error.



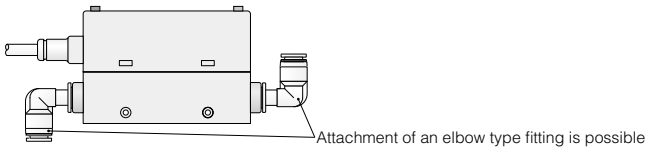
- High accuracy: Max. ± 3%F.S. Precise flow measurement is possible.
- Quick response time: Max. 50msec. High-speed response is realized by incorporating a platinum sensor chip processed with silicon micromachining. It contributes to shorten cycle time.
- Bi-directional flow measurement is possible. Bi-directional flow model can measure the flow of preset direction. Flexibility of the plumbing installation improves and usable for reverse flow detection.



- Free installation orientation. The sensor can be mounted in any orientation: top, bottom, left, or right.



- No straight piping is required at both upstream or downstream side



Model designation of Flow sensor (Example)

FUS20 (1) - **N** (2) **V** (3) - **F** (4) **005** (5) - **4** (6) **1** (7) **B** (8) **N** (9)

(1) **FUS20**: Flow sensor

(2) Output type
- **N**: Switch output NPN 2 points, 1 point Analog output
- **P**: Switch output PNP 2 points, 1 point Analog output

(3) Analog output type
- **V**: Voltage output (1V~5V)
- **A**: Current output(4mA~20mA)

(4) Flow direction
- **F**: One-directional
- **R**: Bi-directional*

* Selectable only for no needle valve equipped type.

(5) Flow rate range (Full scale flow rate)
- **005**: 0.5ℓ/min
- **010**: 1ℓ/min
- **020**: 2ℓ/min
- **050**: 5ℓ/min
- **100**: 10ℓ/min
- **200**: 20ℓ/min
- **500**: 50ℓ/min
- **101**: 100ℓ/min
- **201**: 200ℓ/min

*Please refer to the table below for the combination of flow range and applicable tube size.

Table: Flow range and applicable tube size

		Applicable tube size code			
		4	**6**	**8**	**10**
Flow rate code	**005**	●	●		
	010	●	●		
	020	●	●		
	050	●	●		
	100	●	●		
	200	●	●		
	500		●	●	
	101			●	●
	201			●	●

(6) Applicable tube size
- **4**: ø4mm
- **6**: ø6mm
- **8**: ø8mm
- **10**: ø10mm

* Please refer to right table for the combination of flow range and applicable tube size.

(7) Cable
- **No code**: Without cable
- **1**: 1m
- **3**: 3m

(8) Bracket
- **No code**: Without Bracket
- **B**: With bracket
- **P**: With panel mount kit set

(9) Needle valve
- **N**: Built-in needle valve
- **No code**: No needle valve

Model designation of Accessories (Example)

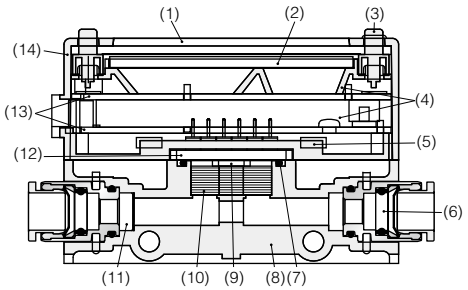
FUS20 (1) - **B1** (2)

(1) **FUS20**: Flow sensor

(2) Accessory option
- **B1**: Bracket
- **P**: Panel mount kit set
- **PN**: Panel mount kit set for built-in needle valve type
- **C51**: 5-core cable 1m
- **C53**: 5-core cable 3m

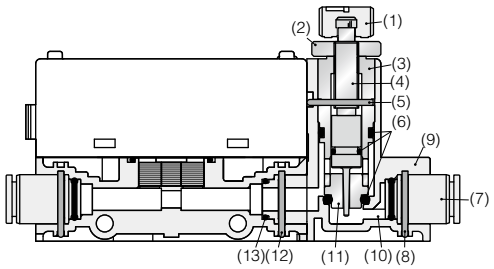
Construction

■ No needle valve



No	Parts	Material
(1)	LCD cover	Acryl resin
(2)	LCD	–
(3)	Switch	EPDM
(4)	Circuit board spacer	PC
(5)	Module retainer	PA
(6)	Cartridge fitting	–
(7)	Sensor gasket	FKM
(8)	Resin body	PA
(9)	Sensor chip	Semiconductor chip
(10)	Rectification plate	Stainless steel
(11)	Port filter	Stainless steel
(12)	Sensor circuit board	Alumina
(13)	Electronic substrate	–
(14)	Case	ABS

■ Built-in needle valve



No	Parts	Material
(1)	Knob	PBT
(2)	Lock nut	Nickel plated brass
(3)	Needle guide	Nickel plated brass
(4)	Needle	Nickel plated brass
(5)	Fixing pin	Stainless steel
(6)	O-ring	FKM
(7)	Cartridge fitting	–
(8)	Fixing pin for fitting	Stainless steel
(9)	Needle valve body	PA
(10)	Port filter	Stainless steel
(11)	Orifice	Nickel plated brass
(12)	Fixing pin for fitting	Stainless steel
(13)	O-ring	FKM(Fluororesin coating)

*Please refer to no needle type for the main parts of the sensor.
*Needle of FUS20…005/010/020 is stainless steel.
*Orifice of FUS20…005/010/020 is PTFF.

RoHS The products listed in this page are ECO-friendly products.
* Please refer to page 4 for the details of ECO-friendly products.

FUS20
No needle valve, one directional type

Model code FUS20-[2][3]-[4]-[6][7][8]
FUS20-[2][3]-F005-[6][7][8]
FUS20-[2][3]-F010-[6][7][8]
FUS20-[2][3]-F020-[6][7][8]
FUS20-[2][3]-F050-[6][7][8]
FUS20-[2][3]-F100-[6][7][8]
FUS20-[2][3]-F200-[6][7][8]
FUS20-[2][3]-F500-[6][7][8]
FUS20-[2][3]-F101-[6][7][8]
FUS20-[2][3]-F201-[6][7][8]

FUS20
No needle valve, bi-directional type

Model code FUS20-[2][3]-[4]-[6][7][8]
FUS20-[2][3]-R005-[6][7][8]
FUS20-[2][3]-R010-[6][7][8]
FUS20-[2][3]-R020-[6][7][8]
FUS20-[2][3]-R050-[6][7][8]
FUS20-[2][3]-R100-[6][7][8]
FUS20-[2][3]-R200-[6][7][8]
FUS20-[2][3]-R500-[6][7][8]
FUS20-[2][3]-R101-[6][7][8]
FUS20-[2][3]-R201-[6][7][8]

FUS20
Built-in needle valve type

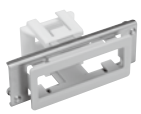
Model code FUS20-[2][3][4]-[6][7][8]N
FUS20-[2][3]-F005-[6][7][8]N
FUS20-[2][3]-F010-[6][7][8]N
FUS20-[2][3]-F020-[6][7][8]N
FUS20-[2][3]-F050-[6][7][8]N
FUS20-[2][3]-F100-[6][7][8]N
FUS20-[2][3]-F200-[6][7][8]N
FUS20-[2][3]-F500-[6][7][8]N
FUS20-[2][3]-F101-[6][7][8]N
FUS20-[2][3]-F201-[6][7][8]N

Accessories

FUS20-C5□
Connector cable

Model code
FUS20-C51
FUS20-C53

FUS20-P
Panel mount kit set



Model code
FUS20-P

FUS20-PN
Panel mount kit set for needle valve type

Model code
FUS20-PN

FUS20-B1
Bracket

Model code
FUS20-B1

Caution
*For [2], please select output type.
*For [3], please select analog output type.
*For [6], please select applicable tube size.
*For [7], please select cable code.
*For [8], please select bracket code.

Package specification
1 pc. in a bag

Specification

Item		Full scale flow rate		005	010	020	050	100	200	500	101	201
Flow rate range(*1)	005	500mℓ/min		●								
	010	1ℓ/min			●							
	020	2ℓ/min				●						
	050	5ℓ/min					●					
	100	10ℓ/min						●				
	200	20ℓ/min							●			
	500	50ℓ/min								●		
	101	100ℓ/min									●	
	201	200ℓ/min										●
Port size	4	ø4mm Push-in fitting		●	●	●	●	●	●			
	6	ø6mm Push-in fitting		●	●	●	●	●	●	●		
	8	ø8mm Push-in fitting								●	●	●
	10	ø10mm Push-in fitting									●	●
Built-in needle valve type		N (*9)		●	●	●	●	●	●	●	●	●
Flow rate display(*1)(*2)		Indication range		4 digits + 4 digits 2 colors LCD								
		Indication system	F	0~500 mℓ/min	0~1000 mℓ/min	0~2.00 ℓ/min	0~5.00 ℓ/min	0~10.00 ℓ/min	0~20.0 ℓ/min	0~50.0 ℓ/min	0~100.0 ℓ/min	0~200 ℓ/min
			R	-500~500 mℓ/min	-1000~1000 mℓ/min	-2.00~2.00 ℓ/min	-5.00~5.00 ℓ/min	-10.00~10.00 ℓ/min	-20.0~20.0 ℓ/min	-50.0~50.0 ℓ/min	-100.0~100.0 ℓ/min	-200~200 ℓ/min
		Indication resolution		1mℓ/min		0.01ℓ/min			0.1ℓ/min			1ℓ/min
Integrating function(*3)		Display range		9999999mℓ		99999.99ℓ			999999.9ℓ			9999999ℓ
		Indication resolution		1mℓ		0.01ℓ			0.1ℓ			1ℓ
		Integrating pulse output rate		5mℓ	10mℓ	0.02ℓ	0.05ℓ	0.1ℓ	0.2ℓ	0.5ℓ	1ℓ	2ℓ
Operating conditions		Admitted media (*4)		Clean air (JIS B 8392-1.1.1~5.6.2.), Compressed air (JISB 8392-1.1.1.~1.6.2), Nitrogen gas								
		Max. operating pressure		0.7MPa (101.5psi)								
		Min. operating pressure		-0.09MPa (-26.58in. Hg)								
		Proof pressure		1MPa (145psi)								
		Operating ambient temp. and hum.		32 ~ 122°F (0 ~ 50°C) 90%RH or less								
		Operating media temp.		32 ~ 122°F (0 ~ 50°C) (No freezing)								
Accuracy		Accuracy assurance range		3 ~ 100%F.S.								
		Linearity(Display/analog output)		±3%F.S. or less (Open to air at secondary side, 25°C)								
		Pressure characteristics		±5%F.S.or less (-0.09~0.7Mpa criteria: Open to air at secondary side)								
		Temperature characteristics		Max. ±0.2%F.S./°C (15 to 35°C, 25°C criteria)								
		Repeatability (Repeat accuracy)		±1%F.S. or less								
Response time			(*5)	50ms or less								
Output	Switch output		N	2 points (NPN open collector output, 50mA or less, voltage drop 2.4V or less)								
			P	2 points (PNP open collector output, 50mA or less, voltage drop 2.4V or less)								
	Analog output		V	1 points (1 to 5V voltage output and connected load impedance 50kΩ and over)								
			A	1 points (4 to 20mA current output and connected load impedance 300Ω or over)								
Power supply voltage(*6)			V	12 ~ 24VDC (10.8~26.4V)								
			A	24VDC (21.6~26.4V)								
Current consumption			(*7)	50mA or less								
Lead wire				ø3.7 AWG26 equivalent × 5 cores (connector), Outside diameter of insulator is ø1.0								
Functions				Flow rate display, flow rate display-peak hold, output and analog output								
Installation	Installation orientation			Both vertical and horizontal								
	Straight piping part			Not required								
Protective structure				IEC standards IP40								
Protective circuit			(*8)	Power supply and switch output reverse connection protections, and switch output load short-circuit protection								
EMC directive				Compliant								

Note 1: Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa)

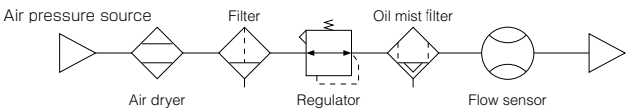
Note 2: Flow late display is only the read within rough ± 1% F.S. Therefore, the value differs from accuracy assurance range.

Note 3: Integrated flow display is reference value. When power-off, it is reset.

Note 4: When using compressed air, use clean air complying with JIS B 8392-1:2003 class over 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration rating: 5μm), air dryer (minimum pressure dew point 10°C or less) and oil mist filter (maximum oil concentration 0.1mg/m^3) on the primary side of the product to maintain product function.

When using for purposes other compressed air, use dry gas that does not contain corrosive elements such as chlorine, sulfur or acids, and clean gas that does not contain dust or oil mist.

〈Recommended circuit〉



[Recommended to use]
Air filter
Oil mist filter

Note 5: The response time can be selected from 50ms to 1500ms (7 levels).

Note 6: Power supply specification of voltage output type and current output type is different.

Note 7: Current consumption: at VDC24 connected with no-load. Current consumption changes depending on load.

Note 8: This product's protective circuit is effective only for specific incorrect connections and load short-circuits. It does not necessarily protect circuit from all inconnections.

Note 9: This product cannot be used as shut-off valve. Flow sensor allows leakage to certain extent.

Detailed Safety Instructions

Before using the PISCO products, be sure to read the "Safety Instructions", "Common Safety Instructions for Products in This Catalog" on page 13 to 16.

■Safety rules for use

Before using PISCO products, be sure to read the following instructions.
When designing and manufacturing a device using PISCO products, it is obligated for the device manufacturer to check that device safety mechanical mechanism, pneumatic control circuit, or water control circuit and the system operated by electrical control that controls the devices is secured.
It is important to select, use, handle, and maintain the product appropriately to ensure that the PISCO product is used safely.
Observe warnings and instructions to ensure device safety.
Check that device safety is ensured, and manufacture a safe device.

⚠Warning : 1. This product is designed and manufactured for use in general industrial machines. Therefore, handle it with enough knowledge and experience.
2. Use this product within the specifications. The usage out of the specifications is prohibited. Never remodel or process the product additionally. Application range of this product is limited to use in general industrial machines. It shall not be used outdoors, under the conditions and environment below.
(1) Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, or applications coming into contact with beverage or food, amusement equipment, emergency shutoff circuits, press machine, brake circuits, or for safeguard.
(2) Use for applications where life or assets could be adversely affected, and special safety measures are required.
3. Observe corporate standards and regulations, etc., related to the safety of device design and control, etc.
ISO 4414, JIS B 8370 (pneumatic system rules)
JPAS 005 (policy for pneumatic cylinder use and selection)
High Pressure Gas Maintenance Laws Occupational Safety and Sanitation Laws, and other safety rules, association standards and regulations.
4. Do not handle, pipe, or remove devices before confirming safety.
(1) Inspect and service the machine and devices after confirming safety of the entire system related to this product.
(2) Note that there may be hot or charged sections even after operation is stopped.
(3) When inspecting or servicing the device, turn off the energy source (air supply or water supply), and turn off power to the facility. Discharge any compressed air from the system, and pay enough attention to possible water leakage and leakage of electricity.
(4) When starting or restarting a machine or device that incorporates pneumatic components, make sure that the system safety, such as pop-out prevention measures, is secured.
5. Observe warnings and cautions on the pages below to prevent accidents.

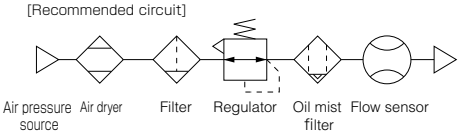
■Design and selection

1. Fluid medium

⚠Danger • A flammable fluid must not be used.

⚠Warning • This product cannot be used for commercial purposes.
Not conformed to the Japanese Measurement Law, do not use the product for the commercial purpose. Use the product as an industrial sensor.
• Do not use the product with other than applicable fluid medium, or the accuracy can not be guaranteed.
• Install a filter, an air dryer and an oil mist filter onto the primary side (upstream) of the sensor since the compressed air from the compressor contains drain (water, oil oxide and foreign material, etc.) Mesh (wire net) in a sensor is used to rectify the flow in the pipe. Always install a filter since this mesh is not a filter to remove foreign materials, etc.

[Recommended circuit]



• When using a valve on the primary side of this product, only use an oil-prohibit specification valve. This controller could malfunction or fail if subject to splattering grease or oil, etc. Install a filter to prevent galling of the valve from adhering to the sensor.
• Do not use the product in an environment containing corrosive gas such as chlorine, sulfur, acid and etc. Fluid medium should be dry and clean gases which do not dust of oil mist.
• Do not seal fluid medium in the piping for long time. It may negatively affect the product depending of quality of the fluid medium.

2. Usage environment

⚠Danger • Flammable environment
A flammable fluid must not be used. Please do not use the product in flammable gas environment. Since the product is not explosion-proof, explosion or fire may be caused.

⚠Warning • Corrosive environment
Please use the product within the ambient / fluid temperature ranges 0 to 50 °C. Even in the specified temperature range, please do not use the product where ambient / fluid temperatures change suddenly, and form dew condensations
• Max. operating pressure and flow range
Please use the product in accordance with specifications. If used out of the maximum operating pressure and operating flow range, the product may result in failures.
• Drip-proof environment
The protective structure of this product is equivalent to IP40. Please do not install the product where moisture, salt, dust or swarf is contained, or where pressurized, or depressurized, neither Even in the specified temperature range, do not use the product where ambient and fluid temperatures will change suddenly, and form dew condensations.

3. Flow rate unit

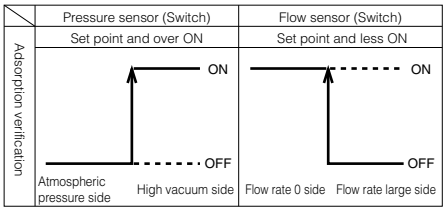
⚠Caution • The flow rate of this product is measured by mass flow not depended with temperature and pressure. Unit is l/min where mass flow is converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa).

4. Overflow

⚠Caution • Even if twice as much overflow as each series measuring range is applied to the sensor, it is no problem, however, If dynamic pressure is applied near to the maximum working pressure, (when the pressure applied to the primary side with the secondary side released.), the sensor may fail. When feeding work pieces during leakage inspection, if dynamic pressure is applied, always provide a by-pass circuit or a needle valve to avoid dynamic pressure applying to the sensor.

5. Adsorption verification and equivalent application

⚠Caution • When using this product with adsorption verification, etc., select the flow rate range according to vacuum range and adsorption nozzle diameter.
• When using this product with adsorption verification, etc., always install an air filter onto the upstream of suction side to prevent suction of foreign materials.
• When using this product with adsorption verification, etc., considering atmospheric dew point and ambient temperature of this product, use the product under the conditions that dew condensations will not be formed in the inside of pipe.
• When using this product with adsorption verification, etc., response time may delay per pipe volume between this product and adsorption nozzle. In that case, take countermeasures such as reducing piping volume.
• When using the product with vacuum applications such as air absorption, etc., do not bend the tube near the push-in joint section. If stress is applied to the tube near the push in joint, insert the tube into the push-in joint after inserting the insert ring.
• When the sensor for adsorption verification is replaced from the pressure sensor (switch) to the flow sensor (switch), the theory of sensor output (switch output) is reversed as in the below figure. Care must be taken since change and modification of sequence program of PLC are required. If source pressure/vacuum is not supplied when equipment power turned on. Take necessary treatment to prevent problems in sequence program, etc., of PLC since flow sensor (switch) maintains [flow rate 0] = [sensor output (switch output) ON].



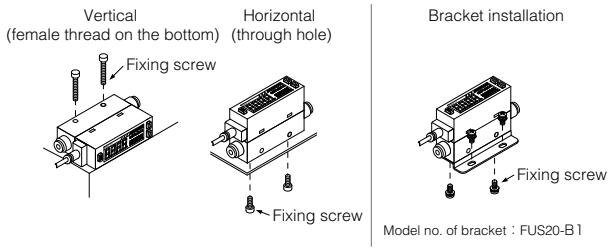
■Installation & adjustment

1. Piping

⚠Warning
- Please finish piping and installation before wiring.
- Make sure the flow direction and direction specified on the body matches.
- Please flash the pipe by air blow to remove foreign substances and swarf before piping. Large amount of foreign materials or swarf inside piping may damage rectification plate, sensor chip and other parts.
- Insert a tube fully until tube end and make sure the tube does not come off by pulling before the actual use. Besides, a tube should be cut at right angle by a dedicated tube cutter.

2. Installation

⚠Warning
- Indication of flow rate is LED. Indication is not easy to see from some angle.
- This product can be installed with any orientation; vertical, horizontal, right or left.



* Tightening torque of fixing screw is 0.5N.m.

* Tightening torque of panel stopper is 0.06N・m.
* Make sure to conduct piping before installing panel mount so as not to apply excessive force to panel mount parts.
* At panel mount installation, avoid to give vibration to the product as much as possible.

3. Wiring

⚠Danger
- Power supply voltage and outputs must be used with the specified voltage. Applying more than specified voltage may cause malfunction, damage of sensor, electric shock or fire. Please do not apply load more than the rated output. Damage of the output or fire may be caused.

⚠Warning
- Line color must be checked when wiring. Check the wiring color with instruction manual, since improper wire connection may result in damage, failure or malfunction of the sensor.
- Insulation of wiring should be checked.
  Eliminate factors which can cause damage on sensor or malfunction such as contact, ground fault and terminal insulation defective with other circuits, or overcurrent.
- For the power supply to be used, use DC stabilized power supply insulated form alternating current power supply and in rated range. If power supply is not insulated, electric shock may be created. If power supply is not stabilized, the peak magnitude may exceed the rated value, causing damage of this product, or reducing the accuracy.
- Please make sure to put connector cover on after connecting connector.
- Please do not stress a cable drawing position directly or connector.
- For wiring, stop control unit/machinery and equipment, and turn off the power supply. Sudden operation may create unexpected motions, causing a danger. First, attempt energizing test, then set the desired switch data while control unit, machinery and equipment are stopped. Discharge static electricity built in body, tool and equipment before and during work. Use a wire with elasticity such as wire for robot in the movable part.
- Power supply voltage should be used with specified voltage. Applying the voltage more than specified voltage or alternating current may cause malfunction, damage of sensor or damage by fire.
- This product and wiring must be installed as far away as possible from noise source such as strong electric line, etc. Take other countermeasures for a surge on the power supply line.
- Do not short-circuit a load, or damage or burn will be caused.
- Output impedance of analog voltage output type is 1kΩ. In the case impedance of connected load is low, margin of output becomes large. Check the margin of connected load before use the product.

Example)

Voltage output impedance: Ro=1kΩ
Load inside impedance: Rx=1MΩ

$$\text{Output value} = \left(1-\frac{Ro}{Ro+Rx}\right)\times 100\%$$

$$= \left(1-\frac{1k\Omega}{1k\Omega+1M\Omega}\right)\times 100\% \Rightarrow \text{Output margin Approx. 0.1\%}$$

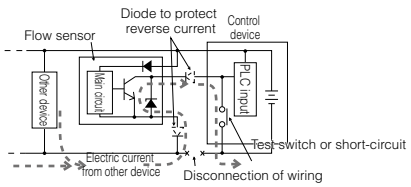
4. Adjustment

⚠Warning
- Switching when the flow is unstable such as pulsation may cause instability of operation. At such a case, secure enough gap between 2 set values or avoid switching within the unstable range. Make sure switching operation is proper before use.

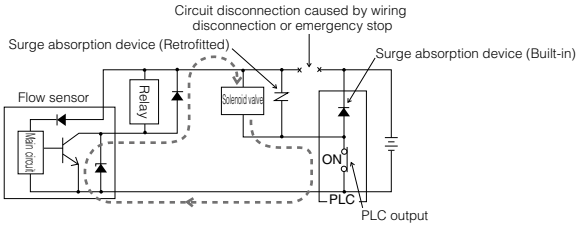
■Use and maintenance

⚠Warning
- Output accuracy is affected by self-heating caused by energizing other than temperature characteristics. At the time of usage, stand-by time. (over 5 minutes after energization) must be provided.
- For self-diagnosis, this product does not conduct flow rate detecting switch operation for about 4 seconds immediately after energized.
  Please make a control circuit and programs to ignore signals for about 4 seconds after energized.

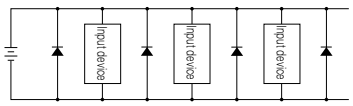
⚠Caution
- Turn off power and stop operation immediately is any trouble found and contact PISCO.
- This product should be used within the rated flow rate.
- This product should be used within the specified operation current.
- When changing set points of the output, please stop the equipment, then change the set points, or an accident may occur on control devices.
- Implement a periodical maintenance more often than 1 time/year and check for normal operation.
- Disassembly and modification must not be done or causing a failure.
- Case material is resin. Solvent/alcohol/cleaner, etc., should not be used to remove contamination, etc., or causing a resin to be corroded. Please wipe with diluted neutral detergent by tightly squeezed cloth, etc.
- Please take care of reverse current generated by disconnection of wiring or wiring resistance. When Flow Sensor shares the same power source with other devices, short-circuiting switch output wire and the negative side of power source to check operation of control devices' input function, or disconnection of the negative side of power course may cause reverse current at switch output wiring and cause damage.



• Take following measures to protect reverse electric current.
1) Avoid concentration of electric current to power source wiring, especially to the power source wiring at negative side and have wiring thick as much as possible.
2) Limit devices connected to the same power source as Flow sensor.
3) Wire a diode in series at output wire of Flow sensor to prevent reverse electric current.
4) Wire a diode in series at the negative side of power source to prevent reverse electric current.
• Take care of surge electric current.
In case Flow sensor shares the same power resource with induction load device generating surge current such as solenoid valve or relay and if the electric circuit is disconnected with induction load on, surge current may enter switch output circuit and damage it depending on a place of a surge absorption device.



• Please take following countermeasures to prevent damage by enter of surge current.
1) Separate power source for output devices such as solenoid valve, relay and others which are induction load from that for input devices for flow sensor and others.
2) When separating power source is not possible, directly install surge absorption devices for all induction loads. Surge absorption device connected to PLC can protect only the device.
3) Furthermore, wire surge absorption devices at some places as the below figure to be ready for the unexpected possible disconnection.



Make sure to power off when disconnect connectors. Disconnecting connectors while energizing may damage output circuit because of the above explained phenomenon.

• When flow range is out of the specification, analog output is possible. Indication is either “Hi” or “Lo”. But flow rate accuracy is not guaranteed in that case.
• Do not press the display, or troubles may be caused.

■Detailed safety instructions for Built-in Needle Valve Type

1. Design and selection

⚠Caution
• This product cannot be used as a stop valve requiring air tightness since it allows some leakage.
• Dust emission in flow path of needle valve is not zero. When dust emission is a trouble, use a filter such as Hollow Fiber Membrane filter (MFU) together with.

2. Installation and adjustment

⚠Caution
• Do not rotate the knob too much to close or open fully (Tightening torque: Max.0.05N m). Besides, do not grab Lock-nut to adjust needle, or needle may be damaged.

3. Use and maintenance

⚠Caution
• Vibration can rotate needle and may change the flow rate.