

Flow Sensor **FUS20**

*Suction lift verification of small workpiece,
which is hard to detect by pressure sensor,
or flow management is possible.*



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.

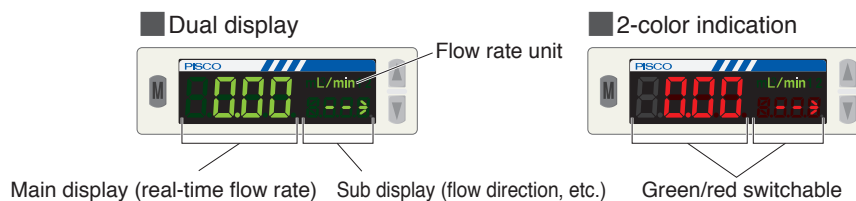


Coherent installation is possible

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. $\pm 3\%F.S.$

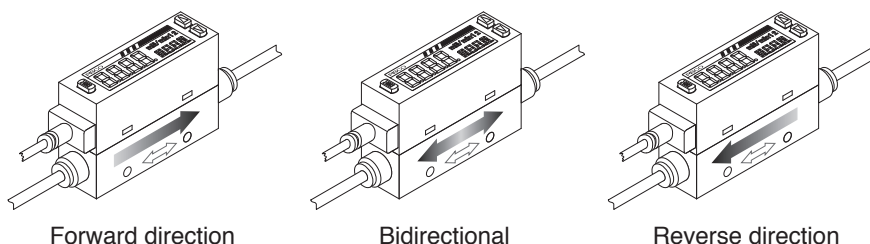
Accuracy of $\pm 3\%F.S.$ is realized, and precise flow measurement is possible.

Quick response time, Max. 50msec.

High-speed response is realized by incorporating a platinum sensor chip processed with silicon micromachining. It contributes to shorten takt time.

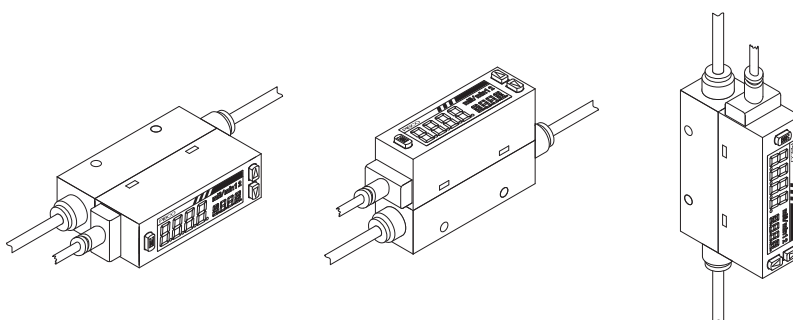
Bidirectional flow measurement is possible.

Bidirectional flow model can measure the flow of preset direction. Flexibility of the plumbing installation improves and usable for reverse flow detection.



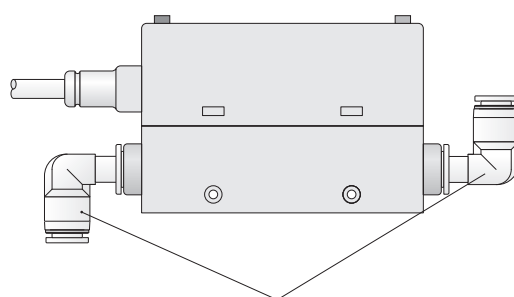
Free installing orientation

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



No straight piping requires

The newly proposed rectifying structure eliminates the need for a straight piping section upstream or downstream.



Elbow plumbing is possible.

Model Designation (Example)

FUS20 - **N****V** - **F** **005** - **4****1****B****N**

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

①.Flow sensor

②.Output type

Code	N	P
Output type	2 points NPN switch output + 1 analog output	2 points PNP switch output + 1 analog output

③.Analog output type

Code	V	A
Output type	Voltage output (1 to 5V)	Current output (4 to 20mA)

④.Flow direction

Code	F	R (*)
Flow direction	One-way direction	Bi-directional

*. Selectable for no needle valve model only.

⑤.Flow range (full-scale flow)

Code	005	010	020	050	100	200	500	101	201
Flow range	0.5ℓ/min	1ℓ/min	2ℓ/min	5ℓ/min	10ℓ/min	20ℓ/min	50ℓ/min	100ℓ/min	200ℓ/min

*. Please refer to the table, the combination chart of flow range and tube size.

⑥.Tube dia.

Code	4	6	8	10
O.D.	ø4mm	ø6mm	ø8mm	ø10mm

*. Please refer to the table, the combination chart of flow range and tube size.

⑦.Cable

Code	No code	1	3
Cable	No cable	1m	3m

⑧.Brackets

Code	No code	B	P
Brackets	No bracket	With bracket	With panel mount option

⑨.Built-in needle valve

Code	No code	N
Needle valve	No needle valve	Built-in needle valve

Table: the combination chart of flow range and port size

		⑥.Tube dia.			
		4	6	8	10
⑤.Flow range code	005	●	●		
	010	●	●		
	020	●	●		
	050	●	●		
	100	●	●		
	200	●	●		
	500		●	●	
	101			●	●
	201			●	●

Model Designation of Option (Example)

FUS20 - **B1**

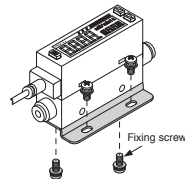
① ②

①.Flow sensor

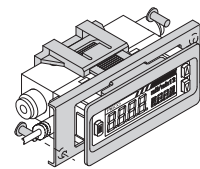
②.Option

Code	Option
B1	Bracket
P	Panel mounting kit
PN	Panel mounting kit (for built-in needle valve type)
C51	1m length 5 core cable
C53	3m length 5 core cable

Bracket : B1



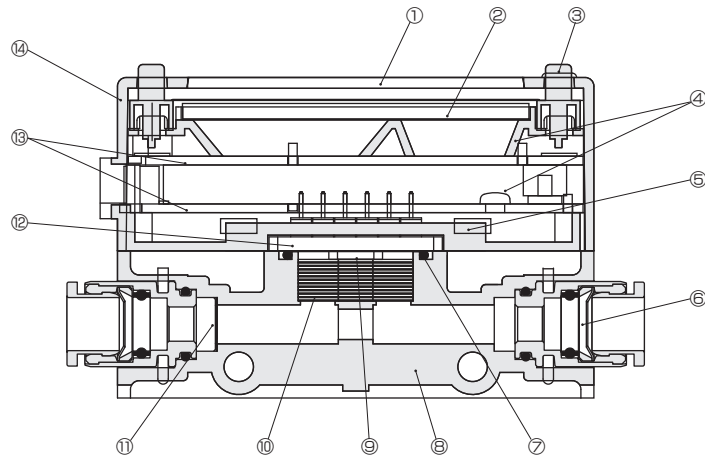
Panel mounting kit : P,PN



Construction

*. Parts materials are subject to change without notice.

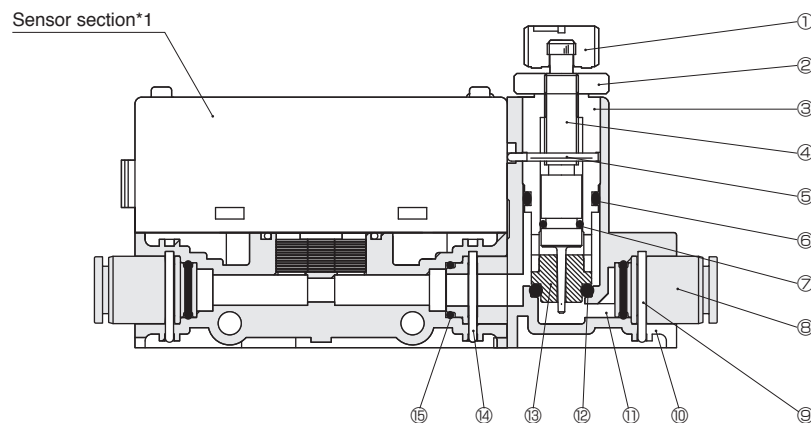
No needle valve model



No.	Parts	Material
①	LCD cover	Acryl resin
②	LCD	-
③	Switch	EPDM
④	Circuit board spacer	PC
⑤	Module holder	PA
⑥	Quick-Fitting Joint	-
⑦	Sensor gasket	FKM

No.	Parts	Material
⑧	Resin body	PA
⑨	Sensor chip	Semiconductor chip
⑩	Rectifier plate	stainless steel
⑪	Port filter	stainless steel
⑫	Sensor substrate	Alumina
⑬	Circuit board	-
⑭	Case	ABS

Built-in needle valve model



No.	Parts	Material
①	Knob	PBT
②	Lock nut	nickel-plated brass
③	Needle guide	nickel-plated brass
④	Needle	nickel-plated brass (*2)
⑤	Fixing pin	stainless steel
⑥	O-ring	FKM
⑦	O-ring	FKM
⑧	Cartridge fitting	-

No.	Parts	Material
⑨	Fitting fixing pin	stainless steel
⑩	Needle valve body	PA
⑪	Port filter	stainless steel
⑫	O-ring	FKM
⑬	Orifice	nickel-plated brass (*3)
⑭	Fitting fixing pin	stainless steel
⑮	O-ring	FKM (fluororesin coating)

*1. Please refer to construction of no needle valve model for the main sensor parts.

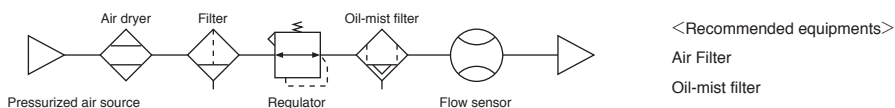
*2. Stainless steel for FUS20...005/010/020

*3. PTFE for FUS20...005/010/020

Specification

Item	Full-scale flow	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 Quick-fitting	●	●	●	●	●	●			
	6	ø6mm Quick-fitting	●	●	●	●	●	●			
	8	ø8mm Quick-fitting						●	●	●	
	10	ø10mm Quick-fitting							●	●	
Built-in needle valve	N (*9)	●	●	●	●	●	●	●	●	●	
Flow rate display (*1) (*2)	Display method		4 digits + 4 digits, 2 color LCD								
	Display range	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
	Minimum unit setting		1 ml/min		0.01 l/min			0.1 l/min		1 l/min	
Accumulation (*3)	Max flow rate		9999999 ml		99999.99 l			999999.9 l		999999 l	
	Mini. unit setting		1 ml		0.01 l			0.1 l		1 l	
	Accumulated pulse output rate		5 ml	10 ml	0.02 l	0.05 l	0.1 l	0.2 l	0.5 l	1 l	2 l
Working condition	Fluid medium (*4)		Clean air (JIS B8392-1.1.1 to 5.6.2), Compressed air (JIS B8392-1.1.1 to 1.6.2), and nitrogen gas								
	Max working pressure		0.7MPa								
	Min working pressure		-0.09MPa								
	Withstand pressure		1MPa								
	Ambient Temp. & humidity		0 to 50°C, max. 90%RH								
	Working fluid temp.		0 to 50°C (no dew condensation)								
Accuracy	Assured accuracy range		3 ~ 100%F.S.								
	Linearity (display/analog output)		Max ±3%F.S. (Air vent for 2ndary side, 25°C)								
	Pressure characteristics		Max ±5%F.S. (-0.09 to 0.7MPa, where air vent for 2ndary side is reference)								
	Temp. characteristics		Max ±0.2%F.S./°C (15 to 35°C, where 25°C is reference)								
	Repeatability		Max. ±1%F.S.								
Response time (*5)		Max.50ms									
Output	Switch output	N	2 points output (NPN open collector output: max. 50mA, voltage drop: max. 2.4V)								
		P	2 points output (PNP open collector output: max. 50mA, voltage drop: max. 2.4V)								
	Analog output	V	1 voltage output 1 to 5V (connected load impedance: min. 50kΩ)								
		A	Current output 4 to 20mA (connected impedance: 0 to 300Ω)								
Power supply voltage (*6)	V	DC12 ~ 24V (10.8 ~ 26.4V)									
	A	DC24V (21.6 ~ 26.4V)									
Current consumption (*7)		Max.50mA									
Lead wire		ø3.7 AWG26 equiv. x 5 core cable (connector joint), Insulator O.D. ø1.0mm									
Functions		Flow rate display, flow rate - peak hold, switch output, analog output, and other									
Installation	Installing orientation		Horizontal or vertical								
	Straight pipe introduction		Not required								
Protective structure		IEC standard: IP40									
Protective circuit (*8)		Power supply and switch output reverse connection protections, and switch output load short-circuit protection									
EMC directive		Conformity									

- *1. Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa)
- *2. Displayed flow rate less than approx. ±1% F.S is rounded down (zero adjusted).
- *3. Accumulated flow rate is a calculated reference value and reset when shut down.
- *4. When flowing compressed air, please use a clean air conforming to JIS B8392-1:2003 Grade 1.1.1 ~ 1.6.2. Please install a filter (filtering rate: 5µm), an air dryer (minimum pressure dew-point: max 10°C) and an oil mist filter (max oil content: 0.1mg/m³) onto the primary side (upstream) of the sensor since the compressed air from the compressor contains drain (water, oil oxide and foreign material, etc.)
 <Recommended circuit>



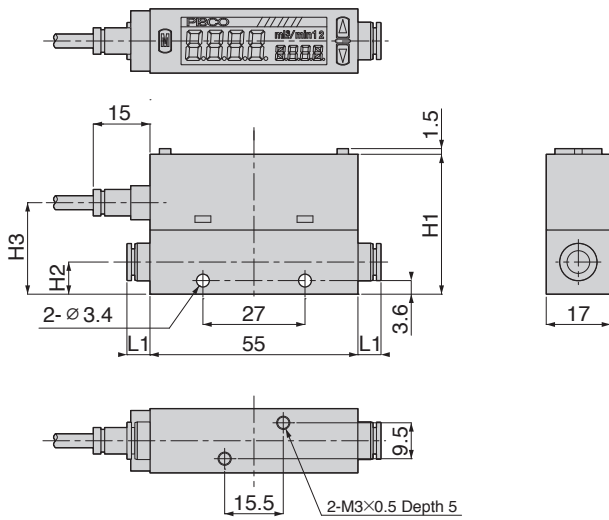
- *5. Response time can be set in 7 stages from max 50ms to 1.5s.
- *6. Power voltage specifications differ for the voltage output and current output.
- *7. Current for 24 VDC connection with no load connection. Consumed current varies with the load connection.
- *8. This product's protective circuit is effective only against specific incorrect connections and load short circuits. It does not necessarily provide protection against all incorrect connections.
- *9. The product cannot be used as shut-off valve requiring no leakage. A certain degree of leakage is allowed as specifications.

■ Unit wieght

ø4mm Quick-fitting model	About 50g (about 80g for built-in needle valve model)
ø6mm Quick-fitting model	About 50g (about 80g for built-in needle valve model)
ø8mm Quick-fitting model	About 70g (about 110g for built-in needle valve model)
ø10mm Quick-fitting model	About 75g (about 115g for built-in needle valve model)

FUS20 No needle valve

Model : FUS20-□□-□□-□□□□



Outer dimensions by fitting size

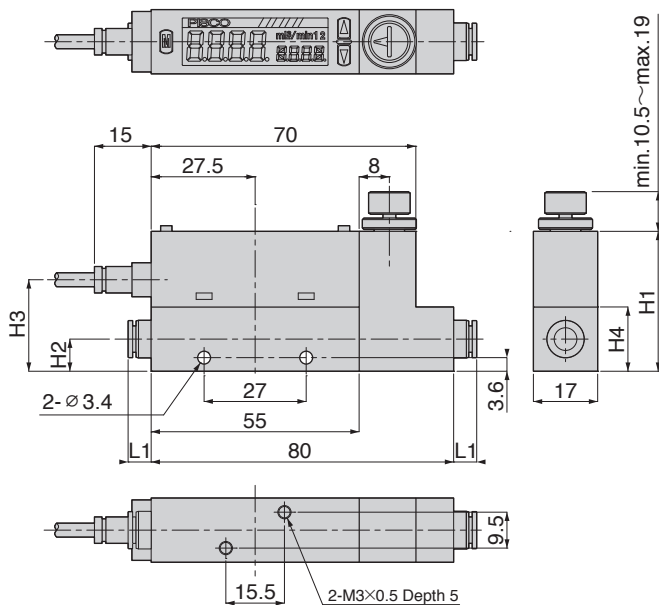
Unit: mm

Fitting size	∅4	∅6	∅8	∅10
L1	5	6.1	9	17
H1	37		43	
H2	8.5		13	
H3	24.2		30.2	

Terminal no.	Cable color	Wiring destination
1	Brown	DC12-24V
2	Black	CH1 (OUT1)
3	White	CH2 (OUT2/INPUT)
4	Gray	ANALOG OUT
5	Blue	GND

FUS20 Built-in needle valve

Model : FUS20-□□-□□-□□□□N



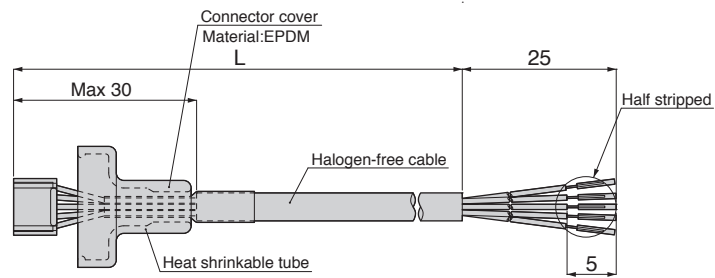
Outer dimensions by fitting size

Unit: mm

Fitting size	∅4	∅6	∅8	∅10
L1	5	6.1	9	17
H1	37		43	
H2	8.5		13	
H3	24.2		30.2	
H4	17		23	

Terminal no.	Cable color	Wiring destination
1	Brown	DC12-24V
2	Black	CH1 (OUT1)
3	White	CH2 (OUT2/INPUT)
4	Gray	ANALOG OUT
5	Blue	GND

FUS20-C5 5 core cable

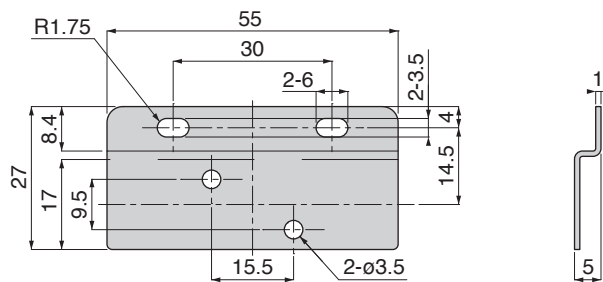


Terminal no.	Cable color	Wiring destination
1	Brown	DC12-24V
2	Black	CH1 (OUT1)
3	White	CH2 (OUT2/INPUT)
4	Gray	ANALOG OUT
5	Blue	GND

Unit: mm

Model	L
FUS20-C51	1040 ±20
FUS20-C53	3040 ±20

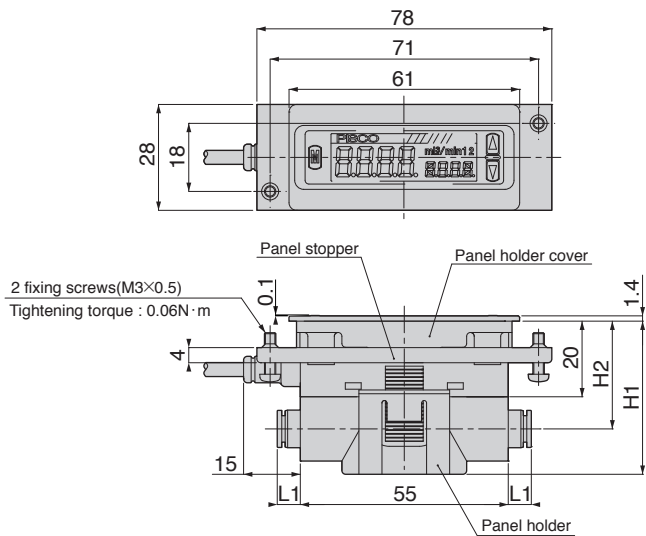
FUS20-B1 Bracket



*. 2 fixing screws M3×0.5 (length 6mm) are included

FUS20-P Panel mounting kit

● No needle valve model with panel mounting kit option



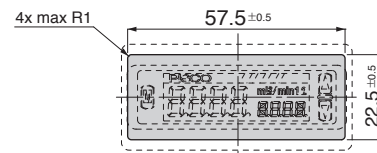
■ Outer dimensions by fitting size

Unit: mm

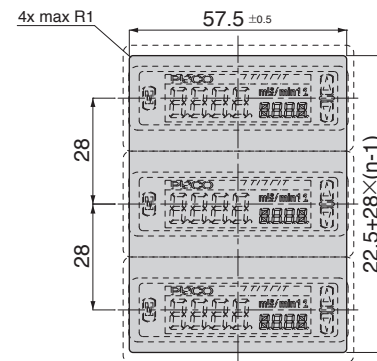
Fitting size	ø4	ø6	ø8	ø10
L1	5	6.1	9	17
H1	40.5		46.5	
H2	28.5		30	

<Panel cut dimensions>

■ Single installation

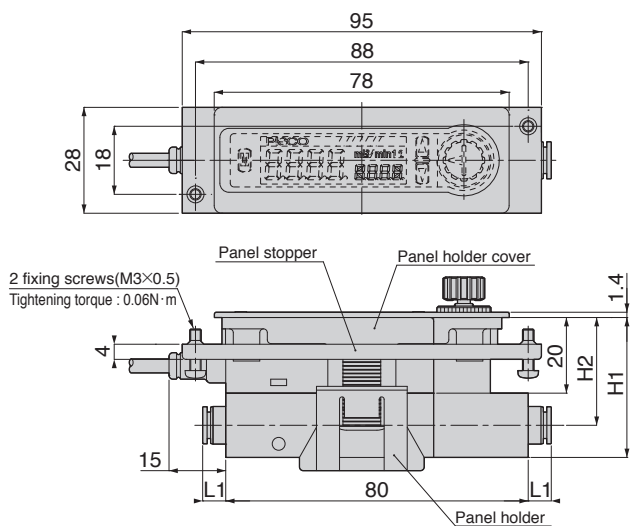


■ Coherent installation



*. Panel thickness: 0.8 ~ 6mm

● Built-in needle valve model with panel mounting kit option



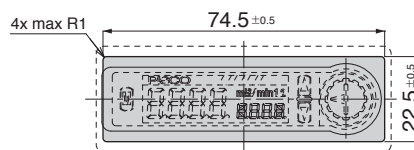
■ Outer dimensions by fitting size

Unit: mm

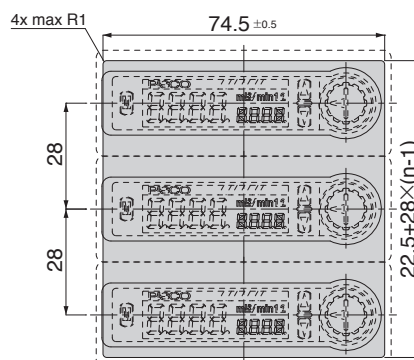
Fitting size	ø4	ø6	ø8	ø10
L1	5	6.1	9	17
H1	40.5		46.5	
H2	28.5		30	

<Panel cut dimensions>

■ Single installation



■ Coherent installation

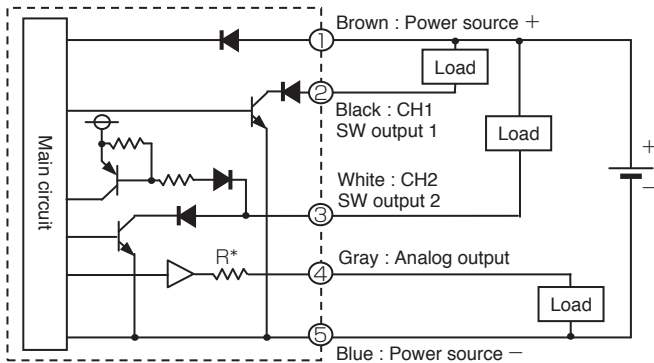


*. Panel thickness: 0.8 ~ 6mm

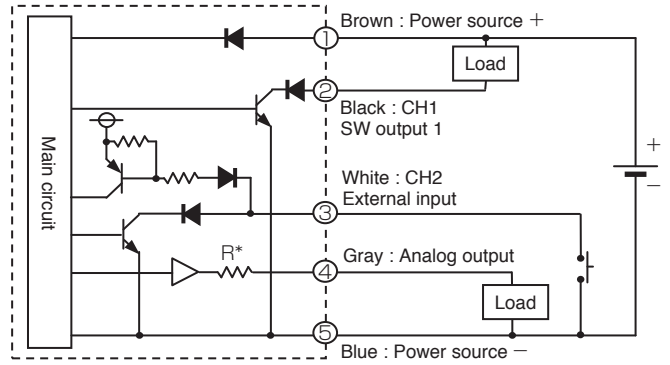
Internal circuit and load connection example

NPN output model

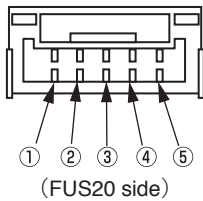
<Using CH2 as SW output>



<Using CH2 as external input>



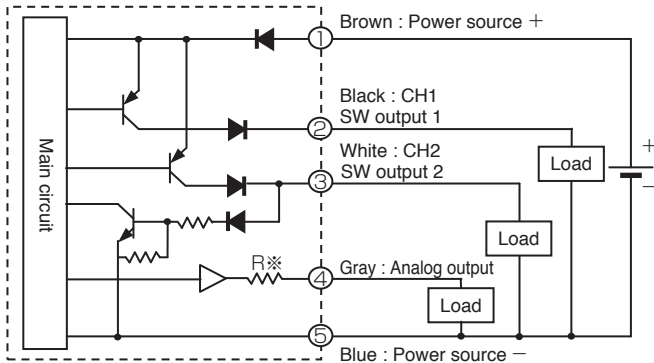
*. Analog voltage output type R : about 1K Ω
 Analog current output type R : about 100 Ω



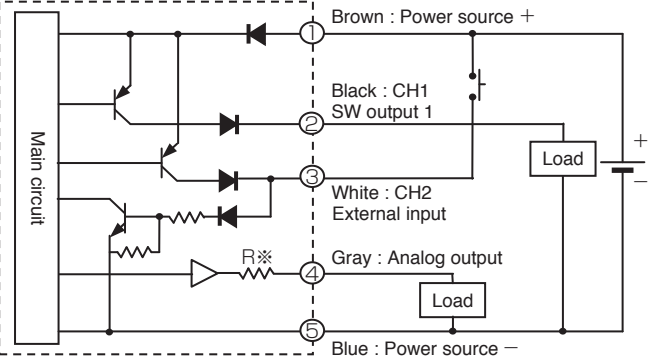
Terminal no.	Optional cable color	Wiring destination
①	Brown	Power source + (voltage output: 12 to 24V, current output: 24V)
②	Black	CH1 (Switch output 1 : max50mA)
③	White	CH2 (Switch output 2: max 50mA or external input)
④	Gray	Analog output
		Voltage output: 1 to 5V, load impedance: min. 50k Ω Current output: 4 to 20mA, load impedance: max. 300 Ω
⑤	Blue	Power source - (GND)

PNP output model

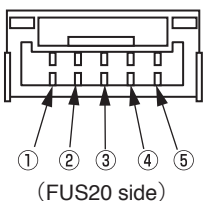
<Using CH2 as SW output>



<Using CH2 as external input>



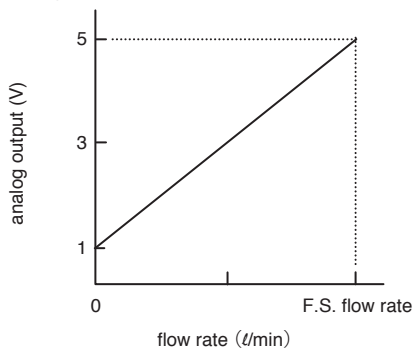
*. Analog voltage output type R : about 1K Ω
 Analog current output type R : about 100 Ω



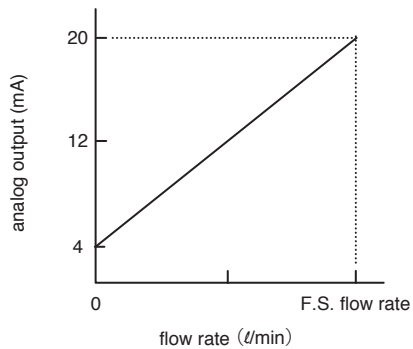
Terminal no.	Optional cable color	Wiring destination
①	Brown	Power source + (voltage output: 12 to 24V, current output: 24V)
②	Black	CH1 (Switch output 1 : max50mA)
③	White	CH2 (Switch output 2: max 50mA or external input)
④	Gray	Analog output
		Voltage output: 1 to 5V, load impedance: min. 50k Ω Current output: 4 to 20mA, load impedance: max. 300 Ω
⑤	Blue	Power source - (GND)

■ Analog output property

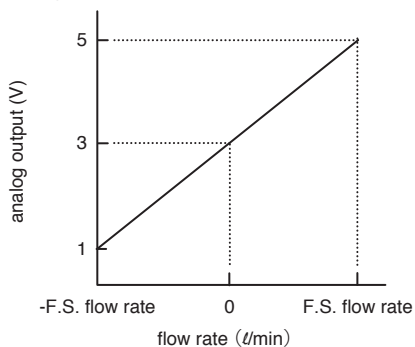
Voltage output type: one-way flow direction



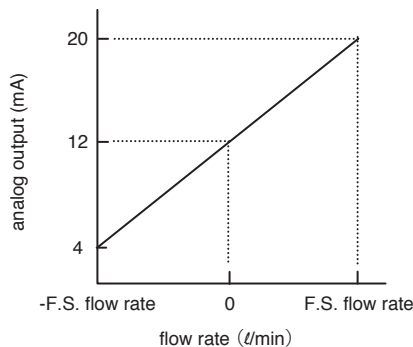
Current output type: one-way flow direction



Voltage output type: bidirectional flow direction



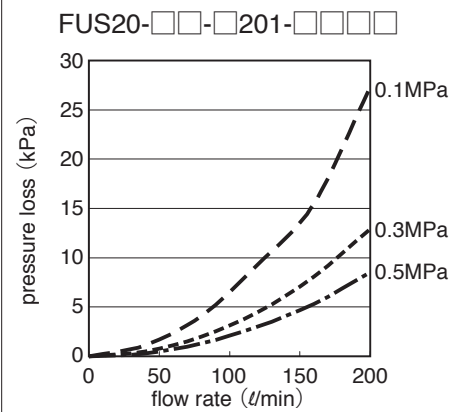
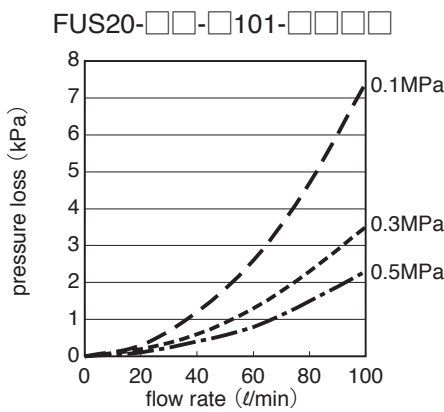
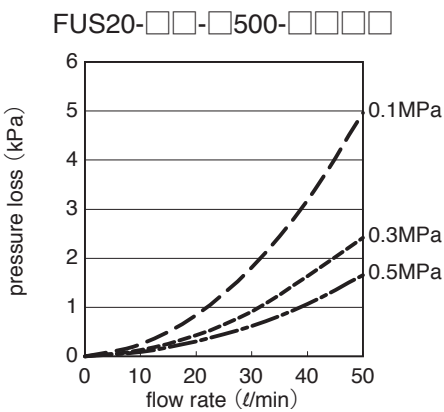
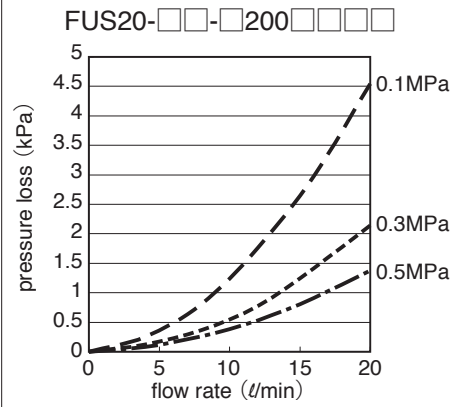
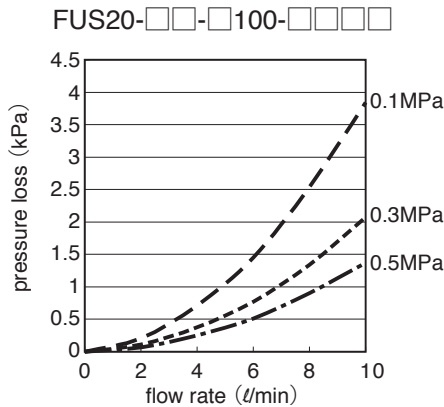
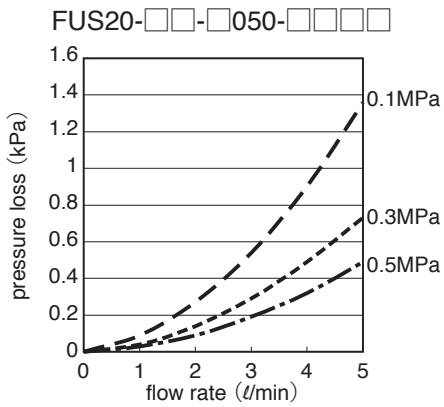
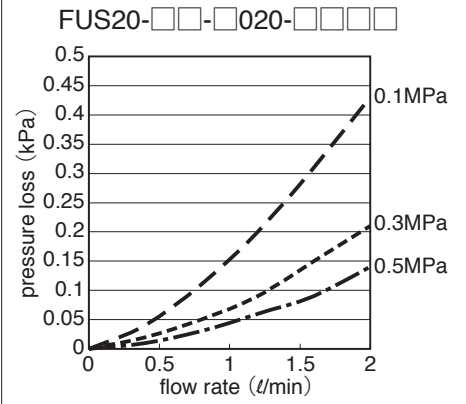
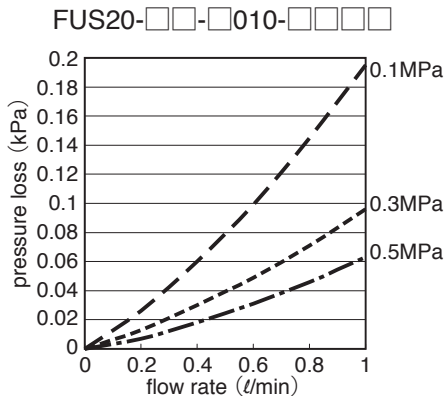
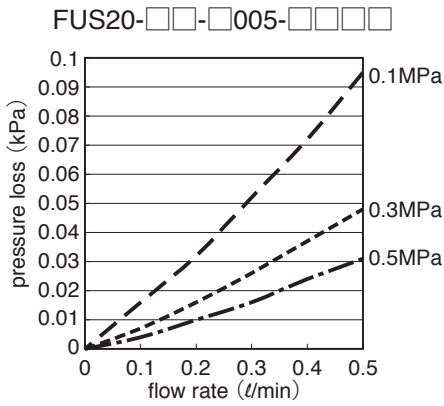
Current output type: bidirectional flow direction



*. Bidirectional model can be switched to one-way directional output by setting the button.

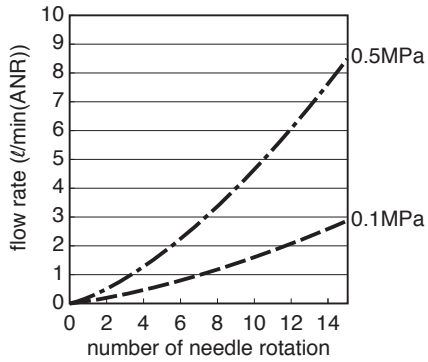
Pressure loss characteristics

■ No needle valve model

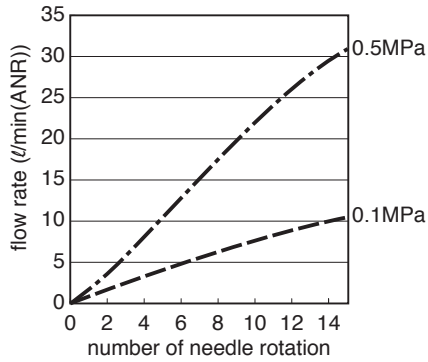


Needle valve flow characteristic

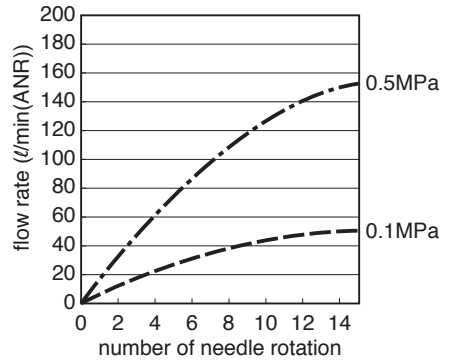
FUS20-□□-□005-□□□N
FUS20-□□-□010-□□□N
FUS20-□□-□020-□□□N



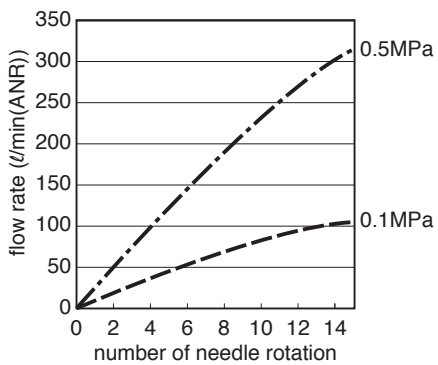
FUS20-□□-□050-□□□N
FUS20-□□-□100-□□□N



FUS20-□□-□200-□□□N
FUS20-□□-□500-6□□N

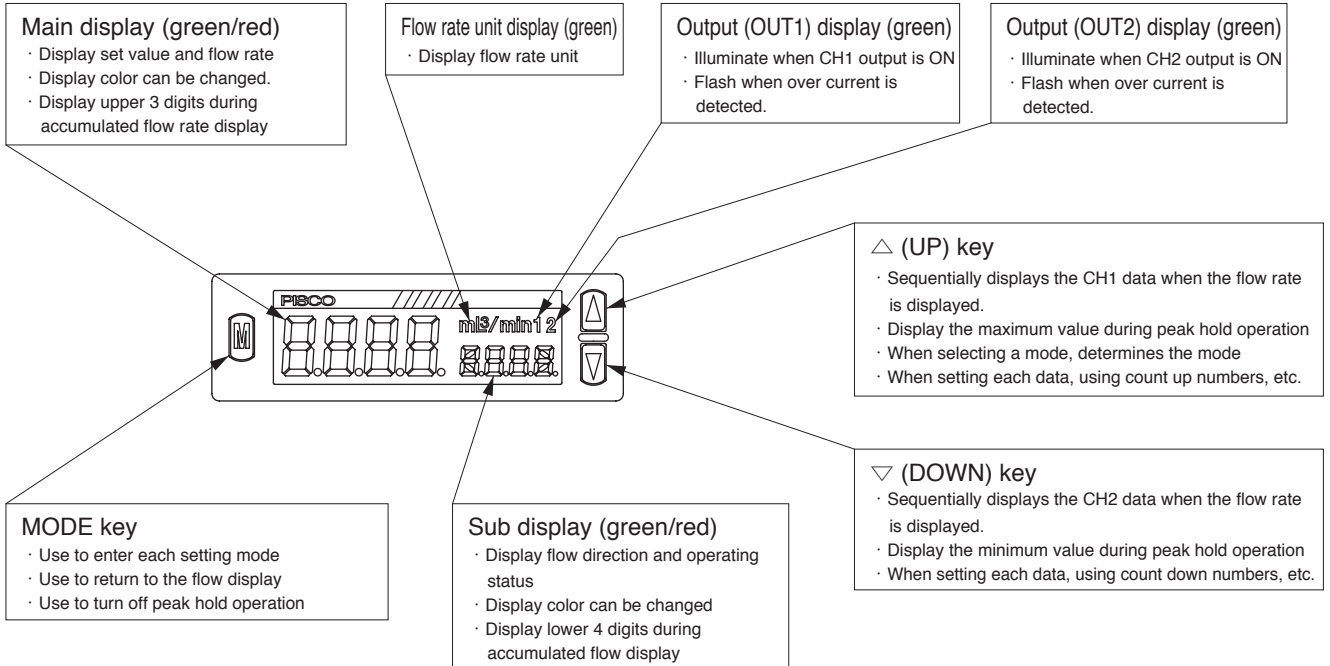


FUS20-□□-□500-8□□N
FUS20-□□-□101-□□□N
FUS20-□□-□201-□□□N



Operation method

Display/operating section names and functions



< Display example > In case of FUS20-NV-100-□

Indication	LCD display
Real-time flow display Reverse direction 10L/min(ANR)	<p>*For bidirectional setting (note: one-way directional type indicates "Lo")</p>
Accumulated flow display At 99999.99L	<p>*Values will return to "0.00" if it goes beyond "99999.99" (It will be reset.)</p>

■ Explanation of function

Some functions and settings are completed when the normal flow is displayed, and some after entering setting mode. The setting mode is divided into standard setting mode and detailed setting mode based on the frequency of use.

● Normal operation

Item	Description	Default setting
Real-time flow display	Real-time flow rate is displayed.	—
Accumulated flow display	It can be changed to accumulated flow display. The switch output function includes turning the switch ON and OFF when the specified accumulated value is exceeded, and an accumulated pulse function that outputs a pulse after a set count value. It will be reset if power is turned off and can be reset with button operation or external input.	Real-time flow display
Peak hold function	Maximum and minimum flow rates within a set interval are displayed.	Peak hold OFF
Key lock function	Key operations are disabled to prevent incorrect operation.	Key lock invalid
Error display function.	The status of errors is displayed when trouble or error occurs.	—

● Standard setting mode

Item	Description	Default setting
Switch output function	Having 2 points switch output, 7 operation patterns and operation stop can be set.	Both CH1 and CH2 are set to switch OFF
Forced output function	Switch output is forcibly turned on to check line connections and default operation of the input device.	—
Zero adjust function	Zero point deviation is corrected. (Range : $0 \pm 10\%F.S.$)	Adjusted value: 0

●Detailed setting mode

Item	Description	Default setting
Selection of flow direction (available only on bidirectional model)	The flow direction is set to bidirectional, one-way forward direction, or one-way reverse direction.	Bidirectional
Select CH2 operation	Select CH2 function. Select whether to use CH2 as switch output or as external input (accumulated value reset/auto reference).	Switch output
Auto-reference function	When CH2 is set to auto-reference, the threshold of switch output can be read by external input or button operations. The threshold is changed automatically when the threshold of switch changes.	Auto-reference function OFF
Response time setting	The response time is set in 7 stages from max.50 ms to 1.5 s. Chattering or incorrect operations caused by abrupt flow change or noise are prevented.	Response time : Max. 50ms
Display speed setting	The digital display's update cycle is set in 3 stages from 250 ms to 1 sec. Display blinking is minimized by making the display update cycle longer.	Display speed: 250ms
Sub display setting	Set the sub display indication selecting from flow direction, flow unit, or fluid medium display ("Ai" for air or N ₂) type.	Flow direction
Display color setting	Set the display color. The display color is set for the normal display and switch output ON.	For both main and sub, Normal display: green, Switch ON: red
Hysteresis setting	Set hysteresis of switch setting value. Use this if flow pulsates and the switch chatters near the threshold.	Hysteresis: 1% F.S.
Flow unit setting	Select the display unit from the standard state or reference state. Standard state (ANR): Flow converted to volumetric flow at 20°C & 1 barometric pressure Reference state (NOR): Flow converted to volumetric flow at 0°C & 1 barometric pressure (*1)	Flow unit: ANR
ECO MODE setting	ECO MODE is selectable. If no button is pressed for one minute, the mode changes to ECO and the backlight turns off, minimizing current consumption.	ECO MODE OFF
Reset settings	Settings are set to the default.	—

*1. The reference status display is a calculated (reference) value.

Switch output function

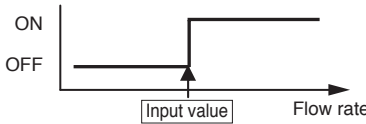
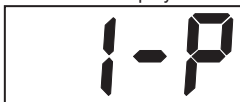

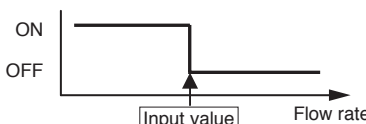


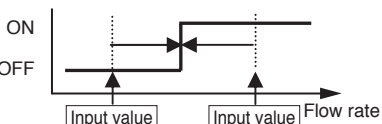


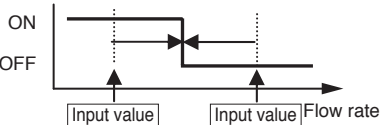


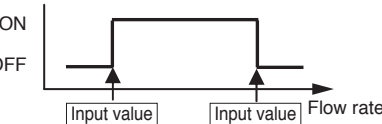





Switch output function is selected from 7 operation patterns depending on an application. The operation pattern can be set to each CH1 and CH2.

Operation pattern	Description	Timing chart	LCD display
Window comparator operation 1 (ON within specified range)	Switch output goes ON within the specified range.		<Sub display>
Window comparator operation 2 (ON out of specified range)	Switch output goes ON outside of the specified range.		
Hysteresis operation 1 (Lower flow rate side ON)	Hysteresis is set arbitrarily, and when the flow reaches and exceeds the designated flow level, switch output goes OFF.		
Hysteresis operation 2 (Larger flow rate side ON)	Hysteresis is set arbitrarily, and when the flow reaches and exceeds the designated level, switch output goes ON.		
Accumulated output 1 (ON above accumulated flow)	Switch output goes ON when on or higher than the set accumulation value.		
Accumulated output 2 (OFF below accumulated flow)	Switch output goes OFF when on or higher than the set accumulation value.		
Accumulated pulse output	An accumulated pulse is output at each preset accumulation value. Refer to specifications for details on the preset accumulation value. (pages 6, 7)		
Switch operation OFF	This is switch operation OFF status.		

■ Auto-reference function

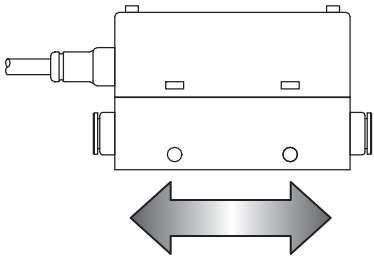


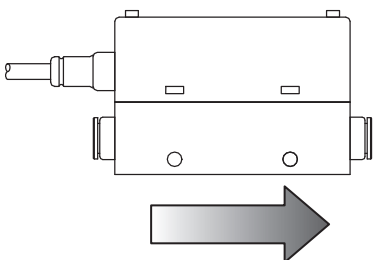


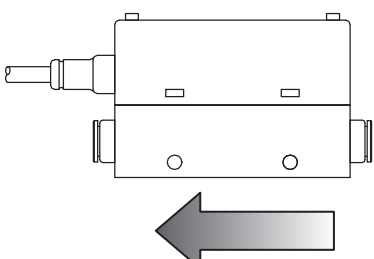

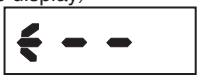
When CH2 is set to auto-reference, the threshold of switch output can be read by external input or button operations. The threshold is changed automatically when the threshold of switch changes, such as when workpiece changes. The input value is the flow rate when the external input is turned ON.

The switch setting of CH2 is disabled during auto-reference operation.

No. of input	Operation pattern	Description	Timing chart	LCD display
1 point	ON above input value	The switch turns ON when on or higher than the read value. (Threshold: input value)		<Main display>  <Sub display> 
	OFF above input value	The switch goes OFF when on or higher than the read value. (Threshold: input value)		<Main display>  <Sub display> 
2 points	ON above the mean value of 2 points	The switch goes ON when on or higher than the mean value of two read points. (Threshold: ("input 1" + "input2")/2)		<Main display>  <Sub display> 
	OFF above the mean value of 2 points	The switch goes OFF when on or higher than the mean value of two read points. (Threshold: ("input 1" + "input2")/2)		<Main display>  <Sub display> 
	ON between 2 points	The switch goes ON between two read points. (Threshold 1: input value 1) (Threshold 2: input value 2)		<Main display>  <Sub display> 
	OFF between 2 points	The switch goes OFF between two read points. (Threshold 1: input value 1) (Threshold 2: input value 2)		<Main display>  <Sub display> 

■ **Flow direction selection (bidirectional model only)**

With the built-in display bidirectional model, the flow direction is selected by button operations.

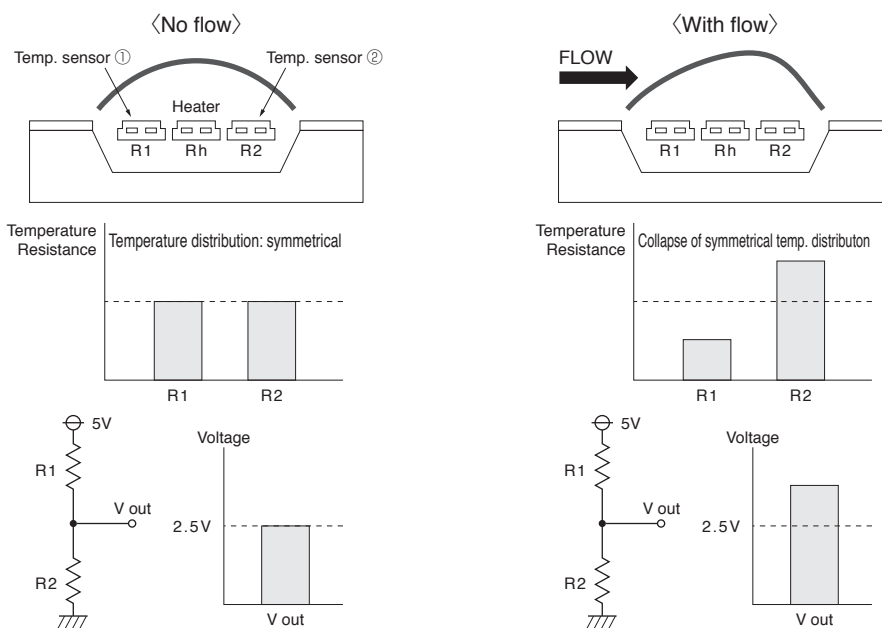
Flow direction	LCD display	Analog output characteristic
<p>< Bidirectional ></p> 	<p>< Main display ></p>  <p>Minus "-" indication with reverse flow direction</p> <p>< Sub display ></p>  <p>The arrow direction changes according to the flow direction.</p>	
<p>< One-way (forward) direction ></p> 	<p>< Main display ></p>  <p>< Sub display ></p> 	
<p>< One-way (reverse) direction ></p> 	<p>< Main display ></p>  <p>< Sub display ></p> 	

Technical data

FUS20 series measuring principle

The FUS20 series incorporates a platinum sensor chip (3 mm x 3.5 mm) machined with silicon micromachining. The sensor is thermally insulated from the silicon substrate. The heating capacity is extremely low, enabling high sensitivity with a high speed response.

At the sensor, two temperature sensors are arranged with a heater in between. Platinum, which has a resistance that changes based on temperature, is used for the temperature sensor. When the heater is turned on and heated, the temperature distribution is symmetrical about the center of the heater if there is no flow. When flow is received, the symmetrical property of temperature distribution is lost, and temperature upstream of the heater drops, and that downstream rises. This difference of temperature becomes the difference of the resistance level of the temperature sensor and changes by flow rate. If flow is reversed, the temperature difference (resistance value difference) is reversed. A bidirectional flow is thus detected. This is suitable for detecting relatively small flows.



How to select flow sensor

The following is a guide to select the flow range when using a flow sensor to verify suction and release by suction nozzle, leakage tests, and etc. The flow is calculated by the effective sectional area of nozzle (pin hole), and the pressure difference inside and outside of the nozzle.

$$P_1 \geq 1.89P_2 \text{ (sonic flow)}$$

$$Q = 113.2 \times S \times P_1$$

$$P_1 < 1.89P_2 \text{ (subsonic flow)}$$

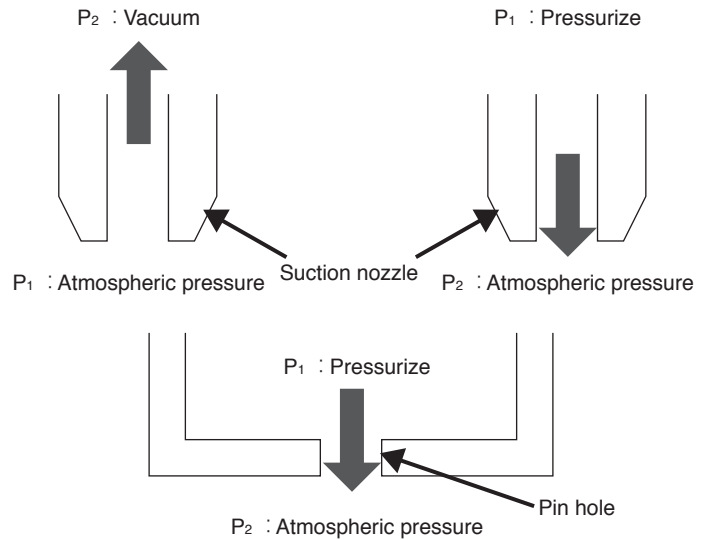
$$Q = 226.4 \times S \times \sqrt{P_2(P_1 - P_2)}$$

Q : Flow rate ℓ/min

P₁ : Absolute primary pressure MPa

P₂ : Absolute secondary pressure MPa

S : Nozzle (pin hole) effective sectional area mm²



Calculation example

The following table gives the calculated flow rate when using nozzle diameter ø0.1 to 2 with variable P₂.

	P ₁ (MPa) Abs. press.	P ₁ (MPa) Gauge press.	P ₂ (MPa) Abs. press.	P ₂ (MPa) Gauge press.	Sonic/subsonic	Calculated flow rate (ℓ/min)									
						φ 0.1	φ 0.2	φ 0.3	φ 0.4	φ 0.5	φ 0.7	φ 1	φ 1.5	φ 2	
Suction	0.1013	0	0.0313	-0.07	Sonic	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0413	-0.06	Sonic	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0513	-0.05	Sonic	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0613	-0.04	Subsonic	0.088	0.352	0.792	1.408	2.200	4.312	8.800	19.801	35.202	
	0.1013	0	0.0713	-0.03	Subsonic	0.082	0.329	0.740	1.315	2.055	4.028	8.220	18.494	32.878	
	0.1013	0	0.0813	-0.02	Subsonic	0.072	0.287	0.645	1.147	1.792	3.512	7.166	16.125	28.666	
	0.1013	0	0.0913	-0.01	Subsonic	0.054	0.215	0.483	0.859	1.343	2.631	5.370	12.083	21.480	
Blow (leakage inspection)	0.1113	0.01	0.1013	0	Subsonic	0.057	0.226	0.509	0.905	1.414	2.772	5.657	12.727	22.626	
	0.1213	0.02	0.1013	0	Subsonic	0.080	0.320	0.720	1.280	2.000	3.920	8.000	17.999	31.998	
	0.1413	0.04	0.1013	0	Subsonic	0.113	0.453	1.018	1.810	2.828	5.543	11.313	25.454	45.252	
	0.1613	0.06	0.1013	0	Subsonic	0.139	0.554	1.247	2.217	3.464	6.789	13.856	31.175	55.423	
	0.1813	0.08	0.1013	0	Subsonic	0.160	0.640	1.440	2.560	4.000	7.840	15.999	35.998	63.996	
	0.2013	0.1	0.1013	0	Sonic	0.179	0.716	1.610	2.862	4.472	8.765	17.888	40.248	71.552	
	0.3013	0.2	0.1013	0	Sonic	0.268	1.071	2.410	4.284	6.694	13.119	26.774	60.242	107.096	
	0.4013	0.3	0.1013	0	Sonic	0.357	1.426	3.209	5.706	8.915	17.474	35.660	80.236	142.641	
	0.5013	0.4	0.1013	0	Sonic	0.445	1.782	4.009	7.127	11.137	21.828	44.547	100.230	178.186	
	0.6013	0.5	0.1013	0	Sonic	0.534	2.137	4.809	8.549	13.358	26.182	53.433	120.224	213.731	

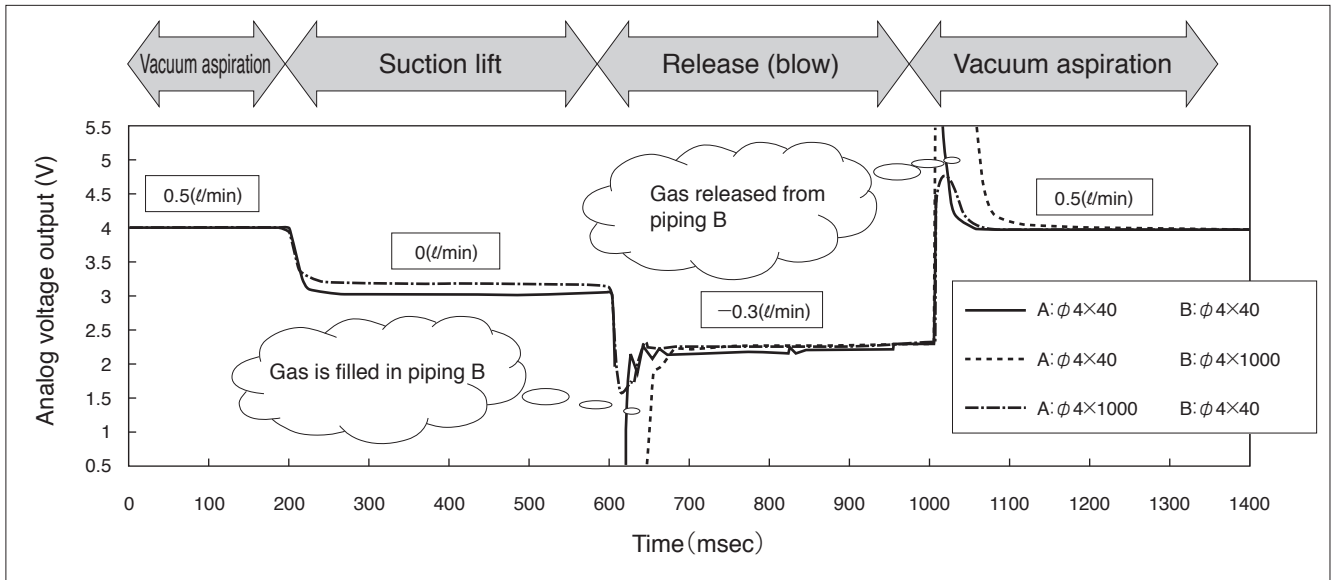
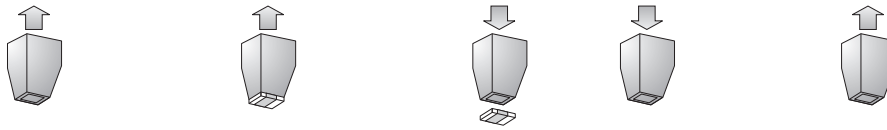
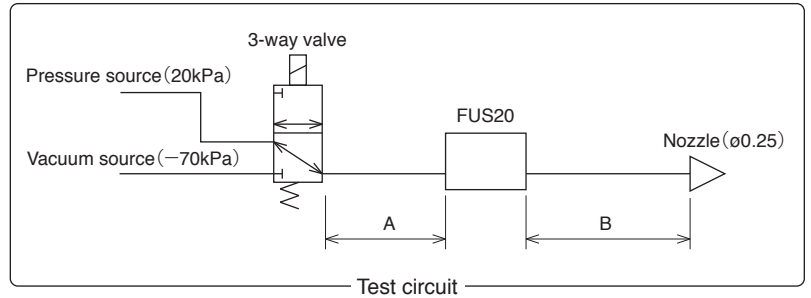
(caution)

- If there is leakage in piping, etc., the actual flow will be larger than the calculated value. Please take such pipe leakage into account when selecting the flow rate.
- If there is a section narrower than the suction nozzle diameter in piping, the flow will be restricted, and may be less than the calculated value. It may not be possible to check suction, etc.
- The effective sectional area is a guideline. If the nozzle is long and thin, the effective sectional area will be smaller than the nozzle's opening.
- The response speed is determined and depended by the piping inner volume between the flow sensor and the suction nozzle (pin hole). Desiring a high-speed detection, please set the flow sensor near the suction nozzle, or reduce the inner volume as much as possible.

Suction lift verification

1. Response time

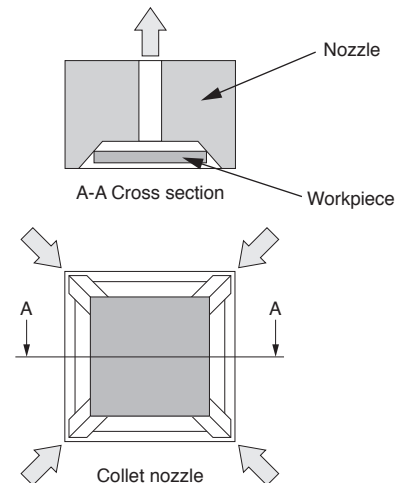
Response time during suction lift verification is determined by the inner volume of piping, the exhaust capacity of vacuum pump, and etc. When piping like shown at right test circuit, for example, the dependence of response time on piping becomes as shown below. Based on this, to shorten response time, the inner volume of piping should be minimized.



Dependency of response on piping

2. Using collet nozzle

A collet nozzle is often used when the workpiece to be picked up should not be directly seated against the nozzle. The collet nozzle is shaped like a pyramid so when the workpiece is picked up, a gap forms at the four corners. This causes leakage during pick up. If the effective sectional area of the piping, including valve and joints, etc., is smaller than the collet nozzle and workpiece gap (effective sectional area), because the flow is determined by the piping's effective sectional area, and the difference in flow rate between suctioning and non-suctioning become small and hard to detect even by flow sensor. In such case, suction lift can be accurately verified by making the effective sectional area of piping larger as much as possible than the one of the gap between the collet nozzle and workpiece.





Safety Instructions

This Safety Instructions aim to prevent injuries to human bodies and damage to properties by requiring proper use of PISCO devices.

Also the relevant requirements of ISO 4414 and JIS B8370 must be observed.

ISO 4414: Pneumatic fluid power ... Recommendations for the application of equipment to transmission and control systems.

JIS B 8370: General standards for pneumatic systems

Safety instructions are classified into "Danger", "Warning" and "Caution", depending on the degree of danger or damage involved when the safety instructions are not complied with in handling the equipment.



Danger

Failure to heed the warning of apparent danger may result in death or serious injuries.



Warning

Failure to heed the warning of conditionally dangerous situations may result in death or serious injuries.



Caution

Failure to heed the warning of conditionally dangerous situations may result in minor or not too serious injuries or damage to properties.

Warnings : 1. Make a selection of pneumatic equipment.

- (1) Well knowledgeable and experienced persons such as a pneumatic system designer or who is in charge of deciding specification should select pneumatic equipment.
- (2) The applicable conditions of the products in this catalogue are diverse. Therefore, judge the conformity of systems with required analysis or tests by system designers or persons who is in charge of deciding specifications. The guarantee of initial performance and safety of the system is on responsibility of the person who decides specifications. Hereafter, examine all the specification with updated products catalogues and technical documents in order to avoid malfunctions of equipment, and then develop systems.
2. Handle pneumatic equipment with enough knowledge and experience.
 - (1) Mishandling of compressed air is dangerous. Conduct assembly, operation and maintenance of devises with pneumatic equipment by persons with enough knowledge and experience.
3. Do not operate and remove the equipment until safety is confirmed.
 - (1) Conduct inspection and maintenance of equipment after confirming fail-proof measures of work pieces or runaway-proof device are properly working.
 - (2) When removing equipment, make sure that above safety measures are conducted. Then, stop air supply and electric source of equipment making sure the pressure inside the system is zero before removing equipment.
 - (3) When re-activate equipment, make sure safety measures against fly-out are taken and re-activate equipment with care.

Disclaimer

1. We take no responsibility whatsoever for any incidental and indirect damages (e.g. manufacturing line stop, business interruption, loss of profit and physical injury) caused by the use or defect in use of PISCO devices.
2. We take no responsibility whatsoever for the device failure damage caused by natural disaster, fire, except fire responsible to us, act by a third party and intention or negligence by customers.
3. We take no responsibility whatsoever for the damage caused by uses beyond the range of specification described in our catalogues and handling instructions.
4. We take no responsibility whatsoever for the damage caused by the re-creation of devices and the failure from the combinations of software and connected equipment.
5. We pay the damage for the failure caused by PISCO devises up to a ceiling of the purchased Pisco devise expense.

* Safety Instructions are subject to change without advance notice.



Common Safety Instructions for Products Listed in This Manual

PISCO products are designed and manufactured for use with general industrial machinery and equipment. Therefore be sure to observe the following safety instructions:

Danger : 1. Do not use PISCO devices with the following equipment:

- (1) Equipment used for the sustenance or control of people's health or lives
- (2) Equipment used for the movement or transport of people
- (3) Equipment used specifically to ensure safety

Warnings : 1. Avoid the following uses for PISCO devices:

- (1) Use under conditions not specified for the device.
 - (2) Use at outdoors, or at a place getting the direct sunlight.
 - (3) Use in locations where the device is exposed to excessive vibration or shocks.
 - (4) Use in locations where the device is exposed to any corrosive gas, inflammable gas, chemicals, seawater, or vapor.
 - * Certain PISCO devices, however, can be used in environments as described above. Therefore check on the specifications for the use of individual devices.
2. Do not disassemble or remodel the PISCO devices in such a way as may affect the basic structure, performance or function of them.
 3. The maintenance check of product should be performed after turning the power off, stopping air supply, and confirming that the pressure inside the plumbing becomes zero.
 4. Never touch the release ring of the Quick-Fitting Joint when there is pressure working on it. Touching may release the ring, which in turn may cause the tube to fall out.
 5. Avoid too frequent switching of air pressure. Otherwise the device body may heat up to cause burns on you.
 6. Do not allow tension, twist or bending forces to act on the products. Undue forces may damage the products.
 7. For applications in which the threaded side or the tube connection side is subject to swinging or rotation, use Rotary Joints, High Rotary Joints or Multi-Circuit Rotary Blocks only. Swinging or rotation may damage the joint body.
 8. Except for Die Temp. Control Fitting, Tube Fitting Stainless SUS316, SUS316 Compression Fitting, and All Brass Compression Fitting, please do not use products with hot water or thermal oil over 60°C. There is danger to cause the damage of the main body of product by heat and hydrolysis.
 9. For applications in which the scattering of static electricity or charging must be prevented, use no other joints than EG (anti-static) specification products. Static electricity may cause system malfunction or trouble.
 10. Never use joint other than Spatter spec. products or all metal products where they are exposed to spatter. Otherwise spatter can cause fire.
 11. Carry out maintenance and checks of equipment only after turning power off, shutting fluid off and making certain that the pressure in the piping has dropped to zero. Please conduct maintenance after confirming following points.
 - (1) Make sure that maintenance is safe for all systems involving PISCO products.
 - (2) When re-activate equipment after maintenance, make sure safety measures against fly-out are taken and re-activate equipment with care.
 - (3) Please secure space for maintenance when the circuit is designed.
 12. When the fluid is admitted to the equipment and if there is a possibility to cause damage to it due to leakage, conduct safety measures such as protective cover beforehand.

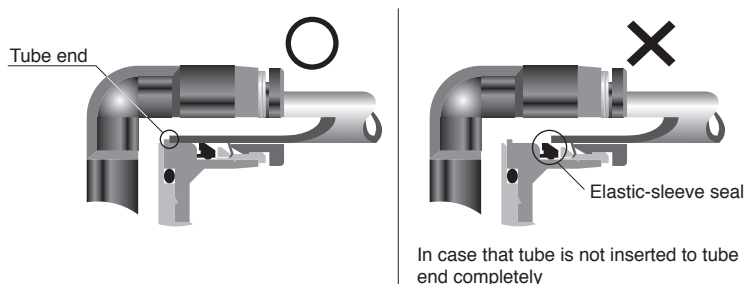
- Cautions :**
1. In installing the piping, be sure to remove dust or drainage from the inside of piping. Dust or drainage left unremoved may enter other equipment, thus causing troubles.
 2. When using an ultrasoft tube to connect to a Quick-Fitting Joint, be sure to use an insert ring in the bore of the tube. Otherwise the tube may fall out to cause leakage.
 3. A crack occurs under the influence of ozone and causes malfunction if NBR is used as material of a seal rubber, a vacuum pad, and a gasket. Ozone usually exists in high density near neutralization air, a cleanroom, a high voltage motor, etc. The change of rubber materials to HNBR or FKM is necessary for measures. Please consult nearest Pisco sales office for the details.
 4. The infinitesimal leakage may be produced on the product with oil-free specifications. If a fluid medium is liquid or an application require something severe condition, please consult nearest Pisco office.
 5. When you use tubes of brands other than ours, be sure to confirm that the outside diameter of the tubes satisfies the tolerance specified Table 1.

Table 1. Tube O.D. Tolerance

mm size	Nylon tube	Urethane tube	inch size	Nylon tube	Urethane tube
ø1.8mm	—	±0.05mm	ø1/8in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)
ø3mm	—	±0.15mm	ø5/32in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)
ø4mm	±0.1mm	±0.15mm	ø3/16in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)
ø6mm	±0.1mm	±0.15mm	ø1/4in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)
ø8mm	±0.1mm	±0.15mm	ø5/16in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)
ø10mm	±0.1mm	±0.15mm	ø3/8in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)
ø12mm	±0.1mm	±0.15mm	ø1/2in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)
ø16mm	±0.1mm	±0.15mm	ø5/8in.	±0.1mm (0.0039in.)	±0.15mm (0.0059in.)

6. Cautions on the fitting of tube

- (1) Make certain that the end of the tube is cut at right angles, the tube surface is free from flaws, and the tube is not deformed into an ellipse.
 - (2) When fitting a tube, refer to the dimensional specification of Table 2. To prevent leaks, insert the tube to end completely.
 - (3) On completion of fitting, make certain that the tube does not come out at your pulling.
- * At the time of installing a tube on a fitting, although it is hard to identify the lock-claws by looking into release-ring hole, tube not always looses. Most of causes of loosing tube are ① shear drop of fore-end of lock-claws and ② abnormal (small) tube outer diameter. Therefore, please insert the tube following the procedure of fitting of tube (1) to (3) even if the lock-claws is not observed.



7. Cautions on the release of tube

- (1) Before releasing the tube, make certain that the pressure inside the tube is zero.
- (2) Push the release ring fully inside and pull out the tube. Unless you push it completely in, the tube may not come out and scrapings of tube may be left inside the joint.

Common Safety Instructions for Products Listed in This Manual

8. Cautions on the installation of joint body

- (1) For installation of a product, please tighten it with a proper tool using outer hexagonal part or internal hexagonal part. Please pay attention that the tool and lock-claws are not come in contact when inserting the tool into hexagonal hole. The loss of tube lock function may be caused by deformation of fore-end of lock-claws and may cause loosening tube.
- (2) In tightening the screw, use the tightening torque recommended in Table 2.
 - Use of a torque higher than the recommended level may damage thread or deform gasket, thus causing leaks.
 - Use of a torque lower than the recommended level may cause loose screw and leakage.
- (3) With the joint whose piping direction will not change after tightening, make adjustment within the recommended range of tightening torques.

Table 2. Tightening Torque, Sealock Color and Gasket Material

Thread type	Thread size	Tightening torque	Sealock color	Gasket material
Metric thread	M3×0.5	0.7N·m	-	SUS304, NBR
	M5×0.8	1 ~ 1.5N·m		
	M6×1	2 ~ 2.7N·m		
	M3×0.5	0.5 ~ 0.6N·m		POM
	M5×0.8	1 ~ 1.5N·m		
	M6×0.75	0.8 ~ 1N·m		
Taper pipe thread	M8×0.75	1 ~ 2N·m	White	-
	R1/8	7 ~ 9N·m		
	R1/4	12 ~ 14N·m		
	R3/8	22 ~ 24N·m		
Unified thread	R1/2	28 ~ 30N·m	-	SUS304, NBR
	No. 10-32UNF	1 ~ 1.5N·m		
Pipe thread General purpose (inch)	1/16-27NPT	7 ~ 9N·m	White	-
	1/8-27NPT	7 ~ 9N·m		
	1/4-18NPT	12 ~ 14N·m		
	3/8-18NPT	22 ~ 24N·m		
	1/2-14NPT	28 ~ 30N·m		

*.Since it may different by product, please also refer to the detailed safety instruction of each product.

9. Cautions on the removal of joint body

- (1) When removing the joint body, loosen it with a proper tool, using the outside or inside hexagon.
 - (2) Remove sealant sticking to the thread on the mating equipment. The sealant left sticking may enter the peripheral equipment and cause trouble.
10. Please make plumbing so that torsion, tension, moment load, vibration, and a shock are strained to tube and fitting. If not, damage to a fitting, or squashed, burst or loosen tube may be caused.



Common Safety Instructions for Flow Controller

In order to use the sensor safely

Please always read this instruction before starting use.

When designing and manufacturing a device using PISCO products, the manufacturer is obligated to check that device safety 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 or maintain the product appropriately to ensure that PISCO products are used safely.

Please observe warning and cautions to ensure the safety of equipment.

Please check that the safety of equipment be ensured, then manufacture safe equipment.

- Warnings :**
1. The products are designed and manufactured as parts for general industrial machines. Therefore, the person that has sufficient knowledge and experience must handle them.
 2. Please make sure to use the products within the specifications range.
It is not allowed to use the products outside the specifications range. Please do not attempt to modify or additionally machine the products. Because the products are designed and manufactured as parts for general industrial machines, it is not approved when using it outdoors, and when using it under the conditions and environment below.
 - (1) Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, equipment or components directly contacting to beverage, food, etc., amusement equipment, emergency shutoff circuits, press machines, brake circuits, safeguard, etc.
 - (2) Use for applications where life or assets could be adversely affected, and special safety measure are required.
 3. For the safety on equipment design/control, etc., corporate standards, regulations, and etc., must be observed.
ISO4414 and JIS B 8370 (pneumatic system rules)
JFPS2008 (principles for use and selections of pneumatic cylinder)
High Pressure Gas Maintenance Law, Occupational Safety and Sanitation Laws, other safety regulations, corporate standards, and etc.
 4. Please do not handle the products, plumbing, nor remove components before confirming safety.
 - (1) Please inspect and service the machines and devices after confirming safety of the entire system related this product.
 - (2) Care must be taken even after operation is stopped since it may be hot or there may be charged section.
 - (3) When inspecting or servicing the device, please turn off the energy source (pneumatic or hydraulic source), and turn off power to the facility. Please discharge the residual pressure and pay special attention to possible leakages of water and electricity.
 - (4) When starting and restarting a machine or device using pneumatic components, please make sure the system safety, such as popping-out prevention measures and etc. is secured.
 5. Warning and cautions on the following pages must be observed to prevent accidents.

Warning/cautions at the time of design & selection

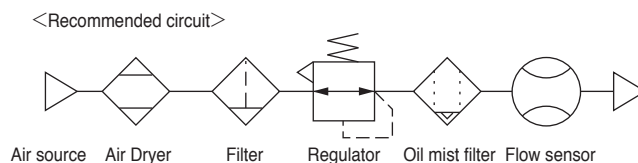
1. Fluid medium

Danger

- A flammable fluid must not be used.

Warnings

- The product can not be used as a business meter.
 Since it is not conformed to the Measurement Law, please do not use the product for the commercial purpose. Please use the product as an industrial sensor.
- Please do not use the product with other than applicable fluid medium, or the accuracy can not be guaranteed.
- When flowing compressed air, please use a clean air conforming to JIS B8392-1:2003 Grade 1.1.1 ~ 1.6.2. Please install a filter, an air dryer and an oil mist filter (micro alescser) 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. Please always install a filter since this mesh is not a filter to remove foreign materials, etc.



- When a valve is used in the primary side of the sensor, an oil-free valve must be used. The sensor may malfunction or be destroyed by splash of grease oil, and etc. Please install filter to prevent flowing abrasion powder, which may be generated from a valve, into a sensor.
- Please use dry clean gas, which do not contain dust, oil mist and corrosion ingredients such as chlorine, sulfur, acid or etc.
- Depending on the property of fluid, bad influence on performance may be caused when such fluid remained in the sensor for a long time. Please do not seal up a fluid in the plumbing for a long time.

2. Working Environment

Danger

- Flammable environment
 Please do not use the product in flammable gas environment. Since the product is not explosion-proof, explosion or fire may be caused.

Warnings

- Corrosive environment
 Please do not use the product in an environment containing corrosive gas such as sulfurous acid gas, or etc.
- Ambient / fluid temperature
 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.
- Working pressure range / Working flow range
 Please use the product in accordance with specifications. If used out of the maximum working pressure and working 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. The product can not be used where the temperature changes suddenly or has high humidity since a failure by dew condensation may be produced in the body.

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. If dynamic pressure is applied such as feeding workpiece during leakage inspection, please always provide a by-pass circuit or a needle valve to avoid applying dynamic pressure to the sensor.

5. Suction lift verification, etc.

Cautions

- When using this product with suction lift verification, etc., select the flow rate range according to vacuum range and vacuum nozzle diameter. Refer to Page 22 "How to select flow sensor."
- When using this product with suction lift verification, etc., please always install an air filter onto the upstream of suction side to prevent suction of foreign materials.
- When using this product with suction lift verification, etc., considering atmospheric dew point and ambient temperature of this product, please use the product under the conditions that dew condensations will not be formed in the inside of pipe.
- When using this product with suction lift verification, etc., response time may delay per piping volume between the sensor and vacuum nozzle. In that case, please take measures such as, reducing piping volume, etc.
- When using the product with vacuum applications such as air aspiration, etc., please do not bend the tube near the quick-fitting. If stress is applied to the tube near the quick-fitting, please insert the tube into the quick-fitting after inserting the insert-ring.
- When the sensor for suction lift verification is replaced from the pressure sensor (switch) to the flow sensor (switch), in the image (refer to below figure), the theory of sensor output (switch output) is reversed. Care must be taken since change and modification of sequence program of PLC are required. If source pressure/vacuum is not supplied especially when equipment power turned on, problems must not be created in sequence program, etc., of PLC since flow sensor (switch) maintains "Flow-rate 0"="Sensor output (switch output) ON".

	Pressure sensor (switch)	Flow sensor (switch)
	ON at set-point or over	ON at set-point or below
Suction lift verification		
	Atmospheric pressure side High vacuum side	Flow-rate 0 side Flow-rate large side

Common Safety Instructions for Products Listed in This Manual

Warning/cautions of installation & adjustment

1. Piping

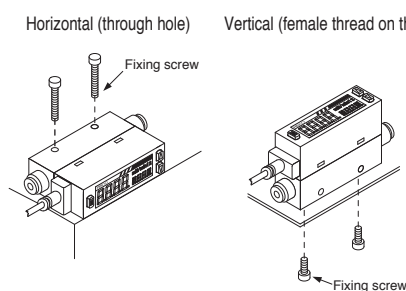
Cautions

- Installation and plumbing must be done prior to wiring.
- It must be piped, while matching the flow direction and direction specified on the body.
- Please flash the pipe by air blow to remove foreign substances and swarf, etc., in inside of pipe before piping. If many foreign materials and swarf, etc. entrain into the inside, the rectifier and the sensor tip could be damaged.
- If a quick-fitting is used, the tube must be inserted certainly. Please pulls the tube to check that it will not come out. Cut the tube at the right angle with the dedicating cutter.

2. Installation

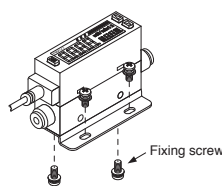
Cautions

- The flow display uses liquid crystal. It may be hard to see by an angle.
- This product can be installed with any orientation; vertical, horizontal, right or left.



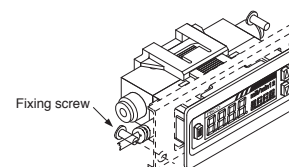
* Tightening torque of fixing screw is 0.5N.m.

Bracket installation (use dedicated bracket)



Model no. of bracket : FUS20-B1
 * Tightening torque of fixing screw is 0.5N.m.

Panel mount installation



- *1. Tightening torque of fixing screw is 0.06N.m.
- *2. Please make plumbing before installation.
- *3. If plumbing is made after installation, the part may be broken by excessive force.
- *4. If panel mounting is selected, please avoid vibrations are not affecting to the sensor.

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.

Warnings

- Line color must be checked when wiring. Please check the wiring color with handling precaution, since improper wire connection may result in damage, failure or malfunction of the sensor.
- Insulation of wiring must be checked.
 Please eliminate contact, ground fault and terminal insulation defective with other circuits, or overcurrent will be admitted into the sensor, and damage is caused.
- For the electrical power supply, please use rated stabilized DC power supply insulated from AC power supply. 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, please stop control unit, machinery and equipment, and turn off the power supply first. Drastic operation may lead to unexpected motions, causing a danger. First, please attempt energizing test, then set the desired switch data while control unit, machinery and equipment are stopped. Please discharge static electricity built in body, tool and equipment before and during work. Use a wire with elasticity as wire for robot connection in the movable part.
- Please do not use the product beyond the power supply voltage range. If voltage more than its range is applied, or if alternating current power (100VAC) is applied, it may cause a damage or burn.
- This product and wiring must be installed as far away as possible from noise source such as strong electric line, etc. Please take other countermeasures for a surge on the power supply line.
- Please do not short-circuit a load, or causing damage or burn.
- Output impedance of analog voltage output type is approximately 1 kΩ. If the impedance of connecting load is low, error of output value becomes large. Please check the error of connecting load impedance before use. However, analog current output type is excluded.

Example).

(V output impedance : $R_o=1K\Omega$

Internal load impedance : $R_x=1M\Omega$

$$\begin{aligned} \text{Output value} &= \left(1 - \frac{R_o}{R_o + R_x}\right) \times 100\% \\ &= \left(1 - \frac{1K\Omega}{1K\Omega + 1M\Omega}\right) \times 100\% \Rightarrow \text{Approx. } 0.1\% \end{aligned}$$

Error of output value

4. Adjustment

Caution

- If a switch is activated in unstable flow rate state such as a fluid pulsation, etc., unstable operation may be provided. In this case, maintain a sufficient difference between two set points, or avoid switch setting in the unstable area, then use the product after checking that switching operation becomes stabilized.

Common Safety Instructions for Products Listed in This Manual

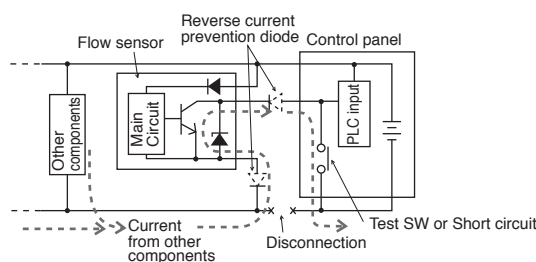
Usage and Maintenance

Warnings

- 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.

Cautions

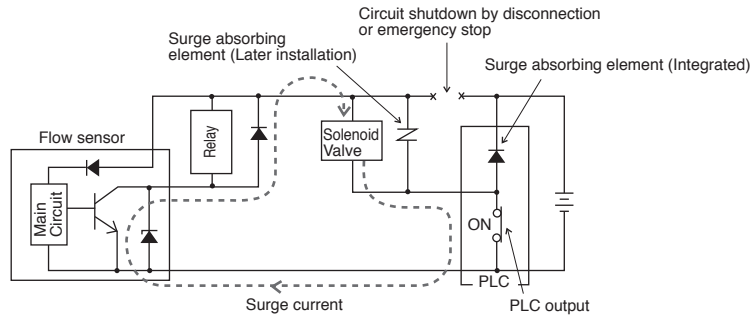
- When an error occurs during operation, please turn off power supply immediately, and terminate the operation, and contact to the sales office.
- Use the product within range of rated flow.
- Use the product within range of working pressure.
- When changing set points of the output, please stop the equipment, then change the set points, or an accident may occur.
- A periodic inspection should be done at least once a year, then please make sure that the product be operated properly.
- Disassembly and modification must not be done or causing a failure.
- The material of case is resin. Solvent/alcohol/cleaner, etc., must not be used to remove contamination, etc., or causing a resin to be corroded. Please wipe with diluted neutral detergent by tightly squeezed waste cloth, etc.
- Please be careful of reverse current by disconnection/wiring resistance. If other components including other flow sensors are connected to the same power source of the sensor, when switch output line and "-" side of power line are short-circuited to check operation of input device in the control panel, or if "-" side of power line is disconnected, reverse flow in switch circuit may cause damage.



- Preventing damage by reverse current, please take the following countermeasures.
 - (1) Please avoid concentration to "-" side power line, and use the wire as fat as possible.
 - (2) Please narrow the number of components to connect to the same power source of the sensor.
 - (3) Please provide a diode on the flow sensor output line in serial to prevent reverse current.
 - (4) Please provide a diode on "-" side of flow sensor power line to prevent reverse current.

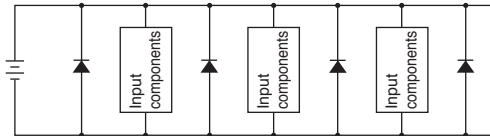
■ Please be careful of leading of surge current.

If the flow sensor shares the power source with inductive load forming surge of a solenoid valve or a relay, etc., when a circuit is disconnected while the inductive load is activating, depending on the installed position of surge absorbing element, surge current may lead to the switch output circuit, causing a damage.



■ Please take the following countermeasures to prevent damage by surge current leading.

- (1) Please separate output system; inductive load such as solenoid valve and relay, and input system; flow sensor.
- (2) If the power source can not be separated, please provide surge suppressor elements to all inductive loads directly. Surge absorbing element connected PLC, etc., merely protect a single component connected.
- (3) Furthermore, please connect surge suppressor element per power line to protect the product from disconnection.



If components are connected with connectors, when the connector is removed while energizing, the output circuit may be damaged. So, please always mount or dismount the connector after the power is turned off.

■ Even if exceeding the flow rate range, analog output will be provided. "Hi" or "Lo" will be displayed.

However, please be noticed in advance that accuracy is not guaranteed.

■ Please do not punch sensor display. It may cause a failure.

Common Safety Instructions for Products Listed in This Manual

■ Detailed Safety Instruction of built-in needle valve flow sensor

1. Design & selection

Cautions

- The product cannot be used as shut-off valve requiring no leakage. A certain degree of leakage is allowed as specifications.
- Please select and use a clean filter such as hollow fiber membrane filter (MFU) or etc. if dusts and particles, which are generated in a flow path of needle valve, causes a problem.

2. Installation & adjustment

Caution

- Please do not turn the needle with excessive force at the time of full open or close (Max. 0.05N.m). Please do not turn the needle with holding a rock nut. It may cause galling or breakage of needle.

3. Usage and maintenance

Caution

- The flow rate may change by needle rotation caused by vibrations.

NIHON PISCO CO.,Ltd.

OVERSEAS OPERATION TEAM

3884-1, MINAMIMINOWA, KAMIINA, NAGANO-PREF., 399-4588 JAPAN

Tel. +81-(0)265-76-7751 Fax. +81-(0)265-76-3305 Website. <http://www.pisco.co.jp/english/pisco.htm> E-mail. intl@pisco.co.jp