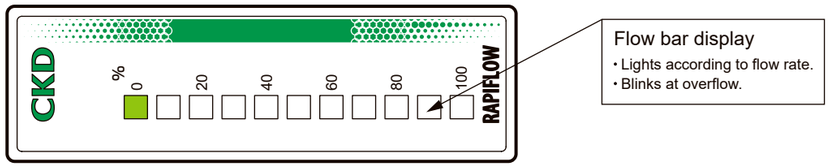
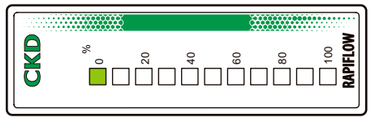
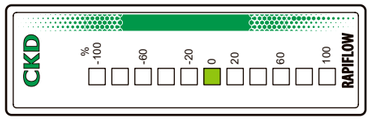
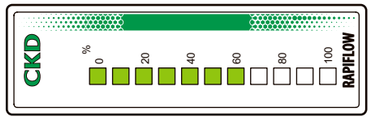
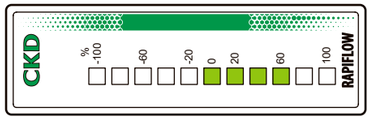
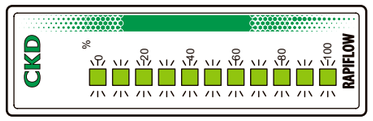
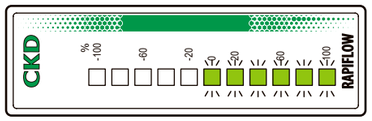
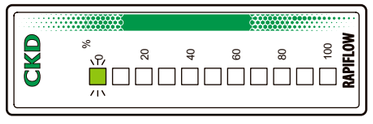
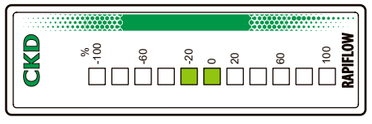
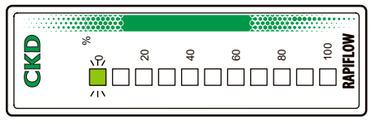
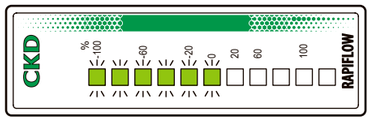
Names and functions of display/operation section (bar display-type)

●Indicator section name



[Display example] Display for FSM3-B101□□□□□□□.

Flow rate	Uni-direction	Bi-directional
0		
60 (Forward direction)		
+110% (Forward direction) Blinks at overflow. *Blinks at +110%F.S. and over.		
-10% (Reverse direction)		
-110% (Reverse direction)		

Safety Precautions

Be sure to read this section before use.
For general pneumatic components precautions, refer to Intro 17 for details.

Product-specific cautions: Compact flow rate sensor FSM3 Series Environment-resistant specifications

Design / Selection

Working fluids

DANGER

■Never use this product with flammable fluids.

WARNING

■This product cannot be used as a billing meter. Do not use this product for commercial transactions as it is not compliant with the Measurement Act. Intended applications include industrial sensors.

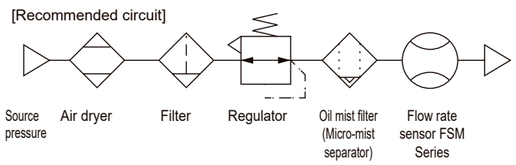
■Do not use fluids which are not applicable.

■Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist.

■When installing the product during piping or fitting assembly, use the above clean gas for the fluid used to blow out for cleaning. Check that foreign matter does not enter the product from the port of the product. When using compressed air in this process, use clean air compliant with the air quality listed in the following item (ISO 8573-1 Class 2010 1.1.1 to 1.6.2).

■When using compressed air, use clean air that complies with ISO 8573-1 2010 Class 1.1.1 to 1.6.2. Since compressed air from the compressor contains drainage (water, oil oxides, foreign matter, etc.), attach a filter, an air dryer and an oil mist filter (Micro-mist separator) to the primary side (upstream) of the sensor. The sensor's mesh rectifies flow in the pipe. It does not filter out foreign matter, so provide a filter.

[Recommended circuit]



■Depending on the fluid, retaining the fluid for long periods could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.

■Working pressure/flow rate range
Applications exceeding the max. working pressure and specified flow rate range may result in breakdown. Use this product only within the specified range. If energized in a vacuum state of -0.09 MPa or less, the sensor's heat dissipation will suffer, leading to degradation of the sensor.

■When using a valve on the primary side of the sensor, use only valves with oil-prohibited specifications. This sensor could malfunction or fail if exposed to splattering grease, oil, etc. As friction powder may be generated depending on the valve, mount a filter to prevent the powder from entering the sensor.

■The sensor for oxygen gas is a custom model. To prevent ignition accidents, treat the inside of the flow paths on oxygen models in accordance with oil free specifications. Do not allow oxygen to flow again when it has been used on fluids other than oxygen to flow even once.

■When using liquefied gas such as carbon dioxide, always vaporize it first. Failure may result if liquefied gas enters the product.

Working environment

DANGER

■Flammable environment
Refer to "ATEX Compliance" on P. 352 for safety precautions.

WARNING

■Corrosive environment
Do not use this product in an atmosphere containing corrosive gases such as sulfur dioxide.

■Ambient/fluid temperatures
Use at ambient/fluid temperatures within the specified range of 0 to 50°C. Even if the temperature is within the specified range, do not use this product if the ambient temperature and fluid temperature could suddenly change and cause dew to condense.

■ Degree of protection
The degree of protection of this product is equivalent to IP65. This product employs a dust-proof, waterproof structure that provides reliability during maintenance and cleaning, during which it may be exposed to water splashing. Note that this product cannot be used in environments where it will be constantly exposed to water, or in water or where water or oil may exude violently. Also refer to the precautions regarding "explosion-proof structures and protective structures" on Page 351 for design and selection.

Flow rate unit

⚠CAUTION

■ This product's flow rate is measured at a mass flow rate unaffected by temperature or pressure. The unit is L/min, but this is the display when the mass flow rate is converted to volumetric flow rate at 20°C 1 atmosphere (101 kPa) relative humidity 65%RH. (Conditions for gas-types other than air are 20°C, 1 barometric pressure (101 kPa), relative humidity 0%)

Overflow

⚠CAUTION

■ With each series, no problem will occur in the sensor, even in an overflow double the measured range. If dynamic pressure is applied near the maximum working pressure (when a pressure difference exceeding the max. working pressure is applied between primary and secondary sides), a problem could occur with the sensor. When dynamic pressure is applied, such as when filling a workpiece for leakage inspection, be sure to provide a bypass circuit or a squeezer to prevent dynamic pressure from being applied to the sensor.

Use for suction confirmation, etc.

⚠CAUTION

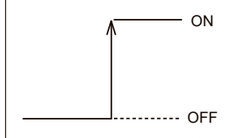
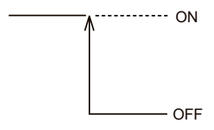
■ Mount an air filter upstream from suction in compliance with the working status to prevent the entry of foreign matter.

■ Use the product under conditions where no condensation occurs in the piping, taking into consideration the dew point of the atmosphere and the ambient temperature of the product.

■ Select the flow rate range based on the operating vacuum pressure and suction nozzle.

■ Response speed may be delayed by the piping volume between the suction nozzle and this product. In this case, take countermeasures to reduce piping capacity.

■ When the suction confirmation sensor is switched from a pressure sensor (switch) to a flow rate sensor (switch), sensor output (switch output) logic will be reversed. (Refer to the drawing below.)
Note that the PLC sequence program must be changed or revised. If source pressure or vacuum source is not supplied when device power is turned ON, "flow rate 0" = "sensor output (switch output) ON" status is set at the flow rate sensor (switch). Check that this occurs with the PLC sequence program, etc.

Suction confirmation	Pressure sensor (switch)	Flow rate sensor (switch)
	ON at setting value or more	ON at setting value or less
		

Piping

⚠CAUTION

■ Do not install a pressure reducing valve (regulator), solenoid valve, etc. immediately before this product. Deflected currents may occur and cause errors. Provide a straight pipe with approx. 10 times the bore size when necessary.

■ Be sure to connect a fitting even when using with the OUT side opened. The port filter could come off.

■ Do not rotate fittings while fluid pressure is still applied to this product. The sealant parts could seize or wear, leading to external leakage.

■ Establish the installation method, piping order, and fitting assembly method from the design stage before use. Check that sealing tape, sealant, and foreign matter do not enter the product during installation and fitting assembly. In particular, freshly piped sections may contain unexpected foreign matter. Be sure to discharge air with air blow, etc., before installing this product.

Mounting

⚠CAUTION

■ The LCD display flow rate meter uses a liquid crystal display. This may be difficult to read depending on the angle.

■ Do not install multiple product bodies in close contact. The generation of heat on each part could cause the product's temperature to rise, hastening changes in characteristics or deterioration of the resin material. When using the products in a row, set intervals of distance of 10 mm and over.

■ Although the mounting is "unrestricted in vertical/horizontal direction", the flow rate may vary depending on difference in the mounting orientation or piping conditions.

Wiring

⚠WARNING

■ Install the product and wiring as far away as possible from sources of noise such as power distribution wires. Provide separate countermeasures for surge applied to the power cable. The display or output could fluctuate.

■ The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output error increases. Check error with the impedance of the connecting load before using. (The analog/current output type is excluded.)

Example of calculation

(FSM3-voltage output impedance: Ro = 1kΩ
Load internal impedance: Rx = 1 MΩ

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

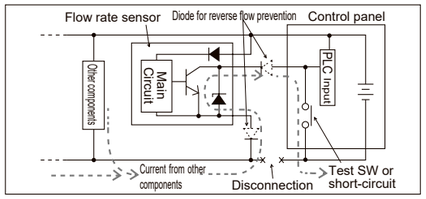
$$= \left(1 - \frac{1\ k\Omega}{1\ k\Omega + 1\ M\Omega}\right) \times 100\% \quad \text{Output value error} \Rightarrow \text{approx. } 0.1\%$$

■ Use a DC stabilized power supply within the specified rating, insulated from the AC power supply. A non-isolated power supply could result in electrical shock. If power is not stabilized, the peak value could be exceeded. This could damage the product or impair accuracy.

■ The power supply is a DC stabilized power supply completely isolated from the AC primary side. Connect either the + side or - side of the power to the FG. Between the internal power circuit and metal body, a varistor (limit voltage approx. 40 V) is connected to prevent dielectric breakdown of the sensor. Do not conduct a withstand voltage test or insulation resistance test between the internal power circuit and metal body. Disconnect wiring first if this testing is required. An excessive potential difference between power and metal body will burn internal parts. An excessive potential difference between the power supply and product housing will burn internal parts. After installing, connecting and wiring the unit, electrical welding of the device/frame, short-circuit accidents, etc., could cause welding current, excessively high voltage caused by welding, or surge voltage, etc., to run through the wiring, ground wire, or fluid path connected between the above devices, damaging wires or devices. Conduct any work such as electrical welding after removing this device and disconnecting all electric wires connected to the FG.

■ Check that stress (10 N and over) is not directly applied to lead wire leadouts.

■Pay attention to reverse currents caused by disconnected wires and wiring resistance. If other devices, including a flow rate sensor, are connected to the same power supply as the flow rate sensor, and the switch output wire and power cable negative (-) side are short-circuited to check the operation of the control panel input unit, or if the power cable negative (-) side is disconnected, reverse current could flow to the flow rate sensor's switch output circuit and cause damage.



■Take the following measures to prevent damage caused by reverse current:

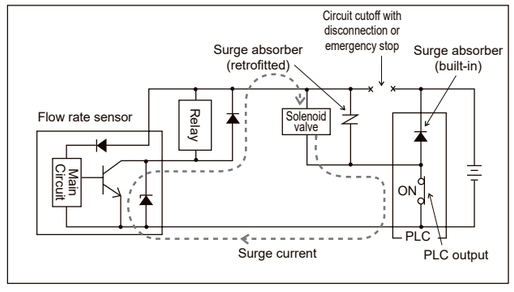
①Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.

②Limit the number of devices connected to the same power source as the flow rate sensor.

③Insert a diode parallel to the flow rate sensor's output line to prevent reverse current.

④Insert a diode parallel to the flow rate sensor power wire's negative (-) side to prevent reverse current.

■Pay attention to surge current flow-around. When flow rate sensor power is shared with an inductive load that generates surges, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, surge current could enter the switch output circuit and cause damage depending on where the surge absorber is installed.

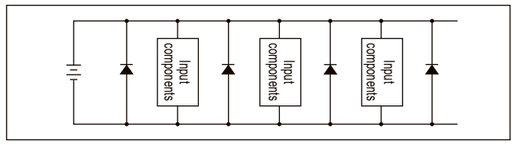


Take the measures below to prevent damage from sneak surge current.

①Separate the power supply for output including the inductive load, such as the solenoid valve and relay, and input, such as the flow rate sensor.

②If a separate power supply cannot be used, directly install a surge absorption element for all inductive loads. Consider that the surge absorber connected to the PLC, etc., protects only the individual device.

③Connect a surge absorber to places on the power wiring shown in the figure below, as a measure against disconnections in unspecified areas.



When the devices are connected to a connector, the output circuit could be damaged by the above phenomenon if the connector is disconnected while the power is ON. Turn power OFF before connecting or disconnecting the connector.

Other

⚠WARNING

■CE-compliance working conditions
This product is CE-marked, indicating conformity with the EMC Directives. The standard for the immunity for industrial environments applied to this product is EN61000-6-2; the following requirements must be satisfied in order to conform to this standard:
Conditions
- The evaluation of this product is performed by using a lead wire that has a power supply line and a signal line paired to assess the product's performance.
- This product is not equipped with surge protection. Implement surge protection measures on the system side.

■Output accuracy is affected by self-heating due to energization as well as temperature characteristics. Provide a standby time (5 minutes or more) after turning the power ON for use.

■Immediately after power is turned ON, flow rate detection switch operation is not performed for approx. 5 seconds to complete self-diagnosis. Provide a control circuit/ program that ignores signals for at least two seconds after power is turned ON.

⚠CAUTION

■The flow path is not completely free of dust generation, so if dust generation is a problem, a final clean filter should be used in conjunction.

■If the actual flow rate is fluctuating, the measured flow rate value also fluctuates. Increase the FSM3 display cycle or response time, or average the analog output on the device. In particular, using a circuit that opens and closes the control valve such as a solenoid valve frequently in a short time or near a pump is likely to cause damage.

■Measuring the pulsating flow rate may cause errors in the measured flow rate. Use the fixed orifice and needle valve, etc., to restrict the flow rate and set the laminar flow state (normal flow without irregular fluctuations).

■The flow rate measured with the gas switching function is a reference value calculated inside the product based on the converted value. Accuracy other than in air mode is a guideline.

■This product uses a micro-sensor chip, and must be installed where it will not be subject to dropping, impact or vibration. Handle this product as a precision component during installation and transportation.

■Use the product within the rated flow range.

■Use within the working pressure.

■Analog output continues even if the flow rate range is exceeded. With the LCD display, "Hi" or "Lo" will be displayed. With the bar display, the bar display will blink. Note that this is outside the guaranteed precision.

■The accuracy may vary from the initial status depending on the working environment or working conditions. It is recommended to check the operation of the product periodically.

■Since the sensor chip will change its detection flow rate due to deterioration after prolonged use, periodic inspections should be performed.

■The explosion-proof and protective structures function with the protective cover (transparent cover) correctly attached. Regularly confirm that the cover bolt (M3) for fixing the protective cover is tightened to the following torque. Also, when opening and closing the protective cover, make sure that there is no floating or displacement of the protective cover and that there is no adhered foreign matter, etc., on the seal surface. Tighten and fix with the following torque.
Cover bolt tightening torque: 0.6 N·m ±10%

ATEX Compliance

■ The following are supported.
II3 G Ex ec II C T6 Gc 0°C ≤ Ta ≤ 50°C

■ Working conditions
1) There is a risk of static electric discharge. Attach to grounded metal and wipe with a wet cloth.
2) Use in a clean environment with a contamination level of 2 or more.
3) This product's cable fixing parts do not have sufficient fixing functions. Provide the cable with an additional retainer function to ensure that tension is not transmitted to the end when using.
4) The protective cover of this product can be opened and closed, but it has an explosion-proof structure only when the protective cover is closed and the cover bolt is tightened with the specified torque. Cover bolt tightening torque: 0.6 N·m±10%

■ Fluid temperature rating
The temperature of the fluid measured for explosion-proof specifications is 50°C.

■ ATEX command 2014/34/EU
EN standards for explosive atomosheres
EN IEC 60079-0:2018
EN IEC 60079-7:2015/A1:2018

⚠ WARNING
■ Do not remove or insert cables while energized in an explosive atmosphere.
■ Do not loosen the cover bolt while energized in an explosive atmosphere. Also, do not open the protective cover.
■ Do not disassemble or modify the product.

⚠ CAUTION
■ The separated display (FSM2-D) is not compliant with the ATEX standard.
When using the separated display (FSM2-D) together, install it outside the explosive atmosphere.

For precautions during mounting, installation, adjustment, use and maintenance, refer to the CKD Components Product Site (https://www.ckd.co.jp/kiki/en/) → "Model No.→ Instruction Manual

MEMO