



Pneumatic components (sensors)
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

Design / Selection

Working fluids

DANGER

■ Never use this product with flammable fluids.

WARNING

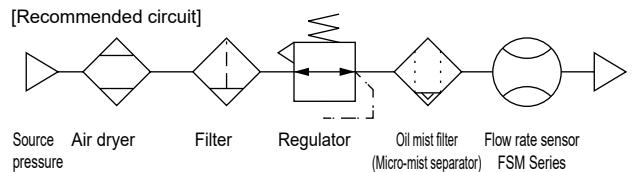
■ This product cannot be used as a billing meter. Do not use this product for commercial transactions as it is not compliant with the Measurement Act. Intended applications include industrial sensors.

■ 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.



■ 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
Never use this product in an explosive gas atmosphere. The structure is not explosion-proof, and explosions or fires could occur.

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.

Drip-proof environment

The degree of protection of this product is equivalent to IP40. Do not install this product where water, salt, dust, or swarf is present or in a pressurized or depressurized environment. The product cannot be used with large temperature variations or high temperature/humidity since condensation may occur inside the body.

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.

Needle valve integrated

CAUTION

■ This valve cannot be used as a stop valve that requires no leakage. Slight leakage is allowed for in the product specifications.

■ The needle valve does not change linearly along with the rotation speed, so be sure to use it as fixed restriction.

■ Vibration could cause the needle to turn and the flow rate to change.

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.

■ When this product is used for vacuum applications such as air supply, do not bend the tube near the push-in fitting. If stress is applied to the tube near the push-in fitting, insert an insert ring into the tube, and connect the tube to the push-in fitting.

■ 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.

	Pressure sensor (switch)	Flow rate sensor (switch)
	ON at setting value or more	ON at setting value or less
Suction confirmation		
	Atmospheric pressure side High vacuum side	Flow rate 0 side High flow rate side

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.

■ The resin body screw-in fittings of this product are compliant with push-in fittings for pneumatic pressure. Do not use this product for pneumatic pressure circuits with steel pipe connections. If this product is used for steel pipe connection, the misalignment of the IN side steel pipe bore and OUT side steel pipe bore will cause excessive force to be applied to the body, as well as external leakage, risking damage to the product.

■ Connect a fitting even when using the metal body 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.

■ The resin body elbow fitting or screw-in fitting (1/8, 1/4) can be rotated about 10 times, but it cannot be rotated further or constantly. Do not rotate it beyond the required number of times. Rotating the sealant more than necessary may cause the sealant to-bite or wear, and lead 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.

■ If you mount the elbow fitting in a downward position, it may interfere with the DIN rail mounting.

■ The bracket mounting position may interfere with the elbow fitting.

■ The inside of the upper resin case of this product contains wiring parts, including the electronic circuit board. If stress is applied to the resin case during installation, fitting installation, and piping, stress will be transmitted internally as well, and internal parts may be damaged. Establish from the design stage, mounting methods that do not apply stress to the resin case area or fitting mounting methods before use.

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: $R_o = 1\text{ k}\Omega$
Load internal impedance: $R_x = 1\text{ M}\Omega$)

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

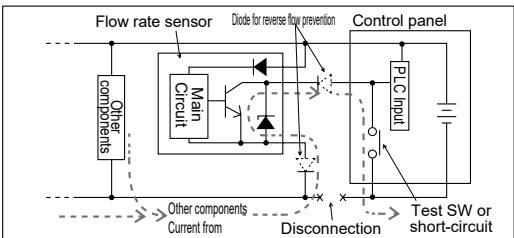
■ Use a DC stabilized power supply within the specified rating, insulated from the AC power supply. A non-isolated power supply could result in electrical shock. If power is not stabilized, the peak value could be exceeded. This could damage the product or impair accuracy.

■ The power supply for the metal body (stainless steel body) type 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 metal body 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. After installing, connecting and wiring the metal body, electrical welding of the equipment/frame or short-circuit accidents, etc., could cause welding current, excessive high voltage caused by welding, or surge voltage, etc., to run through the wiring, ground wire, or fluid path connected between such 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 (7 N and over) is not directly applied to lead wire leadouts or connectors.

CAUTION

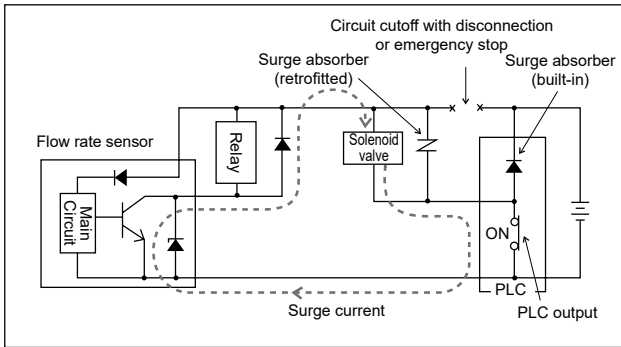
■ Pay attention to reverse currents caused by disconnected wires and wiring resistance. If other devices, including a flow rate sensor, are connected to the same power supply as the flow rate sensor, and the switch output wire and power cable negative (-) side are short-circuited to check the operation 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:

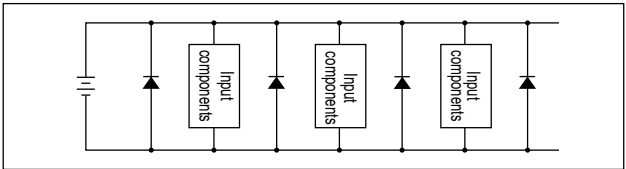
- ① Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.
- ② Limit the number of devices connected to the same power source as the flow rate sensor.
- ③ Insert a diode parallel to the flow rate sensor's output line to prevent reverse current.
- ④ Insert 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.

- ① Separate the power supply for output including the inductive load, such as the solenoid valve and relay, and input, such as the flow rate sensor.
- ② If 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.
- ③ Connect 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, note that it can easily occur if a control valve such as a solenoid valve is opened and closed at a high frequency in a short time or near a pump.

- Measuring the pulsating flow rate may cause errors in the measured flow rate. Restrict the flow rate with the fixed orifice and needle valve, etc., and use in a 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. Treat the product as a precision components 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.

MEMO

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