



Safety precautions

Pneumatic components: Warning and Cautions

Always read this section before use.

Please see Page 63 in the preface for general precautions on air pressure equipment.

Product-specific precautions: Compact flow sensor FSM3 series

Design/selection

Working fluids

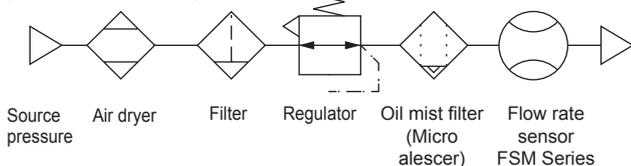
DANGER

- Do not use this product for flammable fluids.

WARNING

- This product cannot be used as a business 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.
- 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.
- When using compressed air, use clean air that complies with JIS B 8392-1: 2012 Class 1.1.1 to 1.6.2. As compressed air from the compressor contains drainage (water, oil oxides, foreign matter, etc.), install a filter, air dryer, and oil mist filter (micro alescerc) on the primary side (upstream side) 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]



Working pressure/flow rate range

Applications exceeding the max. working pressure and specified flow rate range may result in faults. Use this product only within the specified range. If energized in a vacuum state of -0.07 MPa or less, the sensor's heat dissipation performance will suffer, leading to degradation of the sensor.

- When using a valve on the primary face 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 inface of the flow paths on oxygen models in accordance with oil free specifications. Do not allow oxygen gas to flow again when a fluid other than oxygen has flown even once.
- When using with liquefied gases such as carbon dioxide, always vaporize the gas. Failure may result if liquefied gas enters the product.

Working environment

DANGER

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

WARNING

- Corrosive environments
Do not use this product in an atmosphere containing corrosive gases such as sulfur dioxide.
- Ambient/fluid temperatures
Use ambient temperature/fluid temperature from 0 to 50°C within specified range. 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 environments
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 barometric pressure (101 kPa), and relative humidity of 65%. (Conditions for gas types other than air are 20°C, 1 barometric pressure (101 kPa), relative humidity 0%)

Overflow

⚠ CAUTION

- With each series, the sensor can handle 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), the sensor may operate abnormally. If dynamic pressure is applied, such as when a workpiece is filled for leakage inspection, provide a bypass circuit or restrictor so that dynamic pressure is not applied to the sensor.

Integrated needle valve

⚠ CAUTION

- This valve cannot be used as a stop valve that requires no leakage. Slight leakage is allowed for in this product's specifications.
- Please be sure to use needle valves as fixed apertures as they do not become linear in accordance with the number of rotations.

Use for suction confirmation, etc.

⚠ CAUTION

- Provide an air filter upstream from suction to prevent the entry of foreign matter.
- Consider the atmospheric dew point and the product's ambient temperature, and use the product under conditions in which dew does not condense in pipes.
- When this product is used for vacuum applications such as air suction, 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 time 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 is not a problem with the PLC sequence program, etc.

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

Others

⚠ CAUTION

- The flow path is not completely free of dust generation. A final clean filter should be used in circuits where dust generation could be a problem.

SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder Switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R.(module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending

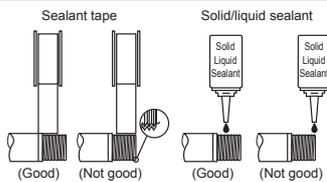
Mounting, installation and adjustment

Piping

CAUTION

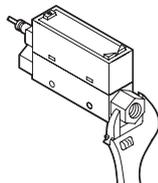
- Always attach the pipes before starting wiring.
- Align the fluid flow direction to the direction indicated on the pipe when connecting the pipes.
- Do not install the regulator/solenoid valve, etc., immediately before this product. Generated drift may cause errors. Provide a straight pipe with approx. 10 times the bore size when necessary.
- Before installing piping, clean out the pipes using air blower to remove all foreign matter and cutting chips from the pipes. The rectifier or sensor chip could be damaged if a large amount of foreign matter, cutting chips, etc., enters.
- Check that sealant tape or sealant material does not get inside during piping.
 - * When using for clean room specifications, make sure that the sealant material matches the system.

When winding fluoro resin sealing tape around threads, wind sealing tape once or twice, leaving two to three threads open at the end of the thread. Press tape with your fingernail tip to stick it onto threads. When using liquid sealant, leave one to two threads open from the end, and avoid applying too much. Check that the sealant does not get on device threads.



- 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.

- Attach a wrench to metal sections when tightening pipes so that force is not applied to the resin section.



- Refer to the torque below so that excessive screw-in torque or load torque is not applied to the connection port.

[Reference value]

Port thread	Tightening torque N·m
Rc1/8 (G1/8)	3 to 5
Rc1/4	6 to 8
Rc1/2	16 to 18

- When using a push-in fitting, accurately insert tube and confirm that it cannot be pulled out. Cut the tube at a right angle with a dedicated cutter before use.

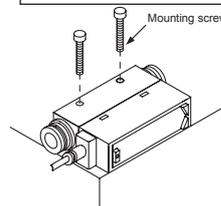
- Be sure to connect a fitting even when using the metal body with the OUT side opened. The port filter could become detached.
- Make sure that the leakage detection solution does not enter the inface of this product when inspecting the pipe for leaks.
- Do not turn fittings while fluid pressure is still applied to this product. Doing so might result in external leakage. The elbow fitting is not designed with the degree of freedom in the piping leadout direction. However, it is not designed with rotation in mind, so be sure to fix the fitting and not turn it more than necessary.

Mounting

CAUTION

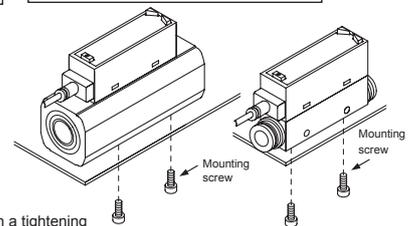
- The LCD display type flow rate meter uses a liquid crystal display. This may be difficult to read depending on the angle.
- Do not install multiple product bodies in close contact. The generation of heat on each part could cause the product's temperature to rise, hastening changes in characteristics 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.

Lateral mounting (use of through hole)

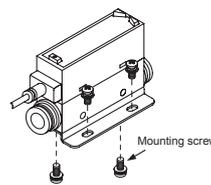


Tighten the mounting screw with a tightening torque of 0.5 N·m.

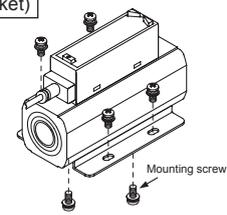
Vertical mounting (use of female thread on bottom surface)



Bracket mounting (use of dedicated bracket)

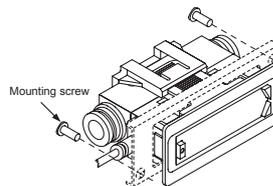


For FSM3-□005 to 201
Bracket model No.: FSM3-B1
Tighten the mounting screw with a tightening torque of 0.5 N·m.



For FSM3-□501 and 102
Bracket model No.: FSM3-B2

Panel mounting

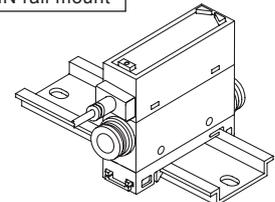


Tighten the mounting screw with a tightening torque of 0.06 N·m. Complete the piping before assembly.

If the pipes are connected after assembly, excessive stress will be applied and may damage the product.

When using the panel mounting method, make sure that vibration is not applied to the product. When using on a stainless steel body, the vibration will be amplified and could damage the product.

DIN rail mount



- Note that if you mount the elbow fitting in a downward position, it may interfere with the DIN rail mounting.
- Note that the bracket mounting position may interfere with the elbow fitting.

Wiring

⚠ DANGER

- Use power supply voltage and output within the specified voltage.
If voltage exceeding the specified voltage is applied, the sensor could malfunction or be damaged, or electrical shock or fire could occur. Do not use any load that exceeds the rated output. Otherwise, output damage or fire may result.
- Stop the control device and equipment and turn power OFF before wiring. Starting operation suddenly could cause unpredictable and dangerous operation. Conduct an energized test with controls and machine devices stopped, and set target switch data. Be sure to discharge any accumulated electrostatic charge among personnel, tools, or equipment before and during work. Connect and wire bending resistant material, such as robot wire material for movable sections.

⚠ WARNING

- Install the product and wiring away 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.
- Do not short-circuit the load. Failure to observe this could result in rupture or burning.
- The output impedance of the analog output voltage output type is approximately 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 output current output type is excluded.)

Example of calculation

$$\begin{aligned} & \left(\begin{array}{l} \text{FSM3-voltage output impedance: } R_o = 1 \text{ k}\Omega \\ \text{Load internal impedance} \quad \quad \quad : R_x = 1 \text{ M}\Omega \end{array} \right. \\ & \text{Output value} = \left(1 - \frac{R_o}{R_o + R_x} \right) \times 100\% \\ & = \left(1 - \frac{1 \text{ k}\Omega}{1 \text{ k}\Omega + 1 \text{ M}\Omega} \right) \times 100\% \Rightarrow \text{error approx. 0.1\%} \end{aligned}$$

- Check wiring insulation.
Check that wires do not come into contact with other circuits, that no ground faults occur, and that the insulator between terminals is not defective. Overcurrent could flow in and damage the sensor.
- Check line color when wiring. As incorrect wiring could result in sensor damage and malfunctions, check wire color against the instruction manual before wiring.

- Use a stabilized DC power supply within the specified rating that has been insulated from the AC power supply. A non-insulated 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 - face 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, transient 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.
- Do not use at levels exceeding the power supply voltage range. If voltage exceeding this range or AC power is applied, the controller could rupture or burn.
- Check that stress (7 N and over) is not directly applied to lead wire leadouts or connectors.
- Please be sure to attach the connector cover after connecting the connector when using an LCD display type or bar display type.
 - The L-shaped cable connector does not rotate. Be sure to never turn it.
 - Please be sure to turn the power OFF before pulling the M12 connector out or inserting it.
 - Please be sure to hold the connector part of the M12 connector when pulling it out or inserting it. Do not pull out by the cable.
 - When fitting the M12 connector; securely position the convex part of the connector terminal on the main body side with the concave part of the cable connector terminal before inserting, and fasten clockwise while holding the knurled part so that the screw threads do not become damaged.
 - Please note that the connector on the main body side can be damaged if the M12 connector is screwed in too tightly. Suggested torque: 0.4 to 0.49 N·m
 - Please keep the length of the wiring between the master and device (the product) 20 m long or shorter when extending the M12 connector cable.

SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder Switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R.(module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending

SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder switch
MN3E
MN4E
4GA/B
M4GA/B
MN4GA/B
F.R (module unit)
Clean F.R
Precision R
Press gauge
Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending

During adjustment

⚠ CAUTION

■ If switches are operated when fluid is pulsating or flow rate is otherwise unstable, operation may be unstable. In this case, provide sufficient margin between the two setting values and avoid setting switches in an unstable area. Confirm that switch operation is stable before use.

Integrated needle valve

⚠ CAUTION

■ Do not turn the knob forcibly when fully closing or opening it (0.05 N·m or less). Do not use the lock nut to adjust the needle. Otherwise this could cause needle galling or damage.

■ The set flow rate may be unstable if turning the dial of the needle valve forcibly when fully closing. Do not turn the knob forcibly.

During Use & maintenance

⚠ WARNING

■ Working conditions for CE compliance

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 immunity. Implement surge protection measures on the system side.

■ Do not disassemble or modify this product. Doing so could result in faults.

■ Output accuracy is affected by temperature characteristics and heat generated when energized. Provide a standby time (5 minutes or more) after turning the power ON for use.

■ Immediately after power is turned ON, this product does not start flow rate detection switch operation for approx. 5 seconds to complete self-diagnosis. Provide a control circuit/program that ignores signals for at approximately five seconds after power is turned ON.

⚠ CAUTION

■ If a problem occurs during operation, immediately turn power OFF, stop use, and contact your dealer.

■ 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.

■ Keep this product's flow rate within the rated flow range.

■ Use this product within the working pressure range.

■ Do not turn the product's fitting while the fluid pressure is ON, since it may cause external leakage. Also avoid use that may cause the fitting to rotate during operation.

■ If the output setting value is changed, control system devices could operate unintentionally. Stop devices before changing settings.

■ 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.

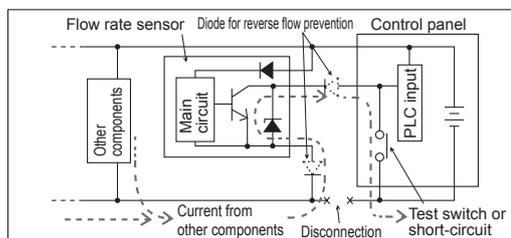
Note that this is outside the guaranteed precision.

■ 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.

■ The sensor chip will degrade when used for a long time and cause the detected flow rate to vary. Periodically inspect the sensor chip.

■ Replace the working gas in the flow paths before changing the gas type.

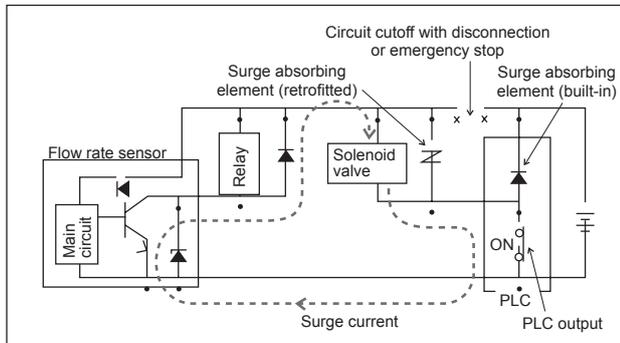
■ Pay attention to the reverse current caused by disconnected wires/wiring resistance. If other devices, including a flow rate sensor, are connected to the same power supply as the flow rate sensor, and the switch output wire and power cable negative (-) side are short-circuited to check the operation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

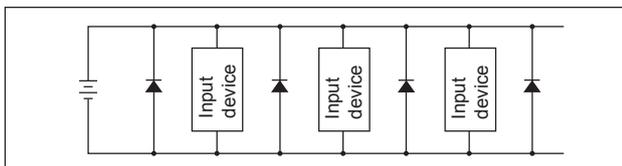
- ① Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.
- ② Limit the number of devices connected to the same power supply as the flow rate sensor.
- ③ Insert a diode parallel to the flow rate sensor's output line to prevent the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

- Care must be taken for surge current leading. 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 absorbing element is installed.



Take the following countermeasures as followings to prevent damages caused by reverse 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 absorption element connected to the PLC, etc., protects only the individual device.
- ③ Connect a surge absorption element to the following places on the power wiring as shown 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 the power OFF before connecting or disconnecting the connector.

- When using the LCD display type, do not press down on the display section. This may lead to failure.
- The case is made of resin. Do not use solvent, alcohol or detergent in cleaning, since the resin could absorb it. There is a risk of affecting the resin. Wipe off dirt with a rag soaked in a diluted neutral detergent solution and wrung out well.

Integrated needle valve

⚠ CAUTION

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

SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder Switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R.(module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending

SCPD3 Product-specific cautions: Separated display FSM2-D Series

SCM Design/selection

SSD2 **CAUTION**

MDC2 ■ The corresponding sensor is the voltage output (1 to 5 V) type. If the current output type or other voltage output type is connected, it will not operate properly. When using the FSM3, use the bar display voltage output type. This product is connected to the sensor using the e-CON connector. The e-CON connector is attached with the FSM2-D Series as standard. However, the cable used is within AWG24 to 26, and the insulator O.D. is within 1.0 to 1.2. Confirm that this cable is available before using the e-CON connector. When using with a cable that is outside the range, be sure to separately prepare a usable e-CON connector.

SMG *The FSM2-D socket uses Sumitomo 3M made 37204-62B3-004PL.

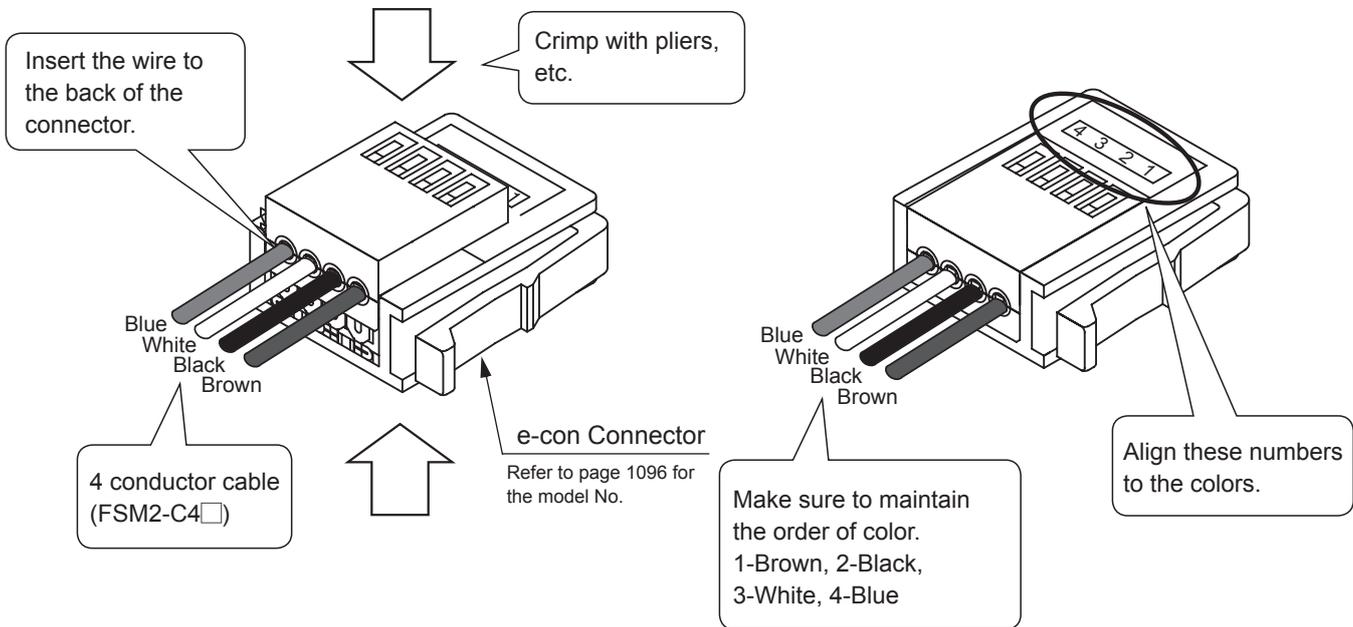
LCM LCR LCG LCX STM STG

Mounting, installation and adjustment

STG **CAUTION**

STR2 ■ Cut the half-strip section at the end of the e-con connector wiring before use. Insert the wire through to the back of the connector, and securely crimp with pliers, etc. The wire sheath does not need to be removed. Check that the pin No. and wire color are correct before crimping. Incorrect wiring can lead to sensor or separated indicator damage, faults or malfunction.

Cylinder switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R (module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending



* The e-con connector is attached with the separated display.

■ When attaching or removing the lead wire, hold the connector instead of the cable. Holding the cable could result in a contact fault, broken wire or short-circuit, etc., could damage the sensor or separated indicator, or cause malfunctions.

■ Do not apply a load of 15 N or over on the lead wire.