



Operation Manual

PRODUCT NAME

Flow Controller for Water

MODEL / Series / Product Number

FC3W5##

SMC Corporation

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Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “**Caution**,” “**Warning**” or “**Danger**.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)^{*1)}, and other safety regulations.

*1) ISO 4414: Pneumatic fluid power - General rules and safety requirements for systems and their components
ISO 4413: Hydraulic fluid power - General rules and safety requirements for systems and their components
IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 10218-1: Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots
etc.



Danger

Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.



Warning

Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



Caution

Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. SMC products cannot be used beyond their specifications. They are not developed, designed, and manufactured to be used under the following conditions or environments. Use under such conditions or environments is not allowed.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Use for nuclear power, railways, aviation, space equipment, ships, vehicles, military application, equipment affecting human life, body, and property, combustion equipment, entertainment equipment, emergency shut-off circuits, press clutches, brake circuits, safety equipment, etc., and use for applications that do not conform to standard specifications such as catalogs and operation manuals.
3. Use for interlock circuits, except for use with double interlock such as installing a mechanical protection function in case of failure. Please periodically inspect the product to confirm that the product is operating properly.



Safety Instructions

Caution

SMC develops, designs, and manufactures products to be used for automatic control equipment, and provides them for peaceful use in manufacturing industries.

Use in non-manufacturing industries is not allowed.

Products SMC manufactures and sells cannot be used for the purpose of transactions or certification specified in the Measurement Act of each country.

The new Measurement Act prohibits use of any unit other than SI units in Japan.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.

Read and accept them before using the product.

Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.*2)
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***2) Vacuum pads are excluded from this 1 year warranty.**

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

Operator

- ◆ This operation manual is intended for those who have knowledge of machinery using pneumatic equipment, and have sufficient knowledge of assembly, operation and maintenance of such equipment. Only those persons are allowed to perform assembly, operation and maintenance.
- ◆ Read and understand this operation manual carefully before assembling, operating or providing maintenance to the product.

■ Safety Instructions

Warning

- Do not disassemble, modify (including replacing the circuit board) or repair.
Otherwise, it can cause an injury or product failure.
- Do not operate the product outside of the specifications.
Do not use the product with flammable or harmful gases or fluids.
It may cause fire, malfunction, or damage to the product.
Check the specifications before use.
- Do not use in an environment where flammable, explosive or corrosive gases are present.
It may cause fire or an explosion.
The product is not designed to be explosion-proof.
- Do not use the product with flammable or highly permeable fluids.
It may cause fire, explosion, damage or corrosion.
- Do not use the product in a place where static electricity is a problem.
Otherwise, it may cause failure or malfunction of the system.
- If using the product in an interlocking circuit:
 - Provide a double interlocking system, for example, a mechanical protection function using a different system.
 - Check the product for correct operation.Otherwise, it may cause an accident due to malfunction.
- The following instructions must be followed during maintenance:
 - Turn off the power supply.
 - Stop supplying the flow before maintenance.Otherwise, it may cause an injury.

Caution

- Do not touch the terminals and connectors while the power is on.
Otherwise, it may cause electric shock, malfunction, and damage to the product.
- After completing maintenance, perform appropriate functional inspections and leak tests.
Stop operation if the equipment does not function correctly or there is a leakage of fluid.
When leakage occurs from parts other than the piping, the product might be faulty.
Disconnect the power supply and stop the fluid supply.
Do not apply fluid if the system is leaking.
Otherwise, it may cause an unexpected malfunction and safety cannot be assured.

■ Precautions for handling

- Follow the instructions described below for selecting and handling.
 - The instructions on design and selection (installation, wiring, environment, adjustment, operation, maintenance, etc.) described below must be followed.
 - * Product specifications
 - The direct current power supply used should be UL approved as follows.
Circuit (Class 2) of maximum 30 [Vrms] (42.4 V peak) or less, with UL1310 Class 2 power supply unit or UL1585 Class 2 transformer.
 - The product is a UL-approved product only if it has a  mark on the product body and label.
 - Use the product within the specified voltage.
Otherwise, it may cause failure or malfunction.
 - The operating fluid is water (0 to 50 °C).
Use of fluids other than those mentioned above is not guaranteed.
Do not use a fluid containing chemicals, synthetic oils including organic solvent, salt, and corrosive gases.
Mixture of these substances may cause damage or operation failure of the product.
 - Use the product within the specified operating pressure, flow rate, and temperature range.
Otherwise, it may damage the product, it will not be able to perform proper flow rate control.
 - Take care that pressure exceeding the specified range will not be applied due to water pulsation.
<Examples of measures for reducing water pulsation>
 - (1) Use a water pulsation-resistant valve.
 - (2) Use elastic piping material such as rubber hose, etc. and an accumulator to absorb impact pressure.
 - (3) Keep the piping length to a minimum.
 - (4) Design the pipe diameter so that the flow velocity in the pipe is less than 2 m/s.
 - It may be affected by the pulsation of the pump and may destabilize the flow rate measurement and control.
<Examples of measures for reducing pump pulsation>
 - (1) Install a tank and reduce pulsation.
 - (2) Use elastic piping material such as rubber hose, etc. and an accumulator to absorb pulsation.
 - This product is not suitable for applications to completely cut the flow rate.
If it is necessary to completely cut the flow rate, install a stop valve, etc. separately.
 - Impurities including metal ions contained in the fluid may be accumulated in the control valve of the product and may cause abnormalities such as valve operation failure. Specifically, do not use copper piping or other piping that tend to have liquation of metal ions.
 - Reserve a space for maintenance.
Design the system to allow the required space for maintenance.

●Product handling

*Mounting

- Tighten screws to the specified tightening torque.

If the tightening torque is exceeded, the mounting screws, brackets, the product, and other parts may be damaged. Insufficient torque can cause displacement of the product from its correct position and looseness of the screws. (Refer to Mounting and Installation on page 18).

- If a commercially available switching power supply is used, be sure to ground the frame ground (FG) terminal.

- Do not use where the product is subjected to vibration or impact.

Otherwise, it may damage the internal components and cause malfunction.

- Do not pull the lead wire forcefully or lift the product by the lead wire.

(Tensile strength 49 N or less)

Hold the product body when handling.

Otherwise, it may damage the product and may cause failure and malfunction.

- For piping of the flow controller, hold the piping with a spanner on the metal part of the product only (metal piping attachment).

Holding other parts with a spanner may damage the product.

Specifically, make sure that the spanner does not damage the M12 connector.

This may damage the connector.

- Any dust left in the piping should be flushed out by air blow before connecting the piping to the product.

Otherwise, it can cause damage or malfunction.

- Refer to the fluid flow direction indicated on the product label during installation and piping.

Otherwise, it will be unable to measure accurately.

- Avoid sudden changes to the piping size on the IN side of the product.

If the piping size is reduced or there is a restrictor such as a valve, close to the product on the IN side, the fluid velocity distribution in the piping will be disturbed, leading to improper measurement.

Pipe size on the IN side of the product is recommended to be 9 mm or larger in inner diameter for FC3W504/520 and 13 mm or larger in inner diameter for FC3W540.

- Do not insert metal wires or other foreign matter into the flow path.

The sensor may be damaged causing failure or malfunction.

- Never mount the product in a place that will be used as a mechanical support.

The product may be damaged if excessive force is applied by stepping or climbing onto it.

- If the fluid may contain foreign matter, install and connect a filter on the IN side.

Accurate measurement may not be obtained if foreign matter has adhered to the vortex generator or vortex detection element of the flow rate sensor unit.

In addition, the adhesion of foreign matter to the valve parts may cause issues with the valve operation. Therefore, the installation of a filter with 150 meshes (100 μm) or more is recommended.

- Design and install the product to keep the internal passage filled with fluid.

- Do not mount the product with the display facing downward.

- When mounting it vertically, the fluid must flow from the bottom to the top.

An accurate measurement may not be obtained when fluid flows from the top to the bottom due to bubbles of entrained air.

(There should not be a problem as long as the fluid passage is completely filled with fluid).

- The product body is made of resin. Do not apply load directly to the body when piping.

Otherwise, it may damage and/or cause water leakage.

*Wiring (Including connecting/disconnecting the connectors)

- Do not pull hard on the lead wire.

Otherwise it may damage the internal components and cause malfunction or detachment from the connector.

- Avoid repetitive bending, stretching or applying a heavy object or force to the lead wire.

Repetitive bending stress or tensile stress can cause the sheath of the wire to peel off, or breakage of the wires.

If the lead wire is movable, fix it near to the body of the product.

The recommended bend radius of the lead wire is 6 times the outside diameter of the sheath, or 33 times the outside diameter of the insulation material, whichever is larger.

Replace any damaged lead wire with a new one.

- Wire correctly.

Incorrect wiring may cause malfunction or damage to the product.

- Do not perform wiring while the power is on.

Otherwise, it may damage the internal components and cause malfunction.

- Do not route wires and cables together with power lines or high voltage lines.

Route the wires of the product separately from power lines or high voltage lines to prevent noise and surge from entering the signal line.

- Confirm correct insulation of wiring.

Poor insulation (interference with other circuits, poor insulation between terminals, etc.) can apply an excessive voltage or current to the product causing damage.

- Keep wiring as short as possible to prevent interference from noise and surge.

Do not use a cable longer than 30 m.

When using it as an IO-Link device, do not use a cable longer than 20 m.

Wire the DC(–) line (blue) as close as possible to the power supply.

- When an analogue output is used, install a noise filter (line noise filter, ferrite element, etc.) between the switch-mode power supply and the product.

***Operating environment**

- Do not use the product in an environment where the product is constantly exposed to water splashes.
Otherwise, it may cause failure or malfunction. Take measures such as using a cover.
- Do not use in an atmosphere with corrosive gases, chemicals, sea water, water steam, or where there is direct contact with any of these.
Otherwise, it may cause failure or malfunction.
- Do not use the product in a place where the product may be exposed to oil or chemicals.
If the product is to be used in an environment containing oils or chemicals such as coolant or cleaning solvent, even for a short time, it may be adversely affected (damage, malfunction, or hardening of the lead wires).
- Do not use in an area where surges are generated.
Machines or equipment that generate large surges near the product (electromagnetic type lifter, high-frequency inductive furnace, motor, etc.) may cause deterioration and damage to the internal components. Take protective measures to isolate the surge sources, and prevent the lines from coming into close contact.
- The product is CE/UKCA marked but is not immune to lightning strikes. Take measures against lightning strikes in the system.
- Mount the product in a location that is not affected by vibration or impact.
Otherwise, it can cause damage or malfunction.
- Do not use the product in the presence of a magnetic field.
Otherwise, it may cause malfunction.
- Do not use the product in an environment that is exposed to temperature cycles.
Temperature cycles other than ordinary changes in temperature can adversely affect the internal components of the product.
- Do not expose the product to direct sunlight.
If used in a location directly exposed to sunlight, protect the product using a cover.
Otherwise, it can cause damage or malfunction.
- Observe the specified operating fluid temperature range and operating temperature range.
The fluid temperature range and operating temperature range are 0 to 50 °C.
Freezing of fluid may cause damage and malfunction of the controller. Take measures to prevent freezing.
Fluid with a temperature lower than the ambient temperature may damage the product or cause malfunction due to condensation.
Avoid abrupt temperature changes even within the specified temperature range. Otherwise, it can cause damage or malfunction.
- Do not operate close to a heat source, or in a location exposed to radiant heat.
Otherwise, it may cause malfunction.

*Adjustment and operation

- Connect the load before turning the power supply on.
- Do not short-circuit the load.

The product may be damaged due to over-current.

- Check that the system is in the status below when performing flow rate control (at flow rate command input).

- (1) A valve in the same piping is open.
- (2) Operation of a pump, etc. has been started.
- (3) Filled with fluid inside the flow passage of the product.

- The control valve inside the product will be fully opened when the flow rate is insufficient for the controlled flow rate (when closing the valve, when stopping the pump, or other events). This may delay the flow rate setting time when restarting control or may shorten the life when such a condition is repeated. Therefore, turn the power of the product off before the water flow stops when closing the valve or stopping the pump or fix (maintain) the control valve position using the external input function (control stop input).

When starting the flow rate control operation, supply water first to allow starting of the flow rate control and then turn on the power or release the external input (control start).

- The product uses a Karman vortex to measure the flow rate. Karman vortex has the characteristic to have a decrease in flow rate output when the flow rate is excessive, which may disable accurate flow rate detection and flow rate control. (Fig. 1)

Excessive flow rate may be applied when the flow rate is not controlled before turning the power on, depending on the opening of the flow rate control valve inside the product. Therefore, take measures to apply pressure after turning on the power of the product.

In addition, an excessive flow rate may be applied depending on the pressure if the operation of the flow rate control valve stops when using the external input signal (control stop input). Therefore, pay attention to the increase of line pressure when the control is stopped.

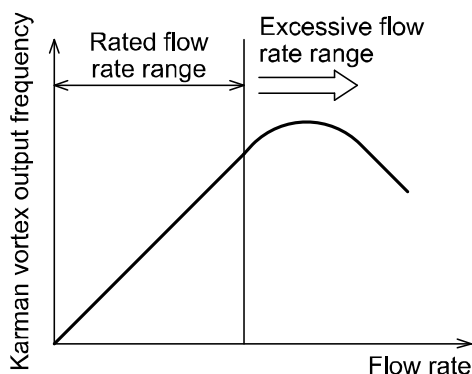


Fig. 1 Output characteristics of the flow rate sensor

*Maintenance and inspection

- Turn off the fluid supply, turn off the power supply, and confirm safety before performing maintenance and inspections.

Otherwise, it may cause unintended malfunction of system components.

- Perform regular maintenance and inspections.

There is a risk of unexpected failure of components due to the malfunction of equipment and machinery.

- Do not use solvents such as benzene, thinner, etc. to clean the product.

These can damage the surface of the body and erase the markings on the product.

Use a soft cloth to remove stains. For heavy stains, use a damp cloth that has been soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

Model Indication and How to Order

FC3W5 **04** - **R** **03** - **A1** **C** - **R** **Z**

Rated controlled
flow rate range

Symbol	Rated controlled flow rate range
04	0.5 to 4 L/min
20	2 to 16 L/min
40	4 to 40 L/min

Thread type

Symbol	Thread
R	Rc
N	NPT
F	G

Port size

Symbol	Port size	Rated controlled flow rate range		
		04	20	40
03	3/8	●	●	—
04	1/2	—	●	●
06	3/4	—	—	●

Input/output specifications

Input output specifications			
Symbol	IN1	IN2	OUT1
A1	Voltage 1 to 5 V	No-voltage input (Stop control)	Voltage 1 to 5 V
A2	Current 4 to 20 mA		Current 4 to 20 mA
A3	Voltage 0 to 10 V		Voltage 0 to 10 V
L	IO-Link		

Operation manual/Proofreading Certificate

Symbol	Content	
	Operation manual	Proofreading Certificate
Y	None	None
Z	Available	None
T	None	Available
K	Available	Available

*2: The format is Japanese and English.

Option 2 (Bracket)

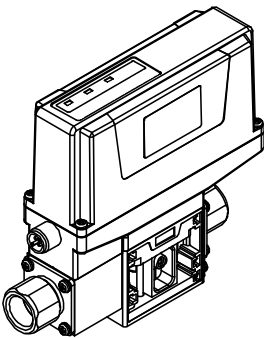
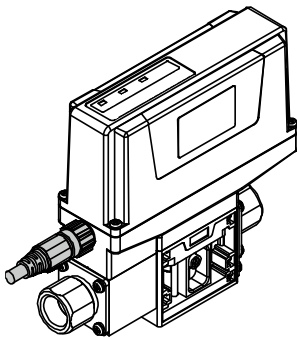
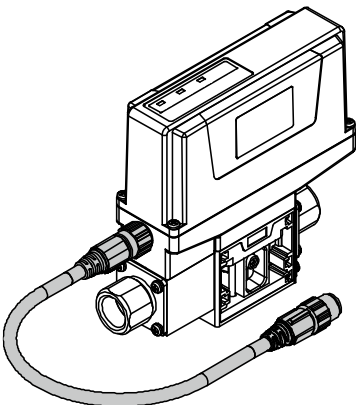
Symbol	Included bracket
R	Available*1
N	None

*1: The bracket is not assembled to the product.
It is to be shipped together with six mounting screws.

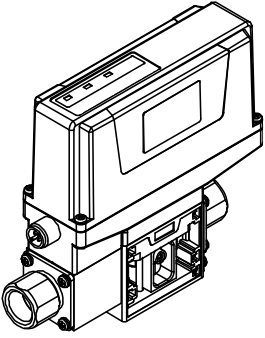
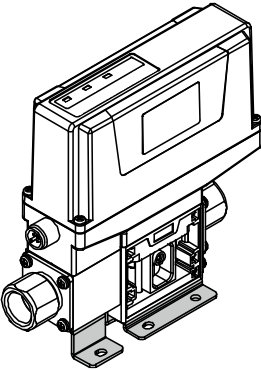
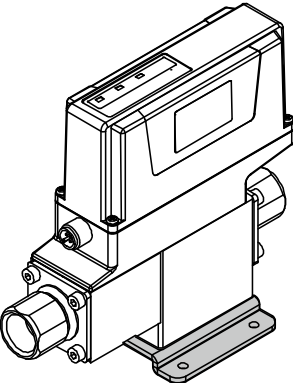
Option 1 (Lead wire)

Symbol	Cable
C	Lead wire with M12 connector (3 m)
N	None
Q	Lead wire with M12-M12 connector (3 m)

Option 1 (Lead wire)

N	C	Q
None	With lead wire and M12 connector (3 m)	With lead wire and M12-M12 connector (3 m)
		

Option 2 (Bracket)

N	R	
None	FC3W504, FC3W520	FC3W540
		
	The product is shipped together with bracket and 6 self-tapping screws (3 × 8L).	The product is shipped together with bracket and 4 screws (M4 × 8L).

Accessories/Part numbers

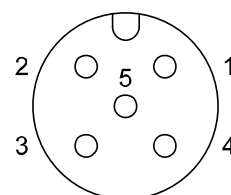
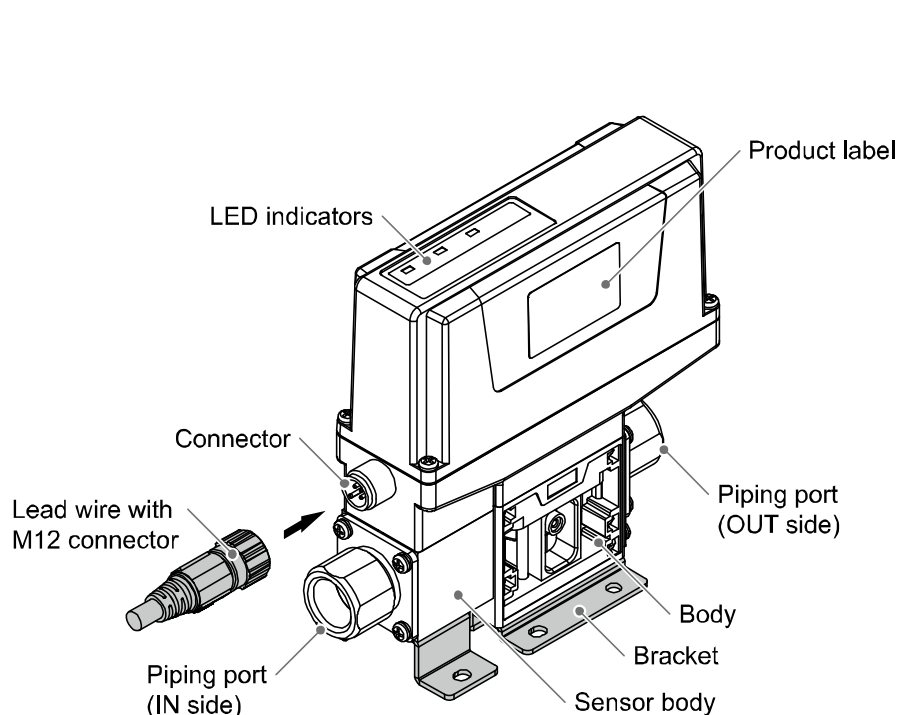
If an accessory is required, order using the following part number.

Part number	Options	Remarks
ZS-53-A	Lead wire with M12 connector	Length: 3 m, 5-core
ZS-53-D	Lead wire with M12-M12 connector	Length: 3 m, 5-core, M12(socket)-M12(plug)
ZS-54-A	Bracket (FC3W504, FC3W520)	Shipped with 6 self-tapping screws 3 × 8L
ZS-54-B	Bracket (FC3W540)	Shipped with 4 mounting screws M4 × 8L

*: For other optional items, please refer to the Accessories (P) section.

Names and Functions of Product Parts

Body



Connector pin numbers
(on the product)

*FC3W5#-A1/2/3

1	DC(+)
2	IN1
3	DC(-)
4	OUT1
5	IN2

*FC3W5#-L
(IO-Link Port Class B)

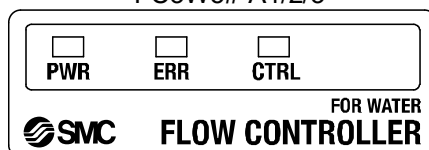
1	L(+)
2	2L(+)
3	L(-)
4	C/Q
5	2L(-)

*L(+) line and 2L(+) line are isolated.

Name	Function
Lead wire with M12 connector	Lead wire to supply power supply voltage, input signal and output signal.
Connector	Connector for lead wire with M12 connector.
Piping port	Piping connections. IN represents inlet and OUT represents outlet.
LED indicators	LED to indicate power supply status, abnormalities, and flow rate control status.
Body	Part of the product comprising the flow path.
Product label	A product label containing information including the product model and flow direction.
Bracket	Mounting bracket for installing the product.

LED indicators

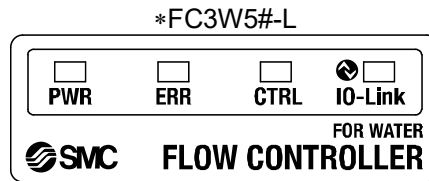
*FC3W5#-A1/2/3



LED	Colour	Status	Explanation	Lighting method
PWR (Power status indicator)	Green	Power supply status	Power supply voltage is supplied to the product.	LED is ON continuously
ERR (Error status indicator)	Red	System error	Abnormality of internal data. *1	LED is ON continuously
		Over-current error	Excessive current is applied to the product. *1	
		Insufficient flow rate	The controlled flow rate does not reach the commanded flow rate.	
		Abnormal power supply voltage	The power supply voltage is lower than about 18 V. *1	
CTRL (Control status indicator)	Green	Control completed	The controlled flow rate is set at within $\pm 5\%$ F.S. of the commanded flow rate.	LED is ON continuously
		Fully closed completed	The control valve is fully closed.	
		During control	The flow rate control is operating aiming for the commanded flow rate.	
		Control stop	The control operation of the control valve is stopped due to the generation of an error or by an external input signal (control stop signal).	LED is OFF

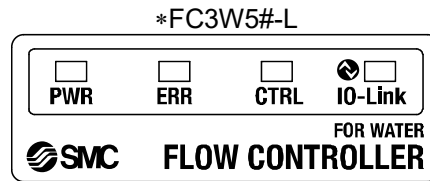
*1: Stops the control operation. Check the Troubleshooting (page 37) and remove the cause.

LED indicators



LED	Colour	Status	Explanation	Lighting method
PWR (Power status indicator)	Green	Power supply status	Power supply voltage is supplied to the product.	LED is ON continuously
ERR (Error status indicator)	Red	Error	The pattern when lit or blinking Indicates the contents of the error.	See table below.
CTRL (Control status indicator)	Green	Control completed	The control flow rate has reached the flow command value (including dead zone).	LED is ON continuously
		Fully closed completed	The control valve is fully closed.	
		During control	The flow rate control is operating aiming for the commanded flow rate.	
		Control stop	Control valve control operation is stopped due to error or control stop mode.	LED is OFF
IO-Link	Green	Communicating	State of Operate Normal communication PDout enabled	LED is on.
		Communication breakdown	Start up state Preoperate state At communication start When communication breakdown is detected	LED is blinking.
		Not connected	After fallback	LED is OFF

■Error display



LED			Status	Explanation	Treatment method
ERR	CTRL	IOL			
○	×	-	System error	Internal data error.	Disconnect power, check for noise sources, and turn power back on. If it does not recover, we will need to investigate.
○	◎	-	Control state mismatch	Valve opening control command with home position undetected	Please perform Valve opening control after returning to the origin.
◎	×	-	monitor abnormality	There is no drive power. Or there is an overcurrent in the motor.	Supply the drive power. There is a possibility of internal damage.
◎	○	-	Control error	Flow control and Valve opening control are not possible.	Possible causes include flow channel abnormality, gear damage, position sensor failure, etc.
◎	◎	●	Version mismatch	IO-Link version with master does not match. (Ver. 1.0 is used).	Match the IO-Link version of the master to the device.
◎	◎	○	Output PD out of setting range	Output process data is outside the setting range.	Output process data must be within the setting range.
◎1	×	-	Power supply voltage abnormal	The power supply voltage is not within the range of 24 VDC ±10%.	Supply power voltage of 24 VDC ±10%.
◎2	×	-	Control error	Even if the control valve is fully opened due to insufficient supply pressure, the command value is not reached.	Increase the pressure value in the rated pressure range to allow the desired flow rate to flow.
◎2	○	-	Lower end control error	Flow rate is detected when fully closed.	Pulsation of the pump or other equipment may be detected. Remove the pulsation or put in a command value higher than the pulsation before adjusting to the desired command value.

○: ON

×: OFF

◎: Flashing

●: Flashing (Opposite phase to ◎)

◎1: One 250 ms ON with a cycle time of 2 s.

◎2: Two 250 ms ONs with a cycle time of 2 s.

■ Definition and terminology

	Terminology	Definition
A	Analogue output	Outputs a value proportional to the flow rate. When the analogue output is in the range 1 to 5 V, it will vary between 1 to 5 V according to the change in flow rate. The same for analogue output of 4 to 20 mA.
	Attachment	The metal part of both sides of the product to which piping is connected.
F	Fluid temperature range	Range of fluid temperature that can pass through the product.
	F.S. (full span, full scale)	This means "full span" or "full scale," and indicates the difference between the rated maximum value and minimum value of the product. F.S. of controlled flow rate is the maximum value of the rated controlled flow rate range. F.S. with analogue output when 1 to 5 V output is 4 V (5 V – 1 V). *: The same for analogue output of 4 to 20 mA and 0 to 10 V.
I	Instantaneous flow	The flow rate passing per unit of time. If it is 10 L/min, there is a flow of 10 L passing through in 1 minute.
K	Karman vortex	When an object is placed in a fluid stream, a vortex will be created in the fluid on the downstream side. This is called a Karman vortex. The frequency at which the vortices are generated is proportional to the fluid velocity (flow rate). Therefore, it is possible to calculate the fluid flow rate by measuring the Karman vortex frequency.
M	Min. operational differential pressure	The min. difference between the primary and secondary pressure of the product to satisfy the product specification.
O	Operating humidity range	Humidity range in which the product can operate.
	Operating pressure range	The pressure range in which the product can be used.
	Operating temperature range	Ambient temperature range in which the product can operate.
P	Parts in contact with fluid	A part that comes into physical contact with the fluid.
R	Rated controlled flow rate range	Controlled flow rate range that meets the product specifications.
	Repeatability	The repeatability of the control accuracy or analogue output value when the measured flow quantity is repeatedly increased or decreased.
S	Settling time	Time to set the flow rate to be within $\pm 5\%$ F.S. of the commanded flow rate when an input signal is input. The time when a step signal of 0 → 100% is input is described as the specification of this product.
T	Temperature characteristics	Change in the control accuracy and analogue output when the ambient temperature is changed.
W	Water hammer	Water hammer is a pressure surge due to pressure spread when a fluid in motion is forced to stop or change direction by a switch open/close equipment such as a valve. This pressure surge is called a water hammer or impact pressure.
	Withstand pressure	Pressure limit that if exceeded will result in mechanical and/or electrical damage to the product.

Mounting and Installation

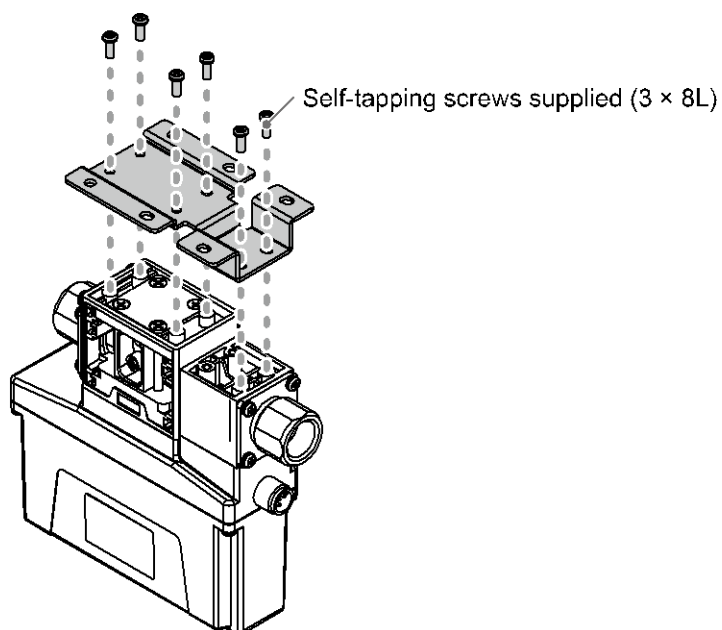
Check the product specifications before use and operate in an appropriate environment.

■ Installation by bracket

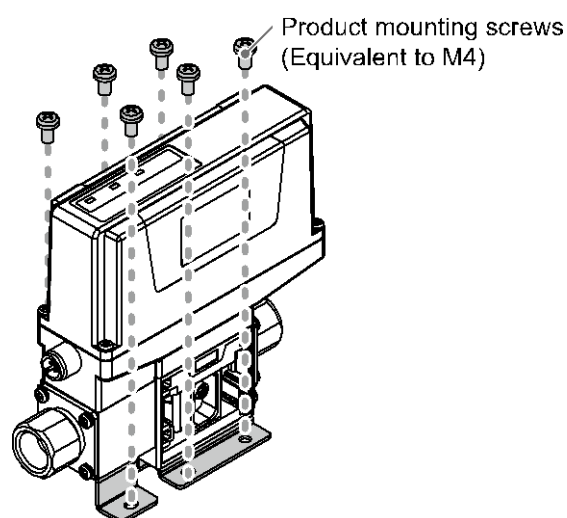
•FC3W504/520

Mount the bracket to the product using the self-tapping screw supplied (3 × 8L, 6 pcs.).
(Tightening torque: 1.0 to 1.2 N·m)

Mount on a panel using the product mounting screws (equivalent to M4: 6 pcs.).
Use screws with sufficient length for the bracket plate thickness (1.5 mm).



Mounting the bracket

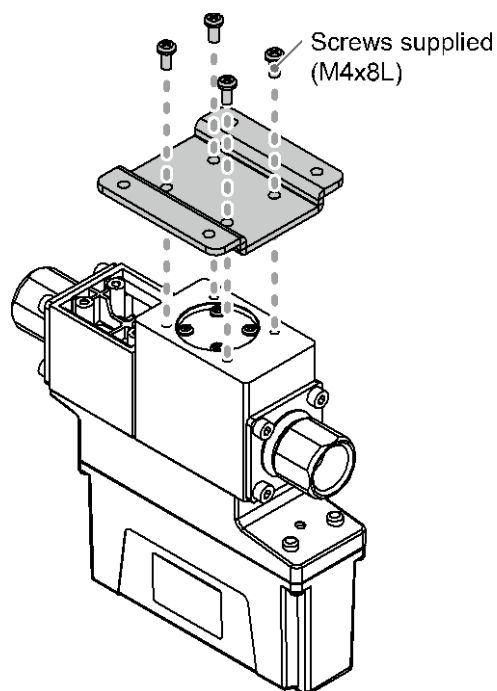


Mounting on a panel

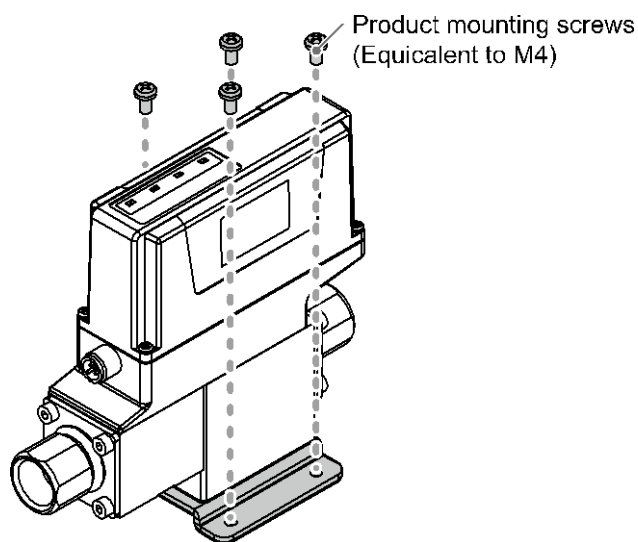
•FC3W540

Mount the bracket to the product using the screw supplied (M4 × 8L, 4 pcs.).
(Tightening torque: 1.5 to 1.7 N·m)

Mount on a panel using the product mounting screws (equivalent to M4: 4 pcs.).
Use screws with sufficient length for the bracket plate thickness (3 mm).



Mounting the bracket



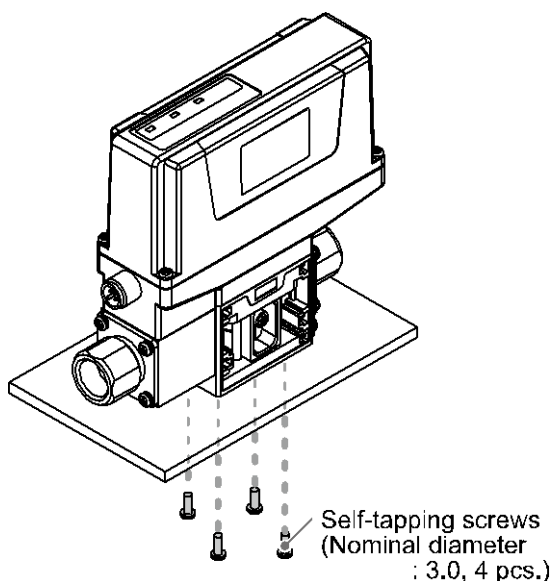
Mounting on a panel

■Direct mounting

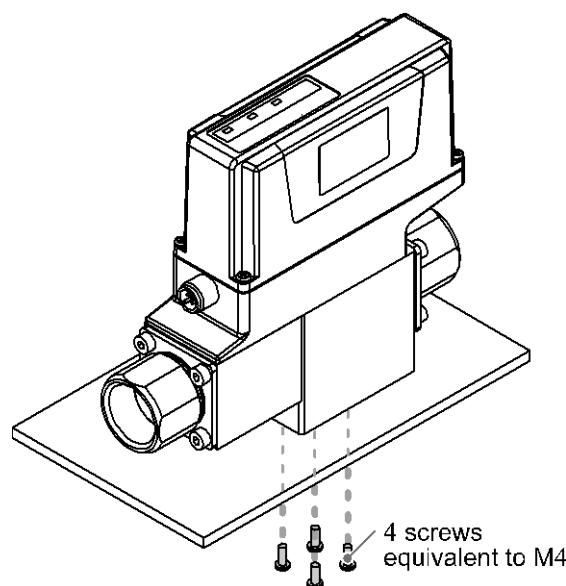
FC3W504/520: Use tapping screws (nominal diameter: 3.0) for mounting.

FC3W540: When mounting, use M4 equivalent screws.

FC3W504/520



FC3W540

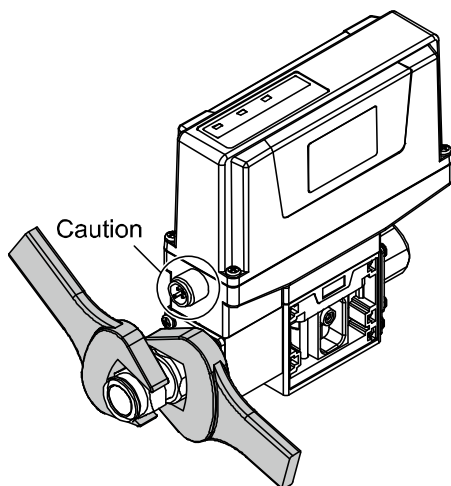


■Piping method

Refer to the fluid flow direction indicated on the product label for installation and piping.

When piping the product, hold the piping with a spanner on the metal part of the product (metal piping attachment on the piping side). Using a spanner on other parts may damage the product.

Make sure that the spanner does not impact the connector. Otherwise, it may damage the connector.



Attachment details

Nominal thread size	Width across flats of attachment
Rc3/8, NPT3/8	20.9 mm
G3/8	23.9 mm
Rc1/2, NPT1/2	23.9 mm
G1/2	26.9 mm
Rc3/4, NPT3/4	29.9mm
G3/4	31.9mm

After hand tightening the piping, apply a spanner to the spanner flats on the product, and tighten it for 2 to 3 rotations.

The recommended tightening torque is shown in the table below.

Guideline for tightening torque

Nominal thread size	Tightening torque
Rc3/8, NPT3/8	15 to 20 N•m
Rc1/2, NPT1/2	20 to 25 N•m
Rc3/4, NPT3/4	28 to 30 N•m

The product may be damaged if the tightening torque is exceeded.

If the tightening torque is insufficient, the piping may become loose and cause leakage.

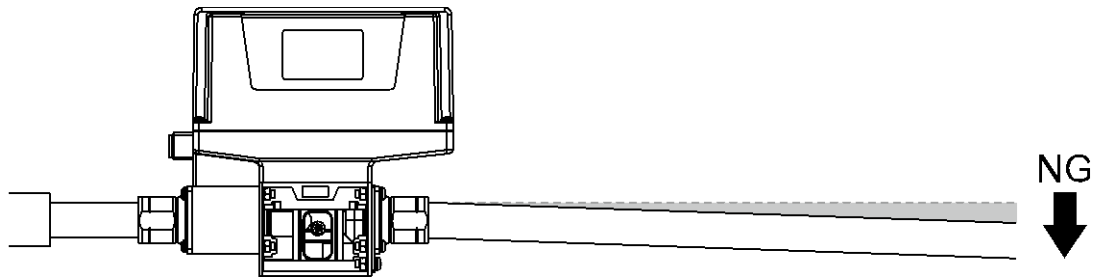
Prevent any sealing tape from getting inside the piping.

Caution

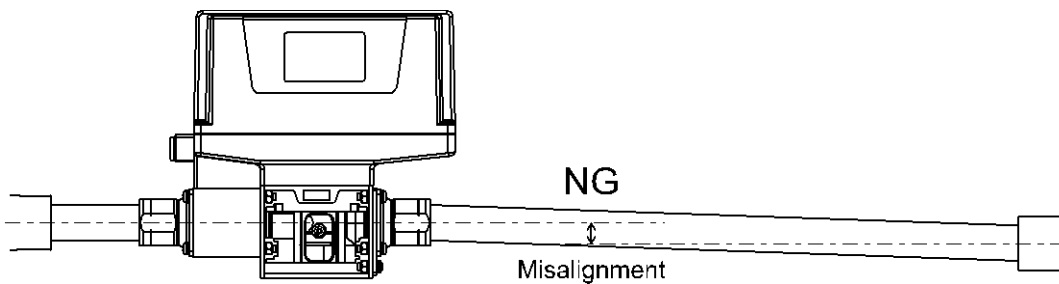
The product body is made of resin. The installation and piping of the product must satisfy the following requirements.

Otherwise, it may damage the product and/or cause water leakage.

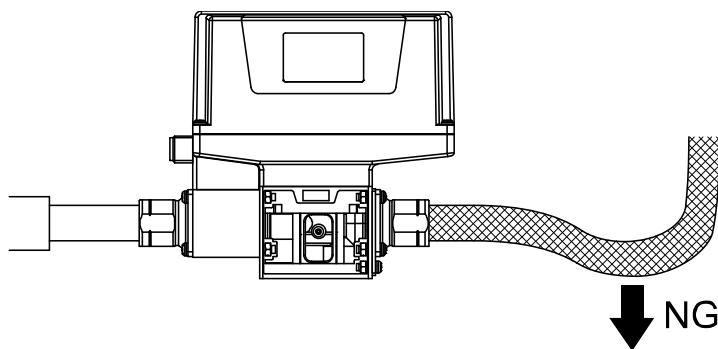
- No load should be directly applied to the product.



- Do not perform piping when the piping is not aligned.
A permanent load will be applied to the product after piping.



- When a flexible hose is used for the piping, the hose must be fixed with brackets, etc.
If it is not fixed, the load weight of the flexible hose and the fluid will be applied to the product.

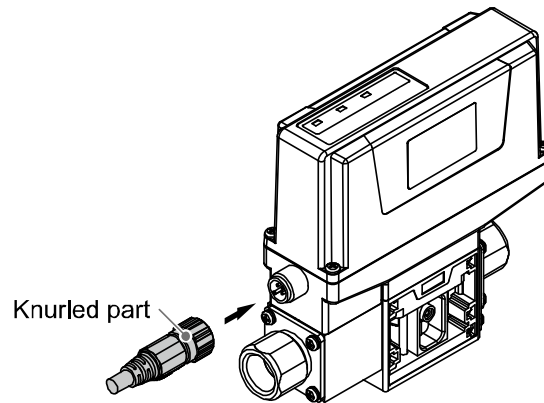


■ Wiring method

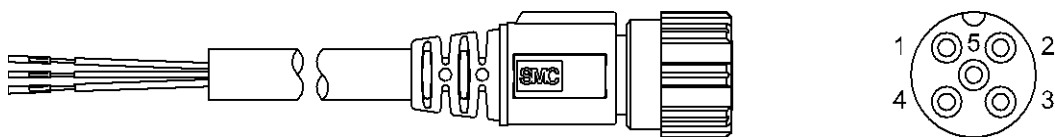
- Connections should only be performed with the power supply turned off.
- Use a separate route for the product wiring and any power or high voltage wiring. Malfunctions stemming from noise may occur if the wire is installed in the same route as that of power lines or high voltage lines.
- If a commercially available switching power supply is used, be sure to connect the frame ground (FG) terminal to ground. If the product is connected to a commercially available switching power supply, switching noise will be superimposed and the product specifications will not be satisfied. In that case, insert a noise filter such as a line noise filter/ferrite between the switching power supply or change the switching power supply to a series power supply.

○ Connection method

- Align the cable connector key groove with the product connector key to insert and rotate the knurled part of the cable connector.
- Check that the connection is not loose.



○Lead wire and connector



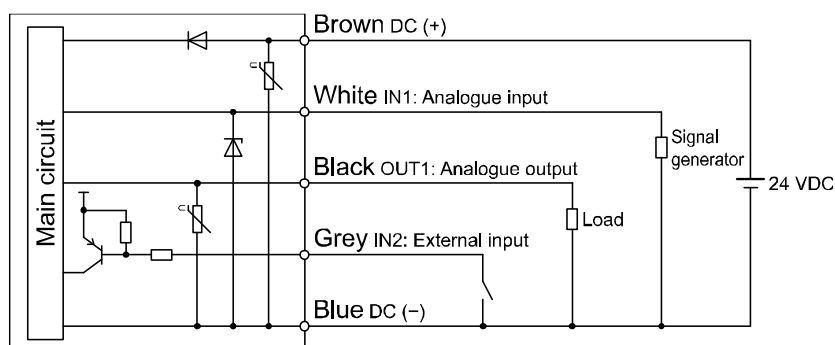
*FC3W5#-A1/2/3

Pin number	Lead wire colour	Name	Explanation
1	Brown	DC(+)	24 VDC
2	White	IN1	Analogue input (Flow rate command input)
3	Blue	DC(-)	0 VDC
4	Black	OUT1	Analogue output (Flow rate output)
5	Grey	IN2	External input (Control stop input) *: Control stops with a Lo input at 0.4 V or less and 30 ms or more *: Hold valve state at signal input

*FC3W5#-L

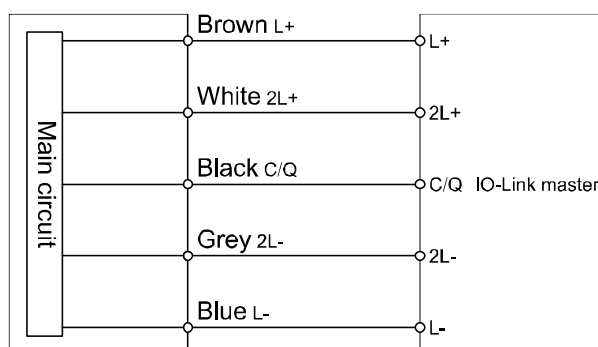
Pin number	Lead wire colour	Name	Explanation
1	Brown	L(+)	24 VDC Control power supply
2	White	2L(+)	24 VDC Power supply for valve drive
3	Blue	L(-)	0 V Control power supply
4	Black	C/Q	Communication data (IO-Link)
5	Grey	2L(-)	0 V Power supply for valve drive

○Internal circuit and wiring

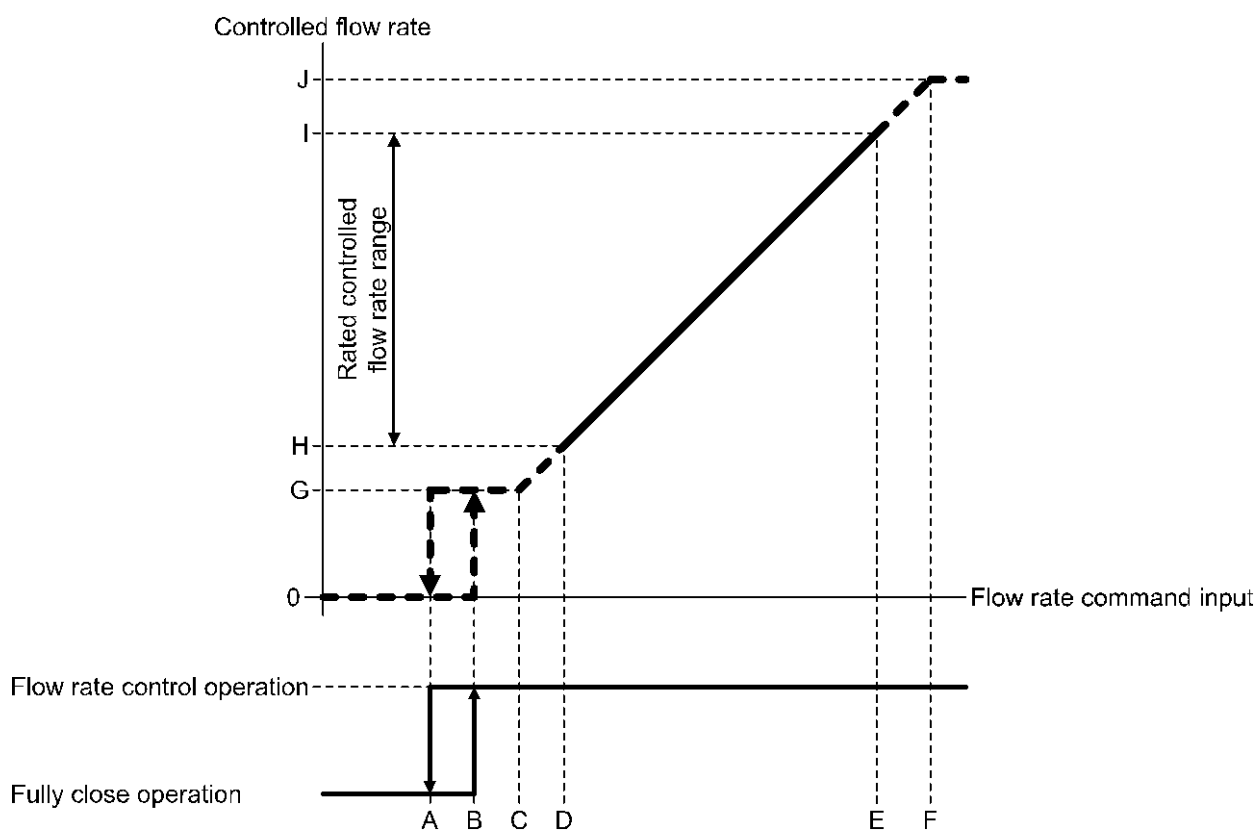


Model	Input/output specifications			
	Name	Function	Specifications	Remarks
FC3W5##-##-A1#-##	IN1	Analogue voltage input	1 to 5 V	Input impedance: approx. 1 MΩ
	OUT1	Analogue voltage output	1 to 5 V	Output impedance: approx. 1 kΩ
	IN2	External input (Control stop input)	Input with no voltage	0.4 V or less, 30 ms or more
FC3W5##-##-A2#-##	IN1	Analogue current input	4 to 20 mA	Input impedance: 250 Ω or less
	OUT1	Analogue current output	4 to 20 mA	Load impedance: 50 to 600 Ω
	IN2	External input (Control stop input)	Input with no voltage	0.4 V or less, 30 ms or more
FC3W5##-##-A3#-##	IN1	Analogue voltage input	1 to 10 V	Input impedance: approx. 1 MΩ
	OUT1	Analogue voltage output	1 to 10 V	Output impedance: approx. 1 kΩ
	IN2	External input (Control stop input)	Input with no voltage	0.4 V or less, 30 ms or more

*FC3W5##-##-L#-##



■Flow rate command input and controlled flow rate



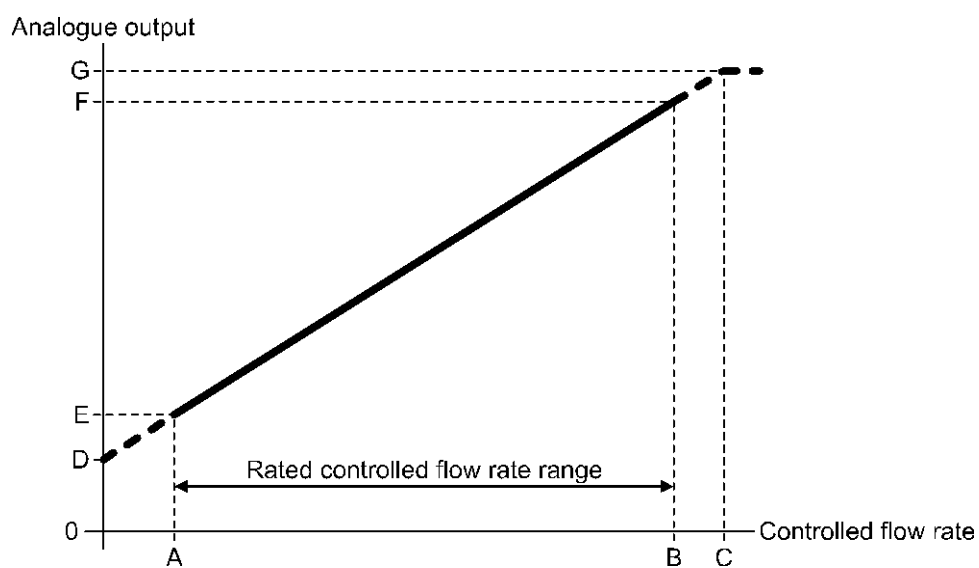
•Flow rate command input

Symbol Model	A	B	C	D	E	F
FC3W5#-A1	1.2 V	1.3 V	1.4 V	1.5 V	5.0 V	5.2 V
FC3W5#-A2	4.8 mA	5.2 mA	5.6 mA	6.0 mA	20.0 mA	20.8 mA
FC3W5#-A3	0.5 V	0.75 V	1.0 V	1.25 V	10.0 V	10.5 V

•Controlled flow rate

Symbol Model	G	H	I	J
FC3W504	0.4 L/min	0.5 L/min	4.0 L/min	4.2 L/min
FC3W520	1.6 L/min	2.0 L/min	16.0 L/min	16.8 L/min
FC3W540	4.0 L/min	5.0 L/min	40.0 L/min	42.0 L/min

■ Controlled flow rate and analogue output



• Controlled flow rate

Symbol Model	A	B	C
FC3W504	0.5 L/min	4.0 L/min	4.2 L/min
FC3W520	2.0 L/min	16.0 L/min	16.8 L/min
FC3W540	5.0 L/min	40.0 L/min	42.0 L/min

• Analogue output

Symbol Model	D	E	F	G
FC3W5#-A1	1.0 V	1.5 V	5.0 V	5.2 V
FC3W5#-A2	4.0 mA	6.0 mA	20.0 mA	20.8 mA
FC3W5#-A3	0.0 V	1.25 V	10.0 V	10.5 V

IO-Link Specifications

■ IO-Link function overview

○ Communication function

This product can check the commanded flow rate setting as well as the measurement value, diagnostic information through the cyclic data communication via the IO-Link system.

○ Product status monitoring function

This function monitors the product status via IO-Link.

- Multiple error conditions (e.g. internal hardware errors) can be monitored.
- Multiple warning conditions (flow rate measurement error, etc.) can be detected.

○ Data storage function

The data storage function stores the IO-Link device parameter settings to the IO-Link master.

With the IO-Link data storage function, the IO-link device can be replaced easily without re-setting the equipment construction or setting the parameters.

When the device parameters are set and downloaded to the device using the IO-Link setting tool, the parameters will be uploaded to the data storage in the master by the system command after download (backup instruction by the communication command).

When the device is replaced with the same type of IO-Link device due to failure, the parameter settings stored in the master are downloaded automatically, and the device can be operated using the parameter settings of the previous device.

Device parameter setting is applicable to 3 types of back-up levels of the master setting ("Inactive", "Back-up/Restore", "Restore").

"Back-up" implies the activation of an upload and "restore" implies a download.

■ Communication Specifications

IO-Link type	Device
IO-Link version	V1.1
IO-Link Port Class	Class B
Communication speed	COM2 (38.4 kbps)
Min. cycle time	5.7 ms
Process data length	Input Data: 6 bytes, Output Data: 6 bytes
On request data communication	Available
Data storage function	Available
Event function	Available

■ Process data

Process data is the data which is exchanged periodically between the master and device.

In this product, the process data consists of the following:

- Input process data (hereafter "PD_IN")
- Output process data (hereafter "PD_OUT")

○ PD_IN

Bit offset	Item	Remarks
0 to 1	Control mode	0: Stopping the control 1: Flow control 2: Valve opening control 3: Home recovery
2	Flow control complete	0: Unfinished 1: Finished
3	Valve opening control complete	0: Unfinished 1: Finished
7	Origin detection	0: Not detected 1: Detected (homing completed, valve opening control possible)
8	Measurement diagnosis	0: Within range 1: Out of range (measured flow rate is out of the rated flow range)
9	Output PD diagnosis	0: Within range 1: Out of range (output process data out of range)
10	Insufficient flow	0: Normal 1: Insufficient flow
11	Life span diagnosis	0: Normal 1: Life threshold exceeded
14	Error	0: No error occurred 1: Error occurred
15	System error	0: No error occurred 1: Error occurred
16 to 31	Valve opening	Signed: 16 bit Before home detection : Lower limit PD value of measurement position After home detection : Valve opening degree
32 to 47	Measured flow rate	Signed: 16 bit

Bit offset	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
Item	Flow rate measurement															

Bit offset	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Item	Valve opening															

Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item	System error	Error	Reserved		Life Span diagnosis	Insufficient flow	Output PD diagnosis	Accumulation diagnosis	Reference condition	Reserved			Valve opening control complete	Flow control complete	Control mode	

○PD_OUT

Bit offset	Item	Remarks
0 to 1	Control mode	0: Control stop mode 1: Flow control mode 2: Valve opening control mode 3: Home return mode
16 to 31	Valve opening setpoint	Signed: 16 bit
32 to 47	Flow control command value	Signed: 16 bit

Bit offset	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
Item	Flow control command value															

Bit offset	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Item	Valve opening setpoint															

Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item	Reserved														Control mode	

- The data process type of this product is Big-Endian.
When the transmission method of the upper communication is Little-Endian, the byte order will be changed. Refer to the table below for the Endian type of the major upper communication.

Endian type	Upper communication protocol
Big-Endian type	Such as PROFIBUS and PROFINET
Little-Endian type	Such as EtherNET/IP, EtherCAT and CC-Link IE Field

○Measurement/command value (PD)

•Measurement value (PD_IN)

Target	Units	Range	Rated control range			Measurable range		
			Min.	to	Max.	Min.	to	Max.
Instantaneous flow	L/min	4 L/min	0.5	to	4.0	0.0	to	4.4
		16 L/min	2	to	16	0	to	17.6
		40 L/min	5	to	40	0	to	44
Valve opening	%	4 L/min	0	to	100	-5	to	110
		16 L/min						
		40 L/min						

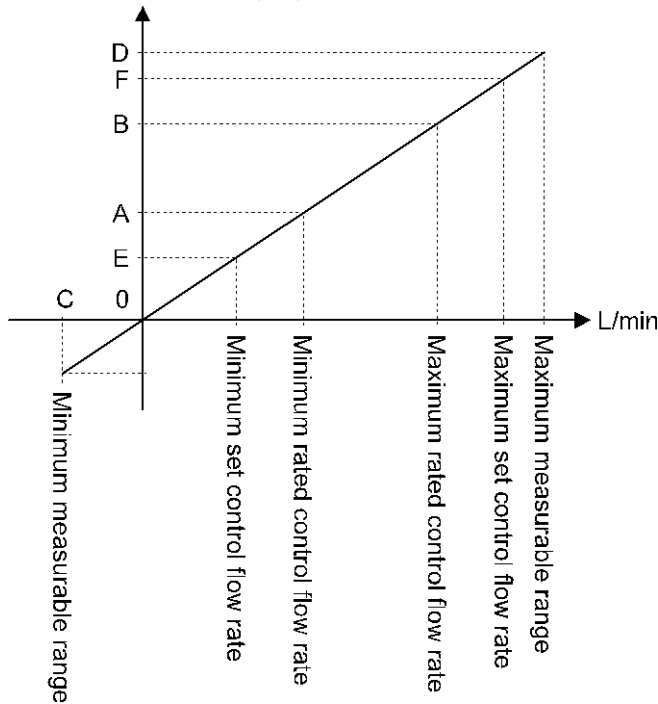
Target	Units	Range	PD value					
			Rated control range			Measurable range		
			A	to	B	C	to	D
Instantaneous flow	L/min	4 L/min	125	to	1000	0	to	1100
		16 L/min						
		40 L/min						
Valve opening	%	4 L/min	0	to	1000	-50	to	1100
		16 L/min						
		40 L/min						

•Command value (PD_OUT)

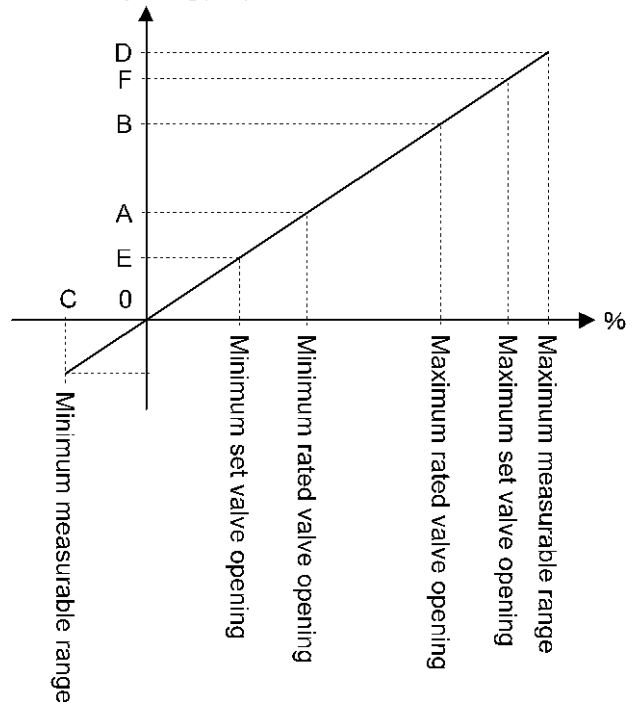
Target	Units	Range	Rated control range			Set controlled rate range		
			Min.	to	Max.	Min.	to	Max.
Instantaneous flow	L/min	4 L/min	0.5	to	4.0	0.4	to	4.2
		16 L/min	2	to	16	1.6	to	16.8
		40 L/min	5	to	40	4	to	42
Valve opening	%	4 L/min	0	to	100	0	to	100
		16 L/min						
		40 L/min						

Target	Units	Range	PD value					
			Rated control range			Set controlled rate range		
			A	to	B	E	to	F
Instantaneous flow	L/min	4 L/min	125	to	1000	100	to	1050
		16 L/min						
		40 L/min						
Valve opening	%	4 L/min	0	to	1000	0	to	1000
		16 L/min						
		40 L/min						

Flow rate measurement (PD)



Valve opening(PD)



○ Conversion formula for process data and measurement/command value

(1) Conversion formula for process data to measurement/command value: $Pr = a \times (PD) + b$

(2) Conversion formula for measurement/command value to process data: $(PD) = (Pr - b) / a$

Pr: Measurement value and command value

PD: Measurement value (process data)

A: Inclination

B: Intercept

[Inclination and intercept to the units specification]

Target	Units	Range	Inclination a	Intercept b
Instantaneous flow	L/min	4 L/min	0.004	0
		16 L/min	0.016	0
		40 L/min	0.04	0
Valve opening	%	4 L/min	0.1	0
		16 L/min		
		40 L/min		

[Calculation example]

(1) Conversion for process data to flow rate measurement/command value
(Range: 4 L/min; PD = 500)

$$\begin{aligned}
 Pr &= a \times (PD) + b \\
 &= 0.004 \times 500 + 0 \\
 &= 2 \text{ [L/min]}
 \end{aligned}$$

(2) Conversion for flow rate measurement/command value to process data
(Range: 16 L/min; Pr = 6 [L/min])

$$\begin{aligned}
 (PD) &= (Pr - b) / a \\
 &= [6 - (0)] / (0.016) \\
 &= 375
 \end{aligned}$$

■IO-Link parameter settings

○IODD file

IODD (I/O Device Description) is a definition file which provides all properties and parameters required for establishing functions and communication of the device.

The IODD includes the main IODD file and a set of image files such as vendor logo, device picture and device icon.

The IODD file for this product is as follows:

Product number	IODD file *
FC3W5**-**-**-**	SMC-FC3W5**-**-**-**-yyyyymmdd-IODD1.1

*: "-" indicates the product model which corresponds to each IODD file.

*: "yyyyymmdd" indicates the date of creation of the file, with yyyy, mm, and dd representing the year, month, and date, respectively.

The IODD file can be downloaded from the SMC website (<https://www.smcworld.com>).

○Service data

The tables below indicate the parameters which can be read or written by simple access parameter (direct parameters page) and ISDU parameters which are applicable to various parameters and commands.

●Direct parameters page 1

DPP1 address	Access	Parameter name	Default (decimal number)	Description
0x07	R	Vendor ID	0x0083(131)	"SMC Corporation"
0x08				
0x09	R	Device ID	0x02DF(735)	FC3W504-xx-Lx-xx
0x0A			0x02E0(736)	FC3W520-xx-Lx-xx
0x0B			0x02E1(737)	FC3W540-xx-Lx-xx

●ISDU parameters

Index (decimal number)	Subindex	Access *1	Parameter	Initial value	Note
0x0002 (2)	0	W	System command	-	Refer to "System command". (Page 34)
0x0010 (16)	0	R	Vendor name	SMC Corporation	
0x0011 (17)	0	R	Vendor text	www.smcworld.com	
0x0012 (18)	0	R	Product name	Example FC3W504-xx-Lx-xx	
0x0013 (19)	0	R	Product ID	Example FC3W504-xx-Lx-xx	
0x0014 (20)	0	R	Product text	Flow controller	
0x0015 (21)	0	R	Serial number	Example "xxxxxxxx"	•Indicated in 8 digits •16 octets fixed character string
0x0016 (22)	0	R	Hardware version	HW-Vx.y	x: Major revision number y: Minor revision number
0x0017 (23)	0	R	Software version	FW-Vx.y	x: Major revision number y: Minor revision number
0x0018 (24)	0	R/W	Application specific tag	ALL "*"	Can be changed arbitrarily
0x0024 (36)	0	R	Device status parameter	-	Refer to "Device status parameter". (Page 34)
0x0025 (37)	0	R	Detailed device status parameter	-	Refer to "Device details status parameter". (Page 34)
0x0028 (40)	0	R	Process data input	-	The latest process data can be read.
0x0029 (41)	0	R	Process data output	-	The latest process data can be read.

*1: R: Read; W: Write

●System command (Index 2)

In the ISDU index 0x002 SystemCommand (system command), the command shown in the table below will be issued.

The button for each system command is displayed on the IO-Link setting tool (excluding "ParamDownloadStore").

Click the button to send the system command to the product.

Writeable commands are shown below.

Data type: 8 bit UInteger

Value	Definition of status	Description
128	Device Reset	Restart the device
129	Application Reset	Initialize set values to factory defaults (except tag information)
130	Restore Factory Reset	Reset of a set value to the factory default value
131	Back to box	Initialize set values to factory defaults (waiting for power-on)

●Device status parameter (Index 36)

The readable device statuses are as follows.

Data type: 8 bit UInteger

Value	Definition of status	Description
0	Normal operation	-
1	Maintenance is required	Not available
2	Out of spec.	Event category: Warning
3	Function check	Not supported
4	Failure or problem	Event category: Error

●Device details status parameter (Index 37)

Event details of the readable device statuses are as follows.

Layout	Event	Event class		Event code
		Definition	Value	
1	Internal failure or problem	Error	0xF4	0x8D03
2	Internal failure or problem	Error	0xF4	0x8D04
3	Internal failure or problem	Error	0xF4	0x8D05
4	Internal failure or problem	Error	0xF4	0x8D01
5	Internal failure or problem	Error	0xF4	0x8D06
6	Motor overcurrent	Error	0xF4	0x8D31
7	Uncontrollable error	Error	0xF4	0x8D30
8	Control state mismatch	Error	0xF4	0x8DF0
9	Control error (Insufficient supply flow pressure)	Error	0xF4	0x8D32
10	Lower end control error (flow rate detected when fully closed)	Error	0xF4	0x8D33
11	Power supply voltage abnormal	Error	0xF4	0x8D40
12	Output PD out of settable range	Warning	0xE4	0x8D90
13	Flow measurement range over	Warning	0xE4	0x8D60
14	Lifetime judgment threshold exceeded	Notification	0x54	0x8D50
15	Test event A	Warning	0xE4	0x8CA0
16	Test event B	Warning	0xE4	0x8CA1
17	Data storage upload request	Notification	0x54	0xFF91

●Product individual parameters

Index		Sub index	Access *1	Parameter		Data type *2	Initial value	Data storage *3	Setting value *4	Remarks
dec	hex									
1800	0x0708	0	R/W	Filter (Digital Filter)		U8	1	Y	0 : 0.5 1 : 1.0 2 : 2.0 3 : 5.0 4 : 10.0 5 : 15.0 6 : 20.0 7 : 30.0	Irrelevant to control
2310	0x0906	1	R/W	Output PD setting in case of communication error	Operation selection (Operation selection)	U8	0	Y	0 : Keep last 1 : Fail safe	Keep last : Use output PD when output PD is enabled → disabled Fail safe : Use configured output PD
		2	R/W		Flow (Value at flow control)	S16	0	Y	0 to 1050	Valid only when Fail safe is selected for operation selection and flow control is selected for control mode setting.
		3	R/W		Position (Value at valve opening control)	S16	0	Y	0 to 1000	Valid only when Fail safe is selected for operation selection and valve opening control is selected for control mode setting.
		4	R/W		MODE (Control mode setting)	U16	0	Y	0 : Control stop (Control stop) 1 : Flow control (Flow control) 2 : Valve opening control (Valve opening control) 3 : Origin return (Origin return)	Valid only when “Fail safe” is selected in the operation selection
3010	0x0bc2	0	R/W	Origin return direction (Direction of return to origin)		U8	0	Y	0 : Fully closed(Fully closed) 1 : Fully open(Fully open)	
3020	0x0bcc	1	R/W	Control dead zone(Control dead zone)		U16	2	Y	0 to 10	Unit [%]
		2	R/W	Delay time(Control Delay)		U16	0	Y	0 to 5000	Unit [ms]
3030	0x0bd6	3	R/W	Fully closed (Opening when fully closed)		U16	0	Y	0 to 300	x 0.1 [%]
3040	0x0be0	0	R	Product Fatigue (Product Usage)		U16	-	N	-	Control valve operating status unit [%].
3050	0x0beA	0	R/W	Lifespan threshold (Lifespan Judgment Threshold)		U16	100	Y	0 to 500	Event if product usage exceeds threshold

●Product individual parameters (continued)

Index		Sub index	Access *1	Parameter		Data type *2	Initial value	Data storage *3	Setting value *4	Remarks
dec	hex									
8000	0x1F40	0	R	Measurement (Flow)	Position PD Inclination a	F32	-	N	See table "Slope and Intercept for Unit Specification and intercept" (page **)	
8010	0x1F4A	0	R		Position PD Intercept b	F32	-	N	See table "Slope and Intercept for Unit Specification and intercept" (page **)	
8090	0x1F9A	1	R		Lower limit of rated range	U16	-	N	0 fixed	
		2	R		Rated range upper limit	U16	-	N	1000 fixed	
		3	R		Measurable range lower limit	U16	-	N	0 fixed	
		4	R		Measurable range upper limit	U16	-	N	1100 fixed	
		5	R		Lower limit of settable range	U16	-	N	0 fixed	
		6	R		Settable range upper limit	U16	-	N	1050 fixed	
		7	R		Lower limit of control range	U16	-	N	125 fixed	
8200	0x2008	0	R	Measurement (Position)	Position PD Inclination a	F32	-	N	See table "Slope and Intercept for Unit Specification and intercept" (page **)	
8210	0x8210	0	R		Position PD Intercept b	F32	-	N	See table "Slope and Intercept for Unit Specification and intercept" (page **)	
8290	0x8290	1	R		Lower limit of rated range	U16	-	N	0 fixed	
		2	R		Rated range upper limit	U16	-	N	1000 fixed	
		3	R		Measurable range lower limit	S16	-	N	-50 fixed	
		4	R		Measurable range upper limit	U16	-	N	1100 fixed	
		5	R		Lower limit of settable range	U16	-	N	0 fixed	
		6	R		Upper limit of settable range	U16	-	N	1000 fixed	

*1: R means Read and W means Write.

*2: Refer to table below for symbols.

Symbol	Data type (IO-Link standard)	Data length Bit[byte]	Description
U8	UIntegerT	8[1]	Unsigned integer
U16		16[2]	
S16	IntegerT	16[2]	Signed integer
F32	Float32T	32[4]	Floating point number
C32	StringT	32[4]	Character string

*3: "Y" indicates that the parameter setting data is saved to the master, and "N" indicates that the parameter is not saved.

*4: Read/write to unselectable items will be rejected depending on the product No.

Troubleshooting

Confirm the cause of the problem from the following table when an operation failure of the product occurs. The product itself may be faulty if a cause applicable to the problem cannot be identified and normal operation is recovered by replacement with a new product.

The product may fail depending on the operating environment. Please consult SMC for solutions.

●Troubleshooting list

Problem	Possible cause	Investigation method	Countermeasures
Cannot control the flow rate. Flow does not start.	Abnormal wiring	Check that all wiring is connected properly.	Check and correct the wiring.
	System error		Turn off the power supply, check whether there is any noise-generating source, and turn the power supply back on. If the failure cannot be resolved, contact SMC.
	Abnormal power supply voltage	Check the power supply voltage.	Use a power supply voltage of 24 VDC $\pm 10\%$. (The control operation of the product will be stopped forcefully when the power supply voltage drops to about 18 V).
	Application of Lo level voltage to an external input terminal (control stop input)	Check that the voltage applied to the external input terminal (control stop input) is not less than 0.4 V.	Set the external input terminal (grey wire) in open status when starting the control operation.
	Piping connected in the wrong direction	Check that the IN and OUT ports mounting direction of the product matches the flow direction described on the product label.	Install the piping in the correct direction.
	Insufficient flow rate	Check that the pressure has not decreased.	Increase the pressure value to within the rated pressure range to obtain the desired flow rate.
	Water supply shortage	Confirm whether the fluid path is full or not.	Fill the fluid path with fluid.
	Foreign matters in the sensor fluid path	(1) Check for any possibility of entry of foreign matter. (2) Observe inside the flow path of the product from the upstream side and check for any adhesion of foreign matter or discoloration inside the piping.	A filter with filtration of approx. 150 mesh is recommended. Prevent any sealing tape from getting inside the piping.

Problem	Possible cause	Investigation method	Countermeasures
Cannot control the flow rate. Flow does not start.	Operation failure due to accumulation of foreign matter inside the valve (adhesion)	(1) Check for any possibility of entry of foreign matter. (2) Observe inside the flow path of the product from the upstream side and check for any adhesion of foreign matter or discoloration inside the piping.	When using copper piping, etc., liquation of copper ions may occur within the fluid depending on the operating environment and may cause operation failure when fully closed because the valve with an accumulation of copper ions may get adhered to the orifice inside. Therefore, take measures including changing the piping material.
	Abnormal control valve over-current	Check if there is a power line or a high voltage line that generates noise in the wiring route.	Turn off the power supply, check whether there is any noise-generating source, and turn the power supply back on. If the failure cannot be solved, contact SMC.
	Effect of pump pulsation	When the internal flow rate sensor malfunctions due to pulsation, the valve may not open even when the flow rate command is input in a fully closed condition.	Take the measures described below when affected by pump pulsation. •Change the pump •Mitigate pulsation by installing a tank •Mitigate pulsation using an accumulator or rubber hose

Problem	Possible cause	Investigation method	Countermeasures
The analogue output cannot be output. Unstable analogue output.	Abnormal wiring	Check that each wire is connected correctly.	Check and correct the wiring.
	System error		Turn off the power supply, check whether there is any noise-generating source, and turn the power supply back on. If the failure cannot be resolved, contact SMC.
	Foreign matter in the sensor fluid path	(1) Check for any possibility of entry of foreign matter. (2) Observe inside the flow path of the product from the upstream side and check for any adhesion of foreign matter or discoloration inside the piping.	A filter with filtration of approx. 150 mesh is recommended. Prevent any sealing tape from getting inside the piping.
	Effect of pump pulsation	It may be affected by pump pulsation when the analogue output is fluctuating unstably.	Take the measures described below when affected by pump pulsation. •Change the pump •Mitigate pulsation by installing a tank •Mitigate pulsation using an accumulator or rubber hose
	Noise	Check if there is a power line or a high voltage line that generates noise in the wiring route.	Route signal wiring separately from power lines and high voltage lines.
External input (control stop input) not accepted.	Abnormal wiring	Check that all wiring is connected correctly.	Check and correct the wiring
	System error		Turn off the power supply, check whether there is any noise-generating source, and turn the power supply back on. If the failure cannot be resolved, contact SMC.
	Input time is short Input voltage is high	Check whether the potential of 0.4 V or less can be maintained with the grey line for 30 ms or more.	When applying external input, connect to a potential of 0.4 V or less for 30 ms or more.

Specifications

Model			FC3W504	FC3W520	FC3W540
Fluid spec.	Applicable fluid		Water		
	Fluid temperature range		0 to 50 °C (No condensation or freezing)		
Flow rate spec.	Flow rate detection method		Karman vortex		
	Rated controlled flow rate range * ¹		0.5 to 4.0 L/min	2.0 to 16.0 L/min	5.0 to 40.0 L/min
	Leakage when fully closed * ²		0.4 L/min or less	1.0 L/min or less	2.0 L/min or less
Control spec.	Control accuracy * ³		±5%F.S.		
	Control dead zone * ⁴	Output A1 to 3	Within ±2% F.S. of flow command value		
		Output L	±0 to 10 %F.S. (Default ±2%F.S., variable at ±1%F.S.)		
	Repeatability		±3%F.S.		
	Temperature characteristics		±5%F.S. (0 to 50 °C, Reference 25 °C)		
	Setting time * ⁵		Within the range of ±5%F.S. of the commanded flow rate within 10 seconds		
Pressure spec.	Operation when power supply is not connected * ⁶		Hold valve state		
	Operating pressure range * ⁷		0.2 to 0.4 MPa		
	Minimum operating differential pressure		0.2 MPa		
Analogue input * ⁸ (Flow rate command)	Withstand pressure		0.6 MPa		
	Voltage	Input type	1 to 5 VDC/0 to 10 VDC		
		Input impedance	Approx. 1 MΩ		
	Current	Input type	4 to 20 mADC		
Input impedance		250 Ω or less			
Analogue output (Flow rate output)	Voltage	Output type	1 to 5 VDC/0 to 10 VDC		
		Output impedance	Approx. 1 kΩ		
	Current	Output type	4 to 20 mADC		
		Output impedance	50 to 600 Ω		
External input (Control stop input)	Input type		Input with no voltage (0.4 V or less), input time: 30 ms or more		
	Operation		Flow rate control operation stop (Hold valve state)		
Electrical spec.	Power supply voltage	Output A1 to 3	24 VDC ±10%		
		Output L	L+ : 24 VDC ±10%(control power) 2L+ : 24 VDC ±10%(drive power)		
	Current consumption * ⁹	Output A1 to 3	0.1 A or less (At control stop and control setting) 0.5 A or less (During control operation)		
		Output L	L+ : 0.06 A or less (control power line) 2L+ : 0.5 A or less (drive power line)		
Operation LED		Output A1 to 3	PWR (green): Power supply status display ERR (red): Error status display CTRL (green): Control status display		
		Output L	PWR (green): Power supply status display ERR (red): Error status display CTRL (green): control status display IO-Link (green): Communication status display		

Model		FC3W504	FC3W520	FC3W540
Environmental resistance	Enclosure rating	IP65 (IEC 60529)		
	Operating temperature range	0 to 50 °C (No condensation)		
	Operating humidity range	Operation and storage: 35 to 85%R.H. (No condensation)		
	Withstand voltage	1000 VAC for 1 minute between terminals and housing		
	Insulation resistance	50 MΩ or more between terminals and housing (with 500 VDC megger)		
Standards		CE/UKCA marked		
Materials in contact with fluid		FKM, Stainless steel 303/304, PP+PE, POM, PPS		
Piping specifications		3/8 (Rc, NPT, G)	3/8, 1/2 (Rc, NPT, G)	1/2, 3/4 (Rc, NPT, G)
Weight	Body	Approx. 480 g	Approx. 500 g	Approx. 1330 g
	Bracket	Approx. 50 g		Approx. 110 g
	Lead wire (3 m)	Approx. 180 g		

*1: Operation may become unstable when it is outside the rated controlled flow rate range.

*2: This product is not suitable for applications to completely cut (stop) the flow rate.

If it is necessary to completely cut the flow rate, install a stop valve, etc. separately.

*3: Includes a control dead zone of $\pm 2\%$ F.S.

*4: When the controlled flow rate falls within the range of the commanded flow rate $\pm 2\%$ F.S. (control dead zone), the control operation halts.

*5: The condition is the step change of the commanded flow rate in the range from 0% to 100% at an operating pressure of 0.3 MPa.

The settling time may be delayed in other conditions.

*6: The control valve operation stops and the valve opening will be maintained when the power supply is turned OFF.

*7: Normal control operation may not be available when it is outside the operating pressure range.

*8: The product will perform a fully closed operation when the analogue input terminal is in open status (signal is not input).

*9: Current consumption higher than the actual use may be present when abnormalities of control operation such as no supply pressure occurs.

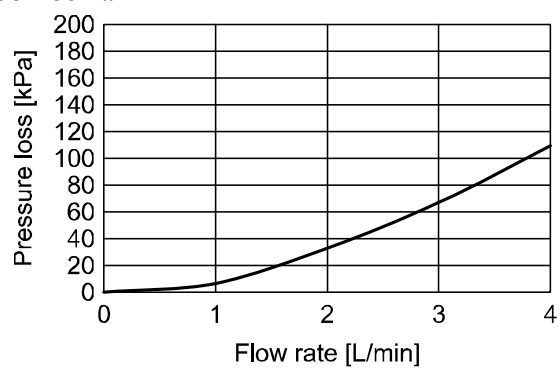
*10: Any products with tiny scratches, smears, or variations in the display colour or brightness, which does not affect the performance of the product, are verified as conforming products.

○Cable specification

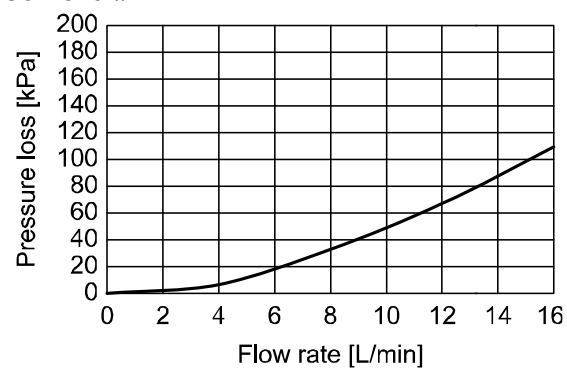
Conductor	Nominal cross section	AWG21
	Outside diameter	Approx. 0.9 mm
Insulator	Outside diameter	Approx. 1.7 mm
Sheath	Material	PVC
Finished outside diameter		$\phi 6$ mm
Min. bending radius		60 mm

●Pressure loss

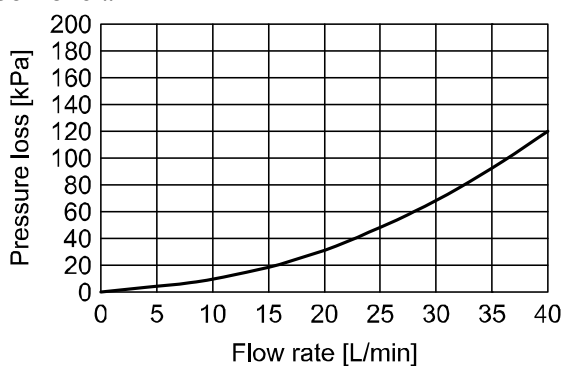
FC3W504-#



FC3W520-#



FC3W540-#



●About water hammer (reference data)

Rapid shutting on the secondary side of the product may lead to product damage due to water hammer. If the flow velocity in the pipeline falls into the area shown in the graph below, implement the following reduction measures.

<Water hammer reduction measures>

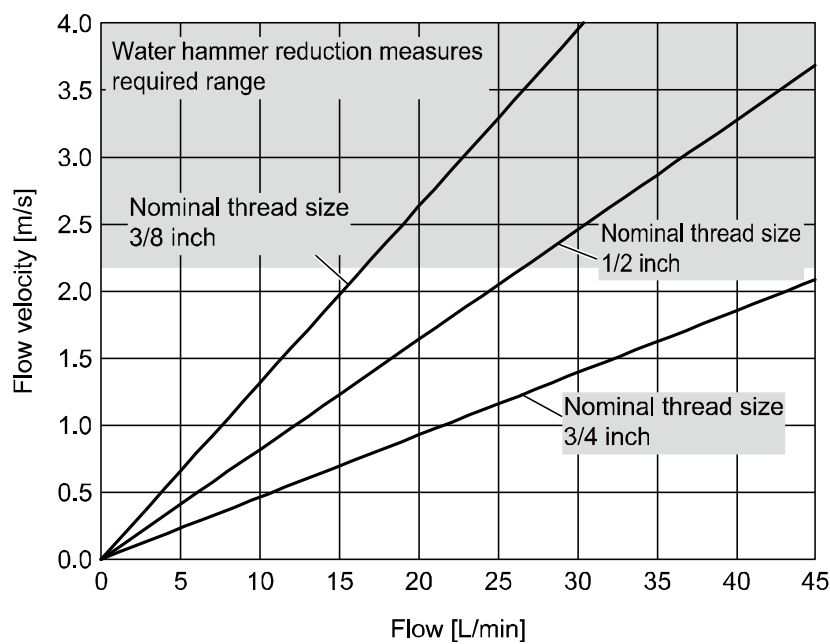
Select a larger pipe diameter.

Use FC3W to control the flow rate to a low level before shutting.

Keep the pipe length as short as possible.

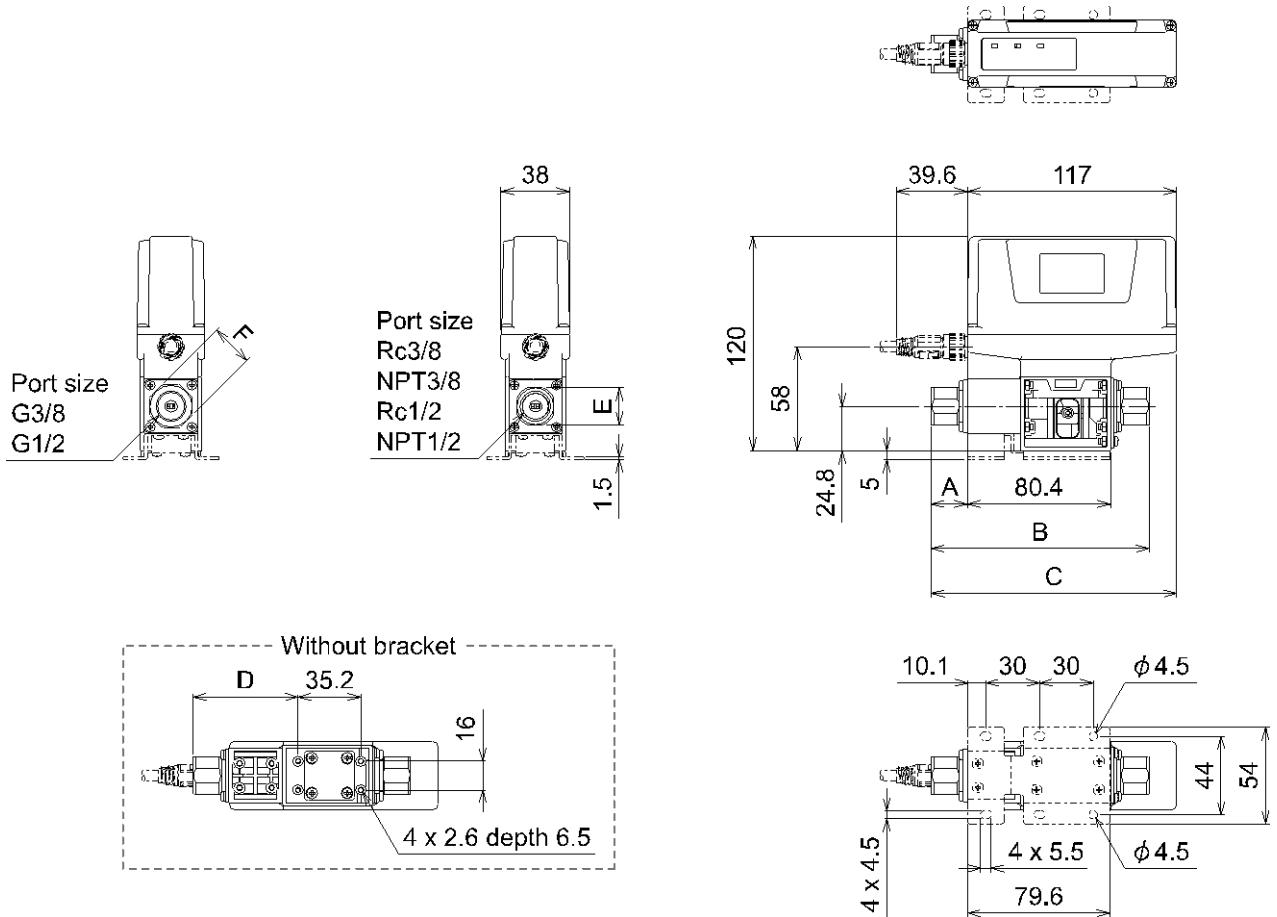
Use a water hammer mitigation valve.

Use rubber hoses or other elastic piping materials and accumulators to absorb impact pressure.



■ Outline dimensions

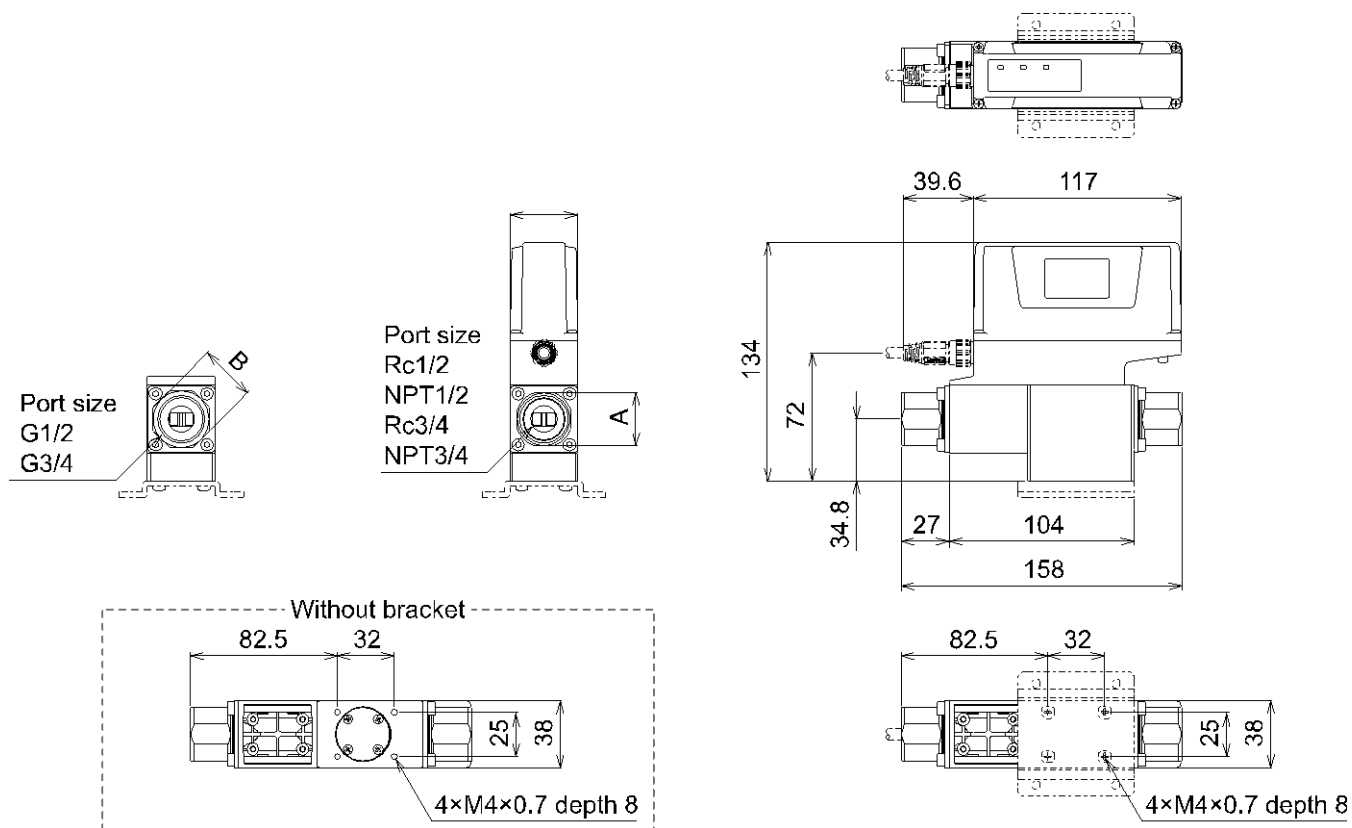
- FW3W504/520-#03
- FW3W520-#04



(mm)

Model	Port size	A	B	C	D	E	F
FC3W504-R03-#	Rc3/8	20	121.9	137.2	58.8	20.9	-
FC3W504-N03-#	NPT3/8	20	121.9	137.2	58.8	20.9	-
FC3W504-F03-#	G3/8	20	121.9	137.2	58.8	-	23.9
FC3W520-R03-#	Rc3/8	24	129.9	141.2	62.8	20.9	-
FC3W520-N03-#	NPT3/8	24	129.9	141.2	62.8	20.9	-
FC3W520-F03-#	G3/8	24	129.9	141.2	62.8	-	23.9
FC3W520-R04-#	Rc1/2	24	129.9	141.2	62.8	23.9	-
FC3W520-N04-#	NPT1/2	24	129.9	141.2	62.8	23.9	-
FC3W520-F04-#	G1/2	24	129.9	141.2	62.8	-	26.9

•FW3W540-#04/06



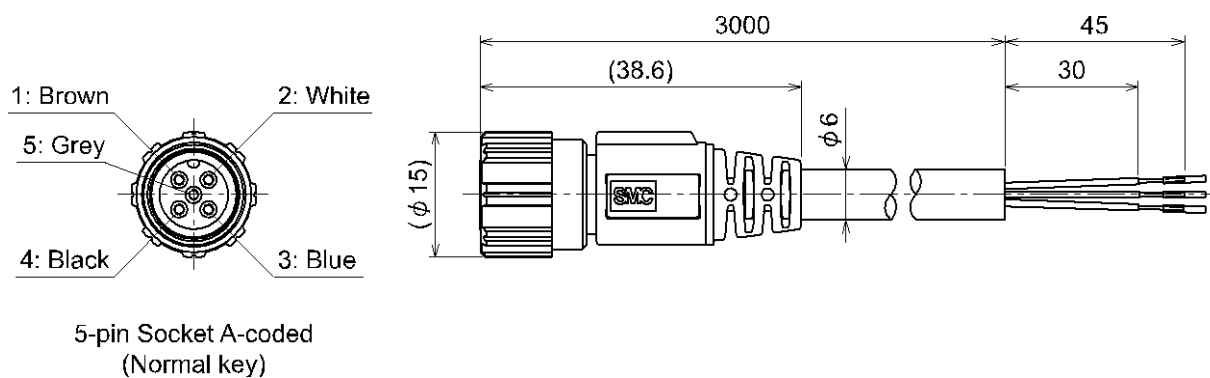
(mm)

Model	Port size	A	B
FC3W540-R04-#	Rc1/2	23.9	-
FC3W540-N04-#	NPT1/2	23.9	-
FC3W540-F04-#	G1/2	-	26.9
FC3W540-R06-#	Rc3/4	29.9	-
FC3W540-N06-#	NPT3/4	29.9	-
FC3W540-F06-#	G3/4	-	31.9

■Accessories

○Lead wire with M12 connector

•ZS-53-A



Cable material specifications

Conductor	Nominal cross-sectional area	5 x AWG21
	Outside diameter	About 0.9 mm
Insulator	Outside diameter	About 1.7 mm
Sheath	Material	PVC
Finished outer diameter		φ6 mm

•EX500-AP**-*

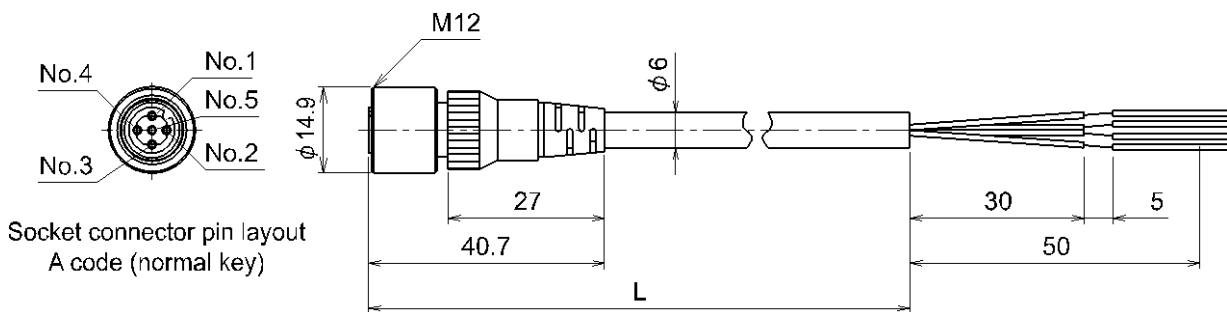
EX500-AP **050** - **S**

Cable length(L)

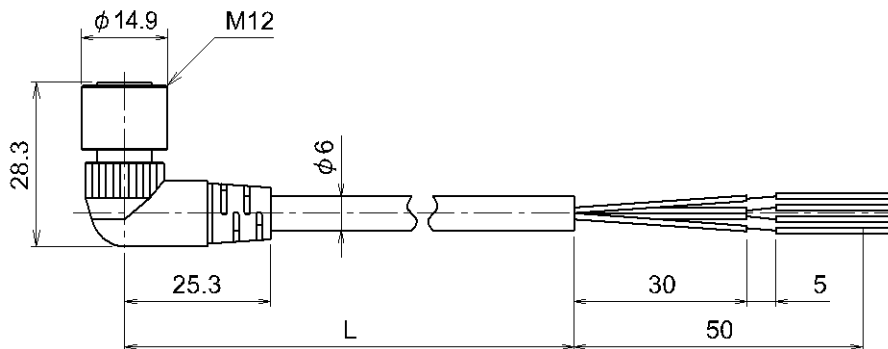
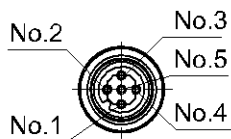
Symbol	Length
010	1000 mm
050	5000 mm

Connector specifications

Symbol	Specifications
S	Straight
A	Angle



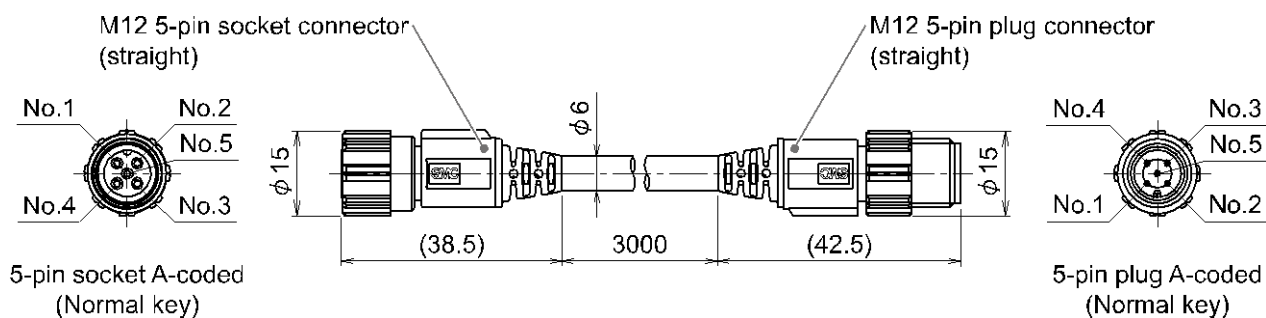
Socket connector pin layout
A code (normal key)



Item	Specifications
Cable outer diameter	φ6 mm
Nominal cross-sectional area of conductor	0.3 mm ² /AWG22
Cable outer diameter (including insulators)	1.5 mm
Minimum bending radius (When fixed)	40 mm

○Lead wire with M12-M12 connector

•ZS-53-D



Cable material specifications

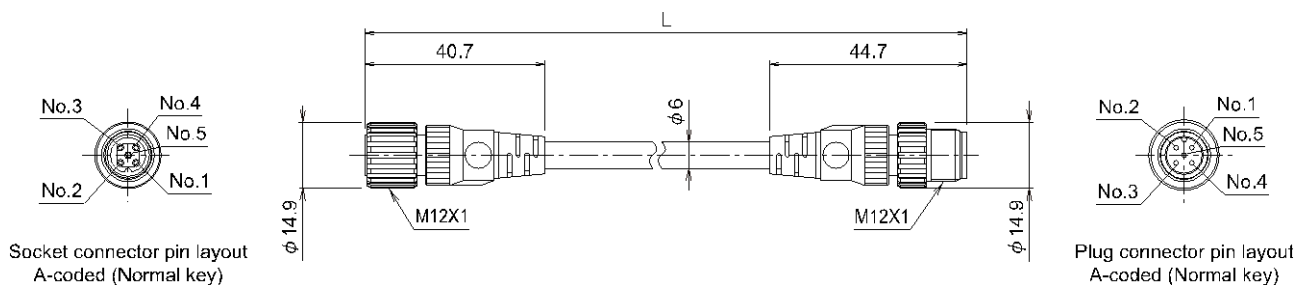
Conductor	Nominal cross-sectional area	5 x AWG21
	Outside diameter	About 0.9 mm
Insulator	Outside diameter	About 1.7 mm
Sheath	Material	PVC
Finished outer diameter		$\phi 6$ mm

•EX9-AC*-SSPS

EX9-AC **005** - SSPS

Cable length(L)

Symbol	Length
005	500 mm
010	1000 mm
020	2000 mm
030	3000 mm
050	5000 mm
100	10000 mm

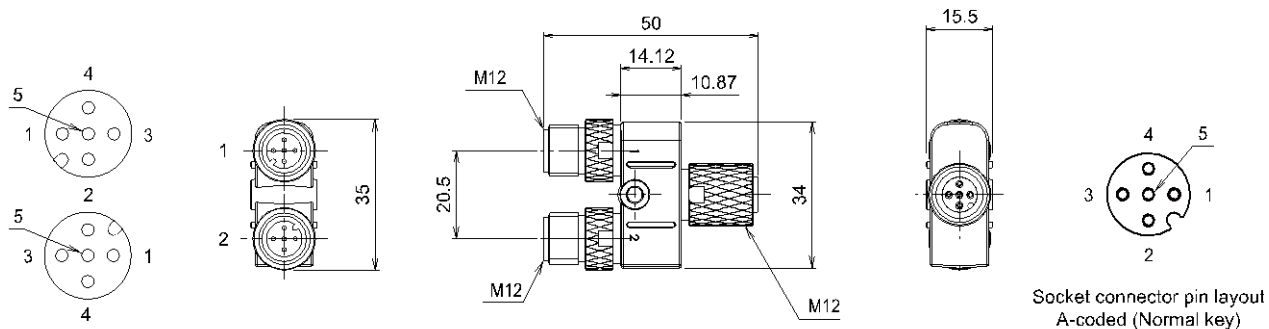


Item	Specifications
Cable outer diameter	$\phi 6$ mm
Nominal cross-sectional area of conductor	0.3 mm ² /AWG22
Cable outer diameter (including insulators)	1.5 mm
Minimum bending radius (When fixed)	40 mm

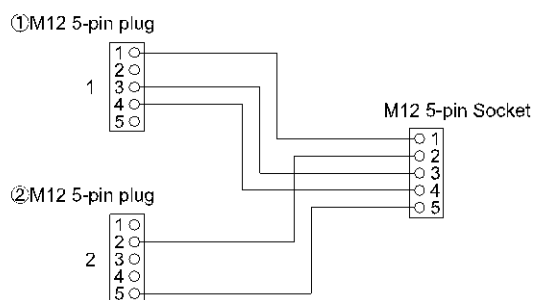
○Y-branch connector

•EX9-ACY02-S

This is a connector for branching IO-Link communication cables and supplying valve drive power when using an IO-Link master of port class A.



Plug connector pin layout
A-coded (Normal key)

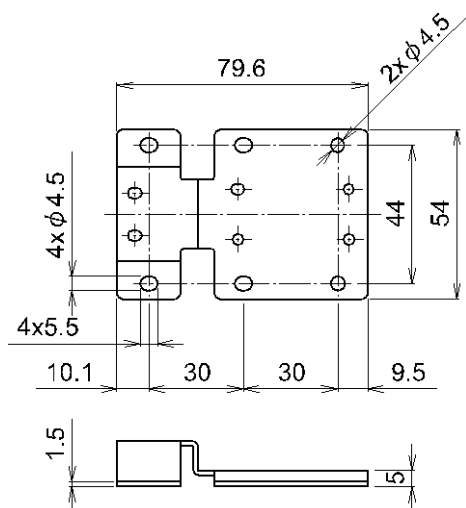


Pin arrangement on the cable side for valve drive power supply using a branch connector

1	-	Unused
2	2L+	Valve drive 24 V
3	-	Unused
4	-	Unused
5	2L-	Valve drive 0 V

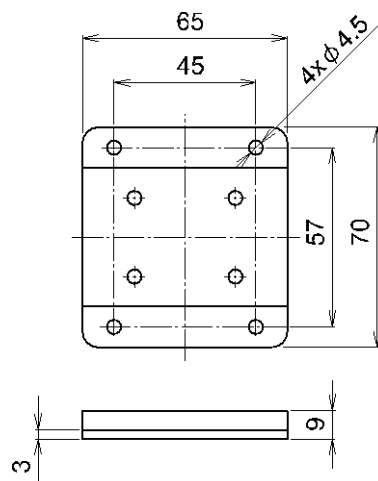
○Bracket

•ZS-54-A



6 tapping screws (3 x 8L) are included.

•ZS-54-B



Mounting screws (M4 x 8L) are included.

Revision history

- A: Contents revised in several places.
[May 2024]
- B: Contents revised in several places.
[March 2025]
- C: Contents revised in several places.
[August 2026]

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URL <https://www.smcworld.com>

Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.
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No.PF※※-OMA1018-C