

FCV

Instruction manual

Outline

The water volume controller FCV is designed to control a liquid flow rate with microcomputer control. The controller consists of flow-rate sensors, valves, and a control unit. A detected flow rate is adjusted automatically with valve opening so that it will become its targeted value. As the controller has a high accuracy and quick response, you can apply this to wider applications, such as water volume control, process control, liquid control, and water saving.

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Before using the product

- Be sure to read the instruction manual to understand the contents before using this product.
- Be sure to follow the directions for use, working conditions, and precautions specified in the instruction manual.

Safety precautions

The meanings of warning labels used in this instruction manual are as follows:

 Warning	Items with this label show that wrong operation disregarding this warning may result in serious consequences, such as death or serious injuries.
 Caution	Items with this label show that wrong operation disregarding this warning may result in damages of the product or a house, household goods, or others.
	Never make this operation.
	Always make operation following the directions.



Occurrence of abnormalities or failures

- ❗ Using this product in abnormal or failure conditions, such as smoke, strange smell, or instability in operation, may result in a fire or an accident. In this case, stop power supply immediately, and contact your dealer for providing situations. You are not allowed to make a disassembling or overhauling by yourself.

Service conditions

- ⊘ Using this product at a place having high humidity or condensation may accumulate moisture inside the product, causing an accident or failure.
- ⊘ Using this product at a place subject to a shock or impact may result in improper operation, an accident, or a failure.
- ⊘ As this product does not have an explosion-proof construction, never use this at dangerous places with inflammable gases, explosive gases, corrosive gases, or others.
- ⊘ As this product is designed for inside installations, never use this outdoors.
- ⊘ Using this product at a place which may subject to the influence of a pulsation may result in an accident or failure.
- ❗ If this product is used at a place with a heating equipment or others, its internal temperature will rise, resulting in an accident or a failure; therefore, always use this in regular working conditions.




Maintenance inspection

- ❗ For safety, operation should be made after stopping water supply and bringing the inside of piping into the non-pressure status.
- ❗ For safety, stop power supply before making operation. Neglecting the warning may result in an accident or a failure.









Caution


Handling of cables

-  Placing a heavy item on a cable or pulling a cable from the main body of a sensor may result in an accident or a failure.
-  Contacts between cables which are not used, or between a cable and outside equipment may result in an accident or a failure, so use this product after making insulation processing for each of the cables.
-  When output load conditions and the tolerance of the power supply voltage are outside the range specified in this book at the time of wiring, an accident and a failure may occur; therefore, be sure to observe the contents described in sections, such as "Electric wiring," "I/O properties," "How to apply load," and "Electric properties."


Service conditions

-  Using this product at a place exposed to magnetism, electromagnetic waves, radiation, or ultraviolet rays may result in an accident or a failure.
-  Using this product at a place with static electricity charged may result in an accident or a failure.
-  Using this product at a place subject to the influence of electric noise, such as the periphery of a high-frequency power, may result in an accident or a failure.
-  Using this product at a place subject to the influence of electric erosion may result in an accident or a failure.
-  When there is a risk that foreign substances, such as metal pieces or seal tapes, may mix into a fluid, be sure to install a filter in the upstream side.
-  You cannot make measurement correctly if air bubbles are mixed in fluid. Use this product after removing air bubbles completely.



Unpacking, conveyance

-  Be careful not to drop the product at the time of unpacking or conveyance. Neglecting the warning may result in the falling of main body of a sensor, causing an accident or a failure.

Installation works


-  Keep in mind that getting a finger caught in the main body of a sensor at the time of piping works or others may result in an injury.

Maintenance inspection

-  Touching the electronic substrate inside the display cover may result in an accident or a failure. Request internal inspection, adjustment, or repair to your dealer.
-  Only a person in charge with enough technical knowledges and experiences shall be allowed to carry out piping, wiring works, maintenance, and inspection.



Others

-  When you find damages or deformations with a product at the time of unpacking, notify the information to your dealer without using it.

Characteristics

1. High performance

As this product has a high precision ($\pm 3\%$) and a high-speed response (within 3 seconds) as a water-volume controller, which may fully satisfy user requirements, you can apply this to a wider area, including a process control.

2. Small size/light weight

A design is made to impose less burden on a mounting place due to the followings: sensors and valves are compact; a wide area is not required for mounting; and lightweight materials are used.

3. Easy operation

You can view flow rates/target values/control status with LCD and LED displays by simple operation (setting of an target flow rates only).

4. Ability to adapt

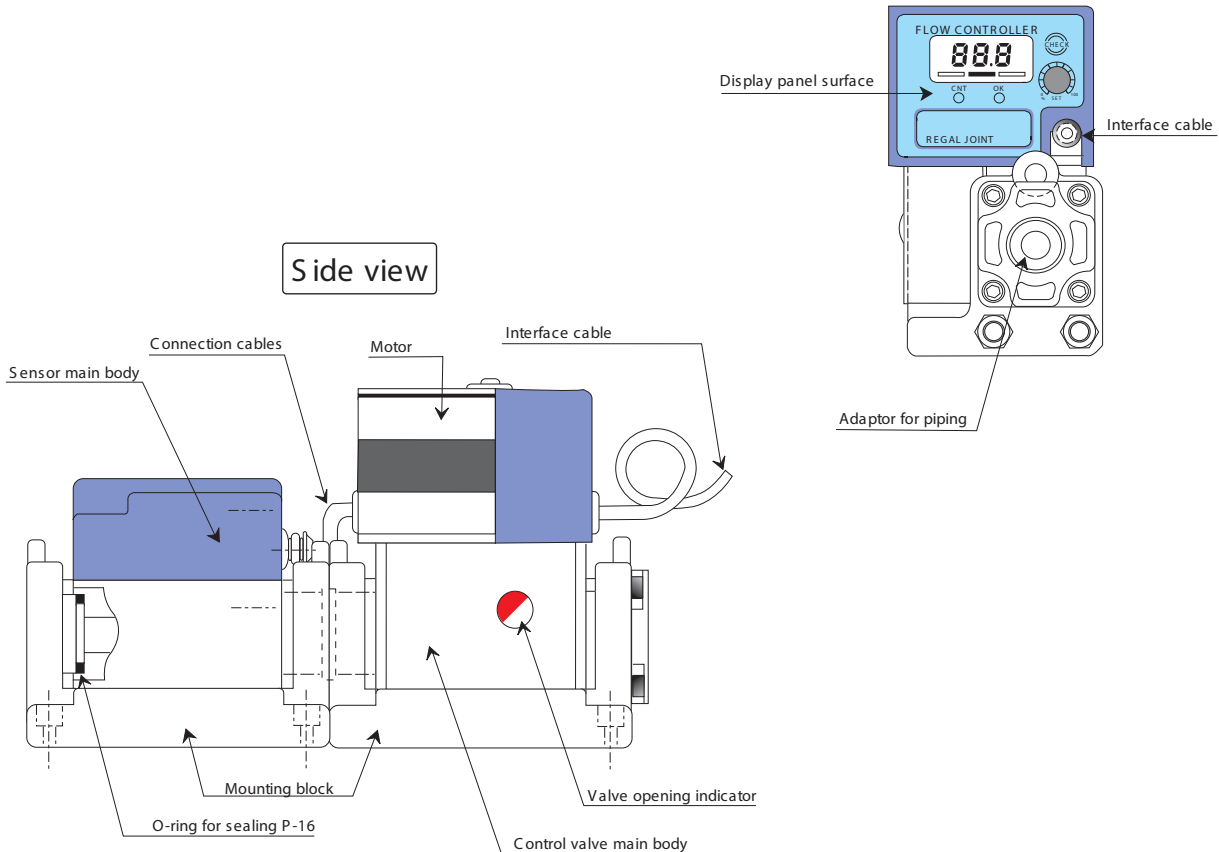
FCV can carry out optimal operation according to piping systems using regulating functions.

5. Interface

You can supply the I/O signals at various kinds of levels so that it may be helpful for you to make a connection to user equipment. (Settings are made at shipping to each of I/O signals of 0-10 V, 1-5 V, and 4-20 mA.)

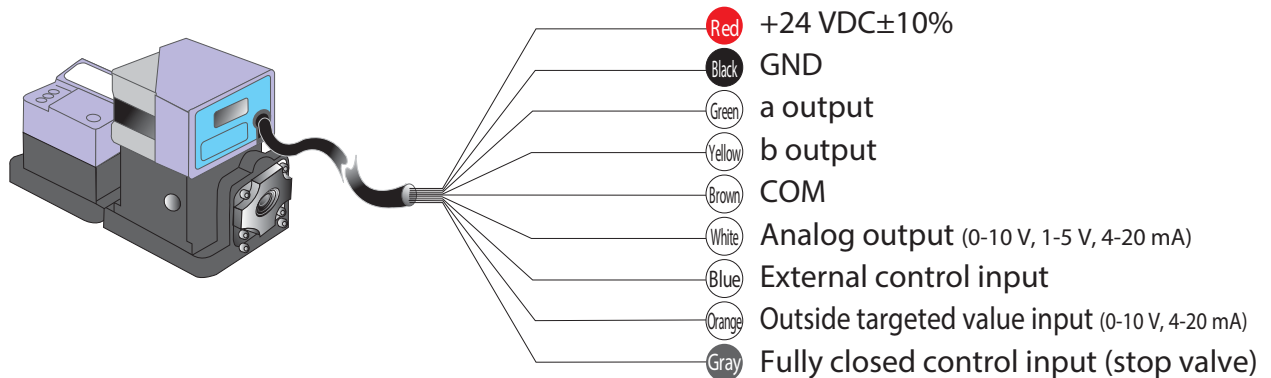
Structure

The followings show the names of the main parts.



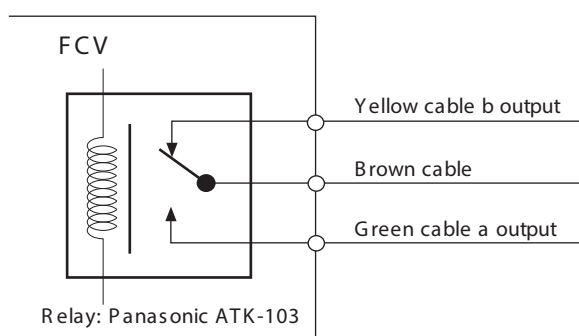
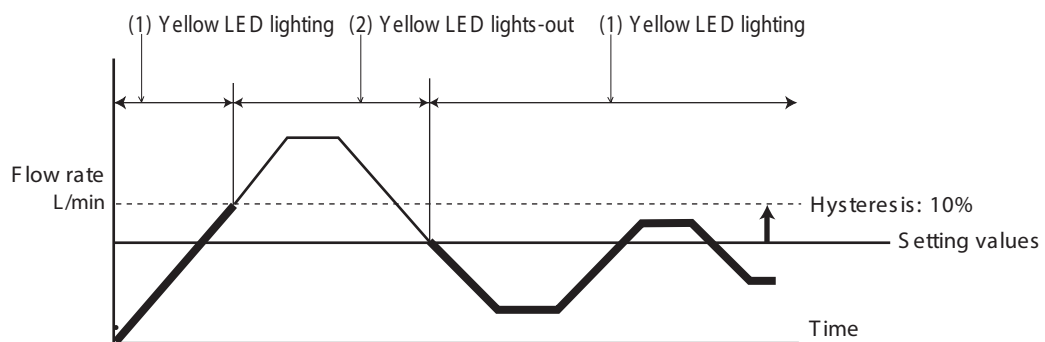
Electric wiring

AWM2448 is a terminal unprocessed cable of 9 core/0.2 mm² with the length of 500 mm. Make a connection to a relay terminal or a connector, by the soldering or crimping. A core wire size of #24-#28 with a covering external diameter of 10 mm at MAX is recommended as a connector. Terminal processing should be made for wires unused.



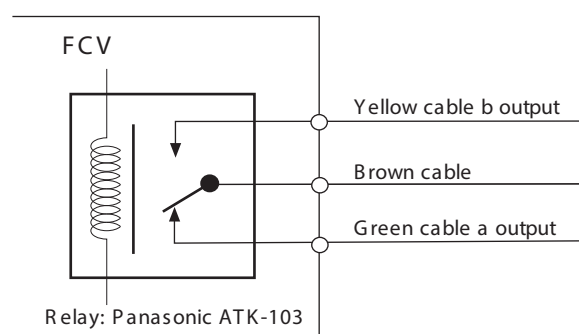
GND is used as a common earth cable for other signal wires (FLOW, REF, CONT, SHUT), including the common return, i.e., a power.

Flow sensor relay operation descriptions



(1) Relay is as the left figure shows when a real flow rate is smaller than a trimmer setting value. Yellow LED lights ON at the same time.

MAX 30 VDC, 2 A load possible

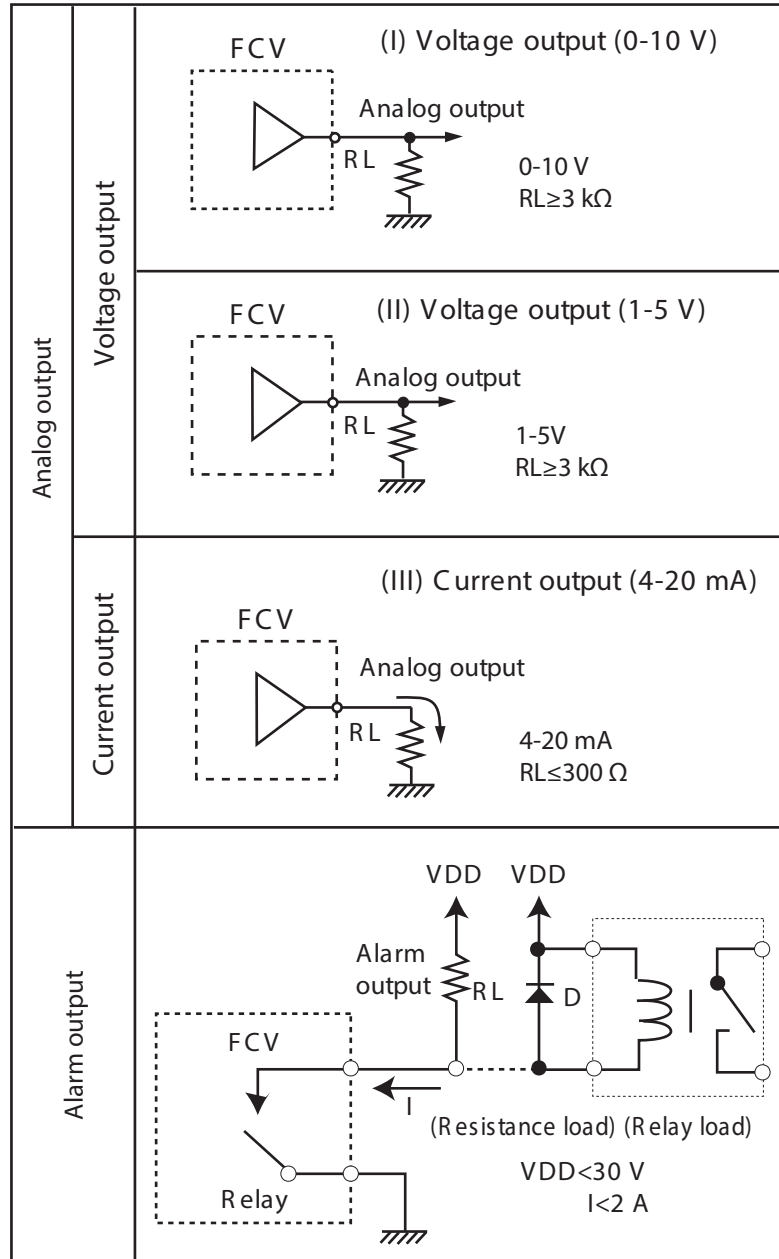


(2) Relay is as the left figure shows when a real flow rate is larger than a trimmer setting value. Yellow LED lights OUT at the same time.

MAX 30 VDC, 2 A load possible

How to apply load

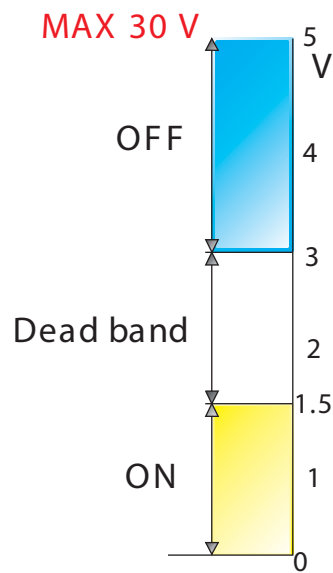
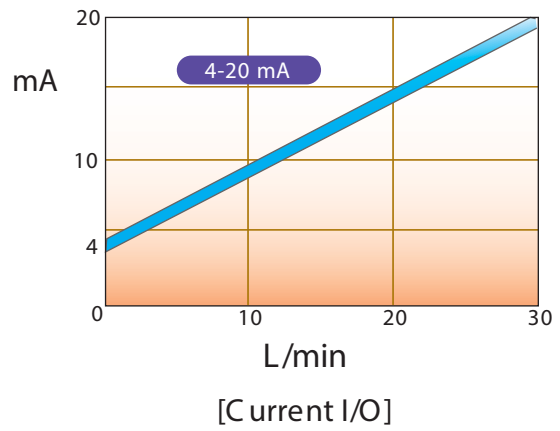
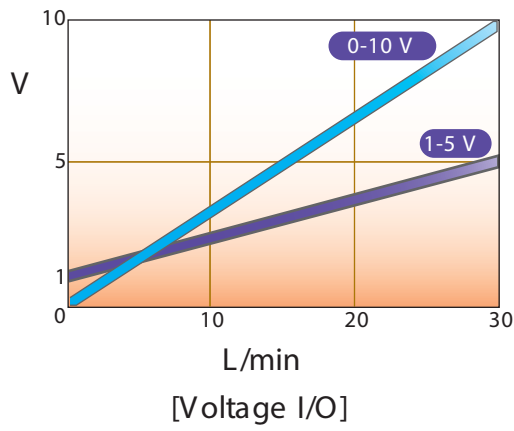
Carry out the representative way for setting load resistance at the unit side.



* Use a diode (D) for preventing transistors from being damaged due to a back electromotive force at the time of loading a relay. Example) 1S5245 (ROHM)

I/O properties

This is an I/O signal which can be connected to the interface of a sequencer or personal computer. Some changes are possible according to an user's conditions. Feel free to contact us.



[Control signals]

Interface

The roles of a cable are as follows:

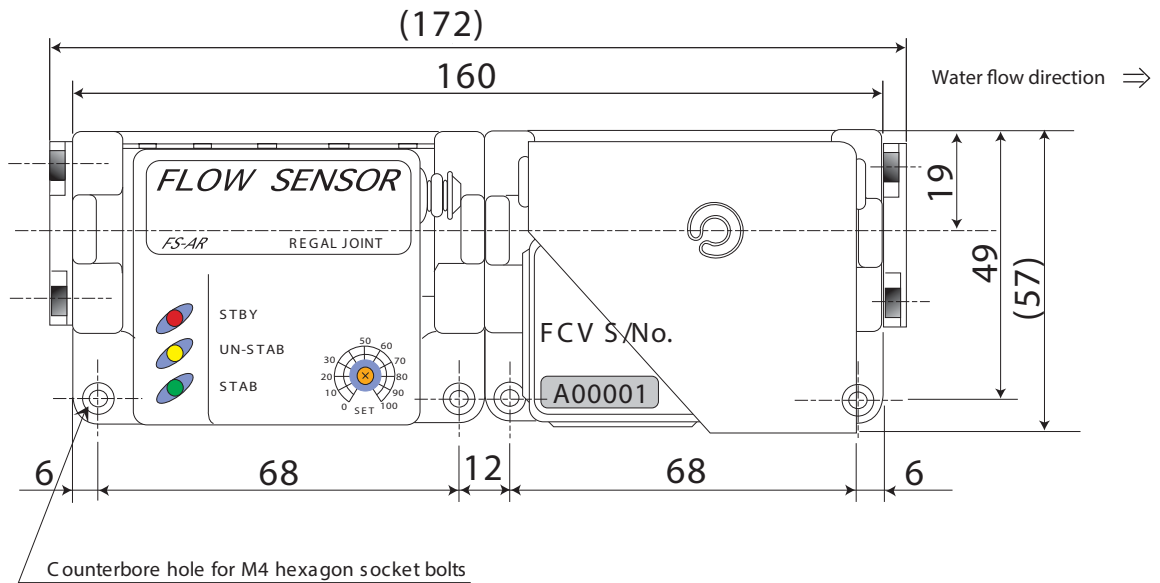
Symbol	Name	Direction	Conditions	Connection of cables
POW (red)	Power	Outside → FCV	24 VDC±10% MAX 300 mA	This supplies 24 VDC from outside. A power switch is not equipped in the FCV main body, so the circuit is put into operation on supplying the voltage.
GND (black)	Earth	Outside → FCV	—	This is a common earth wire. Only one line serves as the current return common to nine lines including POW.
FLOW (white)	Flow rate	Outside ← FCV	0-10 V/1-5 V/4-20 mA Load: >3 kΩ (voltage output) <300 Ω (current output)	This carries out sending-out according to flow rates at present. Refer to "I/O properties" displayed on page 7 for responses to a flow rate and output voltage (or current).
REF (orange)	Target value	Outside → FCV (EXT)	Same as the above	This provides a target value in flow-rate control.
		FCV → Outside (INT)	REF volume rotation on a panel	
CONT (blue)	Control	Outside → FCV (EXT)	TTL level (negative logic) (control signal)	This executes the flow rate control at ON and does not execute at OFF. This checks water flow or others at OFF.
		FCV → Outside (INT)		
SHUT (gray)	Fully closed	Outside → FCV	TTL level (control signal)	This is used to fully close the valve at ON and to execute the flow rate control at OFF.
COM (brown)	Common	Outside ← FCV	Relay circuit common	This is the common for warning output.
a (green)	a output	Outside ← FCV	Relay circuit MAX 30 VDC, 2 A	This is warning a output.
b (yellow)	b output	Outside ← FCV	Relay circuit MAX 30 VDC, 2 A	This is warning b output.

Notes) INT .EXT indicates the direction of a MODE switch. Refer to optional operation on page 13.

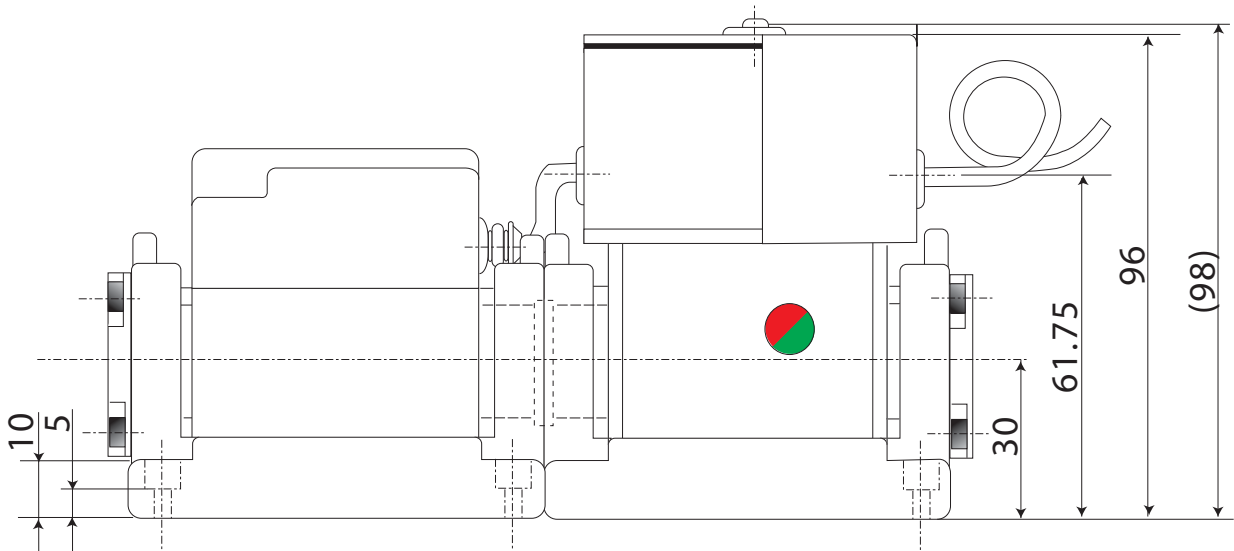
Unit mounting block dimensions (mm)

The followings show the measurements of the main parts.

Front view

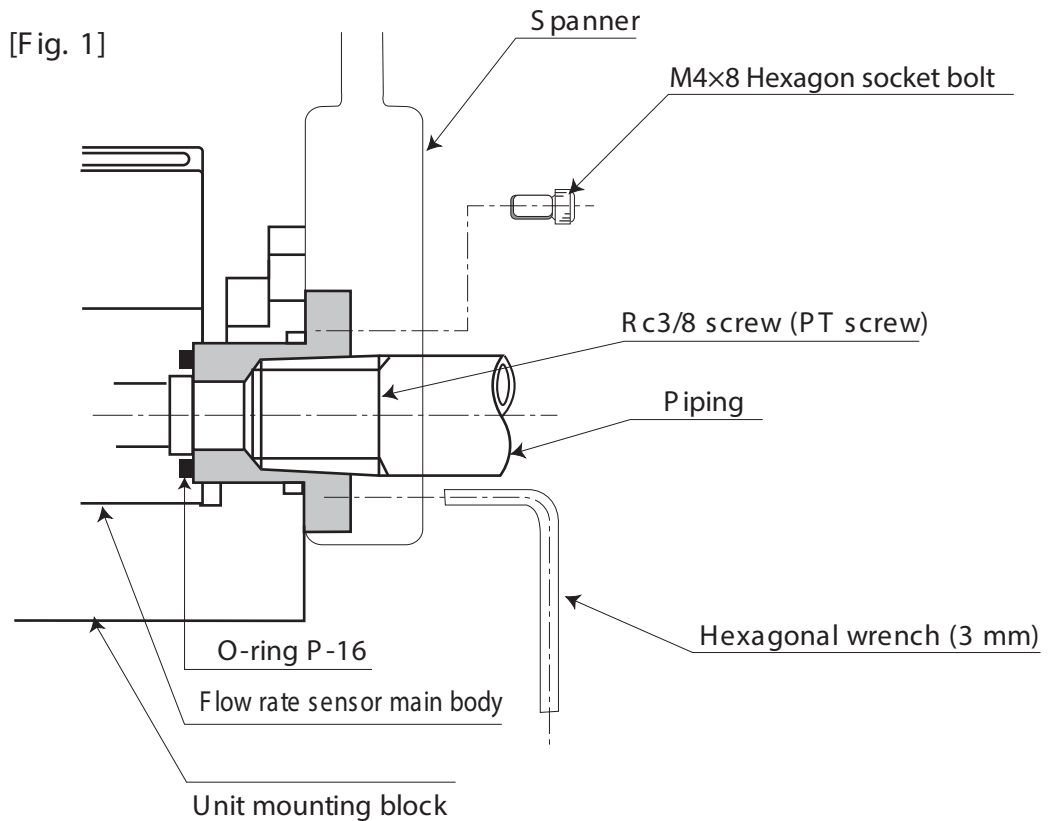


Side view



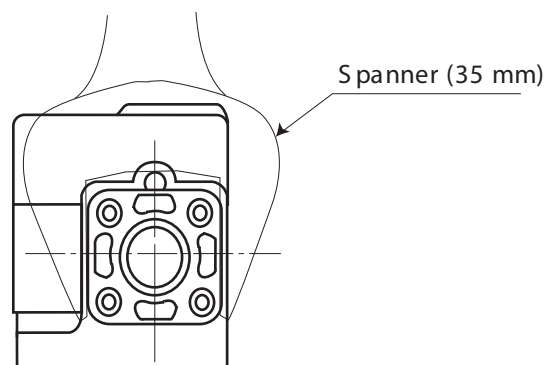
* A unit mounting block needs to fix its bottom surface according to mounting dimensions (using four M4 hexagon socket screws), or needs to be fixed with a pipe, or others.

Piping connection

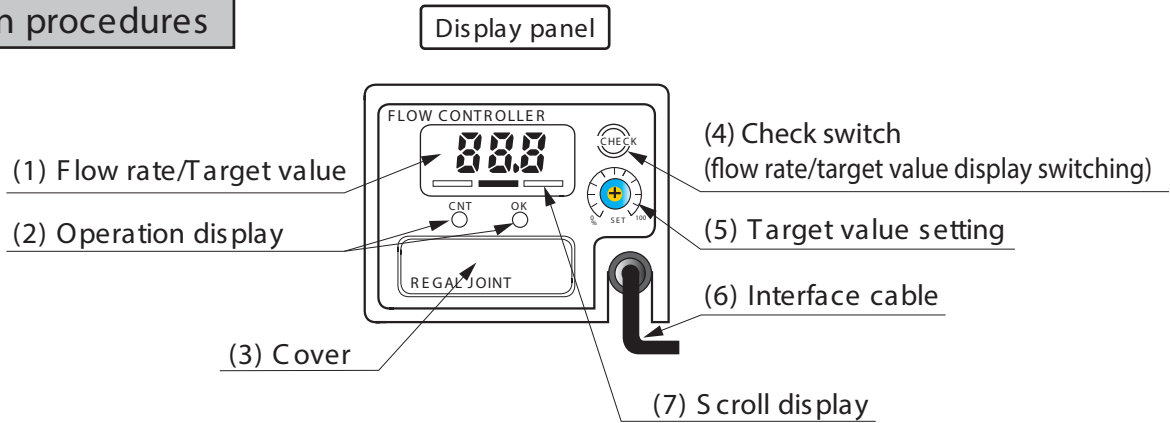


1. Piping works should be carried out by screwing pipes into the adaptor for piping, or by using a Kantouch joint, our product, or others.
2. Caution at mounting of piping material: When you use a spanner (35 mm), be sure to use the periphery of the adaptor for piping. Using a spanner while holding the mounting block directly may cause a damage. [refer to Fig. 2.]

[Fig. 2]



3. The inner diameter of the adaptor for piping is processed to Rc3/8 screw (PT 3/8 screw).
4. The adaptor for piping is fixed to the mounting block with four hexagon socket screws of M4x8. Use a 3-mm hexagon socket screwdriver or a L-type wrench for mounting or dismounting.
5. O-ring P16 is set in the sealing surface between the main body of a flow sensor and the adaptor for piping. Be careful enough not to forget to mount it or not to cause a biting or a mixing of dust or others.



[Fig.-1] Opening indicator



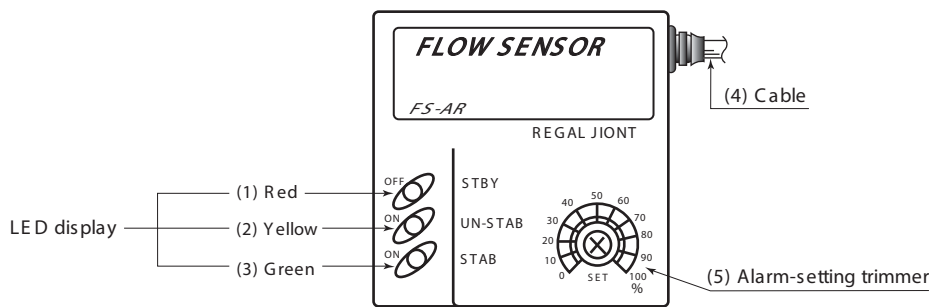
1. Standard operation

- 1-1 Connect a cable to user equipment. Refer to the page describing the connection of an interface cable (page 8). Among the nine core cables, two cores are for POWER and the remaining seven cores are those for I/O. A POWER earth and an I/O earth are shared by one cable.
- 1-2 A flow rate and an operation display will light up at Power ON (it is turned ON not by the power switch but by cable connection). You can confirm that control operation has started when a flow rate (three digits) is displayed and CNT (yellow) lights up.
- 1-3 Pressing the check switch (CHECK) makes the blinking display show a target value. In main-body adjustment, you need to rotate a target value setting (using a small screwdriver) to adjust to a target flow rate. In the case of outside input, input is made from a cable.
- 1-4 When pressing the check switch again, you can recognize that control operation is being made after returning to flow-rate display with CNT lamp (yellow) lighting. After the flow rate actually running reaches a target value, the CNT lamp goes off and the OK lamp (green) will light instead. The above-mentioned flow shows that stable operation is being made continuously.

[Other]

- Flow display: The display of low-speed three-point scroll shows that there is a flow of water. These displays show the existence of water flow regardless of other display operations. You can use them as an indication that piping has been made and the valve has been opened.
- Opening indicator: This indicator is located in the lower part of the side surface. [Fig.-1] shows a valve opening; green color indicates a fully opened status and red color indicates a fully closed status. This is equipped for viewing the opening-and-closing status of a valve.

[Fig.-2] Sensor-side operation panel



2-1 LED display descriptions

- (1) Power supply indication light (red)
The lamp will light by supplying power from the FCV side.
- (2) Relay operation confirmation lamp (yellow)
The lamp will light with an alarm-setting value or less.
- (3) Impeller rotation lamp (green)
The lamp will light while the fluid is flowing.

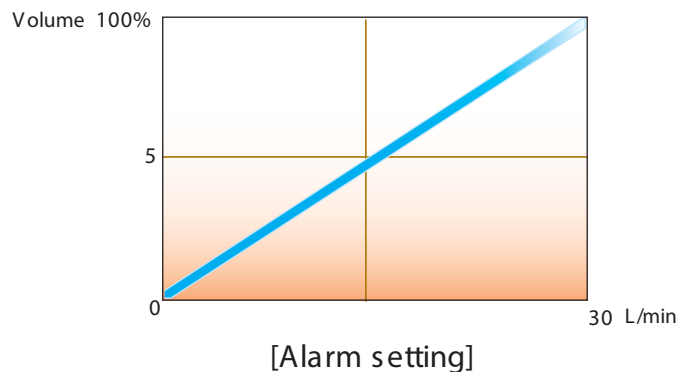
2-2 Cable

- (4) This is an output cable from the sensor side to the valve side.
(This has already been connected.)

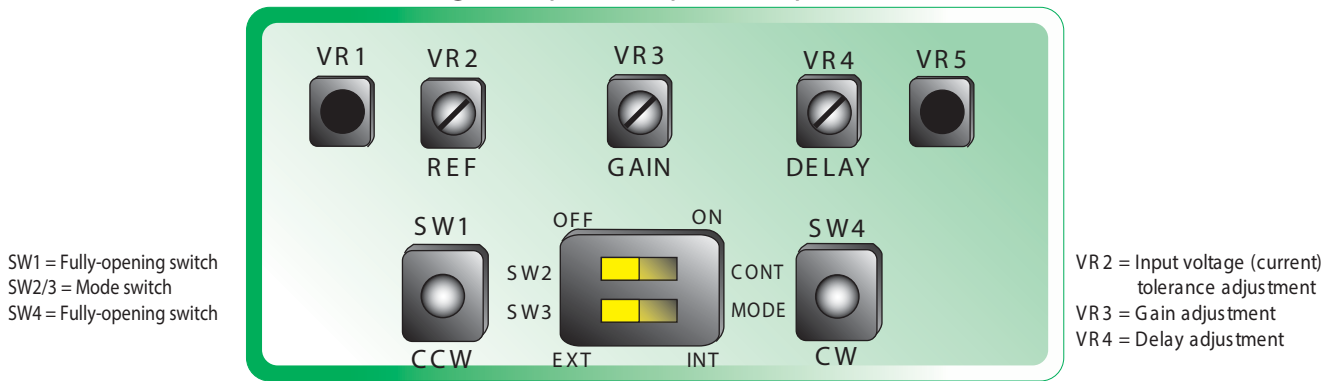
2-3 Alarm-setting trimmer

You can set up an alarm signal by removing the cap of (5) and turning the volume inside.

A scale is divided by every 10% between the range of 0-100%. You need to make a setup by adjusting to a target scale referring to the graph below or one attached to the sensor side face.



[Fig.-3] Optional operation panel



Besides using this product with the standard shipping setup, you can check the piping system with opening and closing of the valve after cancelling automatic control. At that time, you need to set a target value from user equipment and adjust the properties of this controller for securing operational stability. In the first place, remove the cover of (3).

3-1 CONT switch (SW2)

You make control with the CONT switch ON (opening/closing of a valve is automatically made to move to a target flow rate with feedback control).

Control will be suspended at OFF position with the opening at that moment.

(Both CNT and OK lamps go off) ... [ON at shipping]

3-2 CW and CCW Switch (SW1/4)

During CCW (SW1) is being pressed, the valve moves to closed status and stops when it is fully closed. During CW (SW4) is being pressed, the valve moves to opened status and stops when it is fully opened. You can view the condition with the opening display. This is used for checking water flow of the piping system.

3-3 MODE switch (SW3)

You can set up a target value with the SET volume on a display panel at the INT position. (Setup and control ON/OFF from a cable are impossible.)

You can make set up a target value setting and control ON/OFF from a cable at the EXT position. (You cannot set up a target value on the display panel.) ... [INT at shipping]

3-4 DELAY, a GAIN volume (VR3/4)

You can also make an adjustment of control system delay and loop gain.

Make adjustment in the case of an unstable operation.

DELAY (VR4) variable range: 0-3 sec

GAIN (VR3) variable range: 0.07-0.2 L/sec

* However, when the difference between a target value and an actual flow rate is 30 L/min

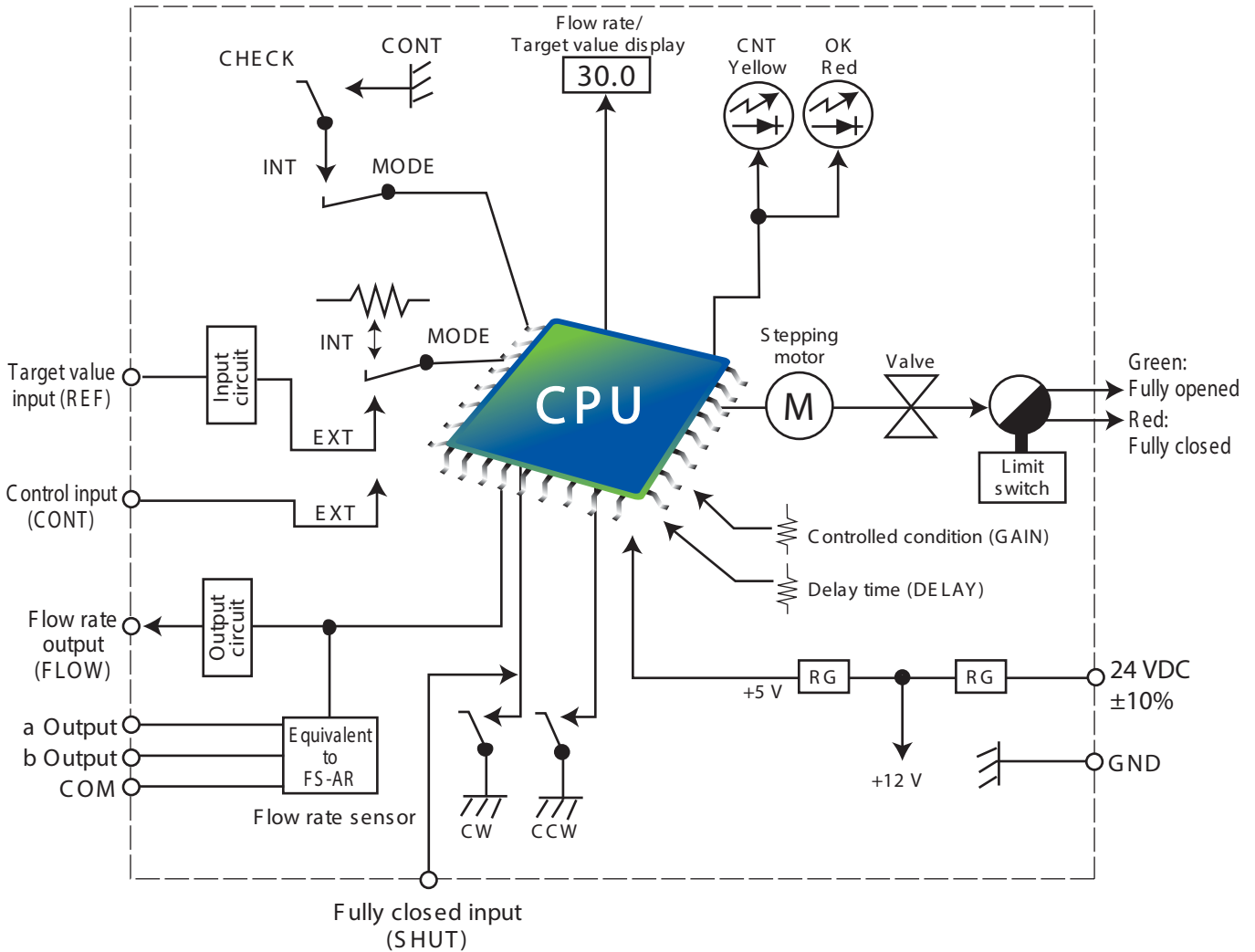
3-5 REF volume (VR2)

When a MODE switch is at EXT position, the adjustment of targeted value level supplied from user equipment is made.

Example) When 5 V is supplied by user equipment from (REF) at the I/O signals (external input voltage) of 0-10V, adjustment is made with VR2 so that flow-rate target value display may be 15 L/min when pressing the check switch. Pressing the check switch again will terminate the adjustment.

3-6 As VR1/5 is for the adjustment at shipping, paint lock is applied for it. Don't use this.

Block diagram



A flow-rate sensor equivalent to our company's FS-AR will detect an instant flow rate. When control input is ON, CPU (microcomputer) recognizes the difference between a targeted value input and a flow rate, and then determines the valve opening to be increased or decreased. The number of revolutions to be sent to a motor which opens or closes a valve will be calculated using setup controlled condition and delay time as coefficients. Calculation results are converted into the number of pulses, rotating a motor through a driver.

After carrying out this operation repeatedly, a flow rate will become closer to a target value. When operation of a valve reaches a limit, the information (output of fully opened or fully closed) will be sent with a limit switch. When control input is OFF, control will be stopped to flow water with a valve opening at that moment, making flow-rate display (and output).

Specifications

Flow rate	0-30 L/min
Maximum working pressure	0.49 MPa
Flow-rate control range	5-25 L/min
Fluid temperature	0-60°C
Ambient temperature	0-40°C (at the time of no freezing)
Flow direction	Specified direction
Mounting posture	No restrictions except for inversion
Power supply	24 VDC±10%
Consumption current	MAX300 mA

Note) 1

Body material	Polyacetal
Material contacting liquid	Polyacetal/Polyamide
Fluid used	Industrial water, water, or others
O-ring for seals	Fluorocarbon rubber
Adaptor material	BsBM/nickel plating
Mounting block	Polyacetal
Piping connection	Rc3/8 (PT screw)
Protective construction	Drip proof type processing for electronic circuits
Cable	AWM2448/9 cores

Note) 2

Electric properties

Flow rate properties	Flow-rate measurement	0-30 L/min
	Flow-rate control range	Target flow rate set range: 5-25 L/min
	Flow-rate value tolerance	FS±3%
	Speed of response	5 sec or less at maximum
	Controlled condition	0.2 L/sec at maximum
	Delay time	Standard of 1 sec
	Control system	Sampled-data control system
Display panel	LCD display	Flow rate: Three-digit lighting/ Target value: Three-digit blinking display/ Flow display: Three-point scroll
	LED display	Green lighting (A flow rate is within its target value.) Yellow lighting (A flow rate has not reached its target.)
	Operation switch	Selector switch between flow rate and target value
	Target value setting	One set of variable resistor
Optional operation	Controlled condition adjustment, delay time adjustment, control ON/OFF, INT/EXT switching, valve opening and closing	
Interface	FLOW (flow rate), a (a output) REF (target value), b (b output) CONT (control), COM (common) SHUT (fully closed) POW (power), GND (earth)	Connect a cable to user equipment with a 9-core cable.

Note) 3

Note) 1 Never set the serial number surface as a bottom face.

Note) 2 Adaptors made of SUS304/316 are available as an option.

Note) 3 As FS (full scale) has 30 L/min, there is a tolerance of ±3% (±0.9 L/min) at the maximum.

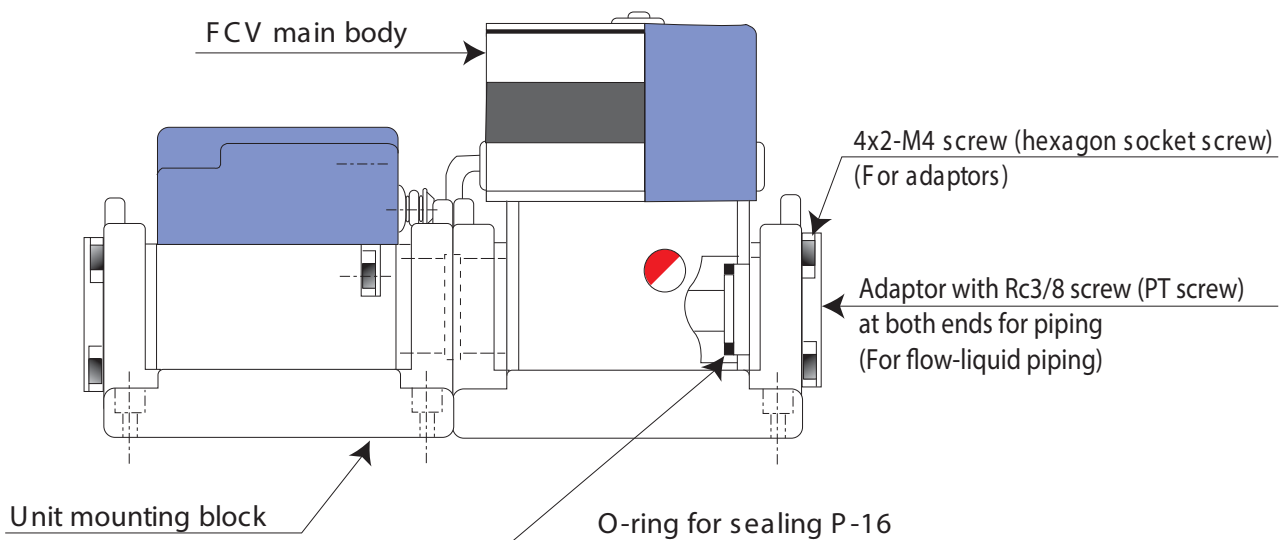
[Dis mounting of FCV main body]

- (1) Turn OFF the power and remove the joints for wiring.
- (2) Loosen four M4 screws for the adaptor (hexagon socket screw of M4×8) with a 3-mm hexagon screwdriver or a hexagon-bar wrench, and remove the adaptor.
- (3) Shift the FCV main body to the adaptor side removed in (2) section.
- (4) A gap is made between the adaptor and the FCV main body, and you can pull the main body toward the upper side of the mounting block or your side. At that time, be fully careful not to lose the O-rings on the both sides.
- (5) Mounting is made in the reverse procedures of removal. Always attach the O-rings on the both sides.

[Warning]

- Keep in mind that mounting without inserting an O-ring may result in water leakage.
- When handling water and industrial water, if you notice dirt of water is remarkable, you need to equip piping with a filter. Neglecting this instruction may cause refuse accumulation at a fluid detecting section, resulting in failure of a sensor.
(According to consultations, our company can prepare a filter.)
- Avoid the use of air when you discharge water from piping. Neglecting this instruction may result in failure of a sensor.

* Feel free to contact us when you have questions on maintenance.
Our company cannot take any responsibility when it is found a failure due to arbitrary overhaul or dis assembly.



Storage methods

- When storing our product, you need to store it at places which satisfy the conditions described below.
 - Places not exposed to rain and water
 - Places not exposed to direct sunlight
 - Places with no dusts
 - Places with no vibrations or impacts
 - Places with measures against static electricity taken
 - Places under air-conditioning control at the ambient temperature range of 0-40 [°C] (with no dew and freezing)
- * Make storage in the packing status at shipping from our company.

Warranty and disclaimers

- Our company cannot take any responsibility about any accidents occurred due to a wrong or improper use.
 - The warranty period of our product is one year from the date of delivery.
 - When our company approves in written form that our company is responsible for defects in performance or materials within the warranty period, our company will offer a substitute. Here, the warranty range of this is limited to our product units. However, the scope of warranty shall not cover losses, harms, injuries, or damages including others directly or indirectly caused by failures in the product.
 - After providing a substitute product in advance responding to your request, if a subsequent cause investigation of a defect proves that our company is not responsible for it, you shall be liable for the cost of the substitute.
- * Basically, a substitute product will be the same one as this product, but an equivalent product may be used for the convenience of our manufacturing.
- * The followings are defect examples outside the scope of our responsibility.
 - Use of this product for those other than the contents described in the instruction manual (latest version)
 - Carelessness in use
 - Disassembly/remodeling of the product

Instruction manual

- The partial or total duplication of this document without prior consent from our company is strictly prohibited.
- The contents of this document are subject to change without notice for property improvement. Refer to the latest version when using the product.
- Operation outline, specifications or others described in this instruction are for explaining standard operation and property of this product. Therefore, when using this product, you need to carry out a proper physical design under the optimal working conditions after taking external various conditions into consideration.
- This document is drawn up under strict quality control standards. Should you notice any errors or description lacking, feel free to contact us about them.

- * Shapes and specifications are subject to change without notice for performance improvement.

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The 9th edition October, 2011