No.PS※※-OMZ1003-D

Operation Manual

PRODUCT NAME

Flow Controller for Air
(IO-Link compatible)

MODEL / Series / Product Number

IN502-44-#
IN502-45-#
IN502-46-#

SMC Corporation

Table of Contents

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

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, fuel 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

We develop, design, and manufacture our products to be used for automatic control equipment, and provide them for peaceful use in manufacturing industries.
Use in non-manufacturing industries is not covered.
Products we manufacture and sell cannot be used for the purpose of transactions or certification specified in the Measurement Act.
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 changing the printed circuit board) or repair.
An injury or failure can result.

■Do not operate the product outside of the specifications.
Do not use for flammable or harmful fluids.
Fire, malfunction, or damage to the product can result.
Verify the specifications before use.

■Do not operate in an atmosphere containing flammable or explosive gases.
Fire or an explosion can result.
This product is not designed to be explosion proof.

■Do not use the product in a place where static electricity is a problem.
Otherwise it can cause failure or malfunction of the system.

■If using the product in an interlocking circuit:
- •Provide a double interlocking system, for example a mechanical system
- •Check the product regularly for proper operation

Otherwise malfunction can result, causing an accident.

■The following instructions must be followed during maintenance:
- •Turn off the power supply
- •Stop the air supply, exhaust the residual pressure and verify that the air is released before performing maintenance

Otherwise an injury can result.

⚠Caution

■Do not touch the terminals and connectors while the power is on.
Otherwise electric shock, malfunction or damage to the product can result.

■After maintenance is complete, perform appropriate functional inspections and leak tests.
Stop operation if the equipment does not function properly 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 under leaking conditions.
Safety cannot be assured in the case of unexpected malfunction.

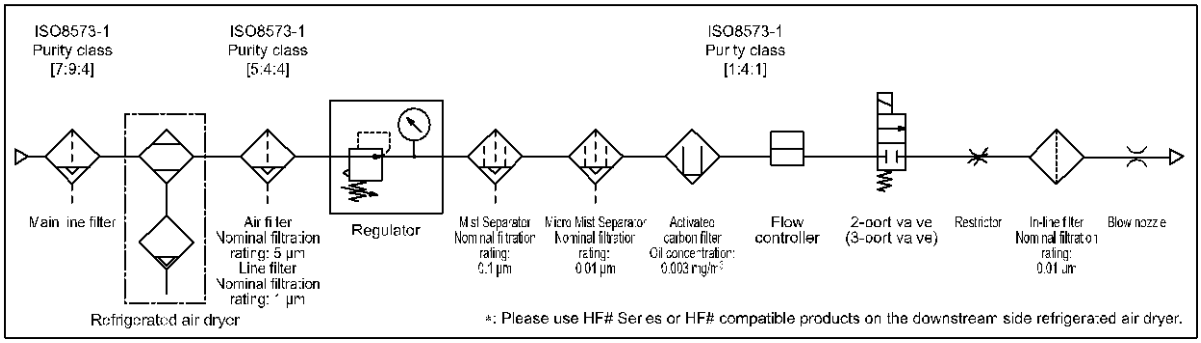
■NOTE

○Follow the instructions given below when designing, selecting and handling the product.

⚠Caution

1. When selecting equipment, carefully consider the application, required specifications, and operating conditions (fluid, pressure, flow rate, filtration, and environment), making sure not to exceed the specification range.
2. This product is provided for normally typical forms of use in the manufacturing industry. As such, to use the product for applications that may affect the human body directly or indirectly such as caisson shield is not foreseen.
3. When the product is used as an air blower for food, install an appropriate filter to eliminate foreign matter in compressed air for air blowing. (Refer to the following example of pneumatic circuit).

Pneumatic equipment circuit of air blower for food application (example)



4. Quality management relating to hygiene for food and medical treatment is not implemented for the product. The product is produced in same line that manufactures other product which uses other materials. In rare cases, some of these materials can be found as a residue.
5. Food grease used
   •Fluid contact parts: NSF H1 grade grease
   •Part other than fluid contact parts: NSF H1 grade grease or grease which is not NSF H1 grade
6. The grease used in the solenoid valves built into the product is not food grease.
   Grease may drain out of the product from the solenoid valve EXH. If necessary, pipe it to the outside of the area.
7. The product generates particles from the wear of sliding parts inside. When the product is used as an air blower, install an appropriate filter on the outlet of the product to prevent foreign matter from flowing to the downstream. Filters require regular inspection, replacement of the element, and maintenance referring to the operation manual.
8. Flush the piping line before using the product for the first time and after it has been replaced. Also, if piping, etc., is to be connected, flush (air blow) before using the product for the first time in order to reduce the effects of the dust generated from the connection, etc. Flushing the line is also required to eliminate contamination resulting from the installation of piping lines. Therefore, be sure to flush the line before running the system.

●The instructions on design and selection (installation, wiring, environment, adjustment, operation, maintenance, etc.) described below must also be followed.

∗Product specifications

•The power is supplied from the circuit reinforced or double-insulated from MAINS.

•The direct current power supply used should be UL approved as follows.
UL1310 Class 2 power supply unit or UL61010-1 LIM (Limited Energy Circuit).

•All external circuits should also be connected to a circuit that is reinforced or double-insulated from the MAINS and free from risk of electric shock and fire hazard.

•If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

•Use the specified voltage.
Otherwise failure or malfunction can result.
Insufficient supply voltage may not drive the load due to a voltage drop inside the product.

•Do not exceed the specified maximum allowable load.
Otherwise it can cause damage or shorten the lifetime of the product.

•Design the product to prevent reverse current when the circuit is opened or the product is forced to operate for operational check.
Reverse current can cause malfunction or damage to the product.

•Input data to the product is not deleted, even if the power supply is cut off.
(Writing time: 10,000 times, Data duration: 20 years after power off)

•The applicable fluids for this product are dry air and N_2.
The operating fluid temperature range is 0 to 50 ºC.

•For the details of compressed air quality, refer to JIS B 8392-1: 2012[2: 6: 3].

•Use within the specified measurement flow rate and operating pressure.
Otherwise it will not be able to perform proper measurement due to delivery delay of the fluid.

•Reserve a space for maintenance.
Allow sufficient space for maintenance when designing the system.

●Product handling

∗Installation

•Tighten to the specified tightening torque.
If the tightening torque is exceeded, the product can be damaged.
Insufficient torque can cause displacement of the product from its proper position and the looseness of the mounting screws.

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

•Do not drop, hit or apply excessive shock to the product.
Otherwise damage to the internal components may result, causing 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 by the body when handling to prevent damage.

•When connecting the piping, hold the piping and a part of the metal area with a spanner.
Holding other parts of the product with a spanner may damage the product.

•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 flow direction of the fluid indicated on the product label for installation and piping.

•Do not mount the body with the bottom facing upwards. Retention of air can cause inability to measure accurately.
The entry of drain or water may cause the sensor to fail or malfunction.

•Do not insert metal wires or other foreign matter into the flow path.
This can damage the sensor causing failure or malfunction.

•Never mount the product in a place that will be used as a scaffold during piping.
The product may be damaged if excessive force is applied by stepping or climbing onto it.

•Visibility decreases if the display is viewed from the opposite side to the buttons.
Check the settings and display from in front of the display.

- This product does not function as a shut off valve. Operate the system to shut off the supply pressure when not operating the product.
- If there is a risk of foreign matter entering the fluid, install a filter of mist separator at the inlet to avoid failure and malfunction.
  Otherwise it can cause damage or malfunction. Or the flow switch will become unable to measure accurately.
- Do not install a lubricator on the inlet side of the product. Otherwise, oil may enter into the product and damage the internal parts.

∗Wiring

- Do not pull hard on the lead wire. Especially never lift the product equipped with fitting and piping by holding the lead wires.
  Otherwise damage to the internal parts can result, causing malfunction or to be off the connector.
- Avoid repeatedly bending or stretching the lead wire, or placing heavy load on them.
  If the lead wire can move, fix it near the body of the product.
  Replace the damaged lead wire with a new one.
- Wire correctly.
  Incorrect wiring can break the product.
- Do not perform wiring while the power is on.
  Otherwise damage to the internal parts can result, causing malfunction.
- Do not route wires and cables together with power or high voltage cables.
  Otherwise the product can malfunction due to interference of noise and surge voltage from power and high voltage cables to the signal line. Route the wires (piping) of the product separately from power or high voltage cables.
- Confirm proper insulation of wiring.
  Poor insulation (interference from another circuit, poor insulation between terminals, etc.) can lead to excess voltage or current being applied to the product, causing damage.
- Design the system to prevent reverse current when the product is forced to operate for operational check.
  Depending on the circuit used, insulation may not be maintained when operation is forced, allowing reverse current to flow, which can cause malfunction and damage the product.
- Keep wiring as short as possible to prevent interference from electromagnetic noise and surge voltage.
  Do not use a cable longer than 20 m.
  Wire the DC(–) line(blue) as close as possible to the power supply.
- When analogue output is used, install a noise filter (line noise filter, ferrite element, etc.) between the switch-mode power supply and the product.

∗Environment

- Do not use the product in area that is exposed to corrosive gases, chemicals, sea water, water or steam.
  Otherwise failure or malfunction can result.
- Do not use the product in an environment where the product is constantly exposed to water or oil splashes.
  If the product is to be used in an environment containing oils or chemicals such as coolant or cleaning solvent, it may be adversely affected (damage, malfunction, or hardening of the lead wires).
- Do not use in an area where surges are generated.
  If there is equipment which generates a large amount of surge (solenoid type lifter, high frequency induction furnace, motor, etc.) close to the product, this may cause deterioration or breakage of the internal circuit of the product. Avoid sources of surge generation and crossed lines.
- Do not use a load which generates surge voltage.
  When a surge-generating load such as a relay or solenoid is driven directly, use a load with a built-in surge suppressor.
- The product is CE/UKCA marked, but not immune to lightning strikes. Take measures against lightning strikes in the system.
- Mount the product in a place that is not exposed to vibration or impact.
  Otherwise failure or malfunction can result.
- Prevent foreign matter such as remnant of wires from entering the product.
  Take proper measures for the remnant not to enter the product in order to prevent failure or malfunction.
- Do not use the product in an environment that is exposed to temperature cycle.
  Heat cycles other than ordinary changes in temperature can adversely affect the inside of the product.

- Do not expose the product to direct sunlight.
  If using in a location directly exposed to sunlight, shade the product from the sunlight.
  Otherwise failure or malfunction can result.
- Keep within the specified ambient temperature range.
  The ambient temperature range is 0 to 50 °C. Operation at low temperature (5 °C or less) may cause damage or operation failure due to frozen moisture in the air.
  Protection against freezing is necessary.
  Avoid sudden temperature change even within specified temperature.
- Do not operate close to a heat source, or in a location exposed to radiant heat.
  Otherwise malfunction can result.
- Use an altitude of 3,000 m or less.
- Use an environment with a pollution level of 3 or less.

∗Adjustment and Operation

- Turn the power on after connecting a load.
  Otherwise it can cause excess current causing instantaneous breakage of the product.
- Do not short-circuit the load.
  Although error is displayed when the load at the output part has a short circuit, generated over current may lead to the damage of the product.
- Do not press the setting buttons with a sharp pointed object.
  It may damage the setting buttons.
- If using the product to detect very small pressure rates, Warm up the product for 10 to 15 minutes first.
  The controlled flow rate/analogue output may fluctuate by 2 to 3% for 10 minutes after the power supply is turned on.
- Perform settings suitable for the operating conditions.
  Incorrect setting can cause operation failure.
  For details of each setting, refer to page 20 to 51 of this manual.
- Do not touch the LCD during operation.
  The display can vary due to static electricity.

∗Maintenance

- Turn OFF the power supply before maintenance.
  There is a risk of unexpected malfunction.
- Perform regular maintenance and inspections.
  There is a risk of unexpected malfunction.
- Do not use solvents such as benzene, thinner etc. to clean the product.
  They could damage the surface of the body and erase the markings on the body.
  Use a soft cloth to remove stains. For heavy stains, use a cloth soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

Model Indication and How to Order

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Grease

Symbol	Content
Nil	Grease compatible with low dew points
A	White vaseline
B	Food grease

Specification

Symbol	I/O Specification	Unit specification	Behaviour when the power is cut off *4
5	Analogue voltage I/O *1*2 + IO-Link/SW output	SI unit only	No flow
6		Units selection function	
7	Analogue current I/O + IO-Link/SW output	SI unit only	
8		Units selection function	
13	Analogue voltage I/O *1*2 + IO-Link/SW output	SI unit only	Flow rate kept unchanged
14		Units selection function	
15	Analogue current I/O + IO-Link/SW output	SI unit only	
16		Units selection function	

Rated flow range

Symbol	Content
44	50 to 500 L/min
45	100 to 1000 L/min
46	200 to 2000 L/min

*1: An analogue voltage input 0 to 5 V or 0 to 10 V can be specified by pressing the button.
The factory default setting is 0 to 5 V.
*2: An analogue voltage output 1 to 5 V or 0 to 10 V can be specified by pressing the button.
The factory default setting is 1 to 5 V.
*3: Analogue input cannot be used in the IO-Link mode.
*4: The behaviour of the product when the power is turned off during flow rate control can be selected by reference to the selected product number. Note that "no flow" models do not guarantee that they function as shut off valves. "Flow rate kept unchanged" models do not guarantee that they keep flow rates unchanged.
*5: A lead wire with M12 connector is not included. Order separately.

○Accessories/part numbers

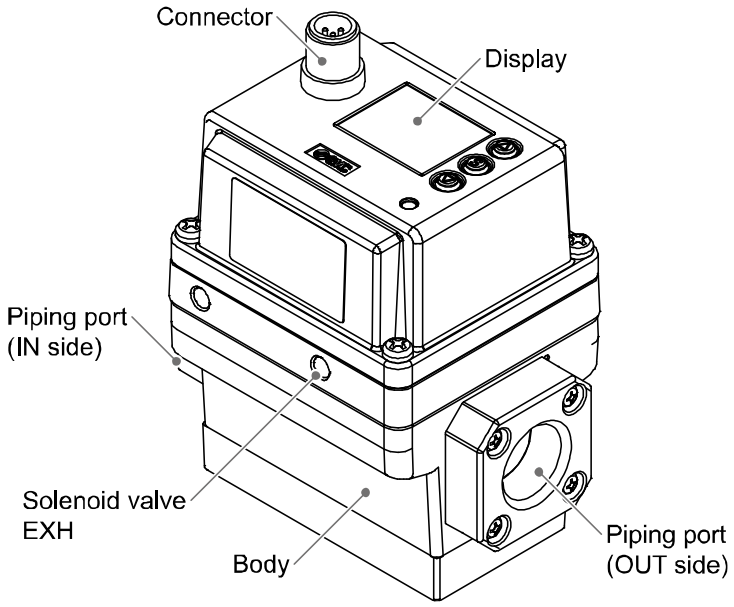
Description	Part no.	Note
Lead wire with M12 connector (Separate line on one side)	EX500-AP010-A	1 metre long, elbow union
	EX500-AP010-S	1 metre long, straight union
	EX500-AP050-A	5 metre long, elbow union
	EX500-AP050-S	5 metre long, straight union
Lead wire with M12 connector (Connector on both sides)	EX9-AC005-SSPS	0.5 metre long, straight union
	EX9-AC010-SSPS	1 metre long, straight union
	EX9-AC020-SSPS	2 metre long, straight union
	EX9-AC030-SSPS	3 metre long, straight union
	EX9-AC050-SSPS	5 metre long, straight union
	EX9-AC100-SSPS	10 metre long, straight union
Bracket A	ZS-56-A	With 4 cross recessed round head screws (M5×10L)
Bracket B	ZS-56-B	With 4 cross recessed round head screws (M5×10L)

*: Accessories is not included. Order separately. Refer to page 85 to 89 for further details.

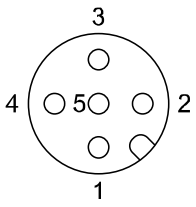
Names and Functions of Product Parts

○Parts names

•Body



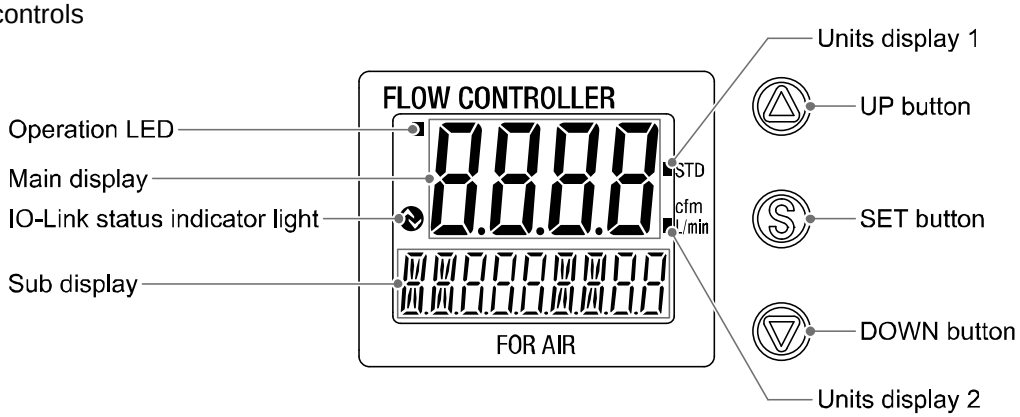
Connector pin numbers
(on the body)



Pin number	Details
1	DC(+)
2	Analogue input
3	DC(-)
4	OUT1 (SW output, C/Q)
5	Analogue output

Connector: Connect a lead wire with M12 connector.
Display: See the diagram below.
Piping port: Port for connecting to piping (Rc 1/2). IN represents "inlet" and OUT represents "outlet."
Solenoid valve EXH: Exhaust port (M5 female thread) for the internal solenoid valve. Do not block the exhaust.

•Display/controls



Operation LED (orange): Turns ON when OUT is ON
Main display (red/green): Displays the current controlled flow, setting mode status, selected display units and error codes.
UP button: Selects the mode and increases the ON/OFF set value.
DOWN button: Changes the sub display, selects the mode and decreases the ON/OFF set value.
SET button: Press this button to change mode and to confirm settings.
Units display 1 (red/green): Reference condition: Turns on when STD is selected.
Units display 2 (red/green): The selected flow rate unit lights up.
For models without the units selection function, the unit is fixed to the SI unit (L/min).
Sub display (left) (orange): Displays a display item label.
Sub display (orange): Displays a display item, setting value, peak/bottom value, etc.
IO-Link status indicator light: Displays OUT1 output communication status (SIO mode, start-up mode, Pre-operation mode, operation mode) and presence of communication data.

●IO-Link indicator light operation and display

Communication with master	IO-Link status indicator light	Status			Sub screen display *1	Content
Yes	☀	IO-Link mode	Correct	Operate	ModE oPE	Normal communication status (Reading of measurement value, command) ∗: Output process data valid
					ModE idLE	Normal communication status (Reading of measurement value) ∗: Output process data invalid
	◪			Start up	ModE StrT	When communication starts up.
				Preoperate	ModE PrE	
			Abnormal	Version does not match	Er 15 V 1.0	Version of master and IO-Link does not match *2
				Lock	ModE LoC	Back-up and re-store required due to data storage lock
No				Communication shut-off	ModE StrT ModE PrE ModE oPE	Correct communication was not received for 1 second or more.
	○	SIO mode			ModE SIO	General switch output

LCD display: "○" OFF, "◪" Flashing, "☀" ON

∗1: "ModE - - -" is displayed when selecting the modes on the sub screen.

∗2: When the product is connected to the master with version "V1.0", error Er15 is generated.

■Definition and terminology

	Term	Definition
A	Analogue output	Function to output a voltage or current proportional to the indicated flow rate.
B	Bottom value display (mode)	The minimum flow recorded from when the power was supplied to the present time.
C	Chattering	Phenomenon of the switch output turning ON and OFF repeatedly at high frequencies.
	Commanded flow rate	Target controlled flow rate obtained from input signals.
	Control accuracy	Accuracy of the controlled flow rate in relation to the commanded flow rate.
D	Delay time	Setting time from when the controlled flow rate reaches the set value, to when the ON-OFF output actually begins operating. Delay time setting can prevent the output from chattering.
	Display colour	Indicates the colour of digits on the digital display. Always green, always red, green (switch OFF) changing to red (switch ON), or red (switch OFF) changing to green (switch ON) are available in window comparator mode.
E	Error indication	A code number displayed to identify the error code detected by the self-diagnostic function of the product. Refer to "Error display function" on page 75 for details of error codes.
	Error output	Switches the switch output to ON/OFF when an error is displayed. Refer to "List of output modes" on page 29 for details of operating conditions. Refer to "Error display function" on page 75 for details of error codes.
F	F.S. (full span, full scale)	Abbreviation of full span or full scale: the difference between the minimum and maximum rated flow values. In other words, the maximum rated fluctuation range of the product. For example, when analogue output is 1 to 5 V, F.S. = 5[V] – 1[V] = 4[V]. (Reference: 1% F.S. = 4[V] x 1% = 0.04[V])
	Fluid temperature range	Range of fluid temperature in which a fluid is suitable for the product.
	Function selection mode	A mode in which setting of functions is performed. It is a separate menu from the pressure setting. If any function setting needs to be changed from the factory default, each setting can be selected using "F∗". The setting items are: display colour, operation mode, output type, power saving mode, security code, etc.
I	Instantaneous flow	The flow passing per unit of time. If it is 10 L/min, there is a flow of 10 L passing through the device in 1 minute.
	Insulation resistance	Insulation resistance of the product. The resistance between the electrical circuit and the enclosure.
K	Key-lock function	Function that prevents changes to the settings of the product (disables button operation).
L	Limit deviation tolerance mode	Mode of output that maintains the switch output level when the controlled flow is within a certain range of the commanded flow rate. Refer to "List of output modes" on page 29 for details of operating conditions.

	Term	Definition
M	Maximum applied voltage	Maximum voltage that can be connected to the output of an NPN device.
	Maximum load current	The maximum current that can flow to the switch output (output line).
	Maximum (minimum) load impedance	Maximum or minimum load (resistance or impedance) that can be applied to the output (output line) of the analogue current output.
	Measurement mode	Operating condition in which flow rate control, display, and switching operations take place.
	Minimum unit	Resolution of indicated values and input signals.
N	Normal condition	Flow rate which is converted into the volume at 0°C and 101.3 kPa (absolute pressure) and displayed. [nor] indicates that the product is in normal condition
	Normal output	One of the switch output types, in which the switch is turned ON when a controlled flow rate is detected within the set limit deviation tolerance range. (Refer to the List of output modes on page 29)
O	Operation LED	A light that turns ON when the switch output is ON.
	Operation mode	Limit deviation tolerance mode or error output mode can be selected.
	Output impedance	Resistance value of components between the voltage output element and output line residing in the output section of the analogue voltage output, which is indicated after a conversion into a resistance value with a resistor connected in series to the voltage output element. An error may occur in the output voltage depending on the output and input impedance of the customer's connected device. (Example: An attempt to output a 5 V analogue output by connecting a pressure switch with 1 kΩ output impedance to an A/D converter with 1 MΩ input impedance results in an approximately 0.005 V error because the detection voltage of that A/D converter is 5(V) x 1(MΩ) / (1(kΩ) + 1(MΩ)) ≒ 4.995(V).
	Output type	The working principle of the switch output. Normal output and reverse output can be selected. Refer to "List of output modes" on page 29 for details of operating conditions.
P	Parts in contact with fluid (or fluid contact parts)	Parts of the product that are in contact with the fluid to be detected.
	Peak value display (mode)	The maximum flow rate recorded from when the power was supplied to the present time.
	Power saving mode	Operating mode in which the digital display turns off to reduce the power consumption.
	Pressure characteristics	Indicates the change in the controlled flow rate due to fluid pressure changes.
R	Rated controlled flow range	Controlled flow range within which the product will meet all published specifications.
	Repeatability	Repeatability of the controlled flow rate, when the measured flow quantity is repeatedly increased and decreased in the same operating environment.
	Residual voltage	The difference between the ideal ON voltage and the actual voltage when the switch output is on. Varies with load current. Ideally should be 0 V.
	Reverse output	One of the switch output types, in which the switch is turned ON when a controlled flow rate outside the set limit deviation tolerance range is detected. (Refer to the List of output modes on page 29)
	Ripple	A type of chattering.

	Term	Definition
S	Set controlled flow rate range	Controlled flow rate range in which the product can be controlled.
	Settling time	Time for the controlled flow rate to reach within ±5% F.S. of the commanded flow rate value in relation to the step input.
	Standard condition	The flow rate which is converted into the volume at 20°C and 101.3 kPa (absolute pressure) and displayed. [Std] indicates that the product is in standard condition.
	Switch output	Sometimes referred to as "ON-OFF output".
T	Temperature characteristics	Indicates the change in the controlled flow rate due to ambient or fluid temperature changes.
U	Units selection function	A function to select display units other than the international unit (SI unit) specified in the new Japanese measurement law. The product for use in Japan is not equipped with this function.
W	Withstand pressure	Pressure limit that if exceeded will result in mechanical and/or electrical damage to the product.
	Withstand voltage	A measure of the product's resistance to a voltage applied between the electrical circuit and the case. Durability in withstanding voltage. The product may be damaged if a voltage over this value is applied. (The withstand voltage is not the supply voltage used to power the product).
Z	Zero-clear function	Function to adjust the indicated pressure to zero.

Mounting and Installation

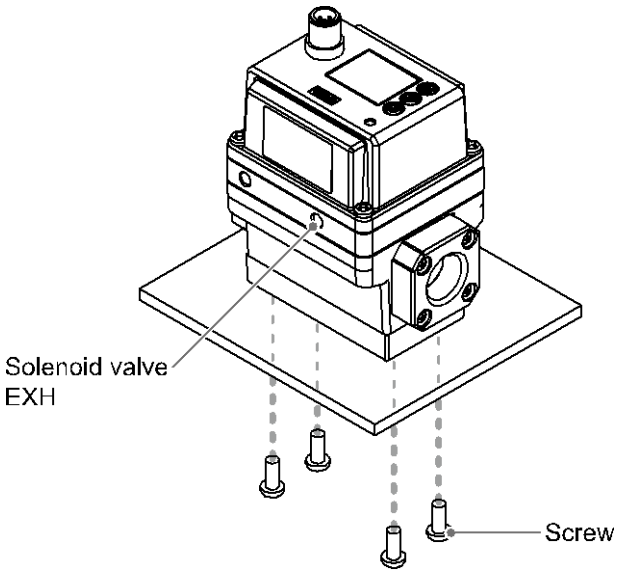
Mounting

•Never mount the product in a place that will be used as a foothold.
•Never mount the product upside down.
•Mount the product so that the fluid flows in the direction indicated by the name plate on the side of the body.

•If the EXH port of the solenoid valve may be exposed to water or dust, connect a fitting and tube (sold separately) and route the tube to a safe place where it will not be affected by water or dust.

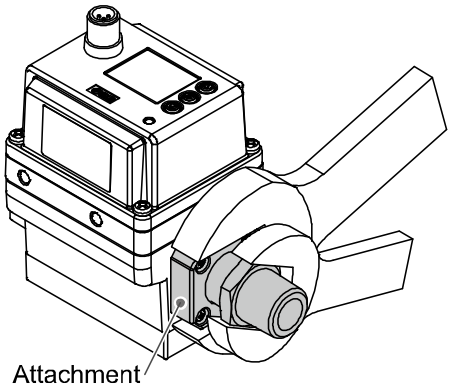
■Installation

•Install the product using 4 screws suitable for the product, according to the required tightening torque.
Suitable screw: M5, Tightening torque: 3 N•m ±10%
•Screws should be prepared by the user.
•Refer to the dimension drawing (page 84) for the diameter and depth of the mounting screw holes.



■Piping

•Use the correct tightening torque: 20 to 25 N•m
•If the tightening torque is exceeded, the product can be damaged.
•If the tightening torque is insufficient, the connection threads and brackets may become loose.
•Avoid any sealing tape getting inside the flow path.
•Confirm that there is no leakage after piping.
•When attaching a fitting, the attachment to attach the fitting should be held with a wrench.
Holding other parts with a wrench may damage the product.



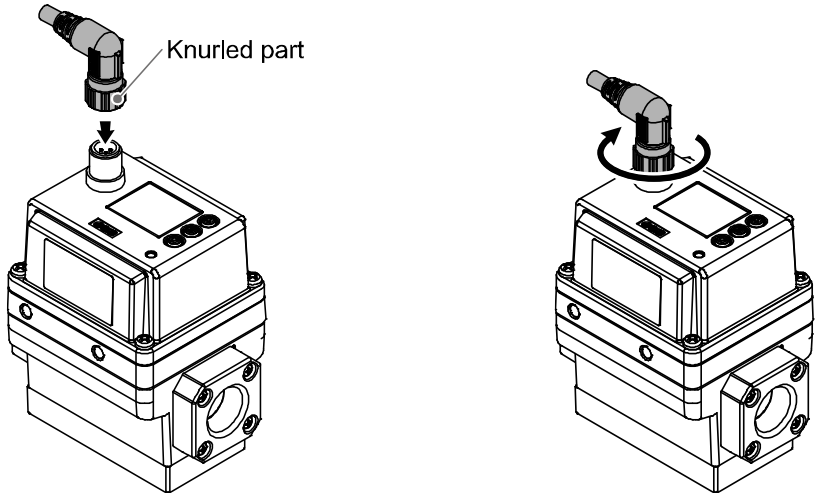
■Wiring

○Wiring connections

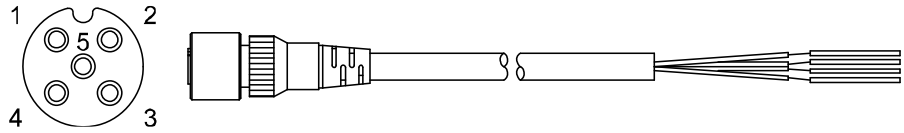
- •Connections should only be made with the power supply turned off.
- •Use a separate route for the product wiring. If wires and cables are routed together with power or high voltage cables, malfunction may result due to noise.
- •If a commercially available switching power supply is used, be sure to ground the frame ground (FG) terminal. If a switch-mode power supply is connected for use, switching noise will be superimposed and it will not be able to meet the product specifications. In that case, insert a noise filter such as a line noise filter/ferrite between the switching power supplies, or change the switching power supply to a series power supply.

○Plugging and unplugging of the connector

- •Align the lead wire connector with the connector key groove on the controller, and insert it straight in. Turn the knurled part clockwise. Connection is complete when the knurled part is fully tightened. Check that the connection is not loose.
- •To unplug the connector, loosen the knurled part and pull it straight out.



Connector pin numbers (lead wire)



•Used as switch output device

Pin number	Colour	Details	Function
1	Brown	DC(+)	24 VDC
2	White	Analogue input	Analogue voltage/current input
3	Blue	DC(-)	0 V
4	Black	OUT1	Switch output
5	Grey	Analogue output	Analogue voltage/current output

•Used as IO-Link device

Pin number	Colour	Details	Function
1	Brown	L(+)	24 VDC
2	White	N.C.	(Analogue voltage/current input)
3	Blue	L(-)	0 V
4	Black	C/Q	IO-Link communication
5	Grey	N.C./Analogue output	Analogue voltage/current output

∗: Do not connect pins 2 and 5 to the IO-Link master.

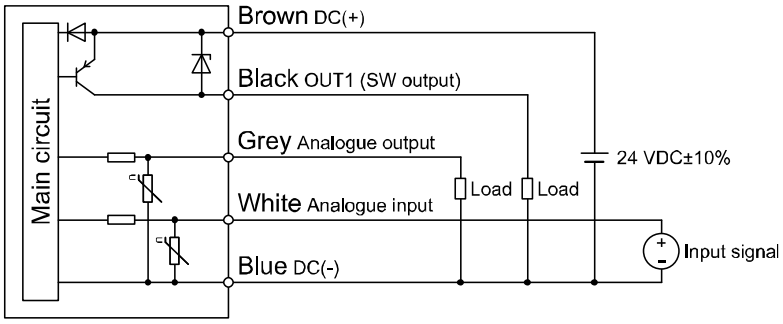
■Internal circuit and wiring examples

○Output specifications

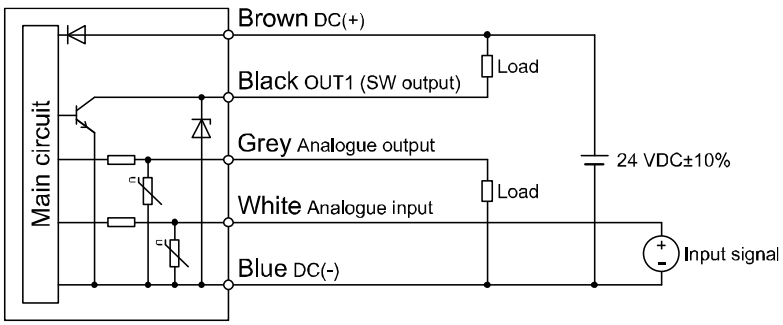
The colours of the wires shown in the circuit diagram (brown, blue, black, white, and grey) apply when the SMC lead wire with M12 connector (product number: EX500-AP###-#) is used.

•Used as switch output device

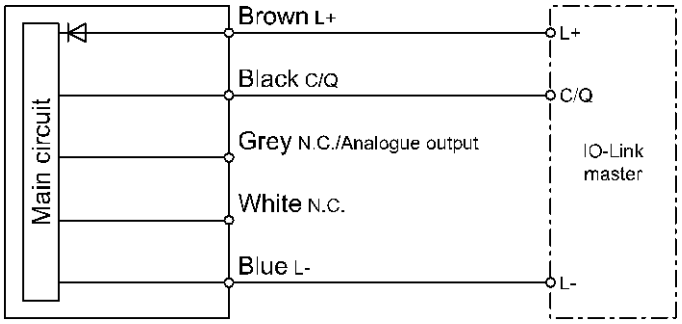
When PNP open collector is selected
Max. 80 mA
Residual voltage: 1.5 V or less
Analogue voltage input/output type: Analogue input: 0 to 5 V (0 to 10 V) input
Input impedance: approx. 1 MΩ
Analogue output: 1 to 5 V (0 to 10 V) output
Output impedance: approx. 1 kΩ
Analogue current input/output type: Analogue input: 4 to 20 mA input
Input impedance: approx. 50 Ω
Analogue output: 4 to 20 mA output
Max. load impedance: 600 Ω
Min. load impedance: 50 Ω



When NPN open collector is selected
Max. 30 V, 80 mA
Residual voltage: 1.5 V or less
Analogue voltage input/output type: Analogue input: 0 to 5 V (0 to 10 V) input
Input impedance: approx. 1 MΩ
Analogue output: 1 to 5 V (0 to 10 V) output
Output impedance: approx. 1 kΩ
Analogue current input/output type: Analogue input: 4 to 20 mA input
Input impedance: approx. 50 Ω
Analogue output: 4 to 20 mA output
Max. load impedance: 600 Ω
Min. load impedance: 50 Ω



•Used as IO-Link device



Outline of Settings

Power is supplied

↓

The product code is displayed for approximately 3 sec. after power is supplied. Then, measurement mode is displayed.
∗: The switch operation starts within approximately 0.2 seconds after power is supplied.

↓

[Initial Settings]

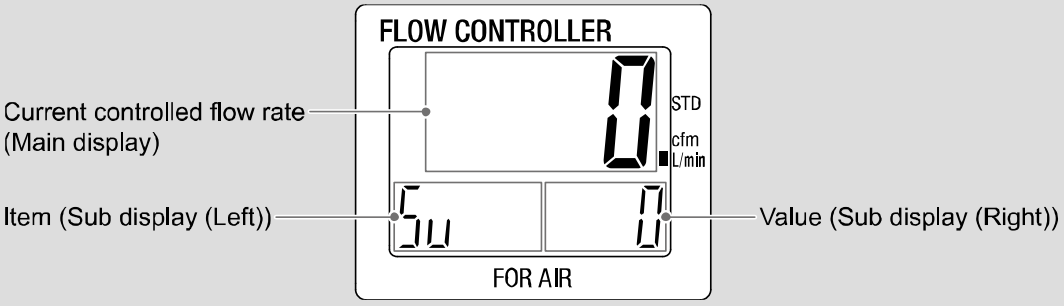
(Refer to page 22)
Set the reference condition, flow rate display unit, pressure display unit, switch output PNP/NPN switch and IO-Link communication.

↓

[Measurement mode]

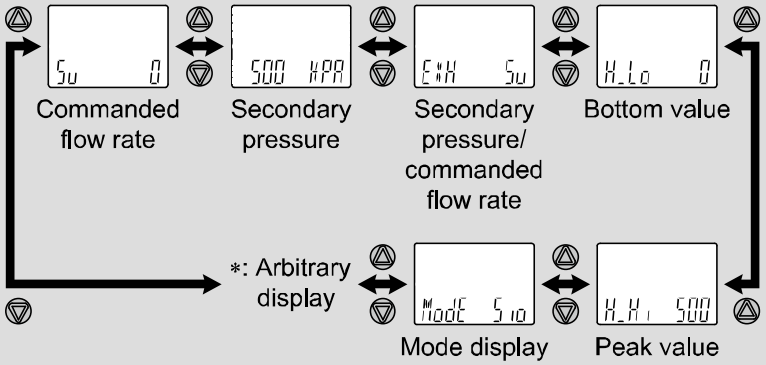
In this mode, flow rate control and display and switch operations are performed in accordance with commanded flow rates.
This is the basic mode; other modes should be selected for set-point changes and other function settings.

Measurement mode screen



Sub display

In measurement mode, the content of the sub display can be switched by pressing the UP or DOWN button.



*: An arbitrary display method can be added using [F10] Sub display settings.

Press the SET button for at least 1 second but no more than 3 seconds.

[Function Selection Mode]
The settings of each function can be changed.
(Refer to page 24)

[Other Settings]
•Zero-clear
•Key-lock
(Refer to page 49)

*: Output continues during setting.
*: If a button operation is not performed for a set period of time during setting, the display will flash. (This is to prevent the setting from remaining incomplete if, for instance, an operator were to leave during setting.)

Zero-clear of the secondary pressure value
When the secondary side is released to the atmosphere and the displayed secondary pressure value is not zero, perform zero-clear.
Refer to page 49 for details of this operation.

Initial Settings

Configure the reference condition, flow rate display unit, pressure display unit, switch output PNP/NPN switch and IO-Link communication.

Reference condition
Standard condition or normal condition can be selected for the standard reference condition of flow rate.
Standard condition and Normal reference condition are defined as follows:
•Standard condition: flow rate converted into volume at 20 °C and 101.3 kPa (absolute pressure)
•Normal condition: flow rate converted into volume at 0 °C and 101.3 kPa (absolute pressure)

Units selection function
The flow rate display units selection function allows for selecting L/min or cfm (ft^3/min) as the standard unit.
The pressure units selection function allows for selecting kPa, MPa, kgf/cm^2, bar, or psi as the standard unit.
This setting is only available for models with the units selection function.

Switch output type
The switch output function can be toggled between PNP and NPN output.

Measurement mode

↓ Press the SET button <u>for at least 1 second but no more than 3 seconds</u>.

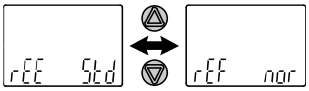
[F 0] Display the reference condition, flow rate display unit, pressure display unit, switch output PNP/NPN switch and IO-Link communication.

Press the SET button. ↓ Move on to reference condition setting.

Reference condition setting

Standard condition or normal condition can be selected as the reference condition.

Press the UP or DOWN button to select a reference condition.

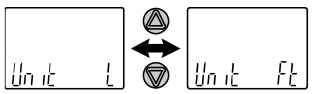


Standard condition　　Normal condition

Press the SET button. ↓ Move on to flow rate display unit setting.

Flow rate display unit setting

Press the UP or DOWN button to select a flow rate unit.



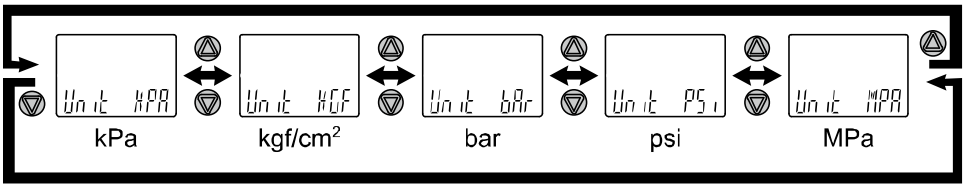
L/min　　cfm (ft^3/min)

∗: Only L can be selected if the product does not have the units selection function.

Press the SET button. ↓ Move on to pressure display unit setting.

Pressure display unit setting

Press the UP or DOWN button to select a pressure unit.



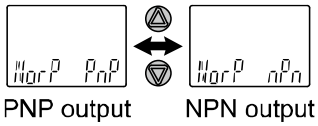
∗: kPa or MPa can be selected even if the product does not have the unit conversion function.

Press the SET button. Move on to switch output PNP/NPN switch.

Switch output PNP/NPN switch

The switch output of this product can be toggled between PNP and NPN output depending on the customer's device configuration.

Press the UP or DOWN button to select a switch output specification.

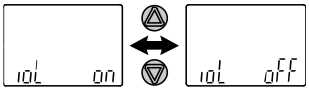


Press the SET button. Move on to IO-Link communication setting.

IO-Link communication setting

If the IO-Link function is not used, it can be switched to disabled.

Press the UP or DOWN button to select an IO-Link specification.



Press the SET button. Return to function selection mode.

[F 0] Setting of the reference condition, flow rate display unit, pressure display unit, switch output PNP/NPN switch and IO-Link communication completed

Press the SET button for 2 seconds or longer.

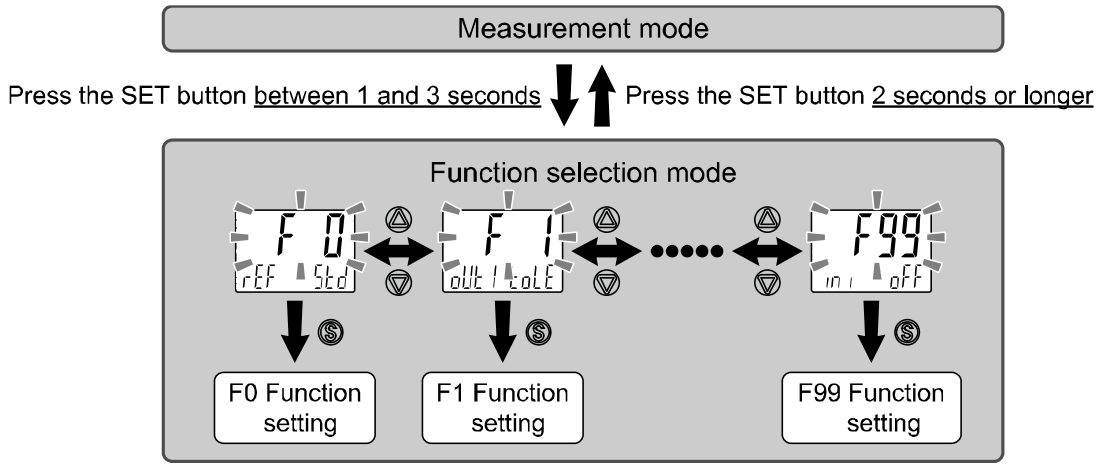
Measurement mode
(Initial setting completed)

Make settings from function selection mode.

Function Selection Mode

■Function selection mode

In measurement mode, press the SET button for at least 1 second but no more than 3 seconds to display [F 0].
The mode in which [F□□] is displayed and changes to the respective function settings are made is referred to as function selection mode.
In function selection mode, press the SET button for 2 seconds or longer to return to measurement mode.



∗: Some functions are not supported on models with specific product numbers. [---] will be displayed on the sub display (right) for functions that are not supported or cannot be selected due to other settings.

■Default setting

The factory default settings are as follows.
If these settings are acceptable, retain for use.
To change a setting, enter function selection mode.

●[F 0] Reference condition, flow rate display unit, pressure display unit, switch output PNP/NPN switch and IO-Link communication ➡ Page 26

Item	Default setting
Reference condition	Standard condition
Flow rate display unit	L/min
Pressure display unit	kPa
Switch output PNP/NPN switch	PNP
IO-Link communication	ON

●[F 1] Setting of OUT1 ➡ Page 27

Item	Description	Default setting
Output mode	Limit deviation tolerance mode, error output mode, or switch output off can be selected.	Limit deviation tolerance mode
Reverse output	Selects which type of switch output is used, normal or reverse.	Normal output
Limit deviation tolerance setting	Switches switch output on or off when the measured flow rate is within the set limit deviation tolerance of commanded flow rate.	±2% F.S.
ON delay time	Delay time (rising) of the switch output can be selected.	0.00 sec.
OFF delay time	Delay time of (falling) the switch output can be selected.	0.00 sec.
Display colour	Select a display colour.	Output ON: Green Output OFF: Red

●Other setting items

Item	Page	Default setting
[F10] Sub display setting	Page 30	dEF (standard)
[F14] Zero cut-off setting	Page 32	5.0% F.S.
[F21] Analogue input setting	Page 33	Voltage input: 0 to 5 V Current input: No configurable items
[F22] Analogue output setting	Page 34	Voltage output: 1 to 5 V Current input: No configurable items
[F32] Control parameter setting	Page 35	0.000
[F33] Output process data setting in the event of abnormal communication	Page 36	Output process data: 0
[F80] Power saving mode setting	Page 37	OFF
[F81] Security code	Page 38	OFF
[F90] Setting of all functions	Page 40	OFF
[F96] Input check	Page 42	No configurable items
[F98] Output check	Page 43	N/A (normal output)
[F99] Reset to default settings	Page 48	OFF

■[F 0] Setting of the reference condition, flow rate display unit, pressure display unit, switch output PNP/NPN switch and IO-Link communication

Refer to "Initial Settings" (page 22) for details.

○Settings and display specifications related to the units selection function

Flow rate units

Model	Unit	Rated controlled flow range	Set and display controlled flow rate range	Minimum display unit
IN502-44	L/min	50 to 500	25 to 525	1
	cfm	1.8 to 17.7	0.9 to 18.5	0.1
IN502-45	L/min	100 to 1000	50 to 1050	1
	cfm	3.5 to 35.3	1.8 to 37.1	0.1
IN502-46	L/min	200 to 2000	100 to 2100	2
	cfm	7.1 to 70.6	3.5 to 74.2	0.1

Pressure units

Unit	Displayable range	Minimum display unit
kPa	-50 to 1050	1
MPa	-0.050 to 1.050	0.001
kgf/cm^2	-0.50 to 10.70	0.02
bar	-0.50 to 10.50	0.01
psi	-7.2 to 152.2	0.2

■[F 1] Setting of OUT1

Set the output mode of OUT1.
By factory default, the output is turned on when the measured flow rate is within the ±2% F.S. tolerance of commanded flow rate.
By factory default, the display colour of the main display turns green when the output is on and turns red when the output is off.
Please refer to "List of output modes" on page 29 for details of behaviours associated with setting items.

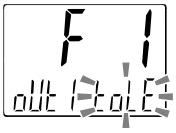
<Operation>

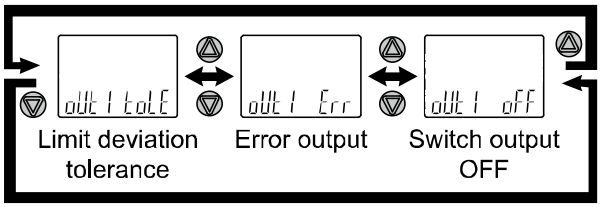
Press UP or DOWN button in function selection mode to display [F 1].

Press the SET button. ⬇ Move on to output mode setting.

Output mode setting

Press the UP or DOWN button to select the desired output mode.

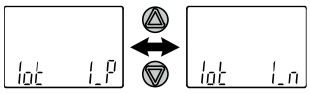




Press the SET button to save the setting. ⬇ Move on to reverse output setting.

Reverse output setting

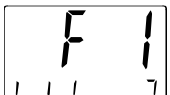
Press the UP or DOWN button to select reverse output.



Press the SET button to save the setting. ⬇ Move on to limit deviation tolerance setting.

Limit deviation tolerance setting

The limit deviation tolerance can be set within the range of the commanded flow rate ±1 to 50% F.S. in increments of 1% F.S.



Press the UP button once to increment the value or press and hold it to continuously increment the value.

Press the DOWN button once to decrement the value or press and hold it to continuously decrement the value.

Press the SET button to save the setting. ⬇ Move on to delay time setting.

[Err] When error output is selected
Press the SET button to move on to display colour setting.

[OFF] When switch output off is selected
Press the SET button to move on to display colour setting.

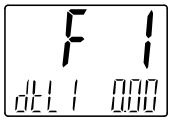
Delay time setting

The delay time can be set within the range of 0.00 to 60.00 s in increments of 0.01 s.

Press the UP button once to increment the value or press and hold it to continuously increment the value.

Press the DOWN button once to decrement the value or press and hold it to continuously decrement the value.

Delay time setting at ON



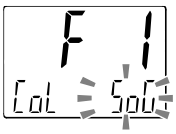
Delay time setting at OFF

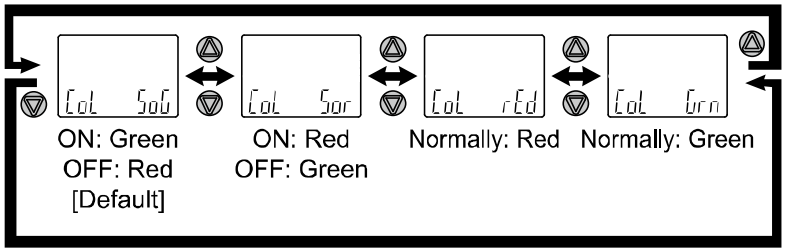
Press the SET button to save the setting.

Move on to display colour setting.

Display colour setting

Press the UP or DOWN button to select a display colour.





ON: Green
OFF: Red
[Default]

ON: Red
OFF: Green

Normally: Red

Normally: Green

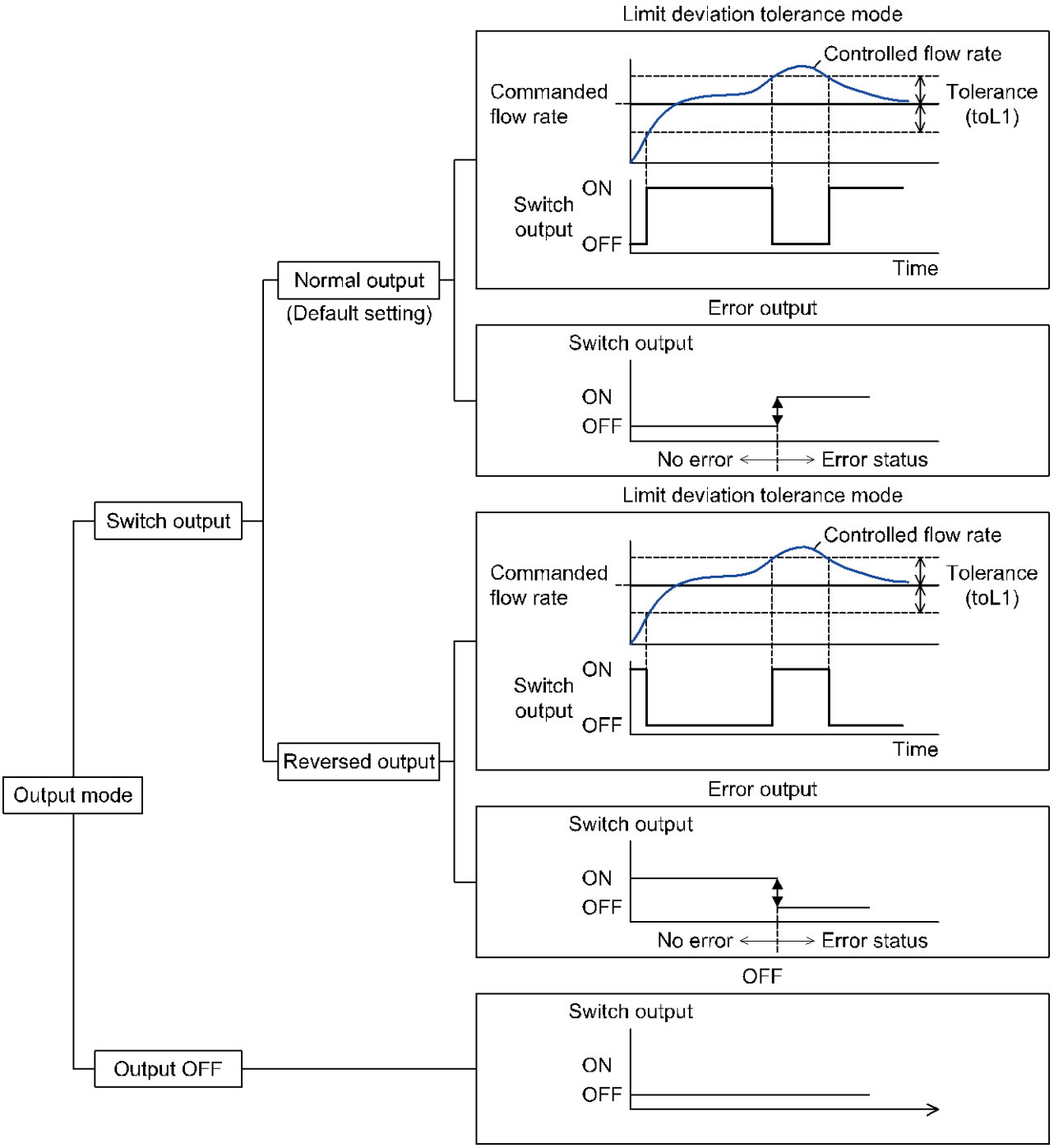
Press the SET button to save the setting. Return to function selection mode.

[F 1] Setting of OUT1 completed

∗1: A selected item is enabled after the SET button is pressed.

∗2: After enabling a setting by pressing the SET button, it is possible to return to measurement mode by pressing the SET button for 2 seconds or longer.

●List of output modes



■[F10] Sub display setting

This function allows for changing the display method of the sub display.
Details of setting values are provided on page 31.

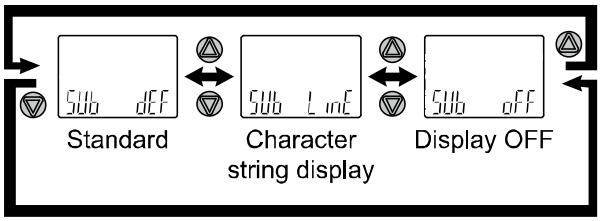
<Operation>

Press the UP or DOWN button in function selection mode to display [F10].

Press the SET button. ↓ Move on to sub display setting

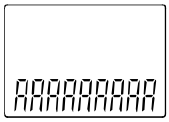
Sub display setting

Press the UP or DOWN button to select a display method of the sub display.



[LinE] When character string display is selected
Press the SET button to move on to line name entry.

Line name entry



Press the UP or DOWN button to input a line name to display on the sub display.
Press the SET button to make the next digit to the right flash and then continue to input a line name.
(If the SET button is pressed at the last digit, the cursor returns to the first digit and the fist digit starts flashing.)

Characters are displayed in this order: A → b → • • • → Y → (Z) → 0 → 1 → • • • → 9 → symbols → space.
(Displayable characters are different in the 1st, 2nd, 6th, and 7th digits from the left.)
Press and hold the UP and DOWN buttons to simultaneously add/delete a dot (decimal point).

Press and hold the SET button for 1 second or longer to make the entire set line name flash.
(At this point, the setting of the line name is not complete)

Press the SET button. ↓ Return to function selection mode.

[LinE] When character string display is not selected
Press the SET button to save the setting.

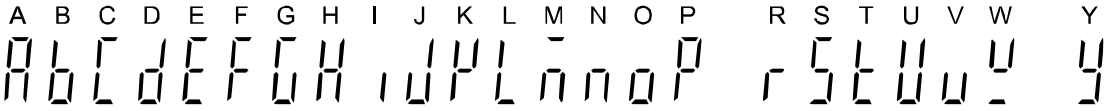
Return to function selection mode.

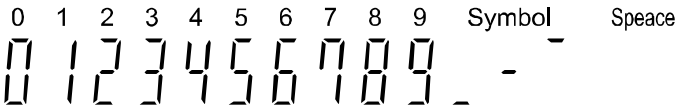
[F10] Sub display setting completed

•Character string display

•Function to display an arbitrary character string on the sub display.
When a line name is entered, displayable characters in each digit are as follows.

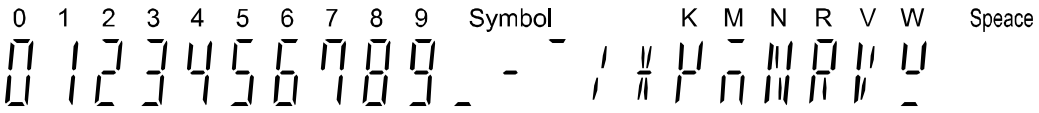
(Display pattern for the 3rd, 4th, 5th, 8th and 9th digits from the left)
The characters Q, X, Z, /, and ∗ cannot be displayed.





(Display pattern for the 1st, 2nd, 6th, and 7th digits from the left)
The letters A to Z can be displayed. It is also possible to display the characters contained in the display pattern for the next three digits.

<Pattern for 3 digits on the right>



•Display OFF

The sub display is turned off.

■[F14] Zero cut-off setting

This function reduces any commanded flow rate value below the zero cut-off setting value to zero when the flow rate is below the controlled flow rate range.
The zero cut-off range can be set in 1.0% F.S. increments within the range of 5.0 to 10.0% F.S.

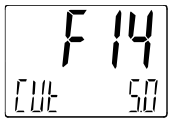
<Operation>

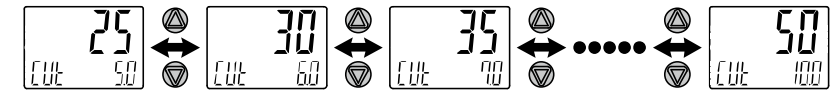
Press the UP or DOWN button in function selection mode to display [F14].

Press the SET button. ⬇ Move on to zero cut-off setting selection.

Zero cut-off setting selection

Press the UP or DOWN button to select a zero cut-off value.





5%F.S. or less is cut to zero | 6%F.S. or less is cut to zero | 7%F.S. or less is cut to zero | 10%F.S. or less is cut to zero

∗: In the example above, the range is 500 L/min and [L] is selected using the units selection function.

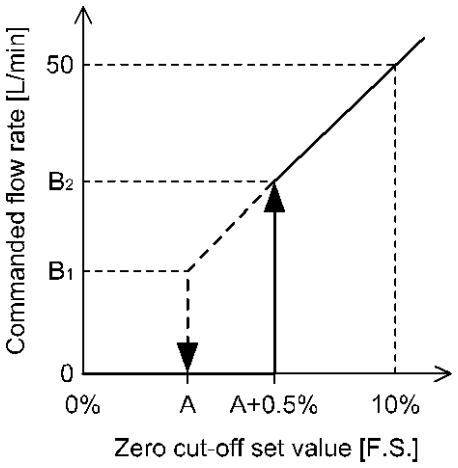
∗: When the actual value is smaller than the value displayed in the upper half of the display, the commanded flow rate is reduced to zero.

∗: In order to prevent repeated switching between zero cut-off and flow control around the zero cut-off setting value, a hysteresis of 0.5% F.S. is allowed between the rise and fall.

Example: when the range is 500 L/min

Commanded flow rates below values presented in the table below are reduced to zero.

Zero cut-off setting value: A	Commanded flow rate [L/min]	
	Fall threshold: B_1	Rise threshold: B_2
5%F.S.	25	27
6%F.S.	30	32
:	:	:
10%F.S.	50	52



Press the SET button to save the setting. ⬇ Return to function selection mode.

[F14] Zero cut-off setting completed

■[F21] Analogue input setting

When an analogue voltage input model is used, 0 to 5 V or 0 to 10 V can be selected for the input voltage.

∗: When an analogue current input model is used, the voltage cannot be changed.

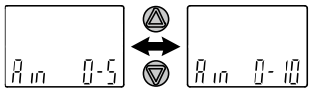
<Operation>

Press the UP or DOWN button in function selection mode to display [F21].

Press the SET button. ⬇ Move on to analogue input setting selection.

Analogue input setting selection

Press the UP or DOWN button to select an analogue voltage input.



0-5 V input 0-10 V input

Press the SET button to save the setting. ⬇ Return to function selection mode.

[F21] Analogue input setting completed

■[F22] Analogue output setting

When an analogue voltage output model is used, 1 to 5 V or 0 to 10 V can be selected for the output voltage.

∗: When an analogue current output model is used, the voltage cannot be changed.

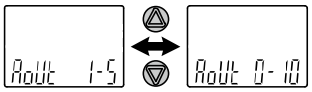
<Operation>

Press UP or DOWN button in function selection mode to display [F22].

Press the SET button. ⬇ Move on to analogue output setting selection.

Analogue output setting selection

Press the UP or DOWN button to select an analogue voltage output.



1-5 V output 0-10 V output

Press the SET button to save the setting. ⬇ Return to function selection mode.

[F22] Analogue output setting completed

■[F32] Control parameter setting

The response or stability of the controlled flow rate can be adjusted by changing the control parameter value.
Increasing the set value results in less responsiveness but can suppress overshoot.

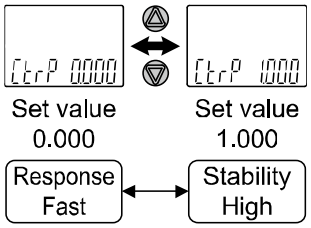
<Operation>

Press the UP or DOWN button in function selection mode to display [F32].

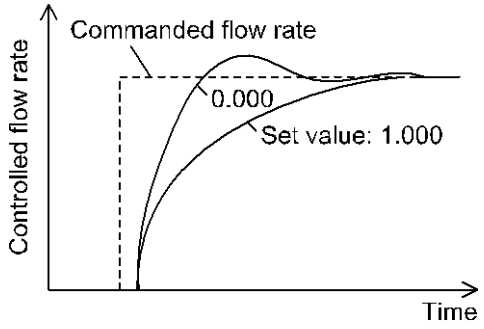
Press the SET button. ⬇ Move on to control parameter value setting.

Control parameter value setting

The control parameter value can be changed within the range of 0.000 to 1.000 in increments of 0.001.
Press the UP button once to increment the value or press and hold it to continuously increment the value.
Press the DOWN button once to decrement the value or press and hold it to continuously decrement the value.



Waveform example)



Press the SET button to save the setting. ⬇ Return to function selection mode.

[F32] Control parameter setting completed

■[F33] Output process data setting in the event of abnormal communication

It is possible to set the condition of the output process data in the event of occurrence of a communication abnormality between the master and a device, or between the master and a host device.
At the setting of output process data, it is possible to select 0 or hold. The definition is as follows.

•Output process data 0: The output process data (PD_OUT) value is set to 0, and the valve will be put into the fully closed state.

•Output process data hold: The output process data value as of before the occurrence of the communication abnormality is retained.

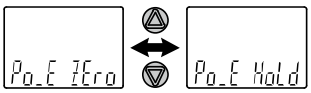
<Operation>

Press the UP or DOWN button in function selection mode to display [F33].

Press the SET button. ↓ Move on to output process data setting in the event of abnormal communication

Output process data setting in the event of abnormal communication

Press the UP or DOWN button to select the output process data condition in the event of abnormal communication.



Output process data: 0 | Output process data: hold

Press the SET button to save the setting. ↓ Return to function selection mode.

[F33] Output process data setting in the event of abnormal communication completed

■[F80] Power saving mode setting

Power saving mode can be selected.
This function is to cause the product to enter the power saving mode when no button operation is performed for 30 seconds.

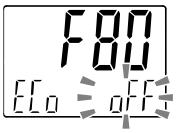
<Operation>

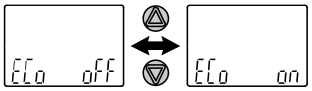
Press the UP or DOWN button in function selection mode to display [F80].

Press the SET button. ⬇ Move on to setting of power saving mode.

Power saving mode

Press the UP or DOWN button to select power saving mode.





Unused　　Power saving mode

Press the SET button to save the setting. ⬇ Return to function selection mode.

[F80] Power saving mode completed

In power saving mode, a key operation causes the display to function normally; if no key operation is performed for 30 seconds, it reverts to power saving mode. (Only in measurement mode)

During power saving mode, [_ _ _] flashes on the sub display and the operation LED is turned ON (only when the switch is ON).

At switch ON　　At switch OFF

■[F81] Security code

This function allows for specifying whether a security code must be entered to unlock the key-lock and changing the security code.

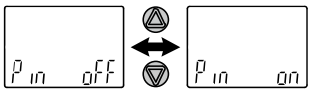
<Operation>

Press the UP or DOWN button in function selection mode to display [F81].

Press the SET button. ↓ Move on to security code.

Security code

Press the UP or DOWN button to specify whether a security code must be entered or not.



Unused Used

Press the SET button to save the setting. ↓ Move on to security code setting confirmation.

Security code setting confirmation

Press the UP or DOWN button to enter the desired security code on the sub display (right). (The factory default setting is [000]) *

For instructions on how to enter a security code, refer to "How to enter and change the security code" on page 51.

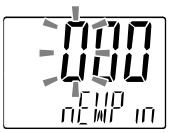
If the security code entered is incorrect, [FAL] will be displayed, and the security code must be entered again.
If the wrong security code is entered 3 times, [nG] is displayed and the device returns to function selection mode.

[oFF] When (Unused) is selected
Press the SET button to return to function selection mode.

Press the SET button for 1 second to save the setting. ↓ Move on to changing of the security code setting.

Changing of the security code setting

Press the UP or DOWN button to enter the desired security code on the main display. *
For instructions on how to enter a security code, refer to "How to enter and change the security code" on page 51.



After entry, press the SET button for 1 second, which causes the changed security code to start flashing.
(At this point, changing of the security code is not completed)
Press the UP or DOWN button to return to setting step.

Press the SET button for 1 second to save the setting.

Return to function selection mode.

[F81] Setting of security code completed

If the security code function is enabled, it will be necessary to input a security code to release the key lock.

∗: If no key is pressed for 30 seconds or longer during security code entry, the product will return to function selection mode.

●Special function settings

■[F90] Setting of all functions

All functions can be set in turn.

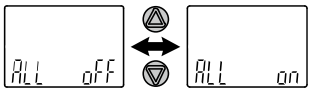
<Operation>

Press the UP or DOWN button in function selection mode to display [F90].

Press the SET button. ↓ Move on to setting of all functions.

Setting of all functions

Press the UP or DOWN button to select all functions.



Unused Used

[on] When (Used) is selected

[oFF] When (Unused) is selected
Press the SET button to save the setting.

Return to function selection mode.

Setting of each function *

Change the setting back to [oFF] (Unused), then press the SET button to save the setting.

Return to function selection mode.

[F90] Setting of all functions completed

*: Setting of each function
Every time the SET button is pressed, the display moves on to the next function in the same order as "Setting of each function" on page 41.
Change the settings using the UP and DOWN buttons.
For details of how to set each function, refer to the relevant function setting section in this manual.

*: Press the SET button for 2 seconds or longer to return from any setting item to measurement mode.

*: Function settings made before returning to measurement mode are stored.

●Setting of each function

Order	Function
1	Reference condition setting
2	Flow rate display unit setting
3	Pressure display unit setting
4	Switch output PNP/NPN switch setting
5	OUT1 output mode setting
6	OUT1 reverse output setting
7	OUT1 limit deviation tolerance setting *1
8	OUT1 ON delay time setting
9	OUT1 OFF delay time setting
10	Display colour setting
11	Sub display setting
12	Zero cut-off setting
13	Analogue input setting
14	Analogue output setting
15	Control parameter setting
16	Output process data setting in the event of abnormal communication
17	Power saving mode setting
18	Security code

∗1: When limit deviation tolerance mode is selected in OUT1 output mode setting

∗: Press the SET button for 2 seconds or longer to return from any setting item to measurement mode.

∗: Function settings made before returning to measurement mode are stored.

■[F96] Input check

It is possible to check the analogue input value (voltage or current value) as well as output process data value and cycle time during IO-Link communication.

<Operation>

Press the UP or DOWN button in function selection mode to display [F96].

Move on to analogue input value display.

Analogue input value display

Press the SET button to display the condition of the analogue input value and the output process data value.

Analogue input value[V] ∗1

Output process data value

Actual cycle time/ setting cycle time ∗2

∗1: The above illustrates the display of the voltage input type. On the analogue current input type display, the current value *.* [mA] is displayed.

∗2: After the label is displayed for 1 second, a numeric value is displayed.

∗: In SIO mode, [- - -] is displayed for the output process data value and cycle time.

■[F98] Output check

The output operation can be checked.
It is possible to arbitrarily turn ON and OFF the switch output, analogue output signal, and process data value.

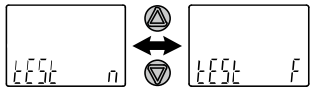
<Operation>

Press the UP or DOWN button in function selection mode to display [F98].

Press the SET button. ⬇ Move on to output check.

Output check

Press the UP or DOWN button to select the output check.



Normal output (Output not checked) | Forcibly output (Output is checked)

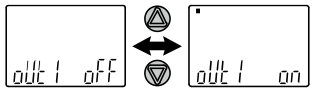
[n] (Normal output)
Press the SET button to save the setting.

Return to function selection mode.

[F] Force output selection
Press the SET button to save the setting. ⬇ Move on to check of OUT1 output.

Check of OUT1 output

Press the UP or DOWN button to select OUT1 output check.

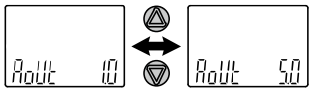


Forcibly output OFF | Forcibly output ON

Press the SET button to save the setting. ⬇ Move on to analogue output check.

Analogue output check

Press the UP or DOWN button to select analogue output check.



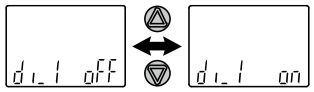
Analogue voltage 1.0 (0.0) [V] output | Analogue voltage 5.0 (10.0) [V] output

∗: The diagram above illustrates a case where the analogue voltage output of 1 to 5 [V] is specified. (The values in parentheses are for when 0 to 10 [V] is specified).
∗: For current output types, 4 to 20 [mA] is output.

Press the SET button to save the setting. ⬇ Move on to diagnostic output check (Flow).

Diagnostic output check (Flow)

Press the UP or DOWN button to select diagnostic output check.



Forcibly output OFF　Forcibly output ON

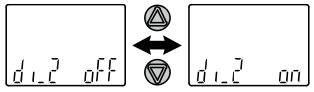
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the diagnostic information.

Press the SET button to set. Move on to diagnostic output check (Pressure).

Diagnostic output check (Pressure)

Press the UP or DOWN button to select diagnostic output check.



Forcibly output OFF　Forcibly output ON

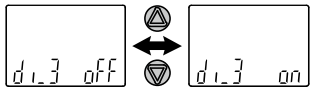
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the diagnostic information.

Press the SET button to set. Move on to diagnostic output check (Temperature).

Diagnostic output check (Temperature)

Press the UP or DOWN button to select diagnostic output check.



Forcibly output OFF　Forcibly output ON

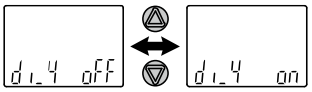
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the diagnostic information.

Press the SET button to set. Move on to diagnostic output check (Output PD out of range).

Diagnostic output check (Output PD out of range)

Press the UP or DOWN button to select diagnostic output check.



Forcibly output OFF　Forcibly output ON

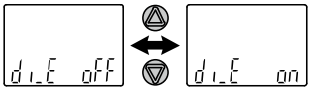
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the diagnostic information.

Press the SET button to set. Move on to error diagnostic.

Error diagnostic

Press the UP or DOWN button to select error diagnostic.



Forcibly output OFF　Forcibly output ON

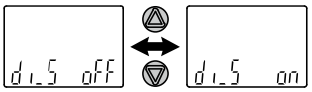
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the error diagnostic.

Press the SET button to set. Move on to system error diagnostic.

System error diagnostic

Press the UP or DOWN button to select system error diagnostic.



Forcibly output OFF　Forcibly output ON

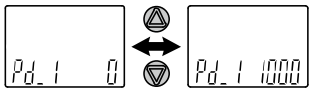
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the error diagnostic.

Press the SET button to set. Move on to process data measurement value output check (Flow).

Process data measurement value output check (Flow)

The upper and lower limit values of the rated flow value can be output compulsively as PD measurement value (process data). Press the UP or DOWN button to select the lower or upper limit value.



Output of the PD measurement value is ON at the rated lower limit value

Output of the PD measurement value is ON at the rated upper limit value

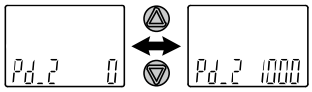
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the PD measurement value.

Press the SET button to set. Move on to process data measurement value output check (Pressure).

Process data measurement value output check (Pressure)

The upper and lower limit values of the rated pressure value can be output compulsively as PD measurement value (process data). Press the UP or DOWN button to select the lower or upper limit value.



Output of the PD measurement value is ON at the rated lower limit value

Output of the PD measurement value is ON at the rated upper limit value

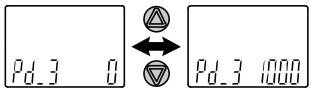
∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the PD measurement value.

Press the SET button to set. Move on to process data measurement value output check (Temperature).

Process data measurement value output check (Temperature)

The upper and lower limit values of the detection temperature value can be output compulsively as PD measurement value (process data). Press the UP or DOWN button to select the lower or upper limit value.



Output of the PD measurement value is ON at the rated lower limit value

Output of the PD measurement value is ON at the rated upper limit value

∗: IO-Link mode can provide the communication function.

∗: Refer to page 53 for details of the PD measurement value.

Press the SET button to return to [n] (normal output), then press the SET button to set.

Return to function selection mode.

Press the SET button for 2 seconds or longer.

[F98] Output check completed

Measurement mode

∗: Measurement mode can return from any setting item by pressing the SET button for 2 seconds or longer.

■[F99] Reset to default settings

If the product settings are uncertain, the factory default values can be restored.

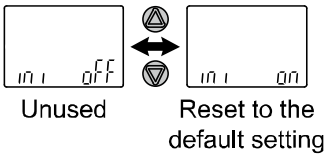
<Operation>

Press the UP or DOWN button in function selection mode to display [F99].

Press the SET button. ⬇ Move on to restoration of the factory default settings.

Restoration of the factory default settings

Press the UP or DOWN button to display [ON] and then press and hold the SET and DOWN buttons simultaneously 5 seconds or longer.



[oFF] When (Unused) is selected
Press the SET button to save the setting.

Return to function selection mode.

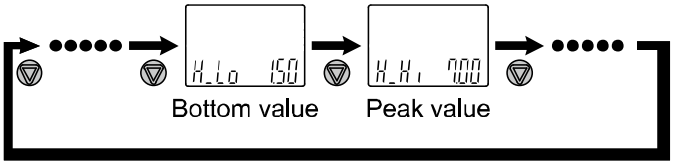
The factory default settings are restored and the function selection mode is entered.

[F99] Restoration of the factory default settings completed

Other Settings

○Peak/Bottom value indicating function

The maximum (minimum) measured flow rate from when the power is supplied is detected and updated. In peak/bottom value display mode, the current flow is displayed.
Press the DOWN button in measurement mode to switch the sub display (left) as shown below.
Peak/bottom values can be displayed on the sub display (right) at the same time as the main display.



When the SET and DOWN buttons are pressed and held for 1 second or longer simultaneously while the peak/bottom value is displayed, the sub display (right) displays [- - -] and the maximum (minimum) pressure value is cleared.

∗: The peak/bottom value is not stored in memory.

○Zero-clear function

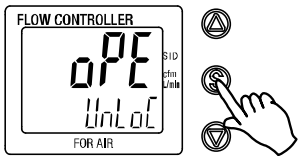
The displayed secondary pressure value can be adjusted to zero if the secondary pressure being measured is within the range of ±50 kPa from the factory default value. (The zero clear range varies by ±10 kPa due to variation between individual products).
When the commanded flow rate is 0 L/min, press and hold the SET and DOWN buttons for 1 second or longer simultaneously while the secondary pressure is displayed on the sub display in measurement mode to cause the sub display (left) to indicate [ZEro], the Sub (right) display to indicate [- - -], and the displayed value to reset to zero. The display returns to measurement mode automatically.

○Key-lock function

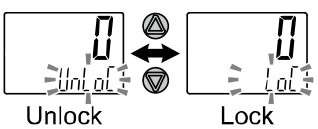
The key lock function is used to prevent errors occurring due to unintentional changes of the set values. If the SET button is pressed when the key-lock is enabled, [LoC] is displayed on the sub display (right) for 1 second.
(Each setting and peak/bottom values can be displayed with the UP and DOWN buttons).

<Operation – Without security code ->

(1) Press the SET button for 3 seconds or longer in measurement mode. When [oPE] is displayed on the main display, release the button.
The current setting [LoC] or [UnLoC] will be displayed on the sub display.
(To release the key-lock repeat the above operation)



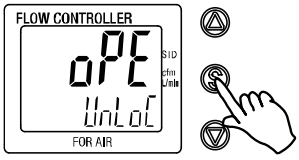
(2) Press the UP or DOWN button to select Lock/Unlock and then press the SET button to enable the setting.



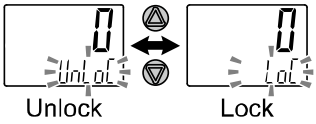
<Operation – With security code ->

•Locking

(1) Press the SET button for 3 seconds or longer in measurement mode. When [oPE] is displayed on the main display, release the button.
The current setting [LoC] or [UnLoC] will be displayed on the sub display.

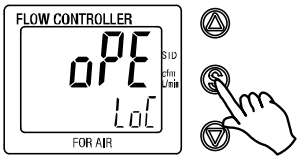


(2) Press the UP or DOWN button to select Lock [LoC] and then press the SET button to enable the setting.

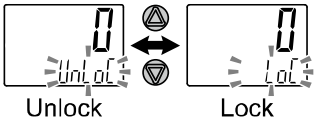


•Unlocking

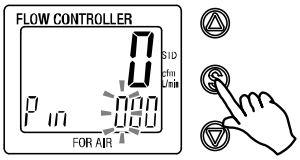
(1) Press the SET button for 3 seconds or longer in measurement mode. When [oPE] is displayed on the main display, release the button.
The current setting [LoC] or [UnLoC] will be displayed on the sub display.



(2) Press the UP or DOWN button to select Unlock [UnLoC] and then press the SET button to enable the setting. Security code entry is required.



(3) For instructions on how to enter a security code, refer to "How to enter and change the security code" on page 51.

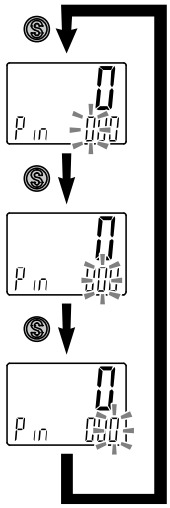


(4) If the entered security code is correct, the main display indicates [UnLoC] and pressing any of the UP, SET, and DOWN buttons disables the key lock and the measurement mode is returned.
If the security code entered is incorrect, [FAL] will be displayed, and the security code must be entered again. If the wrong security code is entered 3 times, [LoC] is displayed and the device returns to measurement mode.

●**How to enter and change the security code**

The left most digit starts flashing.
Press the UP or DOWN button to specify a digit.
Press the SET button to make the next digit to the right flash.
(If the SET button is pressed at the last digit, the first digit will start flashing.)

After the setting is completed, press and hold the SET button for 1 second or longer.
(If an operation is not performed for 30 seconds or longer during entry or change of a security code, the measurement mode is returned).



IO-Link Specifications

■Outline of IO-Link functions

○Communication function

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

○Product status monitoring function

This function monitors the product status via the IO-Link communication.

•Detects the error status (internal hardware error).

•Detects the warning conditions (measurement pressure error).

○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 parameters

When the device parameters are set and downloaded to the device using the IO-Link setting tool, the parameters in the downloaded device will be activated.

After that, these parameters are uploaded to the data storage in the master by stem command (back-up 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, device can be operated with 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 upload and "restore" implies download.

■Communication specifications

IO-Link type	Device
IO-Link version	V.1.1
Communication speed	COM2 (38.4 kbps)
Min. cycle time	5.5 ms
Process data length	Input Data: 8 byte, Output Data: 2 byte
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 (hereinafter referred to as PD_IN): switch output state, error diagnostics result, measurement value
•Output process data (hereinafter referred to as PD_OUT): commanded flow rate
(Refer to the table below.)

○PD_IN

Bit offset	Item	Notes
0	Flow SW: OUT1 output	0: OFF 1: ON
8	Flow rate diagnostics	0: OFF 1: ON Out of flow rate display range (When HHH is displayed)
9	Pressure diagnostics	0: OFF 1: ON Out of outlet pressure display range (When HHH and LLL are displayed)
10	Temperature diagnostics	0: OFF 1: ON When temperature abnormality occurs
11	Output PD	0: In range 1: Out of range
13	Fixed output	0: Normal output 1: Fixed output
14	Error	0: OFF 1: ON When errors are generated
15	System error	0: OFF 1: ON When errors are generated
16 to 31	Temperature measurement value	With symbol 16 bit
32 to 47	Pressure measurement value	With symbol 16 bit
48 to 63	Flow rate measurement value	With symbol 16 bit
1 to 7,11,12	-	Reservation

Bit offset	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
Item	Flow rate measurement value															

Bit offset	47	46	45	44	43	43	41	40	39	38	37	36	35	34	33	32
Item	Pressure measurement value															

Bit offset	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Item	Temperature measurement value															

Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item	System error	Error	Fixed output	Reservation	Output PD	Temperature diagnostics	Pressure diagnostics	Flow rate diagnostics	Reservation							Flow SW

○PD_OUT

Bit offset	Item	Notes
0	Commanded flow rate	With symbol 16 bit

Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item	Commanded flow rate															

•The process data of this product is Big-Endian type.
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/commanded value (PD)

•Measurement value (PD_IN)

Measured object	Range	Rated range			Measurement range		
		Min.	to	Max.	Min.	to	Max.
Flow	500 L/min	50	to	500	25	to	525
	1000 L/min	100	to	1000	50	to	1050
	2000 L/min	200	to	2000	100	to	2100
Pressure	1 MPa	0	to	1000	-50	to	1050
Temperature	50 °C	0	to	50	-20	to	100

Measured object	Range	PD value					
		Rated range			Measurement range		
		A	to	B	C	to	D
Flow	500 L/min	100	to	1000	50	to	1050
	1000 L/min	100	to	1000	50	to	1050
	2000 L/min	100	to	1000	50	to	1050
Pressure	1 MPa	0	to	1000	-50	to	1050
Temperature	50 °C	0	to	500	-200	to	1000

∗: It is possible to check the temperature (fluid temperature) value. Use this only as a guide because an error may be produced depending on the ambient temperature.

∗: The relationship between the measurement value and PD value is shown in the figure below.

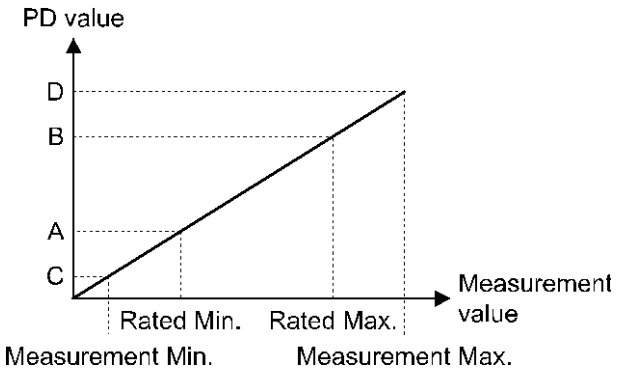
•Commanded value (PD_OUT)

Command target	Range	Rated control range			Controllable range		
		Min.	to	Max.	Min.	to	Max.
Flow	500 L/min	50	to	500	25	to	525
	1000 L/min	100	to	1000	50	to	1050
	2000 L/min	200	to	2000	100	to	2100

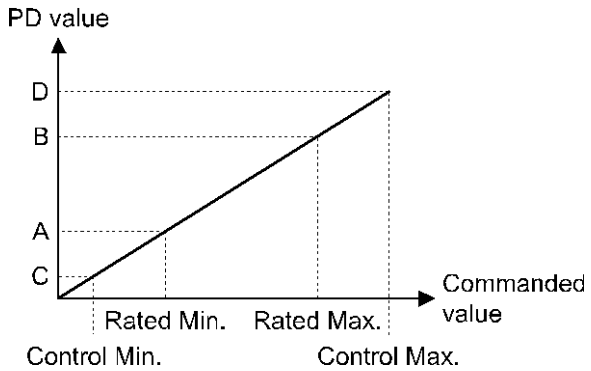
Command target	Range	PD value					
		Rated control range			Controllable range		
		A	to	B	C	to	D
Flow	500 L/min	100	to	1000	50	to	1050
	1000 L/min	100	to	1000	50	to	1050
	2000 L/min	100	to	1000	50	to	1050

∗: The relationship between the commanded value and PD is shown in the figure below.

∗: If a command value exceeding the controllable range is entered, the sub display (left) displays [Sv] and the sub display (right) displays [o.r.].



Relationship between the measurement value and PD_IN value



Relationship between the command value and PD_OUT value

○Conversion formula of process data and measurement/command value

(1) Conversion formula from process data to measurement/command value: Pr = a x (PD) + b

(2) Conversion formula from measurement/command value to process data: (PD) = (Pr – b) / a

Pr: Measurement value and command value
∗: Command value is flow rate only.
PD: Measurement value (process data)
a: Inclination
b: Intercept

[Inclination and intercept to the unit specification]

Target	Range	Unit	Inclination a	Intercept b
Flow	500 L/min	L/min	0.5	0
		cfm	0.017657	0
	1000 L/min	L/min	1	0
		cfm	0.035315	0
	2000 L/min	L/min	2	0
		cfm	0.070629	0
Pressure	1 MPa	kPa	1	0
		MPa	0.001	0
		kgf/cm^2	0.010197	0
		bar	0.01	0
		psi	0.14504	0
Temperature	50 °C	°C	0.1	0

[Calculation example]

(1) Conversion from process data to flow rate measurement/command value
(For range: 500 L/min, unit specification L/min and PD = 500)

Pr = a x (PD) + b
= 0.5 x 500 + 0
= 250 [L/min]

(2) Conversion from flow rate measurement/command value to process data
(For range: 1000 L/min, unit specification cfm and Pr = 30.0 [cfm])

(PD) = (Pr - b) / a
= [30.0 - (0)] / (0.035315)
≒ 850

■IO-Link parameter setting

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

Product No.	IODD file *1
IN502-44-5/6/13/14	SMC-IN502-44-5_6_13_14-yyyymmdd-IODD1.1
IN502-44-7/8/15/16	SMC-IN502-44-7_8_15_16-yyyymmdd-IODD1.1
IN502-45-5/6/13/14	SMC-IN502-45-5_6_13_14-yyyymmdd-IODD1.1
IN502-45-7/8/15/16	SMC-IN502-45-7_8_15_16-yyyymmdd-IODD1.1
IN502-46-5/6/13/14	SMC-IN502-46-5_6_13_14-yyyymmdd-IODD1.1
IN502-46-7/8/15/16	SMC-IN502-46-7_8_15_16-yyyymmdd-IODD1.1

*1: "yyyymmdd" indicates the file preparation date. yyyy is the year, mm is the month and dd is the date.

The IODD file can be downloaded from the SMC Web site (https://www.smcworld.com).

○Service data

The tables below indicates 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.

*: The parameter data of this product is the Big Endian type.
When the transmission method of the upper communication is Little-Endian, the byte order will be changed.

●Direct parameters page 1

DPP1 address	Access	Parameter name	Initial value (dec)	Contents
0x07	R	Vendor ID	0x0083(131)	"SMC Corporation"
0x08				
0x09	R	Device ID	0x00023F(575) 0x000240(576) 0x000241(577) 0x000242(578) 0x0002D7(727) 0x0002D6(726)	"IN502-44-5/6/13/14" "IN502-44-7/8/15/16" "IN502-45-5/6/13/14" "IN502-45-7/8/15/16" "IN502-46-5/6/13/14" "IN502-46-7/8/15/16"
0x0A				
0x0B				

●ISDU parameters

Index (dec)	Sub index	Access *1	Parameters	Initial value	Remarks
0x0002 (2)	0	W	System command	–	Refer to "System command" on page 58.
0x000C (12)	0	R/W *2	Device access lock	0x0000	Refer to "Device access lock parameter" on page 58.
0x0010 (16)	0	R	Vendor name	SMC Corporation	
0x0011 (17)	0	R	Vendor text	www.smcworld.com	
0x0012 (18)	0	R	Product name	Example: IN502-44-5	
0x0013 (19)	0	R	Product ID	Example: IN502-44-5	
0x0014 (20)	0	R	Product text	Flow controller	
0x0015 (21)	0	R	Serial number	Example: "xxxxxxxx"	•Initial value is indicated as 8-digit. •16 octets fixed character string
0x0016 (22)	0	R	Hardware version	HW-Vx.y	x: Large revision number y: Small revision number
0x0017 (23)	0	R	Software version	FW-Vx.y	x: Large revision number y: Small revision number
0x0018 (24)	0	R/W *2	Application specific tag	ALL "*"	Can be changed arbitrarily
0x0024 (36)	0	R	Device status parameter	–	Refer to "Device status parameter" on page 58.
0x0025 (37)	0	R	Device detailed state parameter	–	Refer to "Device detailed state parameter" on page 59.
0x0028 (40)	0	R	Process data input	–	The latest value of process data can be read.
0x0029 (41)	0	R	Process data output	–	The latest value of process data can be read.

∗1: R: Read, W: Write

∗2: When using IODD, only the personnel who are registered as Maintenance/Specialist can Write data.

●System command (index 2)

In the ISDU index 0x0002 SystemCommand (system command), the command shown in the table below will be issued.

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

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

Writable commands are shown below.

Data type: 8 bit UInteger

Value (dec)	State definition	Description
0x80(128)	Device Reset	Reset the device.
0x81(129)	Application Reset	Clear the peak/bottom value of all channels.
0x82(130)	Restore Factory Settings	Restore the set values to the factory settings.
0xA0(160)	Zero Clear	Conduct a zero-clear of pressure value.

∗1: When using IODD, only the personnel who are registered as Maintenance/Specialist can be used.

●Device access lock parameter (index 12)

The contents are as follows.

Data type: 16 bit Record

Value (dec)	Contents
0x0000(0)	Key lock release, DS unlock (Initial value)
0x0002(2)	Key lock release, DS lock
0x0008(8)	Key lock, DS unlock
0x000A(10)	Key lock, DS lock

[Key lock]

Function that prevents changes to the settings of the product (disables button operation).

Even when key lock function is activated, settings can be changed by IO-Link communication.

Restoration by data storage (overwriting parameter data) can be performed.

[Lock data storage (DS lock)]

Data storage function is disabled by locking the Data storage".

In this case, access will be denied for backup and restoration of data storage.

●Device state parameters (index 36)

Readable device states are as follows.

Data type: 8 bit UInteger

Value	State definition	Description
0x00(0)	Normal operation	—
0x01(1)	Maintenance inspection required	Not available
0x02(2)	Outside specification range	Out of measurement range
0x03(3)	Function check	Not available
0x04(4)	Failure	Internal failure of digital pressure switch

●Device detail status parameters (index 37)

Detailed event contents of readable device status are as follows.

Array	Event content	Event classification		Event code
		Definition	Value	
1	Internal product malfunction	Error	0xF4	0x8D03
2	Internal product malfunction	Error	0xF4	0x8D04
3	Internal product malfunction	Error	0xF4	0x8D05
4	Internal product malfunction	Error	0xF4	0x8D01
5	Internal product malfunction	Error	0xF4	0x8D06
6	Internal product malfunction	Error	0xF4	0x8CD0
7	Control error	Error	0xF4	0x8D07
8	Control error	Error	0xF4	0x8D08
9	Control error	Error	0xF4	0x8D09
10	Measurement error	Error	0xF4	0x8DA0
11	Flow rate not reached error	Error	0xF4	0x8DA1
12	Outside the flow rate range	warning	0xE4	0x8D60
13	Outside the pressure range	warning	0xE4	0x8D71
14	Output PD outside the settable range	warning	0xE4	0x8D90
15	Test event A	warning	0xE4	0x8CA0
16	Test event B	warning	0xE4	0xCA1
17	Data storage upload request	notification	0x54	0xFF91

●Product individual parameters

Index (dec)	Sub index	Access *1	Parameter	Data storage *2	Data type *3	Initial value (dec)	Remarks
0x03E8 (1000)	0	R/W	Unit_F (Selection of flow rate unit)	Y	U8	0x00 (0)	Setting of unit of flow rate display. Some units cannot be selected depending on the product number. (Rejection response) 0: L/min 1: cfm
0x0438 (1080)	0	R/W	Unit_P (Selection of pressure unit)	Y	U8	0x01 (1)	Setting of pressure display unit. Some units cannot be selected depending on the product number. (Rejection response) 0: MPa 1: kPa 2: kgf/cm^2 3: bar 4: psi
0x03F2 (1010)	0	R/W	CoL (Selection of display colour)	Y	U8	0x02 (2)	Setting of display colour. 0: rEd (Constantly red) 1: Grn (Constantly green) 2: SoG (OUT1 turns green at ON) 3: Sor (OUT1 turns red at ON)
0x03FC (1020)	0	R/W	N or P (Selection of NPN or PNP)	Y	U8	0x01 (1)	Setting of switch output specification. 0: nPn 1: Pnp
0x042E (1070)	0	R/W	rEF (Selection of reference condition)	Y	U8	0x00 (0)	Setting of the reference condition of flow rate. 0: std (Standard condition) 1: nor (Normal condition)
0x04BA (1210)	1	R/W	oUt1 (Selection of OUT1 output operation mode)	Y	U8	0x00 (0)	Setting of OUT1 output mode. 0: toLE (Tolerance) 1: Err (Error output) 2: oFF (Output OFF)
	2	R/W	1ot (Selection of OUT1 output type)	Y	U8	0x00 (0)	Setting of OUT1 output type. 0: 1_P (Normal output) 1: 1_n (Reverse output)
0x1C2A (7210)	1	R/W	toL1 (OUT1 limit deviation tolerance setting)	Y	U16	0x0002 (2)	Setting of OUT1 limit deviation tolerance. 0x0001 ~ 0x0050 (1 ~ 50) 1%F.S. increment
	2	R/W	dtH1 (OUT1 delay time at ON)	Y	U16	0x0000 (0)	Setting of OUT1 delay time at ON. 0x0000 ~ 0x1770 (0 ~ 6000) 0.01 s increment
	3	R/W	dtL1 (OUT1 delay time at OFF)	Y	U16	0x0000 (0)	Setting of OUT1 delay time at OFF. 0x0000 ~ 0x1770 (0 ~ 6000) 0.01 s increment

●Product individual parameters (continued)

Index (dec)	Sub index	Access *1	Parameter	Data storage *2	Data type *3	Initial value (dec)	Remarks
0x07D0 (2000)	1	R/W	SUb (Setting of sub display option)	Y	U8	0x00 (0)	Setting of the sub display option. 0: dEF (Default) 1: LinE (Line name) 2: oFF (Display OFF)
	2	R/W	dEF (Default setting of sub display)	Y	U8	0x00 (0)	Setting of default display of sub display. 0: Command flow rate display 1: Outlet pressure value display 2: Outlet pressure/command flow rate display 3: Bottom value display 4: Peak value display 5: IO-Link mode display 6: Option (Line name, Display OFF) *: When "6" is set, [dEF - - -] is displayed if the sub display option is set to "dEF".
0x0974 (2420)	1	R/W	Line name 1st letter (11 SEG)	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (11 seg)”.
	2	R/W	Line name 2nd letter (11 SEG)	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (11 seg)”.
	3	R/W	Line name 3rd letter	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (7 seg)”.
	4	R/W	Line name 4th letter	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (7 seg)”.
	5	R/W	Line name 5th letter	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (7 seg)”.
	6	R/W	Line name 6th letter (11 SEG)	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (11 seg)”.
	7	R/W	Line name 7th letter (11 SEG)	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (11 seg)”.
	8	R/W	Line name 8th letter	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (7 seg)”.
	9	R/W	Line name 9th letter	Y	U8	0x00 (0)	Refer to Figure “Line name communication data (7 seg)”.
0x097E (2430)	1	R/W	Line name 1st letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)
	2	R/W	Line name 2nd letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)
	3	R/W	Line name 3rd letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)
	4	R/W	Line name 4th letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)
	5	R/W	Line name 5th letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)
	6	R/W	Line name 6th letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)
	7	R/W	Line name 7th letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)
	8	R/W	Line name 8th letter dot	Y	U8	0x00 (0)	0: OFF (dot OFF) 1: ON (dot ON)

●Product individual parameters (continued)

Index (dec)	Sub index	Access *1	Parameter	Data storage *2	Data type *3	Initial value (dec)	Remarks
0x07EE (2030)	0	R/W	CUt (Zero cut-off setting)	Y	U8	0x00 (0)	Setting of value range in which a measurement/command value near 0 is regarded as zero. 0x05 ~ 0x0A (5 ~ 10) 1.0% increment
0x076C (1900)	0	R/W	Input_vol (Analogue input setting)	Y	U8	0x00 (0)	Setting of analogue voltage input type. For the analogue current input type, a rejection response is set. 0: 0-5 (0 ~ 5 V) 1: 0-10 (0 ~ 10 V)
0x0834 (2100)	0	R/W	Output_vol (Analogue output setting)	Y	U8	0x00 (0)	Setting of analogue voltage output type. For the analogue current output type, a rejection response is set. 0: 1-5 (1 ~ 5 V) 1: 0-10 (0 ~ 10 V)
0x08FC (2300)	0	R/W	Ctrp (Control parameter setting)	Y	U16	0x0000 (0)	Setting of control parameter value. 0x0000 ~ 0x03E8 (0 ~ 1000) 0.001 increment
0x0906 (2310)	0	R/W	Po_E (Output process data setting in the event of abnormal communication)	Y	U8	0x00 (0)	Setting of condition of output process data (PD_OUT) in the event of abnormal communication. 0: ZERO 1: HOLD
0x0960 (2400)	0	R/W	ECo (ECO mode setting)	Y	U8	0x00 (0)	Setting of economy mode. 0: OFF 1: ON
0x096A (2410)	1	R/W *4	Pin (Security code Used/Not used)	Y	U8	0x00 (0)	Setting of the security code to used or not used. 0: OFF 1: ON
	2	R/W *4	PinCode (Security code)	Y	U16	0x0000 (0)	Setting of security code. 0x0000 ~ 0x03E7 (0 ~ 999)

●Product individual parameters (continued)

Index (dec)	Sub index	Access *1	Parameter	Data storage *2	Data type *3	Initial value (dec)	Remarks
0x1F40 (8000)	0	R	Flow rate PD conversion formula Inclination a	N	F32	-	Refer to table "Inclination and intercept to the unit specification". (page 55)
0x1F4A (8010)	0	R	Flow rate PD conversion formula Intercept b	N	F32	-	
0x1F54 (8020)	0	R	H_Hi (Flow rate peak value)	N	U16	-	Refer to process data on page 53 to 55.
0x1F5E (8030)	0	R	H_Lo (Flow rate bottom value)	N	U16	-	
0x2008 (8200)	0	R	Pressure PD conversion formula Inclination a	N	F32	-	Refer to table "Inclination and intercept to the unit specification". (page 55)
0x2012 (8210)	0	R	Pressure PD conversion formula Intercept b	N	F32	-	
0x20D0 (8400)	0	R	Temperature PD conversion formula Inclination a	N	F32	-	Refer to table "Inclination and intercept to the unit specification". (page 55)
0x20DA (8410)	0	R	Temperature PD conversion formula Intercept b	N	F32	-	

∗1: "R" means Read and "W" means Write.
When using IODD, only the personnel who are registered as Maintenance/Specialist can Write data.

∗2: Refer to the table below for the symbol.

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

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

∗4: When using IODD, only the personnel who are registered as Maintenance/Specialist can Read and Write data.

Value (16 Hex number)		00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
Display letter	7seg																
	11seg																
Value (16 Hex number)		10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
Display letter	7seg																
	11seg																
Value (16 Hex number)		20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
Display letter	7seg																	
	11seg																
Supplementary information		: Do not work															

Line name communication data

Maintenance

How to reset the product after a power loss or when the power has been unexpectedly removed
The settings for the product are retained in memory prior to the power loss or de-energizing of the product. The output condition is also recoverable to that prior to the power loss or de-energizing. However, this may change depending on the operating environment. Therefore, check the safety of the whole installation before operating the product.
If the installation is using accurate control, wait until the product has warmed up (approximately 10 to 15 minutes) before operation.

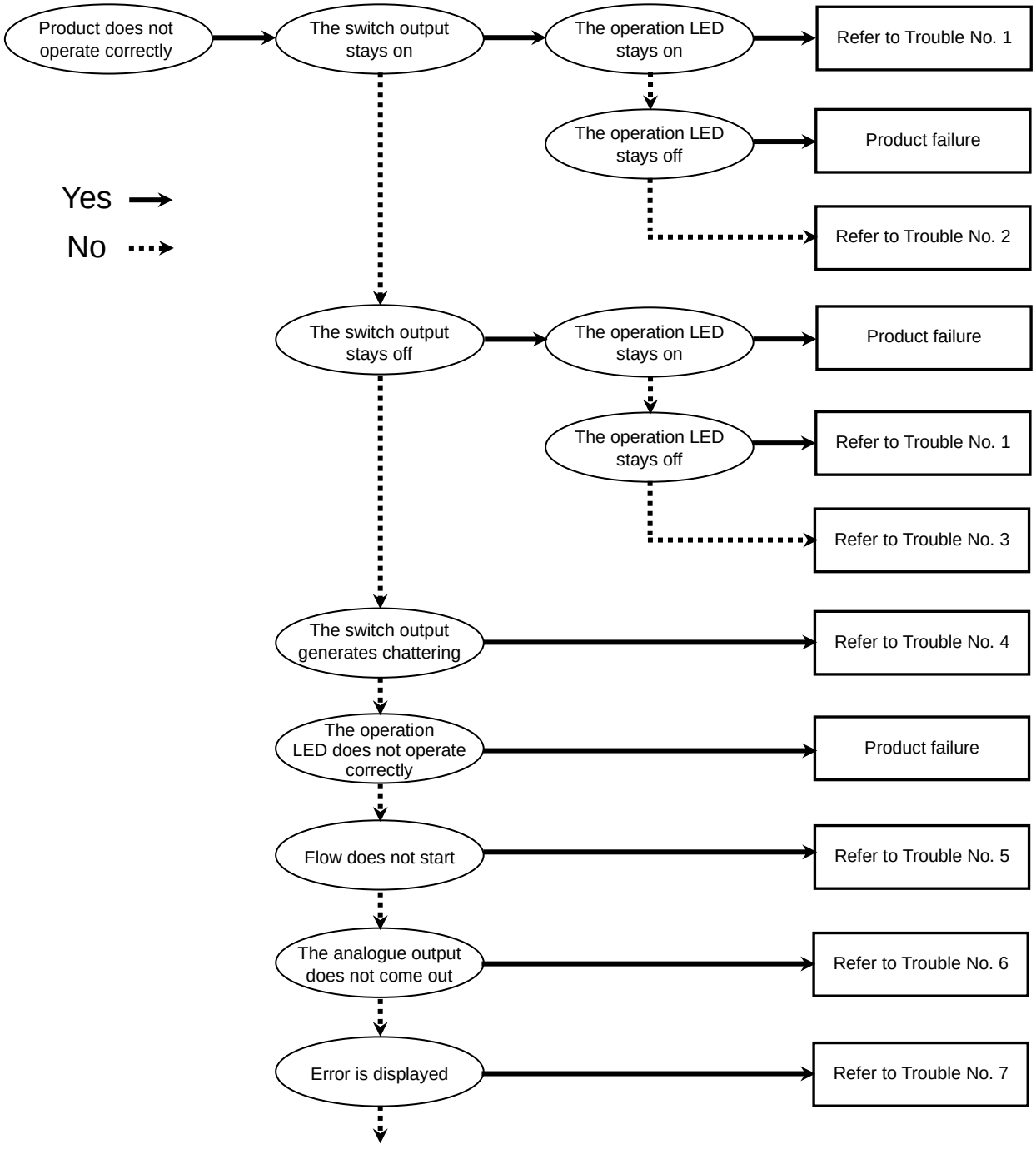
Forgotten the security code

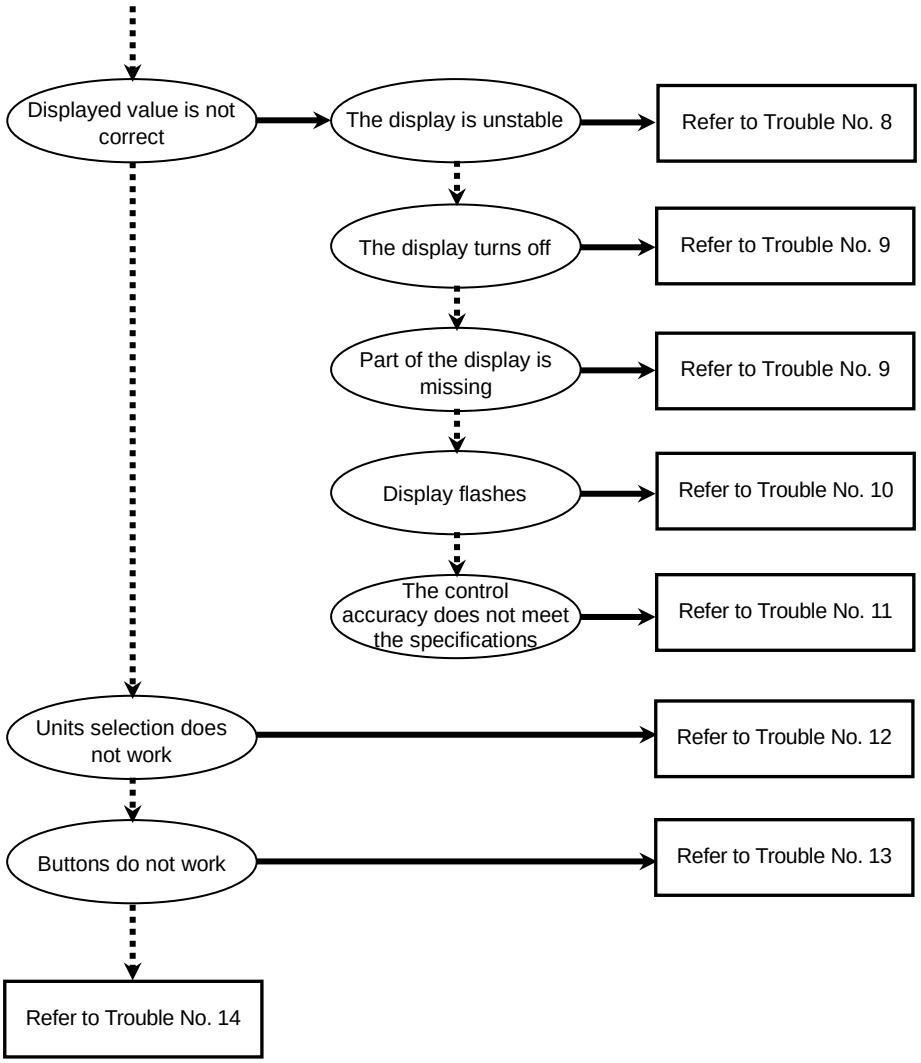
If you have forgotten your security code, please contact SMC directly.

Troubleshooting

○Troubleshooting

When any failure occurs with this product, the following graph can be used to identify the cause of the failure. If a cause applicable to the troubles cannot be identified and normal operation is recovered by replacement with a new product, this indicates that the product itself is faulty. The product may fail depending on the operating environment (network configuration, etc.); please consult SMC for solutions.




Displayed value is not correct
The display is unstable
Refer to Trouble No. 8
The display turns off
Refer to Trouble No. 9
Part of the display is missing
Refer to Trouble No. 9
Display flashes
Refer to Trouble No. 10
The control accuracy does not meet the specifications
Refer to Trouble No. 11
Units selection does not work
Refer to Trouble No. 12
Buttons do not work
Refer to Trouble No. 13
Refer to Trouble No. 14

○Troubleshooting list

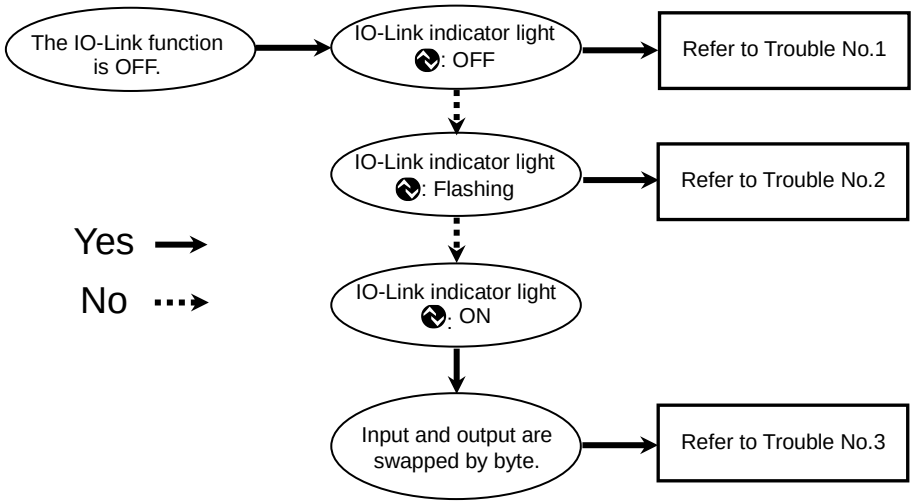
Problem No.	Problem	Problem possible causes	Investigation method	Countermeasures
1	•The output stays on The operation LED stays ON •The output stays off The operation LED stays OFF	Incorrect setting	Check settings. (output mode, normal/reverse output)	Set up the function again.
		Product failure		Replace the product.
2	The output stays on The operation LED functions normally	Incorrect wiring	Check the output wiring. Check if the load is directly connected to DC(+) or DC(–).	Check and correct the wiring.
		Product failure		Replace the product.
3	The output stays off The operation LED functions normally	Incorrect wiring	Check the output wiring. Check if the load is directly connected to DC(+) or DC(–).	Check and correct the wiring.
		Incorrect setting	Check if the PNP setting is used unintentionally instead of the NPN setting, and vice versa.	Re-check the output setting (PNP/NPN).
		Lead wire broken	Check if there is bending stress applied to any part of the lead wire. (bending radius, tensile force to the lead wire)	Correct the wiring. (Reduce the tensile force or increase the bending radius.)
		Product failure		Replace the product.
4	The switch output generates chattering	Incorrect wiring	Check the wiring. Check if the brown and blue wires are connected to DC(+) and DC(–) respectively, and if the output line is secure (contact failure).	Rewire correctly.
		Incorrect setting	(1) Check if the limit deviation tolerance range is too small. (2) Check the delay time setting Check if the delay time is too short.	(1) Increase the limit deviation tolerance. (2) Set up the function again.
		Product failure		Replace the product.
5	Flow does not start	Incorrect wiring	Check the wiring. Check if the analogue input signal is connected to the white wire and the input type (voltage/current) is correct.	Rewire correctly.
		Product failure		Replace the product.
6	The analogue output does not turn out	Incorrect wiring	Check the wiring. Check if a load is connected to the analogue output line (grey wire).	Rewire correctly.
		Mismatch with the load specification	(1) Check if the connected load complies with the specification. (2) Check if the input impedance of the input device (such as an A/D converter) is appropriate.	Connect the correct load.
		Product failure		Replace the product.

Problem No.	Problem	Problem possible causes	Investigation method	Countermeasures
7	•Over current error (Er1) is displayed •System error (Er0, 4, 6, 7, 8, 9, 40) is displayed •"HHH" is displayed •Residual pressure error (Er3) is displayed •Controlled flow rate unreached error (Er50) is displayed •Connected load error (Er51) is displayed •Control error (Er52, 53, 54) is displayed	Excess current was applied to the output (Er1)	(1) Check if the output current is 80 mA or greater. (2) Check if the connected load complies with the specification. Check if the load is short circuited. (3) Check if the relay without surge protection is connected. (4) Check that the wiring is not in the same route as (or bundled together with) a high-voltage or power line.	(1)(2) Connect the appropriate load. (3) Use a relay with a surge voltage suppressor or take measures to prevent surge. (4) Separate the wiring from the high-voltage and/or power line.
		Data inside the product was not processed correctly (Er0, 4, 6, 7, 8, 9, 40)	(1) Check if there is noise interference (such as static electricity). Check if there is a noise source nearby. (2) Check if the power supply voltage is in the range 24 VDC ±10%.	(1) Remove the noise and the noise source (or take measures to prevent noise interference) and reset the product (or turn off and then turn back on the power supply). (2) Power supply voltage is 24 VDC ±10%.
		The indicated flow rate is higher than the upper limit (HHH)	(1) Check if the commanded flow rate exceeds the upper limit of the rated flow rate range. (2) The controlled flow rate is overshot.	(1) Reset the commanded flow rate to a level within the rated controlled flow rate range. (2) Change the control parameter setting to suppress overshoot.
		The secondary pressure of the product is not at atmospheric pressure when zero-clear is performed (Er3)	(1) Check if the secondary pressure of the product exceeds the atmospheric pressure ±50 kPa.	Adjust the applied pressure back to atmospheric pressure, and retry the zero clear operation.
		The controlled flow rate does not reach a commanded flow rate (Er50)	(1) Refer to the characteristic graphs on page 82 to check if the flow rate is within the controllable flow rate range. (2) Check if the environment, including the pipe diameter, allows for sufficient flow.	(1) Change the supply pressure and connected load and use the product within the controllable flow rate range. (2) Review the environment and installation space.
		The load pressure is outside the set pressure range (Er51)	Check if the connected load is too large or too small.	Change the connected load to use the product within the operating pressure range.
		The internal solenoid valve is operating abnormally (Er52)	Check if the power supply voltage is 24 VDC ±10%.	Cut off the power and then supply 24 VDC ±10%.
		The internal sensor is operating abnormally (Er53, 54)	(1) Check if the EXH port is blocked. (2) Check if the product is mounted in the correct orientation (IN-OUT).	(1) Open the EXH port. Set the commanded flow rate to 0, turn the power back on, and then perform the zero-clear operation. (2) Mount the product in the correct orientation.
		Product failure		Replace the product.

Problem No.	Problem	Problem possible causes	Investigation method	Countermeasures
8	The display is unstable	Incorrect power supply	Check if the power supply voltage is 24 VDC ±10%.	Power supply voltage is 24 VDC ±10%.
		Incorrect wiring	Check the power supply wiring Check if the brown and blue wires are connected to DC(+) and DC(-) respectively, and if the wiring is secure	Check and correct the wiring.
		Pulsation in the flow.	Check if pulsation is generated due to the fluctuation of the supply pressure or the characteristics of the compressor or pump used as the pressure source.	Replace the pressure source with one that generates less fluctuation or install a tank that reduces pressure fluctuation.
		Insufficient supply pressure, outside of the connected load range	Refer to the characteristic graphs on page 82 to check if the flow rate is within the controllable flow rate range.	Change the supply pressure and connected load and use the product within the controllable flow rate range.
		Unstable analogue input	Check for fluctuations in analogue input, such as ripples.	Supply stable signals.
		Product failure		Replace the product.
9	The display turns off Part of the display is missing	Incorrect power supply	Check if the power supply voltage is 24 VDC ±10%.	Power supply voltage is 24 VDC ±10%.
		Incorrect wiring	Check the power supply wiring Check if the brown and blue wires are connected to DC(+) and DC(-) respectively, and if the wiring is secure	Check and correct the wiring.
		Energy saving mode	Check if power saving mode has been selected.	Change the response time setting.
		Product failure		Replace the product
10	Display flashes	Incorrect wiring	(1) Check the power supply wiring. (2) Check if there is bending stress applied to any part of the lead wire.	(1) Check and correct the wiring. (2) Correct the wiring (bend radius and stress).

Problem No.	Problem	Problem possible causes	Investigation method	Countermeasures
11	The control accuracy does not meet the specifications	Entry or adhesion of foreign matter	(1) Check the flow passage for any foreign matter. (2) Check if foreign matter is caught in the mesh.	Use a filter to prevent foreign matter from entering or sticking. If there is foreign matter on the mesh, remove it completely, taking care not to damage the product.
		Air leakage	Check if air is leaking from the piping.	Rework the piping. If the tightening torque is exceeded, the mounting screws and the product may be damaged.
		Warming up time inadequate	Check if the product satisfies the specified accuracy 10 minutes after supplying power.	After energizing, the display and output can drift. Allow the product to warm up for 10 to 15 minutes.
		Product failure		Replace the product.
12	Display measurement unit cannot be changed	Model Selection (model selected does not have unit selection function)	Check if the product number printed on the product indicates Unit selection function type.	Unit selection function is not available for models which are fixed to SI units. (The kPa↔MPa switch is available) ∗: The units selection function is not for use in Japan due to a new measurement law. ∗: Fixed to SI units: L/min, kPa, MPa
		Product failure		Replace the product.
13	Buttons do not work	Key-lock mode is activated.	Check if the key-lock function is turned on.	Deactivate key-lock mode.
		Product failure		Replace the product.
14	The operation is unstable (chattering)	Incorrect wiring/broken lead wire	(1) Check the power supply wiring. (2) Check if there is bending stress applied to any part of the lead wire. (bending radius, tensile force to the lead wire)	(1) Check and correct the wiring. (2) Correct the wiring. (Reduce the tensile force or increase the bending radius.)
		Product failure		Replace the product.

○Troubleshooting (IO-Link communication function)



○Troubleshooting list (IO-Link communication)

Problem No.	Problem	Description	Problem possible causes	Investigation method	Countermeasures
1	IO-Link indicator light : OFF	—	incorrect wiring	Check the connection of the connector.	Correct the cable wiring.
			Power supply error from the IO-Link master	Check the power supply voltage from the IO-Link master.	Supply 18 to 30 VDC to the IO-Link master.
2	IO-Link indicator light : Flashing	ModE ***	Communication is not established. IO-Link wiring failure	Check the connection and cable condition of the IO-Link cable.	Additionally tighten the IO-Link cable. (Replace the cable if it is broken.)
		Er 15 V 1.0	IO-Link master and product version are not matched.	Check the IO-Link version of the master and device.	Align the master IO-Link version to the device. *1
		ModE Strt ModE PrE	Communication mode is not transferred to the Operation mode.	Check the setting of the data storage access lock and data storage backup level of the master.	Release the data storage access lock. Or deactivate the setting of the data storage backup level of the master port.
		ModE LoC	Backup and restore required during data storage lock	Check the data storage lock.	Release the data storage lock.
3	Data is swapped by byte.	—	Program data assignment is incorrect.	Check that the Endian type on the master upper level communication transmission format is Big Endian type or Little Endian type.	Assign the program data based on the Endian type of the transmission format of the master upper level communication. Or set to the master byte swap setting. (Refer to page 53 for the Endian type of the upper level communication.)

∗1: When the product is connected to the master with version "V1.0", error Er15 is generated.

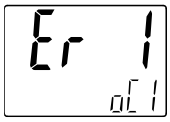
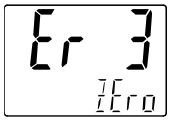
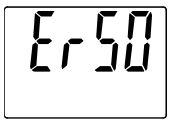
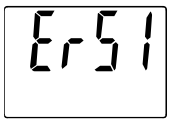
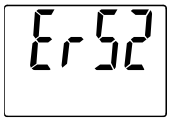
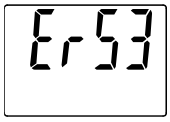
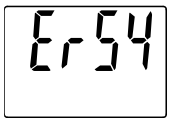
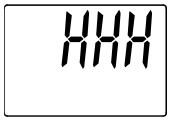
○IO-Link status list

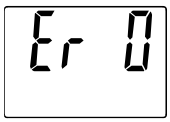
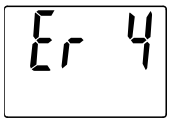
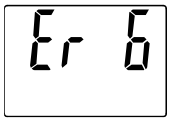
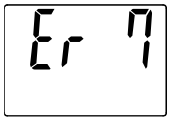
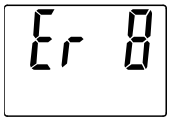
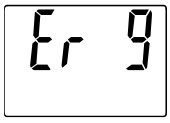
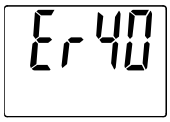
Sub display indication	Details
dS rEAd	Data storage uploading
dS Wr it	Data storage downloading
bP rEAd	Block parameter uploading
bP Wr it	Block parameter downloading
ini ooo	Receiving restore Factory Setting
rPb ooo	Receiving Peak Bottom Clear
ZEro ooo	Receiving Zero Clear
rAPP ooo	Receiving Application Reset

∗: When the operation is completed, the display will return to normal.

○Error display function

This function is to display error location and content when a problem or error has occurred.

Error	Error indication	Description	Measures
Over current error		The switch output load current is 80 mA or more.	Turn the power off and remove the cause of the over current. Then supply the power again.
Residual pressure error		During the zero-clear operation, pressure greater than ±50 kPa is applied. Note that the measurement mode is returned automatically in 1 second. The zero-clear range varies by ±10 kPa due to variation between individual products.	Adjust the applied pressure to atmospheric pressure and retry the zero-clear operation.
Controlled flow rate not reached error		The controlled flow rate does not reach the commanded flow rate within 5 sec.	(1) Refer to the graphs on page 82 to use the product within the controllable flow rate range. (2) Review the environment of installation space, including the pipe diameter.
Connected load error		The operating pressure range is exceeded due to the connected load.	Check if the load pressure is within the operating pressure range.
Control error	  	(1) The internal solenoid valve or sensor is not operating normally. (2) The product is possibly mounted in the opposite orientation (IN-OUT).	(1) Check if the power supply voltage is 24 VDC ±10%. Turn the power off, then turn it on again, then perform the zero-clear operation. (2) Mount the product in the correct orientation.
Excess flow rate error		The flow rate has exceeded the upper limit of the displayable flow range.	The flow display resumes when the flow rate falls within the displayable flow range.

Error name	Error indication	Description	Measures
System error	      	Displayed if an internal data error has occurred.	Turn the power off and on again.

If the error cannot be reset after the above measures are taken, or errors other than above are displayed, please contact SMC for further investigation.

Specifications

Model			IN502-44	IN502-45	IN502-46
Fluid	Applicable fluids *1 *16		Air, Nitrogen		
	Fluid temperature range		0 to 50 °C		
Flow	Rated controlled flow range		50 to 500 L/min	100 to 1000 L/min	200 to 2000 L/min
	Set controlled flow rate range *2		25 to 525 L/min	50 to 1050 L/min	100 to 2100 L/min
	Minimum unit of set controlled flow rate		1 L/min	1 L/min	2 L/min
Pressure	Operating pressure range	Supply pressure *3	1.0 MPa or less *5		
		Load pressure *4	0.1 to 0.6 MPa (when the flow rate is 100% F.S) *5		
	Rated measurement pressure range (Outlet pressure)		0.000 to 1.000 MPa		
	Measured pressure range (Outlet pressure)		-0.050 to 1.050 MPa		
	Accuracy pressure (Outlet pressure)		±5%F.S. (Reference value)		
	Withstand pressure		1.0 MPa		
Temperature *17	Rated measurement temperature range		0 to 50 °C		
	Measured temperature range		-20 to 100 °C		
	Accuracy temperature		±10%F.S. (Reference value) *18		
Electrical specifications	Power supply voltage		24 VDC ±10%		
	Current consumption *6		0.2 A or less		
	Protection		Polarity protection		
Control specifications	Control accuracy *7 *8		±5% F.S.		
	Flow measuring accuracy *9		±3%F.S.		
	Temperature characteristics		±5% F.S. (0 to 50 °C, 25 °C standard)		
	Pressure characteristics		±5% F.S. (operating pressure range, standard pressure *10 standard)		
	Settling time		Reach in the range of ±5% F.S. of the commanded flow rate in 0.5 s or less (at the standard pressure *10)		
Analogue output *11	Voltage	Output type	Voltage output: Select from 1 to 5 V or 0 to 10 V		
		Output impedance	Approx. 1 kΩ		
	Current	Output type	Current output: 4 to 20 mA		
		Load impedance	Approx. 50 to 600 Ω		
Analogue input *11 (During SIO mode)	Voltage	Input type	Voltage input: Select from 0 to 5 V or 0 to 10 V		
		Input impedance	Approx. 1 MΩ		
	Current	Input type	Current input: 4 to 20 mA		
		Input impedance	Approx. 50 Ω		

Model			IN502-44	IN502-45	IN502-46
Switch output (During SIO mode)	Output type		Select from NPN or PNP open collector output		
	Output mode		Limit deviation tolerance, error output, output OFF		
	Switch operation		Normal output, reverse output		
	Maximum load current		80 mA		
	Maximum applied voltage (Only NPN)		30 VDC		
	Internal voltage drop (Residual voltage)		1.5 V or less (at 80 mA load current)		
	Delay time *12		5 ms or less, variable from 0 to 60 s/0.01 s increments		
	Protection		Over current protection		
Indication	Flow rate	Reference condition	Select standard or reference condition		
		Unit *13	L/min, cfm (ft^3/min)		
		Displayable range *2	25 to 525 L/min	50 to 1050 L/min	100 to 2100 L/min
		Minimum display unit	1 L/min		2 L/min
	Pressure	Units *14	kPa, MPa, kgf/cm^2, bar, psi		
		Displayable range	-50 to 1050 kPa		
		Minimum display unit	1 kPa		
	Display method		LCD		
	Number of displays		3 (1 main display and 2 Sub displays)		
	Display colour		Main display: red/green, Sub display: orange		
	Displayed digits		Main display: 4-digit 7-segment Sub display (left): 4 digits (partially 11-segments, 7-segments for other) Sub display (right): 5 digits (partially 11-segments, 7-segments for other)		
	Operation LED		Turns ON when switch output is ON (OUT1: Orange)		
Environmental resistance	Protection		IP65		
	Withstand voltage		1000 V AC for 1 minute between terminals and housing		
	Insulation resistance		50 MΩ or more between terminals and housing (with 500 VDC megger)		
	Operating temperature range		Operation: 0 to 50°C, Storage: -10 to 60°C (no condensation)		
	Operating humidity range		Operation and storage: 35 to 85% RH (no condensation)		
Piping			Rc1/2		
Material of fluid contact parts			Aluminum alloy, POM, SUS304, steel, brass, Si, NBR, HNBR, FKM		
Standards			CE/UKCA marked, UL/CSA (E508758)		
Weight	Body		Approx. 760 g (excluding lead wire with M12 connector)		

∗1: The air quality class is JIS B 8392-1:2012[2:6:3] and ISO8573-1:2010[2:6:3].

∗2: Changes according to the setting of the zero-cut function.

∗3: The operating supply pressure range refers to the range of pressure that can be applied to the primary side of the product.

∗4: The operating load pressure range refers to the range of pressure of the secondary side of the product that is generated by a load connected to the secondary side of the product.

∗5: Refer to the graphs on page 82 for the operating pressure and controllable flow rate.

∗6: When the commanded flow rate is 0, the internal solenoid valve is driven for 1 second every 30 seconds, which causes the current consumption to increase temporarily.

∗7: When the controlled flow rate falls within the range of the commanded flow rate ±1% F.S. (control deadband), the control operation halts.

∗8: Including repeatability±1%F.S. and control deadband±1%F.S.

∗9: Indicates display accuracy and analog output accuracy relative to controlled flow rate.

∗10: Under the condition of 0.6 MPa supply pressure and 0.1 MPa load pressure (when the flow rate is 100% F.S.).

∗11: Refer to the analogue input/output graphs on page 80.
∗12: Internal filter of the analogue input is excluded. Refer to page 80 for time constant of the internal filter.
∗13: This setting is only available for models with the units selection function. Only L/min is available for models without this function.
∗14: This setting is only available for models with the unit selections function. Only MPa or kPa is available for models without this function.
∗15: Any products with tiny scratches, smear, or variation in the display colour or brightness which does not affect the performance of the product, are verified as conforming products.
∗16: When gas other than the applicable fluids is used, perform conversion using the following formula. (However, the usable gas is limited to non-corrosive and non-flammable gas).

$$\text{Flow rate of gas in use} = \text{Flow rate of air} \times \sqrt{\frac{1.293}{\text{Density of gas in use }*}}$$

∗: Density of gas in use: unit [kg/m^3] (0 °C, 1 atm)

Conversion example) When it is intended to flow argon gas (density: 1.784 [kg/m^3]) at 300 L/min

$$300 = \text{Flow rate of air} \times \sqrt{\frac{1.293}{1.784}}$$

According to the above, the air flow rate = 352. Therefore, setting the command flow rate to 352 L/min controls the argon gas flow rate to 300 L/min.

<Caution>
•The flow rate obtained by the above is a reference value, and does not guarantee the product specifications.
•Gas is discharged to the outside of the product through the EXH port due to the control action. Therefore, use the product by giving consideration to safety.

∗17: Only when IO-Link communication is used.
∗18: Errors may occur depending on the ambient temperature. Use this as a guideline.

○Communication specification (During IO-Link mode)

IO-Link type	Device
IO-Link version	V1.1
Communication speed	COM2 (38.4 kbps)
Configuration file	IODD file ∗19
Min. cycle time	5.5 ms
Process data length	Input Data: 8 byte, Output Data: 2 byte
On request data communication	Available
Data storage function	Available
Event function	Available
Vendor ID	131 (0x0083)
Device ID	IN502-44-5/6/13/14: 575(0x00023F) IN502-44-7/8/15/16: 576(0x000240) IN502-45-5/6/13/14: 577(0x000241) IN502-45-7/8/15/16: 578(0x000242) IN502-46-5/6/13/14: 727(0x0002D7) IN502-46-7/8/15/16: 726(0x0002D6)

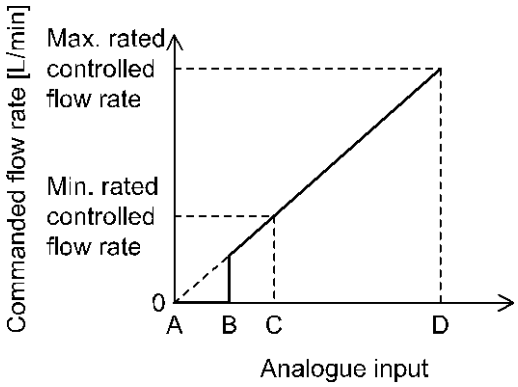
∗19: The configuration file can be downloaded from the SMC website, https://www.smcworld.com.

■Characteristics data

●Flow rate/Analogue input

Analogue input values are converted into corresponding controlled flow rates.

∗: An approximately 25 msec time constant filter is applied to the analogue input.

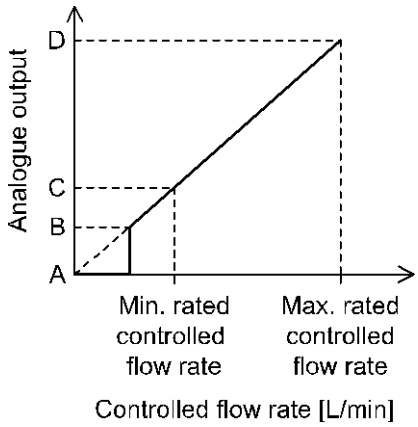


Input specifications		Analogue input values			
		A	B ∗1	C	D
Voltage	0 to 5 V	0 V	0.25 V	0.5 V	5 V
	0 to 10 V	0 V	0.5 V	1 V	10 V
Current	4 to 20 mA	4 mA	4.8 mA	5.6 mA	20 mA

∗: If an analogue input of 110% F.S. or more is entered, the sub display (left) displays [Sv] and the sub display (right) displays [o.r.].

●Flow rate/Analogue output

Analogue output values are output in accordance with controlled flow rates.



Output specifications *2		Analogue output value			
		A	B *1	C	D
Voltage	1 to 5 V	1 V	1.2 V	1.4 V	5 V
	0 to 10 V *3	0 V	0.5 V	1 V	10 V
Current	4 to 20 mA	4 mA	4.8 mA	5.6 mA	20 mA

∗1: B changes according to the setting of the zero-cut function. The values in the table are for 5% F.S. (initial value). Refer to page 32.

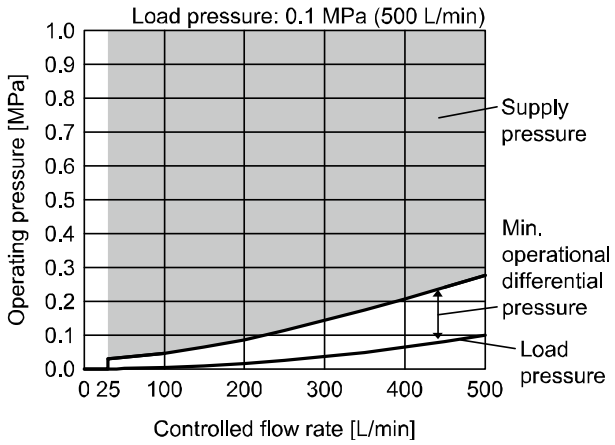
∗2: The analogue output is generated in coordination with the controlled flow rate (indicated flow rate on the main display).

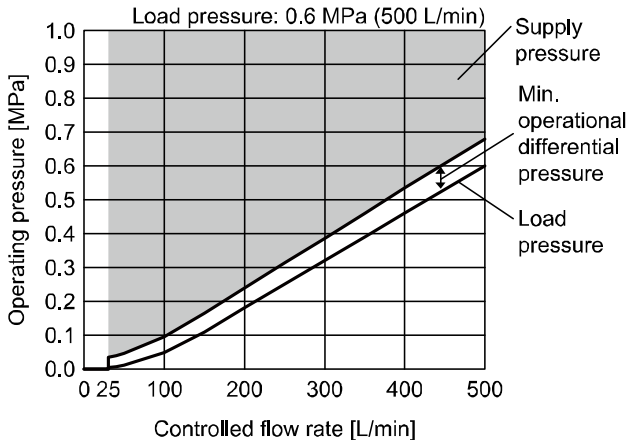
∗3: Set the current that flows from the connected equipment to the analogue output to 20 μA or less when selecting 0 to 10 V. When more than 20 μA current flows, it is possible that the accuracy will not be satisfied below 0.5 V.

Model	Rated controlled flow range	
	Min. value	Max. value
IN502-44	50 L/min	500 L/min
IN502-45	100 L/min	1000 L/min
IN502-46	200 L/min	2000 L/min

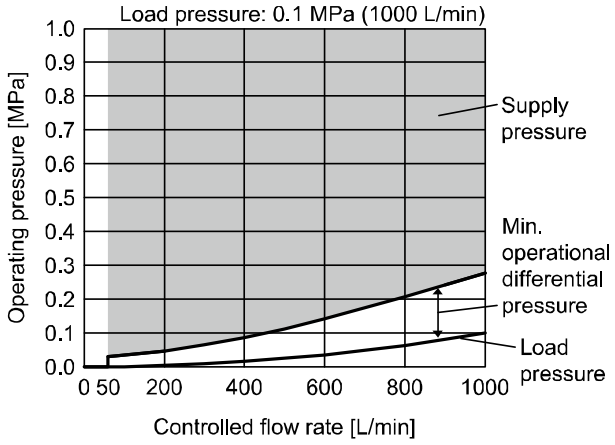
●Relationship between operational pressures and controllable flow rates (reference data)
This data indicates operational differential pressures and supply pressures required for load pressures.
Refer to the graphs below to select a model.

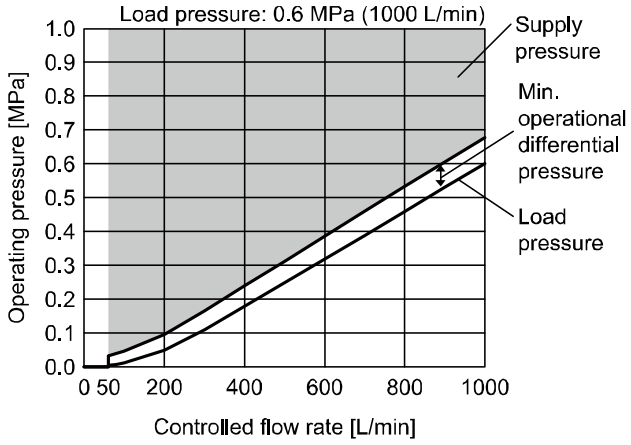
•IN502-44



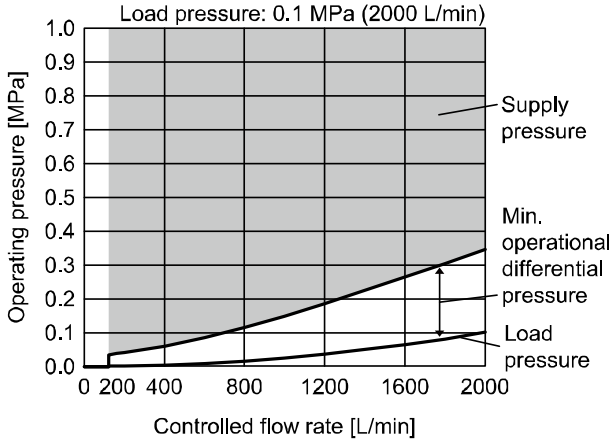


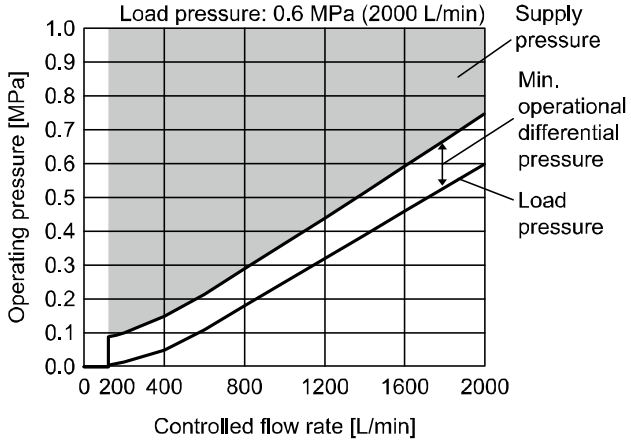
•IN502-45





•IN502-46



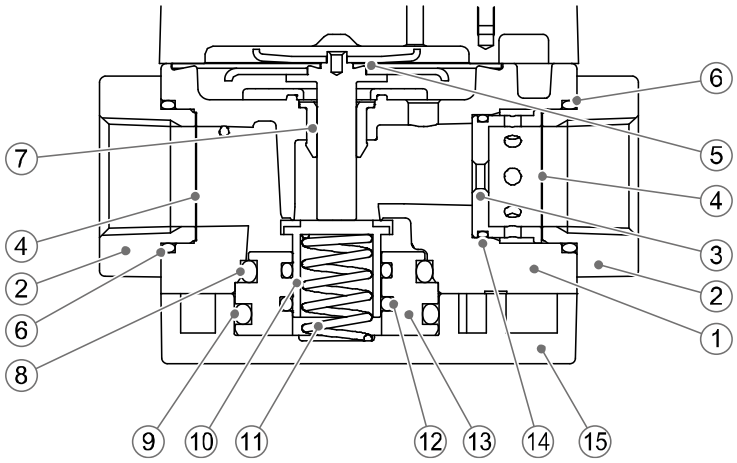


∗: Refer to the displayed secondary pressure value for the load pressure.

∗: The minimum operational differential pressure refers to a differential between supply and load pressures required for the control operation.

∗: The reference conditions of flow rates in the graphs are values in the standard condition.

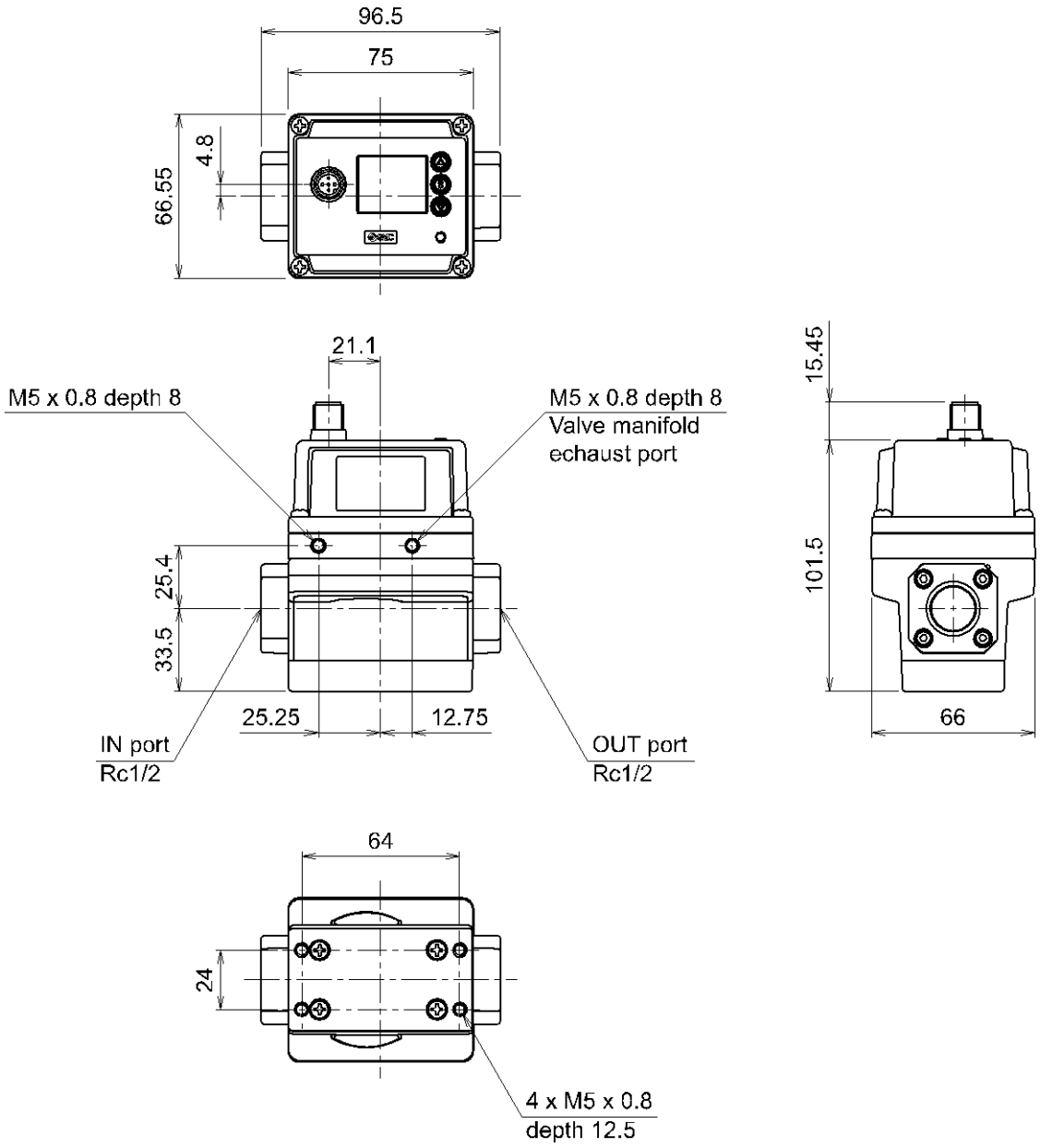
■Parts in contact with fluid parts



Components

No.	Item	Material
1	Main body	Aluminum alloy
2	Attachment	Aluminum alloy
3	Orifice	Brass
4	Rectifying mesh	SUS304
5	Diaphragm assembly	NBR, Stainless steel 304, steel
6	O-ring	HNBR
7	Stem guide	POM
8	O-ring	NBR
9	O-ring	NBR
10	Valve	Brass, HNBR
11	Spring	Steel
12	O-ring	NBR
13	Valve guide	POM
14	O-ring	NBR
15	Bottom plate	Aluminum alloy
-	Sensor unit	Silicon, FKM

■Dimensions


96.5
75
4.8
66.55
21.1
M5 x 0.8 depth 8
M5 x 0.8 depth 8
Valve manifold
echaust port
25.4
33.5
25.25
12.75
IN port
Rc1/2
OUT port
Rc1/2
15.45
101.5
66
64
24
4 x M5 x 0.8
depth 12.5

Accessories

○Lead wire with M12 connector (Separate line on one side)

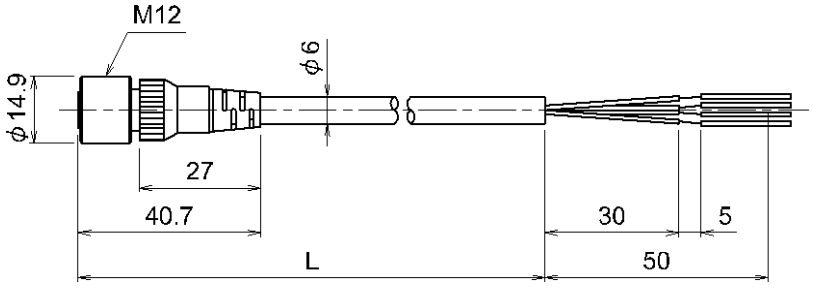
Product number: EX500-AP0 1 0- S

Connector

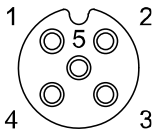
S	Straight
A	Angle

Cable length (L)

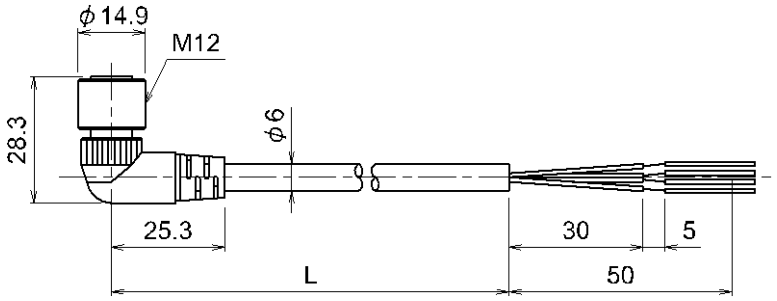
1	1000 [mm]
5	5000 [mm]



EX500-AP0#0-S



Socket connector
pin assignment
A-coded
(Normal key)



EX500-AP0#0-A

Item	Specification
Cable O.D.	ϕ6 mm
Nominal cross section	AWG22
Power supply diameter (Including insulator)	1.5 mm
Minimum bend radius (When fixed)	40 mm

•Used as switch output device

Pin No.	Colour	Details
1	Brown	DC(+)
2	White	Analogue input
3	Blue	DC(-)
4	Black	OUT1
5	Grey	Analogue output

•Used as IO-Link device

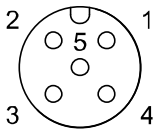
Pin No.	Colour	Details
1	Brown	L(+)
2	White	N.C.
3	Blue	L(-)
4	Black	C/Q
5	Grey	N.C./Analogue output

○Lead wire with M12 connector (Connector on both sides)

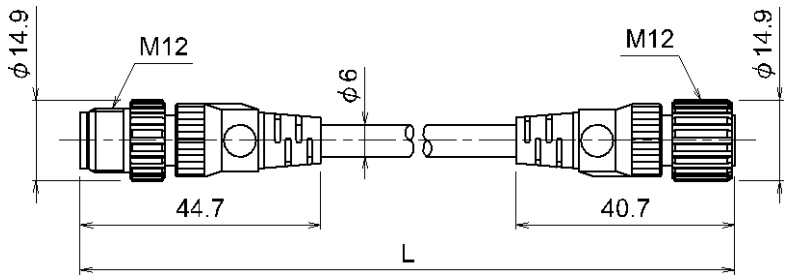
Product number: EX9-AC 005- SSPS

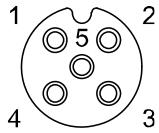
Cable length (L)

005	500 [mm]
010	1000 [mm]
020	2000 [mm]
030	3000 [mm]
050	5000 [mm]
100	10000 [mm]



Plug connector pin assignment A-coded (Normal key)





Socket connector pin assignment A-coded (Normal key)

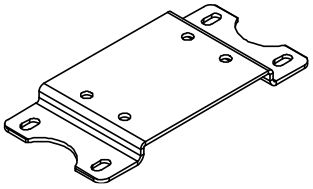
Item	Specification
Cable O.D.	ϕ6 mm
Nominal cross section	AWG22
Power supply diameter (Including insulator)	1.5 mm
Minimum bend radius (When fixed)	40 mm

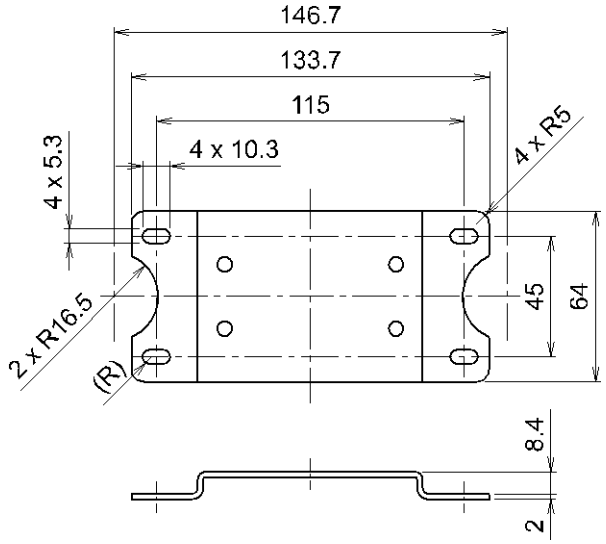
Socket Pin No.	Details	Plug Pin No.
1	DC(+)	1
2	Analogue input	2
3	DC(-)	3
4	OUT1	4
5	Analogue output	5

○Bracket A

ZS-56-A

The 4 cross recessed round head screws (M5 x 10L) is included in the package.

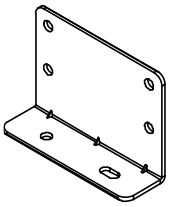


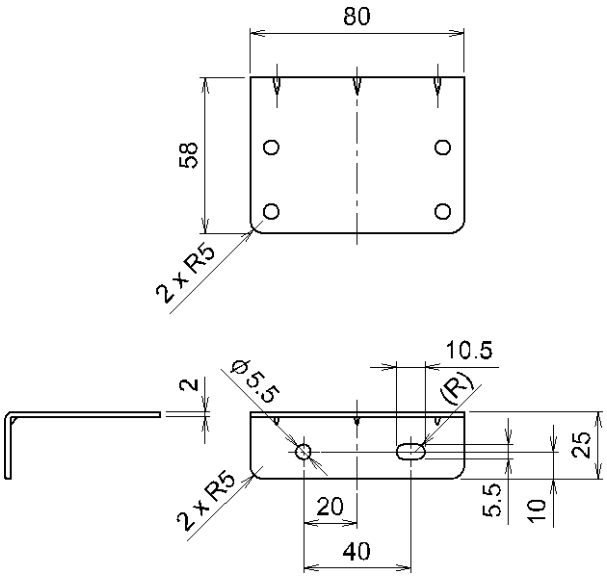


○Bracket B

ZS-56-B

The 4 cross recessed round head screws (M5 x 10L) is included in the package.

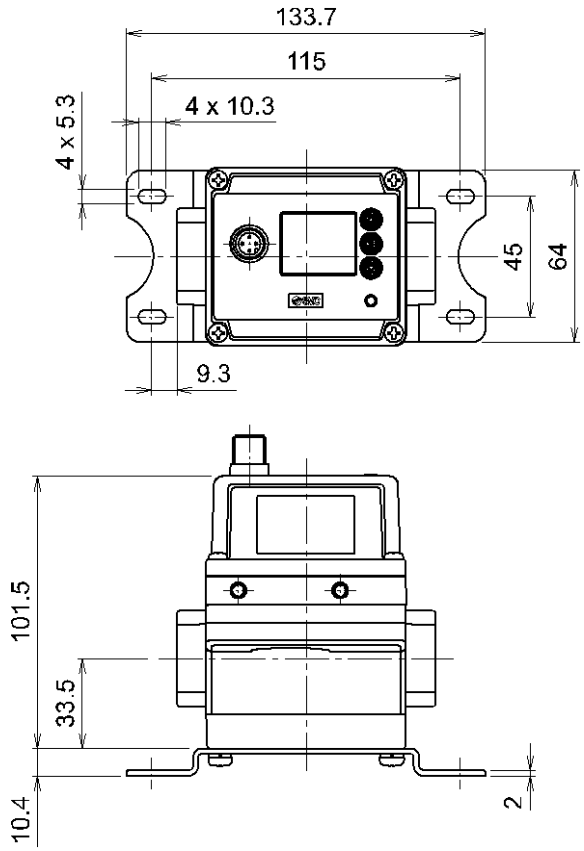




Dimensions with accessories installed

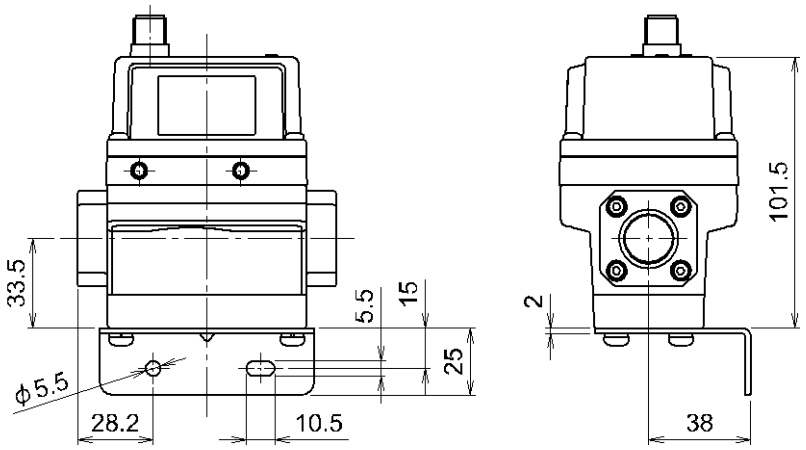
○Bracket A attached

ZS-56-A



○Bracket B attached

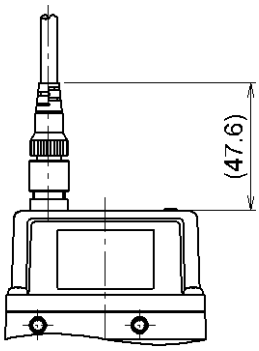
ZS-56-B



○Lead wire with M12 connector attached

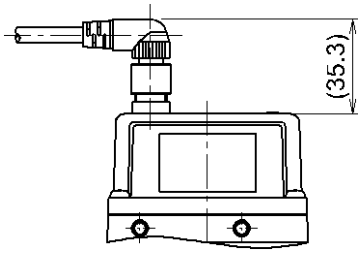
Straight connector type

EX500-AP#-S/EX9-AC#-SSPS



Angle connector type

EX500-AP#-A



Revision history
A: Contents are added. [May 2023] B: Modified errors in text. [Jube 2023] C: Contents are changed. [August 2023] D: Contents are changed. [February 2024]

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No.PS※※-OMZ1003-D