



Operation Manual

PRODUCT NAME

Analogue Auto Switch and
Display Sensor Monitor

MODEL / Series / Product Number

D-MH1AD#

D-MH1B#

SMC Corporation

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Safety Instructions

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

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



Danger

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



Warning

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



Caution

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



Warning

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

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

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

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

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

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

4. 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, with dust.
Fire or an explosion can result.
This product is not designed to be explosion proof.
- 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 terminals and printed circuit board inside the product.
Otherwise it can cause electric shock, malfunction or damage to the product can result.
- After maintenance is complete, perform appropriate functional inspections.
Stop operation if the equipment does not function properly.
Safety cannot be assured in the case of unexpected malfunction.

Cylinders or actuators include cylinders, air grippers, rotary actuators, and electrical actuators/cylinders.

Design/Selection

1. Confirm the specifications.

If the product is used with excess load applied or beyond the specification range, this may cause the product to break or malfunction. We do not guarantee against any damage if the product is used outside of the specification range.

2. Pay attention to the length of time that a switch is ON at an intermediate stroke position.

When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but the operating time will be short if the speed is too fast. As a result, the load may not operate completely. The maximum detectable piston speed is:

$$V[\text{mm/s}] = \frac{\text{Auto switch operating range [mm]}}{\text{Time load applied [ms]}} \times 1000$$

3. Take precautions when multiple cylinders/ actuators are used close together.

When multiple auto switch cylinders/actuators are used in close proximity, magnetic field interference may cause the auto switches to malfunction. Maintain a minimum cylinder separation of 40 mm. (When the allowable interval is specified for each cylinder series, use the indicated value.)

The auto switches may malfunction due to the interference from the magnetic fields.

Use of a magnetic screen plate (MU-S025) or commercially available magnetic screen tape can reduce the interference of magnetic force.

4. Ensure sufficient clearance for maintenance activities.

When designing an application, be certain to allow sufficient clearance for maintenance.

5. Do not mount the cylinder or actuator with the auto switch on a footing.

If work personnel gets on or puts the work personnel's foot on the footing accidentally, an excessive load is applied to the cylinder or actuator, causing the cylinder or actuator to break.

6. Design the circuit so that any back-flow current does not flow in if a short-circuit trouble occurs or forced operation is performed to check the operation.

If a back-flow current occurs, this may cause the switch to malfunction or break.

7. When multiple auto switches are required.

"n" indicates the number of auto switches which can be physically mounted on the cylinders/actuators. Detection intervals depends on the auto switch mounting structure and set position, therefore some required interval and set positions may not be available.

8. Limitations on detectable position

There are positions or surfaces (bottom surface of the foot bracket, etc.) where the auto switch cannot be mounted due to the physical interference depending on the cylinder or actuator mounting status or mounting bracket. Select an appropriate auto switch setting position where the auto switch does not interfere with the cylinder or actuator mounting bracket (trunnion or reinforcing ring) after checking it sufficiently.

9. Keep wiring as short as possible.

Be sure to use a wire length of 100 m or less.

When the wire length is long, we recommend the ferrite core is attached to the both ends of the cable to prevent excess noise. A contact protection box is not necessary for solid state switches due to the nature of this product construction.

10. Do not use a load that generates surge voltage.

If driving a load such as a relay that generates a surge voltage, use a built-in surge absorbing element type device.

11. Pay attention to the internal voltage drop of the auto switch.

Generally, the internal voltage drop of the solid state auto switch is larger than that of the reed auto switch. When the auto switches ("n" pcs.) are connected in series, the voltage drop is multiplied by "n". In this case, the auto switches operate correctly, but the loads may not operate. Additionally, note that the 12 VDC relay does not apply to the auto switch.

12. Pay attention to leakage current.

<2-wire type>

Current (leakage current) flows to the load to operate the internal circuit when in the OFF state.

Operating current of load (OFF condition) > Leakage current

If the criteria given in the above formula are not met, it will not reset correctly (stays ON).

Use a 3-wire auto switch if this specification will not be satisfied.

Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

13. Output operation of the solid state auto switch is not stable for 50 [ms] after powered ON.

In the output operation immediately after powered ON or AND connection operation, the input device (PLC or relay, etc.) may judge the ON position as OFF output or the OFF position as ON output.

So, please make the setting on the equipment so that the input judgement signal is set disabled for 50 [ms] immediately after powered ON or AND connection.

When using SMC's AHC system (Auto Hand Changing System) Series MA, please also make this setting.

14. Install a rotation stopper to the actuator piston rod.

Use a guide or select an SMC product with a rotation stopping function.

The accuracy may decrease without a rotation stopper.

With some cylinders, the magnet may rotate even when the piston rod does not rotate. The magnet inside some cylinders with guide may rotate.

Mounting/Adjustment

1. Do not drop or bump.

Do not drop, bump, or apply an excessive impact (300 m/s² or more for reed auto switches, 1000 m/s² or more for solid state auto switches) while handling the auto switch. It may cause the auto switch to break or malfunction.

2. Observe the proper tightening torque for mounting an auto switch.

When an auto switch is tightened beyond the range of tightening torque, auto switch mounting screws, auto switch mounting brackets or auto switch may be damaged.

On the other hand, tightening below the range of tightening torque may allow the auto switch to slip out of position.

3. Do not carry a cylinder by the auto switch lead wires.

This may cause disconnection of the lead wire or the internal element to break.

4. Do not use screws other than the set screws installed on the auto switch body to secure the auto switch.

If using other screws, auto switch may be damaged.

5. Mount an auto switch at the center of the operating range.

In the case of 2-color display auto switch, mount it at the center of the green LED illuminating range.

Adjust the mounting position of the auto switch so that the piston stops at the center of the operating range.

(The mounting position shown in the catalog indicates the optimum position at stroke end.)

If mounted at the end of the operating range (around the borderline of ON and OFF), operation will be unstable depending on the operating environment. Also there are some cylinders or actuators with individual setting methods for auto switches. If so, mount it in accordance with the indicated method.

Even if 2-color indication solid state auto switches are fixed at a proper operating range (the green light lights up), the operation may become unstable depending on the installation environment or magnetic field disturbance. (Magnetic body, external magnetic field, proximal installation of cylinders with built-in magnet and actuators, temperature change, other factors for magnetic force fluctuation during operation, etc.)

6. Check the actual actuation status and adjust the auto switch mounting position.

According to the installation environment, the cylinder or actuator may not operate even at its proper mounting position. Even when setting at a midpoint of the stroke, check the actuation status and make the adjustment in the same manner.

Wiring

1. Confirm proper insulation of wiring.

If there is any improper insulation (mixed contact with other circuit, grounding fault, or improper insulation between terminals, etc.) in the wiring, an over-current flows in, causing the auto switch to break.

2. Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines.

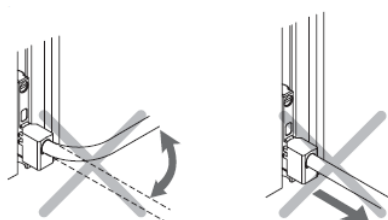
If an inrush current is generated, the noise may cause the auto switch to malfunction.

3. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from repeatedly applying bending stress or stretching force to the lead wires.

Stress and tensile force applied to the connection between the lead wire and auto switch increases the possibility of disconnection.

Keep the lead wire from moving especially in the area where it connects with the auto switch.



4. Be certain to connect the load before power is applied.

<2-wire type>

If the power is turned ON when an auto switch is not connected to a load, the auto switch will be instantly damaged because of excess current (short circuit).

It is the same as when the 2-wire brown lead wire (+, output) is directly connected to the (+) power supply terminal.

5. Carry out the wiring work after shutting down the power.

If the wiring work is performed with the power turned ON, this may cause electric shock, malfunction, or damage to the auto switch.

6. Do not allow short-circuit of loads.

Otherwise, the protection circuit will be activated and the indicator light will flash.

At the same time, the auto switch will be damaged.

7. Avoid incorrect wiring.

1) If connections are reversed on a 2-wire type auto switch, the auto switch will not be damaged if protected by a protection circuit, but the auto switch will always stay in an ON state.

However, it is still necessary to avoid reversed connections, since the auto switch could be damaged by a load short circuit in this condition.

2) If connections are reversed (power supply line + and power supply line –) on a 3-wire type auto switch, the auto switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue wire and the power supply line (–) is connected to the black wire, the auto switch will be damaged.

Operating Environment

1. Never use in an atmosphere of explosive gases, dust.
The structure of auto switches is not intended to prevent explosion. This may lead to explosion hazard.
2. Do not use in an area where a magnetic field is generated.
Auto switches will malfunction or magnets inside cylinders/ actuators will become demagnetized.
3. Do not use in an environment where the auto switch will be continually exposed to water.
Although auto switches satisfy the IEC standard IP67 specifications, do not use in applications continually exposed to water splashing or spray. This may cause improper insulation or malfunction.
4. Do not use in an environment with oil or chemicals.
If auto switches are used in an environment containing coolant, cleaning solvent, various oils, or chemicals even for a short period of time, this may adversely affect the auto switches, resulting in improper insulation, malfunction due to swelling of the potting resin, or hardening of the lead wires.
When using solutions such as cutting oil/grinding oil/cleaning solution, even if there is no problem with a single solution, the workpiece is transported to the next process with the solution from the previous process adhering to it, etc., and multiple solutions may mix and change components, resulting in a short life span.
Depending on the temperature environment and coolant fluid used, water-resistant performance may deteriorate.
5. Do not use in an environment with temperature cycles.
If temperature cycles other than normal temperature changes are applied, this may adversely affect the insides of the auto switches.
6. Avoid accumulation of iron waste or close contact with magnetic substances.
If many iron particles, such as cutting chips or spatters accumulate around a cylinder with the auto switches or an actuator or if a magnetic substance (attracted by a magnet) is put close to a cylinder with the auto switch or an actuator, the magnetic force inside the cylinder or actuator loses, causing the auto switch to malfunction.
7. Do not use in an area where surges are generated.
If there is an equipment unit (electromagnetic lifter, high-frequency induction furnace, motor, or radio, etc.) that generates large surges or electromagnetic waves around cylinders with solid state auto switches or actuators, this may cause the circuit element inside the auto switch to break.
8. Do not use in direct sunlight.
9. Do not mount the product in locations where it is exposed to radiant heat.
10. Take appropriate measures against the lightning surge on the equipment side as the auto switches do not have any lightning surge resistance specified in the CE/UKCA marking.
11. Do not use in environments subject to radiation stress.
It is not designed to withstand radiation, which may cause damage to the malfunction and internal circuit elements of the auto switch.

Maintenance

1. Perform the following maintenance periodically in order to prevent possible danger due to unexpected auto switch malfunction.
 - 1) Secure and tighten auto switch mounting screws.
If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.
 - 2) Confirm that there is no damage to lead wires.
To prevent faulty insulation, replace auto switches or repair lead wires, etc., if damage is discovered.
 - 3) Confirm the detection setting position.
 - Red light of 1-color display auto switch
Confirm that the set position stops at the center of the operating range (red display area).
 - Confirm the green light and position of the 2-color display auto switch.
Confirm that the set position stops at the center of the appropriate operating range (green display area).
If the auto switch shows a red LED while in the ON/OFF position, the mounting position is not correct. Re-adjust the auto switch to the optimum position at the center of the operating range.

Some cylinders or actuators indicate the individual setting procedures for the auto switch. If so, set the mounting position using the individual setting procedures.
2. 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. For heavy stains, use a cloth lightly dampened with diluted neutral detergent, then wipe up any residue with a dry cloth.

Model Indication and How to Order

○Analogue auto switch

D-MH1AD

Electrical entry

Symbol	Contents
Nil	In-line
V	Perpendicular

Lead wire specification

Symbol	Contents
Nil	0.5 m (separate line)
M	1 m (separate line)
L	3 m (separate line)
Z	5 m (separate line)
SAPC	0.5 m (M8 3-pin pre-wired connector)
MAPC	1 m (M8 3-pin pre-wired connector)
SBPC	0.5 m (M8 4-pin pre-wired connector)
MBPC	1 m (M8 4-pin pre-wired connector)
SDPC	0.5 m (M12 4-pin pre-wired connector)
MDPC	1 m (M12 4-pin pre-wired connector)

*: A pre-wired connector cannot directly be connected to the sensor monitor.

○Display sensor monitor

D-MH1B N

Output specification

Symbol	Contents
N	NPN 2 output
P	PNP 2 output

Option 1

Symbol	Contents
Nil	None
L	Lead wire with connector (2 m)

Option 3

Symbol	Contents
Nil	None
C	With connector for sensor

Option 2

Symbol	Contents
Nil	None
A	Bracket
B	Panel mount adapter
D	Panel mount adapter + Front protective cover

○Options/Part numbers

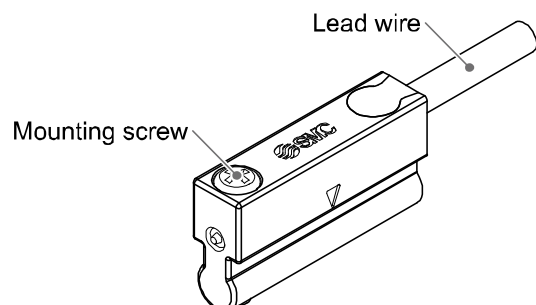
If an option is required independently, order using the following part numbers.

Description	Part number	Remarks
Bracket	ZS-46-A1	With self tapping screw: Nominal diameter 3 x 8L (2 pcs.)
Panel mount adapter	ZS-46-B	-
Panel mount adapter + Front protective cover	ZS-46-D	-
Front protective cover	ZS-27-01	-
Lead wire with connector	ZS-46-5L	5 cores, 2 m
Sensor connector	ZS-28-C ZS-28-CA-2	*: When ordered with the above option part number, the ZS-28-C is included with the product.

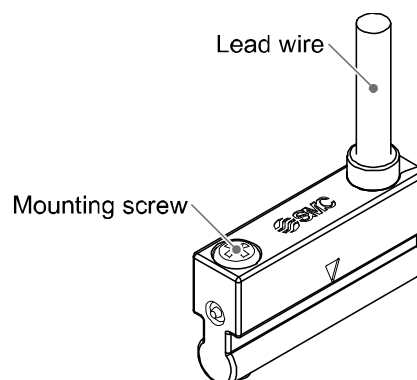
Names and Functions of Product Parts

○Part names (Analogue auto switch)

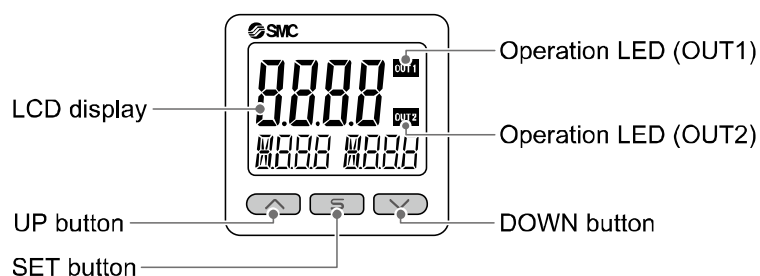
•D-MH1AD#



•D-MH1ADV#



○Part names (Display sensor monitor)



Operation LED: Displays the switch operating condition.

LCD display: Displays the current analogue voltage, setting mode status and error code.

The display method can be selected from four types at the top area of the screen: always in a single red, always in a single green, switching from green to red in conjunction with the output, and switching from red to green in conjunction with the output.

The bottom area of the screen is displayed in a single orange.

UP button: Use this button to select the mode and increase the ON or OFF set value.

DOWN key: Use this button to select the mode and decrease the ON or OFF set value.

SET button: Press this button to change mode and to confirm settings.

■ Definition and terminology

	Term	Definition
B	Bottom hold value display mode	The minimum voltage value up to the present time.
C	Chattering	A phenomenon of repeatedly turning ON and OFF the switch output at high frequencies.
	Copy from sensor monitor	The sensor monitor at the copy source when using the copy function.
	Copy function	A function to copy function settings (excluding settings related to the operating range).
	Copy to sensor monitor	The sensor monitor at the copy destination when using the copy function.
D	Delay time	The setting time from when the signal of the connected analogue ASW reaches the set value to when the ON-OFF output actually begins working. Setting the delay time can prevent the output from chattering.
	Determinable range (Analogue ASW)	The range between the maximum and the minimum peaks in the analogue output waveform when an analogue ASW is mounted to the cylinder, etc. In this range, the magnet position is uniquely determined for an analogue value. (Refer to page 20)
	Digit (smallest settable increment)	An increment of voltage display digit on the sensor monitor, indicating how precisely the voltage can be displayed or set. When 1 digit = 2 [mV], the value is displayed in increments of 2 [mV], e.g., 2, 4, ..., 98, 100.
	Digital filter	A function to add a digital filter to fluctuations in the output signal of the analogue ASW. The function moderates fluctuations in the indicated value in response to a sharp rise or fall of the signal. When the function is used, digital filtering applies to switch output ON or OFF and the analogue response time. Output chattering or flicker in the measurement mode display can be reduced by setting the digital filter. It is 90% response time in relation to the step input.
	Display accuracy (Monitor)	An extent of error between the output voltage of the analogue ASW and the displayed voltage value.
	Display colour	The colour of the digits on the digital display. The display can be selected from four patterns: always green, always red, green (switch OFF) changing to red (switch ON), or red (switch OFF) changing to green (switch ON).
	Display resolution (Resolution)	The number of divisions the rated range can be divided and displayed. Example: If the rated range can be displayed in a 2-mV increment, the resolution is 2/4000.
E	Error indication	A code displayed on the sensor monitor indicating non-conformance that may cause the switch to fail detected by the self-diagnostic function of the product. Refer to "Error Display Function" on page 70 for details of error codes.
F	Function selection mode	A mode used to set various functions. When using the product by changing the settings from the factory default, each setting can be selected using "F*." Specific settings include the operating range setting, display colour, output type, output setting mode, digital filter, display resolution, whether or not to use energy saving mode, and whether or not to use a security code.

	Term	Definition
H	Hysteresis	A difference between the ON and OFF points of the switch. A hysteresis is also referred to as hysteresis. It is a region set outside the ON width on the sensor monitor. Example: If the output point (SP1) is 2688 mV, the ON width (W_1) is 50 mV, and the hysteresis (H_1) is 20 mV: The hysteresis regions of switch output are 2618 to 2638 mV and 2738 to 2758 mV.
	High resolution range (Analogue ASW)	The range where the tilt of analogue output to the cylinder stroke is 0.2 [V/mm] or more in the analogue output waveform when an analogue ASW is mounted to the cylinder, etc. In this range, a minute difference in the cylinder stroke can easily be detected. (Refer to page 21)
I	Insulation resistance	The insulation resistance of the product itself. The resistance between the electrical circuit and the enclosure.
K	Key-lock function	A function that prevents changes to the settings (disables button operation).
M	Maximum applied voltage	The maximum applied voltage that can be connected to the NPN output section (output line) of the sensor monitor.
	Maximum load current	The maximum current that can be flown to the switch output section (output line) of the sensor monitor.
	Most sensitive position (Analogue ASW)	The centre position of the sensor. When the most sensitive position matches the centre of the cylinder magnet, the output of the analogue ASW is approximately 3 V.
N	Normally closed (N.C.)	If the analogue value is outside the operating range set on the sensor monitor, the output signal is ON. It is also referred to as the N.C. type.
	Normally open (N.O.)	If the analogue value is within the operating range set on the sensor monitor, the output signal is ON. It is also referred to as the N.O. type.

	Term	Definition
O	ON width	The ON range of the switch output which is set in a range from minus to plus for the output point set on the sensor monitor. Example: If the output point (SP1) is 2688 mV and the ON width (W_1) is 50 mV: The range of switch output analogue values is 2638 to 2738 mV.
	Operating range	A range of switch output on the sensor monitor in response to a voltage signal of the analogue ASW. In this product, it is the region consisting of the ON width and hysteresis.
	Operation LED	A light that turns ON when the switch output is ON.
	Output impedance	A resistance value of components between the voltage output element and output line in the voltage output of the analogue ASW. The value is converted to a resistance value in a condition where the resistor is connected in series to the voltage output element. An error may occur in the output voltage depending on the output and the input impedance of the customer's connected device. Example: An attempt to detect 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 error of approximately 0.005 V because the detection voltage of that A/D converter is $5 \text{ (V)} \times 1 \text{ (M}\Omega) / (1 \text{ (k}\Omega) + 1 \text{ (M}\Omega)) \approx 4.995 \text{ (V)}$.
	Output point	A setting point to turn ON the switch output on the sensor monitor in response to a voltage signal of the analogue ASW.
	Output setting mode	The number of settable output points can be switched and selected from 2 setting mode and 3 setting mode. In 2 setting mode, two output points corresponding to OUT1 and OUT2 can be set. In 3 setting mode, three output points including the output points in 2 setting mode and an additional simultaneous output of OUT1 and OUT2 can be set. (Refer to page 27)
P	Peak value display (mode)	The maximum voltage value up to the present time.
	Power saving mode	A mode in the sensor monitor function in which current consumption is reduced by turning off the display.
R	Rated range (Monitor)	The voltage range that satisfies the product specifications. A value outside the rated range can be set as long as it is within the setting displayable range, but the specifications are not guaranteed.
	Repeatability	The reproducibility of analogue voltage output or of the ON-OFF output point set on the display at a constant temperature of 25 [°C]. Wobbling of the cylinder/actuator, deformation of the workpiece itself, magnetic field disturbance, and the effect of magnetic body in the surroundings are excluded.
	Residual voltage (Internal voltage drop)	A difference between the ideal ON output voltage and the actual output voltage when the switch output on the sensor monitor is in the ON state. The residual voltage varies with the flowing load current. Ideally it should be 0.
	Ripple	It refers to a pulsation.
S	Settable range	A voltage range for which an operating range can be set.
	Switch output	It is also referred to as switch output (digital output or switch output).
W	Withstand voltage	A measure of the product's resistance to a voltage applied between the electrical circuit and the enclosure. The durability against the voltage of the product. There is a danger of damaging the product if a voltage above this value is applied. (The voltage here is different from the power supply voltage used to operate the product.)

Mounting and Installation

■ Installation method

○ Analogue auto switch

When mounting the analogue auto switch to the cylinder/actuator, a mounting bracket corresponding to the cylinder/actuator should be used.

The mounting method depends on the cylinder/actuator type and tube inner diameter.

When mounting a new sensor, confirm that the cylinder/actuator is of the built-in magnet type and then prepare a mounting bracket corresponding to the cylinder/actuator. A mounting bracket is not necessary for some sensors.

• Correct tightening torque

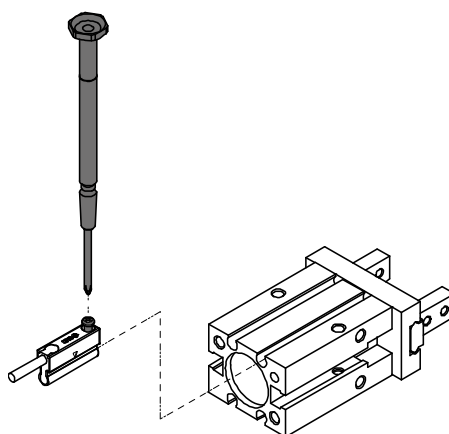
When tightening the mounting screws, use a cross head screwdriver with #0 blade.

The tightening torque should be approximately $0.2 \pm 0.05 \text{ N}\cdot\text{m}$.

If the screws are tightened too tightly, the cylinder/actuator or the switch may be damaged.

If the screws are tightened too loosely, it may cause positional misalignment or malfunction during operation.

*: Do not pull out the mounting screws. Also, do not use mounting screws other than those originally mounted.



○ Display sensor monitor

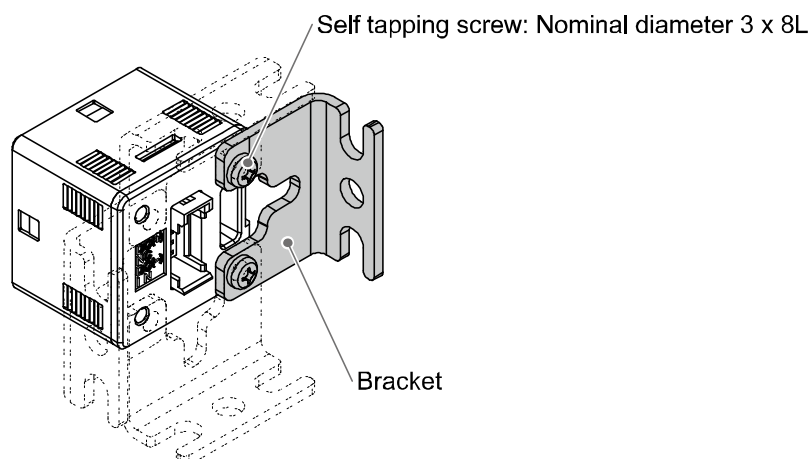
• Mounting with bracket

- Mount the bracket to the body using the mounting screws (self tapping screw: Nominal diameter 3 x 8L (2 pcs.)).

*: Tighten the bracket mounting screws to a torque of $0.5 \pm 0.05 \text{ N}\cdot\text{m}$.

Be aware that since self tapping screws are used, they cannot be mounted or removed more than once.

• Bracket (Part No.: ZS-46-A1)



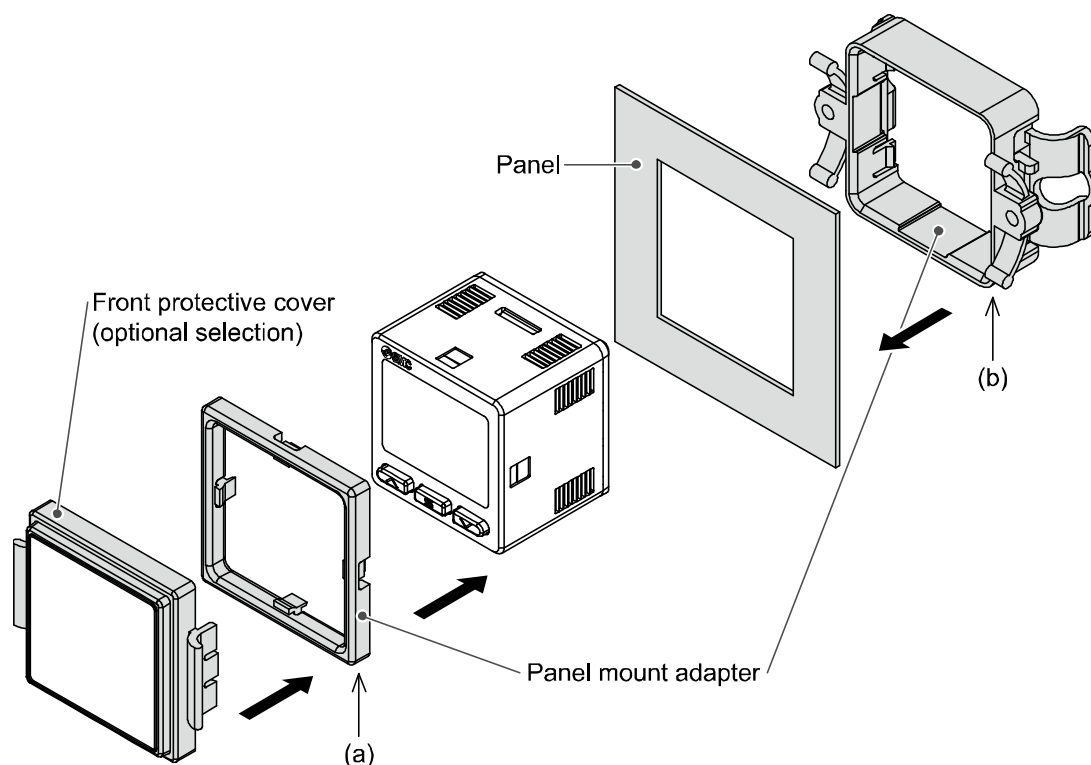
○Mounting with panel mount adapter

- Mount part (a) to the front of the body and fix it. Then insert the body into the panel until (a) comes into contact with the panel front surface.

Next, mount part (b) to the body from the rear of the panel and insert it until (b) comes into contact with the panel where (b) is fixed.

- Panel mount adapter (Part No.: ZS-46-B)

Panel mount adapter + Front protective cover (Part No.: ZS-46-D)

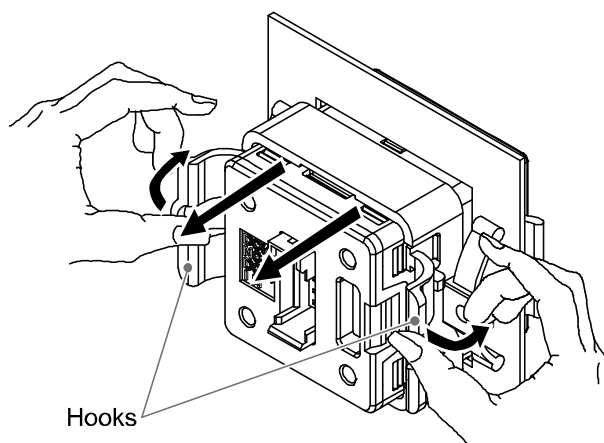


*: The panel mount adapter can be rotated through 90 degrees for mounting.

How to remove the panel mount adapter

- When removing the sensor monitor with panel mount adapter from the equipment, pull it forward while opening up the hooks on both sides as shown in the figure below.

If the panel mount adapter is pulled forward without opening up the hooks, the sensor monitor and the panel mount adapter may be damaged.



■Wiring method

○Wiring connections

- Perform wiring connection work after turning off the power supply.
- 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 using a commercially available switching power supply, be sure to ground the frame ground (FG) terminal. If a commercially available switch-mode power supply is connected for use, switching noise will be superimposed and the product specifications will not be met. 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.

○Internal circuit and wiring examples

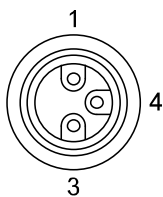
Analogue auto switch



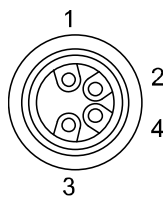
*: The figure inside the parentheses () indicates the connector pin number.

Wiring		Definition
Connector pin number	Wire colour	
1	Brown	Power supply DC (+)
3	Blue	Power supply DC (-)
4	Black	Analogue voltage (1 to 5) output

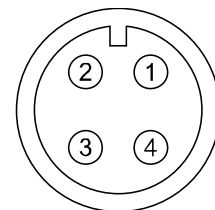
Wiring specifications (Pre-wired connector)



M8 3-pin connector



M8 4-pin connector

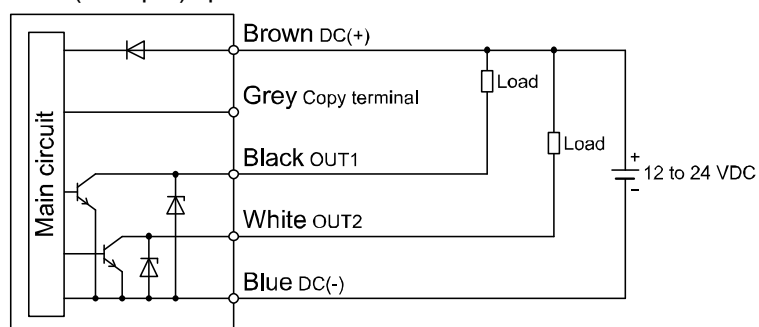


M12 4-pin connector

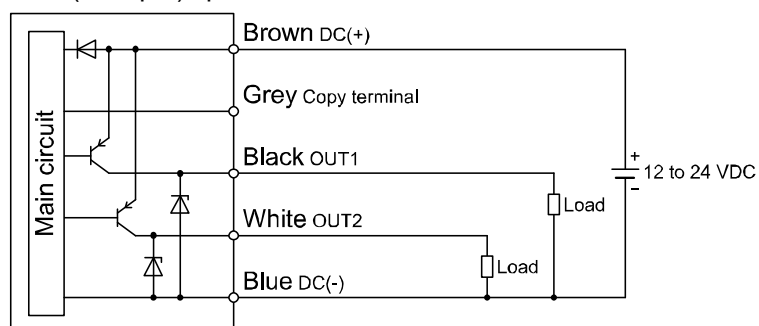
*: A pre-wired connector cannot directly be connected to the sensor monitor.

Display sensor monitor

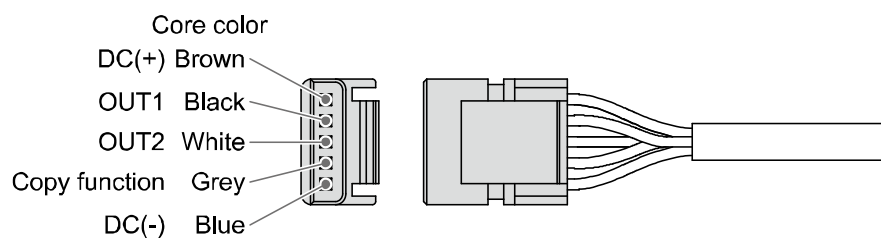
NPN (2 output) specification



PNP (2 output) specification

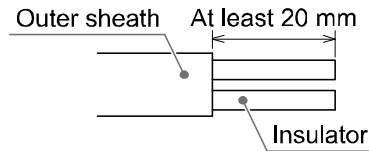


Power supply/output connector pin assignment



○Connection between the analogue auto switch and the sensor monitor

- Prepare the analogue ASW cable as shown in the figure below.



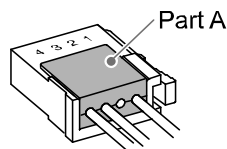
Sensor connector compliance table

SMC product No. (1 pc.)	Conductor cross sectional area (mm ²)	Outside diameter (O.D.) (mm)	Colour of cover
ZS-28-C	0.14 to 0.2	φ0.8 to φ1.0	Red
ZS-28-CA-2	0.1 to 0.5	φ0.9 to φ1.0	

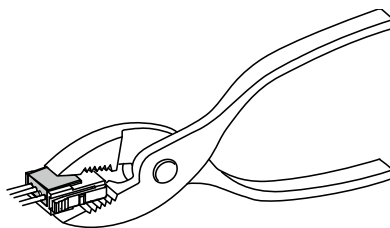
- Do not cut the insulator.
- Insert connectors with the marked sensor connector numbers and the corresponding cable core colours as shown in the table below, to the end.

Connector marking No.	Cable core colour
1	Brown (DC (+))
2	Not connected
3	Blue (DC (-))
4	Black (OUT: 1 to 5 V)

- Check the connector Nos. and core colours and that the cables are inserted to the end, and temporarily connect them by pushing down part A by hand.



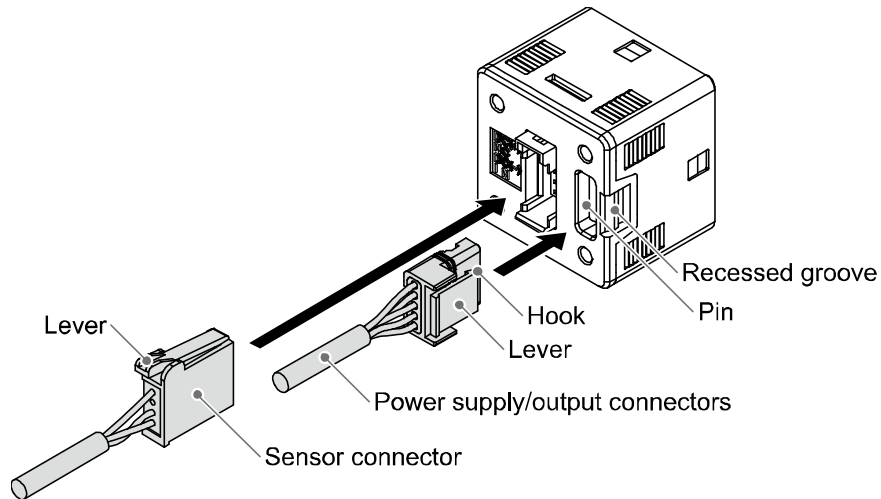
- Hold around the centre of part A and push it straight into connector enclosure using pliers, etc.



- The sensor connector cannot be used again after it has been pressure welded once.
If the core wire orders were mistaken or inserting the cables failed, use a new connector.
- If the sensor is not connected correctly, "LLL" may be displayed on the sensor monitor.

Connector attachment/detachment

- When mounting the connector, insert it straight to the pins while holding the lever and connector body and lock the connector by pushing the lever finger into the recessed groove in the housing.
- To pull out the connector, while pushing the lever downward to remove the finger from the recessed groove, pull it straight out.

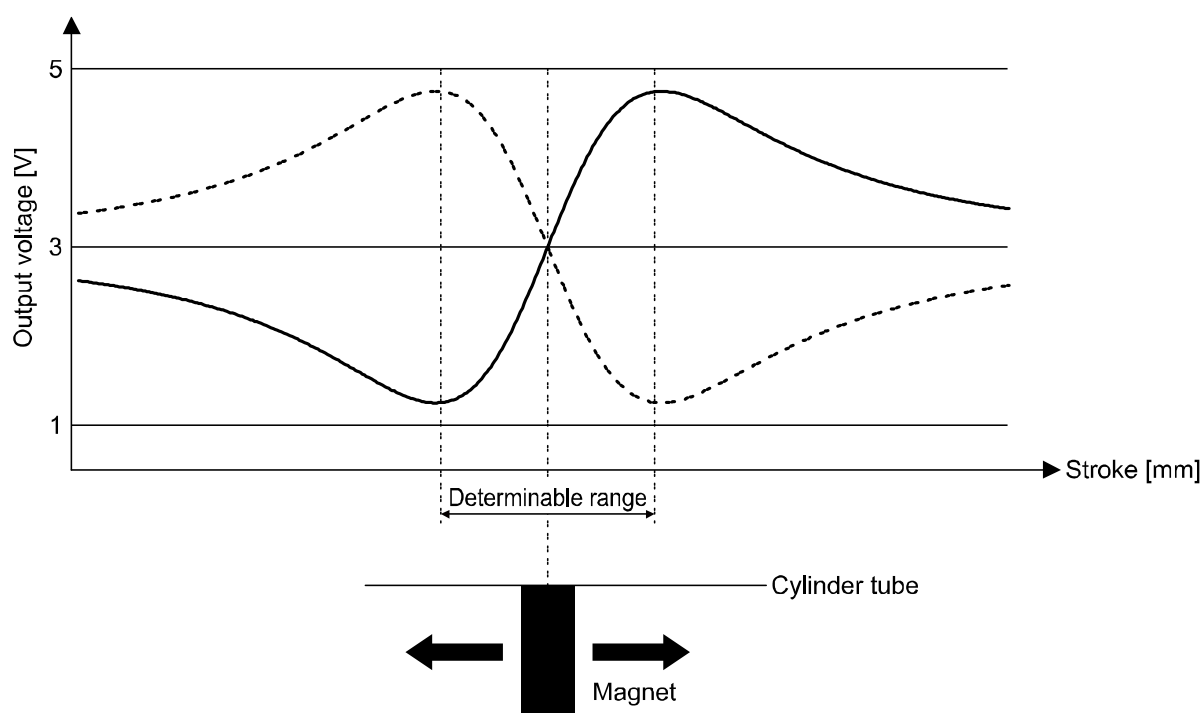


Analogue Auto Switch Overview

When a power voltage is supplied to the analogue ASW, it outputs an analogue voltage of 1 to 5 V according to the magnetic force of the magnet built in the cylinder/actuator. By mounting an analogue ASW on the actuator and reading the analogue output value, the position of the magnet can be detected.

- *: When not using a monitor, the customer needs to configure settings including determining the analogue threshold value on the program on their equipment.
- *: Since the magnetic force of magnets varies, the analogue value is different depending on the actuator.
- *: Some cylinders or actuators may not output a voltage of 1 to 5 V.
- *: If a magnet is not closely located or the most sensitive position of the analogue ASW matches the centre of the magnet, a voltage of approximately 3 V is output.
- *: The analogue output waveform is inverted due to the difference in the N and S poles of the magnet.
(The polarity may not be consistent depending on the actuator model).
- *: The analogue output may fluctuate due to the ambient environment (temperature, magnetic body, terrestrial magnetism, etc.).
Be sure to check the operation of the actual device before use.

○Example of analogue output



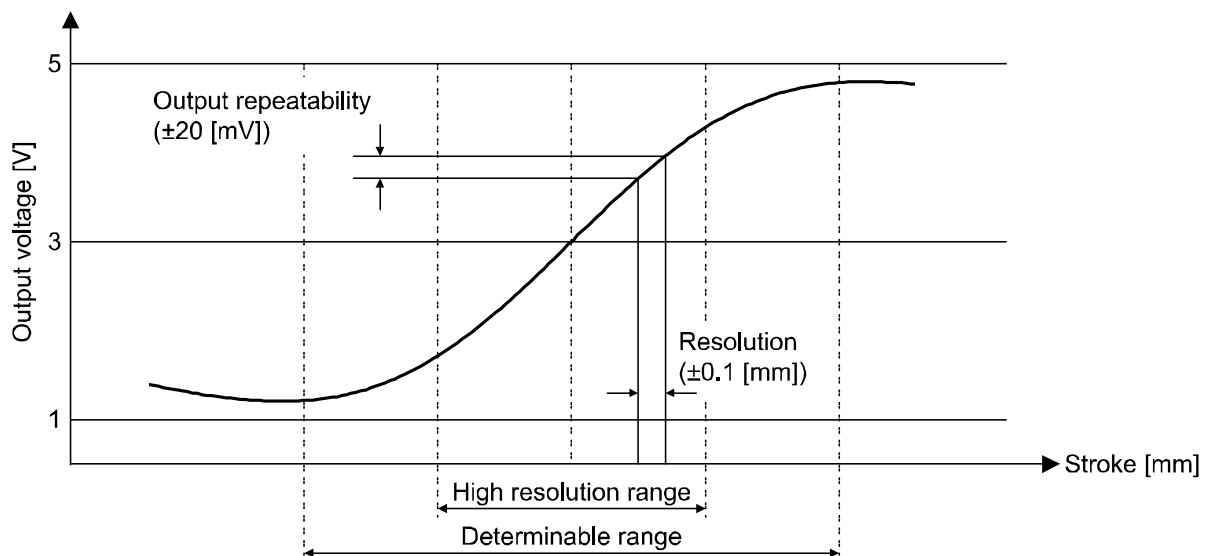
- The range between the peaks in an analogue output waveform is considered as the determinable range. In the determinable range, the stroke position is uniquely determined by the analogue value. Basically, however, there are always two points with the same analogue value.
(The determinable range varies depending on the actuator type and the bore size).

○High resolution range

The range where the angle of the analogue output waveform to the stroke is 0.2 [V/mm] or more in the above determinable range of an analogue output waveform is considered as the high resolution range. As long as it is within the high resolution range, a stroke difference of about ± 0.1 mm* can be distinguished. When using an analogue ASW to distinguish a minute dimensional difference, adjust the mounting position of the analogue ASW so that the position to distinguish will be in the high resolution range.

*: Analogue output fluctuations due to the effect of the ambient environment and effects including the wobbling of the actuator and a deformation of the workpiece are excluded.

○Example of analogue output *: Enlarged view

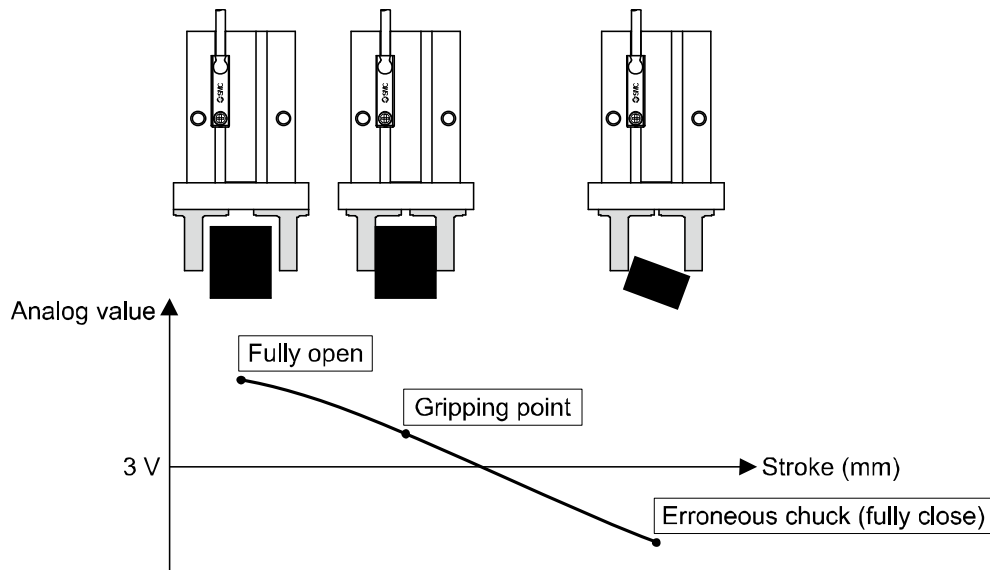


*: Contact SMC for applicable actuators, determinable range for each actuator, and a rough high resolution range value.

○Full-stroke detectable actuator

An actuator in which the full stroke is smaller than the determinable range is considered as a full-stroke detectable actuator.

By mounting an analogue ASW so that the mid point of the stroke and that of the determinable range (approximately 3 V output) match, the entire stroke of the actuator can be determined with one unit of analogue ASW.

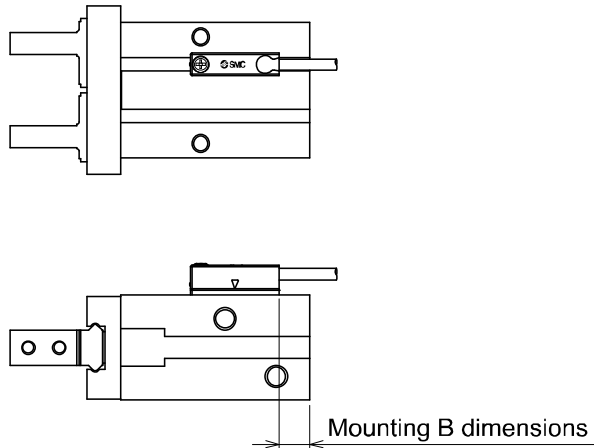


*: The above relationship may no longer be met when the magnetic force fluctuates due to the ambient environment.
Be sure to check the operation with the actual equipment.

○ Mounting an analogue auto switch

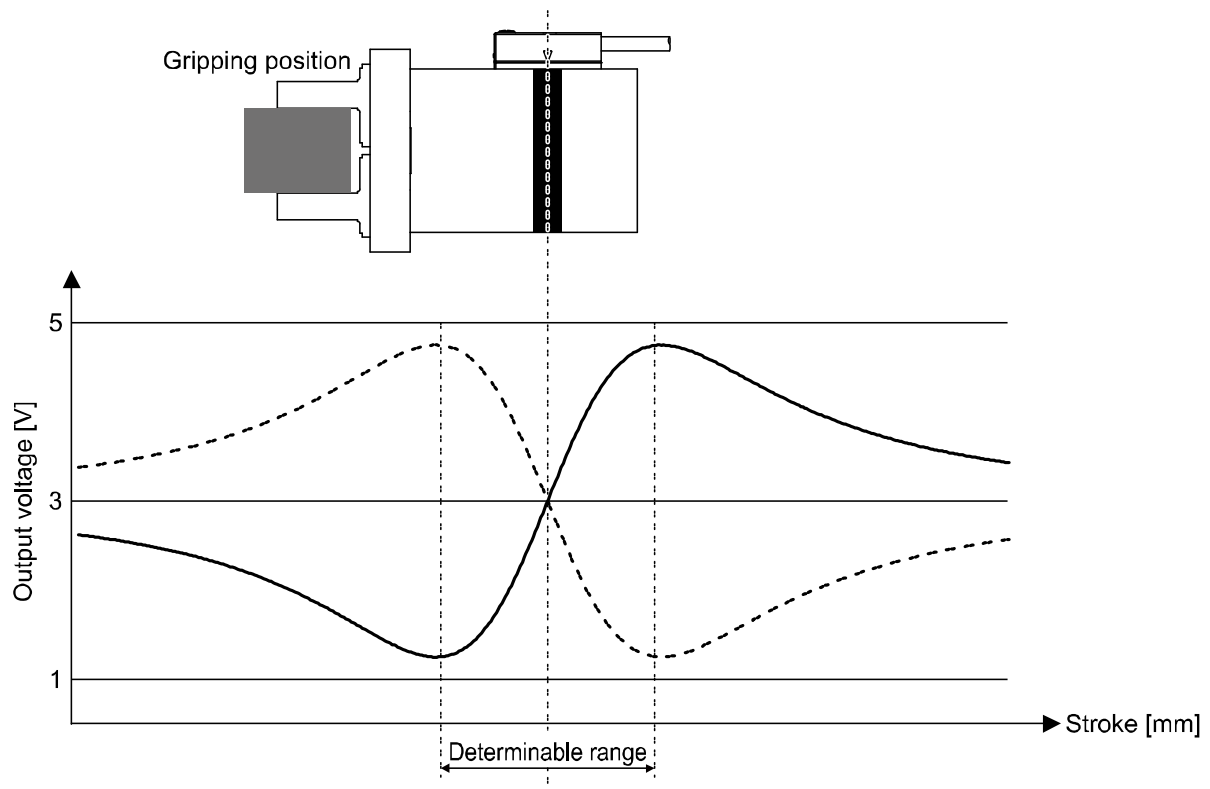
• Full-stroke detectable actuator

With a full-stroke detectable actuator, by mounting the analogue ASW at the recommended position, the position can be determined throughout the entire stroke.



• Other actuators

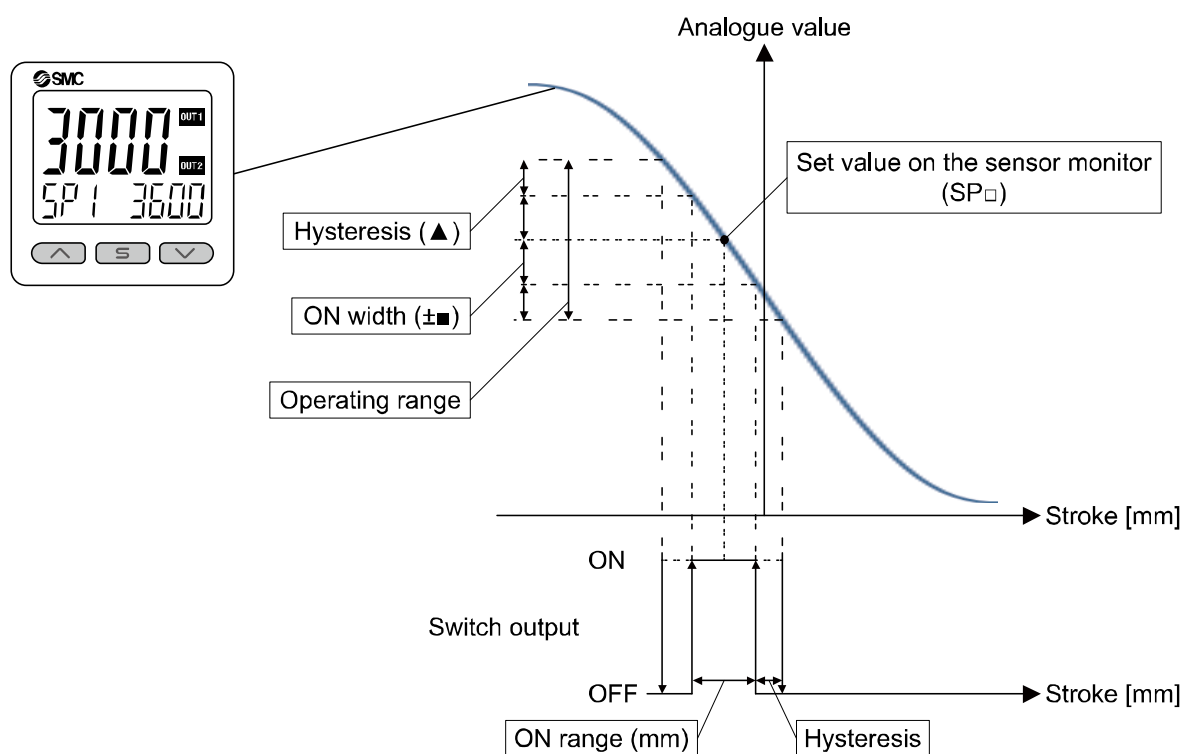
Adjust the analogue ASW position so that the point that needs to be detected (workpiece gripping position, etc.) will be close to the centre (approximately 3 V output) of the determinable range.



Display Sensor Monitor Overview

By using the analogue ASW and the sensor monitor in combination, the switch output can be obtained according to the analogue value. An analogue ASW can be used without an analogue input card, etc. When the analogue ASW and the sensor monitor are connected, the output voltage of the analogue ASW is displayed on the sensor monitor.

By operating the sensor monitor, it is possible to configure settings so that the switch output can be displayed according to any analogue value.



When output points (SP1 to SP3) are set as voltage values on the sensor monitor, the ON width and the hysteresis are set before and after each of the output points.

The ON width and the hysteresis can be changed for each of SP1 to SP3.

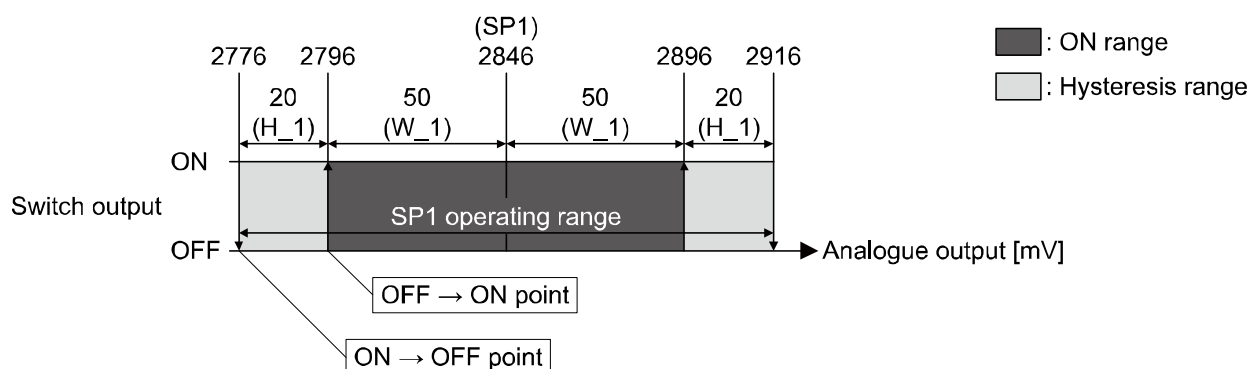
The chattering of switch output can be prevented by setting a hysteresis.

<Setting example>

Output point (SP1): 2846 [mV]

ON width (W₁): 50 [mV]

Hysteresis (H₁): 20 [mV]



*: The ON width plus the hysteresis range is defined as the operating range.

○ Selection of 2 setting mode or 3 setting mode

The 2 setting mode or 3 setting mode can be set by operating the sensor monitor. (Set to 3 setting mode by the factory default settings) (Refer to page 37)

• 2 setting mode

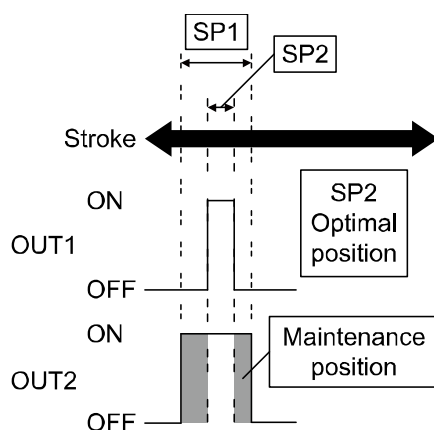
In this mode, two points, SP1 and SP2, can be set.

The set operating range for each of the points may be overlapping.

*: There is no limit in the magnitude correlation between SP1 and SP2.

<Setting example>

For applications such as the determination of a non-standard workpiece size and the diagnosis on the time of maintenance based on the misalignment of the switch itself



• 3 setting mode

In this mode, three points, SP1, SP2 and SP3 can be set.

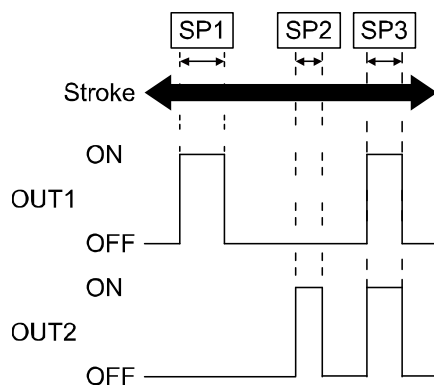
When SP3 is ON, OUT1 and OUT2 are output at the same time.

Therefore, the set operating range for each of the points cannot be overlapping.

*: There is no limit in the magnitude correlation between SP1, SP2 and SP3.

<Setting example>

Using as three pieces of general purpose switches (fully closed, gripping the workpiece, erroneous chuck, etc.)



• The relationship between the output points (SP1 to SP3) and the output terminals of the sensor monitor

Output point	Output terminal
SP1	OUT1
SP2	OUT2
SP3	OUT1 + OUT2

*: In SP3, OUT1 and OUT2 are output at the same time. (The setting is possible only in 3 setting mode)

•The settable range and an output detection range error

The monitor has a settable range and you cannot set an operating range exceeding that range.

In 3 setting mode, an overlapping setting range cannot be set for SP1, SP2, and SP3.

If you try to set one of the above conditions, it will be an SW output detection range error and an error code (Er3) is displayed.

The set value that caused an error is invalid. Change the value and set it again.

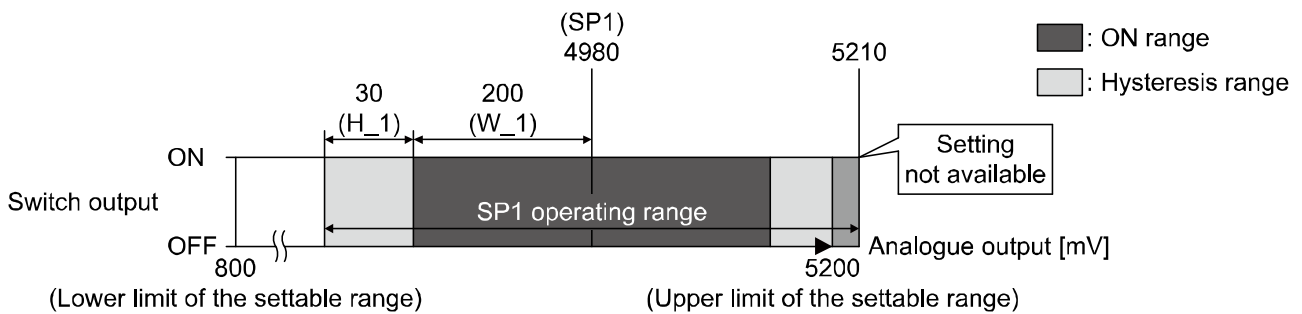
Display and settable range: 800 to 5200 [mV]

<Setting example>

Output point (SP1): 4980 [mV]

ON width (W_1): 200 [mV]

Hysteresis (H_1): 30 [mV]



In the above case, set a smaller ON width and hysteresis values or shift the output point.

<Setting example: In 3 setting mode>

Output point (SP1): 4056 [mV]

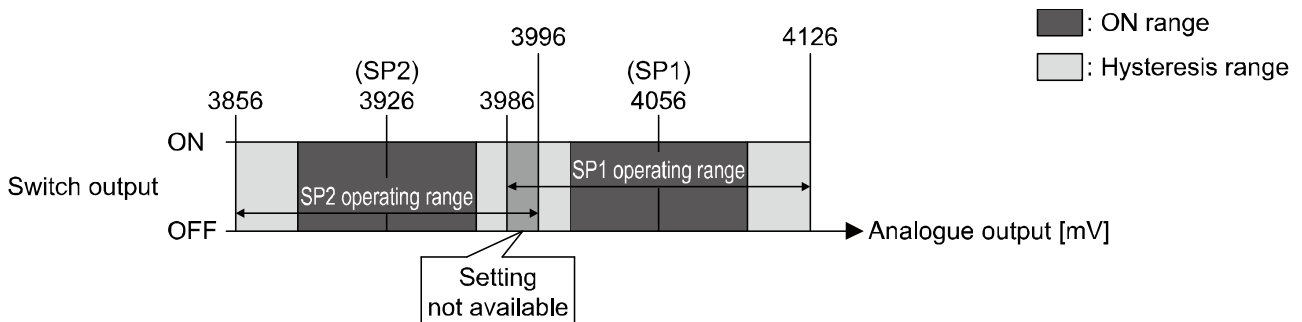
ON width (W_1): 50 [mV]

Hysteresis (H_1): 20 [mV]

Output point (SP2): 3926 [mV]

ON width (W_2): 50 [mV]

Hysteresis (H_2): 20 [mV]

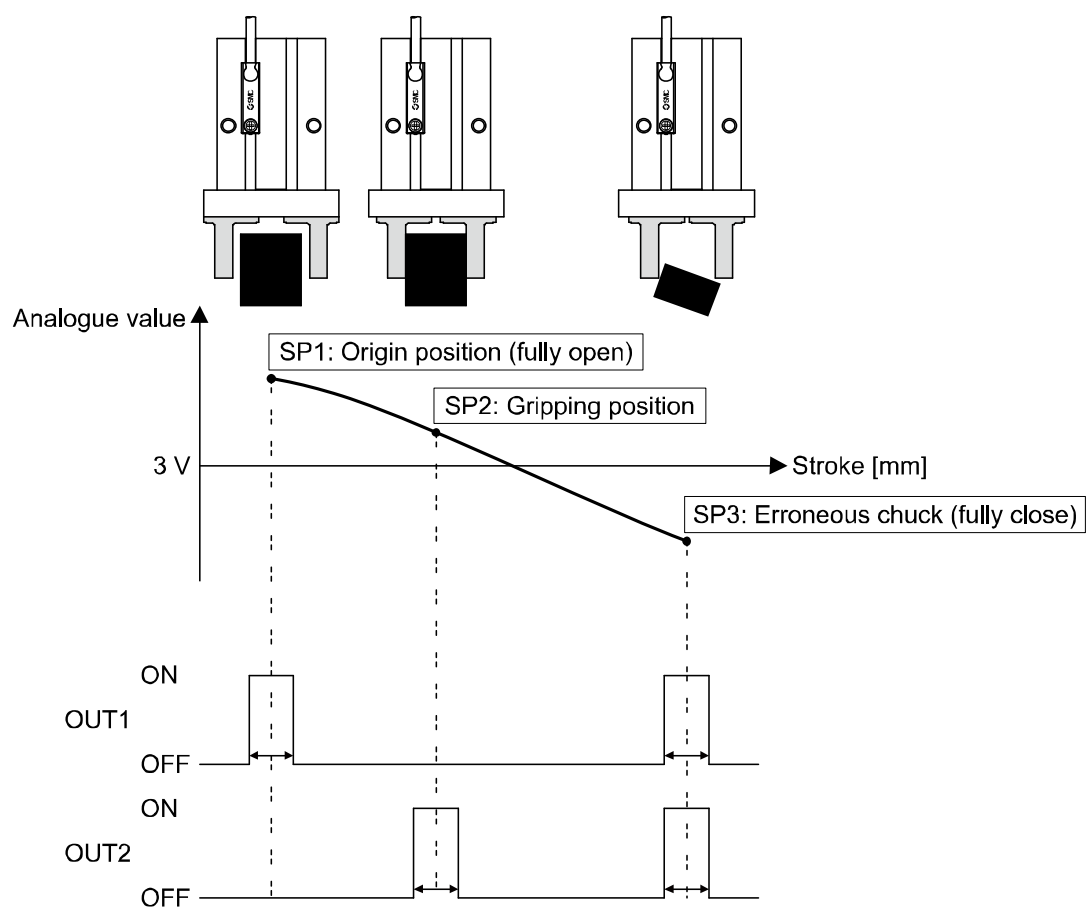


In the above case, change to 2 output mode or set the operating ranges that are not overlapping.

(In 2 setting mode, overlapping operating ranges can be set.)

*: Set an interval of 2 mV or more between the operating ranges.

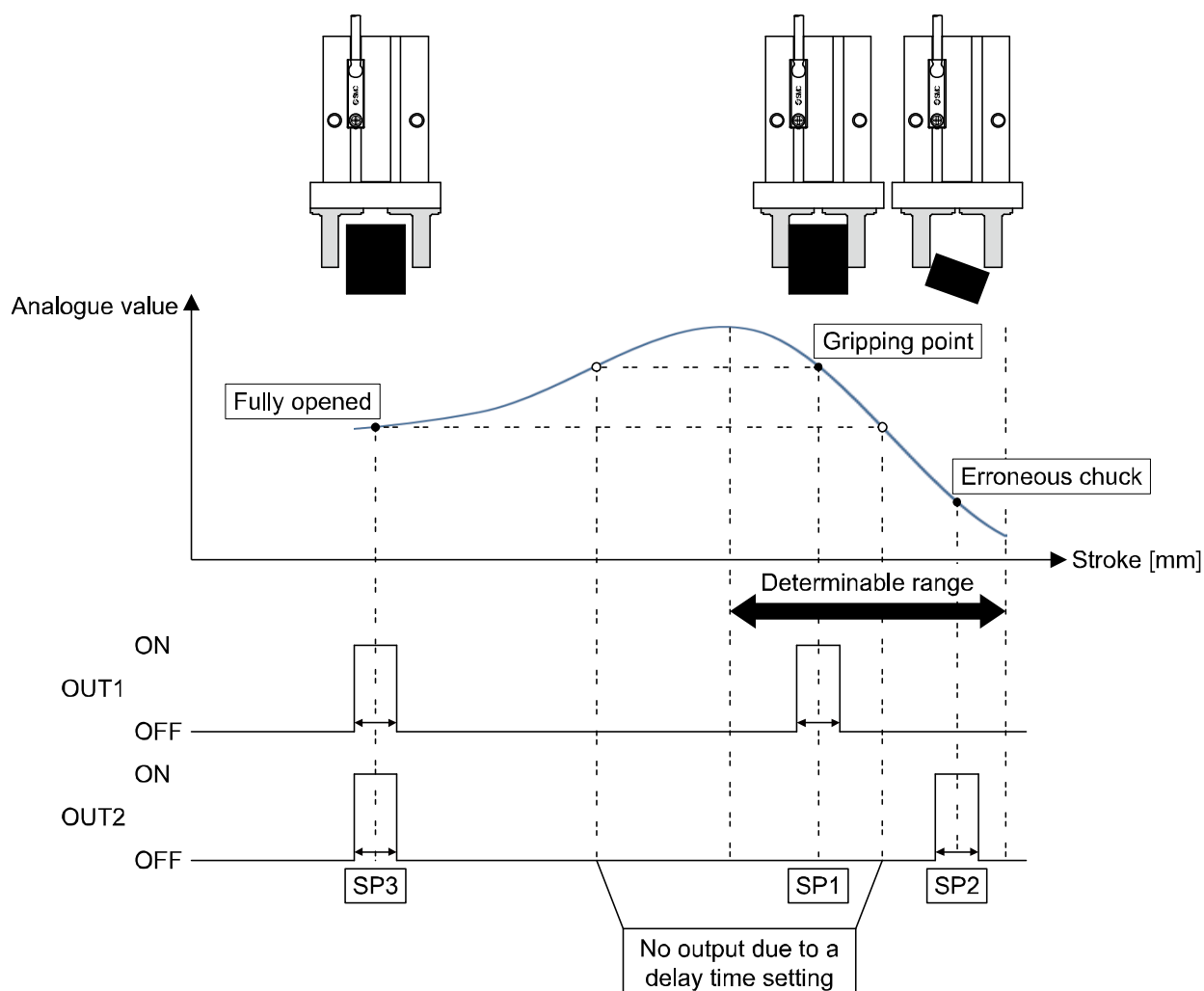
○Setting example for the analogue auto switch and the display sensor monitor



Finger position	OUT1	OUT2
Origin position (SP1)	ON	OFF
Gripping position (SP2)	OFF	ON
Erroneous chuck (SP3)	ON	ON
Other than the above.	OFF	OFF

*: There is no limit in the magnitude correlation between SP1 to SP3.

You may use an actuator with long stroke by setting a delay time for the sensor monitor (refer to page 41) or use it in combination with a general purpose switch.



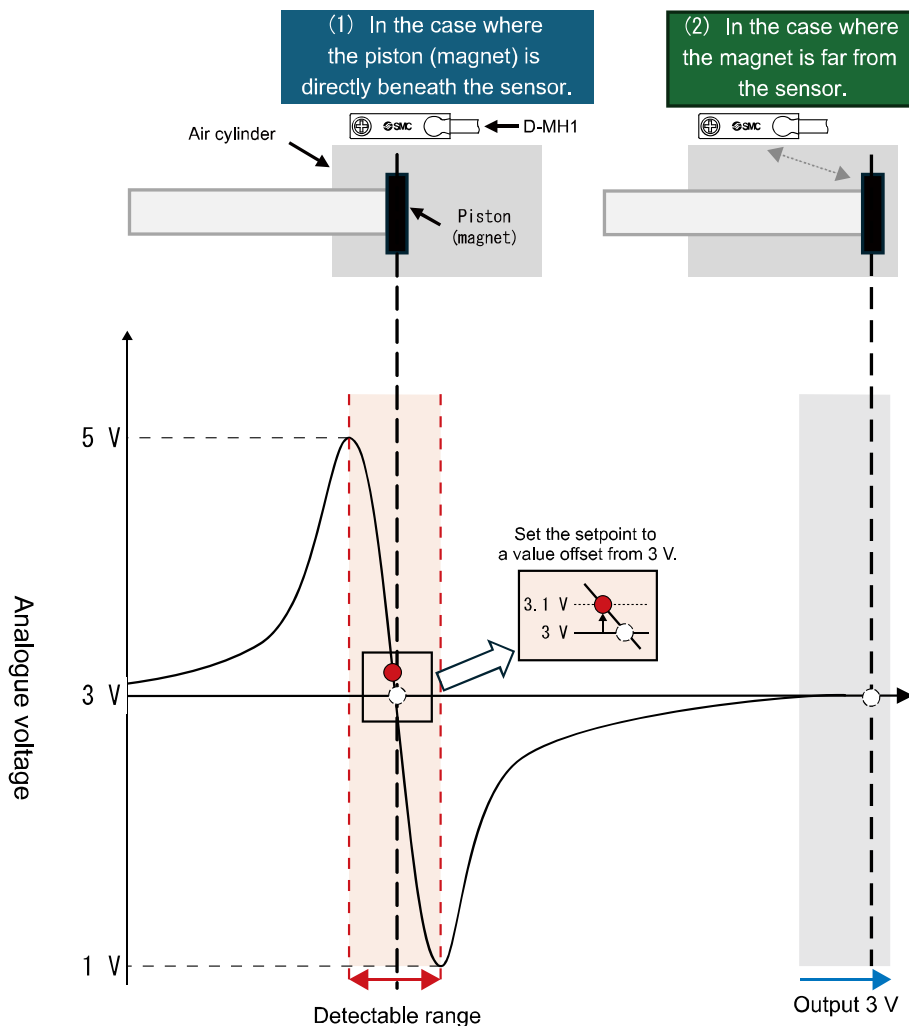
- *: By setting a delay time on the sensor monitor to pass through the operating range at a high speed, you can set not to cause an output. (Be sure to configure settings according to the actual operating environment.)
- *: When using for other purposes such as determination, adjust the mounting position of the analogue ASW so that the workpiece gripping point, etc. will be close to the 3-V output point (the centre of the determinable range).
- *: The analogue ASW outputs approximately 3 V at no magnetic field. If an output point is set at close to 3 V for the gripping point, etc., the output may turn ON even when the magnet is sufficiently away from there. If this is the case, use a general purpose switch, etc. in combination and set your equipment to ignore the monitor output if the general purpose switch is ON, and so on.

○Notes on use with actuators other than chucks

When the stroke length exceeds the detectable range, there may be two positions, (1) and (2), at which the output voltage reaches 3 V.

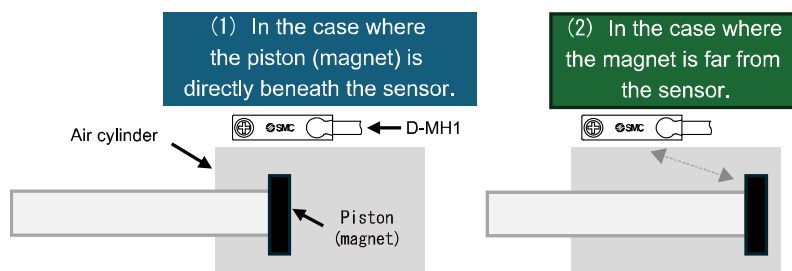
If the setpoint is set to 3 V in this situation, the switch output will turn ON at both positions (1) and (2).

Therefore, set the setpoint to a value other than 3 V. Please note that, depending on the actuator, it may be difficult to set the setpoint within the high-resolution range.



•When the analog voltage is 3 V.

The D-MH1 outputs an analog voltage corresponding to the detected magnetic field strength. The output voltage is 3 V in either of the following cases: when the piston (magnet) is directly beneath the sensor, or when the magnet is far from the sensor.



Display Sensor Monitor Settings Overview

Turn ON the power



The product code is displayed for approximately 3 seconds after power is supplied. Then, measurement mode will be displayed.

※: The switch operation starts within approximately 0.2 seconds after power is supplied.



[Initial settings] (Refer to page 32)

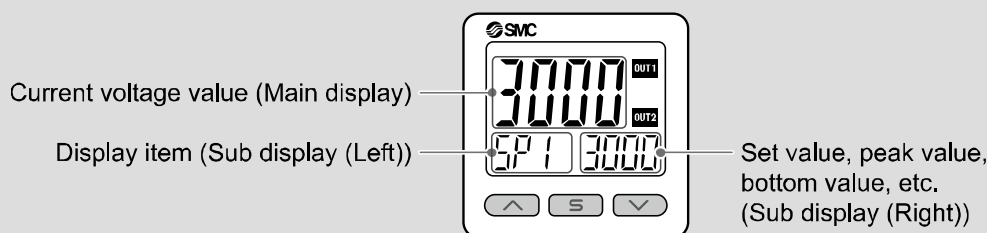
Set the output specifications, including the NPN or PNP setting, and select the output setting mode.



[Measurement mode]

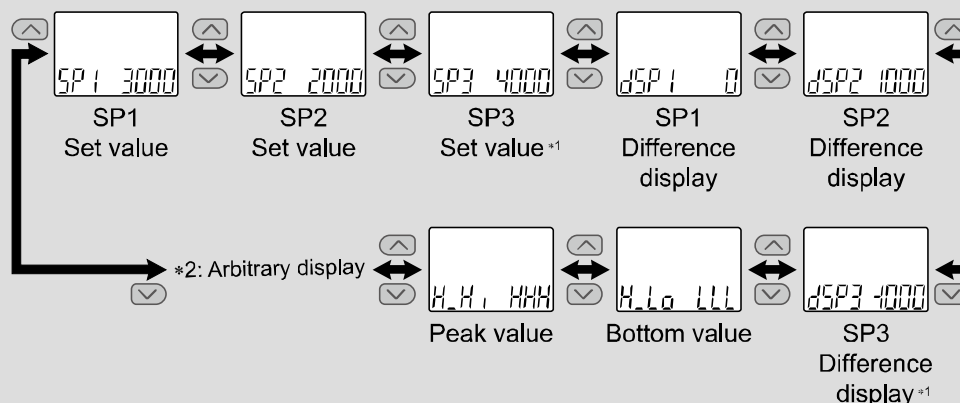
Refers to the state in which the voltage is displayed and switch operation is performed for the analogue ASW after the power is turned on. This is the basic mode; other modes should be selected for set-point changes and other function settings.

Measurement mode screen



Sub display

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



*1: Only in 3 setting mode.

*2: An arbitrary display mode can be added to the sub display by setting the [F10] sub display. If the sub display is changed during the arbitrary display setting, the display will be returned to the arbitrary display 30 seconds later. (The default setting does not include arbitrary display.)



Press the SET button once.

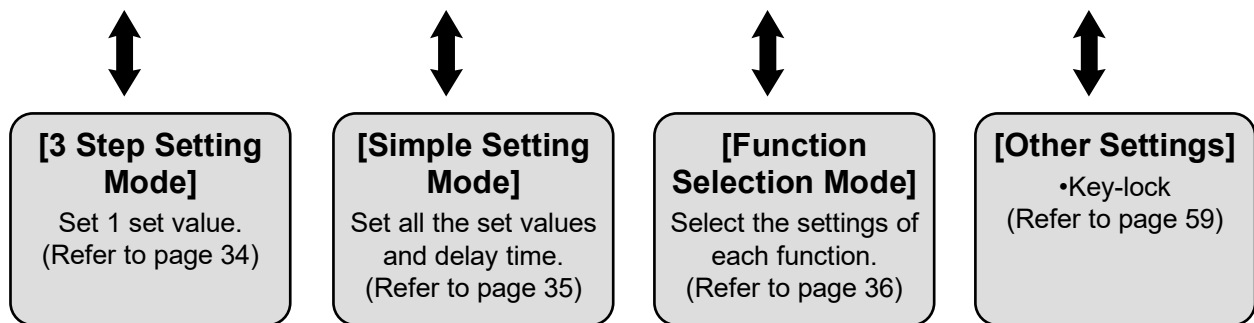


Press the SET button for 1 second or longer but less than 3 seconds



Press the SET button for 3 seconds or longer but less than 5 seconds





*: The output continues to operate during setting.

*: If the button is not operated for a certain period of time during setting, the display will flash. (This is intended to prevent failure to complete the setting due to leaving in the middle of setting.)

*: A setting in 3 step setting mode, simple setting mode, or function selection mode is applied to each of the modes.

Initial Settings

Set the output specifications, including the NPN or PNP setting, and select the setting mode.

Measurement mode



Press the SET button for 3 seconds or longer but less than 5 seconds.

[F 0] Displays the switch output specification and setting mode functions.



Press the SET button.

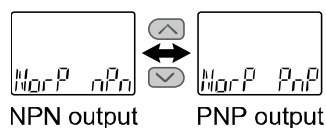


Moves to the setting of switch output NPN or PNP specification changeover.

Setting of switch output NPN or PNP specification changeover

The switch output of this product can be switched to NPN or PNP output in accordance with the configuration of your equipment.

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



Press the SET button to save the setting.

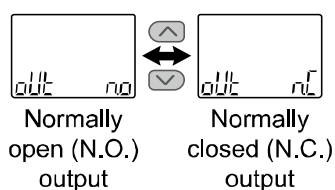


Moves to the setting of switch output. N.O. or N.C. specification changeover.

Setting of switch output. N.O. or N.C. specification changeover

The output specification can be changed to normally open (N.O. type) or normally closed (N.C. type).

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



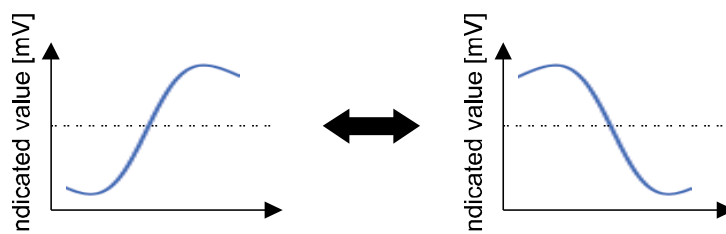
Press the SET button to save the setting.



Moves to the setting of analogue display inversion.

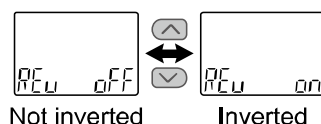
Setting of analogue display inversion

The analogue voltage indicated value can be inverted at 3 [V] as the centre.



*: If the SP1 to SP3 set values have already been set, they will also be inverted in conjunction.

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



Press the SET button to save the setting. ↓ Moves to the setting of output setting mode.

Setting of output setting mode

The 2 setting mode and 3 setting mode can be selected.

•2 setting mode

Output point	Output terminal	
	OUT1	OUT2
SP1	ON	OFF
SP2	OFF	ON

The relationship between the output terminals and output points

- The two points, SP1 and SP2, can be set.
- The operating range may be overlapping.

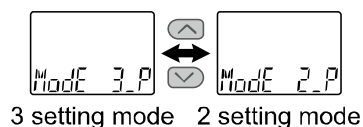
•3 setting mode

Output point	Output terminal	
	OUT1	OUT2
SP1	ON	OFF
SP2	OFF	ON
SP3	ON	ON

The relationship between the output terminals and output points

- The three points, SP1, SP2, and SP3, can be set.
- The operating range may not be overlapping.

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



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

[F 0] Setup of the switch output specification and setting mode functions completed

↓ Press the SET button for 2 seconds or longer.

Measurement mode
(Initial setting completed)

Perform the setting with the 3 step setting mode, simple setting mode and function selection mode.

3 Step Setting Mode

What is the 3 step setting mode?

In this mode, only set values can be input in just three steps.

Use this mode if you want to use the product immediately after changing only the set values.

(The current voltage value is displayed on the main display).

<How to operate>

"3 step setting mode"

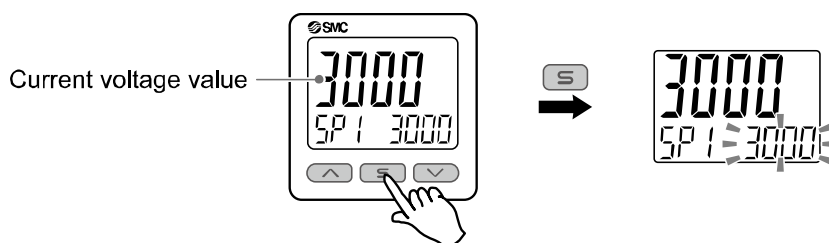
In the 3 step setting mode, the set values (SP1, SP2, SP3 *) can be changed.

*: The setting is possible only in 3 setting mode.

Select the item (SP1 to SP3) that you want to change on the sub display in advance with the UP or DOWN button.

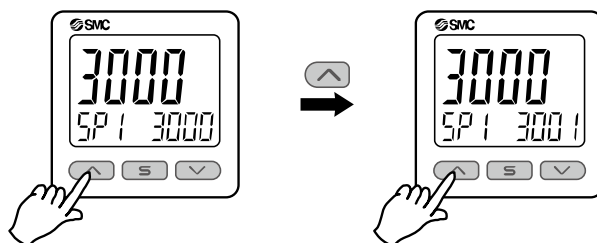
When changing the set value, follow the operation below.

- (1) Press the SET button once when the item to be changed is displayed on the sub display.
The set value on the sub display (right) will start flashing.

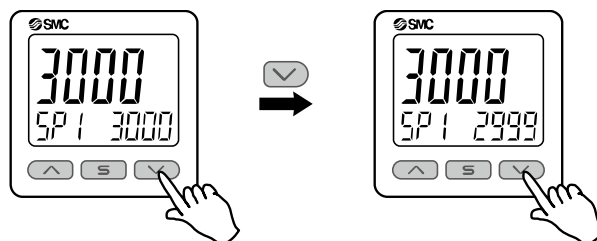


- (2) Press the UP or DOWN button to change the set value.
The set value can be increased with the UP button and can be reduced with the DOWN button.

- 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.



- When the UP and DOWN buttons are pressed simultaneously for 1 second or longer, the set value is displayed as [---], and the set value will be the same as the current voltage value automatically (snap shot function) (Refer to page 59).

Afterwards, readjustment is possible by pressing the UP or DOWN button.

The set value can be deleted by pressing the SET and DOWN buttons simultaneously for 1 second or longer.

- (3) Press the SET button to complete the setting.

Simple Setting Mode

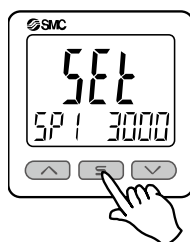
<How to operate>

"Simple setting mode"

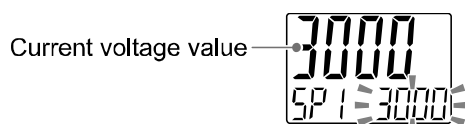
In the simple setting mode, the set value (SP1 to SP3 *) and the delay time (dt) can be changed while checking the current voltage current value (main display).

*: The setting is possible only in 3 setting mode.

- (1) Press the SET button for 1 second or longer but less than 3 seconds in measurement mode. [SEt] is displayed on the main display.
Release the button while [SEt] is showing on the display. The main display will show the current voltage value and the left sub display will show [SP1]. The set value will be flashing on the right sub display.



- (2) Change the set value by pressing the UP or DOWN button, and press the SET button to set the value. Then, the setting moves to [SP2] setting. (The snap shot function can be used. (Refer to page 59))



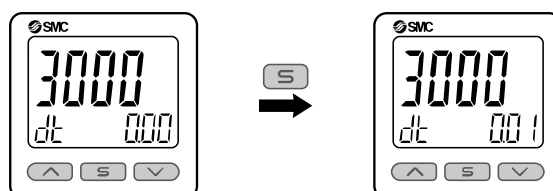
- (3) Set [SP2] in the same manner as for [SP1]. When 3 setting mode is selected, the setting moves to the [SP3] setting after finishing the [SP2] setting. Press the SET button to set the value. Then, the setting moves to the delay time of the switch output.
- (4) Press the UP or DOWN button to select the switch output delay time.



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

(A long press of the button increases the increment.)

Settable range: 0.00 [sec.] to 5.00 [sec.] (0.01 [sec.] increment)



- (5) Press the SET button to set the value and the setting returns to the [SP1] setting again. Press the SET button for 2 seconds or longer in one of the settings screens to complete the setting and return to measurement mode.

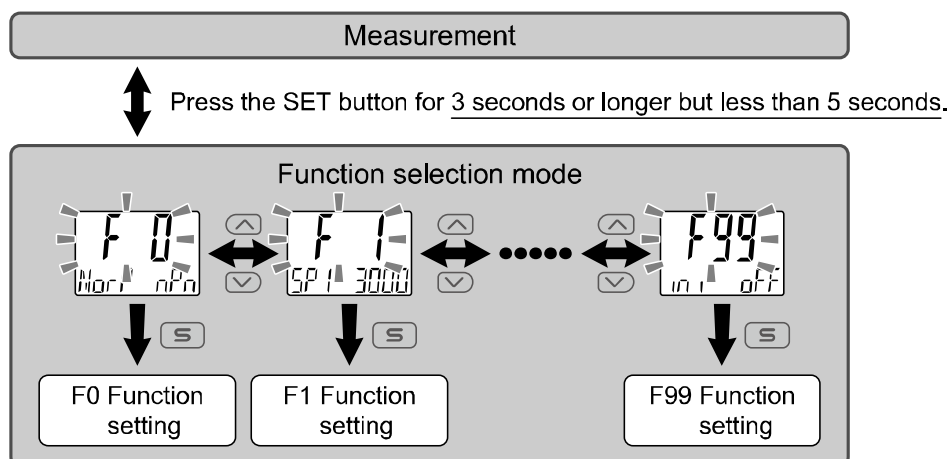
*: Each of the selected items (1) to (4) is enabled after the SET button is pressed.

Function Selection Mode

■What is the function selection mode?

In measurement mode, press the SET button for 3 seconds or longer but less than 5 seconds to display [F 0]. This [F□□] indicates the mode for changing each functional setting.

In function selection mode, press the SET button for 2 seconds or longer to return to measurement mode.



■Factory default setting

The factory default settings are as follows.

If there is no problem with these settings, use them as they are.

To change the settings, do so in function selection mode.

- [F 0] Switch output specification switchover/setting mode switchover functions ➡ Page 38

Item	Factory default setting
NPN or PNP output	NPN *
N.O. or N.C. output	N.O.
Analogue display inversion	OFF
Output setting mode	3 setting mode

*: Depends on the part No.

- [F 1] How to set SP1 ➡ Page 41

Item	Description	Factory default setting
Output point (SP1)	Set the analogue value to switch output.	---- (Not set)
ON width (W_1)	Set the ON range to the switch output.	50
Hysteresis (H_1)	Set an appropriate hysteresis to prevent chattering.	20
Delay time (dt)	Select the delay time of the switch output. *: It is a common setting for SP1 to SP3.	0.00 (1.5 ms or less)
Display colour (CoL)	Select the display colour. *: It is a common setting for SP1 to SP3.	1SoG (Interlocked with SP1) *: ON: Green OFF: Red

●[F 2] How to set SP2 ➡ Page 43

*: The setting items are the same as [F 1].

Item	Description	Factory default setting
Output point (SP2)	Set the analogue value to switch output.	---- (Not set)
ON width (W_2)	Set the ON range to the switch output.	50
Hysteresis (H_2)	Set an appropriate hysteresis to prevent chattering.	20
Delay time (dt)	Select the delay time of the switch output. *: It is a common setting for SP1 to SP3.	0.00 (1.5 ms or less)
Display colour (CoL)	Select the display colour. *: It is a common setting for SP1 to SP3.	1SoG (Interlocked with SP1) *: ON: Green OFF: Red

●[F 3] How to set SP3 ➡ Page 43

*: The setting items are the same as [F 1].

*: The setting is possible only in 3 setting mode

Item	Description	Factory default setting
Output point (SP3)	Set the analogue value to switch output.	---- (Not set)
ON width (W_3)	Set the ON range to the switch output.	50
Hysteresis (H_3)	Appropriate setting of the hysteresis will prevent the switch output from chattering.	20
Delay time (dt)	Delay time of the switch output can be selected. *: It is a common setting for SP1 to SP3.	0.00 (1.5 ms or less)
Display colour (CoL)	Select the display colour. *: It is a common setting for SP1 to SP3.	1SoG (Interlocked with SP1) *: ON: Green OFF: Red

●Other setting items

Item	Page	Factory default setting
[F 7] Digital filter setting	Page 44	0 ms
[F10] Sub display setting	Page 45	std (Standard)
[F11] Display resolution setting	Page 48	1000 partition
[F80] Power saving mode setting	Page 49	OFF
[F81] Security code input setting	Page 50	OFF
[F90] Setting of all functions	Page 52	OFF
[F97] Copy function selection	Page 54	OFF
[F98] Output check	Page 56	N/A (normal output)
[F99] Reset to default settings	Page 58	OFF

■[F 0] Switch output specification switchover/setting mode switchover functions

●Setting of switch output NPN or PNP specification changeover

The specification can be changed to NPN or PNP output in accordance with the configuration of your equipment.

<Example> D-MH1BP: PNP output

*: It is a common setting for OUT1 and OUT2.

*: The default value varies depending on the part No.

●Setting of switch output N.O. or N.C. specification changeover

The switch output specification can be changed to normally open (N.O. type) or normally closed (N.C. type).

*: It is a common setting for OUT1 and OUT2.

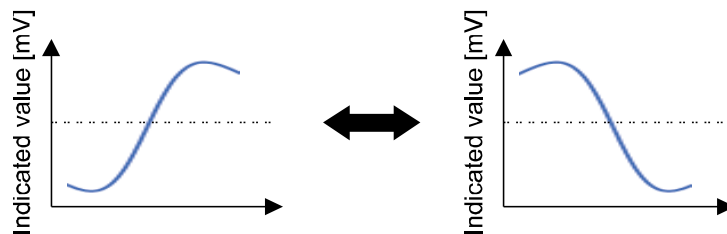
•Output operation

Analogue value	N.O.		N.C.	
	OUT1 (LED)	OUT2 (LED)	OUT1 (LED)	OUT2 (LED)
Within SP1 operating range	ON	OFF	OFF	ON
Within SP2 operating range	OFF	ON	ON	OFF
Within SP3 operating range *	ON	ON	OFF	OFF
Other than the above.	OFF	OFF	ON	ON

*: Only in 3 setting mode

●Setting of analogue display inversion

The displayed analogue voltage can be inverted at 3 V as the centre. This setting can be used for applications such as making the display consistent when the polarity of magnets is not uniform.



<Example>

Displayed analogue value: 4316 [mV] $\Rightarrow$ 1684 [mV] (Inverted)

The following values will also be inverted in conjunction.

- The set value of output points SP1 to SP3
- Peak or bottom measurement indicated value

●Changing the output setting mode

The 2 setting mode and 3 setting mode can be changed.

•2 setting mode

In this mode, two points, SP1 and SP2, can be set.

The operating range for each of SP1 and SP2 may be overlapping.

Analogue value	N.O.		N.C.	
	OUT1 (LED)	OUT2 (LED)	OUT1 (LED)	OUT2 (LED)
Within SP1 operating range	ON	OFF	OFF	ON
Within SP2 operating range	OFF	ON	ON	OFF
SP1 and SP2 overlapping range	ON	ON	OFF	OFF
Other than the above.	OFF	OFF	ON	ON

•3 setting mode (Initial value)

In this mode, three points, SP1, SP2 and SP3, can be set.

The operating range for each of the points cannot be overlapping.

Analogue value	N.O.		N.C.	
	OUT1 (LED)	OUT2 (LED)	OUT1 (LED)	OUT2 (LED)
Within SP1 operating range	ON	OFF	OFF	ON
Within SP2 operating range	OFF	ON	ON	OFF
Within SP3 operating range	ON	ON	OFF	OFF
Other than the above.	OFF	OFF	ON	ON

*: If the output setting mode is changed, the set values for output points (SP1 to SP3) will be cleared. Set them again.

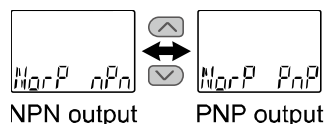
<How to operate>

Press the SET or DOWN button in function selection mode to display [F 0].

Press the SET button. ↓ Moves to the setting of switch output NPN or PNP specification changeover.

Setting of switch output NPN or PNP specification changeover

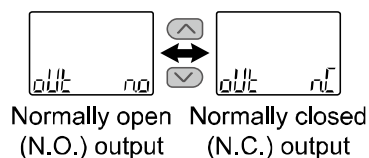
Press the UP or DOWN button to select the switch output specification.



Press the SET button to save the setting. ↓ Setting of N.O. or N.C. output specification

Setting of switch output. N.O. or N.C. specification changeover

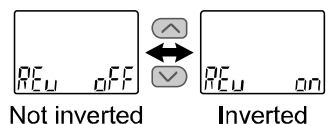
Press the UP or DOWN button to select the switch output specification.



Press the SET button to save the setting. ↓ Selection of analogue display inversion

Setting of analogue display inversion

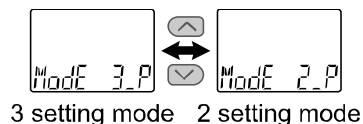
Press the UP or DOWN button to select whether or not to invert the analogue display.



Press the SET button to save the setting. ↓ Selection of the output setting mode

Setting of output setting mode

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



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

[F 0] Setup of the switch output specification and setting mode functions completed

■[F 1] SP1 setting

When the analogue voltage enters the operating range of SP1, the output turns ON.

By the factory default settings, the display colour turns green when the SP1 output is ON and red when the SP1 output is OFF.

<How to operate>

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

Press the SET button. ↓ Moves to the setting of output point (SP1).

Setting of the output point (SP1)

Press the UP or DOWN button to adjust the set value.

The snap shot function can be used. (Refer to page 59)

(You can make minor adjustments with the UP or DOWN button after setting by the snap shot function).

The set value can be deleted by pressing the SET and DOWN buttons simultaneously for 1 second or longer.

Settable range: 800 to 5200



Press the SET button to save the setting. ↓ Moves to the setting of ON width (W_1).

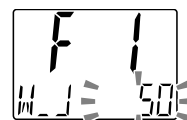
Setting of the ON width (W_1)

Press the UP or DOWN button to adjust the set value.

Keep pressing the button to change it continuously.

(A long press of the button increases the change amount)

Settable range: 0 to 2200



Press the SET button to save the setting. ↓ Moves to setting of hysteresis (H_1).

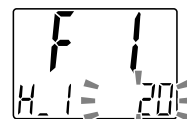
Setting of the hysteresis (H_1)

Press the UP or DOWN button to adjust the set value.

Keep pressing the button to change it continuously.

(A long press of the button increases the change amount)

Settable range: 0 to 2200



Press the SET button to save the setting. ↓ Moves to the setting of delay time (dt).

Setting of the delay time (dt)

Press the UP or DOWN button to adjust the set value.

Keep pressing the button to change it continuously.

(A long press of the button increases the change amount)

*: It is a common setting for SP1 to SP3.



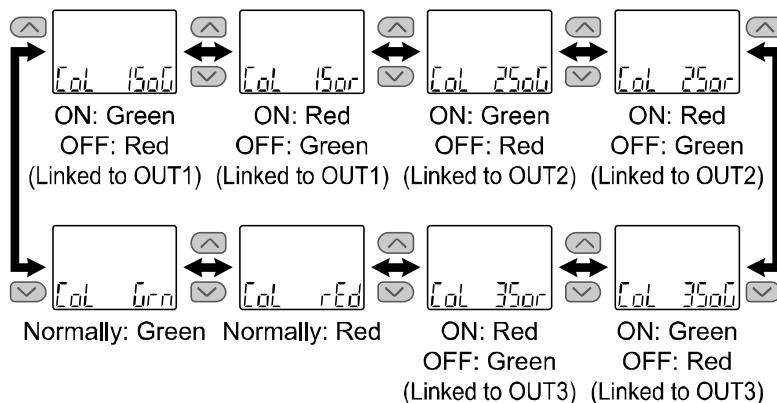
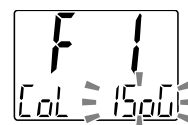
Press the SET button to save the setting. ↓ Moves to the setting of display color (CoL).



Setting of the display colour (CoL)

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

*: It is a common setting for SP1 to SP3.



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

[F 1] SP1 setting 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.

*3: When setting the output mode, output point, ON width, or hysteresis, if the operating range overlaps with the already set operating range (SP2, SP3, etc.), it will be an SW output detection range error and an error code (Er3) is displayed.

The set value that caused an error is invalid. Set the value again without causing the operating range to overlap.

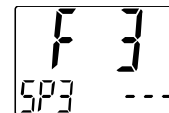
■[F 2] SP2 setting

The setting method is the same as [F 1].

■[F 3] SP3 setting

The setting method is the same as [F 1].

*: In 2 setting mode, the display looks as shown in the figure on the right and you cannot move on to settings by pressing the SET button.



■[F 7] Digital filter setting

The digital filter can be selected.

Output chattering or display flicker in measurement mode can be reduced by setting the digital filter.

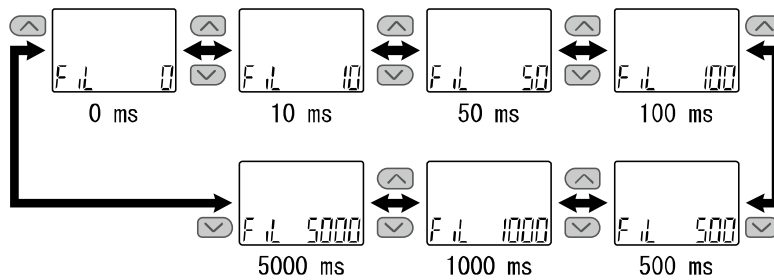
<How to operate>

Press the UP or DOWN button in function selection mode to display [F 7].

Press the SET button. ↓ Moves to the setting of digital filter.

Digital filter setting

Press the UP or DOWN button to select the digital filter.



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

[F 7] Digital filter setup completed

*1: Each set value is a guideline for 90% response time.

*2: Both the switch output and indicated value are affected. If only switch output needs to be affected, select the delay time setting (page 41).

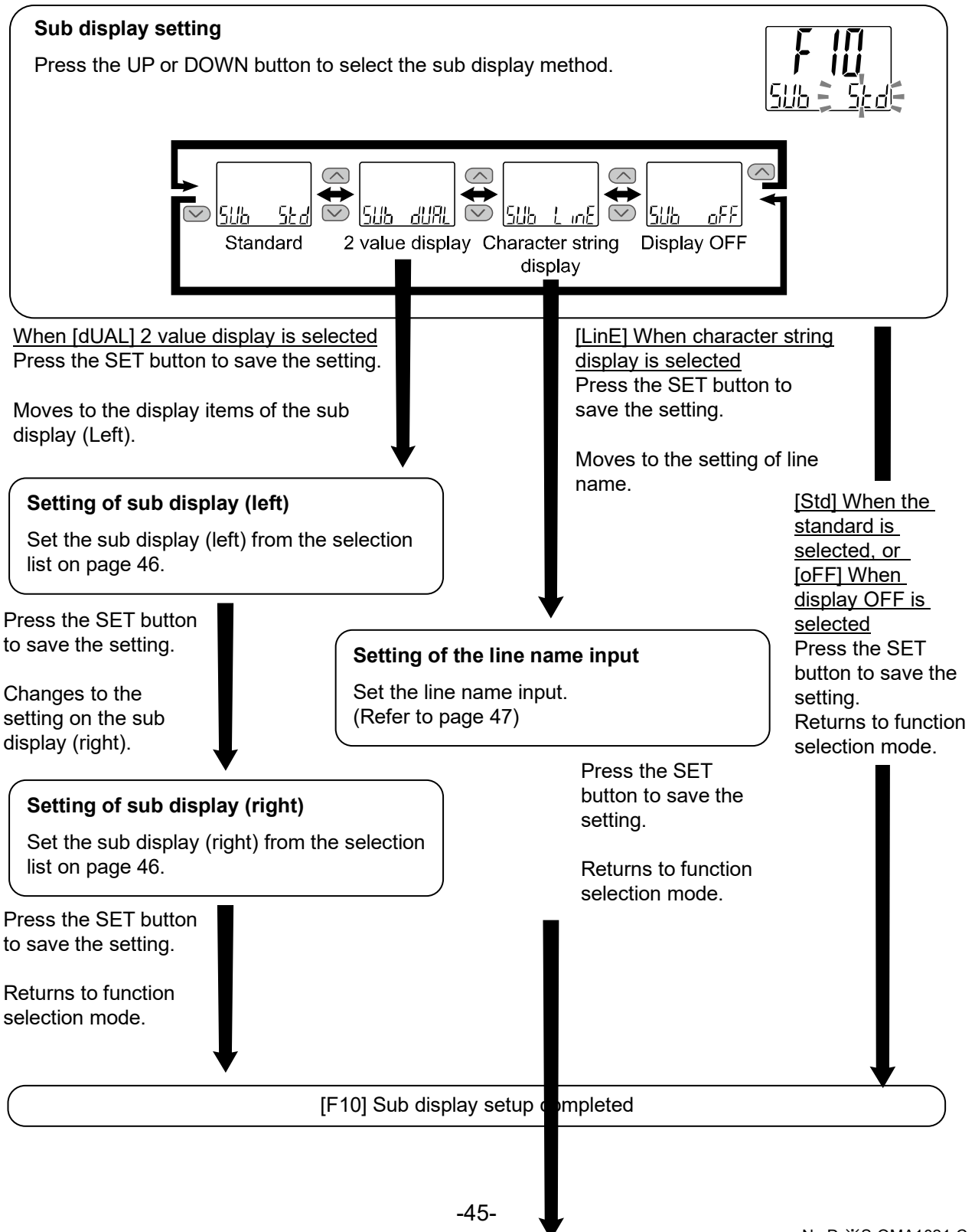
■[F10] Sub display setting

This function is used to change the display method of the sub display.
The details of the settings are described on page 46 onward.

<How to operate>

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

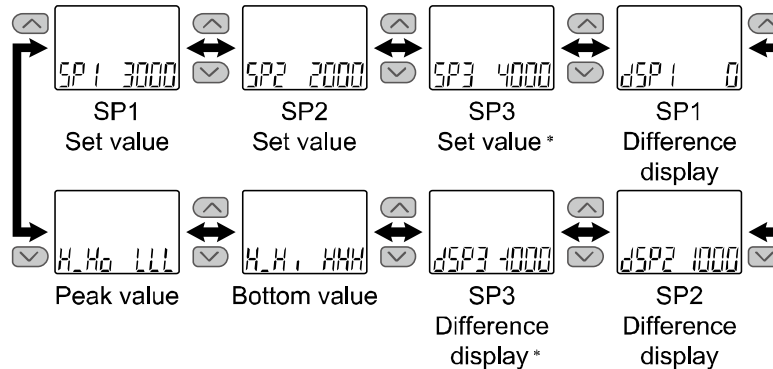
Press the SET button. ↓ Moves to the setting of the sub display.



<The display of the sub display>

•Standard

In the standard display, display items and their values are shown on the sub display.
Select the displayed items by pressing the UP or DOWN button in measurement mode.



*: Displayed only in 3 setting mode.

•2 value display

The 2 value display function allows to select and display the items listed below on the right and left side of the sub display.

List of items for selection

Display item	Details	Sub display selection		Remarks
		Left side	Right side	
SP1	SP1 output point set value	●	○	
SP2	SP2 output point set value	○	●	
SP3	SP3 output point set value	○	○	Only in 3 setting mode.
H_Hi	Peak measurement indication	○	×	
H_Lo	Bottom measurement indication	×	○	
oUt	NPN or PNP output set value	○	○	
LinE	String of random characters	○	○	
oFF	Display OFF	○	○	

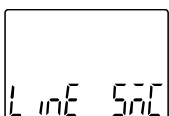
●: Default setting ○: Selectable ×: Not selectable

When using the 2 value display function, 3 step setting is not available in that display.
(When setting 3 steps, select each set value to be displayed by pressing the UP or DOWN button.)

If the output setting mode is changed after selecting the 2 value display, there may be no applicable display items depending on the selection and [- -] may be displayed. In this case, select items for the 2 value display again.

•Character string display

The character string display function is used to display any characters (line name) on the sub display.



•Display OFF

This setting hides the sub display.

○Setting the line name input

<How to operate>

[F10] Press the UP or DOWN button in the sub display settings screen to display [Sub LinE].

Press the SET button. ↓ Moves to the setting of line name input.

Setting of the line name input

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 first digit starts flashing).

A total of eight digits can be input in the sub displays (left and right).

Characters are displayed in this order: A → b → ... → Y → (Z) → 0 → 1 → ... → 9 → symbols → space.

(Characters which can be displayed are different for the 1st and 5th digits and other digits).

Keeping pressing both the UP and DOWN buttons adds or deletes 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 to save the setting. ↓ Returns to function selection mode.

[F10] Sub display (line name input) setup completed

•Characters which can be displayed for each digit are as follows.

(Display pattern of the 1st and 5th digits)

A to Z can be displayed. It is also possible to display the same display pattern as that for other digits.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z

<Display pattern for the
3 digits on the right>

0	1	2	3	4	5	6	7	8	9	Symbol	K	M	N	R	V	W	Space	(dot)
0	1	2	3	4	5	6	7	8	9	-	/	#	~	^	~	u	.	

(Display pattern for other digits)

Q, X and Z and some symbols (slash (/), asterisk (*)) cannot be displayed.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	R	S	T	U	V	W	Y
A	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	r	s	t	u	v	w	y
0	1	2	3	4	5	6	7	8	9	Symbol	Space	(dot)										
0	1	2	3	4	5	6	7	8	9	-	.											

"." (Dot) can be input after the 1st, 2nd, 3rd, 5th, 6th, and 7th digits.

■[F11] Display resolution setting

This function is used to change the number of display digits.
The flicker of the display can be reduced.

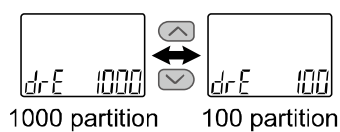
<How to operate>

Press the UP or DOWN button in function selection mode to display [F11].

Press the SET button. ↓ Moves to the setting of resolution.

Display resolution setting

Press the UP or DOWN button to select the resolution.



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

[F11] Display resolution setting completed

*: This setting is intended for measurement indicated values in the main display and does not affect set values, peak or bottom value, or difference indicated value.

■[F80] Power saving mode setting

Power saving mode can be selected.

This function is used to cause the mode to shift to power saving mode when no button operation is performed for 30 seconds.

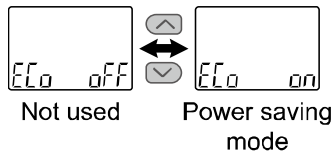
<How to operate>

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

Press the SET button. ↓ Moves to the setting of power saving mode.

Power saving mode setting

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

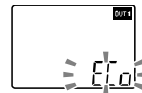


Press the SET button to save the setting. ↓ Returns to function selection mode.

[F80] Power saving mode setting completed

In power saving mode, a key operation sets a normal display mode; if no key operation is performed for 30 seconds, the mode returns to power saving mode. (Only in measurement mode)

During power saving mode, [ECo] will flash in the sub display and the operation LED is ON (only when the switch is ON).



Switch is ON



Switch is OFF

■[F81] Security code input setting

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

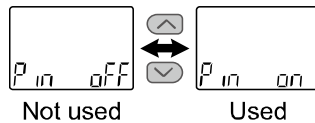
<How to operate>

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

Press the SET button. ↓ Moves to the setting of security code input.

Security code input setting

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



[oFF] When (Not used) is selected
Press the SET button to save the setting.

Returns to function selection mode.

[on] When (Used) is selected
Press the SET button to save the

Moves to checking of the security code setting.

Checking of the security code setting

Press the UP or DOWN button to input the set security code in the sub display (right).
(It is set to [000] by the factory default settings). *



For instructions on how to enter a security code, refer to "How to enter and change the security code" (page 62).

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

Press the SET button for 1 second to save the setting. ↓ Moves to the setting of security code.

Changing the security code setting

Press the UP or DOWN button to enter the required 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" (page 62).



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

Returns 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.

■[F90] Setting of all functions

All functions can be set in turn.

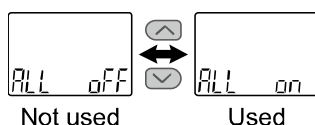
<How to operate>

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

Press the SET button. ↓ Moves to the setting of all functions.

Setting of all functions

Press the UP or DOWN button to select all functions.



[oFF] When (Not used) is selected

Press the SET button to save the setting.

Returns to function selection mode.

[on] When (Used) is selected

Press the SET button to save the setting.

Setting of functions *

[oFF] After returning to (Not used).
press the SET button to save the setting.

Returns 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 53

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	Setting of switch output NPN or PNP specification changeover
2	Setting of switch output. N.O. or N.C. specification changeover
3	Setting of analogue display inversion
4	Setting of output setting mode
5	Setting of the output point (SP1)
6	Setting of the ON width (W_1)
7	Setting of the hysteresis (H_1)
8	Setting of the delay time (dt)
9	Setting of the display colour (CoL)
10	Setting of the output point (SP2)
11	Setting of the ON width (W_2)
12	Setting of the hysteresis (H_2)
13	Setting of the delay time (dt)
14	Setting of the display colour (CoL)
15	Setting of the output point (SP3) *
16	Setting of the ON width (W_3) *
17	Setting of the hysteresis (H_3) *
18	Setting of the delay time (dt) *
19	Setting of the display colour (CoL) *
20	Digital filter setting
21	Sub display setting
22	Display resolution setting
23	Power saving mode setting
24	Security code input 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.

■[F97] Copy function selection

The set values can be copied. When the output specification is the same, this function becomes available. The set value can be copied by up to 10 units simultaneously.

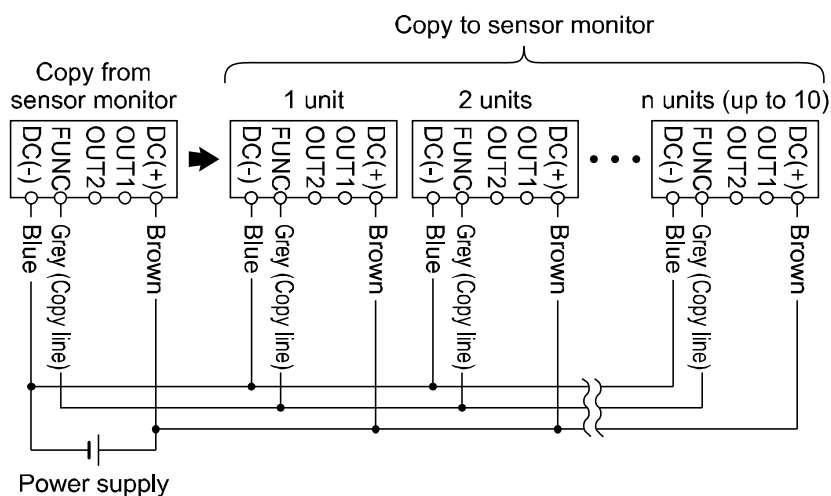
<Connection>

Turn off the power before connecting monitors.

Connect the FUNC terminal of the copy from sensor monitor and the copy to sensor monitor and turn the power ON.

The copy from sensor monitor refers to the sensor monitor at the copy source.

The copy to sensor monitor refers to the sensor monitor at the copy destination.



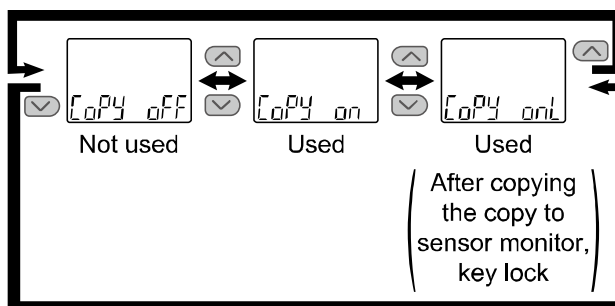
<How to operate>

Press the UP or DOWN button in function selection mode to display [F97] on the sensor monitor to be copied.

Press the SET button. ↓ Moves to the selection of copy function.

Copy function selection

Press the UP or DOWN button to select the copy function.

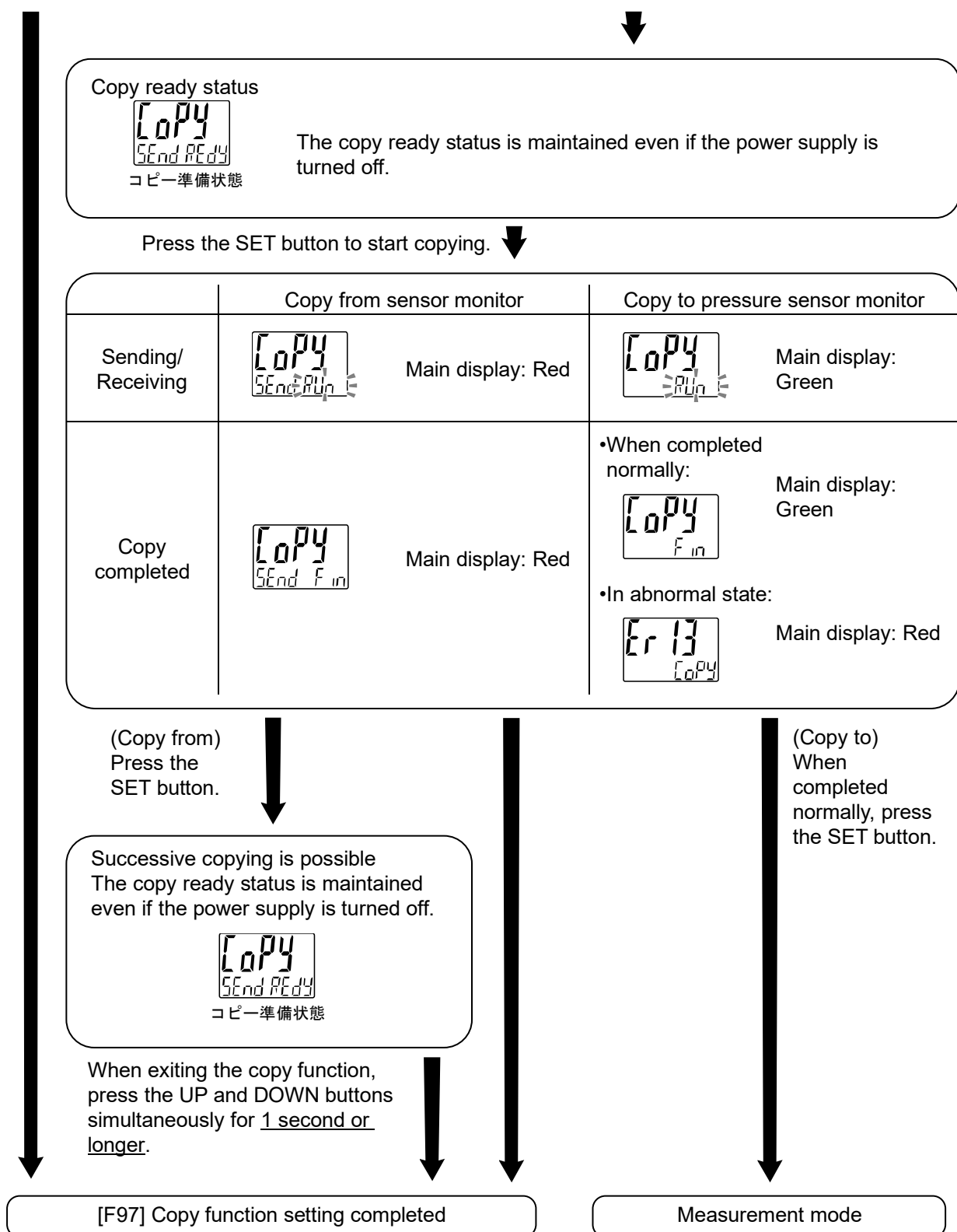


[oFF] When (Not used) is selected
Press the SET button to save the setting.

Returns to function selection mode.

[on] When (Used) or [onL] (Used) is selected
Press the SET button to save the setting.

Move to copy ready status.



*: When the copy to sensor monitor displays [Er13], it indicates a sending and receiving error of the copy function. Press the UP and DOWN buttons simultaneously for 1 second or longer to return to measurement mode. Then check the wiring and specifications and retry the copy function.

*: Copying may not be executed depending on the timing. In that case try again.

*: The set value of SP1 to SP3, W_1 to W_3, and H_1 to H_3 will not be copied. The set value that was set before copying will be maintained. Be sure to set the above values according to the actual operation of each analogue ASW.

■[F98] Output check

The switch output operation and analogue output operation can be selected for an output check. The output can be turned ON or OFF arbitrarily.

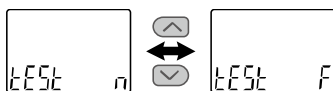
<How to operate>

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

Press the SET button. ↓ Moves to output check.

Output check

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



Normal output
(Output is
not checked)

Forced output
(Output is
checked)

When [n]
(Normal output)
is selected

Press the
SET button to
save the
setting.

Returns to
function
selection mode.

When [F] (Forced output) is
selected

Press the SET button to save
the setting.

Check of OUT1 output

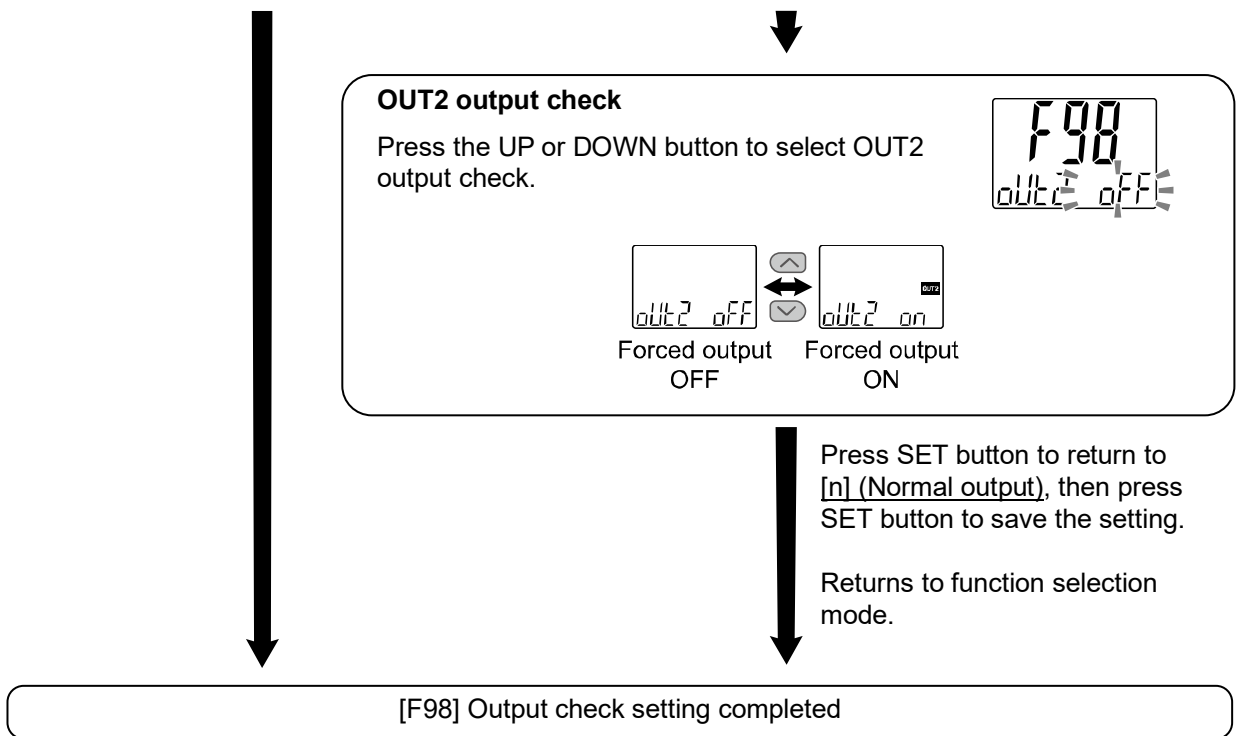
Press the UP or DOWN button to select OUT1
output check.



Forced output
OFF

Forced output
ON

Press the SET button to save
the setting.



*: Press the SET button for 2 seconds or longer to return from any setting item to measurement mode.
If the mode returns to measurement mode during forced output, the normal output conditions are restored automatically.

■[F99] Reset to default settings

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

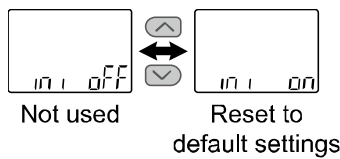
<How to operate>

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

Press the SET button. ↓ Moves to reset to default settings.

Reset to default settings

Press the UP or DOWN button



[oFF] When (Not used) is selected

Press the SET button to save the setting.

Returns to function selection mode.

[ON] When (Reset to default settings) is selected

Press the SET and DOWN buttons simultaneously for 5 seconds or longer.

The device is reset to default settings and the mode returns to function selection mode.

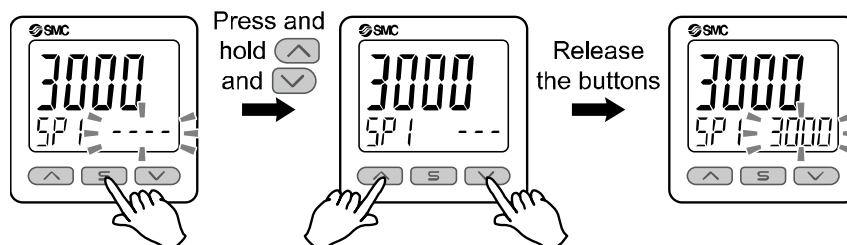
[F99] Reset to default settings completed

Other Settings

○Snap shot function

The current indicated value can be set to the output points SP1 to SP3.

In 3 step setting mode, simple setting mode, or function selection mode, select [SP#] for the display of the sub display (left). While the sub display (right) is flashing, press the UP and DOWN buttons simultaneously for 1 second or longer. The set value on the sub display (right) is shown as [- - -], and when the buttons are released, the same value as the current indicated value is automatically set.

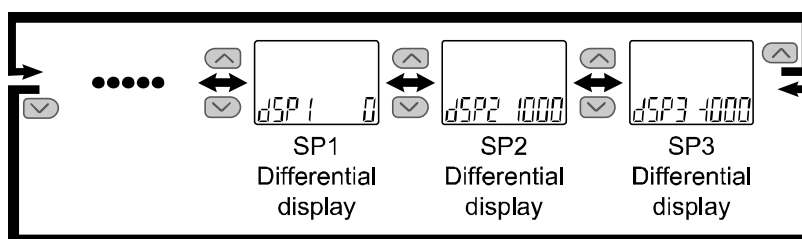


After the setting, readjustment is possible by pressing the UP or DOWN button.

○Differential display function

A differential between each of the set output points (SP1 to SP3) and the current indicated value can be displayed. Press the UP or DOWN button in measurement mode to switch the sub display (left) as shown below.

While displaying the current value on the main display, the difference with each of the output points (dSP1 to dSP3) can be displayed at the same time.



Item	Descriptions	Displayable range	Remarks
dSP1	(Indicated value) - (SP1 set value)	-1999 to 1999 *	
dSP2	(Indicated value) - (SP2 set value)		
dSP3	(Indicated value) - (SP3 set value)		Only in 3 setting mode

*: If "SP#" has not been set or the current value is outside the displayable range (HHH or LLL), "dSP#" is shown as "----".

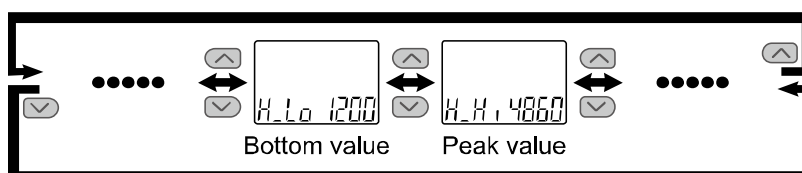
*: If the differential displayable range is exceeded, the differential display will be "HH" or "LL".

○Peak or bottom value indication function

The maximum (minimum) voltage at the power on state is detected and updated. In peak/bottom value display mode, the relevant value is displayed.

Press the Up or DOWN button in measurement mode to switch the sub display (left) as shown below.

The current value on the main display and the peak or bottom value can be displayed on the sub display (right) at the same time.



The peak or bottom value is maintained even if the power supply is cut off.

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

○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 set value, the difference display, and the peak or bottom values can be displayed with the UP and DOWN buttons.)

<How to operate – Without security code>

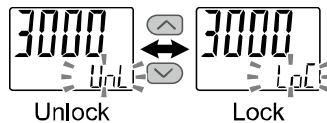
- (1) Press the SET button for 5 seconds or longer in measurement mode. When [oPE] is displayed on the main display, release the button.

The current setting [LoC] or [UnL] 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 or Unlock and then press the SET button to enable the setting.



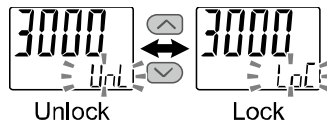
<Operation – With security code>

•Locking

- (1) Press the SET button for 5 seconds or longer in measurement mode. When [oPE] is displayed on the main display, release the button.
The current setting [LoC] or [UnL] will be displayed on the sub display.

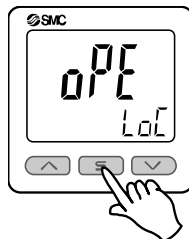


- (2) Press the UP or DOWN button to select Lock [LoC] and then press the SET button to enable the setting.

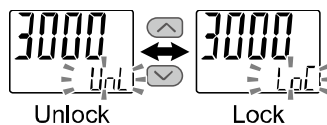


•Unlocking

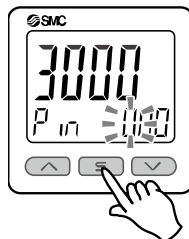
- (1) Press the SET button for 5 seconds or longer in measurement mode. When [oPE] is displayed on the main display, release the button.
The current setting [LoC] or [UnL] will be displayed on the sub display.



- (2) Press the UP or DOWN button to select Unlock [UnL] 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" (page 62).



- (4) If the entered security code is correct, the main display indicates [UnL] and pressing any of the UP, SET, and DOWN buttons disables the key lock and the device returns to measurement mode.
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

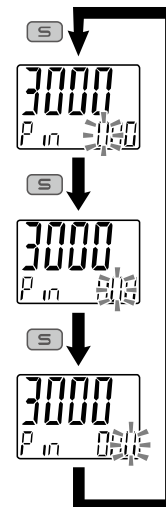
The left most digit starts flashing.

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.)



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.

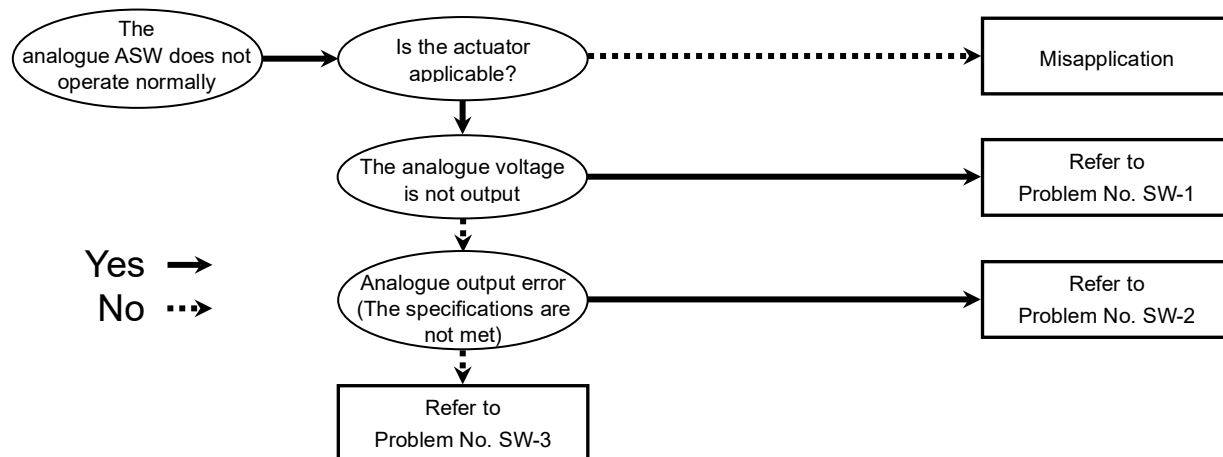
If the installation is using accurate control, wait until the product has warmed up (approximately 10 to 15 minutes) before operation.

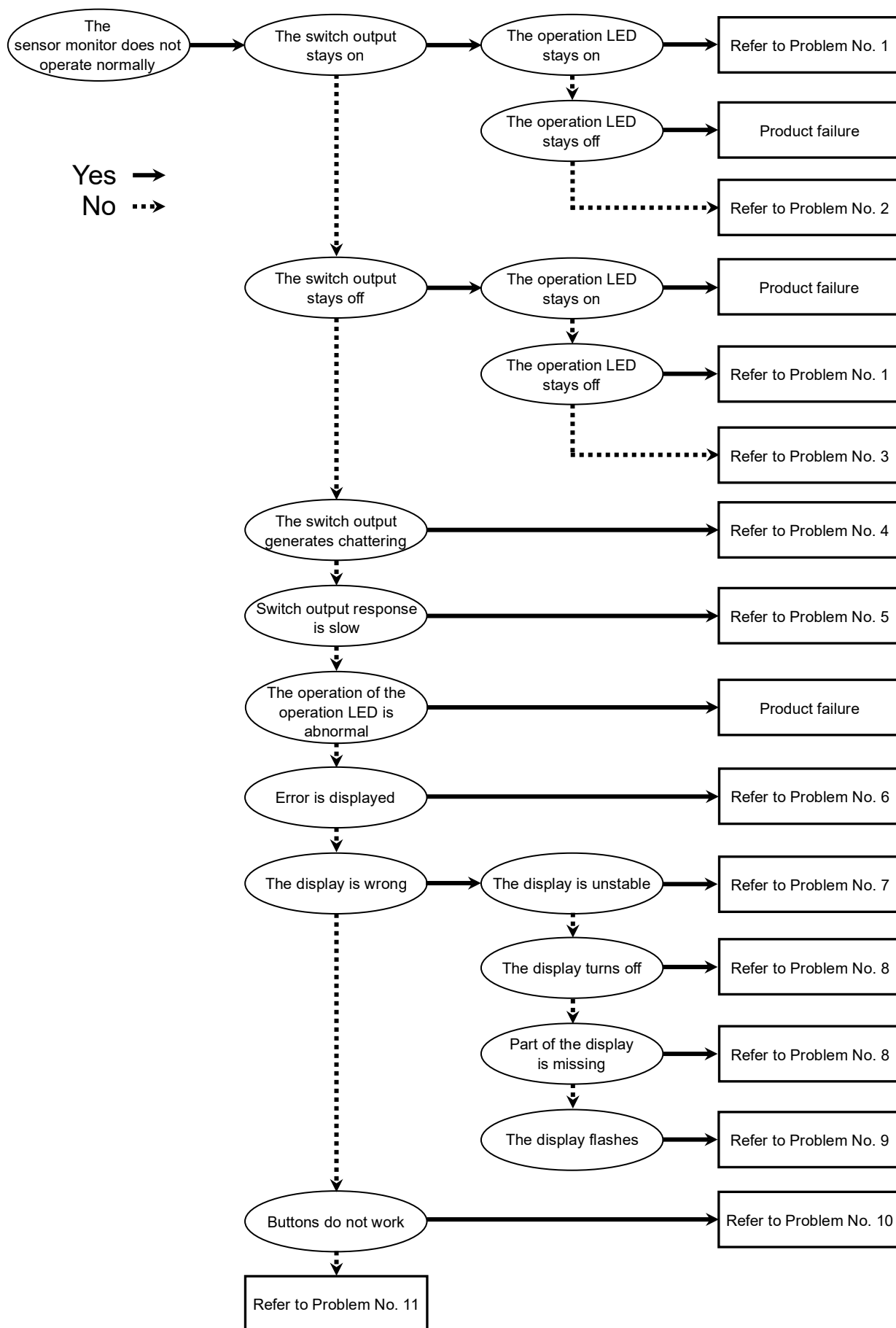
Forgotten the Security Code

Contact SMC if you have forgotten the security code.

Troubleshooting

When any failure occurs with this product, the following chart 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.). In that case, please consult SMC for solutions.





○Troubleshooting list

•Analogue ASW

Problem No.	Phenomenon	Problem Possible causes	Investigation method	Countermeasures
SW-1	The analogue voltage is not output (Near 0 V)	Power supply failure	Check the power supply voltage.	Set the specified power supply voltage value.
		Mis wiring, poor wiring	Check the wiring.	Connect the wire correctly.
		Ferromagnetic field environment	Check to see if a ferromagnetic field outside the specifications is present in the surroundings.	Cannot be used in a welding environment or other environment in which a ferromagnetic field is generated.
		Broken lead wire	Check the repeated bending stress/tension applied to = the lead wire.	Correct the wiring. (Correct the tensile force or increase the bending radius)
		Product failure		Replace the product.
SW-2	Analogue output error (The specifications are not met)	Improper mounting, position displacement	Check for any loose mounting bracket or analogue ASW mounting screws.	Fix by applying the appropriate torque.
		Rotation of cylinder piston rod	Check to see if the piston rod is rotating.	Take measures to stop rotation.
		Wobbling of the base	Check for any loose brackets or screws.	Secure the brackets or screws.
		Effect of a magnetic body	A magnetic body, such as a bracket or screw, is mounted close to the sensor.	Use a non-magnetic material.
		Magnetization or demagnetization of a screw or base due to welding, etc.	Check the operating environment.	Cannot be used in a welding environment or another environment in which a ferromagnetic field is generated. Change the screws or base material to a non-magnetic material.
		Effect of a magnetic field disturbance	Check for the effect of a magnetic field generated by an adjacent actuator.	Increase the interval between actuators. Change the mounting surface of the position sensor.
SW-3	The operation is unstable.	Poor wiring	Check the condition of the wiring connection (connector contact pins and crimping terminals).	Correct the wiring. (Connect the wire at the port location again.)
		Broken lead wire	Check the repeated bending stress/tension applied to a part of the lead wire.	Correct the wiring. (Correct the tensile force and increase the bending radius)
		Product failure		Replace the product.

•Display sensor monitor

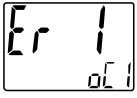
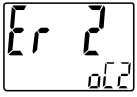
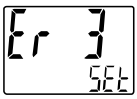
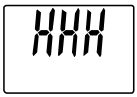
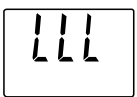
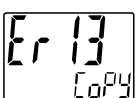
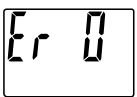
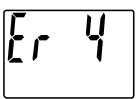
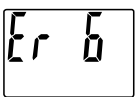
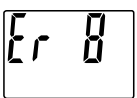
Problem No.	Phenomenon	Problem Possible causes	Investigation method	Countermeasures
1	The output stays ON; the operation LED stays ON; the output stays OFF; the operation LED stays OFF	Incorrect output settings	(1) Check the output point setting. (2) Check the ON width and hysteresis set values. (3) Set N.O. or N.C.	(1) Set the output point again. (2) Set the ON width and hysteresis set values again. (3) Set the output again.
		Product failure		Replace the product.
2	The output stays ON; the operation LED is normal	Incorrect wiring	Check the output wiring. Check if the load is directly connected to DC (+) or DC (-).	Connect the wire correctly.
		Product failure		Replace the product.
3	The output stays OFF; the operation LED is normal	Incorrect wiring	Check the output wiring. Check if the load is directly connected to DC (+) or DC (-)	Check and correct the wiring.
		Incorrect SW output specification setting	Check the SW output specification setting. Check if the SW output is PNP while NPN is intended to be used (and vice versa).	Set the SW output specification again.
		Broken lead wire	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. (Correct the tensile force and increase the bending radius)
		Product failure		Replace the product.
4	The switch output generates chattering.	Mis 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).	Connect the wire correctly again.
		Incorrect output point settings	(1) Check the output point setting. (2) Check if the ON width or hysteresis range is too small. (3) Check the delay time setting. Check if the delay time is too short.	(1) Set the output point again. (2) Increase the ON width or hysteresis. (3) Set up the function again.
		Product failure		Replace the product.
5	The switch output response is slow.	Incorrect delay time and filter time settings	Check to see if the delay time and filter time settings are appropriate.	Set up the function again.

Problem No.	Phenomenon	Problem Possible causes	Investigation method	Countermeasures
6	•Over current error (Er1, 2) is displayed •System error (Er0, 4, 6, 8) is displayed •"HHH" is displayed •"LLL" is displayed •An output detection range error (Er3) is displayed	Over current is flowing to the output (Er1, 2)	(1) Check if an over current of 80 mA or more is flowing to the output. (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 if the wiring is 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 surge protection or take measures to prevent surge. (4) Separate the wiring route from the high-voltage and/or power line.
		Data inside the product was not processed normally (Er0, 4, 6, and 8)	(1) Check if there is noise interference (such as static electricity). Check if there is a noise source nearby. (2) Check that the power supply voltage is within the range 12 to 24 VDC $\pm 10\%$.	(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) Supply power in the range 12 to 24 VDC $\pm 10\%$.
		The analogue value exceeded the upper limit of the displayable value (HHH).	(1) Check that the actuator is applicable. (2) Check that an analogue ASW sensor is connected. (3) Check to see if a ferromagnetic field source is present in the surroundings.	(1) Use an applicable actuator. (2) Use the specified sensor. (3) Cannot be used in a welding environment or another environment in which a ferromagnetic field is generated.
		The analogue value exceeded the lower limit of the displayable value (LLL).	(1) Check that the actuator is applicable. (2) Check that an analogue ASW sensor is connected. (3) Check to see if a ferromagnetic field source is present in the surroundings. (4) Check for any broken sensor cable and the connection condition of the connector section.	(1) Use an applicable actuator. (2) Use the specified sensor. (3) Cannot be used in a welding environment or another environment in which a ferromagnetic field is generated. (4) Modify the wiring; connect the connector again; replace the analogue ASW.
		Output detection range error (Er3)	(1) Confirm that the operating range for each of SP1 to SP3 is within the displayable range. (2) Check if the operating range of each of SP1 to SP3 is overlapping in 3 setting mode.	Set the output point again. Set a smaller ON width and hysteresis.
		Product failure		Replace the product.

Problem No.	Phenomenon	Problem Possible causes	Investigation method	Countermeasures
7	The display is unstable.	Incorrect power supply	Check if the power supply voltage is in the range 12 to 24 VDC $\pm 10\%$.	Supply power in the range 12 to 24 VDC $\pm 10\%$.
		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.
		Deformation of the workpiece itself; deflection of the chuck; fluctuations in the ambient temperature; changes in the mounting orientation	Check if there is any change in the ambient temperature or mounting orientation. Check if the deflection in the workpiece or chuck is acceptable.	If the fluctuation is not acceptable, the number of digits (display sensitivity) can be reduced by changing the display resolution. A digital filter setting may also improve the condition.
8	•The display turns off. •Part of the display is missing.	Incorrect power supply	Check if the power supply voltage is in the range 12 to 24 VDC $\pm 10\%$.	Supply power in the range 12 to 24 VDC $\pm 10\%$.
		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.
		Power saving mode	Check if power saving mode is selected.	Set up the function again.
		Product failure		Replace the product.
9	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).
10	Buttons do not work	Key-lock mode is activated.	Check if the key-lock function is turned on.	De-activate key-lock mode.
		Product failure		Replace the product.
11	The operation is unstable (chattering)	Affected by the fluctuations in the ambient environment because of a too small hysteresis or too short switch delay time.	(1) Check the operating range setting (hysteresis). (2) Check the delay time.	(1) Check the operating range setting. (2) Set up the function again.
		Poor wiring or 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) Modify the wiring. (Correct the tensile force and increase the bending radius)
		Product failure		Replace the product.

○Error display function

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

Error name	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.
Output detection range error		(1) Confirm that the operating range for each of SP1 to SP3 is within the displayable range. (2) Check if the operating range of each of SP1 to SP3 is not overlapping in 3 setting mode.	Set the output point again. Set a smaller set value for the ON width and hysteresis.
Displayable range error		A voltage that exceeds the upper limit of the displayable range is applied.	Check to see if an analogue ASW sensor is connected. Check the sensor connection and wiring.
		A voltage that exceeds the lower limit of the displayable range is applied. Sensor is not connected or wired incorrectly.	
Copy error		Copy function is operated incorrectly.	Press the UP and DOWN buttons simultaneously for <u>1 second or longer</u> to clear the error. Then check the wiring and model before copying again.
System error	   	Displayed if an internal data error has occurred.	Turn the power off and on again. If the failure cannot be solved, contact SMC.

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

Specifications

○Analogue auto switch

Model	D-MH1AD(V)
Power supply voltage	12 to 24 VDC $\pm 10\%$ ripple max. 10% p-p (with polarity protection)
Current consumption	10 mA or less
Output specification	Analogue voltage output: 1 to 5 V
Output impedance	Approx. 1 k Ω
Output repeatability (Ambient temperature: 25°C)	± 20 mV *1
Output temperature characteristics (at 25°C as standard)	± 80 mV (-10 to 60 °C) *2
Operating time	1 ms or less
Electrical entry method	Grommet
Impact resistance	1000 m/s ²
Insulation resistance	50 M Ω or more at a voltage of 500 VDC megohmmeter
Withstand voltage	1 min. at 1000 VAC (between case and cable)
Ambient temperature	-10 to 60 °C
Protection	IP67
Standards	CE/UKCA marked

*1: Single switch unit output characteristics. When the mounting orientation is uniform and there is no magnetic body or magnetic field disturbance in the surroundings.

Excluding a deformation of the workpiece or wobbling of the actuator.

*2: Single switch unit output characteristics. The effect of fluctuations in the magnetic force of the magnet itself is excluded.

*: Do not apply a ferromagnetic field which exceeds 200 [mT] to the analogue ASW. Otherwise, it may no longer operate normally.

○Display sensor monitor

Model		D-MH1B#
Applicable sensor		D-MH1AD(V)#
Rated pressure range		1000 to 5000 [mV]
Display and settable range		800 to 5200 [mV]
Display and minimum set unit		2 [mV]
Electrical specifications	Power supply voltage	12 to 24 VDC $\pm 10\%$, ripple max. 10% p-p (with polarity protection)
	Current consumption	35 mA or less
Accuracy	Display accuracy	± 20 mV ± 1 digit (Ambient temperature: Constant at 25 °C)
	Repeatability	± 4 mV ± 1 digits
	Temperature characteristics	± 20 mV (25 °C standard)
Switch output	Output specification	Select from NPN open collector 2 output or PNP open collector 2 output
	Output mode	Select from 2 setting mode or 3 setting mode
	Switch operation	Select from normal output or reversed output
	Maximum load current	80 mA
	Maximum applied voltage (NPN only)	30 VDC
	Internal voltage drop (Residual voltage)	NPN: 1 V or less (At a load current of 80 mA) PNP: 1.5 V or less (At a load current of 80 mA)
	Delay time *1	1.5 ms or less (Anti-chattering function: can be set to 0.00 to 5.00 sec.) (Smallest settable increment: 0.01 sec.)
	Hysteresis	Variable between 0 to 2200 (Initial value: 20 mV)
	Protection	Over current protection
Sensor input	Input type	Voltage input: 1 to 5 VDC (Input impedance: 1 M Ω)
	Number of inputs	1 input
	Connection method	Connector (e-CON)
	Protection	Over voltage protection (up to a voltage of 26.4 V)
Indication	Display method	LCD
	Number of displays	3 (1 main display and 2 sub displays)
	Display colour	Main display: red or green; Sub display: orange
Digital filter *2 *3		0, 10, 50, 100, 500, 1000, 5000 ms
Environmental resistance	Protection	IP40
	Withstand voltage	1000 VAC for 1 minute between terminals and housing
	Insulation resistance	50 M Ω or more between terminals and housing (with 500 VDC megger)
	Operating temperature range	During operation: 0 to 50 °C, During storage: -10 to 60 °C (No condensation or freezing)
	Operating humidity range	During operation and storage: 35 to 85%RH (No condensation)
Standards		CE/UKCA marked
Weight	Product	25 g (without the power supply/output connection lead wires)
	Lead wire with connector	39 g (Lead wire with connector : ZS-46-5L)

*1: Value without a digital filter (at 0 ms)

*2: It is 90% response time in relation to the step input.

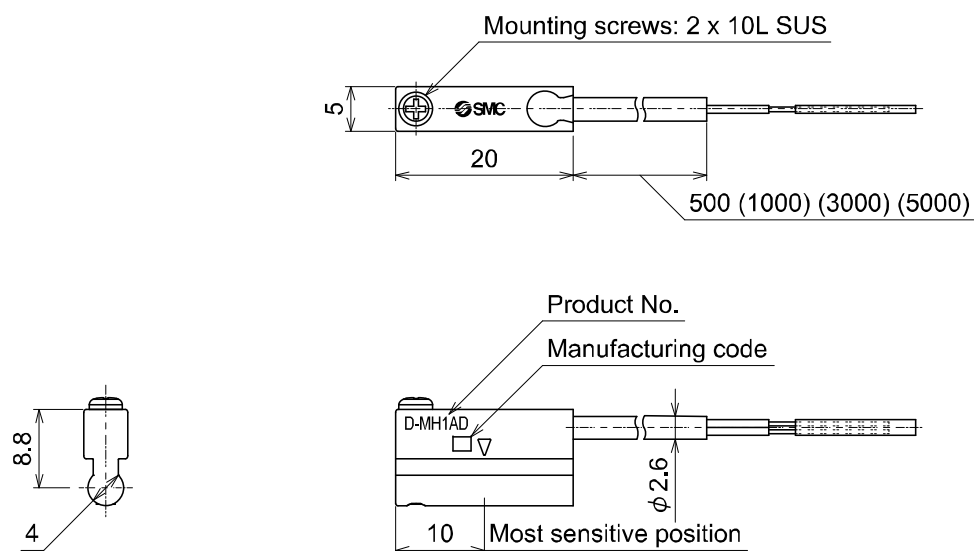
*3: Display, switch output and analogue response time are affected.

*4: We are endeavoring to improve product quality. However, any products with tiny scratches or smears on the appearance or display color or accuracy variation which do not affect the performance are verified as conforming products.

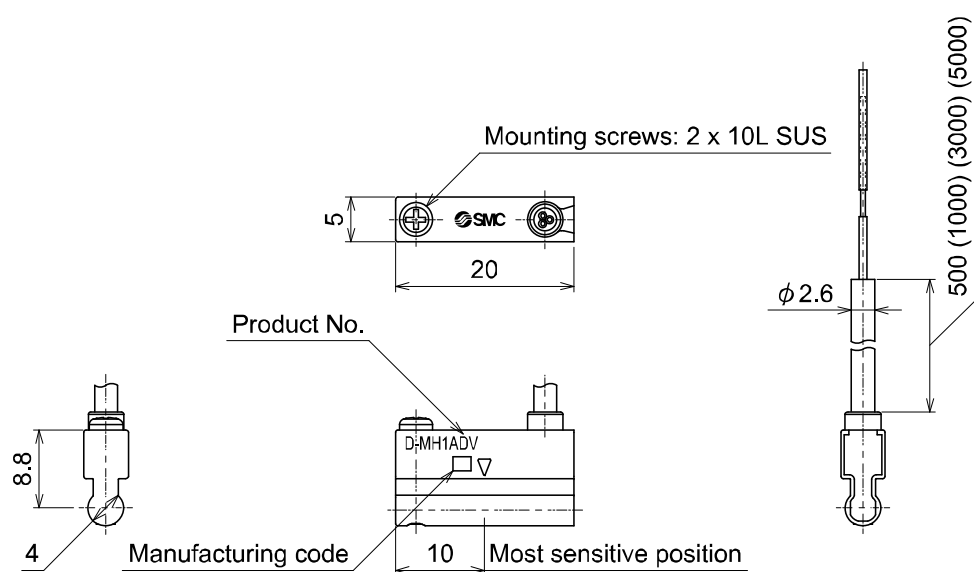
■Dimensions

○Analogue auto switch

•D-MH1AD#



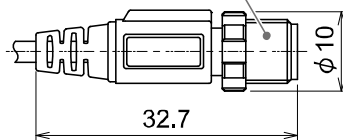
•D-MH1ADV#



•Pre-wired connector

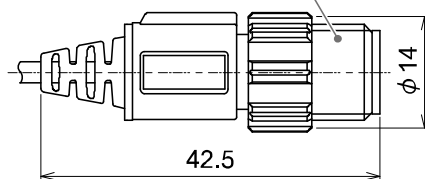
•D-M9###^A_B PC

Connector size M8



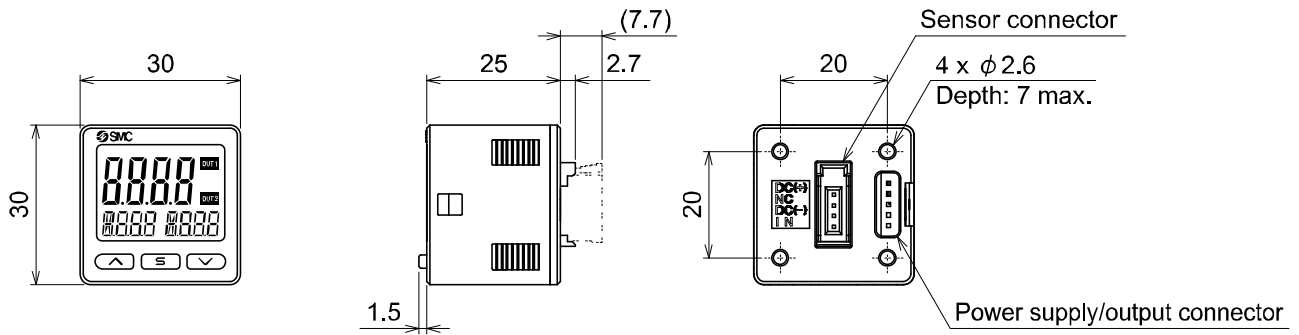
•D-M9###DPC

Connector size M12

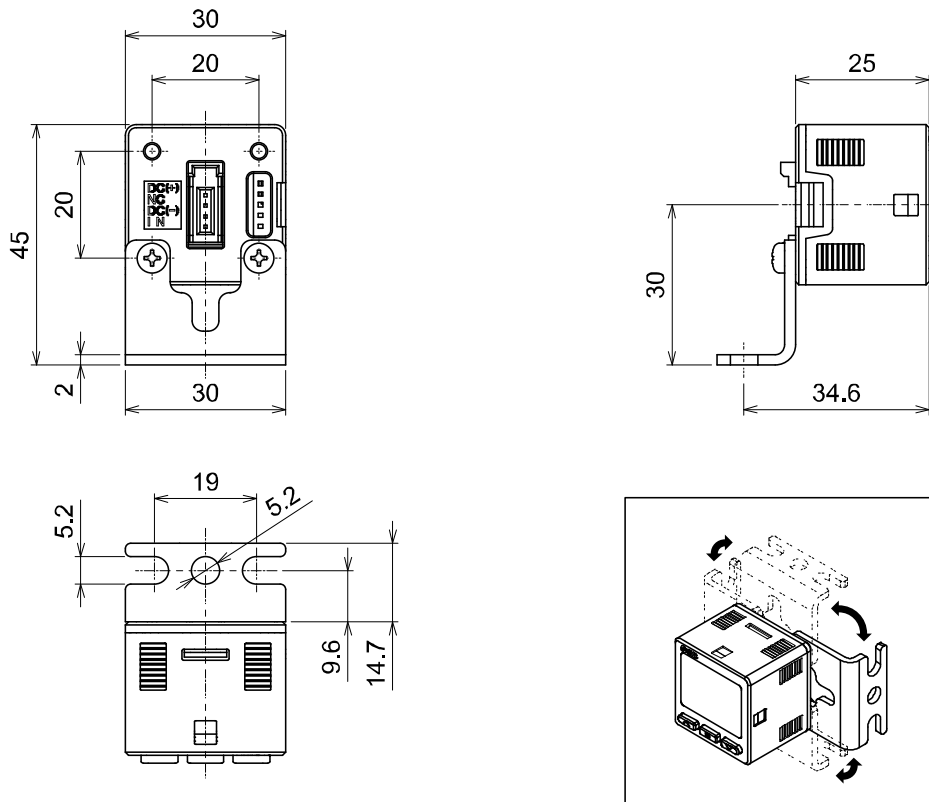


○Display sensor monitor

•D-MH1B#

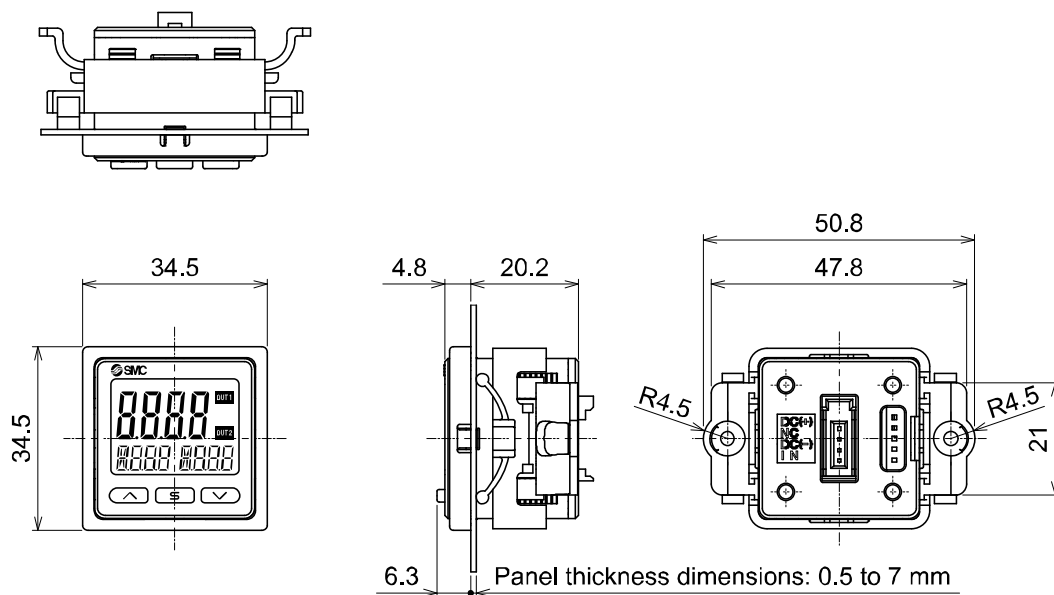


○Bracket (option part No.: ZS-46-A1)

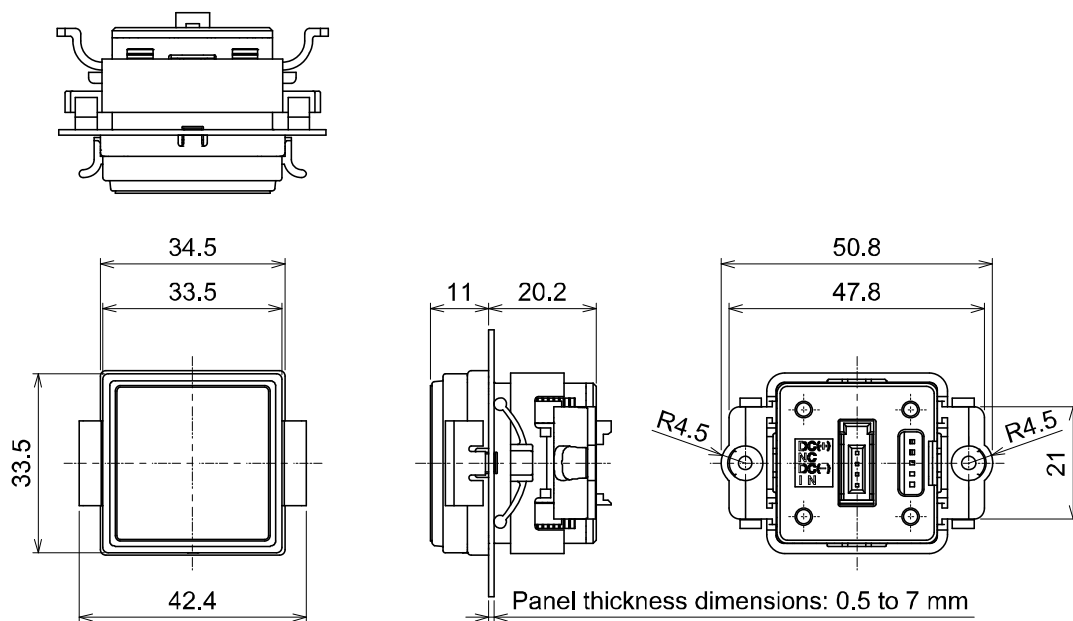


*: Bracket can be mounted to 4 sides.

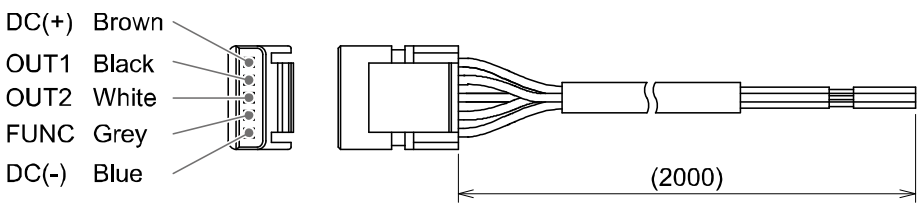
○Panel mount adapter (option part No.: ZS-46-B)



○Panel mount adapter + Front protective cover (Part No.: ZS-46-D)



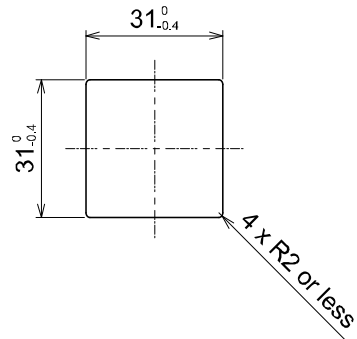
○Lead wire with connector (Option part number : ZS-46-5L)



Conductor cross sectional area		0.15 mm ² (AWG26)
Insulator	O.D.	1.0 mm
	Colours	Brown, Blue, Black, White, Grey (5 core)
Sheath	O.D.	φ3.5

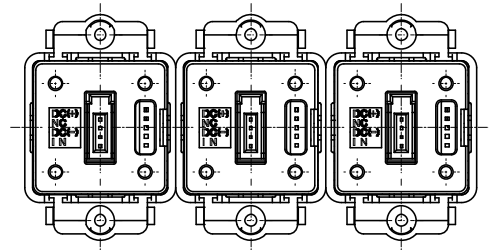
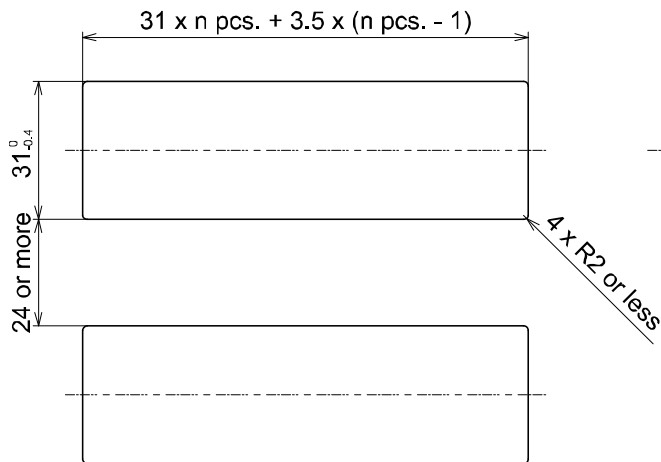
○Panel cutout dimensions

Mounting individually

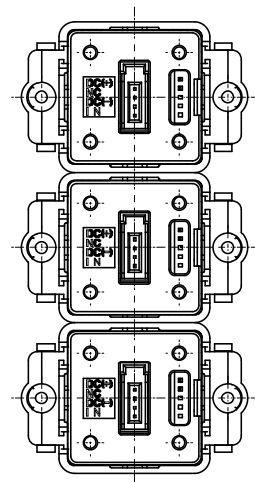
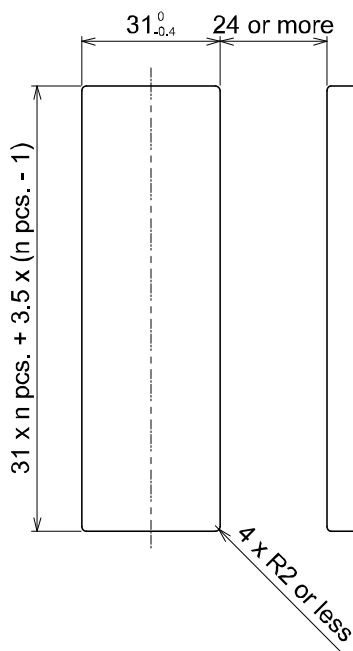


Close mounting of at least 2 pcs. (n pcs.)

<Horizontal>



<Vertical>



Revision history
A: Contents revised in several places. [October 2023]
B: Revised content in accordance with Safety Instructions. [April 2024]
C: Revised due to the addition of content. [August 2026]

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.

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