No.D-※S-OMG0006-D

Operation Manual

PRODUCT NAME

Trimmer Auto Switch

MODEL / Series / Product Number

D-M9K/D-F7K/D-Y7K
D-RNK/D-RPK

SMC Corporation

Table of Contents

Safety Instructions

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

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

Danger	**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
Warning	**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
Caution	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

Warning

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

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

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

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

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

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

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

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

Safety Instructions

⚠ Caution

SMC develops, designs, and manufactures products to be used for automatic control equipment, and provides them for peaceful use in manufacturing industries.
Use in non-manufacturing industries is not allowed.
Products SMC manufactures and sells cannot be used for the purpose of transactions or certification specified in the Measurement Act of each country.
The new Measurement Act prohibits use of any unit other than SI units in Japan.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.
Read and accept them before using the product.

Limited warranty and Disclaimer

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

***2) Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty

Compliance Requirements

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

Operator

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

■Safety Instructions

⚠Warning
•Do not disassemble, modify (including 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 connectors while the power is ON.
Otherwise electric shock, malfunction or damage to the product can result.

• After completing maintenance, perform appropriate functional checks.
Stop operation if the equipment does not function correctly.
Safety cannot be assured in the case of unexpected malfunction.
Perform periodic maintenance checks as follows.

1) Securely tighten the product mounting screws.
If the screws have become loose and the required mounting position has been lost, re-adjust the product to the correct mounting position and re-tighten the screws.

2) Check that there is no damage to the cable.
If damage to the cable is found, replace the product, or repair the cable, to avoid faulty insulation.

3) Check the detecting position setting.
Confirm that the product ON/OFF position is at the centre of the operating range (green light range).
If the product operates with a red light ON at the ON/OFF position, the mounting position is not correct. Re-adjust the product to the optimum position at the centre of the operating range.

Some actuator and cylinder series have their own setting methods. In such cases, follow the instructions given.

• Check the wiring.
Incorrect wiring or short circuit of load may damage the product.

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.
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.

Mounting/Adjustment

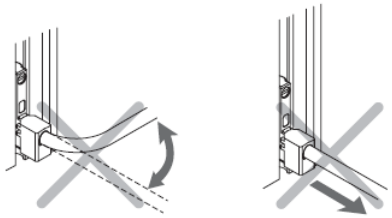
1. Do not drop or bump.
Do not drop, bump, or apply an excessive impact (300 m/s^2 or more for reed auto switches, 1000 m/s^2 or more for solid state auto switches) while handing the auto switch. It may cause the auto switch to break or malfunction.
2. Observe the proper tightening torque for mounting 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.
   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 IP67specificaitons, 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. Take appropriate measure to prevent freezing when the operating temperature is 5 oC or less.

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

○Sensor unit

D-M9K

- M9K: Trimmer Auto Switch
- M: Mounting

M	Direct mount into round groove

∗: One sensor connector (e-con) is included in each package.

D-□7K

- 7K: Trimmer Auto Switch
- □: Mounting

F	Rail mounting
Y	Direct mount into square groove

∗: One sensor connector (e-con) is included in each package.

○Amplifier unit

D-R□K

- K: Trimmer Auto Switch
- □: Output specifications

N	NPN (2 outputs)
P	PNP (2 outputs)

○Accessories (Option)

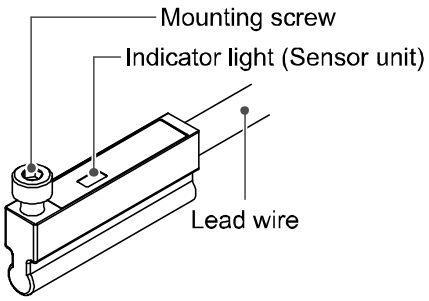
Product number	Contents	Remarks
ZS-28-C-1	Sensor Connector (e-con)	1 pc.
D-MS-A	Mounting screw (M2.5 x 4 L, Steel (Black zinc chromate))	1 pc.
D-MS-AP	Mounting screws (M2.5 x 4 L, Steel (Black zinc chromate))	10 pcs.
D-MS-B	Mounting screw (M2.5 x 4 L, SUS)	1 pc.
D-MS-BP	Mounting screws (M2.5 x 4 L, SUS)	10 pcs.
ISA-2-1	DIN rail (Width 35 mm x Length 105 mm)	1 pc.
ISA-2-2	DIN rail (Width 35 mm x Length 140 mm)	1 pc.
ISA-2-3	DIN rail (Width 35 mm x Length 175 mm)	1 pc.
ISA-2-4	DIN rail (Width 35 mm x Length 210 mm)	1 pc.
ISA-2-5	DIN rail (Width 35 mm x Length 245 mm)	1 pc.
ISA-2-6	DIN rail (Width 35 mm x Length 280 mm)	1 pc.
ISA-2-7	DIN rail (Width 35 mm x Length 315 mm)	1 pc.

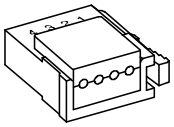
∗: Each accessory is not assembled with the product, but shipped together.

Summary of Product parts

○Sensor unit

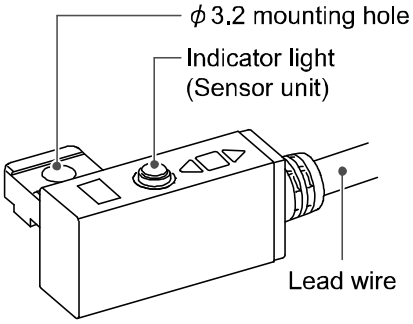
D-M9K



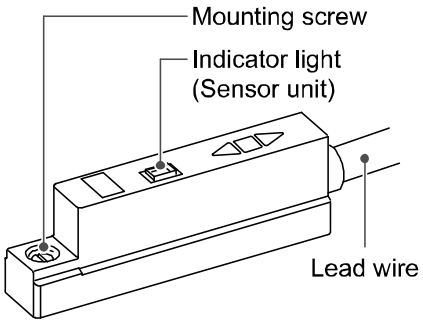


Sensor Connector (e-con)

D-F7K

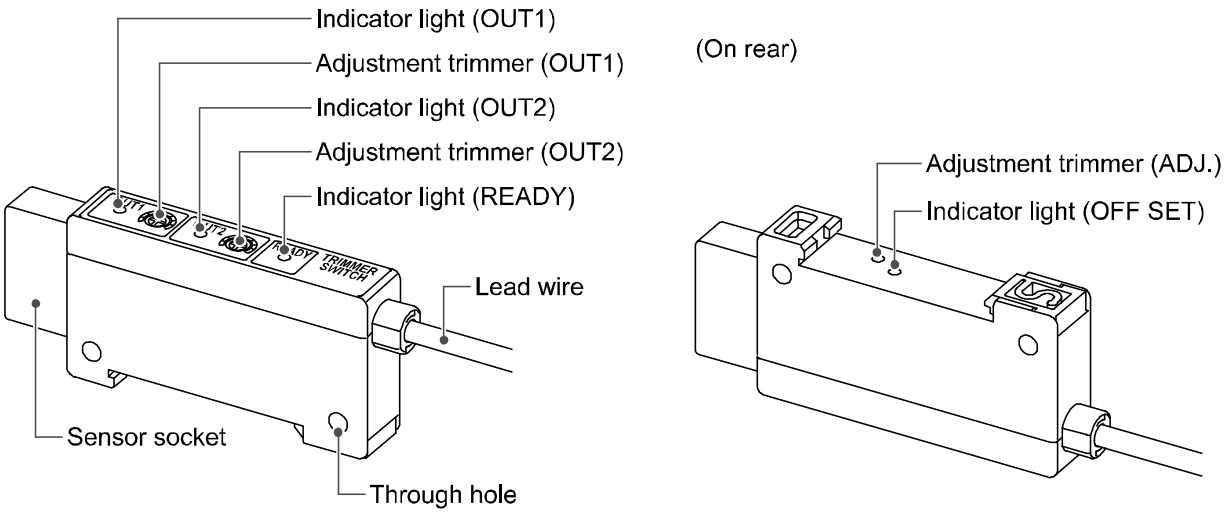


D-Y7K



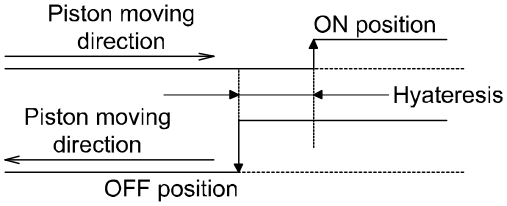
Element	Description
Mounting screw	Screw for securing the sensor unit in the groove in the actuator.
ϕ3.2 mounting hole	Hole for mounting the product to the actuator rail. (Use the mounting bracket included with the actuator)
Indicator light (Sensor unit)	The indicator is ON (red or green) when the Sensor unit detects the magnetic field.
Lead wire	Lead wire for power supply and outputs. (3 m)
Sensor Connector (e-con)	Sensor Connector supplied loose with the product.

○Amplifier unit



Element	Description
Indicator light (OUT1)	Indicates the output status of OUT1. The OUT1 light is ON (Green) when the output is ON.
Adjustment trimmer (OUT1)	For adjusting the detection range of OUT1.
Indicator light (OUT2)	Indicates the output status of OUT2. The OUT2 light is ON (Orange) when the output is ON.
Adjustment trimmer (OUT2)	For adjusting the detection range of OUT2.
Indicator light (READY)	The READY light is ON (Red) when the sensor unit detects the magnetic field. The detection ranges of OUT1 and OUT2 should be adjusted when this light is ON.
Lead wire	Lead wire for power supply and outputs. (3 m)
Through hole	Hole for direct mounting.
Sensor socket	For connecting the sensor.
Adjustment trimmer (ADJ.)	For adjusting the sensor unit when it is connected for the first time. Refer to Offset adjustment (page 17) for details.
Indicator light (OFF SET)	The OFFSET light is ON (Red) when the adjustment is completed.

■Definition and terminology

	Terms	Meaning
2	2-colour indication	Indication in which a red light is ON in the operating position, and a green light is ON in the optimum operating range. 
H	Hysteresis	The difference between the points where the product turns ON and OFF, which is provided to prevent chattering. 
I	Internal voltage drop	The voltage applied between the COM and signal line when the product turns ON.
L	Load current	The current flowing to the load when the product turns on.
M	Most sensitive position	The centre position of the sensor (which provides the strongest reaction from the sensor), and also the centre position of the operating range.
N	Non-polarity	A 2-lead wire type of connection for which polarity is not important. For example the load can be connected to either of (+) or (–).
S	Sequence controller (PLC)	A device which performs sequence control, such as receipt of inputs from the product along with programming and sending of the output to other equipment.
	Solid state Auto switch	Product which generates ON and OFF outputs with or without mechanical contact by using for example a transistor.

Mounting and Installation

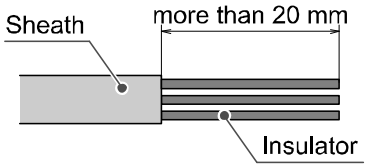
■Wiring

- Connections should only be made with the power supply turned OFF.
- Use separate routes for the product wiring and any power or high voltage wiring. Otherwise, malfunction may result due to noise.
- Ensure that the FG terminal is connected to ground when using a commercially available switch-mode power supply. When a switch-mode power supply is connected to the product, switching noise will be superimposed and the product specification can no longer be met. This can be prevented by inserting a noise filter, such as a line noise filter and ferrite core, between the switch-mode power supply and the product, or by using a series power supply instead of a switch-mode power supply.

●Connecting the wiring

Attaching the sensor connector to the sensor wire

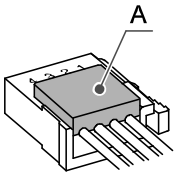
- Strip the sensor wire as shown. Do not cut the insulator.



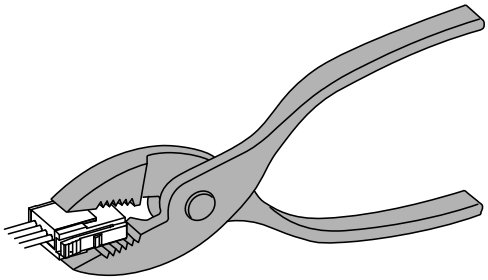
- Insert the corresponding wire colour shown in the table into the pin number printed on the sensor connector, to the bottom.

Pin number on connector	Wire colour	Contents
1	Black	SOUT1
2	Blue	GND
3	White	SOUT2
4	Brown	Vsw

- Check that the above preparation has been performed correctly, then part A shown should be pressed in by hand to make temporary connection.



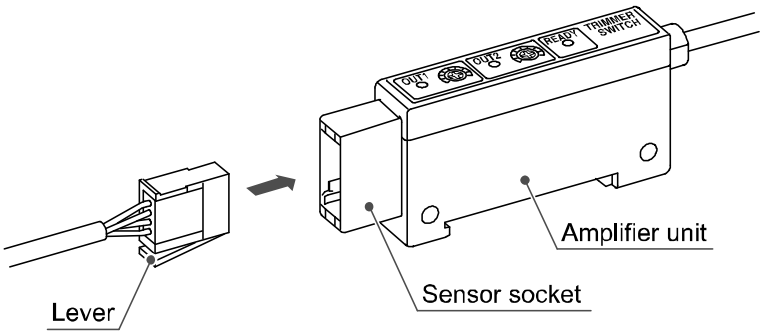
- Part A should then be pressed in using a suitable tool, such as pliers.



- The sensor connector cannot be re-used once it has been fully crimped.
  In cases of connection failure such as incorrect order of wires or incomplete insertion, please use a new connector. (ZS-28-C-1)

●Installation / Removal of the sensor connector to the amplifier unit

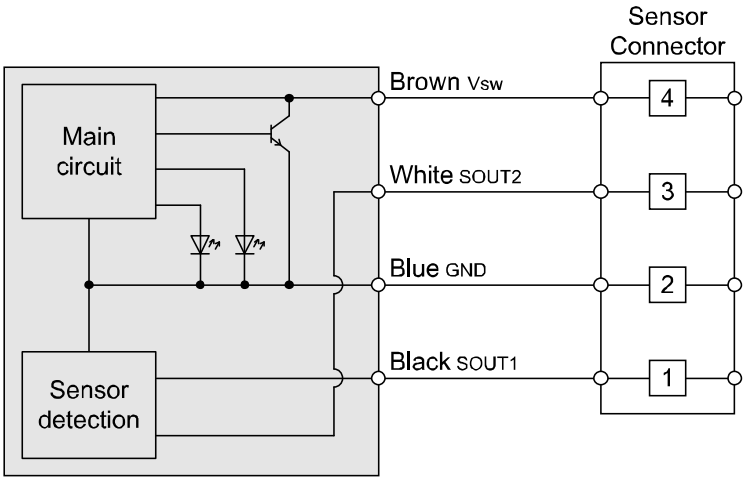
- When connecting the connector, insert it straight into the socket until the connector clicks.
- When removing the connector, press down the lever to release the hook from the sensor socket and pull the connector straight out.



■Internal circuit

○Sensor unit internal circuit

D-M9K / D-□7K



○Amplifier unit internal circuit

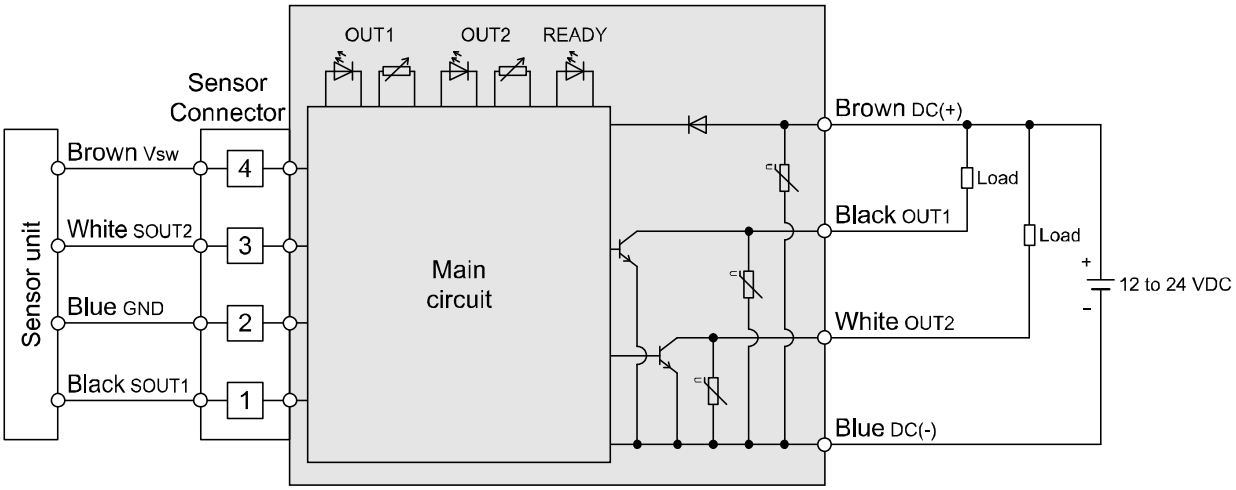
NPN (2 output) type

D-RNK:

Max. load current: 80 mA

Max. applied voltage: 28 V

Internal voltage drop: 1.5 V or less

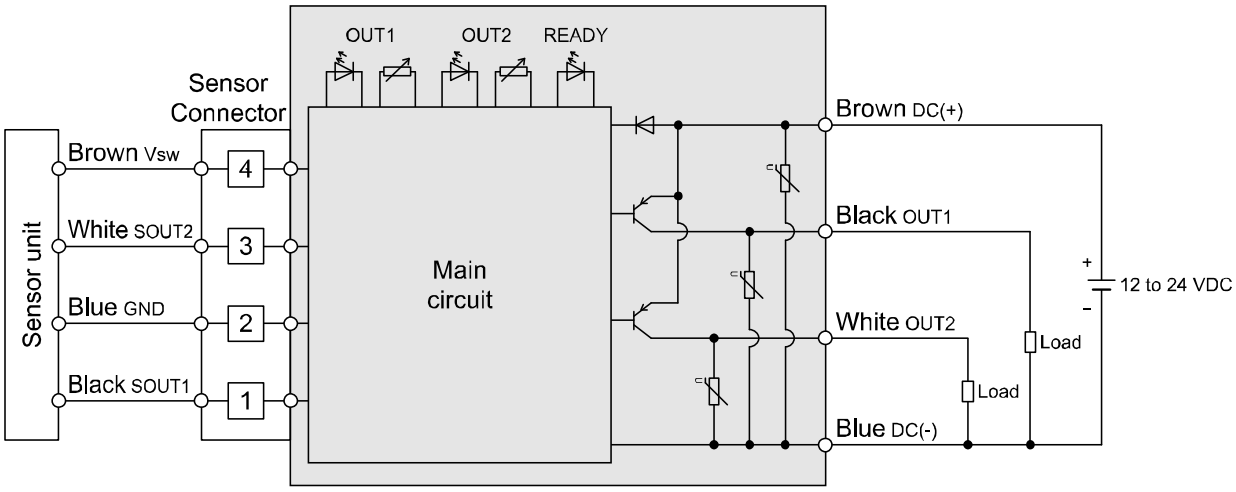


PNP (2 output) type

D-RPK:

Max. load current: 80 mA

Internal voltage drop: 1.5 V or less

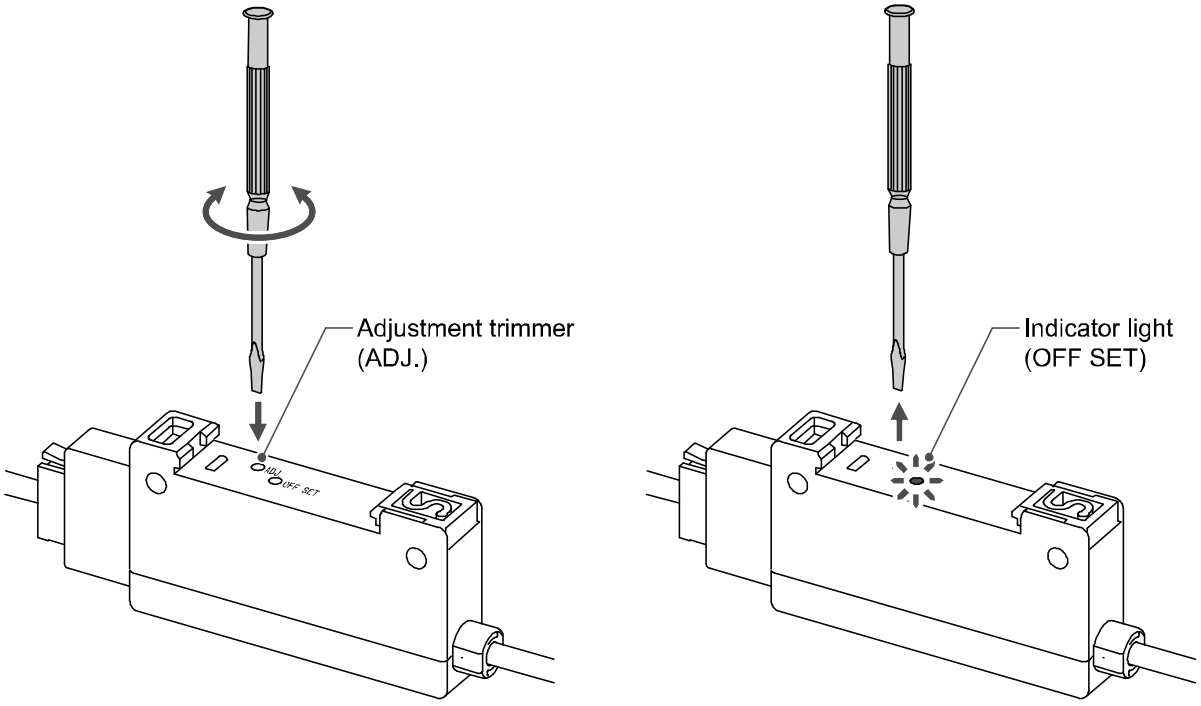


[Note] Please contact SMC if using AND connection.

■Offset adjustment

[Note] During offset adjustment, if the sensor unit is mounted to an actuator, remove the sensor unit from the actuator so that no magnetic field is present. Keep the sensor unit away from any magnetic field as far as possible because the sensor may detect a magnetic field even when the operation light is not ON.

(1) Connect the sensor unit to the amplifier unit, and connect the amplifier unit to the power supply.
(2) Insert a small flat blade screwdriver into the adjustment trimmer (ADJ.) to turn the trimmer clockwise or counterclockwise.
Be careful where the screwdriver is inserted. Inserting the screwdriver into the indicator light (OFFSET) hole may damage the light.
The recommended torque applied to the adjustment trimmer must be 20 mNm or less. The effective rotation is 12 turns.
The adjustment trimmer does not have any rotational stop. If the desired adjustment is not achieved by rotating in one direction, then try the other direction.
(3) When the indicator light (OFF SET) is red, adjustment is complete.



Offset Adjustment
- Offset Adjustment is the optimization of the electrical reference point of the sensor.
- Without offset adjustment, ON/OFF of the output signal cannot be operated correctly.
- When the sensor unit is used for the first time, always perform offset adjustment.
- After the adjustment, further adjustment is not necessary unless the sensor unit is replaced.

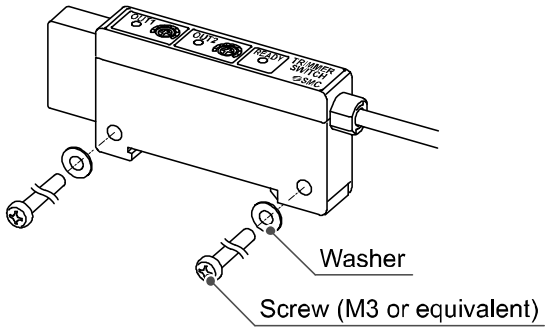
■Installation

●Installation of the amplifier unit

•Perform offset adjustment before the installation of the amplifier unit. Refer to page 17.

○Direct installation

•For direct mounting, use M3 screws (2 pcs.) or equivalent.
•The recommended tightening torque of the screw is 0.5 to 0.7 Nm.
•Mount the product on a flat and even surface. Mounting on an uneven surface can damage the case.
•Screws and washers should be supplied by the user.

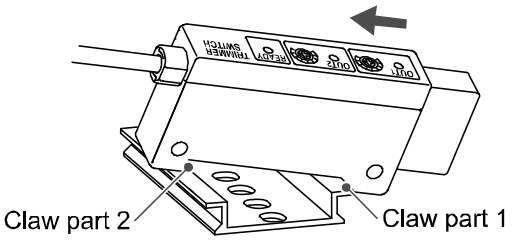


○Installation using DIN rail

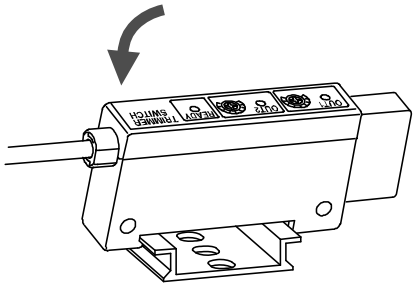
Mounting

(1) Hook the claw part 1 to the DIN rail (35 mm width).
(2) Push the claw part 2 down until it clicks.

(1)



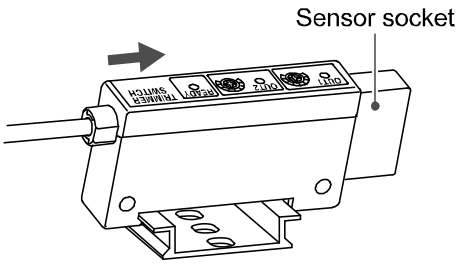
(2)



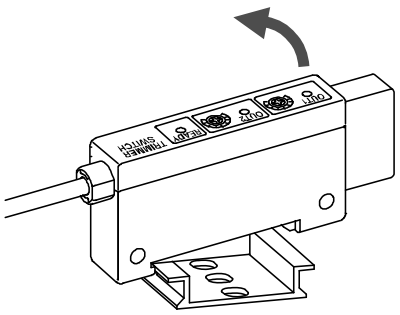
Removal

(1) Push the body towards the Sensor socket end.
(2) Pull the Sensor socket end upwards.

(1)



(2)

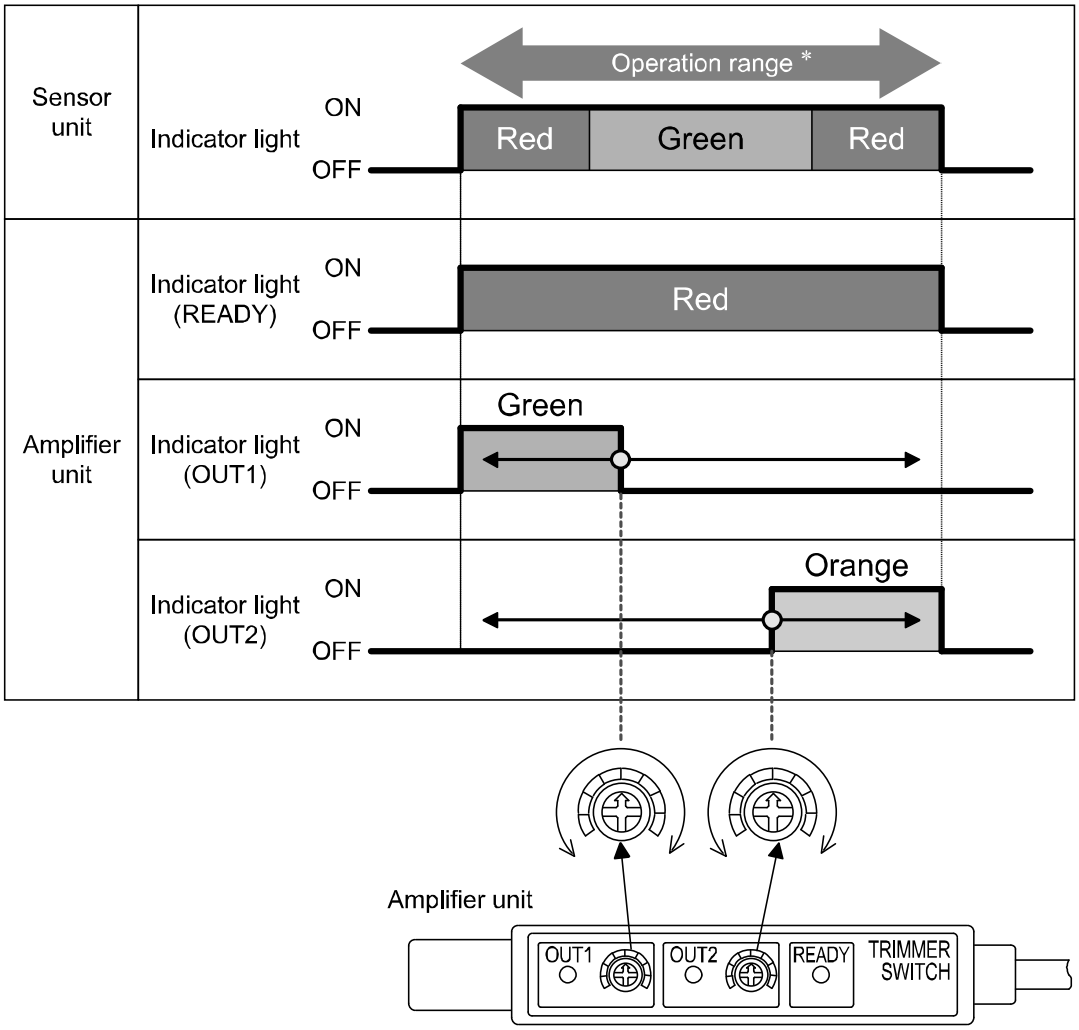


∗: We recommend using an end plate when mounting onto DIN rail. Refer to DIN rail end plate manufacturers for further details.

■Setting

Setting using the Adjustment trimmer.
“How to mount” depends on the actuator type and tube I.D.. Please refer to the actuator catalogue.

The size of the work piece (correct, too small, too large, or no work piece) can be verified by setting the detection range of OUT1 and OUT2 within the operation range using the adjustment trimmer. (See below)



∗: As for standard products, the operating range depends on the actuator and tube I.D.. It cannot be varied.

- The recommended torque applied to the adjustment trimmer is 2 to 20 mNm. The maximum rotation is 260 degrees. Make the adjustment within the specification range.
- The scale of the trimmer does not show the operation range. Please only use this as a guide for setting.

<<Cautions when designing>>

- For setting, do not move the actuator by hand. Use air to start the actuator.
- The Detection range may vary depending on the air supply pressure, variation of the ambient magnetic field, or the presence of any magnetic material.
- The Minimum detection distance is 0.5 mm. This product is not applicable when the size difference of the work piece is less than 0.5 mm in the stroke direction.
- This product is not suitable for work pieces with unstable shapes such as rubber parts.

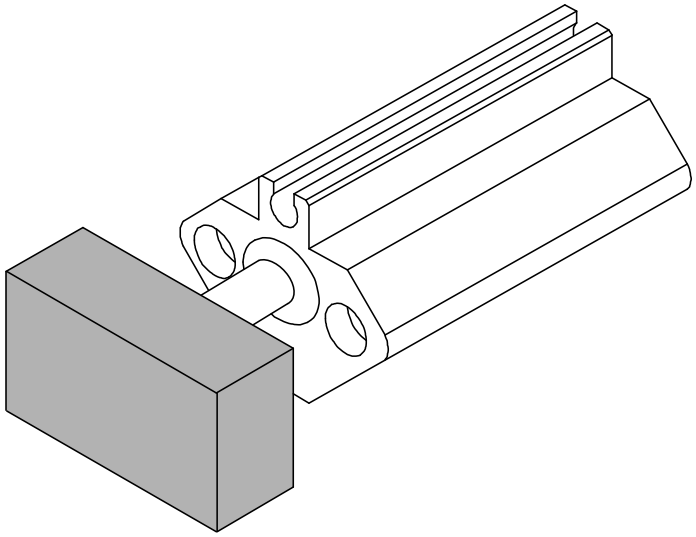
●Setting procedure 1

This is an example of setting.
Perform the setting and operation check with actual equipment.

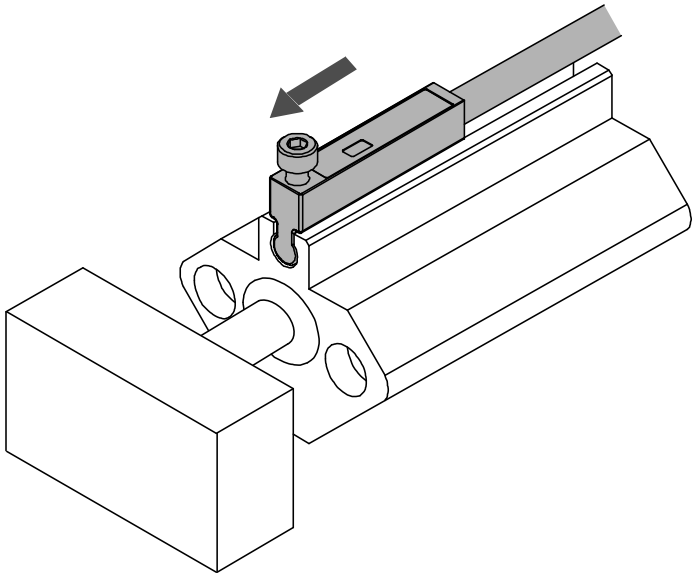
<<Verify 4 work pieces below using Air Gripper (CQ2 series)>>

[A]	Work piece size is correct
[B]	Work piece is too large
[C]	Work piece is too small
[D]	No work piece

(1) Push the largest conformant work piece by supplying air to the actuator.

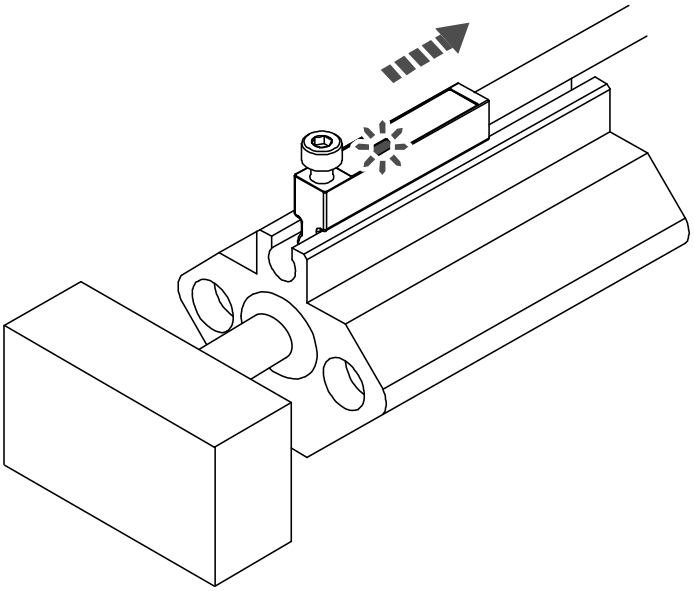


(2) Insert the sensor unit up to the end of the mounting groove. (Figure below) *

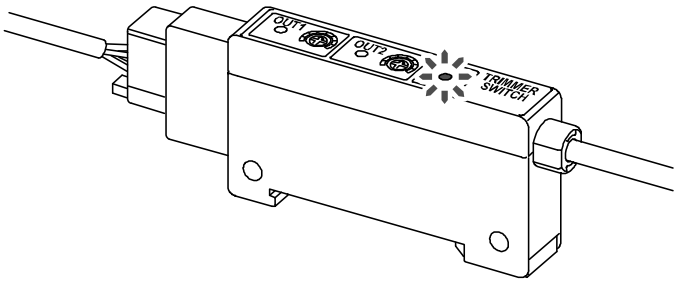


*: The relationship between OUT1 and OUT2 is reversed if the mounting direction is opposite. The Detection range may change. An Operation check with actual equipment should be performed as the location of OUT1 and OUT2 is reversed depending on the cylinder structure.

(3) Pull back the sensor unit. Position the sensor unit where the indicator light changes from red to green.

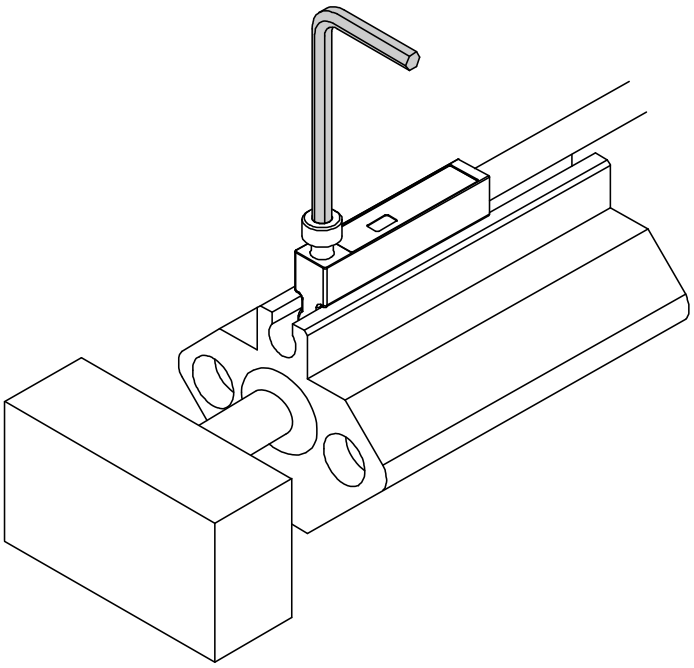


(4) Make sure that the indicator light (READY) on the amplifier unit is ON.



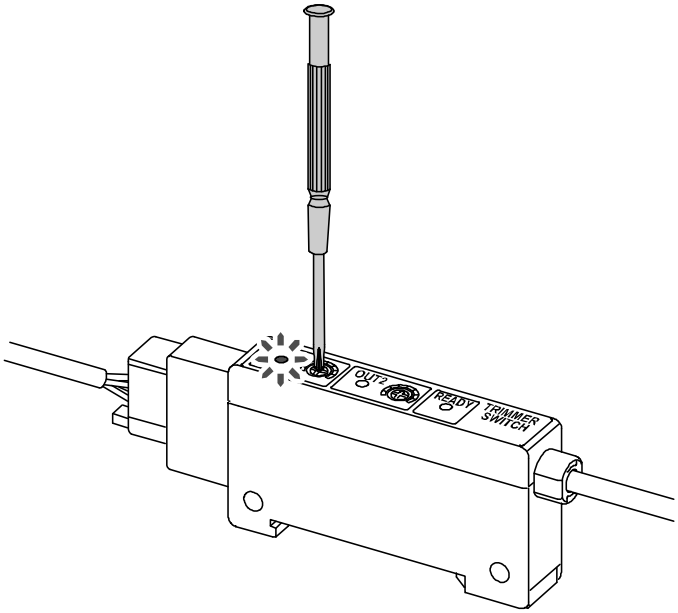
(5) Fix the sensor unit using the mounting screw or a mounting bracket.
Refer to the table below for the tightening torque.

Model	Mounting	Mounting tool	Tightening torque
D-M9K	Hexagon socket head cap screw (M2.5 x 12 L)	Hexagon driver (width across flats:2 mm)	0.1 to 0.2 Nm
D-F7K	Mounting bracket + Mounting screw (M3)	Phillips head screwdriver	0.5 to 0.7 Nm
D-Y7K	Mounting screw (M2.5 x 4 L)	Small flat blade screwdriver	0.05 to 0.1 Nm

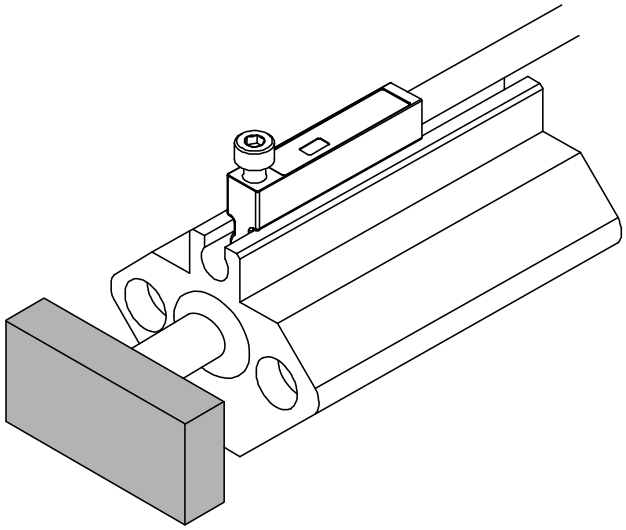


∗: “How to mount” depends on the actuator type and tube I.D.. Please refer to the actuator catalogue.

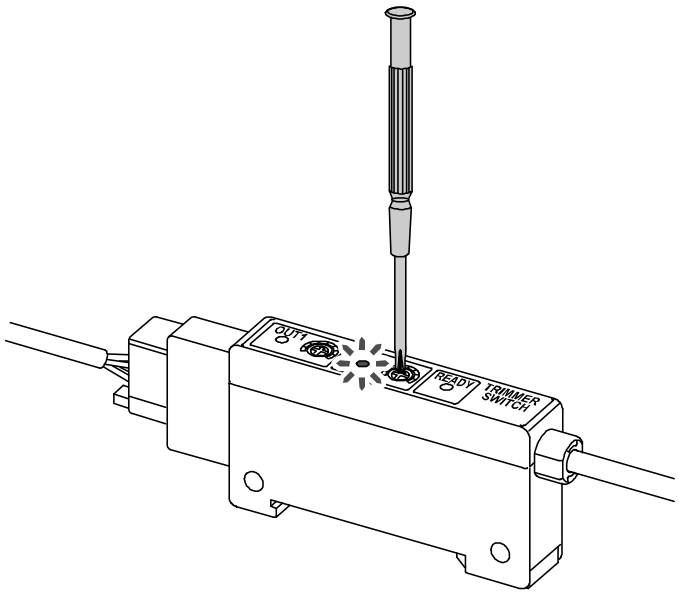
(6) Turn the adjustment trimmer (OUT1) with a screwdriver. Stop turning the screwdriver when the indicator light (OUT1) is ON.
(If the indicator light (OUT1) is already ON, turn the trimmer to turn OFF the light, then adjust the trimmer).



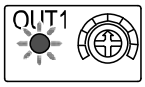
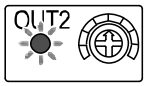
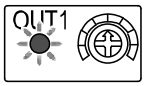
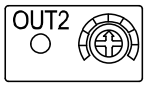
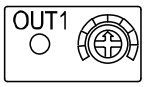
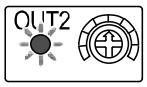
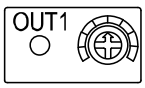
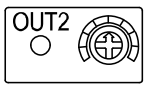
(7) Replace the pushed work piece with the smallest conformant work piece.

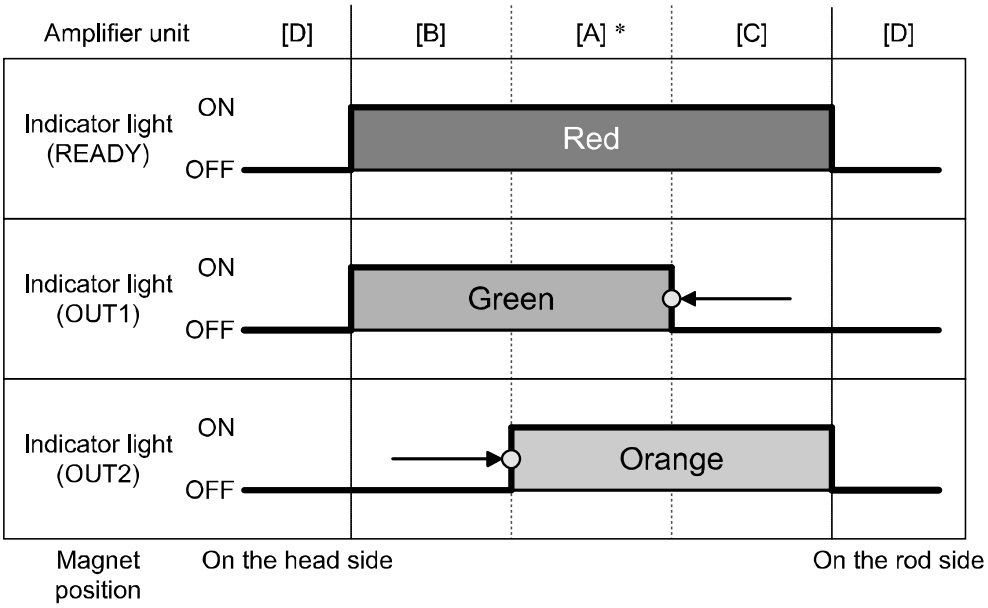


(8) Turn the adjustment trimmer (OUT2) with a screwdriver. Stop turning the screwdriver when the indicator light (OUT2) is ON.
(If the indicator light (OUT2) is already ON, turn the trimmer to turn OFF the light, then adjust the trimmer).



Verification of the work piece

		OUT1 output (Detects the upper limit of the work piece)	OUT2 output (Detects the lower limit of the work piece)
[A]	Work piece size is correct (Conformant range)	ON  (Work piece is smaller than the upper limit. Conformance)	ON  (Work piece is larger than the lower limit. Conformance)
[B]	Work piece is too small	ON  (Work piece is smaller than the upper limit. Conformance)	OFF  (Work piece is smaller than the lower limit. Non-conformance)
[C]	Work piece is too large	OFF  (Work piece is larger than the upper limit. Non-conformance)	ON  (Work piece is larger than the lower limit. Conformance)
[D]	No work piece	OFF  (Work piece is larger than the upper limit. Non-conformance)	OFF  (Work piece is smaller than the lower limit. Non-conformance)



∗: The dimension for [A] should be 0.5 mm minimum in the stroke direction.

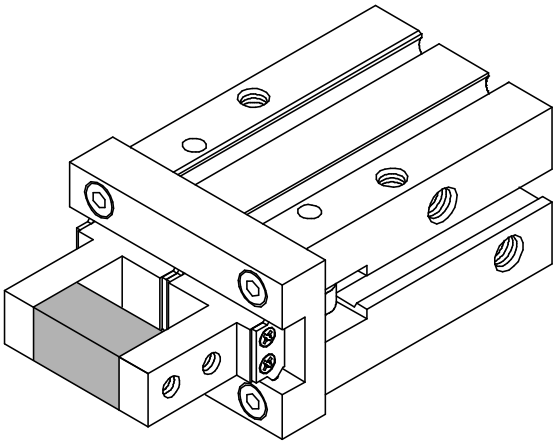
●Setting procedure 2

This is an example for setting.
Perform the setting and operation check with actual equipment.

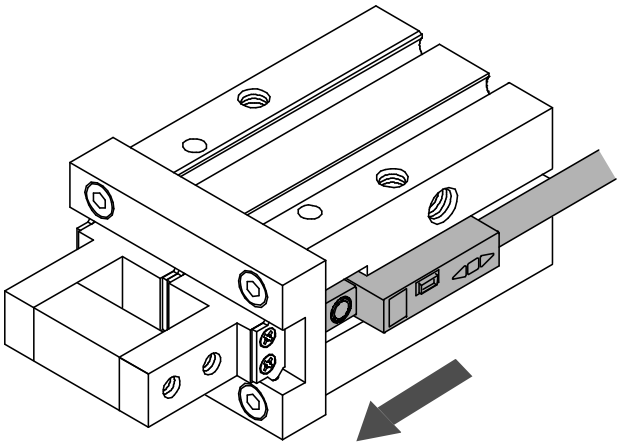
<<Verify 4 work pieces below using Air Gripper (MHZ2 series)>>

[A]	Work piece size is correct
[B]	Work piece size is too large
[C]	Work piece size is too small
[D]	No work piece

(1) Hold the minimum conformant work piece by supplying air to the gripper.

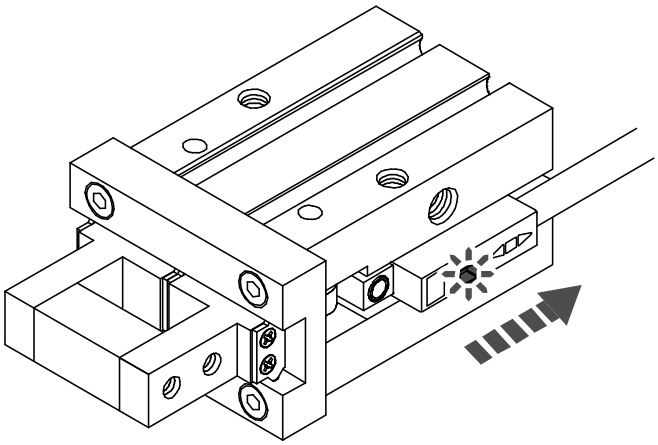


(2) Insert the sensor unit up to the end of the mounting groove. (Figure below) *

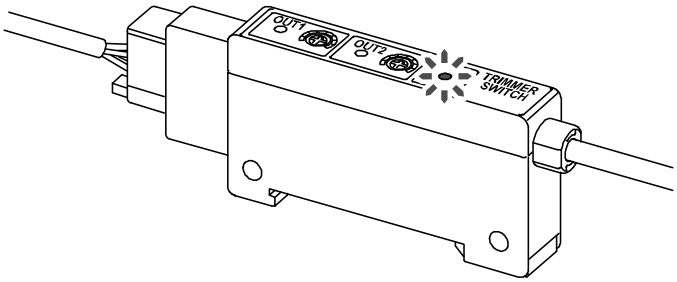


*: The relationship between OUT1 and OUT2 is reversed if the mounting direction is opposite. The Detection range may change. An Operation check with actual equipment should be performed as the location of OUT1 and OUT2 is reversed depending on the air gripper structure.

(3) Pull back the sensor unit. Position the sensor unit where the indicator light changes from red to green.

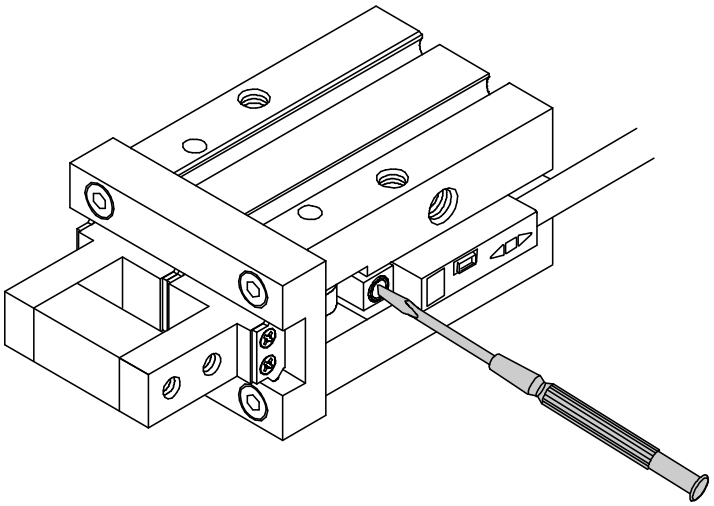


(4) Make sure that the indicator light (READY) on the amplifier unit is ON.



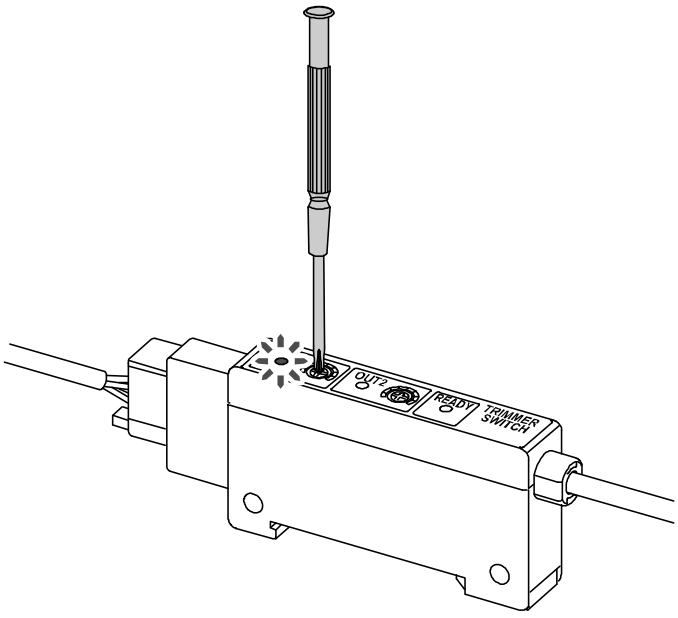
(5) Fix the sensor unit with the mounting screw or a mounting bracket.
Refer to the table below for the tightening torque.

Model	Mounting	Mounting tool	Tightening torque
D-Y7K	Mounting screw (M2.5 x 4 L)	Small flat blade screwdriver	0.05 to 0.1 Nm
D-M9K	Hexagon socket head cap screw (M2.5 x 12 L)	Hexagon driver (width across flats:2 mm)	0.1 to 0.2 Nm
D-F7K	Mounting bracket + Mounting screw (M3)	Phillips head screwdriver	0.5 to 0.7 Nm

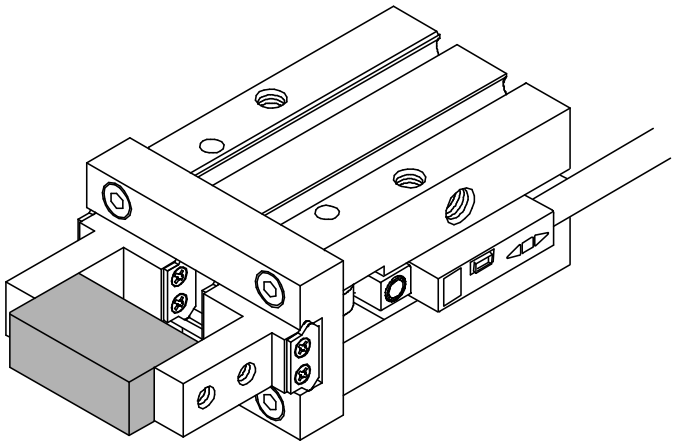


∗: "How to mount" depends on the actuator type and tube I.D.. Please refer to the actuator catalogue.

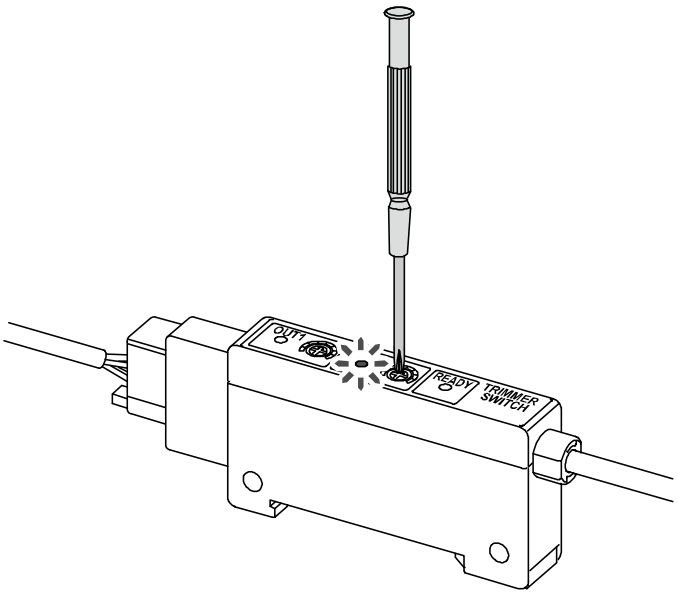
(6) Turn the adjustment trimmer (OUT1) with a screwdriver. Stop turning the screwdriver when the indicator light (OUT1) is ON.
(If the indicator light (OUT1) is already ON, turn the trimmer to turn OFF the light, then adjust the trimmer).



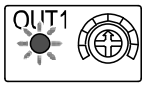
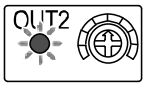
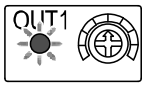
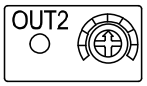
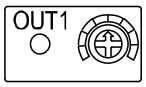
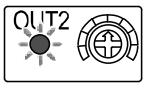
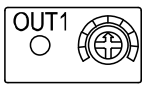
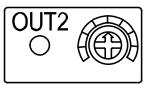
(7) Replace the work piece with the maximum conformant work piece.

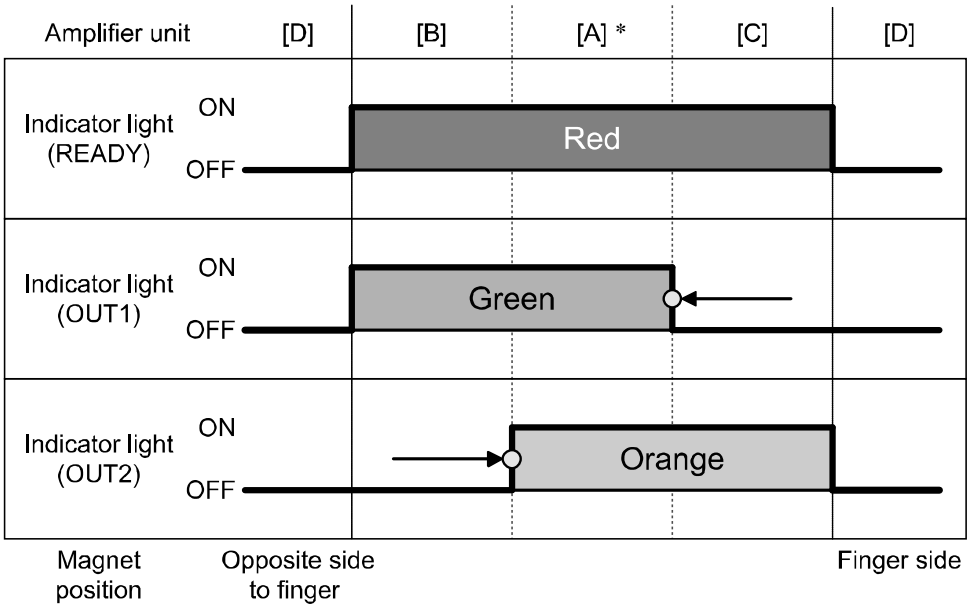


(8) Turn the adjustment trimmer (OUT2) with a screwdriver. Stop turning the screwdriver when the indicator light (OUT2) is ON.
(If the indicator light (OUT2) is already ON, turn the trimmer to turn OFF the light, then adjust the trimmer).



Verification of the work piece

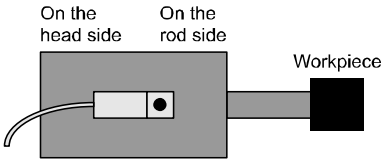
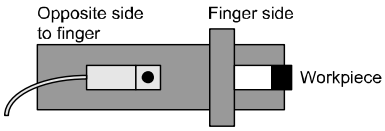
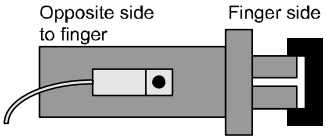
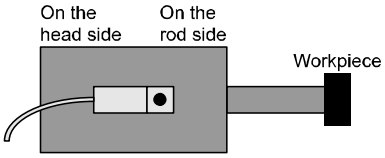
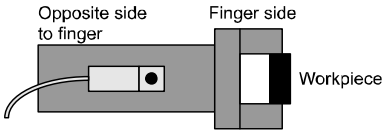
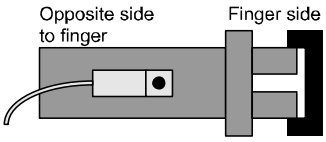
		OUT1 output (Detects the lower limit of the work piece)	OUT2 output (Detects the upper limit of the work piece)
[A]	Work piece size is correct (Conformant range)	ON  (Work piece is larger than the lower limit. Conformance)	ON  (Work piece is smaller than the upper limit. Conformance)
[B]	Work piece size is too large	ON  (Work piece is larger than the lower limit. Conformance)	OFF  (Work piece is larger than the upper limit. Non-conformance)
[C]	Work piece size is too small	OFF  (Work piece is smaller than the lower limit. Non-conformance)	ON  (Work piece is smaller than the upper limit. Conformance)
[D]	No work piece	OFF  (Work piece is smaller than the lower limit. Non-conformance)	OFF  (Work piece is larger than the upper limit. Non-conformance)



∗: The dimension for [A] should be 0.5 mm minimum in the stroke direction.

●Summary of setting (example)

Setting when the sensor wire is on the side away from the work piece

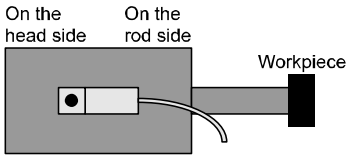
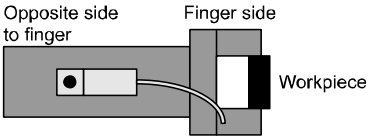
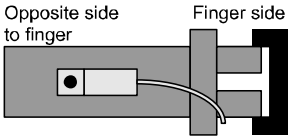
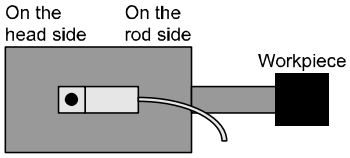
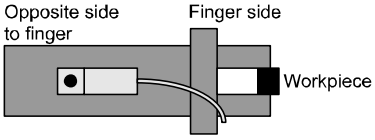
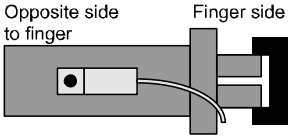
	When pushing with the cylinder	When holding on the outside (outer diameter)	When holding on the inside (inner diameter)
OUT1	Adjust the trimmer while pushing the large work piece (thick or high). 	Adjust the trimmer while holding the small work piece (thin). 	Adjust the trimmer while holding the work piece with small I.D. 
	Cylinder magnet located close to the work piece.		
OUT2	Adjust the trimmer while pushing the small work piece (thin or low). 	Adjust the trimmer while holding the large work piece (thick). 	Adjust the trimmer while holding the work piece with large I.D. 
	Cylinder magnet located close to the head side.		

Judgement

	OUT1	OUT2		OUT1	OUT2		OUT1	OUT2
Work piece size is correct (Conformance range)	ON	ON	Work piece size is correct (Conformance range)	ON	ON	Work piece size is correct (Conformance range)	ON	ON
Work piece size is small	ON	OFF	Work piece size is large	ON	OFF	I.D. is large	ON	OFF
Work piece size is large	OFF	ON	Work piece size is small	OFF	ON	I.D. is small	OFF	ON
No work piece	OFF	OFF	No work piece	OFF	OFF	No work piece	OFF	OFF

∗: These tables are not for guaranteeing the performance of the switch.
Perform operation check after setting the switch.

Setting when the sensor wire is on the work piece side

	When pushing with the cylinder	When holding on the outside (outer diameter)	When holding on the inside (inner diameter)
OUT1	Adjust the trimmer while pushing the small work piece (thin or low). 	Adjust the trimmer while holding the large work piece (thick). 	Adjust the trimmer while holding the work piece with large I.D. 
	Cylinder magnet located close to the head side		
OUT2	Adjust the trimmer while pushing the large work piece (thick or high). 	Adjust the trimmer while holding the small work piece (thin). 	Adjust the trimmer while holding the work piece with small I.D. 
	Cylinder magnet located close to the work piece side.		

Judgement		OUT1	OUT2		OUT1	OUT2		OUT1	OUT2
	Work piece size is correct (Conformance range)	ON	ON	Work piece size is correct (Conformance range)	ON	ON	Work piece size is correct (Conformance range)	ON	ON
	Work piece size is large	ON	OFF	Work piece size is small	ON	OFF	I.D. is small	ON	OFF
	Work piece size is small	OFF	ON	Work piece size is large	OFF	ON	I.D. is large	OFF	ON
	No work piece	OFF	OFF	No work piece	OFF	OFF	No work piece	OFF	OFF

∗: These tables are not for guaranteeing the performance of the switch.
Perform operation check after setting the switch.

Maintenance

How to reset the product after a power cut or when the power has been unexpectedly removed

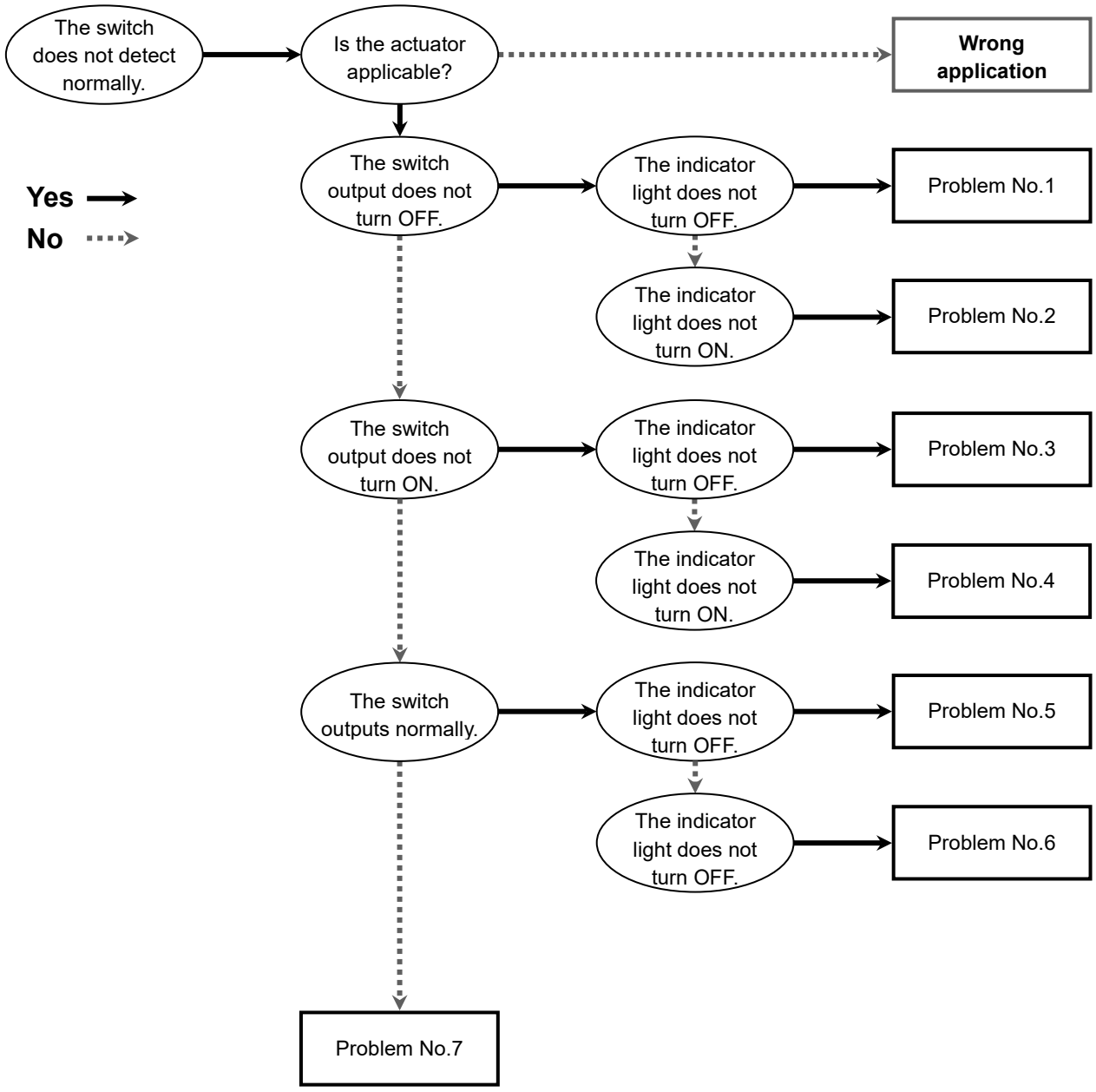
Regarding set up, contents of the program may be maintained by the customer's application systems. Be sure to confirm safety when returning operation of the actuator because it could have been stopped in an unstable condition.

Perform the following maintenance regularly to avoid possible danger due to unexpected product malfunction.

- Make sure that the Adjustment trimmer of the amplifier unit is set in the correct setting position.
- Check if the mounting bracket or mounting screws are loose.
  If the mounting bracket or mounting screws are loose, tighten them using the appropriate tightening torque.
- Make sure that the cable is not damaged.
  A damaged cable may lead to insulation failure. Repair the cable or replace the product.

Troubleshooting

With the product in operation, identify the problem from the following flow chart.
A failure of the product might depend on the operating environment (application etc.) and may need to be investigated by contacting SMC.



•Troubleshooting List

Problem No.	Problem	Possible cause	Countermeasure
1	The switch output does not turn OFF. The Indicator light does not turn OFF.	Malfunction due to magnetic field	Keep the actuator 40 mm or more away from adjacent actuators to avoid the influence of magnetic fields. Install a magnetic shielding plate between the actuators.
			If a magnetic field source is present near the actuator (electric welding machine conductor, motor, strong magnet etc.), use a magnetic shielding plate between the magnetic field source and the actuator.
		Improper setting (mounting) position (Narrow angle)	When the product operation range is larger than the piston stroke range, position the product away from the centre of the operation range.
2	The switch output does not turn OFF. The Indicator light does not turn ON.	Product failure	Replace the Product.
3	The switch output does not turn ON. The Indicator light does not turn OFF.	Product failure	Replace the Product.
4	The switch output does not turn ON. The Indicator light does not turn ON.	Power supply failure	Supply the specified power supply voltage (when the power supply voltage is zero or very low).
		Incorrect wiring	Check and correct the wiring.
		Improper setting (mounting) position	If the product is operating near the limit of the operating range, position the product to the centre of the operating range.
		Displacement from the set position	If the mounting bracket or mounting screws are loose, tighten them using the appropriate tightening torque at the correct position.
		Displacement of the actuator stopping position	When the stop position of the actuator piston is inconsistent, take measures to stabilize the position.
		Reduction in magnetic detection force (demagnetization)	Keep the actuator 40 mm or more away from adjacent actuators to avoid the influence of magnetic fields. Install a magnetic shielding plate between the actuators.
			If a magnetic field source is present near the actuator (electric welding machine conductor or strong magnet), use a magnetic shielding plate between the magnetic field source and the actuator.

Problem No.	Problem	Possible cause	Countermeasure
4	The switch output does not turn ON. The Indicator light does not turn ON.	Reduction in magnetic detection force (demagnetization)	Remove any magnetized substances such as cutting chips or spatter from around the actuator.
		Damaged cable	Replace the product. If repeated stress such as bending stress or tensile force is applied to the cable, take measures to protect the product.
5	The switch output is correct. The Indicator light does not turn OFF.	Product failure	Replace the Product.
6	The switch output is correct. The Indicator light does not turn ON.	Product failure	Replace the Product.
7	The operation is unstable. (chattering)	Improper setting (mounting) position	If the product is operating near the limit of the operating range, position the product to the centre of the operating range.
		Displacement from set position	If the mounting bracket or mounting screws are loose, tighten them using the appropriate tightening torque at the correct position.
		Incorrect wiring	Check and correct the wiring.
		Damaged cable	Replace the product. If repeated stress such as bending stress or tensile force is applied to the cable, take measures to protect the product.
		Malfunction due to magnetic field	Keep the actuator 40 mm or more away from adjacent actuators to avoid the influence of magnetic fields. Install a magnetic shielding plate between the actuators.
			If a magnetic field source is present near the actuator (electric welding machine conductor, motor, strong magnet etc.), use a magnetic shielding plate between the magnetic field source and the actuator.
	The Sensor turns ON even when the piston magnet is not in the operating range. (or the product operates at multiple points).	Malfunction due to magnetic field	Keep the actuator 40 mm or more away from adjacent actuators to avoid the influence of magnetic fields. Install a magnetic shielding plate between the actuators.
			If a magnetic field source is present near the actuator (electric welding machine conductor, motor, strong magnet etc.), use a magnetic shielding plate between the magnetic field source and the actuator.

Specification

■Specifications

Specifications for sensor unit

Model	D-M9K	D-F7K	D-Y7K
Mounting	Direct mount (round groove)	Rail mounting	Direct mount (square groove)
Applicable amplifier unit	D-RNK, D-RPK		
Impact resistance	980 m/s^2		
Insulation resistance	50 MΩ or more under the test voltage 500 VDC (between case and cable)		
Withstand voltage	1000 VAC 1min (between case and cable)		
Ambient temperature	−10 to 60 °C		
Enclosure	IP67		
Weight	55 g (including connector)	58 g (including connector)	
Standards	CE		

Specifications for amplifier unit

Model	D-RNK	D-RPK
Applicable amplifier unit	D-M9K, D-Y7K, D-F7K	
Applicable load	Relay · PLC	
Voltage output	12 to 24 VDC	
Current output	40 mA or less	
Output type	NPN 2 output	PNP 2 output
Load voltage	28 V or less	-
Load current	80 mA or less / 1 output	
Internal voltage drop	1.5 V or less	
Leakage current	100 μA or less / 1 output	
Response time	1 ms or less	
Impact resistance	98 m/s^2	
Insulation resistance	50 MΩ or more under the test voltage 500 VDC (between case and cable)	
Withstand voltage	1000 VAC 1min (between case and cable)	
Ambient temperature	−10 to 60 °C	
Enclosure	IP40	
Weight	70 g	
Standards	CE	

Oil proof flexible cable (sensor unit and amplifier unit)

Sheath	Outside diameter	ϕ3.5 mm
Insulator	Colours	Brown, Blue, Black, White
	Diameter	ϕ1 mm
Conductor	Nominal cross section area	0.15 mm^2 (AWG26)
	Wire diameter	ϕ0.08 mm
Minimum bending radius (Reference value)		21 mm

■Applicable actuator and operating range

Sensor unit: D-M9K

Air gripper

(Values shown for the auto switch operating range used with air grippers includes the range for both fingers opening.)

Unit: mm

Series	Tube I.D.										
	10	16	20	25	32	40	50	63	80	100	125
MHZ2	-	3.5	5.5	6.0	7.5	8.0	-	-	-	-	-
MHZL2	-	3.5	5.5	6.0	-	-	-	-	-	-	-
MHZJ2	-	5.0	6.0	6.0	-	-	-	-	-	-	-
MHS2 (2 fingers)	-	-	4.0	4.5	*				-	-	-
MHS3 (3 fingers)	-	-	4.0	4.5	*						
MHS4 (4 fingers)	-	-	4.0	4.5	*				-	-	-

* When using the MHS series (bore size ø32 or more), use the D-Y7K.

Air cylinder

Unit: mm

Series	Tube I.D.										
	12	16	20	25	32	40	50	63	80	100	125
CQ2	3.0	4.0	4.0	4.0	4.5	4.0	4.5	5.0	5.0	6.0	6.5
CQM	2.5	3.0	4.0	3.5	4.5	4.0	4.5	5.0	5.0	6.0	-
RZQ	-	-	-	-	4.5	4.0	4.5	5.0	-	-	-
MK	2.5	3.5	3.5	4.0	4.5	4.0	4.5	4.5	-	-	-
MGP-Z	3.0	4.0	4.0	4.0	4.5	4.0	4.0	4.5	4.5	5.0	-

Series	Tube I.D.			
	140	160	180	200
CQ2	6.5	6.0	6.0	6.0
CQM	-	-	-	-
RZQ	-	-	-	-
MK	-	-	-	-
MGP-Z	-	-	-	-

* Excludes the axial piping type (CQP2), compact cylinder with end lock (CBQ2), and the low-speed cylinder (CQ2X)

Sensor unit: D-Y7

Air gripper

(Values shown for the auto switch operating range used with air grippers includes the range for both fingers opening.)

Unit: mm or degree (°)

Series	Tube I.D.										
	10	12	16	20	25	32	40	50	63	80	100
MHZ2	3.0	-	5.0	7.0	7.0	8.0	8.5	-	-	-	-
MHZL2	6.0	-	7.0	10.0	11.0	-	-	-	-	-	-
MHL2	7.0	-	8.0	8.5	10.5	11.0	12.5	-	-	-	-
MHS2	-	-	-	-	-	6.5	7.0	7.5	8.5	-	-
MHS3, MHS(L)3	-	-	-	-	-	6.5	7.0	7.5	8.0	-	-
MHS4	-	-	-	-	-	6.5	7.0	7.5	8.5	-	-
MHC2	30º to -10º	-	30º to -10º	30º to -10º	22.5º to -10º	-	-	-	-	-	-
MHW2	-	-	-	88º to -5 º	54º to -6º	58º to -5º	41º to -5º	30º to -4º	-	-	-

Air cylinder

Unit: mm

Series	Tube I.D.							
	20	25	32	40	50	63	80	100
MGP	4.5	4.5	5.5	5.5	5.5	5.5	5.5	6.0
MGZ	-	-	-	5.5	6.5	6.5	-	-
CA2	-	-	-	4.0	4.0	6.0	6.0	6.0

∗ Only the cylinder with end lock (MGP-H/R) and the heavy duty guide rod type (MGPS)

Sensor unit: D-F7K

Air cylinder

Unit: mm

Series	Tube I.D.										
	10	12	16	20	25	32	40	50	63	80	100
CJ2	4.0	-	4.5	-	-	-	-	-	-	-	-
CM2 *1	-	-	-	3.5	3.5	3.5	3.5	-	-	-	-
CQ2 *2	4.5	4.5	5.5	5.5	5.0	5.5	5.5	5.5	6.0	5.5	6.0
MU	-	-	-	-	5.5	6.5	6.5	6.5	6.5	-	-
MK2T	-	-	-	-	-	6.5	6.0	6.0	6.5	-	-

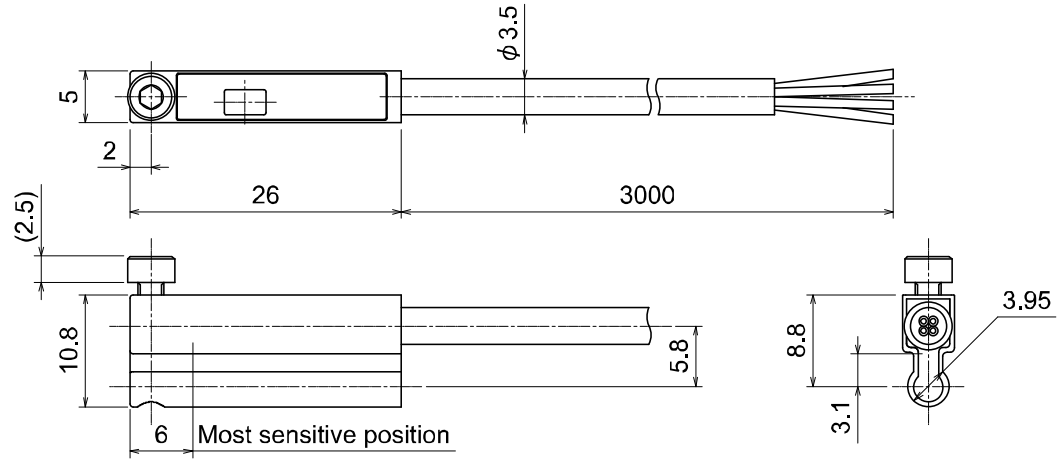
∗1 Use the Made-to-Order product (-XC13: Auto switch rail mounting type) for the CM2 series.

∗2 The axial piping type (CQP2), compact cylinder with end lock (CBQ2), and the low-speed cylinder (CQ2X) are not applicable.

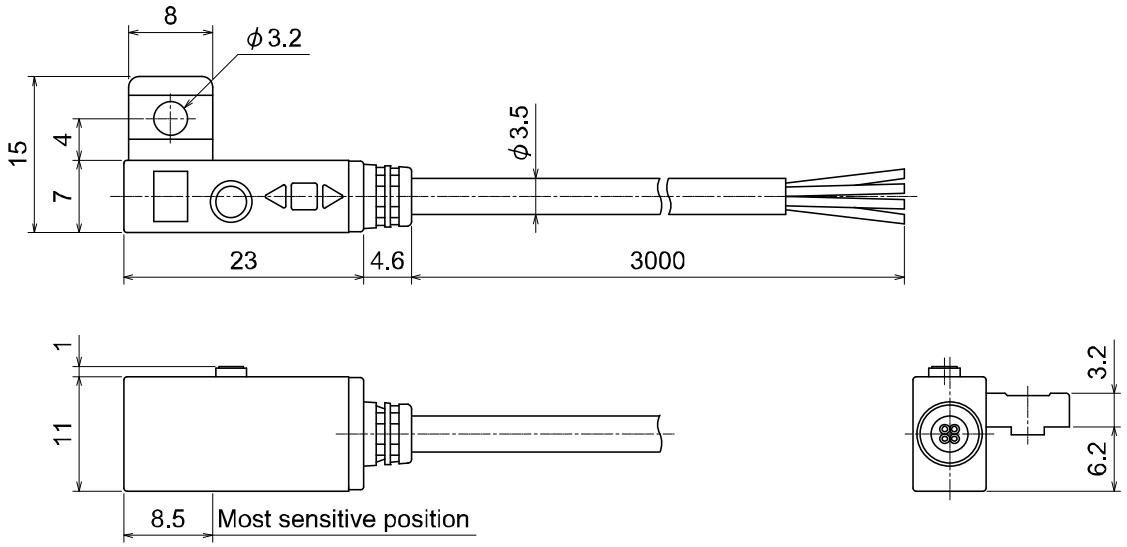
When using with a CA2, CM2 or CQ2 Series, apply a non-rotation mechanism to the rod.
(When a non-rotation rod type is used, this is not necessary).

■Dimensions

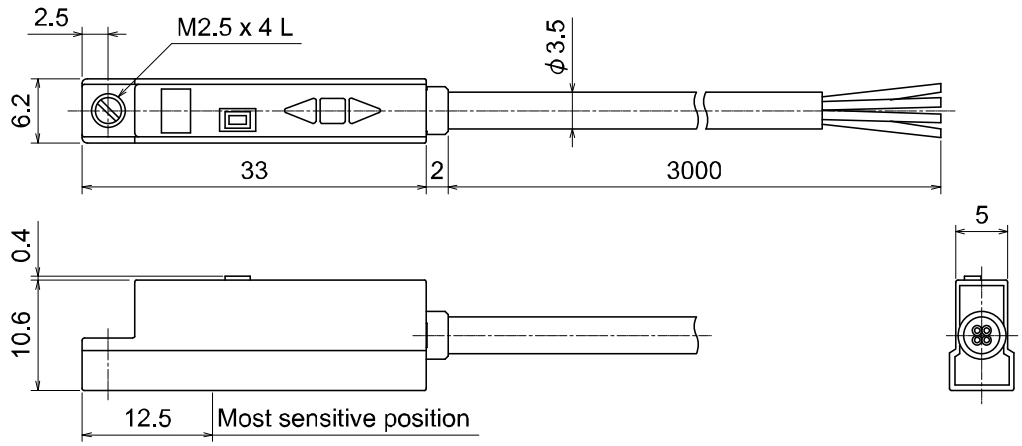
D-M9K



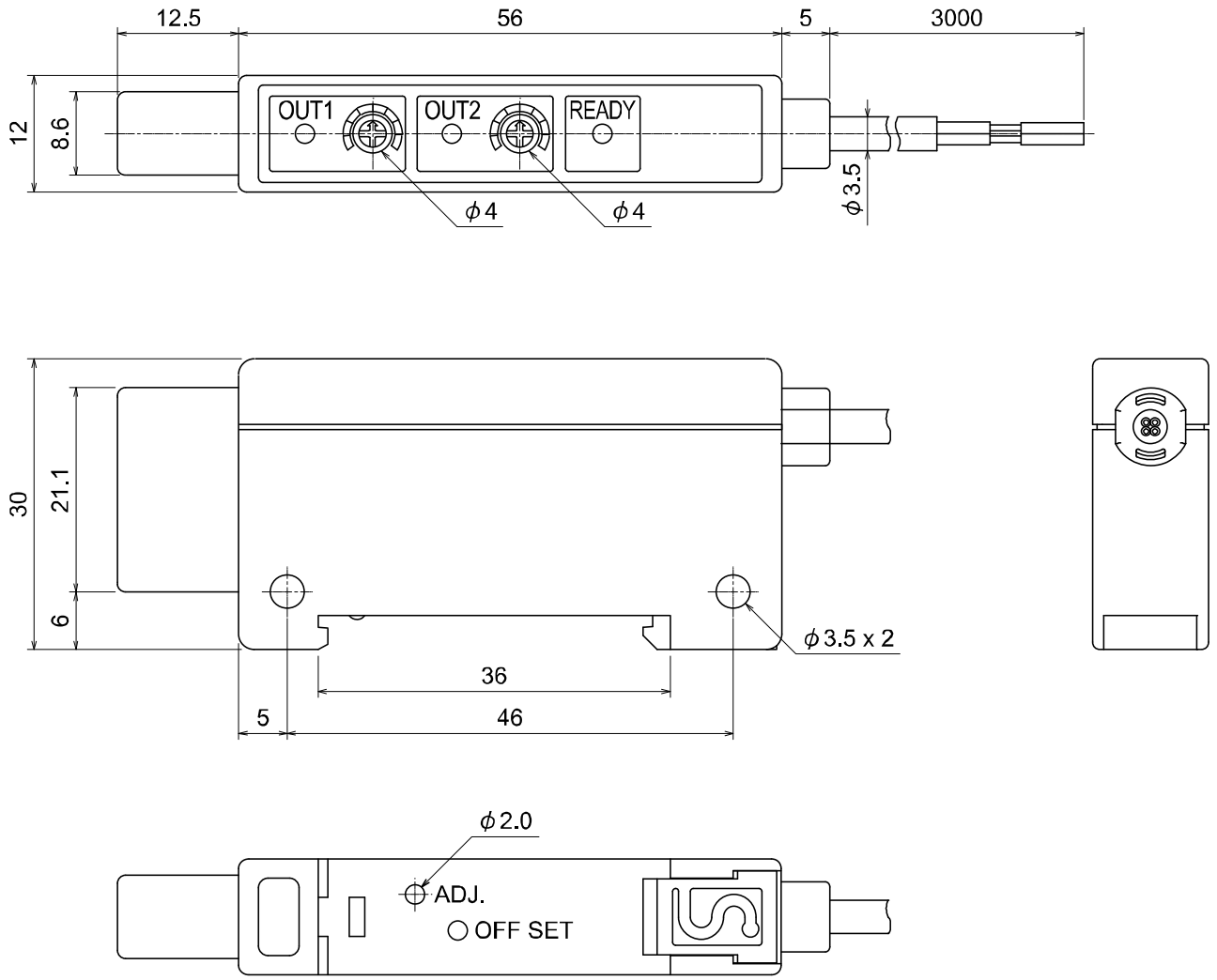
D-F7K



D-Y7K



D-R□K


12.5
56
5
3000
12
8.6
OUT1
OUT2
READY
ϕ4
ϕ4
ϕ3.5
30
21.1
6
ϕ3.5 x 2
36
5
46
ϕ2.0
ADJ.
OFF SET

Revision history
A: Contents changed due to the change of the format. B: Add the product model. C: Add the note. [November 2020] D: Revised content in accordance with Safety Instructions. [April 2024]

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