



Installation & Maintenance Manual

Auto Switch (Solid State)

Series D-F7K / D-Y7K (Sensor unit)

D-RNK / D-RPK (Amp unit)



EMC Directives

EN61000-6-2:2001 Electromagnetic Compatibility (EMC). Generic standards - Immunity for industrial environments.

EN55011 A1+A2:2001 Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical radio-frequency equipment and light industrial environments.

Read this manual before using this product.

For future reference, please keep this manual in a safe place.

This manual should be read in conjunction with the current catalogue.

1.1 General recommendation

These safety instructions are intended to prevent a hazardous situation and/or equipment damage.

These instructions indicate the level of potential hazard by label of "Caution", "Warning" or "Danger".

To ensure safety, be sure to observe ISO4414 (Note1), JIS B 8370 (Note2) and other safety practices.

Caution Operator error could result in injury or equipment damage.

Warning Operator error could result in serious injury or loss of life.

Danger In extreme conditions, there is a possible result of serious injury or loss of life.

(Note 1):ISO 4414: Pneumatic fluid power - Recommendations for the application of equipment to transmission and control systems.

(Note 2):JIS B 8370: Pneumatic system axiom.

WARNING

1.1.1. The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications.

Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

1.1.2. Only trained personnel should operate pneumatically operated machinery and equipment.

Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

1.1.3. Do not service machinery/equipment or attempt to remove component until safety is confirmed.

- 1) Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
- 2) When equipment is to be removed, confirm the safety process as mentioned above. Switch off air and electrical supplies and exhaust all residual compressed air in the system.
- 3) Before machinery/equipment is re-started, ensure all safety measures to prevent sudden movement of actuators etc. (Supply air into the system gradually to create backpressure, i.e. incorporate a soft-start valve).

1.1.4. Contact SMC if the product is to be used in any of the following conditions:

- 1) Conditions and environments beyond the given specifications, or if product is used outdoors.
- 2) Installations in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, emergency stop circuits, press applications, or safety equipment.
- 3) Equipment intended for use in potentially explosive atmospheres. Applications which have the possibility of having negative effects on people, property or animals. Special safety analysis is required.

2. INSTALLATION AND OPERATING ENVIRONMENT

WARNING

Design and selection

- 1) Confirm the specifications.
Read the specifications carefully and use this product appropriately. The product may be damaged or malfunction if it is used outside the range of specifications for load current, voltage, temperature or impact.
- 2) Take precautions when multiple actuators are used close together.
When multiple auto switch actuators are used in close proximity, magnetic field interference may cause the switches to malfunction. Maintain a minimum actuator separation of 40mm.
- 3) 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 if the speed is too great the operating time will be shortened and the load may not operate properly. The maximum detectable piston speed is:

$$V(\text{mm/s}) = \frac{\text{Autoswitch operating range [mm]}}{\text{Load operating time [mm]}} \times 1000$$

- 4) Keep wiring as short as possible
Although longer wiring does not affect the function, please keep it to 100m or shorter
 - 5) Do not use a load that generates surge voltage.
Although a zener diode for surge protection is connected at the output side of a solid state auto switch, damage may still occur if the surge is applied repeatedly. When a load such as a relay or solenoid which generates surge is directly driven, use a type of switch with a built-in surge absorbing element.
 - 6) Cautions for use in an interlock circuit
When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to avoid trouble by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch.
Also perform periodic maintenance and confirm proper operation.
- Ensure sufficient clearance for maintenance activities.
When designing an application, be sure to allow sufficient clearance for maintenance and inspections.

Mount / adjustment

- 1) Do not drop or bump.
Do not drop, bump or apply excessive impacts (1000m/s² or more for solid state switches) while handling. Although the body of the switch may not be damaged, the inside of the switch could be damaged and cause a malfunction.
- 2) Do not carry a actuator by the auto switch lead wires.
Never carry an actuator by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.
- 3) Mount switches using the proper tightening torque.
If a switch is tightened beyond the range of tightening torque, the mounting screws, mounting brackets or switch may be damaged.
On the other hand, tightening below the range of tightening torque may allow the switch to slip out of position.
- 4) Mount a switch at the center of the operating range.
Adjust the mounting position of an auto switch so that the piston stops at the center of the operating range (the range in which a switch is ON). (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 may be unstable.

Wiring

- 1) Avoid repeatedly bending or stretching lead wires.
Broken lead wires can result from wiring patterns which repeatedly apply bending stress or stretching force to the lead wires.
- 2) Confirm proper insulation of wiring.
Be certain that there is no faulty wiring insulation (contact with other circuits, ground fault, improper insulation between terminals, etc.)
Damage may occur due to excess current flow into a switch.
- 3) Do not wire with power lines or high voltage lines.
Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits containing auto switches may malfunction due to noise from these other lines.
- 4) Do not allow short circuit of loads.
All models of switches do not have built-in short circuit protection circuits. Note that if a load is short circuited, the switch will be instantly damaged because of excess current flow into the switch.
- 5) Avoid incorrect wiring
If wiring is incorrect, the switches will be damaged.

WARNING

Operating environment

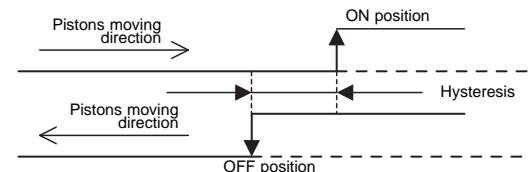
- 1) Do not use in an area where a magnetic field is generated.
Auto switches can malfunction or magnets inside actuators can become demagnetized.
- 2) Do not use in an environment where the auto switch will be continually exposed to water.
Although switches satisfy IEC standard IP67 construction (JIS C 0920: watertight construction), avoid using switches in applications with continual exposure to water splash or spray. Poor insulation or swelling of the potting resin inside switches may cause malfunction.
- 3) Do not use in an environment with oil or chemicals.
Consult SMC if auto switches are to be used in an environment with coolant, cleaning solvent, various oils or chemicals. If auto switches are used under these conditions for even a short time, they may be adversely affected by improper insulation, malfunction due to swelling of the potting resin, or hardening of the lead wires.
- 4) Do not use in an environment with temperature cycles.
Consult SMC if switches are used where there are temperature cycles other than normal air temperature changes, as there may be adverse effects inside the switches.
- 5) Do not use in an area where surges are generated.
When there are units (solenoid type lifter, high frequency induction furnace, motor, etc.) which generate a large amount of surge in the area around actuators with solid state auto switches, this may cause deterioration or damage to the switches. Avoid sources of surge generation and crossed lines.
- 6) Avoid accumulation of iron waste or close contact with magnetic substances.
When a large amount of iron waste such as machining chips or spatter has accumulated, or a magnetic substance (something attracted by a magnet) is brought into close proximity with an auto switch actuator, it may cause auto switches to malfunction due to a loss of the magnetic force inside the actuator.

Maintenance

- 1) Perform the following maintenance periodically in order to prevent possible danger due to unexpected auto switch malfunction.
 - 1) Securely tighten 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 switches or repair lead wires, etc., if damage is discovered.

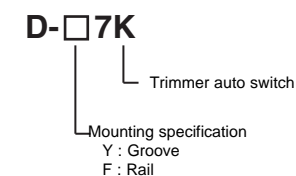
Others

- 1) For durability against water, elasticity, application at welding site, please consult us.
- 2) If ON and OFF position (hysteresis) cause problems, please consult us.



Model Indication Method

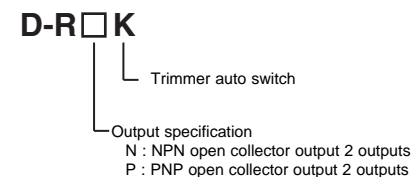
Sensor unit



Accessory : Connector for sensor (1pc) ZS-28-CA-3

* Sensor wire is 3m in length.

Amp unit



* Power and output lead wire is 3m in length.

Specification

Specification for Sensor unit

Part No.	D-F7K	D-Y7K
Mounting	Rail	Groove
Applicable amplifier	D-RNK, D-RPK	
Operation display	Red lights on at sensitive position Green lights on at optimum detecting position	
Electrical entry	Grommet	
Lead wire	Oil-proof vinylcable cord φ3.5 0.14mm ² 4 cores	
Impact resistance	980m/s ²	
Insulation resistance	50M Ω or more at 500VDC Mega (between case and lead wire)	
Withstand voltage	1000VAC 1min.(between case and lead wire)	
Ambient temperature	-10 to 60°C	

Specification (continued)

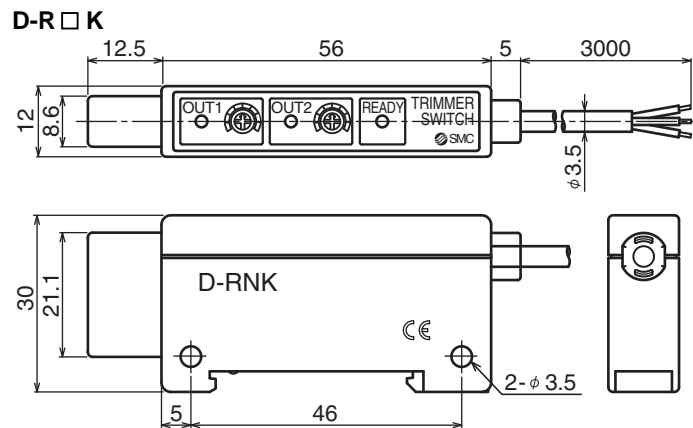
Specification for Amp unit

Part No.	D-RNK	D-RPK
Applicable sensor	D-F7K, D-Y7K	
Application	for Relay/PLC	
Power supply voltage	12 to 24VDC	
Current consumption	40mA or less	
Output type	NPN open connector output, 2 outputs	PNP open connector output, 2 outputs
Load voltage	28VDC or less	-
Load current	80mA or less	
Internal voltage drop	1.5V or less	
Leakage current	100 μA or less	
Response time	1ms or less	
Operating indication Light	READY : Illuminates at detection of piston position (Red). (At connection on sensor unit.) OUT1 : Illuminates at ON. (Green) OUT2 : Illuminates at ON. (Orange)	
Electrical entry	Connection of sensor unit : e-con connector Power · output line : Grommet	
Lead wire	Oil-proof vinyl cabytre cord φ 3.5 0.14mm ² 4-cores	
Impact resistance	98m/s ²	
Insulation resistance	50MΩ or more with 500VDC mega (between case and lead wire)	
Withstand voltage	1000VAC 1min (between case and lead wire)	
Ambient temperature	-10 to 60°C	

*Specification is at sensor connected.

Outline with Dimensions (in mm) (continued)

Amp unit

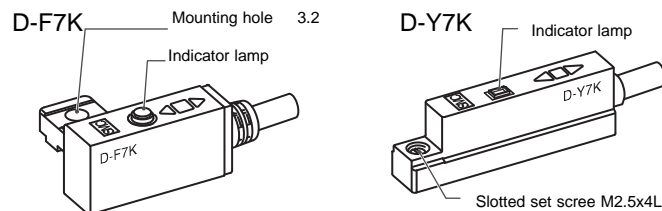


Names and Functions of Individual Parts

Sensor unit

Indicator lamp : The red lamp is lit when the sensor detects the magnetic field. The green lamp is lit at the magnetic field optimum detecting position (including most sensitive position).

Mounting hole φ 3.2, Slotted set screw M2.5 X 4L : This hole is used to mount the sensor to the actuator.



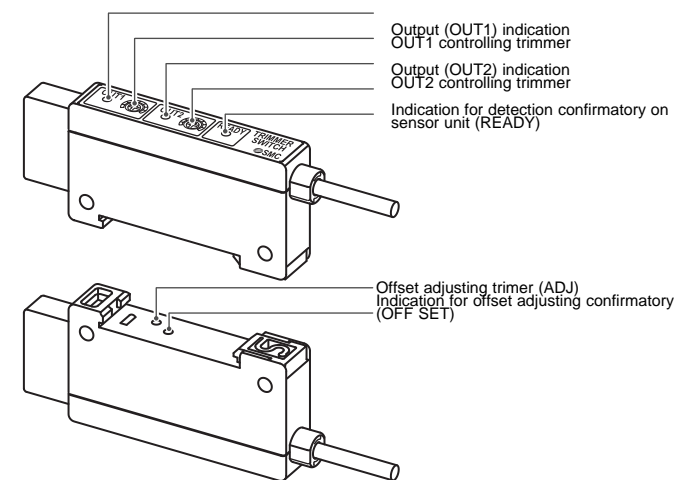
Amp unit

Output (OUT1) indication (green) : Illuminates at OUT1 output.
Output (OUT2) indication (orange) : Illuminates at OUT2 output.
OUT1 controlling trimmer : Controls output width of OUT1 when a magnet field is detected on the sensor unit.
OUT2 controlling trimmer : Controls output width of OUT2 when a magnet field is detected on the sensor unit.

Detection indicator on sensor unit (red) : Sensor illuminates at detection of magnetic field. Be able to control output with of OUT1 and OUT2 while this indication light is illuminating.

Offset adjusting trimmer : Adjust sensor unit at connection. (Once adjusted sensor unit adjustment is not necessary, unless the sensor unit replaces. Be sure to re-adjust after removing sensor unit from actuator. Refer to "Offset adjusting method" in detail.)

Offset adjustment indicator (red) : Offset adjustment lamp illuminates when adjustment is complete.



Installation

Mounting on actuator

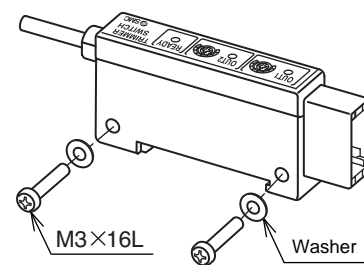
• Auto switch is mounted on actuator with table clamp. Please refer to each catalog regarding how to mount table clamp as actuator type and I.D of tube is different.

For mounting Amp unit

• Use mounting screw (M3× 16L 2pcs) or DIN rail (35mm width).
 • Adjust the offset point before connection with Amp unit. Refer to "Offset adjustment method" in detail.

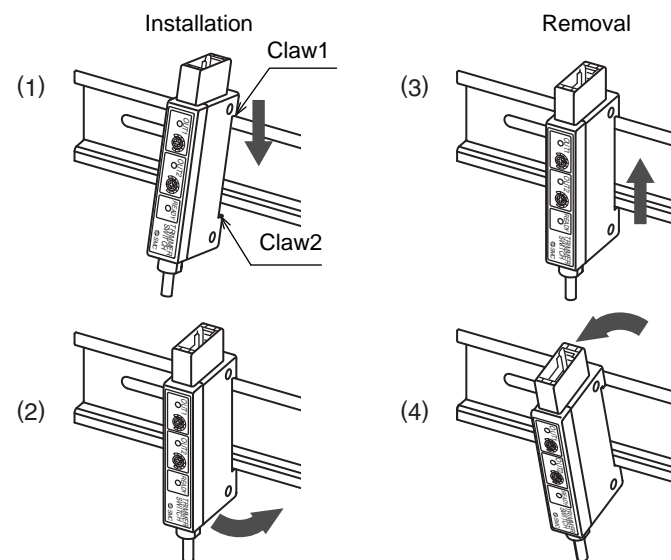
Mounting method of screw

• Tightening torque of mounting screw M3× 16L (2pcs) should be 0.5 to 0.7N · m.
 • Install this switch on the flat place. Otherwise sensor case damage can result.



Installation and removal method of of DIN rail

• Hang claw 1 of switch body on the upper part of DIN rail, push down and fit claw 2 horizontally until click. - Installation (1), (2)
 • To remove switch, push the body up and remove it horizontally by pulling it in front from claw1. - Removal (3), (4)



• Recommended end plate and DIN rail shown below with manufacturer.

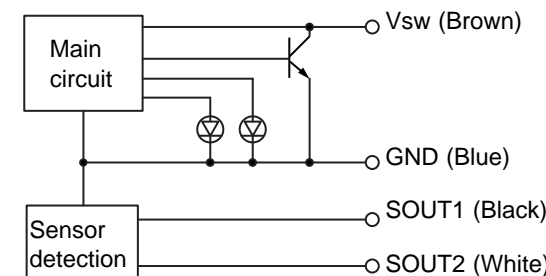
Manufacturer	Type
Omron	PFP-M
IZUMI Corporation	BNL6

• For further information on end plate including handling, contact manufacturer.

Internal Circuit and Wiring

Internal Circuit

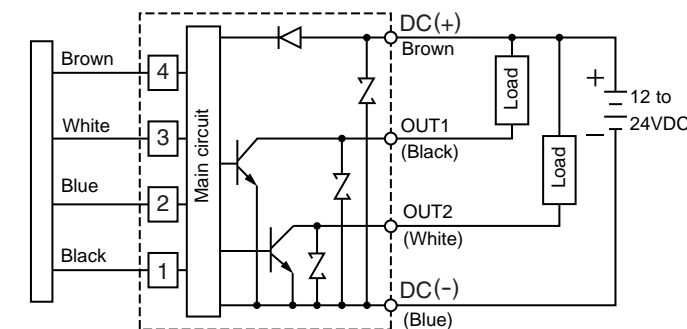
Sensor unit



Amp unit

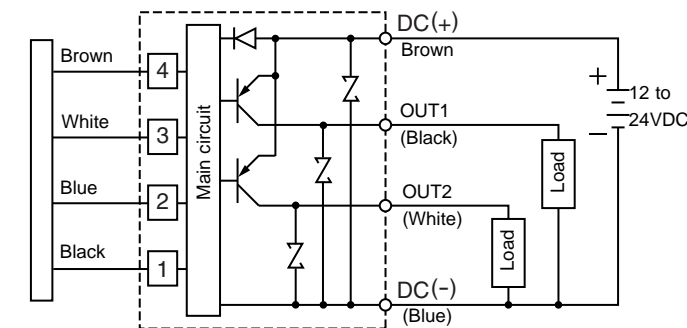
D-RNK :

NPN open collector output 2 outputs Max. 28V, 80mA,
 Internal voltage drop : 1.5V or less



D-RPK :

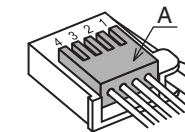
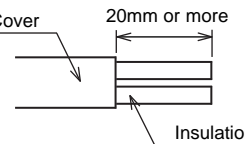
PNP open collector output 2 outputs Max. 80mA,
 Internal voltage drop : 1.5V or less



Attaching the connector to the lead wire

• Strip the sensor wire as shown in the figure on the right.
 • The core of the corresponding color shown in the following table is put into the pin of the number printed on the e-con connector and pushed to the back.

Pin No.	Color of cable core
1	Black (SOUT1)
2	Blue (GND)
3	White (SOUT2)
4	Brown (Vsw)

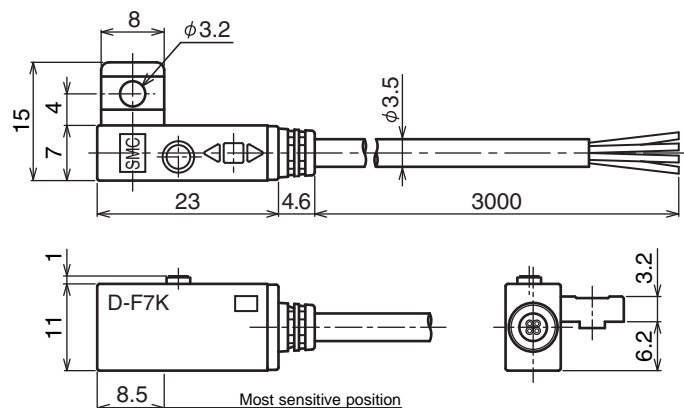


• Check that the above-mentioned preparation work has been performed correctly, then part A shown in the figure is pushed by hand to make temporary connection.

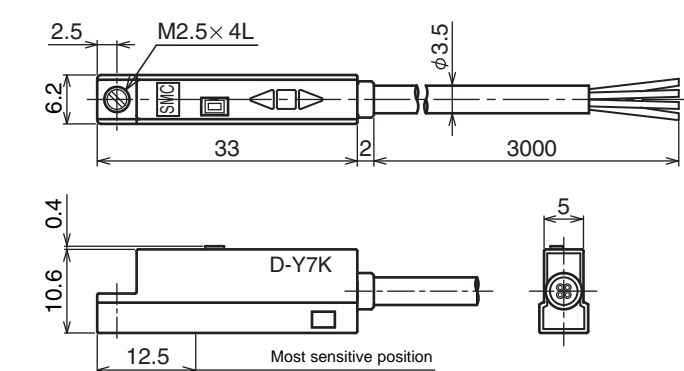
Outline with Dimensions (in mm)

Sensor unit

D-F7K

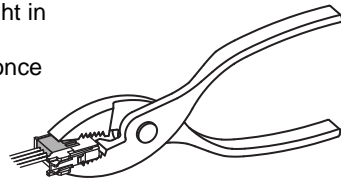


D-Y7K



Internal Circuit and Wiring (continued)

- Part A center is pressed straight in using a tool, such as pliers.
- Re-use cannot be performed once the e-con connector has been completely crimped.
- In case of connection failure such as incorrect order of wires or incomplete insertion, please use a new e-con connector.
- Please use the SMC connector for sensor lead wire (ZS-28-CA-3) or e-con connector as below.

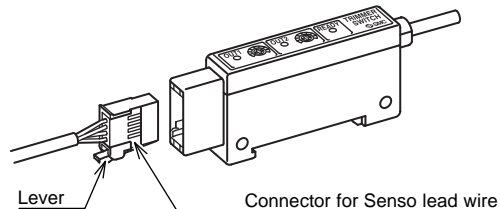


Maker	Model No.
(c)Sumitomo 3M	37104-3122-000FL
Tyco Electronics AMP K.K.	1473562-4

- Please contact connector manufacturer about their e-con connector catalogue.

Connector Connecting/Disconnecting

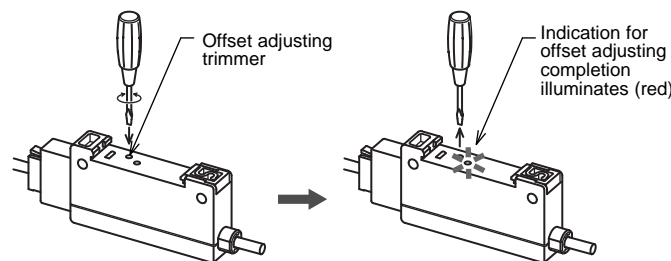
- When connecting the connector, insert it straight on to the pin and lock the connector into the square groove in the housing until connector clicks.
- When disconnecting the connector, push down the lever to disengage the lever claw from the square groove. Then pull out the connector straight.
- Adjust the offset point when connect to the Amp unit. Refer to Operation Manual (Amp unit) for details.



Offset Adjustment Method

Offset adjustment

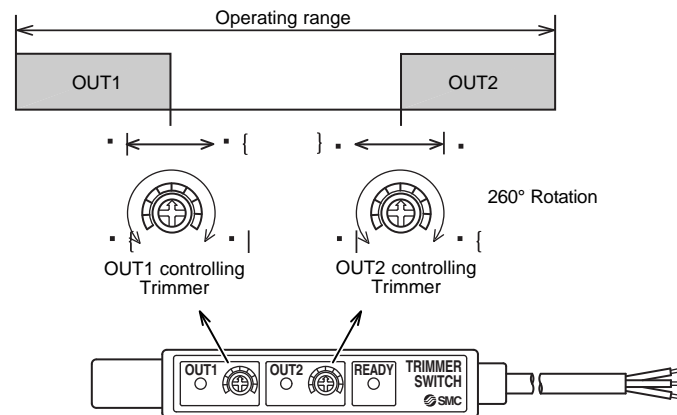
1. Disconnect sensor from actuator before adjustment. *1
 2. Connect the sensor to amplifier. Confirm wiring and then power can be applied.
 3. Insert precision flat screwdriver into offset adjusting trimmer (indicated by ADJ) on the top of amplifier and rotate the trimmer in either direction. *2
 4. When offset adjustment lamp is ON (red), adjustment is finished. (The offset adjusting trimmer is not equipped with non-rotation mechanism. If it cannot be adjusted by rotation in one direction, attempt to rotate in the opposite direction.)
- *1 Offset adjustment should only be carried out with sensor disconnected from the actuator, to prevent the presence of magnetic fields. Due to sensitivity of sensor, adjustment should be performed away from any magnet fields.
- *2 Keep torque for offset adjusting trimmer less than 20mN•m. The effective rotation number of 12. Take care when inserting screwdriver. If the screwdriver is inserted where OFFSET is indicated, the offset adjustment lamp could be damaged.



Setting

Setting of trimmer

- Relationship between rotation direction and output of trimmer during setting



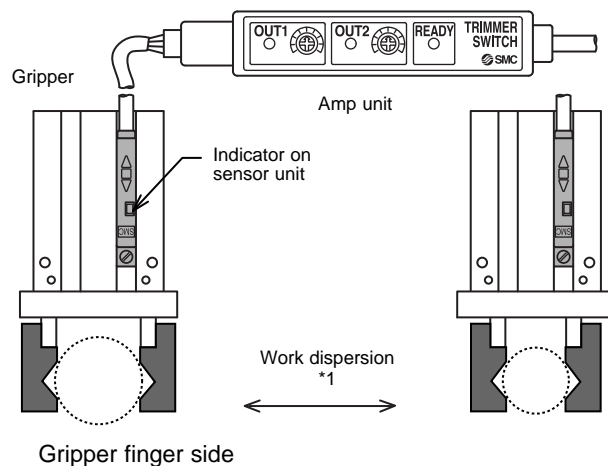
* Scale of trimmer does not indicate setting range or detecting position. Please take advantage of it at reset.

- With opposite installation of sensor, the relation of OUT1 and OUT2 will be reversed. In addition, it might cause change of detection range.
- Due to working air pressure of actuator and fluctuation of ambient magnetic field (with or without magnetic material), detection position might deviate.
- Operating torque of OUT1/OUT2 controlling trimmer is 2 to 20mN•m, mechanical angle of them is 260°. Observe this specification.
- Ensure there is an air supply to the actuator when controlling OUT1 and OUT2 outputs.

Setting example

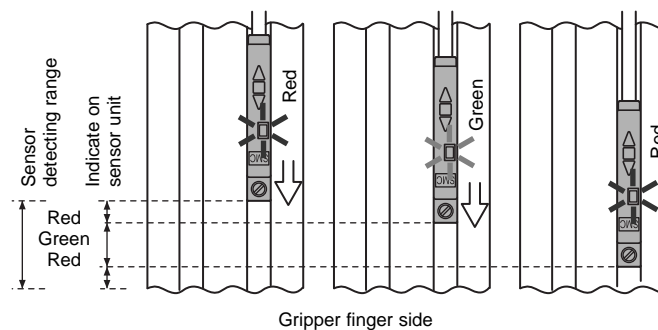
Verify good/bad of the work with an air gripper.

- Identify suitability of work while holding the work by air gripper.
 - * Prior to setting, be sure to perform offset adjustment, refer to "Offset adjustment method" in details. This application is not applicable when work dispersion is less than 0.5mm or when work is easily deformed, such as rubber, etc.
- Verifying correct operation of unit with an air gripper. Ensure sensor indicator, READY indicator, OUT1 and OUT2 indicator lamps are OFF before beginning.



- 1) Hold the thickest (largest) work piece between gripper fingers. *1
- 2) Slide the sensor until the indicator on sensor unit illuminates RED.
- 3) Continue moving sensor until the indicator on sensor unit illuminates GREEN, fasten sensor unit and make sure the READY lamp is lit on the Amp unit under this condition. *2

Setting (continued)

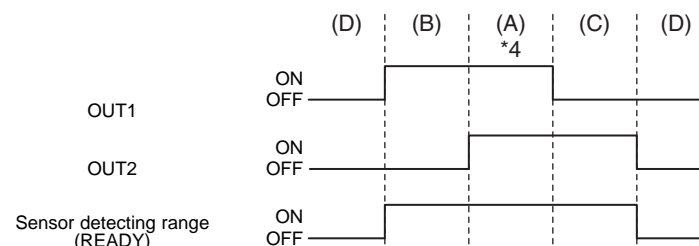


- 4) Turn OUT1 controlling trimmer slowly until OUT1 lamp (on the amp unit) is ON, then STOP. (If the OUT1 indicator is lit before setting, rotate trimmer to turn lamp OUT1 OFF before setting.) *3
- 5) Remove work.
- 6) Hold the thinnest (smallest) work piece between gripper fingers. *1
- 7) Turn OUT2 controlling trimmer slowly until OUT2 lamp (on the amp unit) is ON, then STOP. (If the OUT2 indicator is lit before setting, rotate trimmer to turn lamp OUT2 OFF before setting)*3

With the above situations,

When there is no dimension abnormality :	OUT1 = ON	OUT2 = ON	(A)
When work is too thin (small) :	OUT1 = ON	OUT2 = OFF	(B)
When work is too thick (large) :	OUT1 = OFF	OUT2 = ON	(C)
When piston is out of detection range :	OUT1 = OFF	OUT2 = OFF	(D)

(Refer to the table stated below.)



- *1 Make sure sensor indicator or READY (on amp unit) lamps are ON when grippers are holding a work piece. Fine adjustment of sensor positioning might be required to ensure indicator lamps are ON for both large and small work.
- *2 Setting is available when RED lamp is ON, but should be done in a range where the GREEN lamp is normally ON.
- *3 If, during setting with READY lamp ON the lamps for OUT1 or OUT2 do not illuminate, excessive current may be flowing to the output. In this case, turn power OFF. Check reason for excess current and eliminate. Turn power ON and control OUT1 and OUT2.
- *4 Keep range (A) more than 0.5mm, since sensor will only detect work dispersion of more than 0.5mm.

□ To enquire about the product, please contact the following.

SMC Corporation

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

Phone	
AUSTRIA / (43) 2262-62 280	ITALY / (39) 02-92711
BELGIUM / (32) 3-355 1464	NETHERLANDS / (31) 20-531 8888
CZECH REP. / (420) 5-414 24611	NORWAY / (47) 67 12 90 20
DENMARK / (45) 70 25 29 00	POLAND / (48) 22-548 50 85
FINLAND / (358) 9-859 580	PORTUGAL / (351) 2 610 89 22
FRANCE / (33) 1-64 76 1000	SPAIN / (34) 945-18 4100
GERMANY / (49) 6103 4020	SWEDEN / (46) 8-603 0700
GREECE / (30) 1- 342 6076	SWITZERLAND / (41) 52-396 3131
HUNGARY / (36) 1-371 1343	TURKEY / (90) 212 221 1512
IRELAND / (353) 1-403 9000	UNITED KINGDOM / (44) 1908-56 3888