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## Welding Point Detector

### — INSTRUCTION MANUAL —

### MODEL SWD60 SERIES

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- Use it properly in accordance with the instruction manual and the delivery specification.
- Keep an instruction manual carefully.
- Approve the specification of this product and a contour dimension because it may be changed to the one without the notice.
- The guarantee period of this product is one year after the delivery.
- When a problem by our responsibility arises in the guarantee period of this product. It lets me do only the repair of the part of the problem or the exchange of the problem product.
- Each our product doesn't have a control function such as the prevention of disasters and the prevention of the accident as a product's own function.
- Approve it because our company isn't responsible for the damages due to the disaster if it occurred in the one related to the machine which these products were used for, the accident, and so on and others.

# WELDING POINT DETECTOR

## SWD60 SERIES

### INSTRUCTION MANUAL

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- Prior to your use, carefully read this manual.
- After reading, securely file and keep the manual.

## 1. Outline

This photoelectric switch is used to detect punch holes perforated near the welded line of steel flowing continuously in a cold rolling mill and process line.

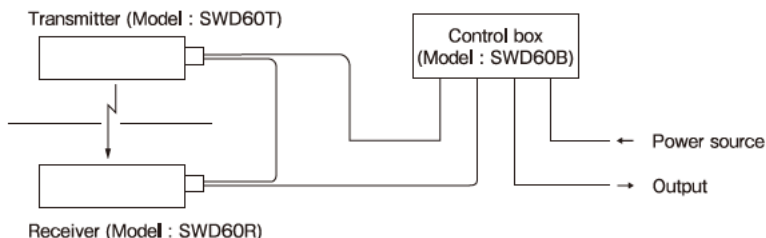
The switch detects single hole and twin holes and outputs signals corresponding to each of them.

## 2. Features

- **Discriminating function between single hole and twin holes**  
The device itself discriminates between single hole and twin holes and outputs the signals corresponding to each of them.
- **Simplified adjustment of optical axis**  
In the complete incidence case (in which nothing exists in the detection area between the transmitter and receiver), the amplifier gain of the receiver is lowered to about 1/10 of the case of the ordinary punch hole detection.  
The "SAFETY" lamp of the receiver lights up, if an optical axis coincide in the former case, under such a condition.
- **Built-in self-checking functions**
  - ◇ A transmitter monitoring circuit is built-in at the transmitter, which checks whether the Transmitter is operating normally, and outputs the result.
  - ◇ As to the Receiver
    - It can check whether it is operating normally by means of an external signal.
    - The amplifier gain of the receiver is lowered automatically to 1/10 in the case of complete incidence.  
At this moment, as the receiver operates in the complete incidence mode, the "SAFETY" lamps in the receiver and the control box light up, and inform us that the operating margin of the receiver is not less than 10.

## 3. Construction

It consists of the following three units.



Air purge unit and cooling water jacket can be mounted as options on the transmitter and receiver.

Air purge unit	AP60ET (transmitter), AP60ER (receiver)
Cooling water jacket	WJ60E (both transmitter and receiver)

## 4. Specifications

### ■ Conditions for detection

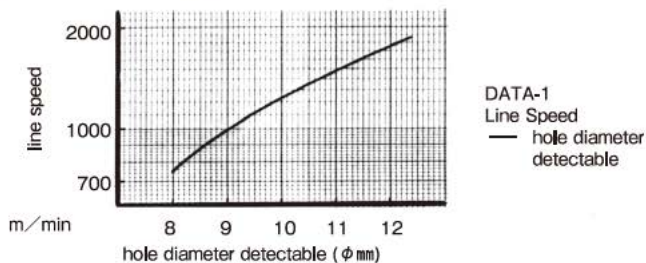
Minimum detection width of the steel plate

500mm (in the case of no meanders of the steel plate)

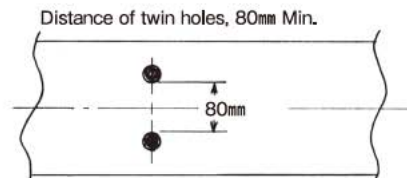
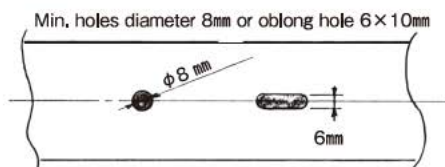
If there are meanders of the steel plate, the detection width is widened just by the amount of the meander.

(Example) when the meander is  $\pm 50\text{mm}$ , the minimum detection width  
 $= 500\text{mm} + 100\text{mm}$  (meander width)  
 $= 600\text{mm}$

Line Speed Max. 750 m/min (in the case of punch diameter 8mm)



Punch hole (hole for detection)

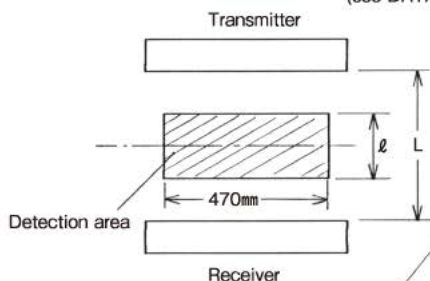


- \* If the distance of twin holes is not longer than 80mm, it might not happen to discriminate between twin holes and a single hole.
- \* Detection of the twin holes requires that incident light passes through them simultaneously. Therefore be careful not to slip the two holes positions.

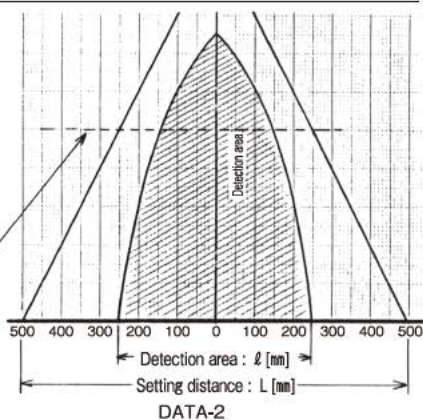
## ■ Transmitter and Receiver

Setting distance | Distance between transmitter and receiver 250 to 1,000mm (Recommended value : 500mm)

Detection area within the setting distance  
(see DATA-2)



(Example)  
For instance the detection area  
at setting distance 500mm is  
 $\pm 150$ mm from the center.



Effective detection width	470mm
Light source (wave length)	Infrared LED (890nm)
Power supply	Supplied from the control box [DC24V (DC20 to 30V). Ripple Max. 10%]
Current consumption	Transmitter : Max. 280mA, Receiver : Max. 210mA
Operating Temperature Range	-25 to +55°C (when cooling water jacket is used +80°C Max.)
Storage Temperature Range	-40 to +70°C
Humidity Range	35 to 85%RH or less
Vibration resistance	10 to 55Hz Double amplitude 1.5mm 2 hours each in X, Y, Z directions
Shock resistance	500m/s <sup>2</sup> 3 times each in X, Y, Z directions
Connection method	Metallic connector type (Attached with connecting cable 2m long) Transmitter : 0.75mm <sup>2</sup> × 5 wires CVV, Approx. $\phi$ 11mm outer diameter Receiver : 0.75mm <sup>2</sup> × 8 wires CVV, Approx. $\phi$ 13mm outer diameter
Enclosure	I P 66
Weight	Transmitter : Approx. 2.6kg (Including connecting cable 2m long) Receiver : Approx. 2.9kg (Including connecting cable 2m long) Air purge unit : Approx. 0.3kg Cooling water jacket : Approx. 1.7kg
Standard painting color	Equivalent to Munsell No. 7.5BG 6/1.5
Cooling water (when cooling water jacket is used)	Flow rate : not less than 4 $\ell$ /min Pressure resistance : 0.3MPa Water temperature : +10 to +35°C
Air purge (when air purge unit is used)	Flow rate : not less than 200 $\ell$ /min

■ Control box

Control output

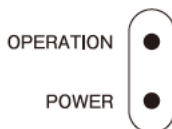
Single hole detection output	Relay contact SPDT and NPN open collector output (floating)							
Twin holes detection output	Relay contact SPDT and NPN open collector output (floating)							
Output rating	Relay contact : AC250V 5A or less (resistance load) NPN open collector output : DC30V 100mA or less							
Operating mode	One shot output : 0.1 to 1s variable (adjustable volume on the panel)							
Response delay time	Relay contact : 30ms, or less NPN open collector output : 3ms, or less							
SAFETY output	Relay contact 1a							
Output rating	AC250V 5A or less (resistance load)							
Alarm output	<p>The diagram shows a timing sequence for the alarm output. It starts with a power source that transitions from OFF to ON. When the power source is ON, the operation mode transitions from Normal to Abnormal. This causes the relay contact to open, which in turn causes the output to transition from closed to open. The duration of the abnormal operation is labeled as <math>t &lt; 1\text{ s}</math>.</p>							
Output rating	Relay contact, AC250V, 5A or less (resistance load)							
Receiver check input	A contact input (operates by short circuiting terminals ⑨ to ⑩).							
Power supply	Either one of AC100V, 110V, 200V, and 220V -15%, +10%, 50/60Hz							
Power consumption	30VA Max.							
Operating Temperature Range	-25 to +55°C							
Storage Temperature Range	-40 to +70°C							
Humidity Range	35 to 85%RH or less							
Withstand voltage/ Insulation resistance	<table border="0"> <tr> <td>Power supply to case</td> <td rowspan="3">] 1500V AC/ one minute 20M<math>\Omega</math> or more. 500V DC</td> </tr> <tr> <td>Relay contact output to case</td> </tr> <tr> <td>Relay contact output to Power supply</td> </tr> <tr> <td>Open collector output to case</td> <td rowspan="2">] 1000V AC/ one minute 20M<math>\Omega</math> or more, 250V DC</td> </tr> <tr> <td>Open collector output to Power supply</td> </tr> </table>	Power supply to case	] 1500V AC/ one minute 20M $\Omega$ or more. 500V DC	Relay contact output to case	Relay contact output to Power supply	Open collector output to case	] 1000V AC/ one minute 20M $\Omega$ or more, 250V DC	Open collector output to Power supply
Power supply to case	] 1500V AC/ one minute 20M $\Omega$ or more. 500V DC							
Relay contact output to case								
Relay contact output to Power supply								
Open collector output to case	] 1000V AC/ one minute 20M $\Omega$ or more, 250V DC							
Open collector output to Power supply								
Vibration resistance	10 to 55Hz Double amplitude 1.5mm 2 hours each in X, Y, Z directions							
Shock resistance	500 m/s <sup>2</sup> 3 times each in X, Y, Z directions							
Connection method	Terminal block type							
Enclosure	I P 40							
Weight	Approx. 9kg							
Standard painting color	Equivalent to Munsell No. 7.5BG 6/1.5							

\* Relay used : HH52P DC24V manufactured by Fuji Electric FA Components & Systems Co., Ltd.  
AP3222F manufactured by Panasonic

## 5. Operation

### ■ Display Panel

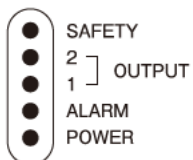
#### ◇ Transmitter



OPERATION : Monitor indicator of transmitter  
It lights up if the transmitter is operating normally.

POWER : Power supply indicator

#### ◇ Receiver



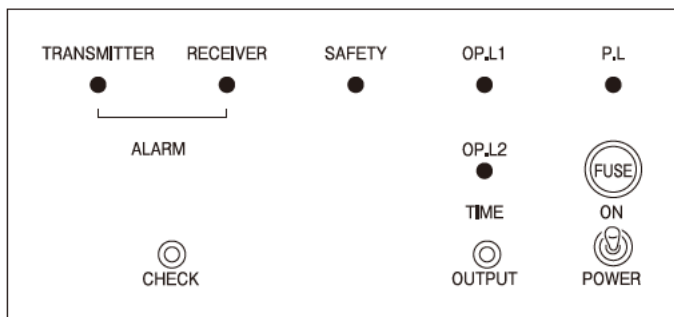
SAFETY : Lights up by complete incidence operation

$\begin{matrix} 2 \\ 1 \end{matrix} \text{ ] OUTPUT : Output indicator}$   
Lamp "2" lights up for twin holes detection and lamp "1" for one hole detection.  
Lighting is done by one-shot operation of 1 to 5s.

ALARM : It light up by the abnormal condition of the receiver.  
Lighting is done by one-shot operation of about five seconds.

POWER : Power supply indicator

◇ Control box

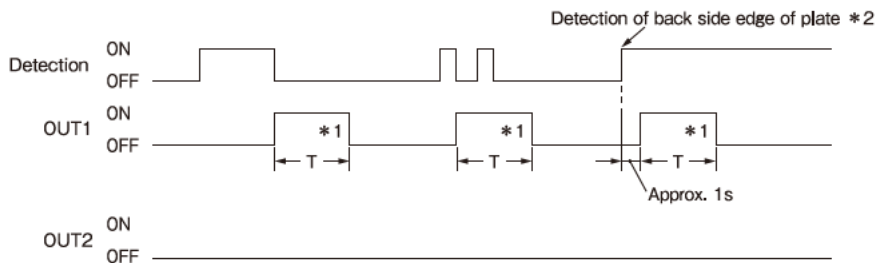


- ALARM : Alarm pilot lamps for transmitter and receiver
- SAFETY : Complete incidence pilot lamp  
Light up by the complete incidence at the receiver.
- OP.L1, Single hole detector output
- OP.L2 : Twin holes detector output
- TIME : Screw head of the knob of variable resistor for adjusting output time (one-shot time)  
By turning the screw head to the right (clockwise), the output time is elongated.
- POWER : Power supply switch and power supply indicator.
- FUSE : Power supply fuse :  $\phi 6.5 \times 30\text{mm}$  1A
- CHECK : Switch for checking the operation of the receiver.  
Refer to page 10 as to the method of its usage.
- P.L : Power supply indicator

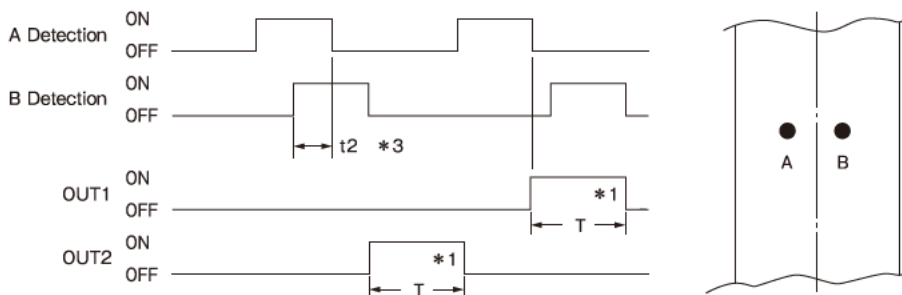


■ Detection output of punch hole

◇ Single hole detection



◇ Twin holes detection



\*1 ) T : output duration time of one-shot pulse (0,1 to 1,0 sec. Variable)

\*2 ) In the case of detection of back side edge of steel plate, a single hole signal is output after complete incidence on the receiver.

However, if the back edge line of the steel plate is irregularly shaped or the detection speed of back side edge of plate is of such a slow value as several meters per minute, it may happen that a single hole signal is output at the moment of complete incidence on the receiver.

Furthermore, if a continuous output signal after detection of back side edge of plate is necessary, please utilize the "SAFETY" output signal.

\*3 )  $t_2 > 250 \mu s$ .

In the case of twin holes, if there is a difference of time in the detection of holes due to the dislocation of holes and the like, discrimination of a single hole from twin holes becomes impossible.

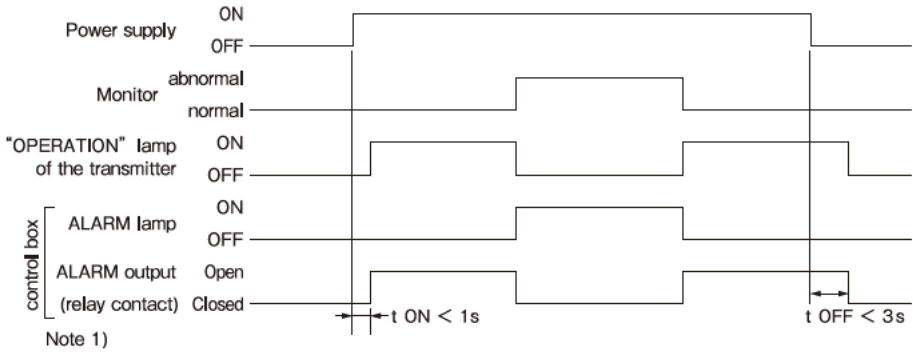
■ Self-checking Functions

◇ Monitor for Transmitter

A monitor circuit is built-in at the transmitter.

As light is emitted normally from the light source (infrared LED), "OPERATION" lamp of the transmitter lights up.

If the irradiation of light from the light source is stopped due to some cause, "OPERATION" lamp of the transmitter becomes extinct, the ALARM lamp of the control box lights up, and a signal is output from relay contact.



Note 1) ALARM output from relay contact operates jointly with ALARM output of the receiver (Refer to "External check input").

If ALARM is output, confirm by the ALARM lamp on the panel in control box whether it is caused by the transmitter side or receiver side.

ALARM output can also be judged by the fact that, while ALARM output of the receiver is one shot output during 5 sec after receiving external check input, ALARM output of the transmitter is a continuous signal.

◇ External Check Input

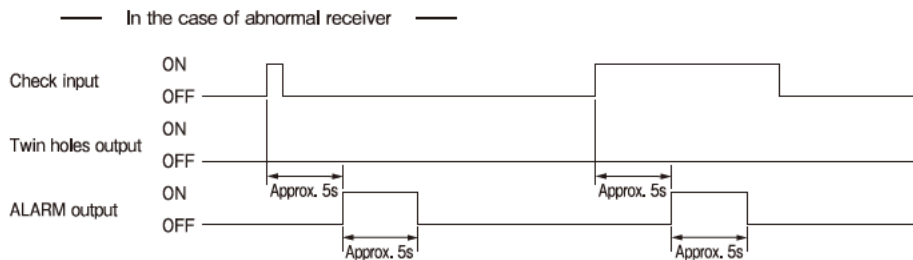
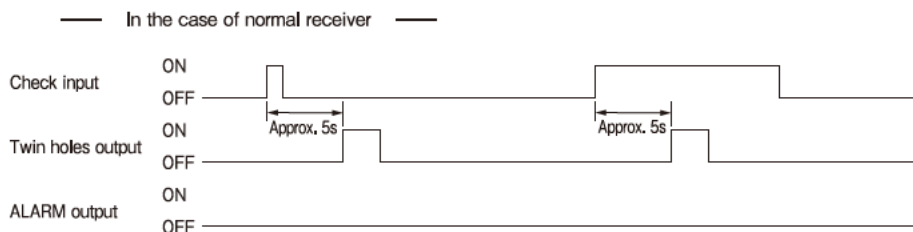
In the case of the absence of steel plate in the detectable area between the transmitter and receiver (complete incidence), the operating margin can be confirmed by the SAFETY function. but if the area is interrupted by a steel plate, the operation of the receiver can be confirmed by inputting an external check signal.

To input an external check signal, either push "check" switch on the control box panel, or short circuit the terminals ⑨ to ⑩.

If the duration of check signal input is not shorter than 1 sec, a state of simulated twin holes detection is attained with in the receiver, and about 5 sec. later, the result is output.

[ If the receiver is normal, twin holes output  
If the receiver is abnormal, ALARM output ] is output

ALARM outout is a one shot output during about 5 sec.



Note) Please apply this external check when light is completely interrupted (light being interrupted over the whole photosensitive area).

If light is even partly incident, it will be incorrectly sensed and there may be a case in which ALARM is sent out despite a normal operation of the receiver.

◇ SAFETY Function

As light is incident completely on the receiver (over the whole photosensitive area), the amplifier gain of the receiver is automatically lowered to 1/10 (compared to the case of light being interrupted), which is informed by "SAFETY" lamps of the receiver and control box. At the same time, the relay contact changes to be closed (Normally open).

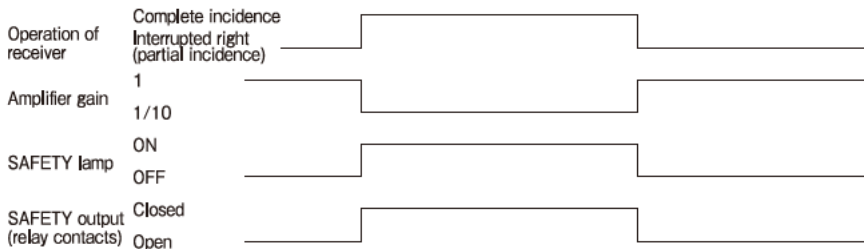
— Adjustment of optical axis and its application to operating margin check —

When a SAFETY lamp lights up, the adjustment of optical axis is completed.

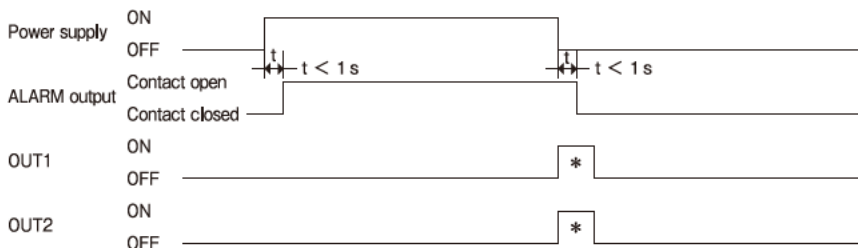
It means that in the ordinary punch holes detection, an operating margin attains to 10 times or more.

Note) There may be a case in which both of the SAFETY lamp and the "OUT-1" lamp light on at the same time. This means an unstable state, namely, operating margin of 10 times is not completely attained over the whole photosensitive area.

In such a case, by the adjustment of optical axis and the like leave "SAFETY" lamp only is lit up while "OUT-1" is put out.



■ Operation when power supply is switched on or off



\* Indefinite

## 6. Installations

### ■ Transmitter and receiver

- \* following installation method is recommended if there is no obstacle regarding the location of installation.

Setting distance : 500mm

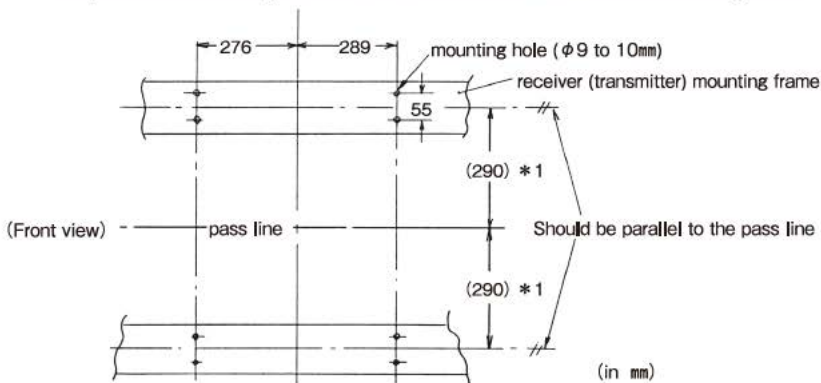
Pass line (passing zone of steel plate) : 250mm from transmitter side

### ◇ Mounting frame

Use rigid shape steel or the equivalent material for the mounting frame of the transmitter and receiver to avoid deflection due to vibrations or the like.

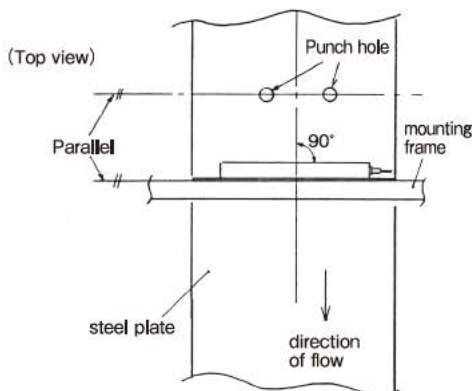
### — Note for the fabrication of mounting frame —

Be careful to the following points not to cause warping of the frame, deflection and the like of the optical axis of mounting frame transmitter and receiver installed on the mounting frame.



- \* 1 Recommended value for setting distance (From the dimensions described above, the setting distance between the transmitter and receiver is about 500mm).

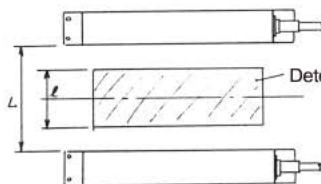
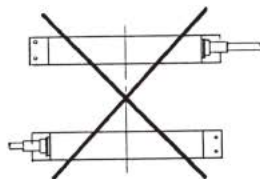
Detection of the twin holes requires that incident light passes through them **simultaneously**. Install the transmitter-receiver at right angle to the direction of pass line.



If the axis of the transmitter-receiver is not parallel against the center line of the twin holes, the timing for the simultaneous passing through of incident light is lost and there may be a case where the difference between a single hole and twin holes cannot be judged. This trouble occurs more easily in the case the diameter of the hole is small and the line speed is high.

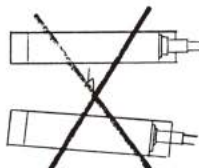
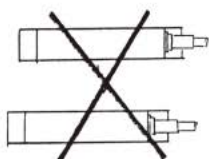
◇ Transmitter and Receiver

The direction of mounting these devices is prescribed.  
Be sure to install them in the same direction.

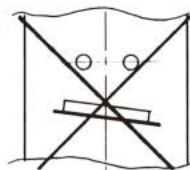
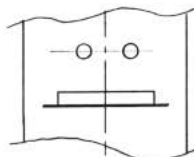


Install them so that their cable outlets lie on the same side.

Detection area [  $\Delta$  ] is confined by the setting distance [ L ].  
About the numerical value Please see the items of "specification" .



- \* Detection of the twin holes require that incident light passes through them simultaneously.  
Therefore, install the transmitter and receiver parallel to the center line of the twin holes to avoid any skew.



If there is a skew in the parallelism of the lines, there may be a case in which the difference between a single hole and twin holes cannot be judged when the line speed is high.

■ Control box

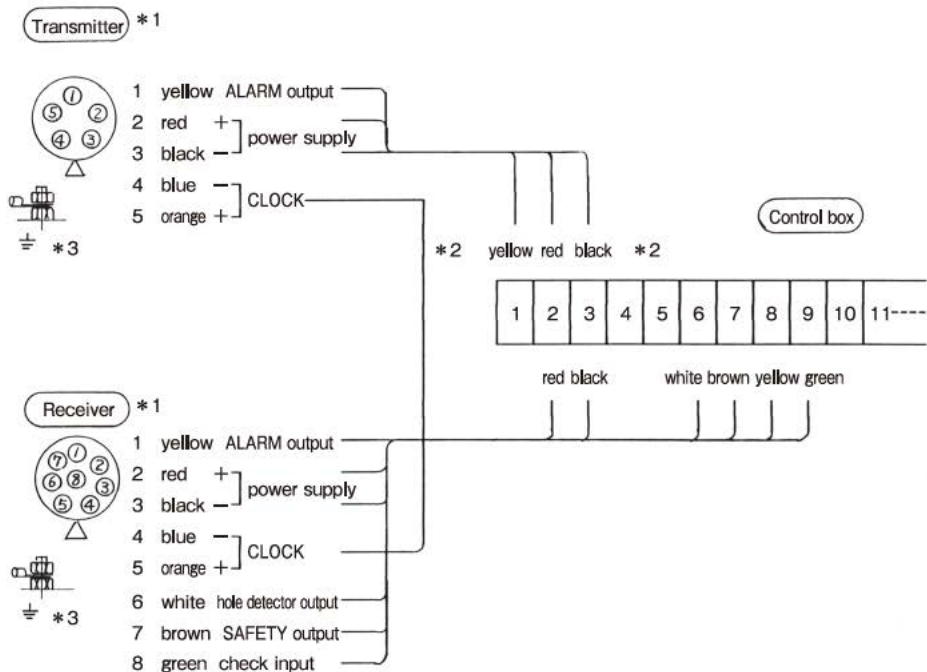
Install the control box as close as possible to the transmitter-receiver with the maximum wiring length 30m between the control box and the transmitter-receiver taking as a criterion.

If the control box is installed within a visible distance from the installed location of the transmitter and receiver, it is convenient for adjustment, checking, etc.

## 7. Connection

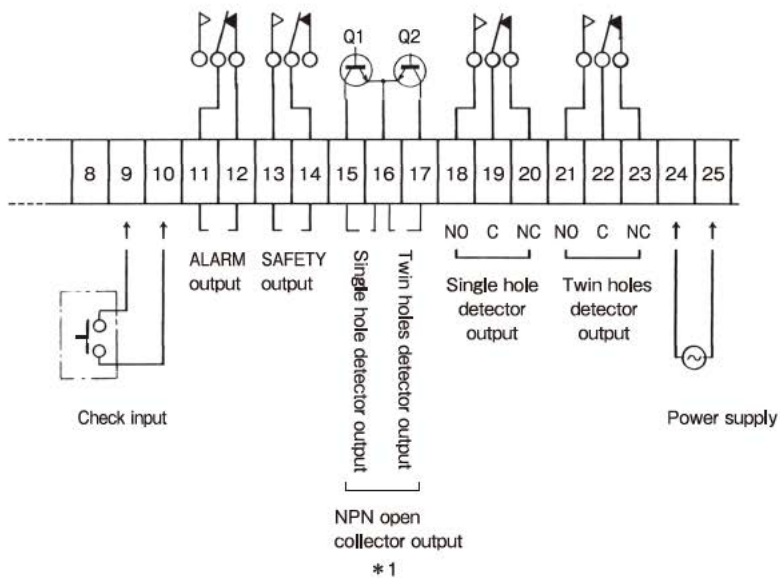
■ Wiring

◇ Transmitter, receiver and control box

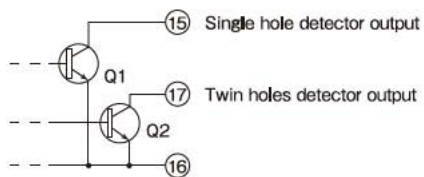


- \*1. Attached cable : Cables 2m long (standard length) are attached to the transmitter and receiver.  
 Transmitter :  $0.75\text{mm}^2 \times 5$  wires CVV, approx.  $\phi 11\text{mm}$  outer diameter  
 Receiver :  $0.75\text{mm}^2 \times 8$  wires CVV, approx.  $\phi 13\text{mm}$  outer diameter
- \*2. Clock : The synchronizing signal between the transmitter and the receiver is approx. 230 kHz.  
 Connect the former to the latter by wiring of minimum distance (not longer than 10m).  
 The terminals ④ and ⑤ of the control box are vacant ones.  
 If a control box is installed close to the transmitter and receiver, these terminals can be used as relay terminals for CLOCK signal.
- \*3. Ground : A ground terminal for the casing of the transmitter and receiver.  
 It is fitted on a side of the cable connector.

◇ Input and output of the control box



\* 1





## 8. Air purge and cooling

- Air purge — Air purge unit AP60ET/AP60ER (option) is used.
- ◇ There is a case in which the air purge unit is attached to the casing of the transmitter-receiver. But if the former is to be purchased separately from the latter or to be repaired, practice it in conformity with the following.
- ◇ Two sorts of air purge units are provided for the transmitter and the receiver. Be sure to confirm it before the installation.
- For transmitter : Type : AP60ET
- For receiver : Type : AP60ER
- ◇ Air flow rate Not less than 200 ℓ /min
- ◇ Assembly
  - Confirm that a screw (PS 1/8) for fixing hose nipple and a screw (M10) for mounting the pipe is fitted into each end of the air purge pipe.
  - The direction of the mounting of the hose nipple is ordinarily so set that the hose nipple is placed on the same side as the connector of the transmitter-receiver, but the direction of flow can be reversed if the mounting direction of the air purge pipe is reversed.

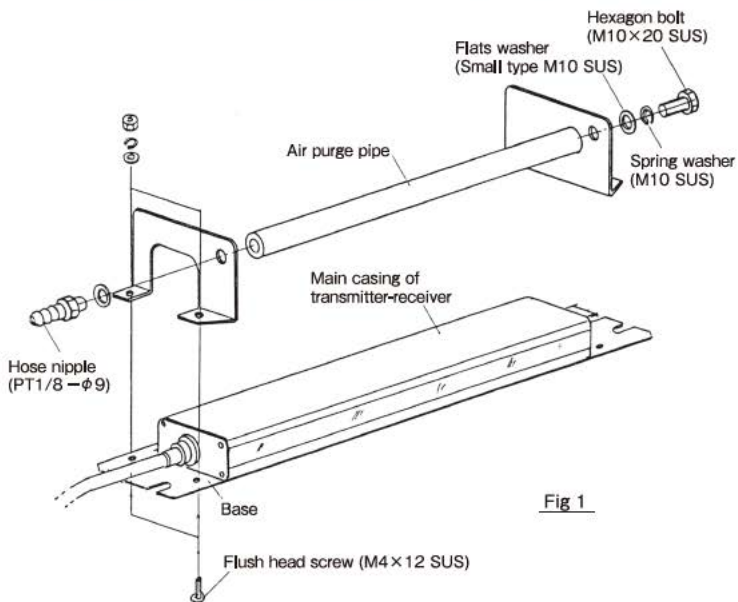


Fig 1

— Fixing angle of air purge pipe

Many holes are perforated in a row on the air purge pipe, and air is blown out from these holes. Fix the air purge pipe at the angle shown in Fig. 2 so that the air is blown toward the glass surfaces of the transmitter-receiver.

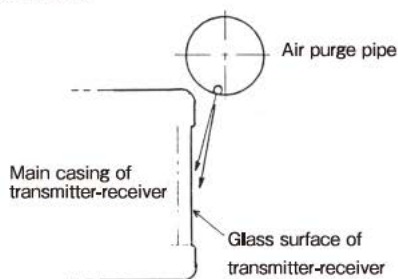


Fig 2

◇ Mounting method of air purge unit in the case of using cooling water jacket

In the case of not using the cooling water jacket, the air purge unit is fixed on the base of the main casing of transmitter-receiver using flush head screw, as shown in Fig. 1.

But in the case the former is used, fix the latter by using a fixing screw (a bolt provided with hexagon hole) for cooling water jacket. (Fig. 3)

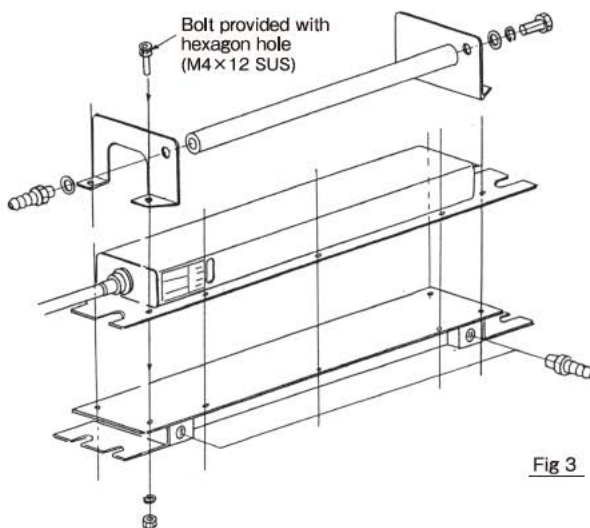


Fig 3

■ Cooling water — Cooling water jacket : WJ60E (option) is used.

◇ There is a case in which the cooling water jacket is attached to the casing of the transmitter-receiver. But if the former is to be purchased separately from the latter or to be repaired, practice it in conformity with the following.

◇ Cooling water jacket is commonly used to the transmitter and the receiver.

Type : WJ60E

◇ Cooling water

Flow rate	Not less than 4 ℓ /min
Withstand pressure	0.3 MPa
Water temperature	+10 to +35°C

◇ Assembly

- By locating the water supply and exhaust ports of the cooling water on the back side of the transmitter-receiver, fix the main casing of the latter on the cooling water jacket. (Fig.4)
- Use seven pairs of bolts and nuts to fix the main casing of the transmitter-receiver on the cooling water jacket. (Fig.4)
- Since hose nipples (outer diameter 9mm) are fitted on the tubular screw PS 1/8 of the water supply and exhaust ports, lay the piping by rubber hoses and the like (the distinction between the supply and exhaust ports is not specified).

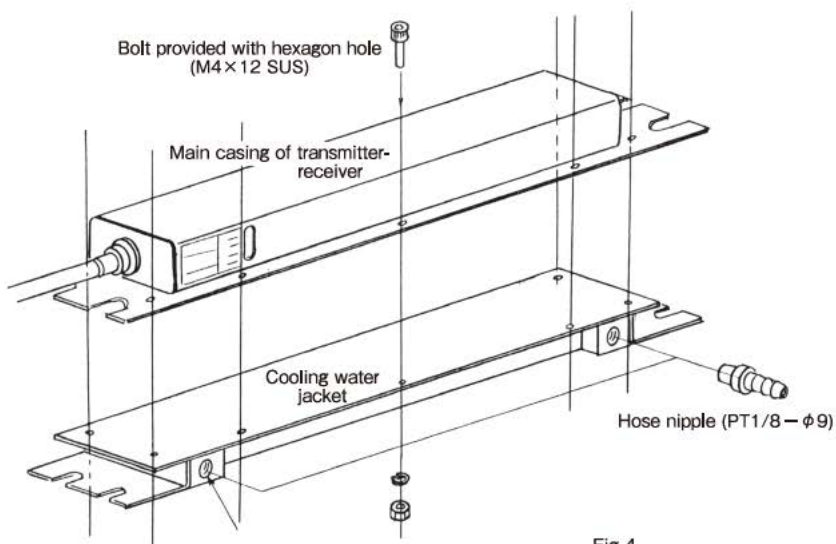


Fig 4

## 9. Adjustment

1. Please do not place anything within the detection area between the transmitter and receiver, and let the light be completely incident on the receiver.
2. Confirm that the wiring is completed, and then switch on the power source.
  - "POWER" lamps on the transmitter, receiver and control box light up.
  - If any of "POWER" lamps does not light up, switch off the power source immediately and confirm the wiring.
3. Confirm that ALARM lamp on the panel in control box remains off.
4. Adjustment of optical axis

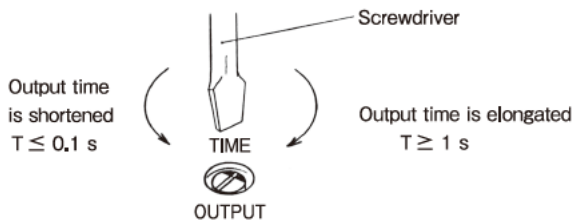
Adjust the direction of the transmitter and receiver so that "SAFETY" lamp (green LED) of the receiver may light up.

There may be a case in which both of the "SAFETY" lamp and the OUT-1 lamp light on at the same time. This means an unstable status to show incomplete incidence on the whole photosensitive area of receiver.

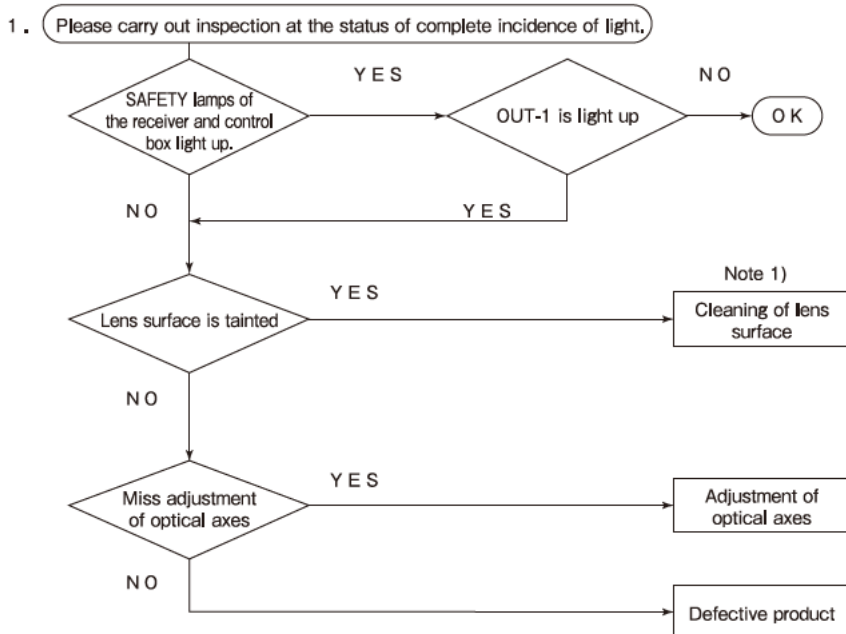
It must be adjusted to light on the SAFETY lamp and POWER lamp.
5. Adjustment of output time

Adjust the output time for one-shot pulse of detection for single/twin holes.

Turn the screw head of the "TIME" variable resistor on the control box by a screwdriver.



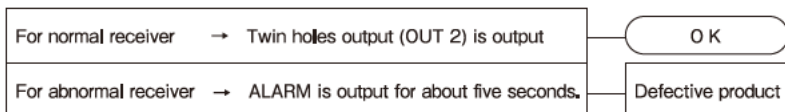
## 10. Inspection



Note 1) Please use soft cloths for cleaning of lens surface.  
Do not rub hard, do not use thinner and alcohol.

### 2. Please carry out when light is completely interrupted.

Either push CHECK switch of control box, or short circuit between terminals ⑨ and ⑩.  
About five seconds later, diagnoses of receiver will be output

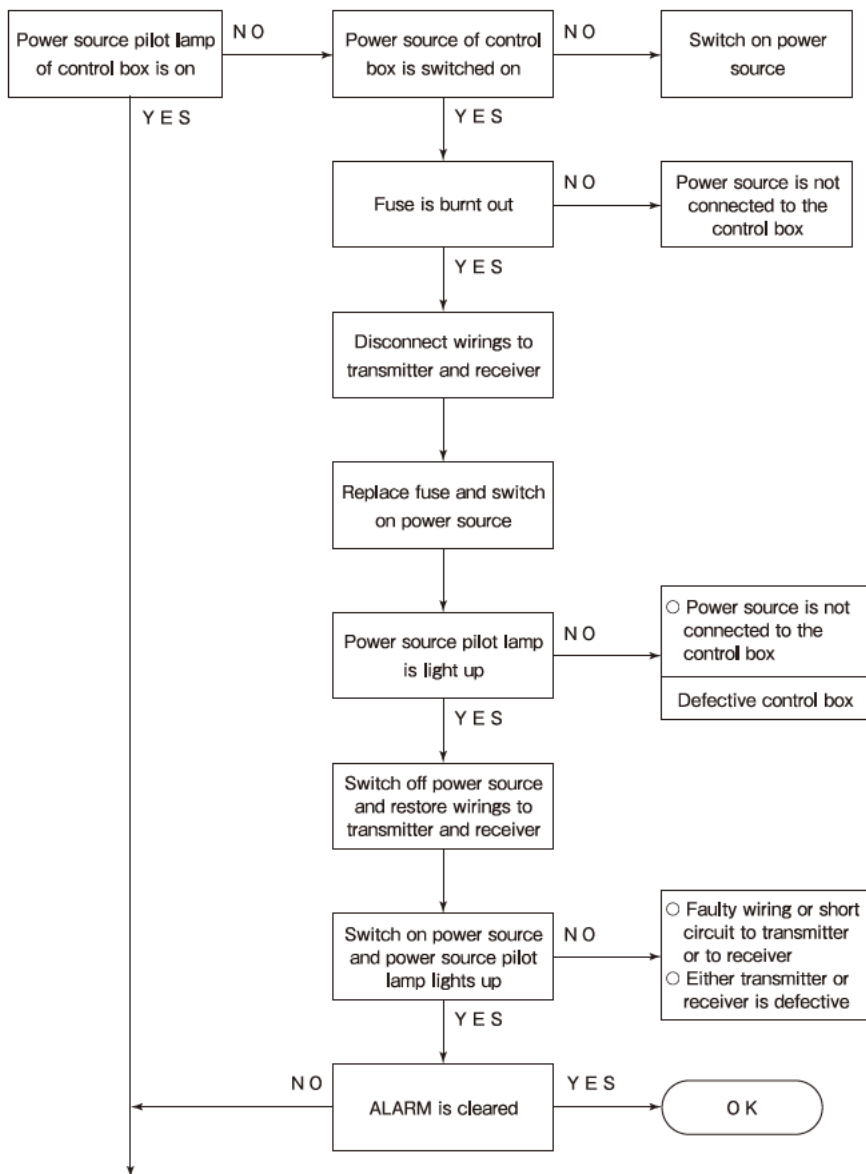


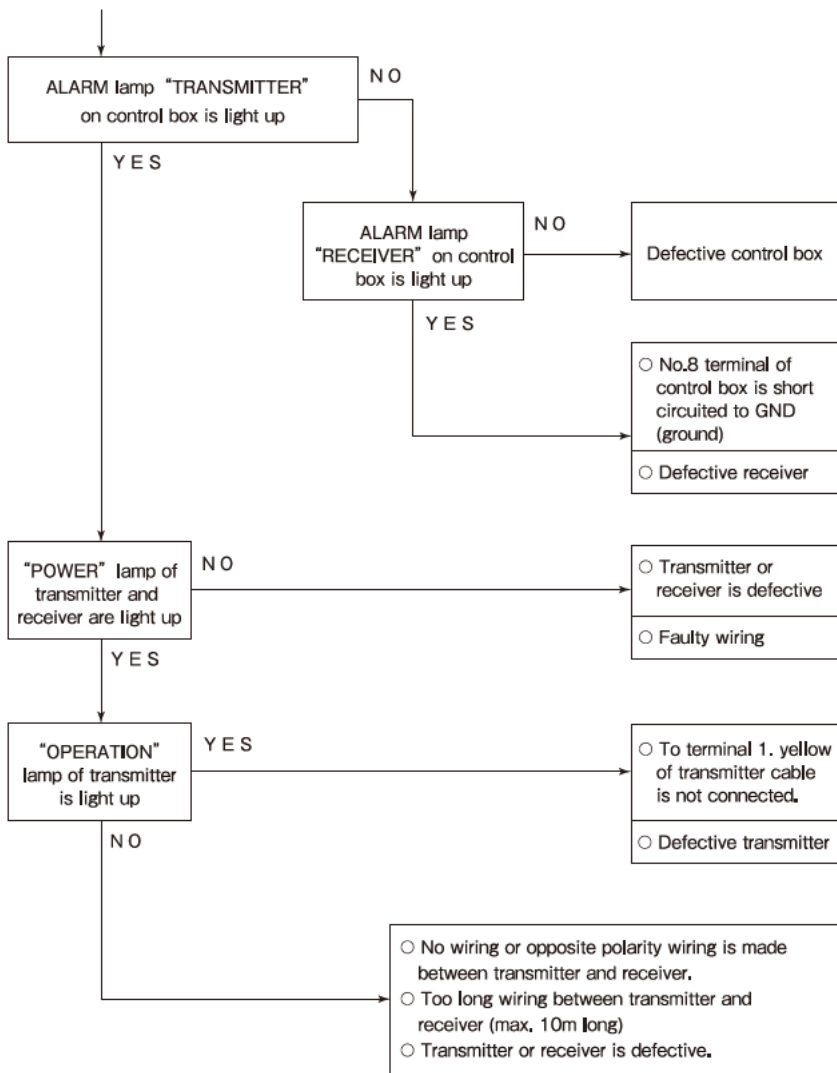
Note) Carry out this CHECK when light is completely interrupted.

Even when a slightest light is incident on receiver, "ALARM" is output even at normal condition.

## 11. Troubles and Countermeasures

■ ALARM is output





■ Malfunction of hole detection — The troubles and the causes —

◇ Hole detection output is not at all sent out

- Deflection of optical axis
- Taint of lens surface
- Other troubles

◇ Output is sent out when light is completely interrupted

- Miss operation due to noises
- Defective connection
- Other troubles

◇ As the line speed increases, one hole detection is output despite twin holes are detected,

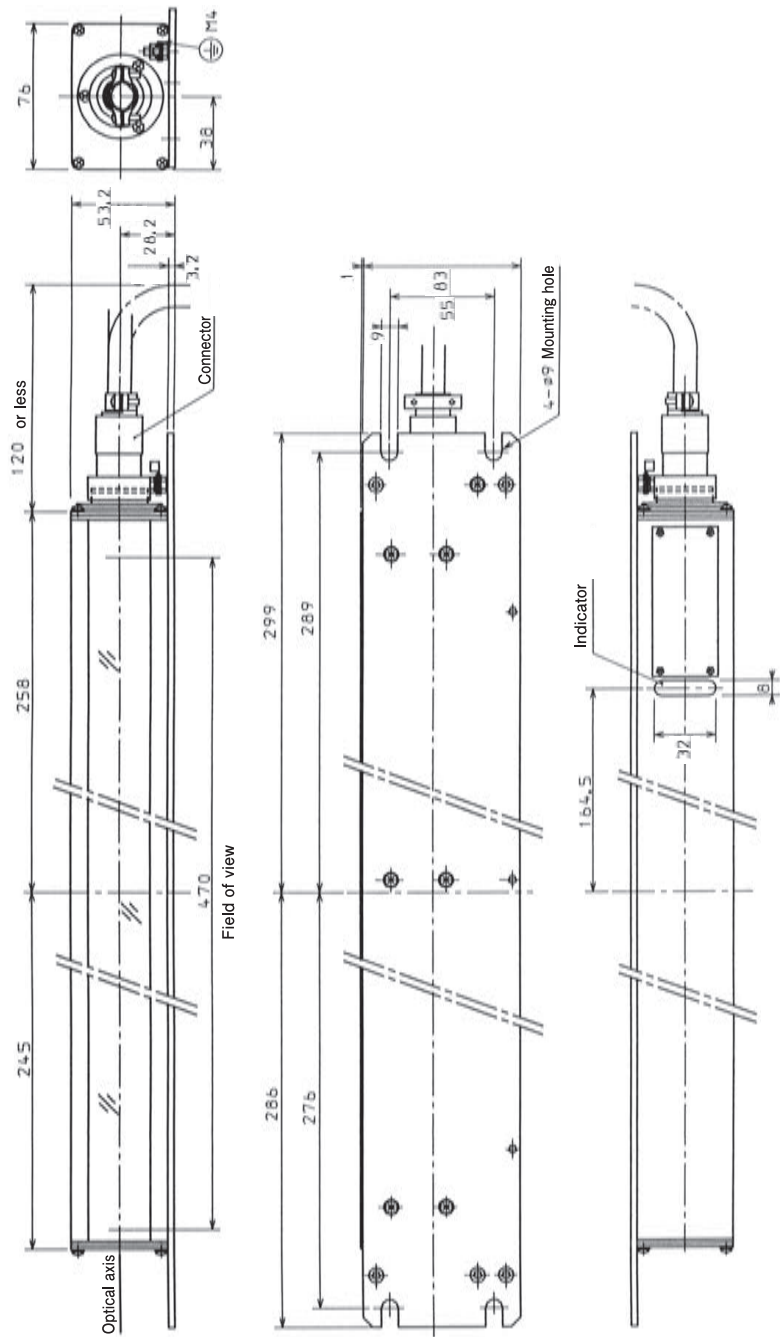
- Deflection of optical axis
- Taint of lens surface
- Staggered location of twin holes \* 1
- Other troubles

\* 1 Detection of the twin holes require that incident light passes through them (is detected) simultaneously.

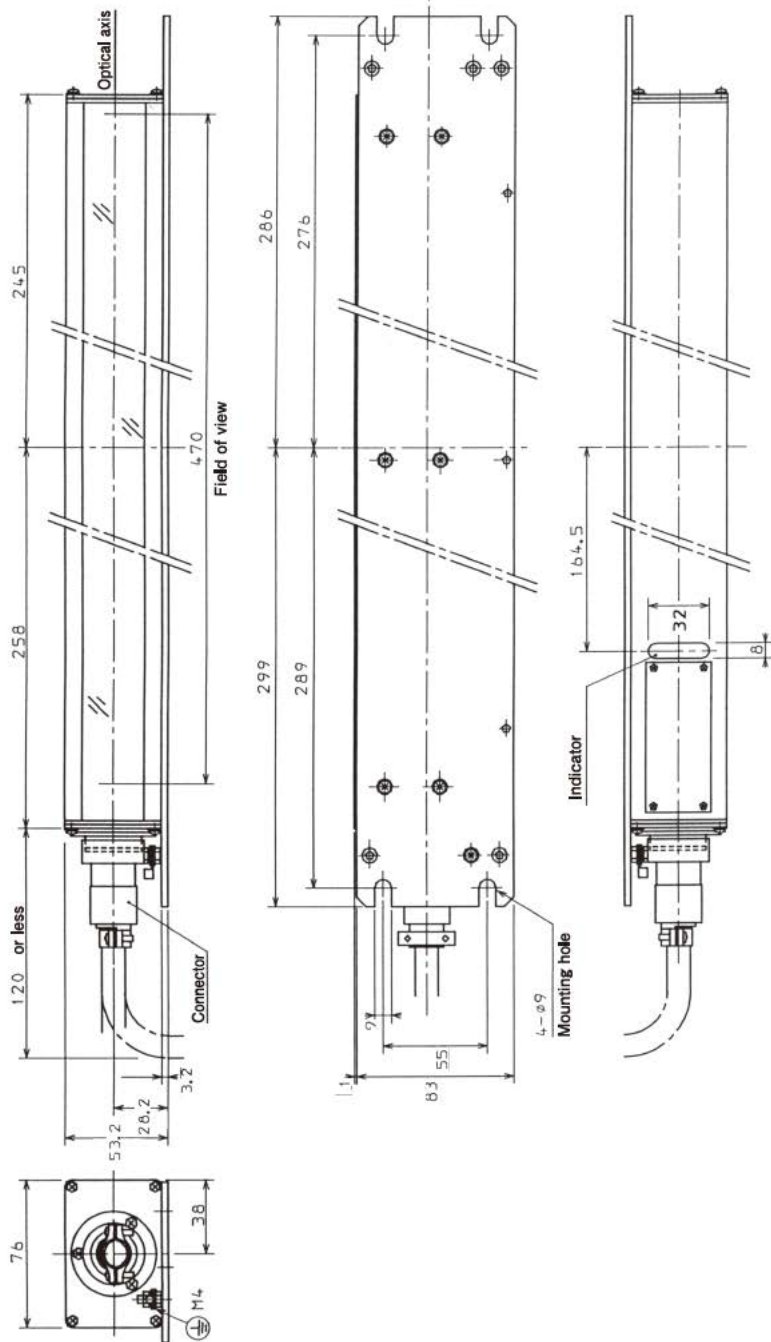
If the hole locations are staggered, or the mounting direction of the transmitter-receiver against the path line of the steel plate is on the skew, misjudgment between a single hole and twin holes detection takes place and a single hole detection might be output. The higher the line speed is, the greater the probability of misjudgment becomes.



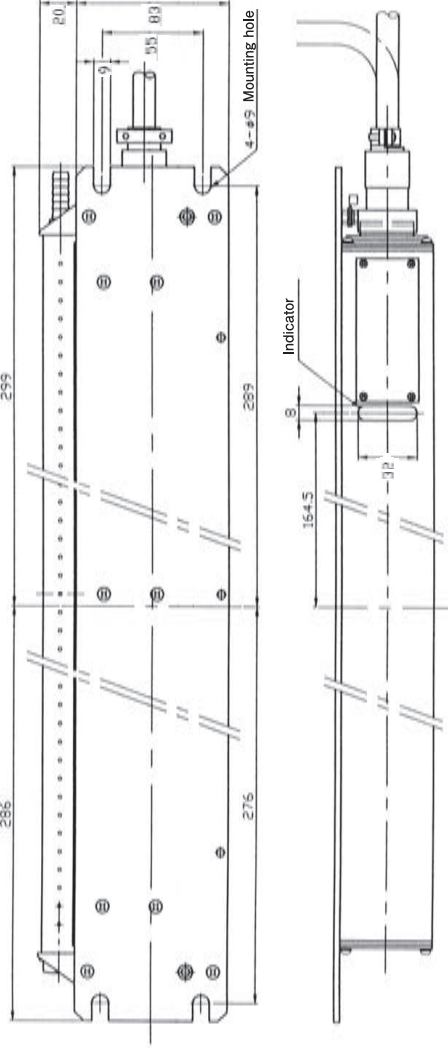
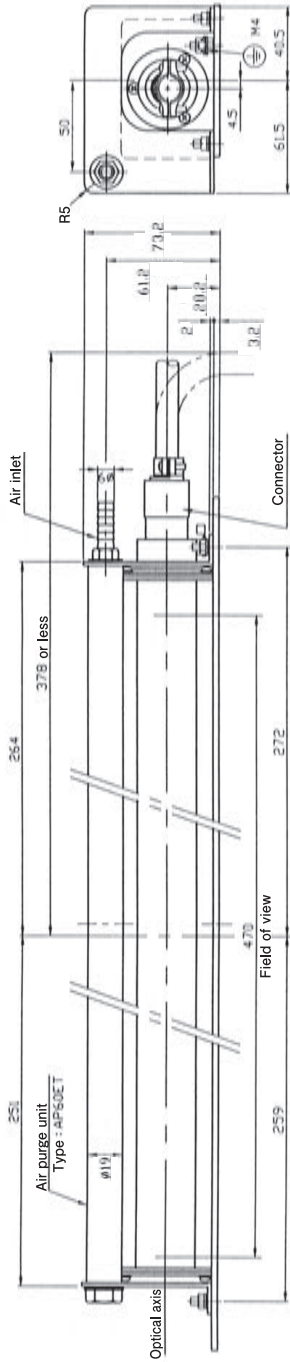
TRANSMITTER (in mm)  
SWD60T



RECEIVER (in mm)  
SWD60R

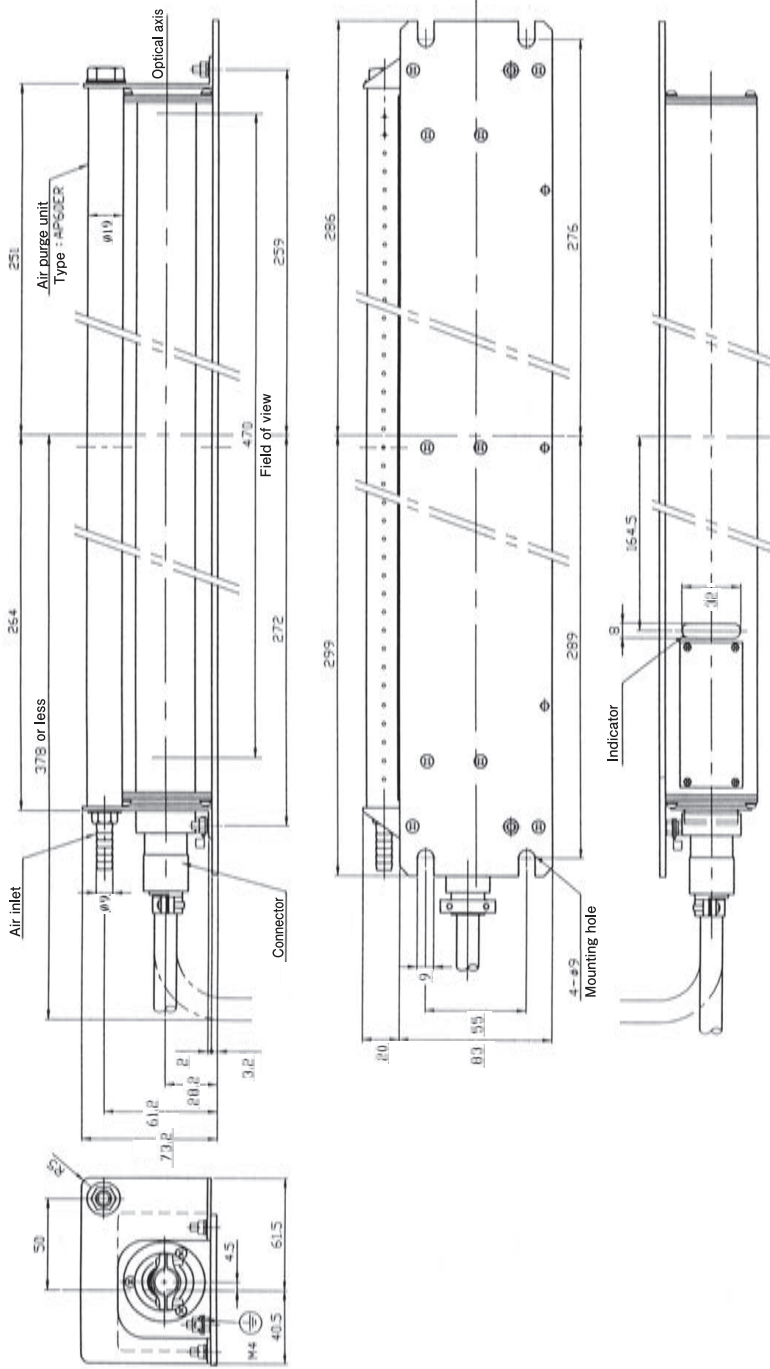


**TRANSMITTER (WITH AIR PURGE)** (in mm)  
**AP60ET**



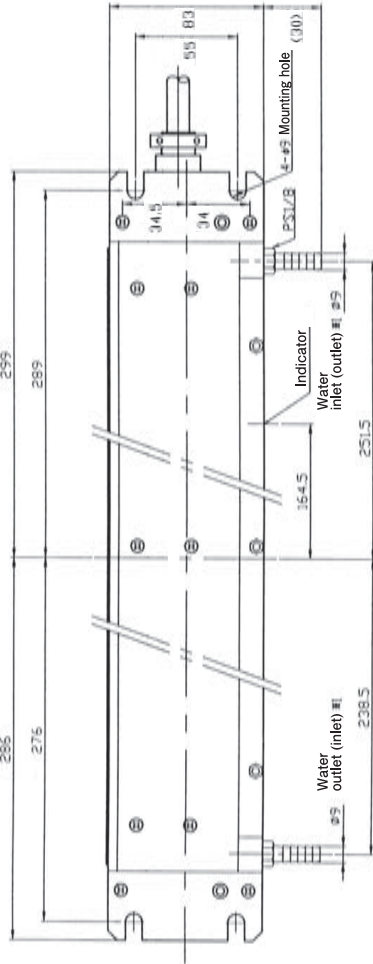
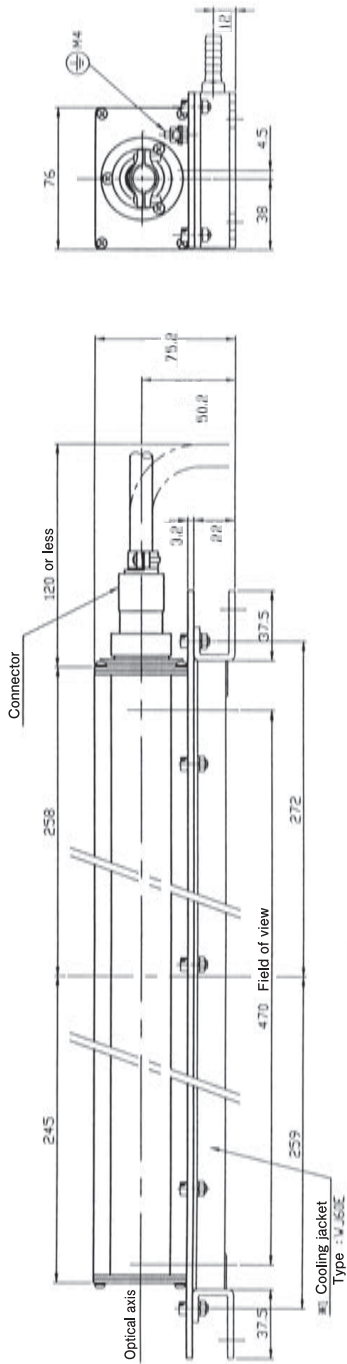
Air purge  
 Air volume : Approx. 200  $\ell$  / min

RECEIVER (WITH AIR PURGE) (in mm)  
AP60ER



Air purge  
Air volume : Approx. 200  $\ell$  / min

TRANSMITTER WITH WATER COOLING JACKET (in mm)  
WJ60E

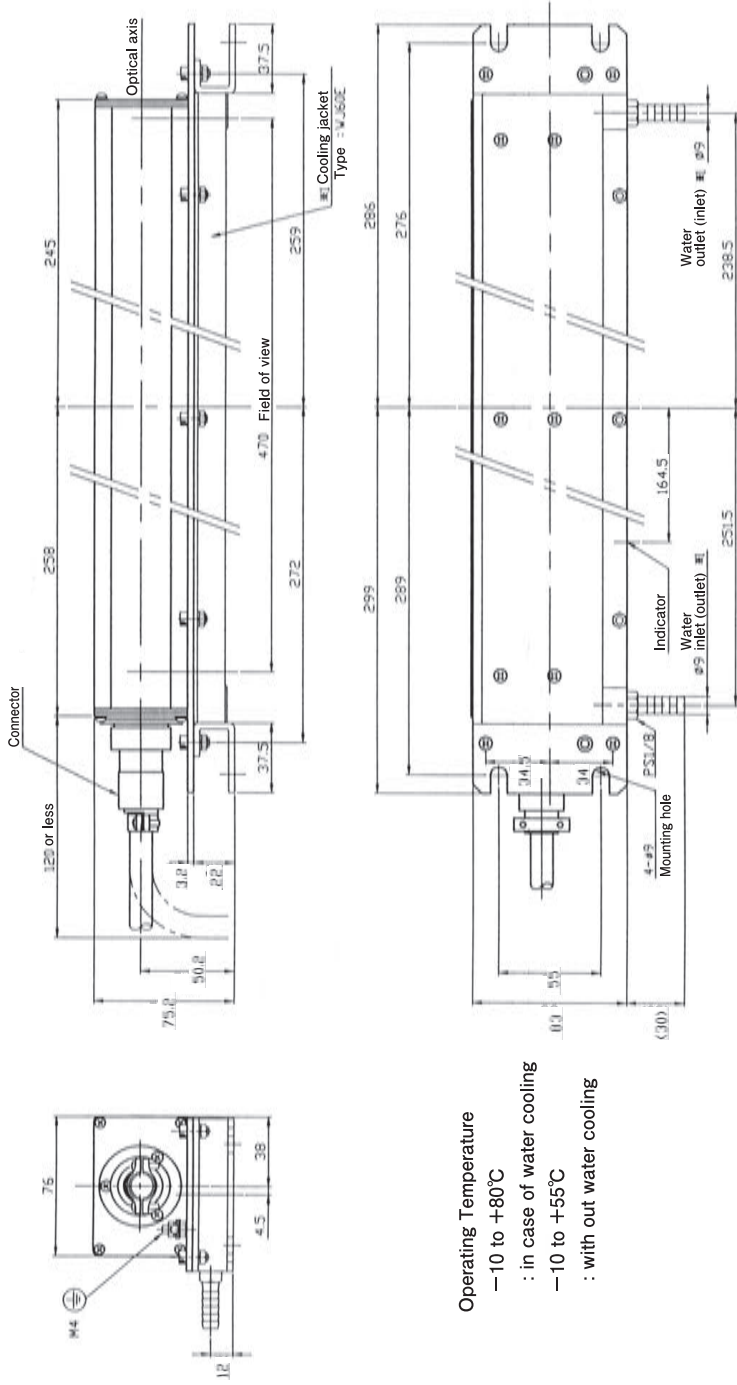


Operating Temperature  
 -10 to +80°C  
 : in case of water cooling  
 -10 to +55°C  
 : with out water cooling

※1 Cooling water  
 Temperature : +10 to +35°C  
 Flow : Approx. 4ℓ/min  
 Withstand pressure : 0.3MPa

# RECEIVER WITH WATER COOLING JACKET (in mm)

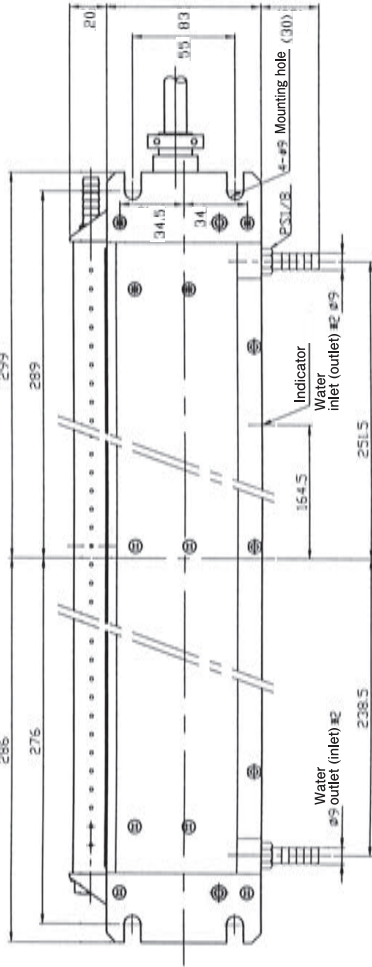
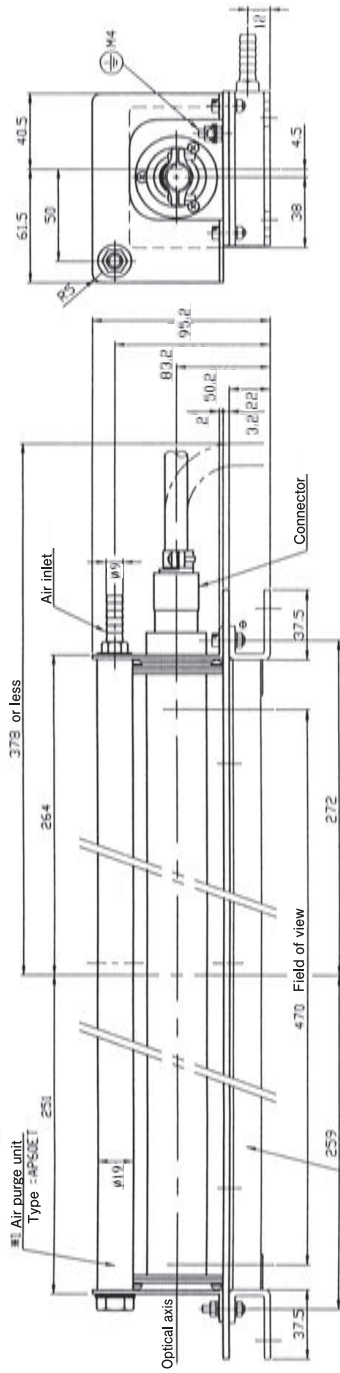
## WJ60E



Operating Temperature  
 -10 to +80°C  
 : in case of water cooling  
 -10 to +55°C  
 : with out water cooling

※1 Cooling water  
 Temperature : +10 to +35°C  
 Flow : Approx. 4ℓ/min  
 Withstand pressure : 0.3MPa

TRANSMITTER WITH AIR PURGE AND WATER COOLING JACKET (in mm)  
 AP60ET, WJ60E



Operating Temperature

- 10 to +80°C
- : in case of water cooling
- 10 to +55°C
- : with out water cooling

※1 Air purge

Air volume : Approx. 200  $\ell$  / min

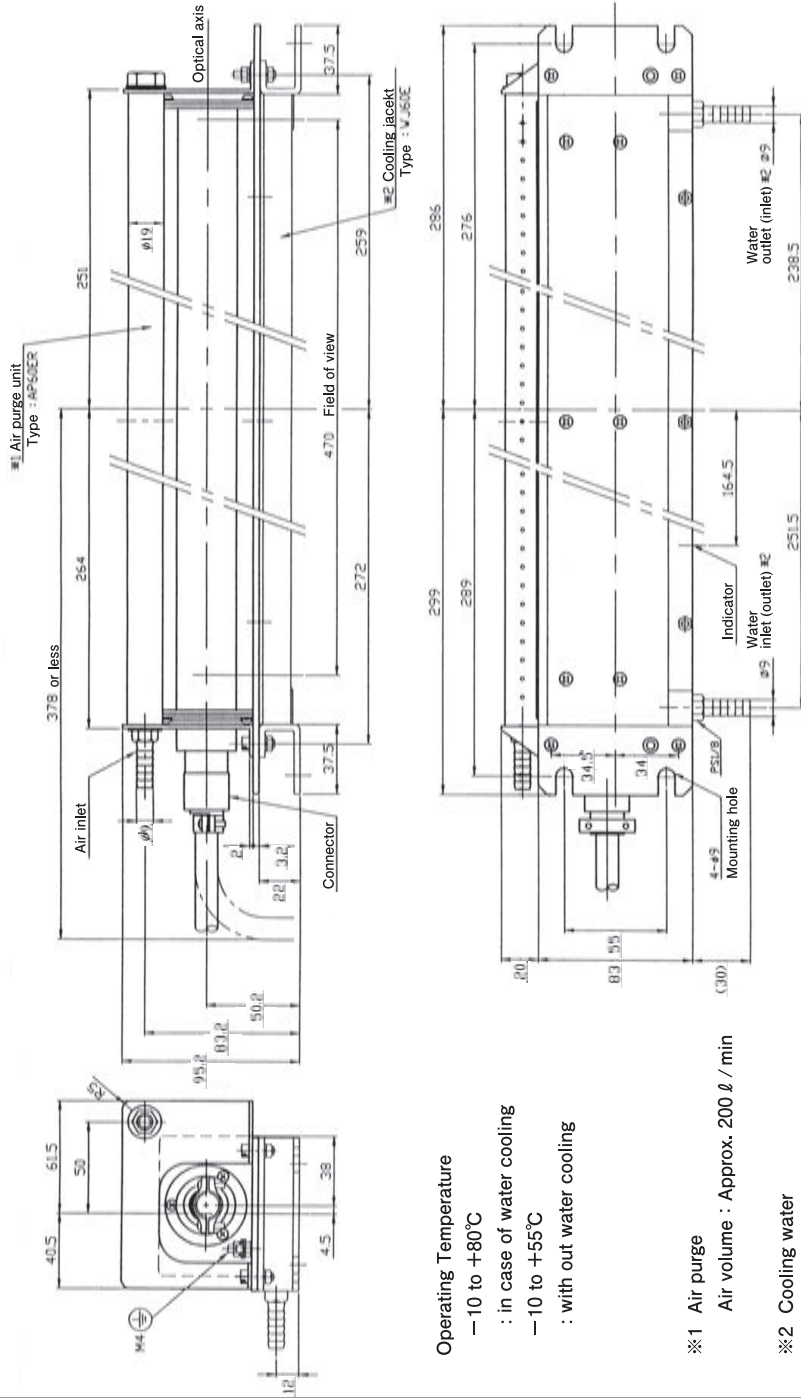
※2 Cooling water

Temperature : +10 to +35°C

Flow : Approx. 4  $\ell$  / min

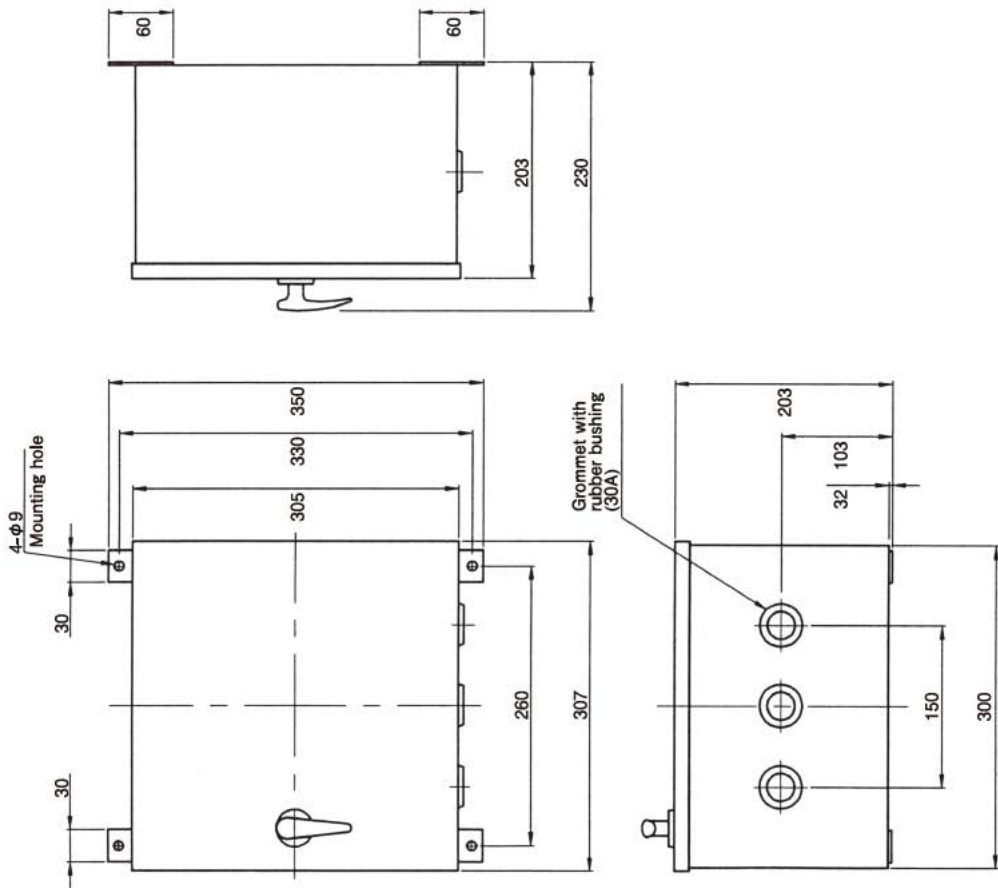
Withstand pressure : 0.3Mpa

RECEIVER WITH AIR PURGE AND WATER COOLING JACKET (in mm)  
 AP60ET, WJ60E



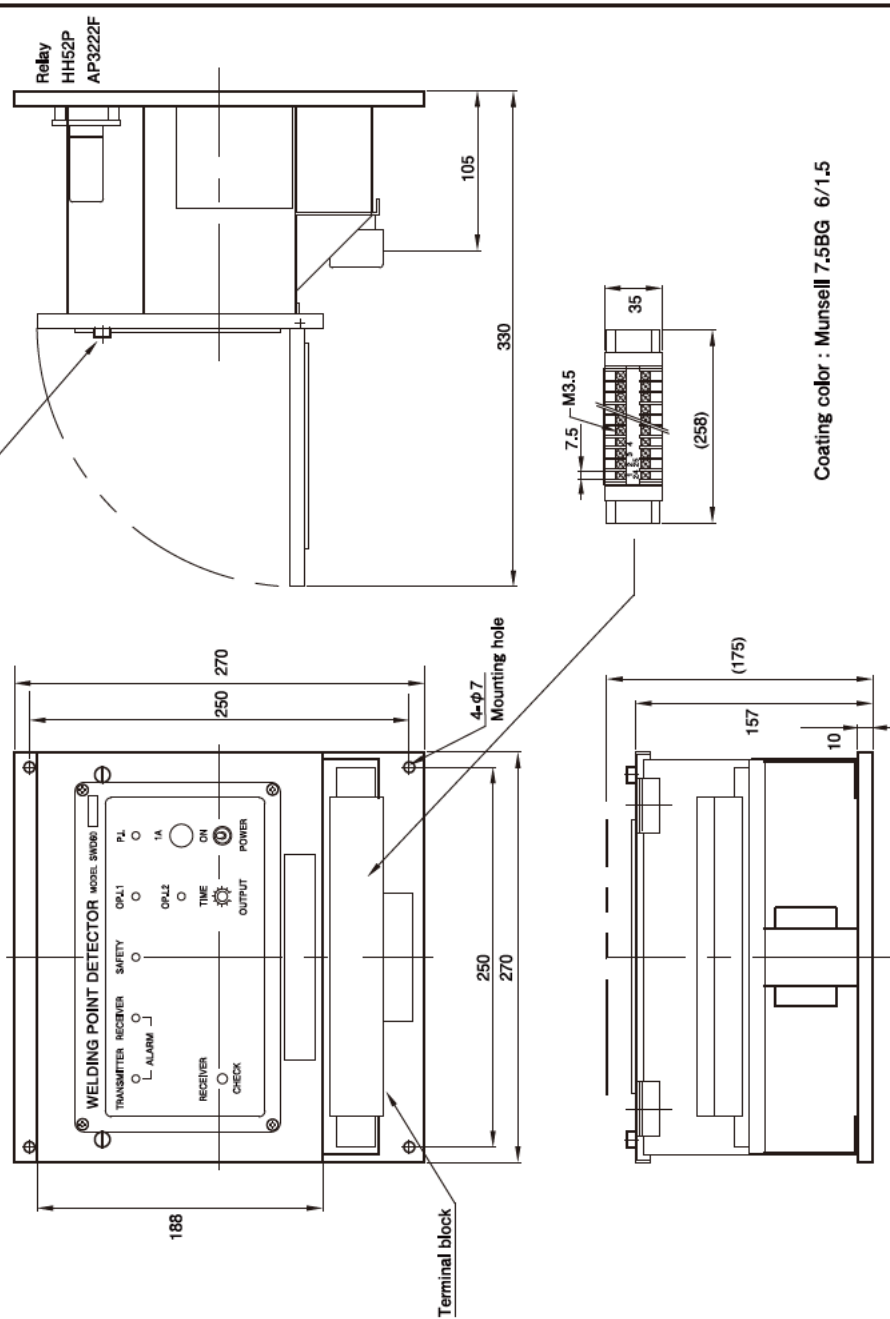


**CONTROL BOX** (in mm)  
**SWD60B**

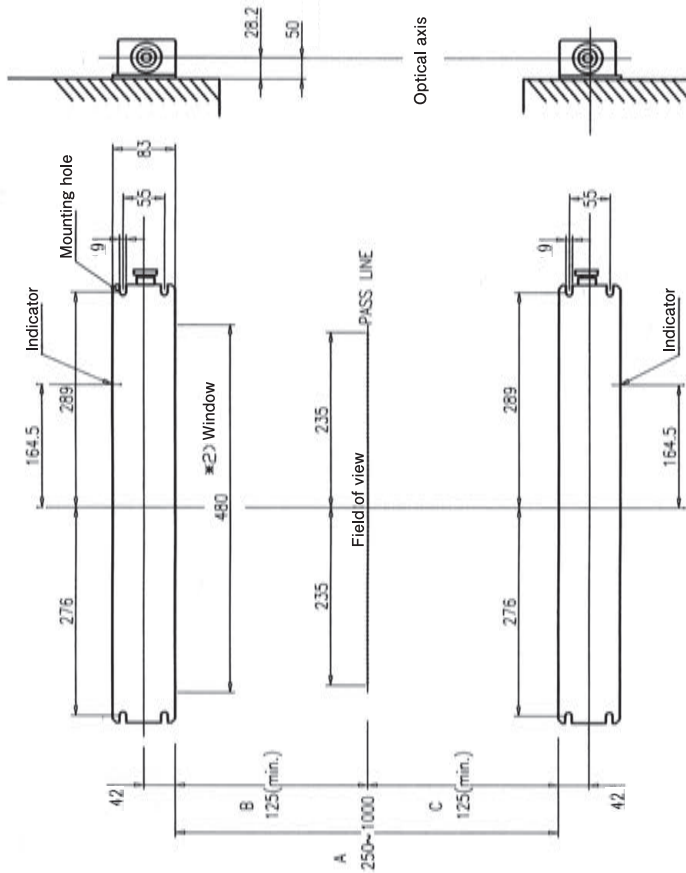


**CONTROL BOX  
SWD60B**

(in mm)



[INSTALLATION] (in mm)



In case of using water cooling jacket

- 1) There is no up-down direction in transmitter and receiver. Set it up so that reflection light from the steel board of the pass line may not be un covered in receiver when there is outside light such as the spark and the electronic flash. There is an indicator which shows operating condition on the back side of the sensor. Install it so that you can see this indicator. The indicator of the receiver is take precedence over it, and install it because it is specially necessary for the optical axis adjustment.
- 2) WINDOW  
This part is a necessary part for an optical axis adjustment. Be sure to open this part when you install an installation base and a protection board.
- 3) AIRPURGE (OPTION)  
(Detail are to see an instruction manual.)  
There is no airpurge in the standard specification. Airpurge is installed with option.  
Quantity : 200 ℓ /min or more
- 4) WATER COOLING JACKET (OPTION)  
(Detail are to see an instruction manual.)  
Use water cooling jacket when a surrounding temperature exceeds 55°C.  
Quantity : 4 ℓ /min or more  
Water Temp : +10 to 35°C

Typical setting range  
 A=500  
 B=250  
 C=250



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