



INSTRUCTION MANUAL

CAPACITANCE TYPE LEVEL SENSORS MODEL : TSS

Meanings of indications for safety used in this Instruction Manual are as follows.



WARNING: Indicates that improper handling assumes the risk of a fatal or serious injury.



CAUTION: Indicates that improper handling assumes the risk of injury or damage to property only.

TOWA SEIDEN INDUSTRIAL CO., LTD.

HEAD OFFICE Phone: 81-6-6340-5522, Fax: 81-6-6340-5519

OSAKA PLANT Phone: 81-6-6340-2831, Fax: 81-6-6349-6551

URL <http://www.towa-seiden.co.jp>

No. ETSS1000-1

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Introduction

1. This instruction manual explains how to use and adjust the product properly. Please be sure to read this manual before using the product. Keep this manual in a convenient location for easy reference as required.
2. This instruction manual describes the standard specifications. If the product you purchased is based on special specifications, the details may differ from the product.
3. The instructions in this manual are subject to change without prior notice.
4. If you have any questions or notice any errors in this manual, please contact our sales representatives.
5. We may modify the product to improve product quality. In the event of such modifications, we may sometimes offer alternative parts rather than original parts or an alternate product to our customers. For more details, please contact our sales representatives.

Safety indications used in this instruction manual have the following meanings.



Warning: This means that improper handling of the product may lead to death or serious injury.



Caution: This means that improper handling of the product may result in personal injury or damage to property or equipment.

Table of Contents

Introduction	1
1. Precautions on Handling the Product	2
2. Product Outlines	2
3. General Specifications	3
4. Outline Drawings	4
5. Type Description Table	5
6. Precautions on Mounting	6
7. Wiring	10
8. Panel Description	13
9. Adjusting Sensitivity	14
10. Setting Delay Timer	15
11. Troubleshooting	15
12. Maintenance	17

1. Precautions on Handling the Product



Warning This product has no explosion-proof structure. Do not use the product in a place where flammable or explosive gas is generated.

- 1) Check the identification plate after unpacking to confirm that the product is what you ordered. In the event the product is not what you ordered, please contact us.
- 2) Check the product for any damage. In the event of any damage, please contact us. Damage may be due to an accident during transportation.
- 3) Do not apply excessive force to the product. Impacts from dropping or tipping the product may cause damage.
- 4) Do not place any object on the product. Doing so may create excessive force on the product leading to damage.
- 5) When applying paint to the product, if paint is applied on the identification plate, information on the plate will be covered by the paint, hindering maintenance.
- 6) Do not use or store the product in a corrosive atmosphere (such as NH_3 , SO_2 , and Cl_2). Corrosive gas may penetrate the product, causing corrosion or damage to internal parts.
- 7) Avoid using or storing the product in a place where large vibration exists. In the event of exposure, remove the source of the vibration or prevent the vibration from being transmitted to the product.

2. Product Outlines

2.1 Product objectives

This product is a sensor for measuring liquids, powder, grains, and slurry in a tank or hopper at the level where the detector is mounted by means of the static capacitance (C) of the measuring instrument.

2.2 Operation Principle

A static-capacitance type level sensor is composed of electrodes (a ground electrode and detection electrode) and electronic circuits, with the electrodes constituting a capacitor. With the ground electrode contacting a tank, a capacitor including the tank is formed. Conditions such as shape, dimensions, layout, and peripheral situations determine the capacitance of the capacitor. If conditions other than the specific permittivity (*1) of the measured objects are the same, the capacitance of the capacitor depends on the specific permittivity of the measured objects. If we take the capacitance for air as a reference, we can distinguish the difference in capacitance created by measured objects with different values of specific permittivity. In addition, by taking either one of the two measured objects with different specific permittivity as a reference, we can distinguish the two objects. This product detects the static capacitance of measured objects and outputs signals.

*1 Specific permittivity is the ratio of the static capacitance of a capacitor where an insulating substance (dielectric) fills the space between its electrodes to the capacitance of the capacitor where a vacuum exists between its electrodes with the dielectric removed. Specific permittivity is a constant depending on the types of materials.

3. General Specifications

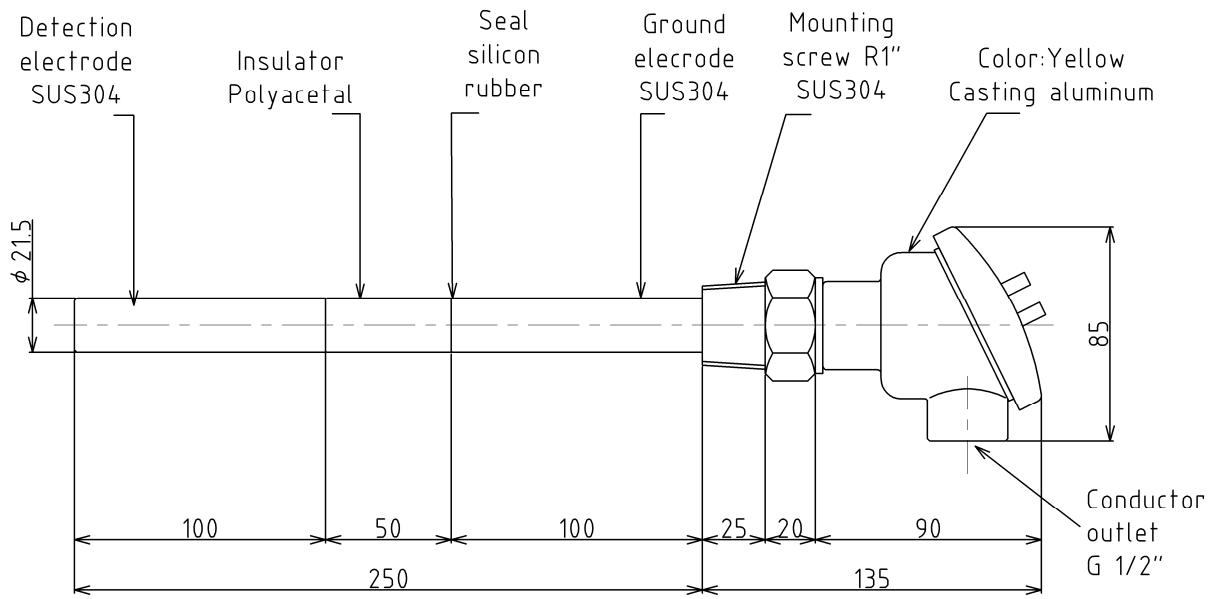
Converter

Type number	TSS-RB1/TSS-RB2	
Power source	Type: TSS-RB1	AC100/200 -10 to +20% (50/60Hz)
	Type: TSS-RB2	DC 24V ±10%
Power consumption	2.0VA	
Output	Relay output (1C Contact)	AC 250V 3A (Resistance load) DC 30V 3A (Resistance load)
Operation indication	Red LED turns on upon detection.	
Delay time	On-delay timer time about 0.1 – 10 seconds (variable)	
Ambient temperature during use	-10°C to 60°C (No condensation or congelation)	
Cable length	Max 100m (between Detector and Converter)	
Protective structure	In-house installation type	
Chassis material	Steel plate	
Painting color	Yellow Munsell 10YR7.5/14	

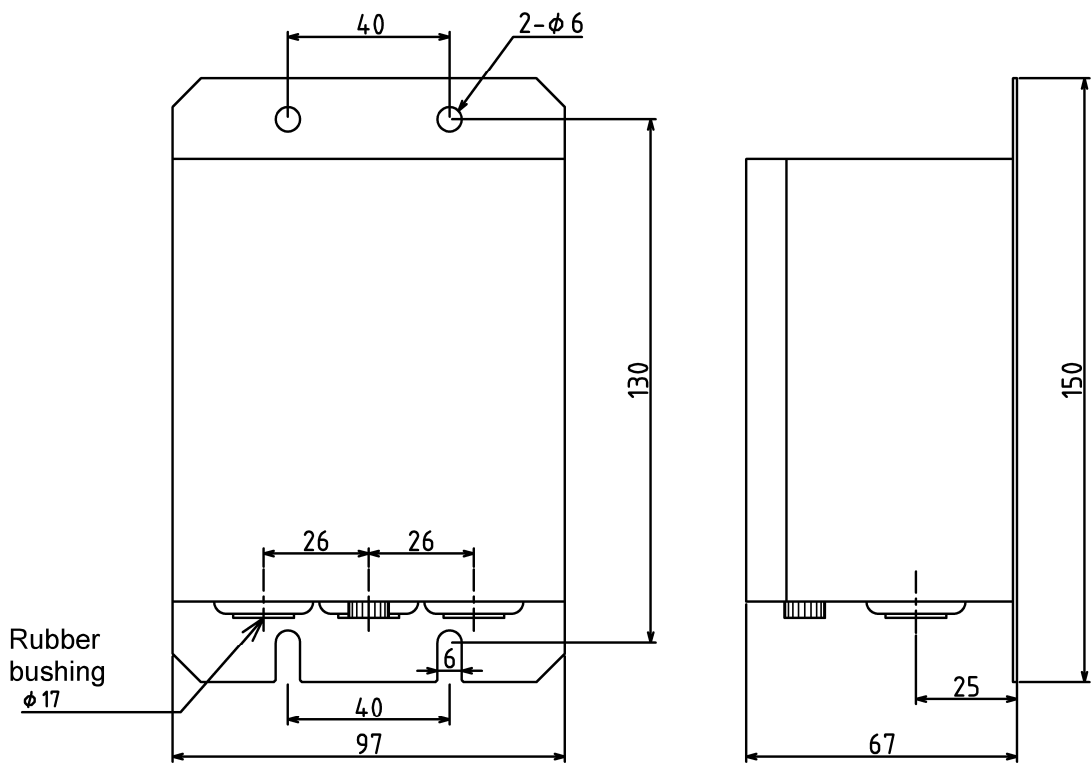
Detector

Type number	TSS-A1SA-025	
Stable detection range	2 to 500 pF (depending on electrode shapes)	
Ambient temperature during use	-10°C to 60°C (No condensation or congelation)	
Protective structure	Drip-proof type	
Chassis material	Cast aluminum	
Painting color	Yellow Munsell 10YR7.5/14	

4. Outline Drawings



Type number: TSS-A1SA-025 Dimensional outline drawing



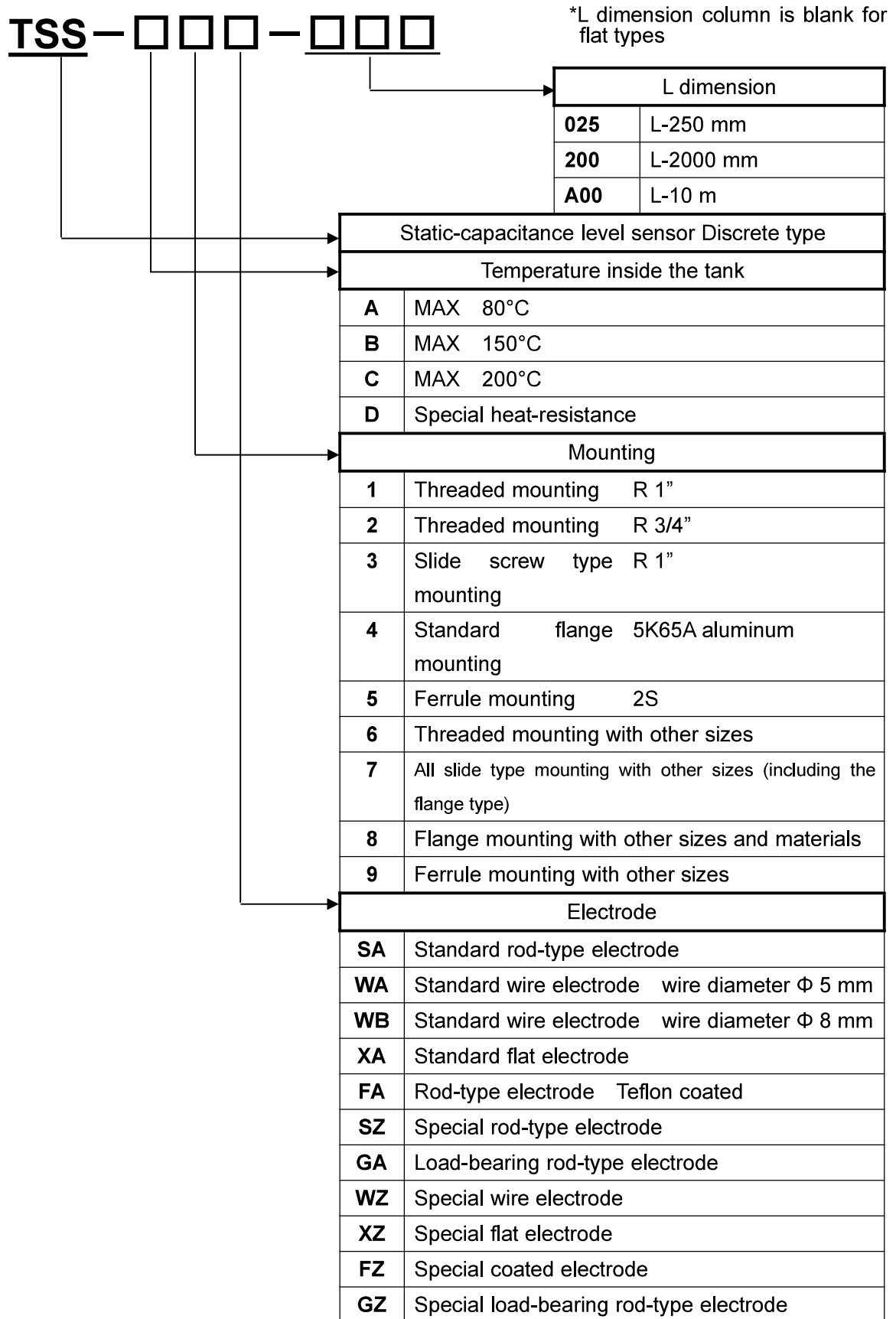
Material : Steel plate
Painting : Yellow

TSS-RB1/TSS-RB2 Dimensional outline drawing

Individual dimensional outline drawings are provided separately.
Please contact our sales representatives.

5. Type Description Table

5.1 Detector



5.2 Converter

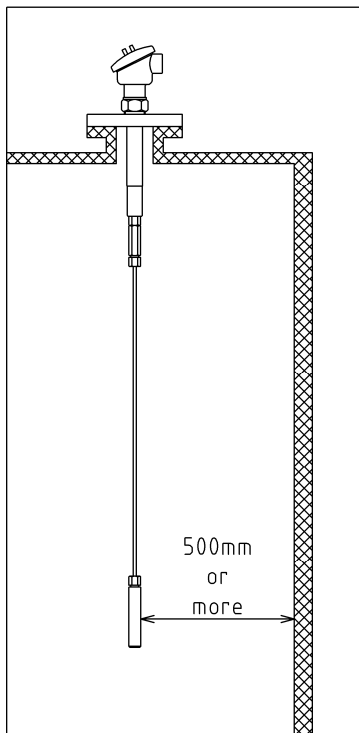
TSS-RB□

Static-capacitance level sensor Discrete type	
Converter	
Power supply specifications	
1	AC 100/200 V -10% to +20% (50/60 Hz)
2	DC 24 V ±10%

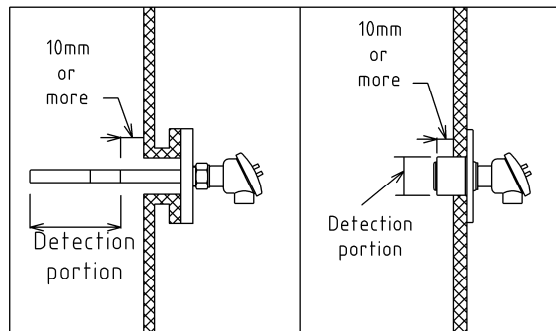
6. Precautions on Mounting

6.1 Checking detector mounting

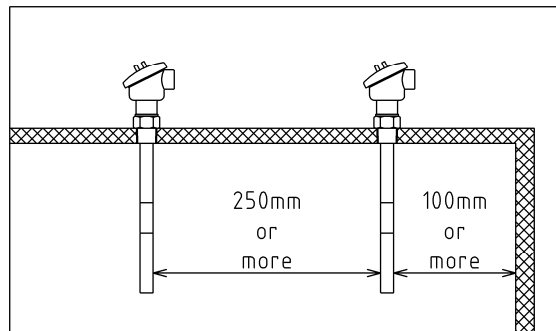
- 1) In mounting the detector, secure space for mounting and an area for maintenance around the periphery of the tank to maintain workability. The space must be secured after mounting the detector, taking subsequent maintenance into consideration. (Space corresponding to at least the total length of the product is required.)
- 2) When mounting the detector using a short pipe, be sure to have the ground electrode protrude from the inner wall of the tank by 10 mm or more.
- 3) When using detectors placed side by side, mount the detectors apart at a distance of 250 mm or more.
- 4) Mount the detection electrode at a distance of 100 mm or more from the tank wall.
- 5) Mount a wire-type electrode at a position where the electrode does not touch the inner wall or a stay of the tank due to swinging of the wire or electrode upon input or output of the measured object.



Mount the wire electrode at a position where it does not touch the inner wall due to its swinging.



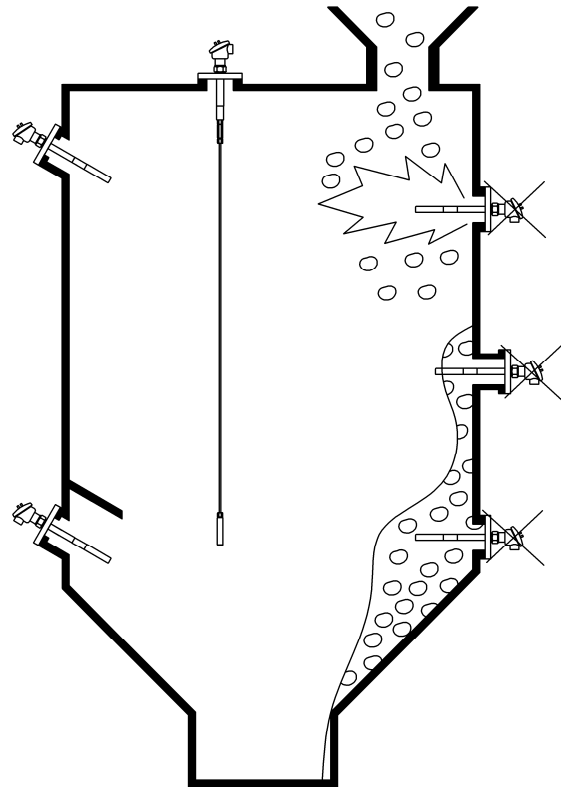
Mount the sensor ground electrode in such a way that it protrudes from the tank inner wall(or nozzle) by 10 mm or more.



When using electrodes placed side by side, mount one electrode at a distance of 250 mm or more from the other. Mount the electrode at a distance of 100mm or more from the tank wall.

Caution: Failure to meet these conditions may result in abnormal use due to adhesion of the measured object to the electrode, deterioration of sensitivity, and inability to make adjustments.

- 6) When mounting the product onto a tank, be sure to establish electrical conductivity between the ground electrode (flange and mounting screw portion) and the tank. In the case of a non-metallic tank, establish a grounding wire to ground the ground electrode (Class D grounding work, 100 Ω or less). In establishing a grounding wire, use the amplifier panel plate, which is electrically conductive to the ground electrode or one of the screws that secure the terminal block.
- 7) Avoid mounting the product near the motor, pump, or inverter that generates noise or an ultrasonic cleaner or a transceiver that generates high-frequency electrical fields. Failure to do so may cause the product to malfunction.
- 8) In detection of powder and grains, pay attention to the angle of repose. Do not mount the detector in a position where powder does not move around the detector due to the angle of repose. Doing so may cause the product to malfunction.
- 9) Pay attention to dead stock. Do not mount the detector in a place where powder remains creating dead stock. Doing so may cause the product to malfunction.
- 10) In detecting powder or grains, mount the detector in a place where no bridge is created. Creation of a bridge may cause the detector to malfunction and damage the sensor when the bridge collapses.
- 11) Do not mount the detector in a place where a lump may hit the detector directly. Failure not to do so may cause the product to malfunction and damage the detection unit of the sensor. Protect the detection unit with a guard plate, as required. In establishing a guard plate, place it at a distance of 100 mm or more from the detection electrode.
- 12) Do not mount the product in a place where it is exposed to vibration or impact. Mounting the product close to a vibrator or an air knocker may damage or cause the product to malfunction .
- 13) When mounting the product in a place where the temperature may rise, be sure to observe the allowable temperature range for the electrode (inside the tank) and the allowable temperature range for the instrument (60°C). Failure to do so may cause the



product to malfunction.

- 14) Do not mount the product in a place where it is exposed to direct sunlight. When the temperature exceeds the allowable range for the instrument, it may cause a malfunction. Provide a protective cover as required.
- 15) Take the precautions described below when using the product in a place where the housing may be exposed to water drops. The housing of the product is provided with drip protection (drip-proof type) for water intrusion. However, inadequate tightening of the cover or improper handling of the conductor outlet may allow water to enter, causing a malfunction or damage to the product. Be sure to handle each portion properly.
- 16) When mounting the detector in a horizontal position, be sure that the conductor outlet is oriented downward.

6.2 Checking converter mounting

- 1) Check that the place where the converter is going to be mounted is free from vibration or mechanical shocks. Failure to do so may cause malfunction or damage of the product.
- 2) The converter is specified for indoor use. Mounting the converter outdoor may cause failure due to intrusion of rain water and dust. When mounting the converter outdoor, be sure to provide an outdoor box or other means to store the converter in.

6.3 How to mount the detector and converter



Caution Do not try to screw in or take out the detector by holding the chassis. The housing may come apart causing damage.

- 1) In the case of a threaded mounting, secure the product by applying force to its hexagonal portion with the appropriate tool. Provide sealing processing, as required, when pressure is generated inside the tank. Do not try to screw in or take out the product by holding the chassis. The housing may come apart causing damage.
- 2) In the case of a flange mounting, check that nominal designations for the companion flange at the tank match those for the flange of the product. If the check result is in order, put the gasket in-between and secure the product with a bolt conforming to the standards using the appropriate tool. Bolts and gaskets are not attached to the product. Please contact our sales representatives as required.
- 3) The converter is to be mounted with four M5 screws.

6.4 Detector mounting orientation

- 1) In the case of a horizontal (transverse) mounting, the electrode is parallel to the measured object, providing a larger electrode area to for detection. This generates a greater change in capacitance even with a small change in the measured object, providing high-accuracy detection. However, if the measured object is an adherent, the stability of detection may deteriorate. Mounting electrodes downward will reduce

accumulation and adhesion of the measured object.

- 2) In the case of a vertical (longitudinal) mounting, adhesion of the measured object to the electrode is less likely, providing stable operation. However, the part of electrode that is effective for detecting the measured object becomes smaller, resulting in reduced accuracy. For detection of the lower limit of a tank, the lengthened electrode is a disadvantage.

7 Wiring

7.1 Precautions on wiring



Warning When implementing wiring, be sure that the supply power sources and power sources applied to the output are shut off. Failure to do so may result in danger of electric shock, electric leaks, and short circuits or combustion.



Warning Converter TSS-RB1 is specified to AC 100/200 V, whereas converter TSS-RB2 is specified differently to DC 24 V. Pay attention because they cannot share the same power source.



Warning Do not connect 200 V to the 0 – 100 terminal. Doing so may cause damage or accidents resulting in injury or death.



Warning When a 0 – 100 V connection is implemented, 200 V is generated at the 200 V terminal. Therefore, pay attention to avoid touching the terminals. Touching terminals may cause electric shock or short circuits.



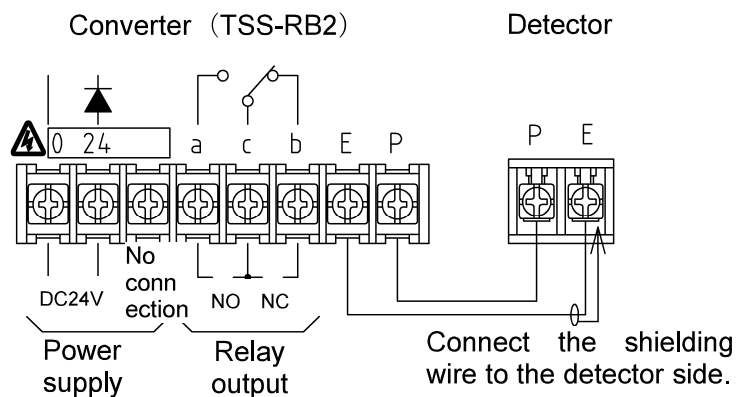
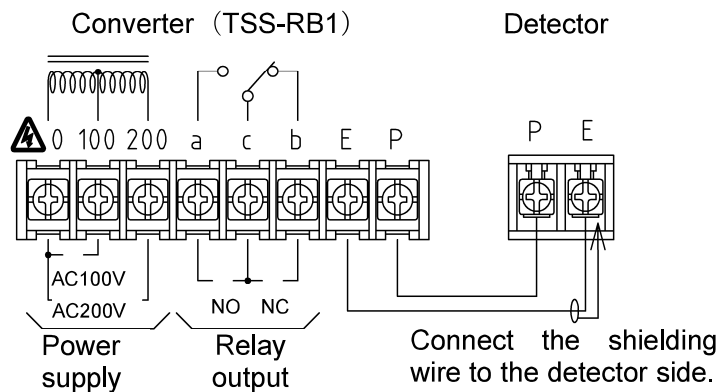
Caution Do not connect a load that exceeds the ratings for the relay contacts. This may cause damage or deterioration of the relay contacts. In the case where load capacity exceeds the ratings for contacts, install a relay that meets the load capacity between the load and the output terminal of the product. Do not connect the relay output terminal with only the power source involved. Be sure to connect a load. Failure to do so may cause a short circuit or damage the product.

7.2 Wiring procedure

- 1) Remove the covers of the detector and converter to check correct wiring to each terminal before starting any wiring work. As for terminal screws, M3 screws are used for the detector and M3.5 for the converter. Be sure to use a driver compatible with each screw. As for crimp terminals, use one with the size equivalent to R□-3 for the detector and size equivalent to R□-3.5 for the converter. (The cross section of the wire used is specified in □)
- 2) Use a two-core shielded wire (0.5 sq or more) for connection between the converter and the detector. Recommended cable: (MRC UL20276SBAWG20x1P manufactured by Hanshin Electric Wire & Cable Co., Ltd.) For other wiring, a cable with an outer diameter of ϕ 6 to 12 mm is recommended.
- 3) For the connection to the detector, use a cable gland or wire tube compatible with the size

of conductor outlet (G1/2") for the cable to run through. For the connection to the converter, create an opening in the center of the rubber bushing and have the cable run through it. When the cable weight applies directly onto the terminal block, replace the rubber bushing with a cable gland or fix the cable to prevent weight from being applied directly.

- 4) For the converter with AC specifications (TSS-RB1), when used at 90–120 V, set up a connection to the 0 and 100 terminals, and when used at 180–240 V, set up a connection to the 0 and 200 terminals. For the converter with DC 24 V specifications (TSS-BR2), connect 24 V to terminal 24 and 0 V to terminal 0. In connecting the converter and detector, connect P to P and E to E, respectively. Connect the shielding wire to E on the detector side.
- 5) No-voltage contact output is provided by a relay. With terminal c shared, terminals c and a are open in a no-detection status and conducting in a detection status, whereas terminals c and b are conducting in a no-detection status and open in a detection status.
- 6) After finishing the wiring, be sure to attach the cover. Be sure that the cover is tightly mounted by screws.

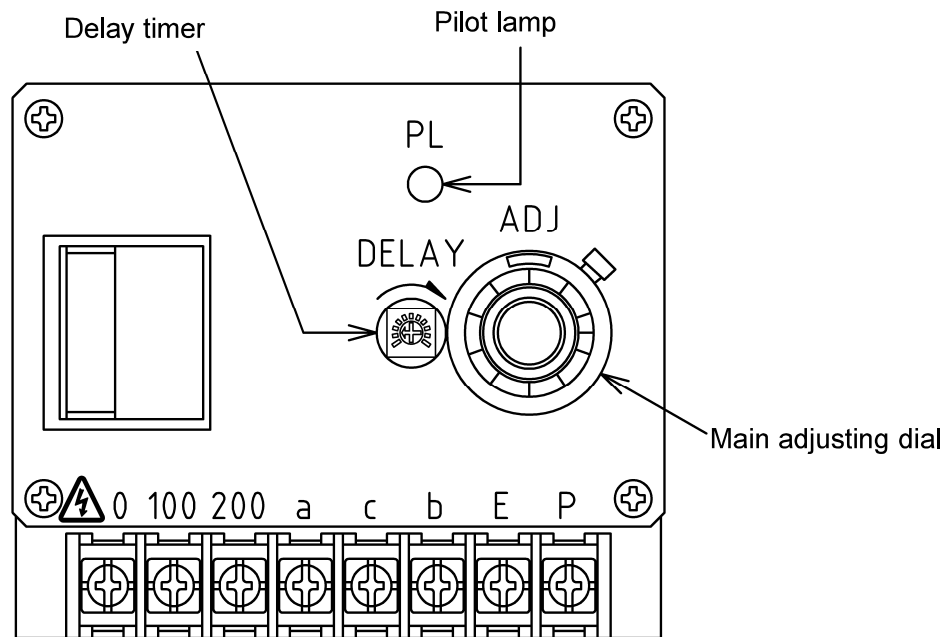


Terminal alignment and wiring diagram

7.3 Conductor outlet

The cable runs through the conductor outlet of the detector and is secured either with a cable gland or with a cable tube that is connected to the housing. In either case, be sure to prevent water coming along the cable or cable tube from directly entering the housing by configuring the connection of the cable and flexible tube downward first and then upward. Improperly securing the cable with a cable gland or inadequate connection of the cable tube may allow foreign material, such as dust and dirt, or water to enter the housing, resulting in a malfunction. Be sure to mount the conductor outlet in the downward direction.

8. Panel Description



Panel diagram

<Description of each unit>

- ADJ (Main adjusting dial)

This dial is used to adjust the sensitivity according to measured objects. The effective range of adjustment is provided by 10 rotations.

- PL (Pilot lamp color in red)

The lamp turns on upon detection.

- DELAY (Delay timer)

Time from detection to output can be varied between 0.1 and 10 seconds. The effective range of adjustment and range of rotation is about 250°.

- Terminal block

Terminals for the power supply, relay output, and connection to the detector

9. Adjusting Sensitivity

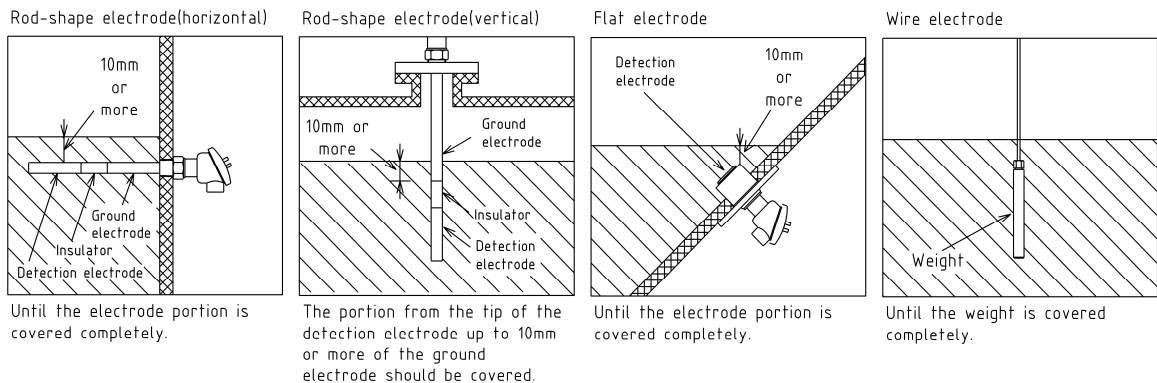
Use the ADJ dial to adjust the sensitivity according to the property of measured objects. Adjustment is done by checking the values at the maximum and minimum adjustment positions and then setting the dial value to the middle point. For details, refer to sections 9.1 to 9.3. Conduct sensitivity adjustment in an actual measurement condition.

9.1 Checking the maximum adjustment position

Check this value when the tank is empty (no measured object exists in the electrode portion). Turn the power on and turn the ADJ dial clockwise until the pilot lamp turns on. This position corresponds to the maximum value of the adjustment range. Be sure to remember the adjusting dial value corresponding to this position.

9.2 Checking the minimum adjustment position

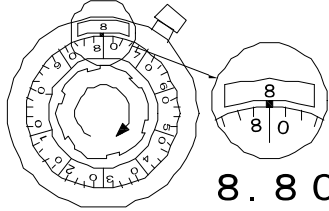
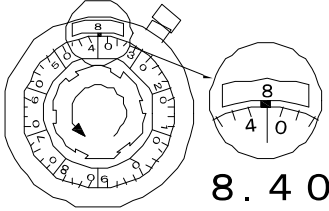
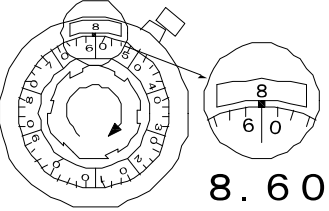
Check this value when the tank is filled with the measured object up to the measuring position. Be sure the electrode is buried in the measured object. (See the figure below.) Check that the pilot lamp has turned on. Turn the ADJ dial counterclockwise until the pilot lamp turns off. Be sure to remember the dial value corresponding to this position. This position corresponds to the minimum value of the adjustment range. The minimum position varies depending on the properties of the measured objects. Check the value every time the measured object or sensitivity category is changed.



9.3 Determining the adjustment position

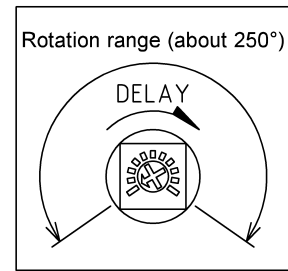
The middle point between the two values checked in 1 and 2 described above is the sensitivity adjustment position. Turn the ADJ dial from the minimum adjustment position clockwise until the sensitivity adjustment position is reached to finish the procedure. Do not move the adjustment position up or down more than necessary. Doing so may cause the product to malfunction.

Confirm that the range of values checked at 1 and 2 described above exceeds 0.2. If the range is 0.2 or less, the operation may be unstable and the product cannot be used.

<p>1. Turn the dial clockwise until the pilot lamp turns on. In this example, the value for the pilot lamp to turn on is assumed to be 8.80.</p>  <p style="text-align: center;">8.80</p>	<p>2. In a situation where the measuring object is filled enough to cover the electrode, turn the dial counterclockwise until the pilot lamp turns off. The value for turning off the pilot lamp is assumed to be 8.40.</p>  <p style="text-align: center;">8.40</p>	<p>3. Adjust the dial to the middle point between 1 and 2, which is 8.60.</p>  <p style="text-align: center;">8.60</p>
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10. Setting the Delay Timer

This product provides a delay in time between detection of the measured object and output operation. Turning the trimmer of the delay timer in the direction of the arrow increases delay time up to 10 seconds maximum for adjustment. Do not turn the trimmer forcibly beyond its stop position. Doing so may cause damage.



11. Troubleshooting

11.1 Trouble in adjustment

- 1) In checking the maximum adjustment position, the pilot lamp does not turn on however much the ADJ dial is turned.
 - Check that power is being supplied or the connections to the converter and detector (P and E) are properly implemented.
- 2) In checking the maximum adjustment position, the pilot lamp remains turned on and does not turn off.
 - Check whether any stay exists close to the detection electrode.
 - Check for condensation.
- 3) In checking the minimum adjustment position, the minimum position does not stabilize.
 - Check whether the tank and the electrode are properly connected.
 - Check whether the electrode is properly buried in the measured object.
- 4) In checking the minimum adjustment position, the range between the maximum value and the minimum value does not exceed 0.2.
 - Check whether precautions on mounting the electrode were properly observed; the distance of the electrode from the tank wall should be 100 mm or more, and the protrusion of the ground electrode from the short tube nozzle should be 10 mm or more.
- 5) Detection works but no output is obtained.
 - Check whether wiring on the output side is properly implemented.

11.2 Trouble during use

- 1) The product does not detect that the measured object has exceeded the measuring position.
 - Confirm the angle of repose and check for a bridge.
 - Check whether the sensitivity adjustment position is too low for use.
- 2) The product detects that the measured object has exceeded the measuring position even though the object is actually still under the measuring position.
 - Check whether the sensitivity adjustment position is too high for use.
- 3) The level of the measured object has reduced below the measuring position but the detection status is not released.
 - Check for residual measured object such as dead stock.
- 4) Detection performance does not stabilize.
 - Check the vicinity for noise sources such as a motor, pump, or inverter.

5) The product is frozen in the detection status.

---Check for adhesion of the measured object to the electrode portion.


---Check for condensation inside the chassis and the electrode.

6) The product stopped outputting signals or is frozen in the output status.

---Check the contact resistance between the output terminals. (The normal value is 1 Ω or less.)

If check actions described above do not improve the problem, please contact our sales representatives.

12. Maintenance

	<p>Warning In implementing maintenance and inspections, be sure to shut off the power supply and the power to the output except for checking the operations. Failure to do so may result in danger of electric shock, electric leaks, and short circuits or combustion.</p>
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Check point	Check period	Check item	Action	Check method
Electrode	Weekly	Check for adhesion of the measured object	Cleaning	Visual
	Monthly	Check for parts displacement, cracks, and deformation	Repair Parts replacement	Visual
	Every 6 months	Without anpulifier,check that the insulation resistance between the detection electrode and the ground electrode is 10 M Ω or more.	Repair Parts replacement	DC 500 V Insulation-resistance meter
Detector Converter Chassis	Weekly	Check that the cover has been tightly fixed.	Tightening	Visual and touching
	Weekly	Check for intrusion of dirt, water, dust and other objects.	Cleaning Actions against intrusion paths	Visual
	Monthly	Check for corrosion, condensation, and deformation.	Repair Parts replacement Check of use environment	Visual
Detector Converter Amplifier	Monthly	Check for loosened screws.	Additional tightening	Screw driver
	Every 6 months	Check that the insulation resistance between each external terminal and the chassis is 10M Ω or more. (TSS-RB1 excepts P,E terminals. TSS-RB2 excepts P,E,0,24 Terminals.)	Amplifier replacement	DC500V Insulation-resistance meter
Operation	Monthly	Turn on the power and check that the pilot lamp turns on and output switching is operating when the screw at the center of detector board is touched with a metallic object such as a precision screw driver.	Amplifier replacement	Screw driver and others Tester