TATSUTA
Electronic Materials &
System Equipment Group

TATSUTA

WATER LEAKAGE DETECTOR SYSTEM

TECHNICAL DOCUMENT

TATSUTA ELECTRIC WIRE & CABLE CO., LTD.

Electronic Materials & System Equipment Group

System Division　System Equipment Division

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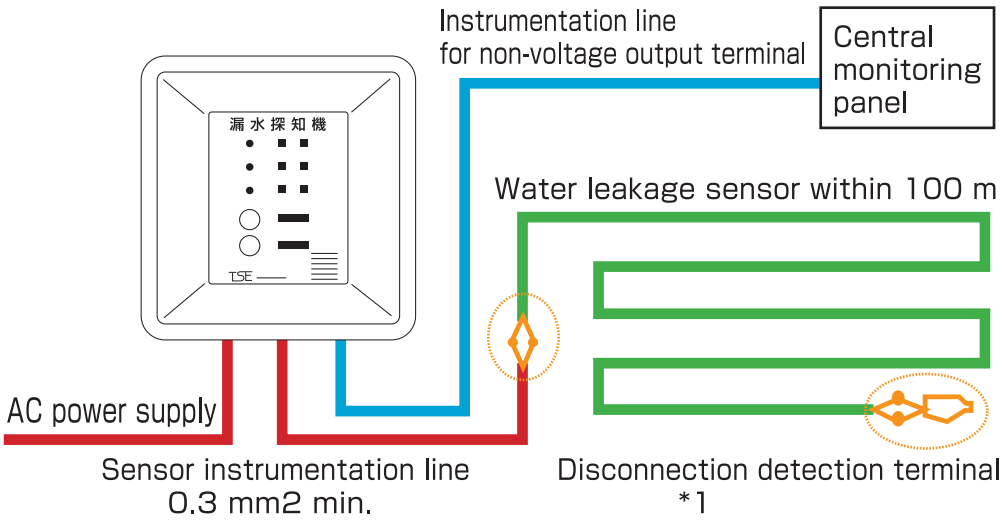
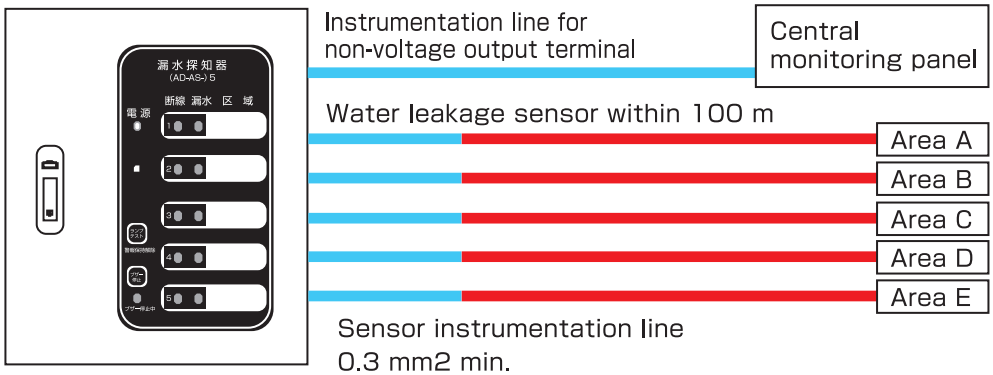
1. Overview

Tatsuta's Water Leakage Detector System protects facilities such as computer rooms, critical facilities, warehouses, and critical document rooms from water leaks and flooding accidents.
The System is composed of at least one line type sensor that quickly detects water leaks along with a water leakage detector that alerts the water leaks to the user in a timely manner.
Tatsuta offers the following water leakage detectors as standard models, which are in control of one or more circuits according to the user's requirement.
Each model incorporates a non-voltage output terminal that can be connected to a central monitoring panel.

Table 1. System Configuration Example

<table>
<tr><th></th><th>Model</th><th>Number of circuits</th><th>System configuration example</th></tr>
<tr><td>Single-circuit use</td><td>AD-AS-1AM
AD-AS-1BM
AD-AS-1CM
AD-AS-1C-SR</td><td>1</td><td>(Single-circuit example) Configuration AD-AS-1AM: 1 unit
E.g., AD-S sensor: 1 sensor
 
</td></tr>
<tr><td>Multi-circuit use</td><td>AD-AS-5DRM
AD-AS-10DRM
AD-AS-□□□
*2</td><td>5 (1 to 5)
10 (1 to10)
N</td><td>(Five-circuit example) Configuration AD-AS-5DRM: 1 unit
E.g., AD-S sensor: 5 sensors
 
</td></tr>
<tr><td>Sensor</td><td colspan="3">• AD-S(Non-coloration model)
• AD-RS(Coloration return model)
• AD-HS(Coloration model)
• AD-FH(Flat model)
• FR-AD(Heat-resistance model)</td></tr>
</table>

*1: The wire disconnection detection terminal consists of a terminating resistor (with a resistance of 20 kΩ) that detects sensor wire disconnections.
*2: The AD-AS-□□□ can be custom made with the user's desired number of circuits incorporated.

2.Features of Water Leakage Detector System

(1) Any part of the sensor (AD-S, AD-RS, AD-HS, AD-FH, or FR-AD) in its whole length infallibly detects leaks.

(2) The sensor has excellent flexibility and can be located in uneven places or on corners.

(3) The sensor can detect pure water, acid solutions, alkali solutions, and salt water as well as ordinary water.

(4) If a sensor wire disconnection occurs, the water leakage detector (provided with a wire disconnection alarm) will detect the disconnection and a lamp with a buzzer will alert the user to the disconnection.

(5) The absorbent part of the AD-RS or AD-HS sensor in use will turn red, thus making it possible to single out the leak point.

- The absorbent part of the AD-RS sensor will turn back to white when it dries.
- The absorbent part of the AD-HS sensor will remain red even when the sensor dries. (See the photograph)

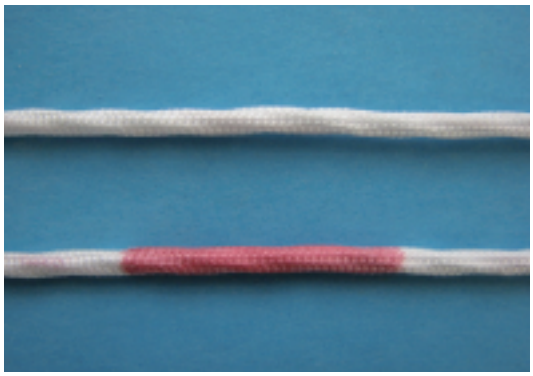


Figure 1. AD-HS Sensor

(6) The sensor has a simple structure and excellent detection capability, thus ensuring ease of maintenance and control.

(7) The AD-S and AD-RS sensors are of braided special plastic fiber structure with good water absorption and fast-drying features. Therefore, these sensors will be ready for reuse within a short time.
(The AD-HS sensor, however, cannot be reused because the absorbent part of AD-HS sensor will remain red even when the sensor dries.)
The AD-FH sensor will dry more quickly if the absorbent surface is wiped with a rag.

(8) The water leakage detector incorporates a non-voltage output terminal interlocked with the alarm, thus making it possible to use the terminal for alarm signal output to central monitoring panels or interlocking signal output to equipment.

(9) The system adopts a circuit that limits the applied voltage of the water leakage detector to the sensor electrodes to a maximum of 5.5 VAC. Furthermore, if the electrodes should short, the circuit will limit the current to a maximum of 2 mA, thus not causing harmful effects.

Table 2. AD-S (AD-RS) Sensor Specifications

Item	Specifications
Electrode structure	Material: Tin-plated soft copper stranded wire Configuration: 0.18 mm in strand diameter × 13 wires (0.33 mm2)
Detection characteristics	A maximum resistance of 5 kΩ (AC) between the electrodes when the quantity of water (tap water) is 3.0 ml or less. •Dripping quantity: Dropped directly onto the sensor (0.05 ml/s) •Measurement environment: Ambient temperature: 24 ° C, Humidity: 60% (RH) •Dielectric constant: 200 μS/cm [5.0 kΩ·cm] at a water temperature of 24°C •Test equipment : Tatsuta-made AD-AS-10DRM detector *The resistance between the electrodes and the quantity of water vary with the installation surface condition of the sensor, the environment, and the quality of water.
Return characteristics	Returns to the original state when the sensor dries or the moisture in the sensor is eliminated after the sensor detects a water leak. The sensor cannot be used again if the water leak contains an electrically conductive or water repellent substance.
Resistance between electrodes (AC)	10 MΩ min./100 m (at a measurement ambient temperature of 24°C and humidity of 60% (RH))
Moisture resistance characteristics	The resistance between the electrodes is a minimum of 100 kΩ/100 m no matter how high the humidity is, provided that there is no dew condensation (at a measurement ambient temperature of 60°C and humidity of 95% (RH)).
Heat resistance	Continuous operating temperature: 60°C max. (Material resistant temperature : 80°C)
Weight	10.5±1.0 g/m

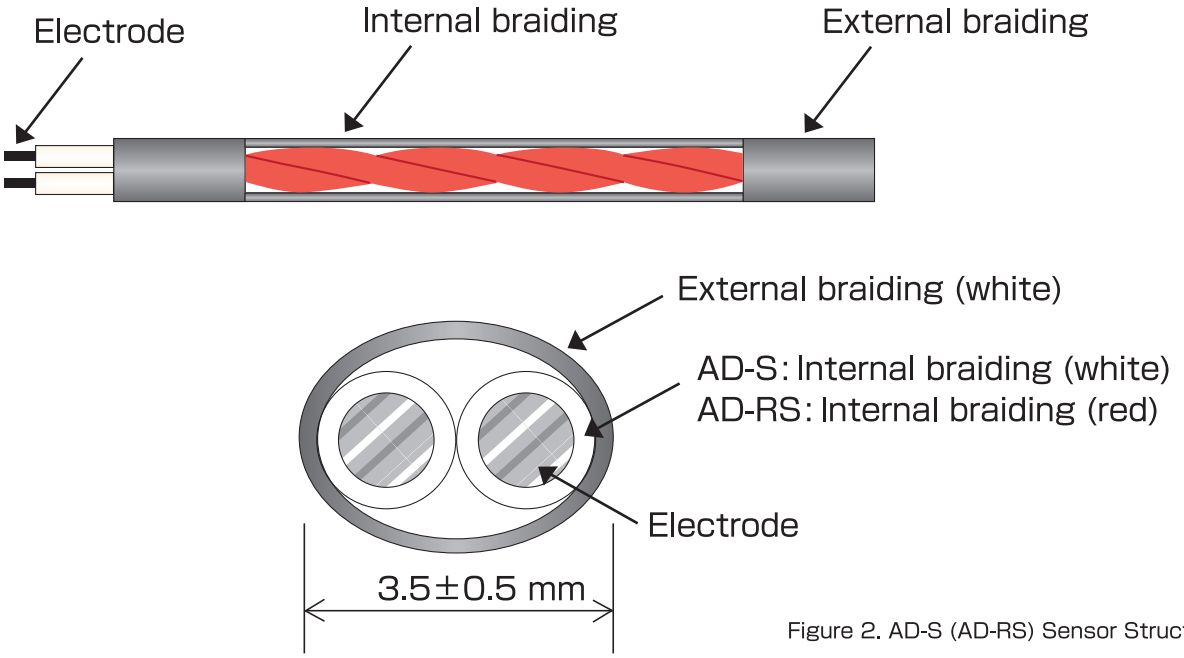


Figure 2. AD-S (AD-RS) Sensor Structure

3-2. AD-FH Sensor Specifications and Structure

Table 3. AD-FH Sensor Specifications

<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>Electrode structure</td><td>Material: Tin-plated soft copper stranded wire
Configuration: 0.18 mm in strand diameter × 13 wires (0.33 mm2)</td></tr>
<tr><td>Detection characteristics</td><td>Wetting length (immersion of the electrodes) and detection of water with a Tatsuta-made detector.
<table>
<tr><td>• Dripping quantity</td><td colspan="3">Dropped directly onto the sensor (0.05 ml/s)</td></tr>
<tr><td>• Measurement environment</td><td colspan="3">Ambient temperature: 24° C, Humidity: 60% (RH)</td></tr>
<tr><td>• Dielectric constant:</td><td colspan="3">200 μS/cm [5.0 kΩ·cm] at a water temperature of 24° C</td></tr>
<tr><td>• Test equipment</td><td colspan="3">Tatsuta-made detector AD-AS-10DRM</td></tr>
<tr><td>Water leak detection level setting</td><td>detection device (20 kΩ)</td><td>Sensor wetting length (immersion of electrodes)</td><td>Quantity of water supply * Reference</td></tr>
<tr><td rowspan="2">5 kΩ</td><td>Not connected</td><td>70 to 120 mm</td><td>12 to 23 ml</td></tr>
<tr><td>Connected</td><td>60 to 100 mm</td><td>7 to 17 ml</td></tr>
<tr><td>8 kΩ (recommended)</td><td>Not connected
Connected</td><td>50 to 80 mm
30 to 60 mm</td><td>4 to 14 ml
2 to 5 ml</td></tr>
</table>
*The sensor wetting length (immersion of the electrodes) varies with the installation surface condition of the sensor, the environment, and the quality of water. The correlation between the quantity of water detected and the sensor wetting length vary with the installation surface condition of the sensor, the environment, and the quality of water as well.</td></tr>
<tr><td>Return characteristics</td><td>The sensor will return to the original state instantaneously when the moisture in the sensor is eliminated after the sensor detects a water leak. (Resistance between sensor electrodes: 100 kΩ min.)
The sensor needs cleaning if the water leak contains an electrically conductive or water repellent substance. The sensor can be used again after the sensor is cleaned.</td></tr>
<tr><td>Resistance between electrodes (AC)</td><td>10MΩ min./100m (at a measurement ambient temperature of 24° C and humidity of 60% (RH)).</td></tr>
<tr><td>Moisture resistance characteristics</td><td>The resistance between the electrodes is a minimum of 100 kΩ/100 m no matter how high the humidity is, provided that there is no dew condensation (at a measurement ambient temperature of 60° C and humidity of 95% (RH)).</td></tr>
<tr><td>Heat resistance</td><td>Continuous operating temperature : 60 °C max. (Material resistant temperature: 80°C)</td></tr>
<tr><td>Weight</td><td>8.5±1.0 g/m</td></tr>
</table>

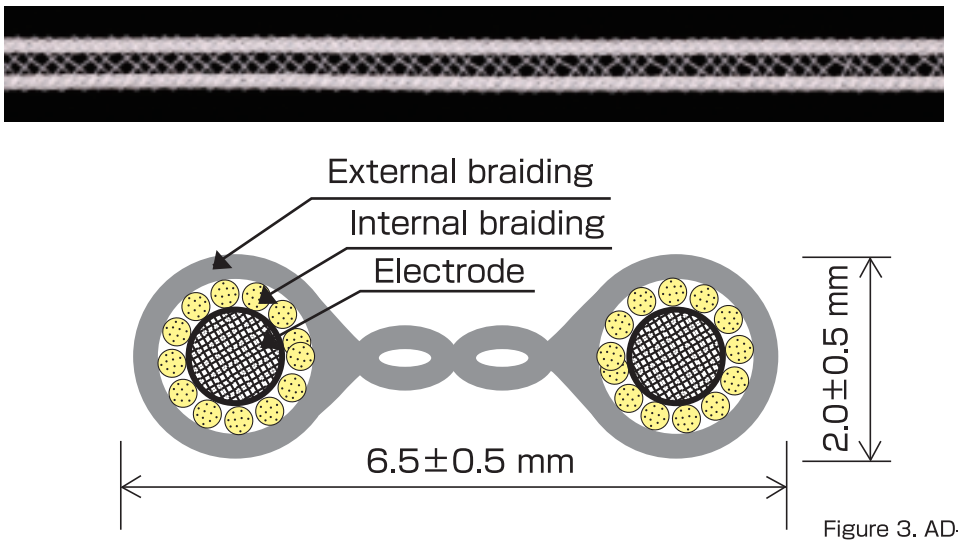


Figure 3. AD-FH Sensor Structure

[Water Absorption (Detection) Characteristics]

When any part of the sensor absorbs approximately 1.5 ml of water, the AC resistance between the sensor electrodes will drop to 5 kΩ or below and the sensor will detect a water leak.

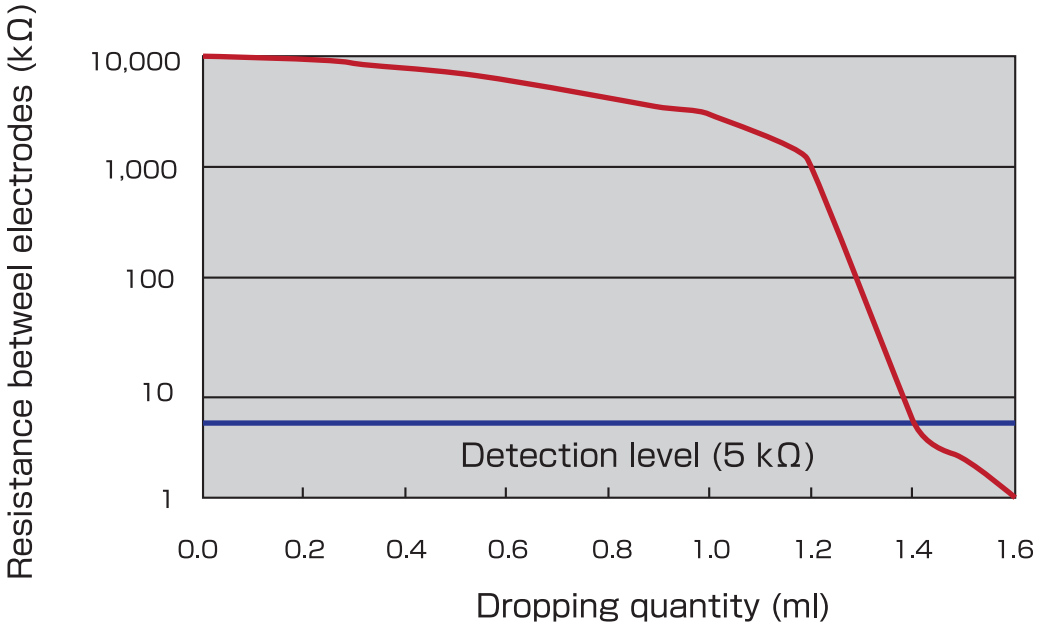


Figure 4. AD-S (AD-RS) Sensor—Water Absorption (Detection) Specifications

[Moisture resistance characteristics]

The AC resistance between the sensor electrodes is 100 kΩ/100 m or over even if the humidity is as high as 95% (RH) at 60°C, which means that the sensor can be used with no problems in high-humidity environments.

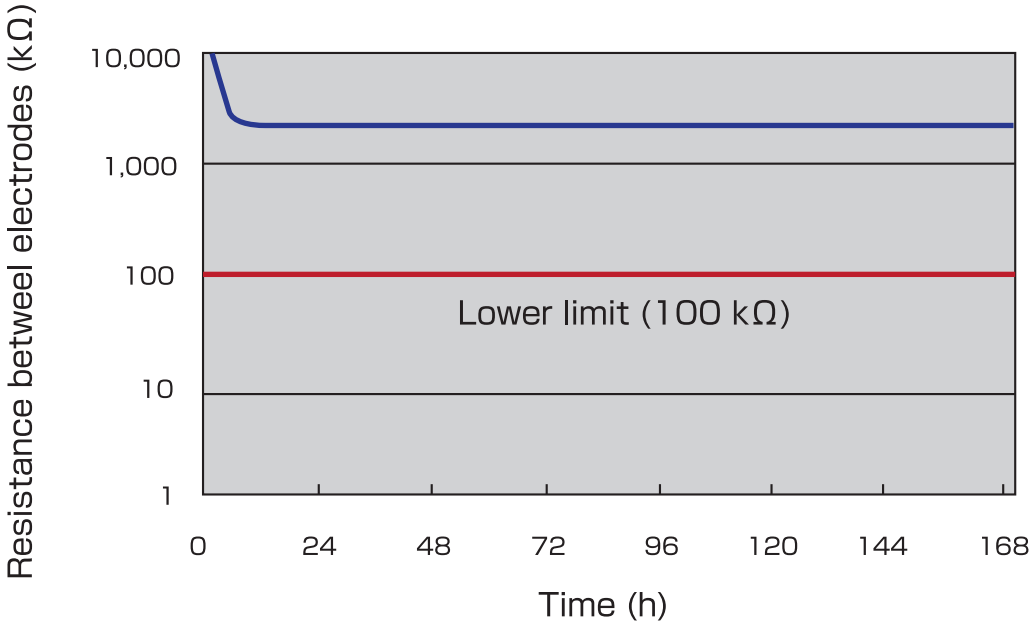


Figure 5. AD-S (AD-RS) Sensor—Moisture Resistance Characteristics

3-4. Detection Performance of Each Sensor for Various Types of Liquids

[Test method]

Each type of liquid was put into a different pipette, dropped onto the sensor at the rate of approximately 0.05 ml a second (in the case of pure water), and the detection volume was measured at a detection level of 5 kΩ.

Table 4. Detection Performance of Each Sensor for Various Types of Liquids

Detector		Standard model		High-sensitivity model *3
Sensor		AD-S sensor AD-RS sensor	AD-FH sensor	AD-FH sensor
Testing solution		Detection volume (ml)	Detection volume (ml)	Detection volume (ml)
Pure water *4		4.30	13.10	0.20
Acid or alkaline *5	Hydrochloric acid (35%)	0.19	0.15	0.15
	Sulfuric acid (97%)	0.19	0.10	0.10
	Nitric acid (65%)	0.08	0.05	0.05
	Phosphoric acid (85%)	0.22	0.06	0.06
	Acetic acid (10%)	0.17	0.33	0.13
	Potassium hydroxide (10g/100 ml)	0.14	0.07	0.07
	Sodium hydroxide (20g/100 ml)	1.50	0.10	0.10
	Ferric chloride (39%)	1.54	0.07	0.07
Organic solution *5	Methyl alcohol	2.85	*6	1.10
	Ethyl alcohol	4.88	*6	0.78
	Acetone	12.36	*6	1.88
	Benzene	Detection disabled	Detection disabled	Detection disabled
	Toluene	Detection disabled	Detection disabled	Detection disabled
	Xylene	Detection disabled	Detection disabled	Detection disabled

*3: High-sensitivity AD-AS-1C-SR detector is used, which is affected by the humidity, depending on the length of the sensor. (For details, contact your Tatsuta representative.)
*4: Pure water is processed from tap water distilled and ion exchanged, the conductivity of which is 0.51 to 0.61 μs/cm (at 24°C).
*5: Each chemical used was a special-grade commercial product, the detection volume of which varies by the concentration. The quantity of solution dropped per second varies with the type of testing solution.
*6: The detection volume will increase in the case of detecting a liquid with a low electric conductivity. Therefore, use a high-sensitivity detector if you want to detect the liquid in a small quantity.

[Pure water]

The AD-S or AD-RS sensor detects pure water sufficiently. In the case of the AD-HS sensor (coloration model), the coloring agent will change the electric conductivity, thus making it possible to detect as little as approximately 2 ml of pure water.

[Acid or alkaline]

Acid or alkali corrodes the electrodes. Replace the electrodes after detection or use a chemical-proof model. (For details, contact your Tatsuta representative.)
NO2 will be generated if the concentration of nitric acid, if used, is 30% or over. Pay attention to the operating environment.
The AD-HS sensor cannot be used because the AD-HS sensor will not develop color in response to acid or alkali.

3-5. Coloration Sensors

The AD-RS and AD-HS sensors incorporate a coloration function in addition to the functions provided for the AD-S sensor.
The coloration model will not develop color under high-humidity environments.

Table 5. Functions of Coloration Sensors

Sensor	Function	Wet state	Dried state
AD-RS	Coloration return model	The absorbent part develops color.	The absorbent part returns to the original state.
AD-HS	Coloration model	The absorbent part develops color.	The color remains.

4. Water Leakage Detector 4-1.Water Leakage Detector Specifications

Table 6. Water Leakage Detector Specifications

	AD-AS-1AM	AD-AS-1BM	AD-AS-1CM	AD-AS-1C-SR	AD-AS-5DRM	AD-AS-5DRM
Number of circuits	1	1	1	1	5	10
Power supply voltage	100 to 240 V		100 or 200 VAC		100 to 200 VAC	
Power supply frequency	50/60Hz					
Sensor applied voltage	2.8 VAC max.	5.3 VAC max.	5 VAC max.	2.8 VAC max.	5.5 VAC max.	
Sensor short-circuit current	0.15 mA max.	0.13 mA max.	1.3 mA max.	0.15 mA max.	0.3 mA max.	
Water-leak alarm	Red LED blinks Buzzer sounds	Orange LED blinks			Red LED lights up Buzzer sounds	
Wire disconnection alarm	Green LED blinks Buzzer sounds	Orange LED blinks	―	Orange LED blinks	Red LED lights up Buzzer sounds	
Non-voltage output terminal rated load (resistive load)	250 VAC 6.0 A 24 VDC 6.0 A	250 VAC 1.5 A 24 VDC 1.5 A	125 VAC 1.5 A 24 VDC 1.5 A		125 VAC 0.4 A 30 VDC 2.0 A	
Power consumption	4.5 VA max.	3 VA max.	2 VA max.		12 VA max.	20 VA max.
Sensitivity adjustment	Yes					
Checking function	Yes	---			Yes	
Overall dimensions W x H x D (mm)	120 x 124 x 55	45 x 72 x 67			300 x 330 x 100	
Weight (kg)	Approx. 0.3	Approx. 0.12	Approx. 0.15		Approx. 0.5	
Box color	Ivory white	Gray			Light beige (5Y 7/1)	

*7 The above specifications are for standard models. Models can be custom made with the user's desired number of circuits incorporated. For details, contact your Tatsuta representative.

4-2. Basic Circuit Diagram of Water Leakage Detector (AD-AS-1AM with Single Circuit)

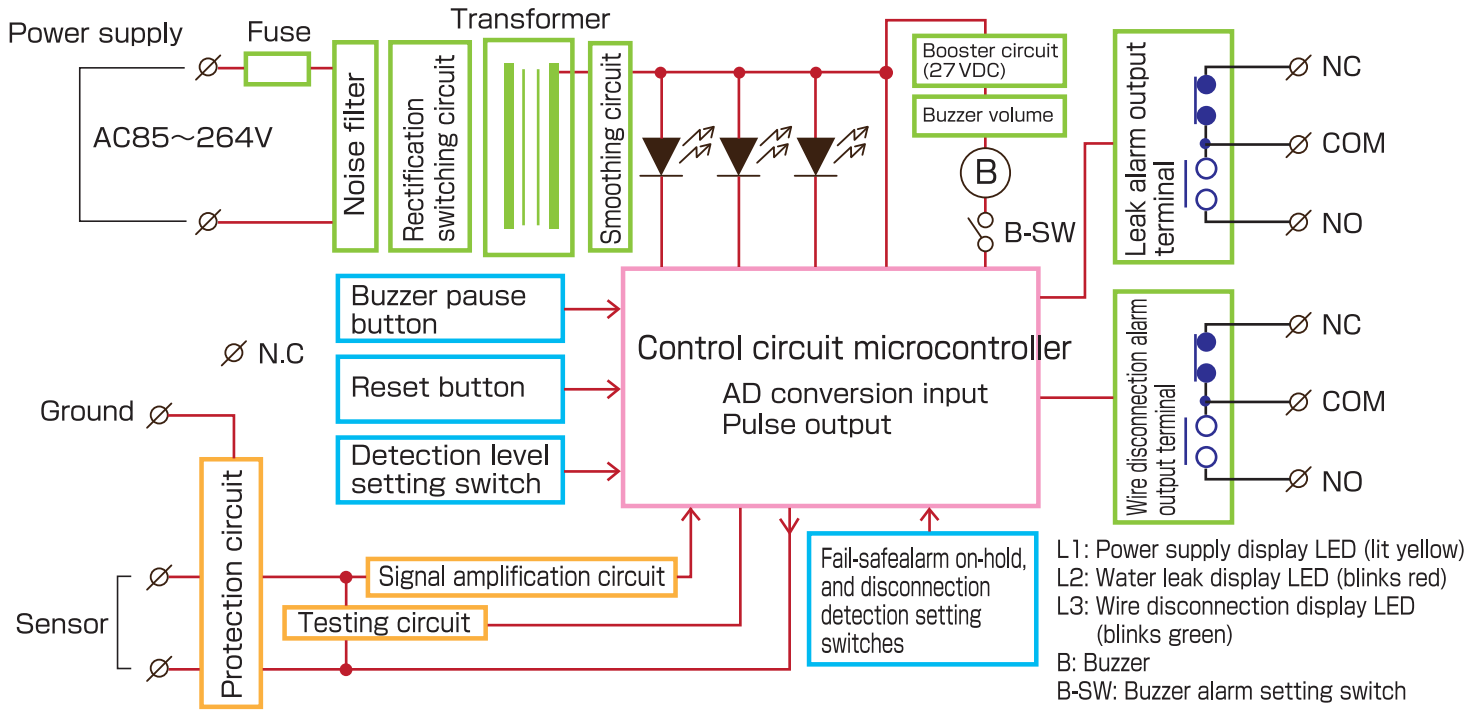


Figure 6. Basic Circuit Diagram of Water Leakage Detector (AD-AS-1AM with Single Circuit)

5. Installation Method 5-1. Precautions for Sensor Installation

(1) To ensure a stable detection level under high-humidity environments, make sure that each sensor line is within 100 m in length.

(2) Do not mount sensors in places where large quantities of dew condensation occur.

(3) Make sure that each sensor and the installation surface or sensing object is as close as possible and that the distance from each sensor to the horizontal installation surface, which may be a floor surface, is 2 mm or less and to the vertical surface, which may be a pillar or beam surface, is 1 mm or less.

(4) Although sensor electrodes are twisted-pair structure in order to suppress the influence of external electromagnetic induction, do not lay them in parallel with high-tension cables, such as power cables, for a long distance.

(5) If a sensor crosses over a power cable at 300 V or higher, install an insulated partition (e.g., a plastic mold) for the sensor.

(6) The sensor discolored at the time of detecting a water leakage will return to the original state when the sensor dries, provided that there are no electrically conductive contaminants in the water. If the above occurs, the sensor needs to be replaced. Therefore, adopt a layout method that allows ease of sensor replacement.

(7) The AD-HS sensor needs to be replaced after it detects water leakage and discolors. Therefore, adopt a layout method that allows ease of sensor replacement. Be sure to protect the installation area including the walls, ceiling, and floor properly because the colorant may flow and discolor them as a result of a water leakage. (The AD-RS sensor will not discolor them.)

(8) Make sure that the water leakage detector in use is of AC type in order to prevent the electrolytic corrosion of the sensor electrodes. (All Tatsuya's water leakage detectors are of AC type.)

(9) Sensors are not simple electric wires. Do not use them for applications other than water leak detection.

(10) Make sure to protect sensors from greasy substances, such as wax, or otherwise the sensors will repel water and not detect water leaks.

5-2. Precautions for Detector Installation

(1) The water leakage detector requires the following installation environments.
Install the water leakage detector in places that ensure ease of inspection and maintenance.
Temperature: -10°C to 50°C (with no icing)
Humidity: 45% to 85% (RH)

(2) Do not use the water leakage detector in places where vibration, toxic gas, or intensive electric induction is generated.

(3) Make an operational check according to the Operation Manual once a year.

(4) Do not use electrical outlets. Be sure to connect a fixed power line in order to prevent power failures causing the water leakage detector to be inoperable.

5-3. Sensor Mounting Brackets

Tatsuta provides stickers and pin saddles to mount sensors.

(1) Insulator sticker

Clean the place of installation with all dust and dirt removed, and fix the sticker with an adhesive seal. Install the sensor as shown below, bend the specified part, and secure the sensor.

(2) Stainless steel sticker

Clean the place of installation with all dust and dirt removed, and fix the sticker with an adhesive seal.

Secure the sensor as shown below. (The AD-HS sensor cannot be used.)

(3) Pin saddle

Fix the sensor to the groove of the pin saddle, hammer in the pin, and secure the sensor. The pin saddle is suitable for sensor installation to concrete surfaces (e.g., wall and ceiling surfaces).

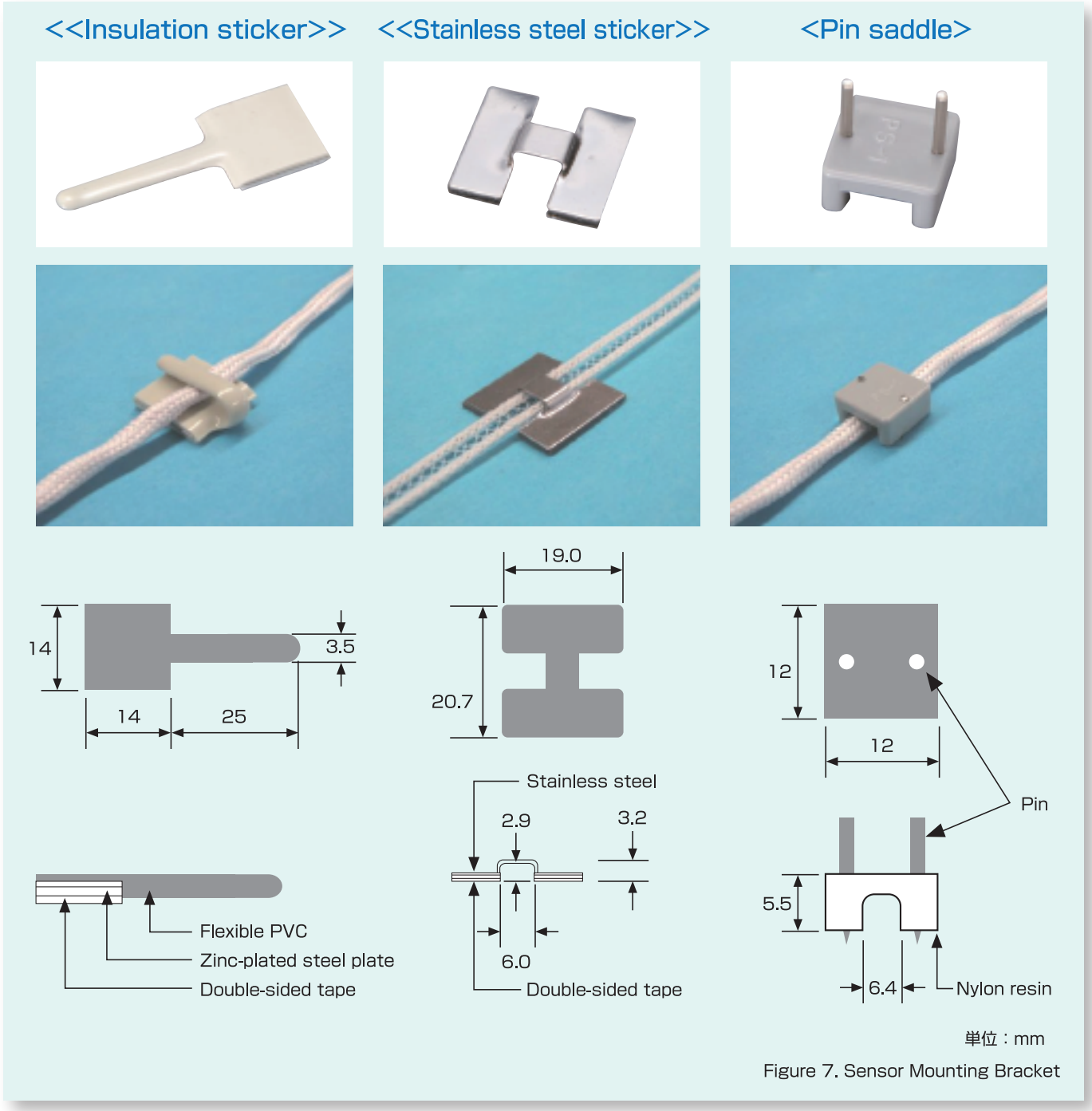


Figure 7. Sensor Mounting Bracket

5-4. Sensor Installation

(1) Sensor installation to floor surface

Clean the sensor and the installation floor surface, secure the sensor at a maximum of 2-m intervals, and install the sensor so that the sensor comes in close contact with the floor surface.

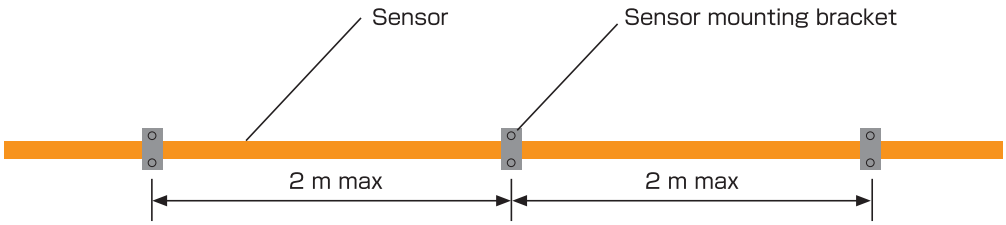


Figure 8. Sensor Installation to Floor Surface

(2) Installation to slope surface

In the case of installing a sensor to a slope, make sure that the sensor is right angled to the direction of the slope.

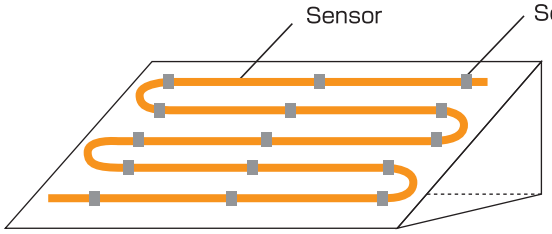


Figure 9. Sensor Installation to Slope Surface

(3) Sensor installation to door

Protect the sensor with a protection cover if there is a fear that people or objects step on the sensor.

Provide the protection cover with a clearance for the ingress of water.

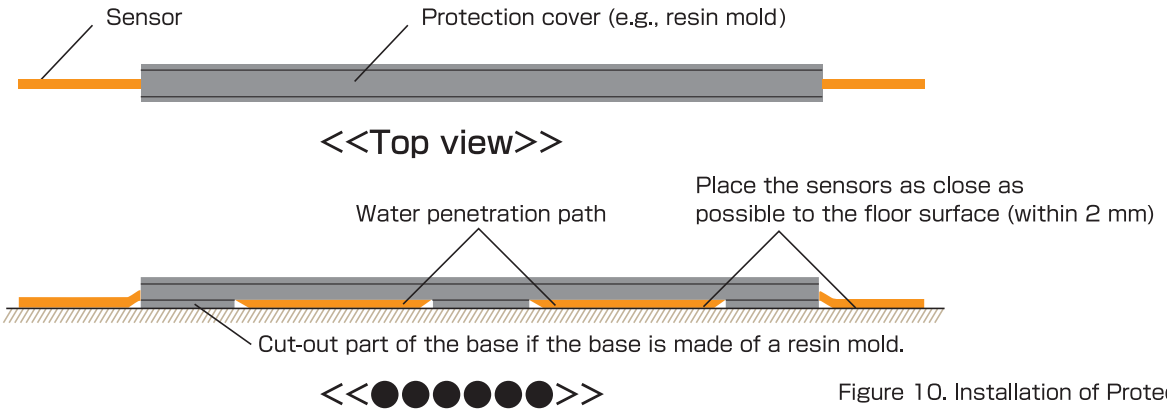


Figure 10. Installation of Protection Cover

(4) Sensor installation around air conditioner

Protect the sensor with a protection cover in order to prevent dust adhesion if the sensor receives the pressure of the wind blowing out of the air conditioner.

(5) Sensor installation to ceiling surface (wall, beam or pillar surface)
Secure the sensor at a maximum of 1-m intervals, and install the sensor so that the sensor comes in close contact with the installation surface.
Install the sensor around the wall, beam, or pillar within 100 mm of the lower surface of the ceiling slab.

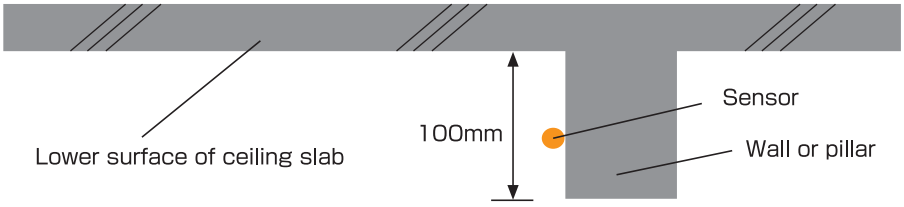


Figure 11. Sensor Installation to Ceiling Surface

(6) Sensor Installation inside pit (e.g., wiring pit)
Prepare two sensors, install and secure each of them at a maximum of 1-m intervals on each inner side of the pit (e.g., the wiring pit) within 100 mm of the floor surface if water penetrates from the floor.

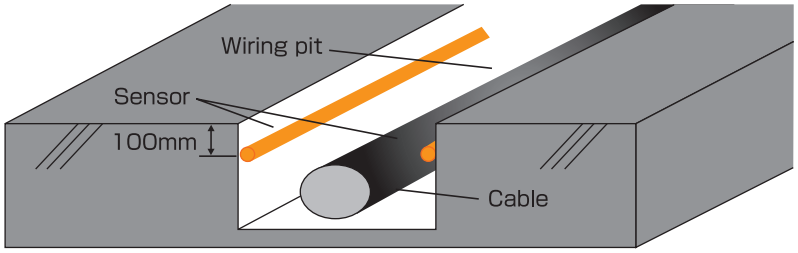


Figure 12. Sensor Installation inside Pit

(7) Sensor Installation along Conduit
In the case of installing the sensor to a vertical conduit, wrap the sensor to the conduit at a pitch within three times the pipe diameter.
In the case of a horizontal conduit, install the sensor along the lower part of the conduit.

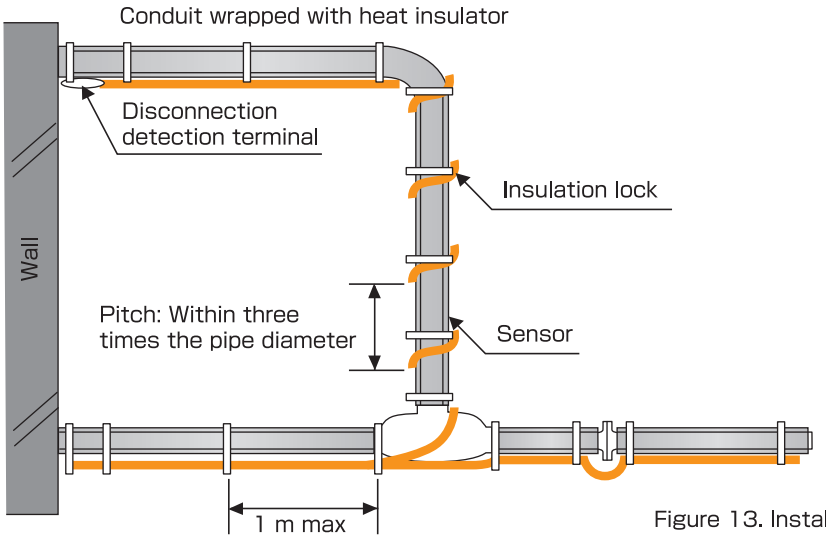


Figure 13. Installation along Conduit

5-5. Sensor Connection Method (Sensor and cable/Sensor and sensor/Sensor and Terminal)

(1) Use crimping sleeves for sensor connections.
(2) Insulate the sensor connections with vinyl tape or other appropriate material so that the sensor electrodes will not short.
(3) Protect the sensor connections in protection boxes, such as joint boxes.
(4) Connect one sensor per detector line (circuit). Do not connect any sensors in parallel to detector circuits.
(5) If you need a wire disconnection alarm for a detector with a function to detect wire disconnection, connect the disconnection detection terminal to the end of the sensor.

5-6. Connections of Water Leakage Detector and Sensors

The water leakage detector connects to sensors through standard instrumentation wires. Connect the detector and sensors through standard instrumentation wires as shown below for areas except for points where water leaks need to be detected. Connect one instrumentation wire per each detector line (circuit)

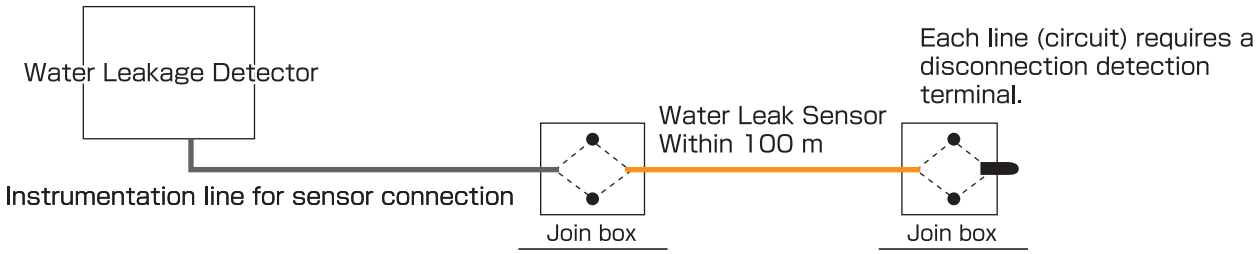


Figure 14. Connections of Water Leakage Detector and Sensors

Table 7. Instrumentation Wire Sizes Vs. Maximum Connection Lengths

Instrumentation wire size		Available connection length	Remarks
Solid wire	0.65 to 0.9 dia.	Within 100 m *8	CPEV and AE
Stranded wire	0.3 to 0.5 mm2		
Solid wire	0.9 dia. or over	Within 1,000 m *8	CPEV-S
Stranded wire	0.75 mm2 or over		

*8: Available connection length varies with the installation environment.
Use a shielded instrumentation wire if the connection length is 100 m or over. Otherwise, the line will be adversely affected by external interference, such as noise.

5-7. Electromagnetic Environment

(1) In order to suppress the influence of external electromagnetic induction, do not lay sensors or instrumentation wires in parallel with high-tension lines, such as power cables. Make a distance of at least 300 mm between the sensors and the high-tension lines if it is unavoidable to lay them in parallel.
(2) If the sensors or instrumentation wires come in contact with power cables or other cables that have an external electromagnetic influence on the sensors or instrumentation wires, lay the sensors or instrumentation wires crossed at right angles or keep a distance of 300 mm or over from the cables.

6. Inspection after Installation

(1) Visually check the condition of the water leakage sensors after installation and make sure that there are no abnormalities (e.g., the lifting, twisting, or disconnection of the sensors).
(2) Check that the detector has no errors after the power is turned on.
(3) Pour water onto the sensors and check the operation of the sensors.
(4) Make an operation check at least once a year.

<< Note >>