Matsushima
Matsushima Measure Tech

TMAL-001E
Rev3:Feb. 7, 2024

INSTRUCTION MANUAL
FOR
Admittance Level Switch

TYPE : MAL-110 / MAL-111 / MAL-120

Contents

Safety Precautions
1. Summary ・・・・・・・・・2
2. Measurement Principle ・・・・・・・・・2
3. Specifications ・・・・・・・・・3
4. Profile ・・・・・・・・・4
5. Mounting ・・・・・・・・・6
6. Connection ・・・・・・・・・8
7. Commissioning ・・・・・・・・・9
8. Maintenance ・・・・・・・・・１２
9. Troubleshooting ・・・・・・・・・１３

※The operator should read this Instruction Manual carefully and handle the device correctly.

Matsushima Measure Tech Co.,Ltd.

1-8-18 Norimatsu-Higashi, Yahatanishi-ku, Kitakyushu 807-0837 Japan
Phone No. (8193)691-3731 Fax No. (8193)691-3735
http://www.matsushima-m-tech.com

Safety Precautions

- Be sure to thoroughly read the instruction manual before using the products.
- Keep the instruction manual in a safe, convenient location for future reference.
- All or part of the contents described in this manual may be changed without any notice.
- Due to our constant striving for further improvement of products, parts or products that differ from those described in this manual may be substituted.

! WARNING (Failure to observe this WARNING may cause a fatal or serious injury.)

- Be sure to confirm that any peripheral equipment does not move before installation work.
  In addition, observe safety requirements for installation work where high-place work is expected.
- Be sure to turn off the power source before wiring, mounting and transportation work. (Failure to observe this WARNING may result in an electric shock/ injury or equipment damage due to short-circuit.)
- Carry out wiring work correctly with reference to a proper drawing.
- Never disassemble the equipment. (Failure to observe this WARNING may result in an electric shock.)
- Do not open the cover under an explosive environmental condition when power is entered. (Failure to observe this WARNING may result in an injury or equipment damage.)
- Do not place or store the equipment in any hostile environmental place where it will be subjected to direct sunlight, rain, water droplet, hazardous gas/water, etc..

! CAUTION (Failure to observe this CAUTION may cause a moderate injury or equipment damage.)

- Do not use the equipment for any purpose other than the original purpose of use.
- Be sure to confirm the specification of equipment and use the equipment within the range of specification. (Mounting conditions such as temperature, power source, frequency, etc.)
- Make sure a correct wiring before applying power source.
- Do not have a shock or strong impact to the equipment.
  (Failure to observe this CAUTION may result in equipment damage.)
- Be sure to connect necessary terminals (grounding, etc.).
- Remove all wiring to the equipment before doing electrical welding work near the equipment.
- Do not forcedly bend or pull the lead wire also do not use unnecessarily long wire.
- Tighten the cover, lead outlet, etc. properly so that dust, rainwater, etc. do not enter inside the equipment.
- Do not use the equipment under a corrosive condition (NH_3, SO_2, Cl_2, etc.).
- Be sure to tighten the cable grand so that outer air does not enter inside the equipment.
- When applying piping connection such as conduit, etc. instead of cable grand, apply putty or equivalents on the cable entry so that outer air does not enter inside the equipment.

! IMPORTANT (indicates notes or information to help customers.)

Limitations of Warranty:

- Warranty period shall be one year from the date of delivery (ex-factory).
- Any damage of any other products that have occurred for use of the equipment is not covered by this warranty. Also any loss induced by failure or malfunction of the equipment is not covered by this warranty.
- Failure or malfunction caused by following are not covered by this warranty:
  a. Modification or repair by a party other than MATSUSHIMA's authorized personnel, or replacement of parts not recommended by MATSUSHIMA.
  b. Inadequate storage, installation, use, inspection or maintenance that does not comply with specifications.
  c. Cause for any peripheral equipment or device.
  d. Accident beyond control and force majeure (fire, earthquake, flood, riots, etc.).

Lack of instructions to MATSUSHIMA for information or safety requirements that can be predicted only by customers' side.
This warranty conditions do not limit customers' legal right.
Price for the equipment does not include any charge for services such as commissioning, supervising, etc..

1. Summary

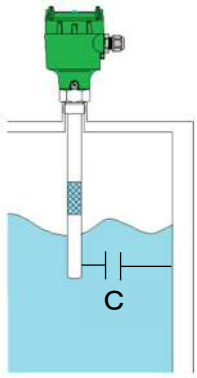
The admittance level switch can be applied to screening and detection of particulates like as grain in powders, and fluid storage level, is mainly used to detect the highest level and the lowest level of storage tank.
This level switch has the side mounting on tank wall and the vertical mounting on tank top, and runs whether the sensing electrode is covered by storage material.
Also this is quite different from a normal capacitance level switch, has a special structure which is hardly affected by adhesions on the ground electrode faces.

2. Measurement Principle

Admittance (Y) is generally known as the inverse of impedance (Z), and shows the following Relational expression;

Formula : Y = 1/Z

And, relations of the capacitive admittance upon presence or absence of a measured object in the actual measurement environment will be as follows;



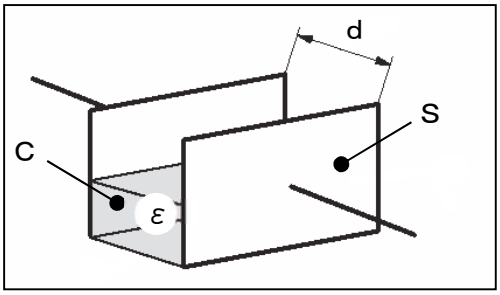
(In case of C as a measured object capacitive;)
Yc : Capacitive admittance
Zc : Capacitive impedance
C : Capacitance (Measured object capacitive)
Yc = 1 / Zc = jwC
# j : Imaginary, w: AC angular frequency
C is bigger, Yc becomes bigger.

Fig. 1 Admittance and Measured Object Capacitive

This is the physical property of electric condenser and the admittance mode switch detects a storage level based on this.
This condenser is composed with the detection electrode and ground electrode, or storage material and tank wall.

【What is Capacitance?】

Capacitance is certainly created between two conductors set in space, its capacity will be decided by a distance between the two conductors, a figure and a space property.



$C = 0.08855 \varepsilon S / d$

C	: Capacitance (pF)
0.08855	: Constant (F / m)
ε	: Relative permittivity
S	: Electrode area (cm^2)
d	: Distance between electrodes (cm)

Fig. 2 About Capacitance

Tank wall made by metal connected with the detection electrode and the ground electrode or the earth terminals, is equal to the condenser plate, the measured object becomes a dielectric.
If an electrode does not contact with the measured object, the air becomes a dielectric (Relative permittivity = 1) and a condenser capacitance shows smaller value.
If an electrode contacts with the measured object, a condenser capacitance increases corresponding to a relative permittivity (Oil = 2, Water = 81) of storage material.
Admittance level switch has basis of inputting these changes of condenser capacitance into the detecting circuit and outputting signals.

◆ Rod type
Style: MAL-110
This is a type to adjust for a length to the specified L dimension
Detecting the highest or the lowest level setting it on tank wall or top will be available.

◆ L dimension variable type
Style : MAL-111
This is a type allow you to change the L dimension later.
(The shape of the product is the same as the rod type)
Detecting the highest or the lowest level setting it on tank wall or top will be available.

◆ Wire type
Style: MAL-120
This is a type to adjust for a length of wire-rope to the specified L dimension.
Detecting the high limit hanging it from tank top will be avalable.

3. Specifications

Table 1. Standard Specification

Style	MAL-110	MAL-111	MAL-120
Product type	Rod		Wire
Power	AC/DC22 to 264V 50/60Hz		
Power consumption	4.7W(AC) 、1.8W(DC)		
Material	Housing : ADC12 (Aluminum casting) Boss : SUS304 Ground electrode : SUS304 Insulator : PTFE Wire-rope : SUS304 (MAL-120 only) Detection electrode : SUS304 Sealing material : VMQ、FKM		
L Dimension	0.25m to 2m	0.3m to 1m	0.7m to 6m
Mounting	R1 Screw		JIS5K65A Flange
Lead inlet	2-G1/2		
Detection (Range)	Range 1 : 0-10pF Range 2 : 0-50pF Range 3 : 0-100pF Range 4 : Special subsutance *1		
Delay time	Max. Approx.10s		
Strength (Lateral load)	Max. 500N		――――――
Allowable tension load	――――――		Max.4500N
Allowable pressure	Max. 1.5MPa		Max. 0.5MPa
Output signal	SPDT × 1 Contact capacity : AC250V/DC30V 5A		
Operation indicator light (LED)	Green lighting on undetected. Red lighting on detected		
Ambient temperature	-20℃ to +60℃(No freezing)		
Detection temperature	-40℃ to +150℃(No freezing)		
Protective structure	IP67(Tightening of cover and lead inlet)		
Mass	Approx.2.0kg (L=250mm)	Approx.2.1kg (L=300mm)	Approx.4.6kg (L=700mm) (0.23kg/m)

*1) Conductivity substance or Substance including many water.(Carbon black and Mud, etc.)

4. Profile

◎Rod type

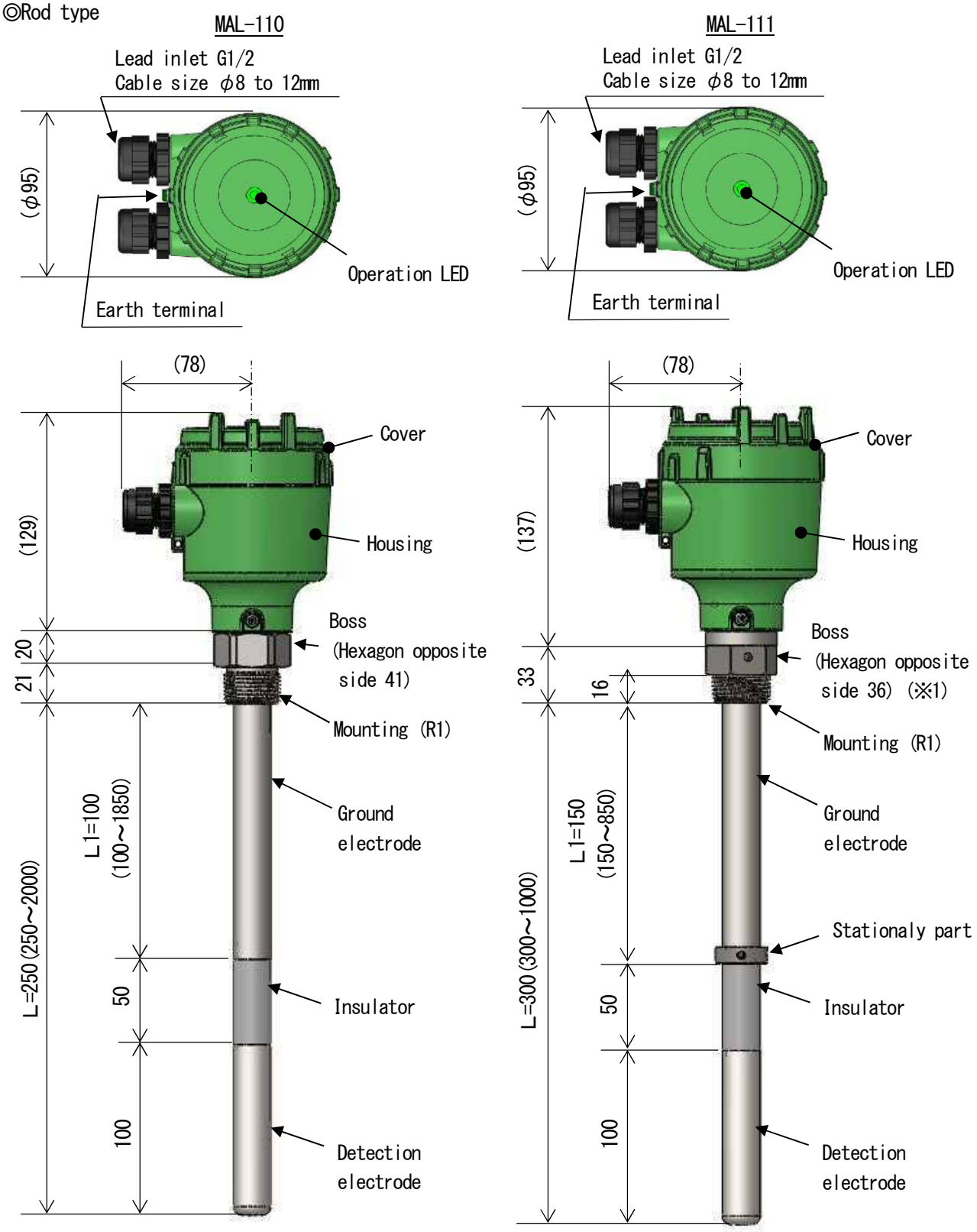


Fig. 3 Standard Dimensions

(※1)

The boss is fixed with set screws(3 locations),and it is possible to move the boss up and down by loosening the set screws.

You can change the L dimension by moving the boss up and down.

【Note】

When changing the L dimension, make sure that the ground electrode protrudes at least 20mm inside the silo.

After changing the L dimension, be sure to tighten the set screw.

◎Wire type

MAL-120

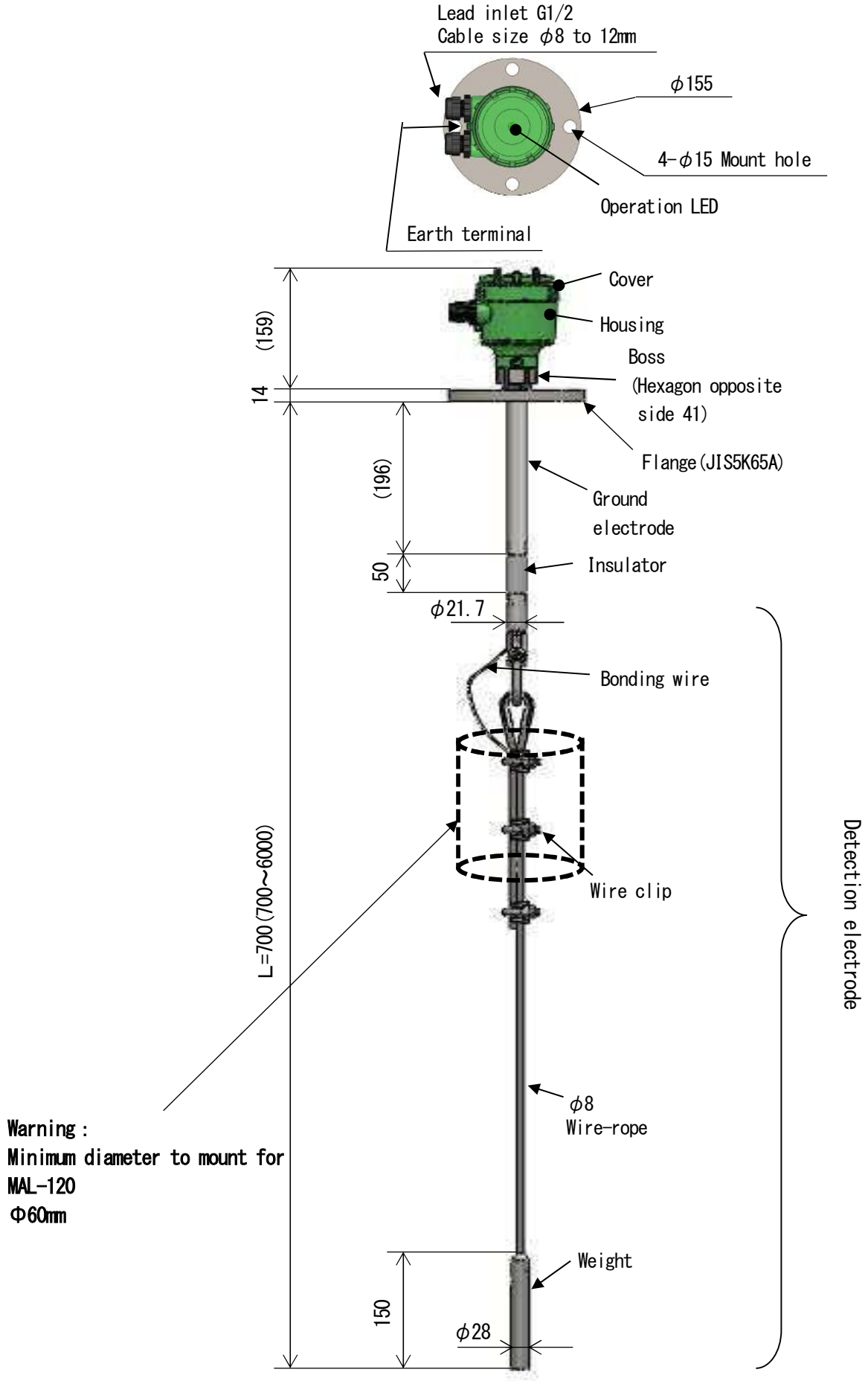


Fig. 4 Standard Dimensions

5. Mounting

5-1. Mounting Device

Screw a "Boss (Hexagon portion)" in a thread part with a spanner, after sealing treatment on it by tapes, to mount the devices.

⚠ Warning: Do not screw a housing part.

⚠ Be sure to take the ground of equipment.
If the equipment isn't grounded, the detection will not be stable.

5-2. Protection of Electrode Part

Mount an electrode part not to impact by hitting with loading powders.
Take action to prevent any hitting with the protection plate, because an electrode could damage by direct hitting with loading material.
Keep a distance between the electrode and the protection plate more than 200mm.

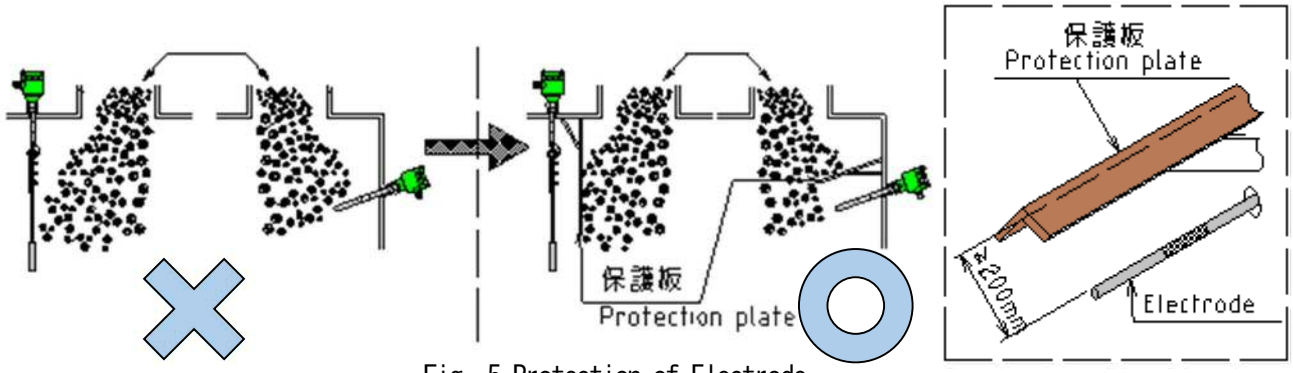


Fig. 5 Protection of Electrode

5-3. Position of Ground Electrode

Set a ground electrode in the silo bolting out more than 20mm.

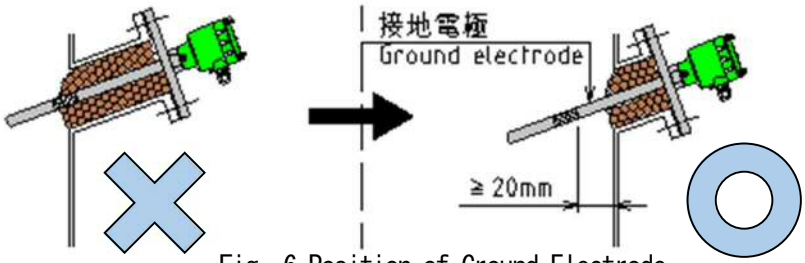


Fig. 6 Position of Ground Electrode

5-4. In Case of Use on Side Mounting;

Mount a device with inclination angle of over 20° .
Load to an electrode can be reduced when removing.

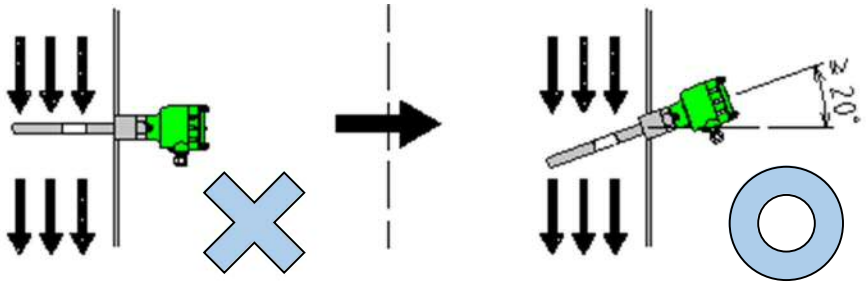


Fig. 7 In Case of Use on Side Mounting

5-5. If mounting two or more devices, keep an each distance of over 300mm among the devices, and from the tank wall face.

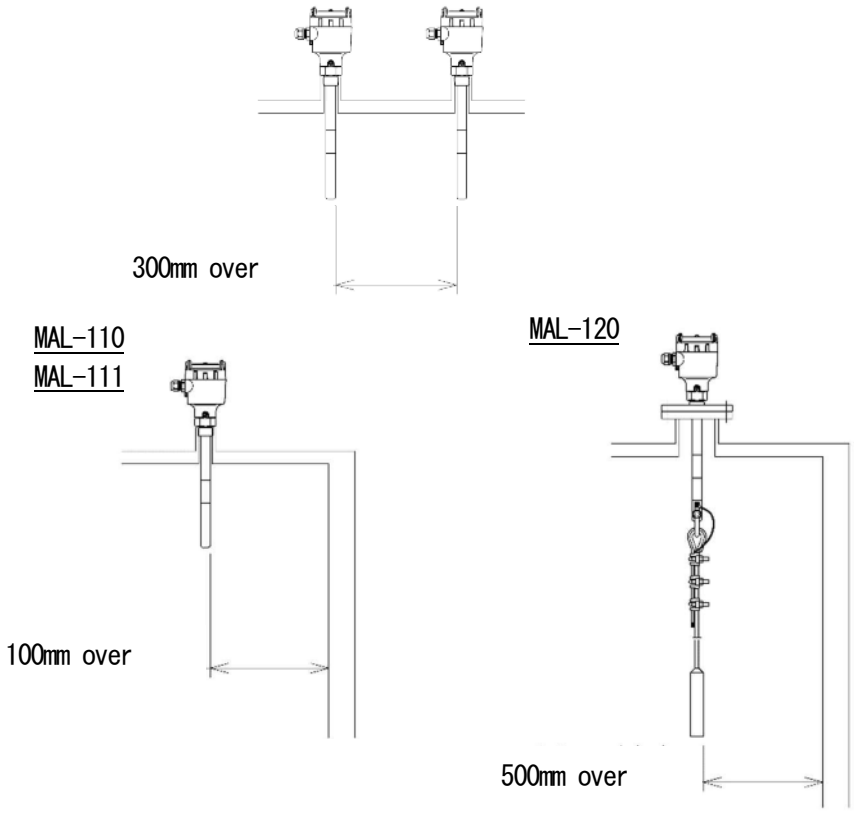
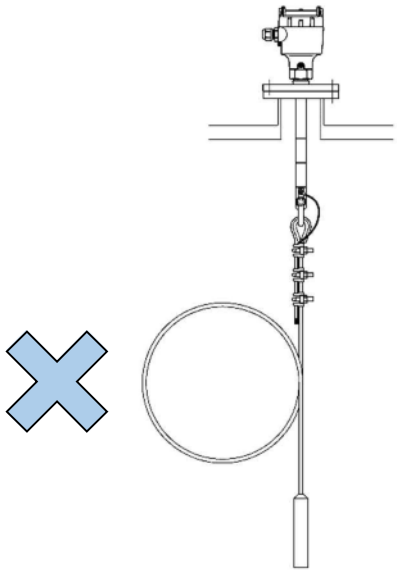


Fig. 8 In Case of Mounting a number of devices, and Distance from the Tank Wall Face

Please avoid the establishment which rounded a wire rope and use.

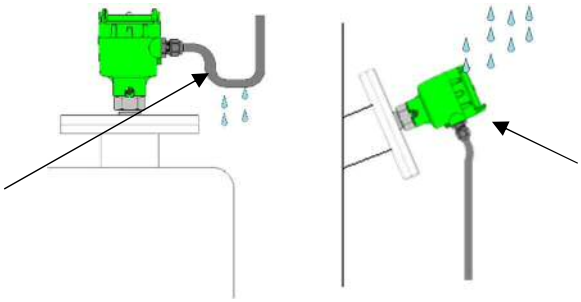
⚠ It'll be contact with a silo wall and the adherent cause of the measurement thing.



5-6. Waterproof Measures

Keep a situation of the housing as Fig. 9, to prevent water influx.
The housing can be turned in a range of approximately 310° .

This is a situation of warping cable to below preventing rain drops influx.



This is a situation of setting the lead inlet to a downward direction.

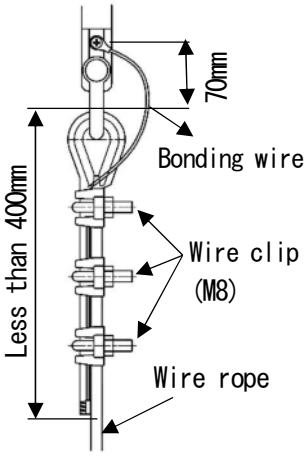
Fig. 9 Sample of Waterproof Measurement

5-7. Adjustment of Wire Length (MAL-120 only)

Adjusting a wire length from bottom of the flange is available.
(Allowance of adjustment : Approx. ±100mm)

Method of Adjustment

1) Ease three points of the wire clips of ϕ8.
2) Adjust a length of the wire-rope from bottom of the flange.
3) After adjusting a length, fix the wire-rope and bonding line with the wire clips on three points again.



6. Connection

Row of the terminals is as the following Fig. 10.

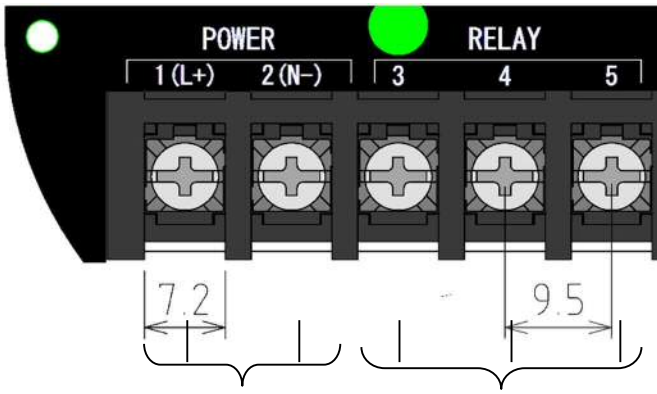


Fig. 10 Row of the Terminals

⚠ Warning : The terminal screw size is M3.5, the suggested wire size is 1.25mm² .
Clamping torque: 0.8～1.2N·m
Contact operation is instructed in the "7. Trial Run, Fig. 15" .

⚠ Note : The terminal screws are not available to remove because of a screw-up type terminal block.

7. Commissioning

Below figure is the display panel.

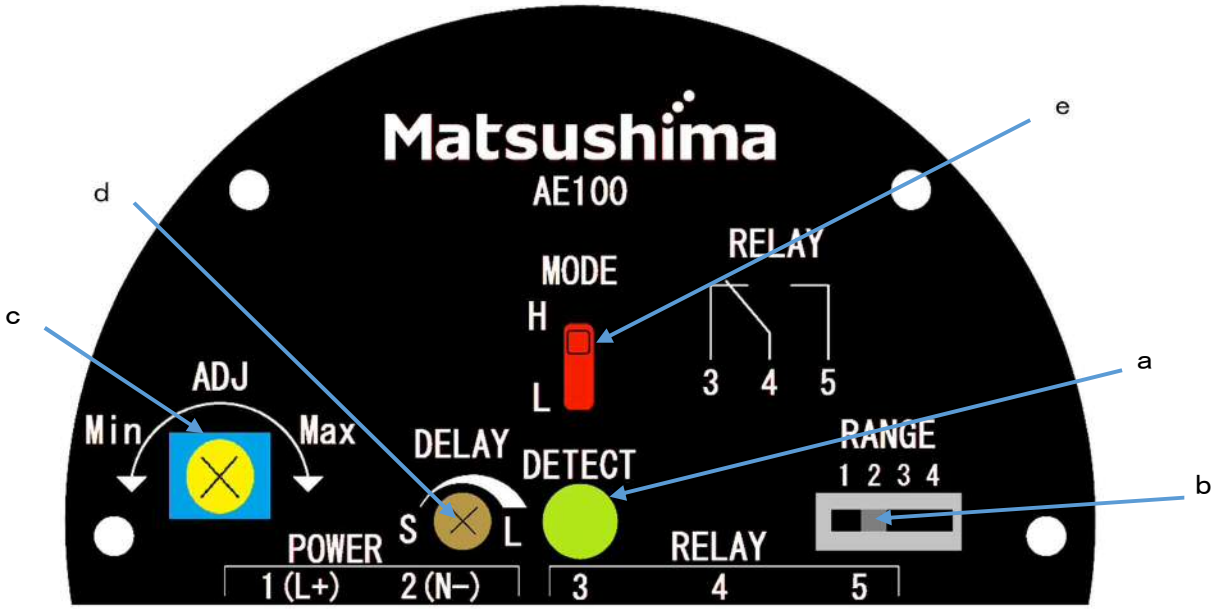


Fig. 11 Display Panel

Name and Function of Each Part

a DETECT ・・・ Operation LED

Red lighting on detected. Green lighting on undetected.

b RANGE ・・・・ Range switch【Factory setting : 2】

Specifying a detecting range to select.

If selecting a narrow range, detection sensitivity becomes sensitized.

Range1 : 0～10pF, Range2 : 0～50pF, Range3 : 0～100pF

Range4 : Special subsutance *1

*1) Conductivity substance or Substance including many water (Carbon black and Mud, etc.)

c ADJ ・・・・・ ADJ Volume【Factory setting : 8】

Specifying a detecting level.

If turning to maximum volume, a detecting level goes down and becomes easy to detect.

(Low "Min" ◀▶ "Max" High)

d DELAY ・・・・ ON／OFF Delay volume【Factory setting : O】

Specifying a delay time of the contact output and the LED lighting operation.

(Fast : Approx. 0.2s " S " ◀▶ " L " Slow : Approx. 10s)

e MODE ・・・・・ Detecting operation switch【Factory setting : H】

Selecting the highest "H" and the lowest "L".

7-1. Specifying Range Switch

According to a detecting condition of the object, specify a detecting classification using the range switch.

The classification has 4 varieties of High, Normal, Low and Ultralow.

The rule of thumb of range setting is different depending on relative permitivity of the measurement thing.

Table 2. Range Classification and Detected Width

RANGE	DETECTED WIDTH	CLASSIFICATION	RELATIVE PERMITIVITY
1	0-10pF	High sensitivity	0-8
2	0-50pF	Normal sensitivity	0-35
3	0-100pF	Low sensitivity	0-80
4	Special subsutance *1	-	-

Factory setting is [2].

*1) Conductivity substance or Substance including many water (Carbon black and Mud, etc.)

7-2. Specifying ADJ Volume

Factory setting is [8], which is around by a mounting situation.

If any changing of the object or the range classification, try to confirm it on a case-by-case basis.

Adjustable ranges of the volume are the number from [2] to [9], do not specify the number of [0] or [10].

7-2-1. Confirming Position of Maximum Sensitivity

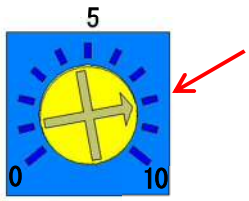
Confirm a empty tank (Electrodes are not contacting with the object).

After supplying power, confirm LED to be red lighting with full turning the ADJ volume clockwise to the number of [10] (Max).

Next, try to turn the ADJ volume counterclockwise between the numbers of [2] and [9], if any position which is green lighting where must be the maximum sensitivity position.

Meanwhile, in case of above with setting the MODE switch "H", the LED lighting color inverts with setting the MODE switch "L".

⚠ **Warning: If specifying the maximum sensitivity, to be subject to false positives because of attaching the object on electrodes.**



MODE Switch: H
In case of green lighting on the number of [8] with turning the volume counterclockwise from the number of [10];
The maximum sensitivity position must be [8].

Fig. 12 Sample of Max. Sensitivity Position

7-2-2. Confirming Position of Minimum Sensitivity

Confirm at a situation of loading the object to a detecting position in the tank.

At this moment, certainly the detection electrodes must be buried into the object.

Confirm a position the LED green lighting with turning the ADJ volume counterclockwise (Min.)

If not green lighting of the operation volume on the number of the ADJ volume [0], the position must be [0] at the moment.

Next, try to turn the ADJ volume clockwise between the numbers of [2] and [9], if any position which is red lighting where must be the minimum sensitivity position.

The minimum sensitivity position changes upon physical property of the object

and the range classification.

Meanwhile, in case of above with setting the MODE switch "H", the LED lighting color inverts with setting the MODE switch "L".

⚠ **Warning: If specifying the minimum sensitivity, to be subject to false positives because of attaching the object on electrodes.**

MODE Switch: H
In case of red lighting on the number of [2] with turning the volume clockwise from the position of green lighting;
The minimum sensitivity position must be [2].

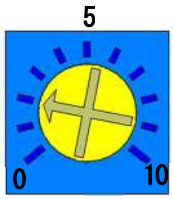


Fig. 13 Sample of Min. Sensitivity Position

7-2-3. Deciding Position of Standard Sensitivity

Middle between the positions confirmed in 7-3-1. and in 7-3-2. must be the standard sensitivity position.
Complete specifying the number of the standard sensitivity position.
Check that distance of two numbers confirmed in 7-3-1. and 7-3-2. Should be more than one number.
If the distance is less than one number, operation is not available to use because of unstable action.

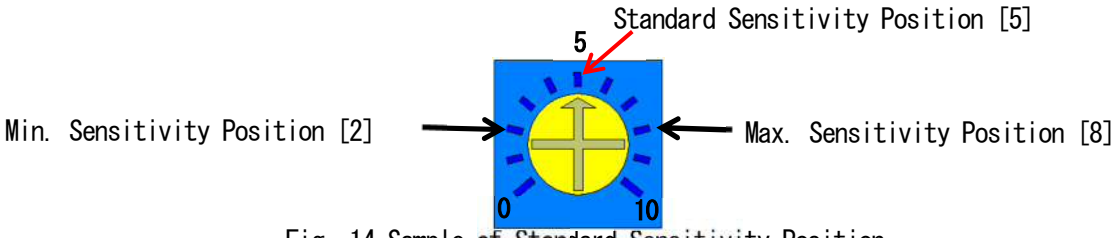


Fig. 14 Sample of Standard Sensitivity Position

7-2-4. Confirming Operation

Confirm whether adjusting the sensitivity rightly, unloading the object in the tank.
Complete the adjustment, if green lighting on the operation LED under a situation of electrodes separating from the object.
(If specifying MODE switch "L", LED lighting color becomes red.)

7-3. Specifying Delay Volume

Adjusting a delay time to prevent chattering relay is available.
Turn the delay volume clockwise (L) to delay a response speed.
Setting of a delay time in maximum approximately 10 sec. is available.
Factory setting is the number [0].

7-4. Specifying Detecting Operation Switch

With specifying the switch, and work to specify the highest contact output and the lowest contact output operations, the specified operating chart for contact and LED operations is as below.

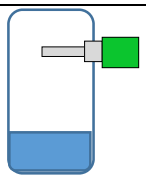
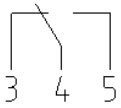
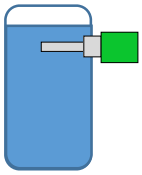
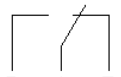
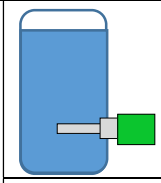
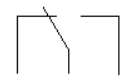
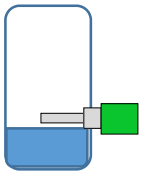
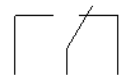
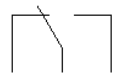
MODE Switch	Detecting	Contacting	LED Operation
H. Mode (Highest Limit Detection)			
			
L. Mode (Lowest Limit Detection)			
			
If Power OFF	All Situations		

Fig. 15 Operating Chart

8. Maintenance

Routinely perform a cleaning of electrodes using some waste cloths.
Maintenance frequency is different upon detecting objects and detecting environments, keep a routine cleaning according to situations.
Perform a cleaning when supply power is OFF.

9. Troubleshooting

If not recovered by the measures in below table, please try to contact us.

Table 3. Troubleshooting

Occurrence	Probable Cause	Measures	Reference
Not lighting on operation LED.	Not supply power.	Supply power.	
	Supplying power out of specifications.	Supply power within specifications.	P.3 Paragraph 3
(Undetected) H. Mode : Not red lighting on operation LED. L. Mode : Not green lighting on operation LED	Detection electrode is not buried into powders.	Relocate level switch to position where detection electrode is buried into powders.	
	Specified sensitivity is getting lower. (Setting [9], not changing on operation LED.)	1. Specify [7] turning ADJ volume. 2. Slide range switch one-by-one to left direction until red lighting on operation LED. 3. Specify ADJ volume.	P.10,11 Paragraph 7-2 and 7-4
(Keeping detection) H. Mode : Continuing red lighting on operation LED. L. Mode : Continuing green lighting on operation LED.	Object is attaching on detection electrode.	Remove object on detection electrode.	
	Detection electrode is buried into surplus.	Relocate to place for preventing surplus. Try measure to avoid surplus.	
	Specified sensitivity is getting higher. (Setting [2], not changing on operation LED)	1. Specify [4] turning ADJ volume. 2. Slide range switch one-by-one to right direction until green lighting on operation LED. 3. Specify ADJ volume.	P.10,11 Paragraph 7-2 and 7-4

Specifications, designs and some others may change for improving our products without any notice.