

Instruction manual for Radar level transmitter Type:MWLM-FM79

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※The operator should read this Instruction Manual carefully

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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 supplied.
(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 forcibly 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 (NH3, SO2, Cl2, etc.).



IMPORTANT (indicates notes or information to help customers.)

Limitations of Warranty:

- Warranty period shall be one year from the date of shipment (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 accepted 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...

•Bluetooth wireless communication

What is Bluetooth?

Bluetooth is wireless communication technology between digital devices in relatively short distance by connection with a PC or a smartphone. No need to connect with devices by an USB cable, and wireless communication with data can be available at anywhere in short distance (within approx. 10m viewable area).

Available range for communication

Distance for Bluetooth communication is within approx. 10m viewable area. Available connection distance will be changed by any block of walls and metals, or around situation and building shape. Make sure of using no barrier place, as much as possible.

Security

Make sure that we do not have any responsibility for any case of data leaking. We recommend setting the password due to higher security.

Refer to the “Instruction manual for an app of Reader level transmitter” for setting the password. If the password is set up, Reader level transmitter will be locked and parameters including other specifications will not be available to be changed. We recommend that the password must be updated routinely for higher security.

Product approvals

A license from radio station to use in some countries is not required because this product has been approved to use in these countries upon Radio Act as the wireless system for power saving data communication. However, breaking, remodeling, and removing nameplate may be punished.

Usable frequency and handling instructions

Usable frequency of Bluetooth (range 2.4GHz) will be used for in-house radio stations (license required), specified low power radio stations (no license required) for mobile facilities in factory at fields of household appliances, industry, science, medical devices and mobile detectors in factory, and amateur radio stations (license required).

1. Make sure of confirming no in-house radio station for mobile detector, specified low power radio station and any amateur radio station near before starting to use.
2. Keep a distance from any electric device as much as possible. If any harmful radio wave interference occurred, immediately cut the power supply to the device.
3. In case of strong radio wave from any radio station or wireless device, it may not be able to connect normally.
4. Please be sure that connection with Bluetooth will cause the battery of the connected device drains faster.

•Trademark/Software license

- The logo “Matsushima Measure Tech Co., Ltd.” is our brand and registered trademark.
- Copyright of “FM79 Smart Com.” is reserved by “Matsushima Measure Tech Co., Ltd.”.
- The Bluetooth and its logo are the registered trademark of Bluetooth SIG, Inc..

1. Overview

Radar level transmitter measures the level of powder and liquid material by the non-contact method, and it makes stable measurement by applying electromagnetic wave (radar).

This transmitter outputs the analog signal (DC4mA to DC20mA) directly on the transmitter power line.

This device transmits a higher frequency signal from the antenna corresponding to time passage. It measures with a suitable frequency which is given by phase detection using received signal reflected from the storage surface and transmission signal.

2. Specifications

Table 1. Specifications

Item		Specification					
Type		MWLM-FM79					
Version		S03	F03	S06	F06	S12	F12
Antenna		Lens					
Power supply (#1)		DC12V to DC36 V					
Power consumption		800 mW					
Mounting	Equivalent JIS10K100A flange with Swiveling mechanism	●	—	●	—	●	—
	Equivalent JIS10K80A fixed flange	—	●	—	●	—	●
Measurable distance(#2)	Min.	0.3 m		0.4 m		0.7 m	
	Max.	30 m		60 m		120 m	
Transmitting frequency		77 GHz to 81 GHz					
Beam angle(-3dB)		Approx. 4° (including side beam approx. 8°)					
Resolution		1 mm					
Accuracy (#2)		±3 mm		±5 mm		±10 mm	
Analog error		10 μA					
Measurement cycle (#3)		Approx. 0.4 s to 4 s (for DC24V)					
Temperature error		±6.4 μA/10℃, Max.±48 μA					
Ambient temp.(#4)(#5)		-20 ℃ to +80 ℃					
Process temp.(#6)		-40 ℃ to +200 ℃					
Allowable pressure(#7)		490 kPa					
Material	Housing	PBT					
	Flange	SCS14A (Equivalent to SUS316)					
	Antenna	PEEK					
Protection(#8)		IP67(Housing cover and lead outlet must be closed.)					
Air purge pressure (#9)		Flow approx. 200L/min(for 0.1MPa)					
Lead outlet		1-G1/2(Applicable size: ϕ8mm to ϕ12mm)					
Output signal		DC4 mA to DC20 mA					
Integral time		0 s to 999 s					
Mass		3.6kg	4.3kg	3.6kg	4.3kg	3.6kg	4.3kg
Bluetooth		5.0					

- (#1) No interfusion of noise surge with less 10% of ripple on power supply voltage for instrumentation.
Maximum load resistance depends on power supply voltage. Please refer Fig.1.
Make sure that wiring load will not over maximum load resistance value on applied power supply voltage.
- (#2) The range and accuracy of measurement must be over 2 of dielectric constant on the measuring medium facing even to antenna surface at normal temperature ($23^{\circ}\text{C}\pm 2^{\circ}\text{C}$) and without floating dust, steam, bubbling, form, barriers.
The range and accuracy of measurement will be changed out of the above conditions.
In case of less than 1.1m, the accuracy is $\pm 10\text{mm}$ (Ver. S03/F03) and $\pm 20\text{mm}$ (Ver. S06/F06/S12/F12).
- (#3) The measurement cycle depends on power supply voltage and output current value.
Please refer to Fig. 3.
- (#4) Make sure of no freeze and condensation in the housing inside.
- (#5) If ambient temperature is over $+70^{\circ}\text{C}$, the display will be OFF.
- (#6) In $+80^{\circ}\text{C}$ or higher process temperature, applicable ambient temperature is changed.
Please refer to Fig. 2.
- (#7) This is a pressure of balanced case of the ball of the flexible flange. If not balanced, its sustaining power will be weakened.
- (#8) If the lead outlet has some loosing cap and gap, the damage may occur with water intrusion. In case of using gas or steam, electronic devices may damage. Please be careful to use in above.
- (#9) Recommendable purge pressure is tank pressure $+0.1\text{MPa}$ (if 0.1MPa , approx. 200L/min).
Please adjust the purge pressure if it is not effective with the recommendable purge pressure.

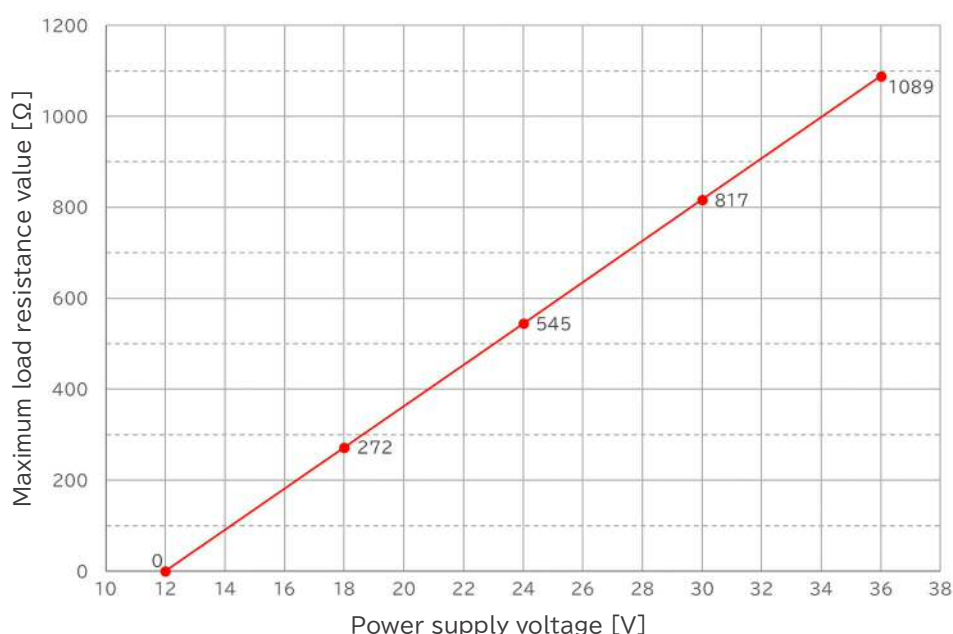


Fig. 1. Power supply voltage vs. Maximum load resistance

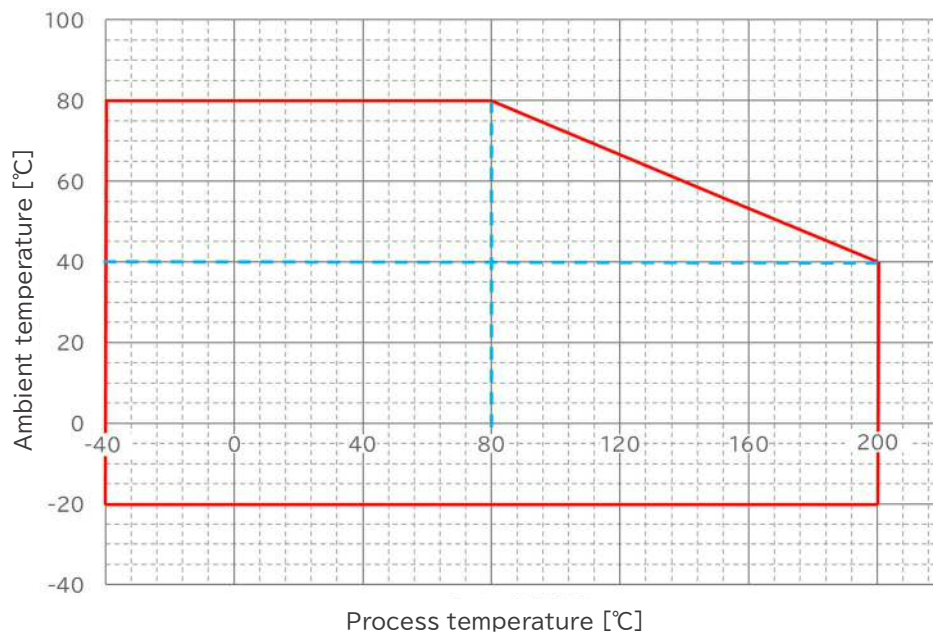


Fig. 2. Process temperature vs. Ambient temperature

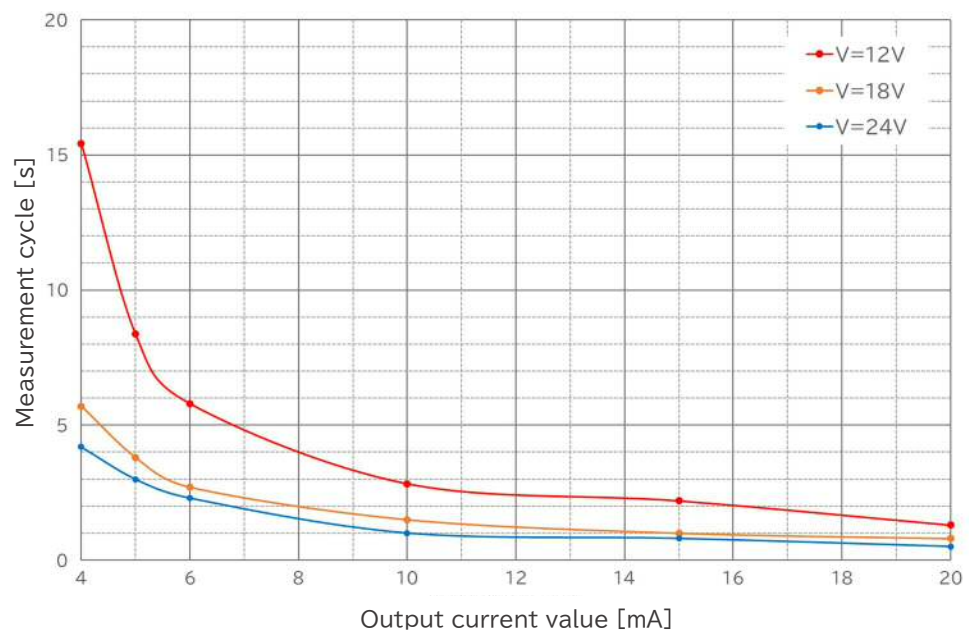


Fig. 3. Output current value vs. Measurement cycle
(Typical value)

3. System configuration

3-1. System configuration

This product is the 2-wire system with DC4mA to DC20mA signal on the DC power supply line.

- Supply voltage:DC12V to DC36V
- Output current signal:DC4mA to DC20mA
- Load resistance:Max.545Ω for DC24V

- Cable size:0.3mm² to 1.25mm²(AWG22 to AWG16)
- The earth terminal (D-class grounding) is no connection with the antenna.
- Use over 1.25mm² grounding wire.

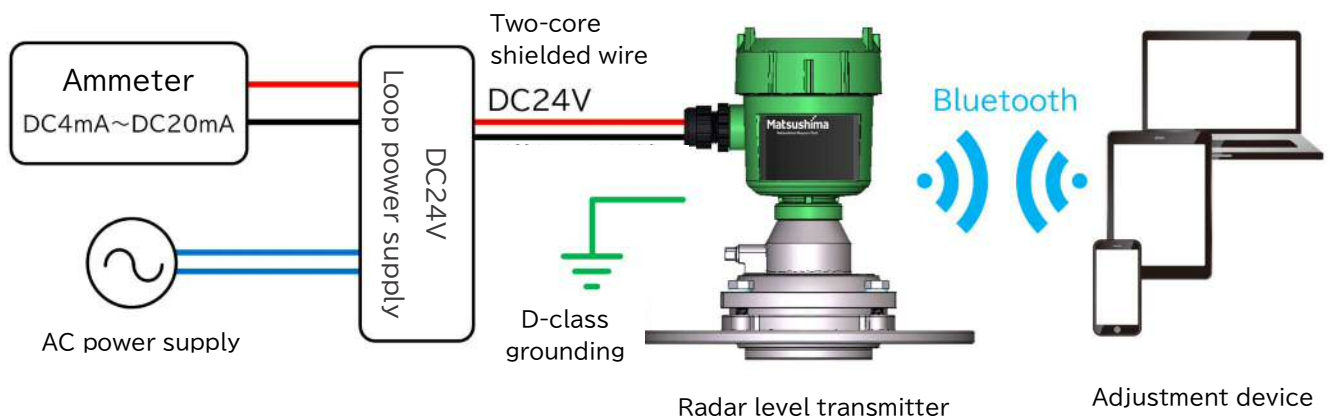


Fig. 4. System configuration example

⚠ Important

: For protection and safety of human body and the total system incl. Level Radar transmitter, comply with the safety instruction of this Instruction Manual at operation. If it is not operated in compliance with these instructions, we will not guarantee the safeness.

Further this Radar level transmitter has the structure and includes the components satisfying the safety requirement of electrical equipment and accordingly the modification without consultation is strictly prohibited.

: The products are designed for discrete wiring connected to current loop supply or isolated interface device and analog board.

If there is anything unclear about the other connection, please consult with us separately.

3-2. Adjustment device

Use adjustment device after installing the adjustment app “FM79 Smart Com.” on a PC, a tablet, and a mobile phone with Bluetooth.

Please refer the following data for installation and handling adjustment app;

- Instruction manual of app for Radar level transmitter

4. Dimensions

4-1. Swiveling flange : Version S03/S06/S12

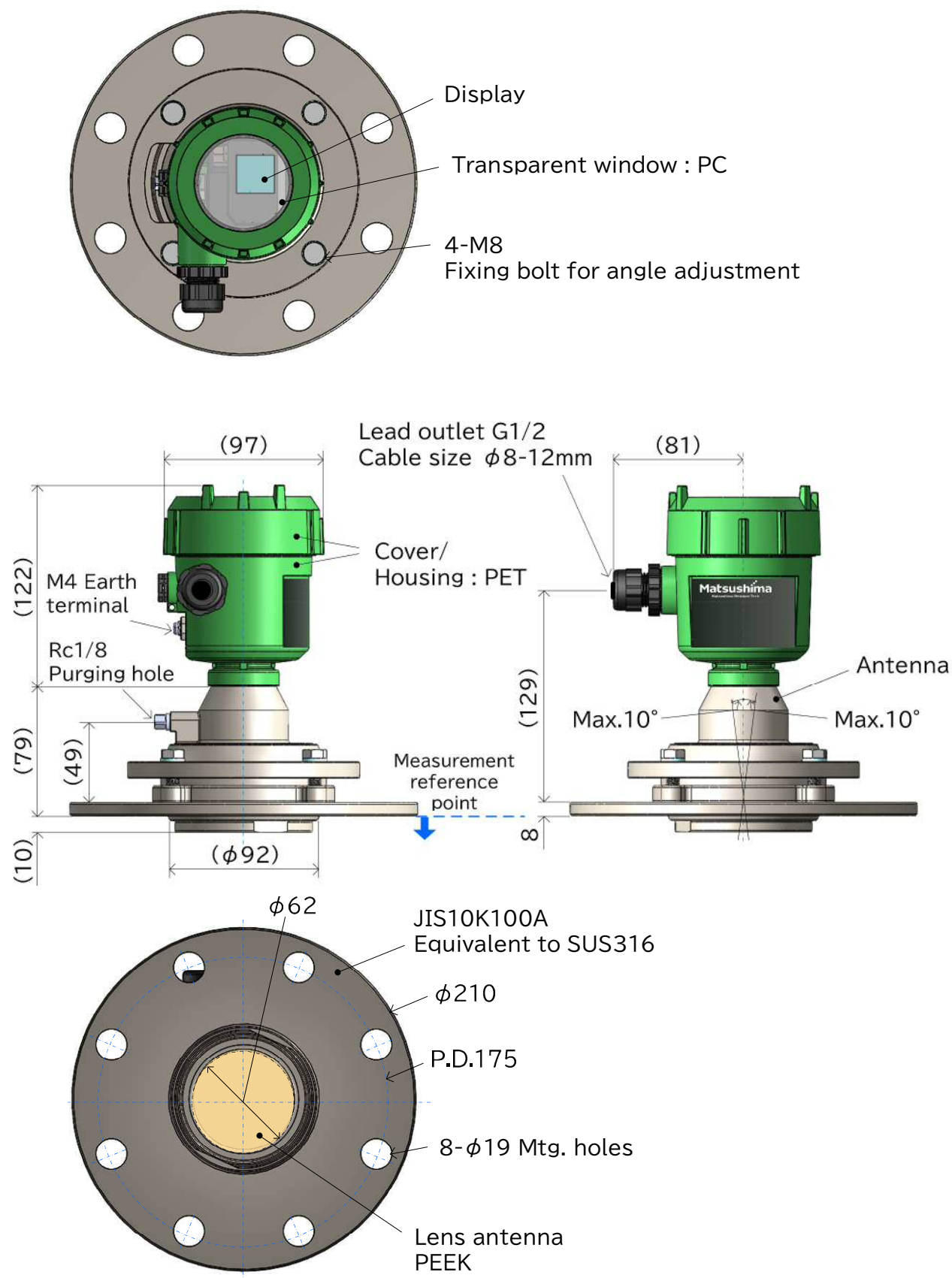


Fig. 5-1. Swiveling flange dimensions

4-2. Fixed flange : Version F03/F06/F12

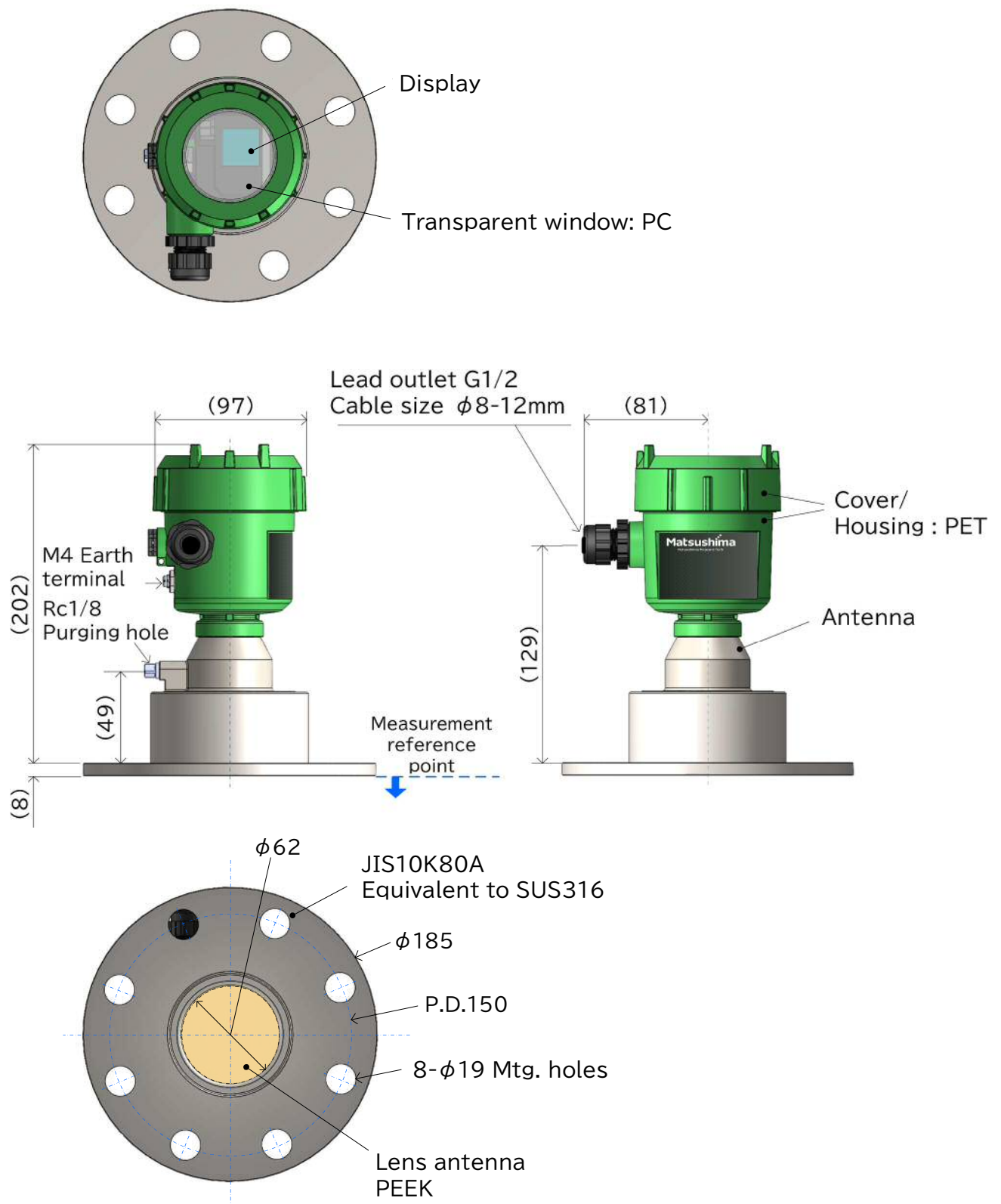


Fig. 5-2. Fixed flange Dimensions

5. Installation

5-1. Min./Max. measurable distance

In case of shorter measure distance than min. measurable distance (inside of dead zone), use an additional short pipe to keep the measured material out of dead zone.

Table 2. Min./Max. measurable distance

Version	S03/F03	S06/F06	S12/F12
Minimum	0.3 m	0.4 m	0.7 m
Maximum	30 m	60 m	120 m

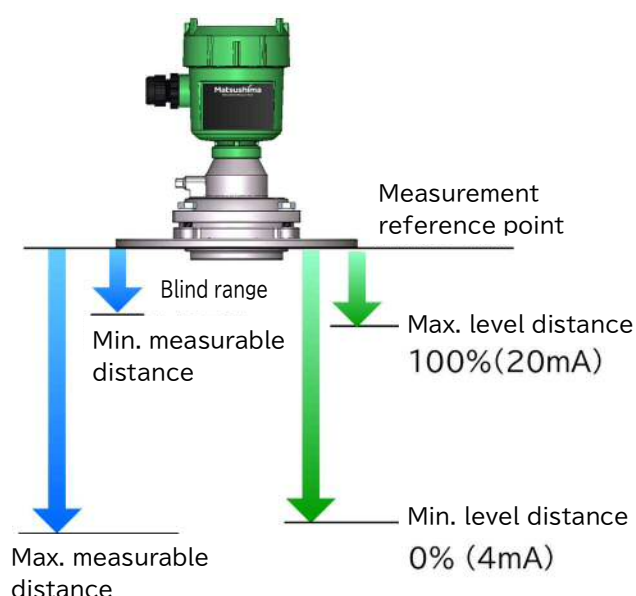


Fig. 6. Min./Max. measurable distance and Min./Max. measuring level

5-2. Size of short pipe

Use an additional short pipe if the measured material goes up to the dead zone. Do not use an unnecessary length of short pipe to prevent unstable measurement.

Install a short pipe not to leak electromagnetic wave from a gap for preventing noise.

Table 3. Recommendable short pipe size

Inner dia. ϕ	Max. length	
	Vertical mounting	Mounting angle 10°
$\phi 80\text{mm}$	150mm	-
$\phi 100\text{mm}$	250mm	50mm
$\phi 150\text{mm}$	600mm	150mm
$\phi 200\text{mm}$	950mm	250mm
$\phi 250\text{mm}$	1300mm	350mm

5-3. Range of radiation angle

Set instrument out of any obstruction with noise and keep clear in range of beam angle (including side beam).

Calculation of radiation angle extent

Beam angle range $X = \text{Distance from measuring point } H \times \tan \theta + \text{Antenna surface (62mm)}$

θ : Main beam = 4° , Side beam = 8°

$\tan \theta$: Main beam $\doteq 0.07$, Side beam $\doteq 0.14$

Example

When $H = 3000\text{mm}$ ($\theta = 4^\circ$: main beam)

$$\begin{aligned} X &= 3000 \times \tan \theta + 62 \\ &= 3000 \times 0.07 + 62 \\ &= 272 \text{ mm} \end{aligned}$$

When $H = 3000\text{mm}$ ($\theta = 8^\circ$: side beam)

$$\begin{aligned} X &= 3000 \times \tan \theta + 62 \\ &= 3000 \times 0.14 + 62 \\ &= 482 \text{ mm} \end{aligned}$$

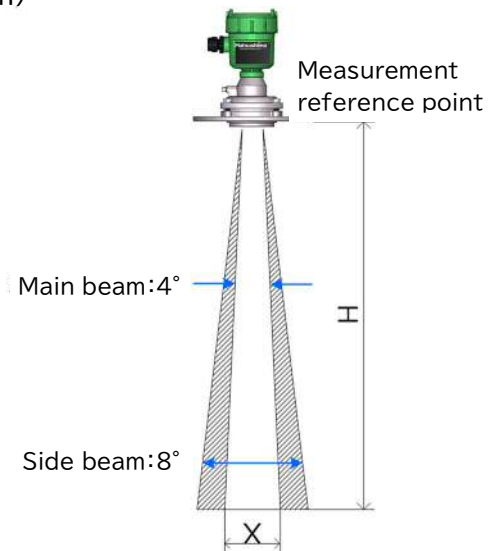


Fig. 7. Beam angle range

Table 4. Measuring distance and beam angle range

Measurement distance	10 m	30 m	60 m	120 m
Extent of main beam	0.7 m	2.2 m	4.2 m	8.4 m
Extent of side beam	1.4 m	4.2 m	8.4 m	16.8 m

5-4. Installation precautions

-If any beam or H-beam in the tank, please make a smaller risk of obstructive reflection with using a shield plate.

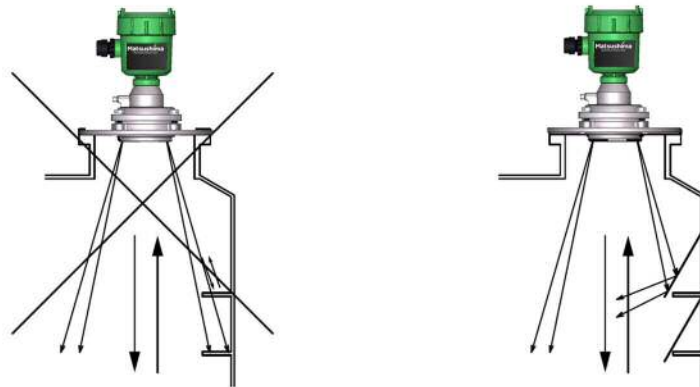


Fig. 8. Installation precaution (1)

-Do not install instrument close to inlet of material charging.

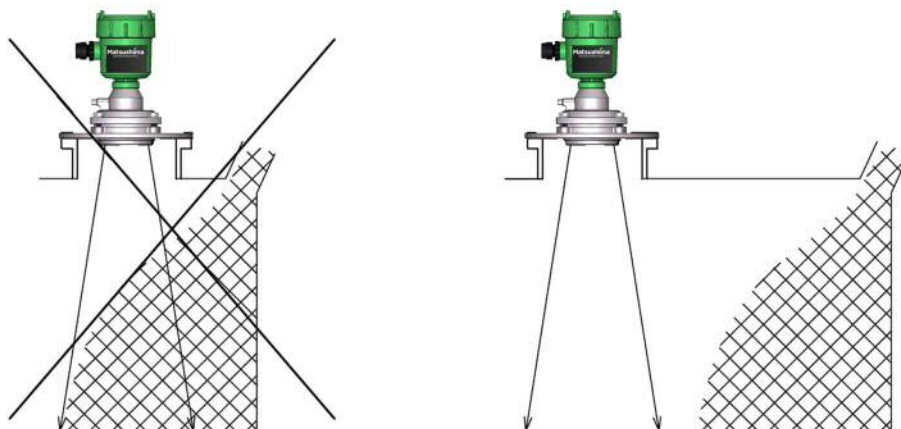


Fig. 9. Installation precaution (2)

-No obstruction with noise in range of radar beam.

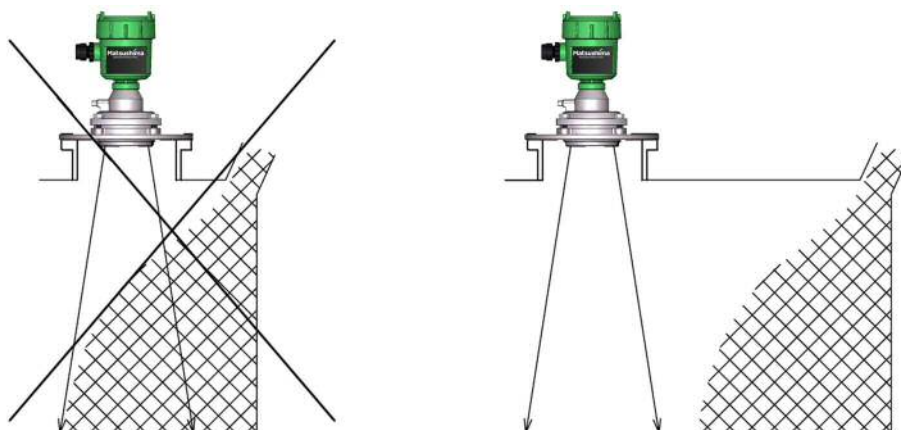


Fig. 10. Installation precaution (3)

- For liquid application, keep vertical position to material surface.

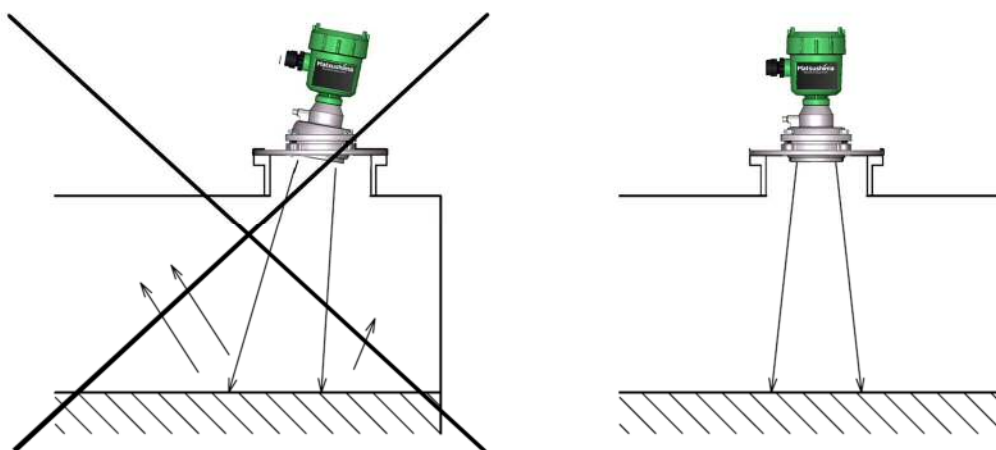


Fig. 11. Installation precaution (4)

(Noise reflection)

Noise reflections can cause inaccurate or unstable level measurement.

Noise reflection can be treated by adjustment app. In case of receiving no reflection or quite small dB from the material surface, the installed position must be changed.

If there is any such obstruction in the tank, please install the transmitter where there is no obstruction within the range of beam angle.



Important:

It is not possible to specify the range of false reflections in dB that can be suppressed by the learning function because the level of actual reflection from the surface of material depends on the Radar level transmitter installation conditions and measuring material type. The general guideline for the level of false reflections that can be suppressed by the learning function is one third ($1/3$) of actual reflection level.

-Install protection such as a simple roof above the Level Meter to avoid exposure to direct sunlight.

Use a well-ventilated cover as simple roof.

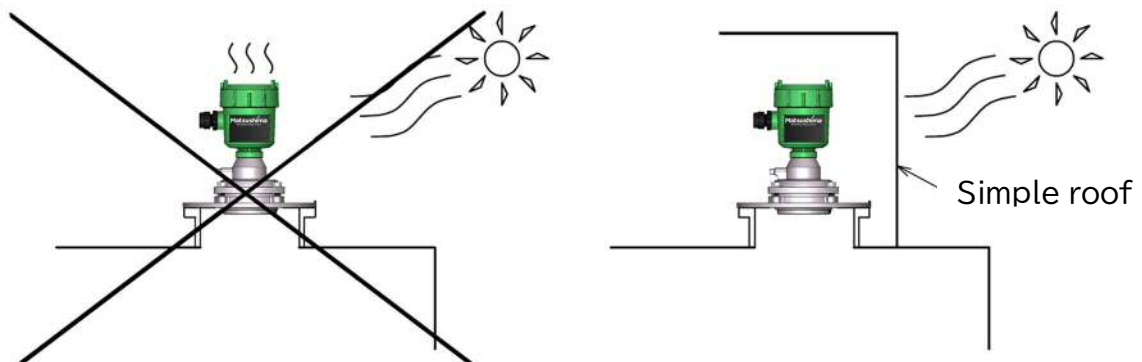


Fig. 12. Installation precaution (5)

6. Wiring

6-1. Remove the cover. (Turn counterclockwise)

6-2. Terminal inlet will open after inserting a flathead screwdriver into the terminal block lever.

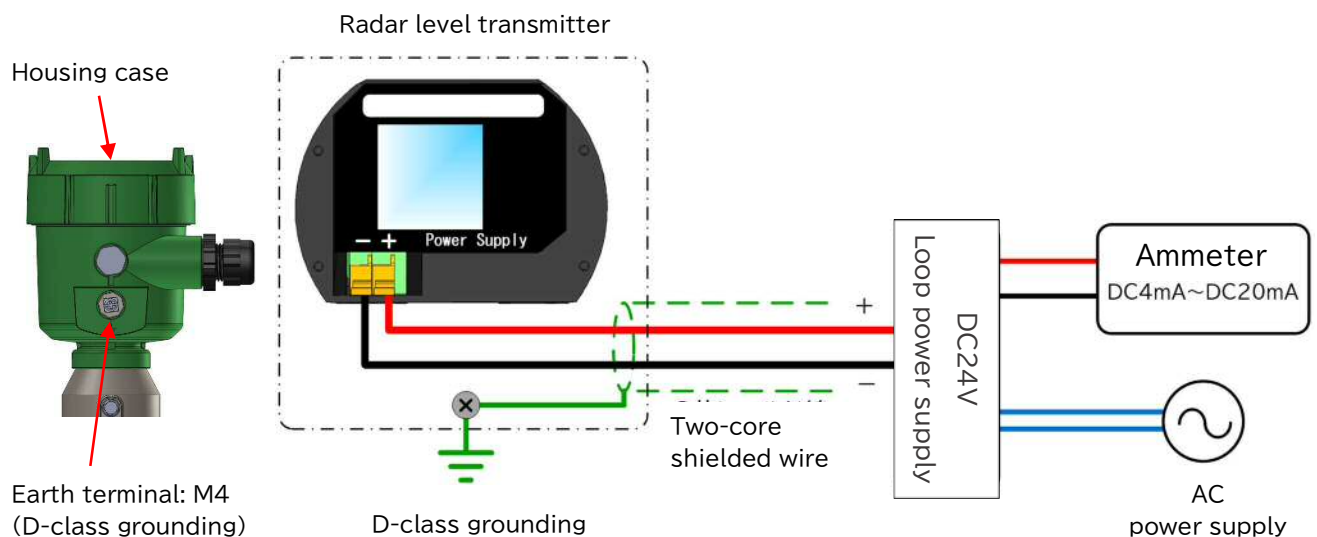
Insert a lead wire in opened terminal inlet. (Recommendable flathead screwdriver: Dia. $\phi 3\text{mm}$, Width 3mm)

Connect “+” with DC power supply (DC24V) positive terminal and “-” with negative terminal.

6-3. Grounding of two-core shield wire

- When grounding on the panel side (power supply side), please connect D-class grounding of the 2-core shielded wire at proper grounding location including the panel housing and earth bar.
- When grounding the sensor side, please connect the two-core shielded wire to the ground terminal inside the sensor housing, and connect D-class grounding from the ground terminal outside the case.

6-4. Set the cover. (Turn clockwise)



The size of a grounding wire must be used larger than 1.25 mm^2
Also, make sure that both ends are not grounded.

Fig. 13. Connection example

⚠ Important:

The size of the acceptable cable is 0.3mm^2 to 1.25 mm^2 . (AWG22 to 16)

Please prepare a longer wire to make the angle adjustment of the sensor.

⚠ Warning:

Do wiring when the instrument is powered OFF.

Avoid short circuit and reverse polarity.

The instrument must be supplied with DC power supply do not apply different voltage.

Tighten the cover and lead outlet firmly after wiring completed.

: The products are designed for discrete wiring connected to current loop supply or isolated interface device and analog board.

If there is anything unclear about the other connection, please consult with us separately.

7. Display

7-1. Screen of measurement

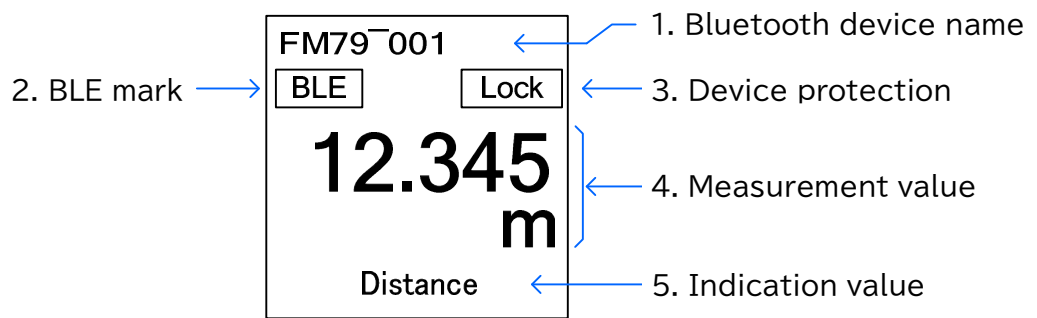


Fig. 14. Display screen

Table 5. Details

Item	Content
1. Bluetooth device name	Display Bluetooth device name (available to change by adjustment app)
2. BLE mark	Display Bluetooth connection with transmitter and adjustment device Display: ON, Non-display: OFF
3. Device protection	Display protection of devices Display: Protecting (Lock), Non-display: Releasing (Unlock)
4. Measurement value	Display measurement value (available to change by adjustment app) Distance/Level distance/Level Percent/Current value
5. Indication value	Display indication of 4. Measurement value Distance/Level distance/Level Percent/Current value

7-2. Display of conditions

Table 6. Conditions

Display	Content
Communicating	Parameters changing
Monitoring	Monitoring waveform on radar app monitoring
Processing	Noise echo leaning processing on transmitter
Device failure	Failure on device of transmitter
Device busy	Device busy of transmitter
No response	No response from transmitter

7-3. Display of error, warning, notice

Try actions in Table 7 if any code is displayed on screen.

Table 7. Code and action

Code	Condition	Comment	Current output
F001	Memory error	Description: The memory part malfunctions. Action: Reset power supply.	Depending on output setting, if trouble <3.6mA to 22mA>
F002	RF module error	Description: The RF module part malfunctions. Action: Reset power supply.	
F003	Power charge error	Description: The charge circuit malfunctions, or the supply voltage is out of range. Action: Check supply voltage range: 12V-36V. Reset power supply.	
F004	Loop current error	Description: The current output value is out of allowable range. Action: Check the load resistance value. Check the supply voltage range (12V to 36V).	
F005	Lost echo error	Description: No reflection within measuring range span. Action: Check the surface of the antenna for any adhesive materials, and clean inside antenna. Check the measurement range.	
S009	Startup processing	Description: State during startup processing of device. Action: Wait for detecting reflection.	<3.6mA
S010	Temp. out of range	Description: The temperature inside the device is out of range. Action: Check the ambient temperature.	Keep output value of measurement
S011	Full alert	Contents: It goes beyond the upper limit, full amount (100%). Action: Check the actual material level. Check the measurement range.	
S012	Empty alert	Contents: It goes below the lower limit, empty amount (0%). Action: Check the actual material level. Check the measurement range.	
S013	Measured value alert	Description: The measured value is out of range. Action: Check the parameter range.	
M017	LCD comm. error	Description: The LCD communication in the device is abnormal. Action: Reset power supply.	If occurring Maintenance notice = Select current output If available, maintenance notification setting current output
M018	Internal comm. error	Description: The time communication in the device is abnormal. Action: Reset power supply.	
M021	Antenna cleaning	Description: The antenna is dirty. Action: Clean the antenna.	
M022	Maintenance date	Contents: The set maintenance date has been passed. Action: Perform maintenance and update the maintenance date.	
C041	Simulation processing	Condition: Performing simulation	Simulation value

If the problem is not solved, please contact your local Matsushima sales office.

8. Troubleshooting

If you face any problems, first check if the following description to solve the problem.

Table 8. Troubleshooting

No.	Problem	Check the following	Corrective actions
1	Powered ON the device, but screen is blank	<ul style="list-style-type: none"> -Are wiring connections correct? -Check whether the power is supplied to the device? -Check power supply DC12V to DC36V -Check whether load resistance is within allowable range? 	<ul style="list-style-type: none"> -Correct the wiring -Supply proper power to the device -Reduce load resistance
2	Measured level reading higher than material level	<ul style="list-style-type: none"> -Are there any obstructions between sensor and material surface to be measured? -Any adhesion on antenna surface? -Check whether charging material comes into the beam angle. 	<ul style="list-style-type: none"> -Execute echo learning to mask noise reflection from the obstacle -Clean antenna surface -Change the sensor installation position
3	Measured level reading lower than material level	<ul style="list-style-type: none"> -Check whether the material level entered to the blind range? 	<ul style="list-style-type: none"> -Change sensor installation
4	Displaying any code	-Perform an action on 7-3. Table 7	

If problem persists, please contact your local Matsushima sales office.

9. Maintenance

Routine maintenance will be recommended.

Table 9. Periodic inspection

No.	Item	Descriptions	Interval (standard)
1	Check of appearance	<ul style="list-style-type: none"> -Confirm whether there is damage on housing etc... -Tighten the cover and lead outlet -Tighten the bolt for installation fixture 	Every 12 months
2	Check of antenna	<ul style="list-style-type: none"> -Clean the antenna 	Every 6 to 12 months



Important:

Standard periodic inspection interval depends on measurement condition and measured material.