Matsushima
Matsushima Measure Tech

TMWLM-006E
Rev0:Sep. 23, 2016

INSTRUCTION MANUAL FOR MICROWAVE LEVEL METER

TYPE : MWLM-PR26HEx

(Code)

Liquid : MWLM-PR26H2G/F Ex

Powder : MWLM-PR26H3G/F/S/SP Ex

MWLM-PR26H7G/F/S/SP Ex

－Contents－

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

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Safety precautions

! 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..
- Never connect the GRAPHIC COM 3 of the optional sale at a dangerous place. (Failure to observe this WARNING may result in an explosion at a dangerous place because it is not explosion -proof circuit)
- Never connect the HART modem , equipment similar to it or measuring instruments to the HART interface terminal of the main body panel part at a dangerous place. (Failure to observe this WARNING may result in an explosion at a dangerous place because it is not explosion -proof circuit.)

! 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 gland, 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. Overview

Microwave level meter measures level of bulk solids and liquids in the storage vessels without physical contact to measuring material. This model of level meter doesn't need separate output unit, which 4..20mA current output signal is carried by same two wires for power supply.

2. Measurement principle

The level meter transmits microwaves at constant intervals, and receives echoes (reflection of transmitted waves) from the surface of material under measurement. The time difference between transmission and reception of microwave is processed by microcomputer to accurately determine level of stored materials.

3. Specifications

3-1.General Specifications

Table1. Standard specification (For Liquid)

Type		MWLM-PR26HEx	
Code		MWLM-PR26H2GEx	MWLM-PR26H2FEx
Explosion-proof construction (TIIS)		Ex ia ⅡB T4 X	
Rating		Intrinsically safe circuit: Equipment Voltage 25.4V Equipment Current 86.8mA Equipment Power 551mW Internal inductance 0.7mH Internal capacitance 5nF	
Division of the danger point	Housing	Zone1, Zone2	
	Other than a housing	Zone0, Zone1, Zone2	
Power Supply（※1）		DC24V (Please supply from safety barrier/KFD2-STC4-Ex1.)	
Power consumption		Max.540mW	
Antenna		Horn (L150mm)	
Mounting（※2）		G1 1/2 thread	JIS5K50A flange
Dead Zone		0.5m below the antenna	
Max Measurable Distance（※3）		20m	
Transmitting frequency		Approx. 26GHz	
Transmitting cycle		Every 83ms	
Bean angle（-3dB）		Approx. 18deg.(Approx.36deg. side beam)	
Resolution		1mm	
Allowable Fluctuation Rate		10cm／s	
Accuracy （※3）	Repeatability	Within 2m or less：±30mm Within 2m or more：±20mm or ±0.04% of measurement range (Whichever is greater)	
	Temp. error	0.06%／10K	
Ambient temp.（※4）		－20℃～＋50℃	
Measured fluid temp.		－40℃～＋100℃	
Allowable pressure		1MPa	0.5MPa
Protection （※5）	Housing	ADC	
	Boss	SUS304	
	Antenna	SUS316L	
Protection（※5）		IP67（Housing）	
Lead outlet		1-G1/2 (Applicable size：φ8～12mm)	
Output signal		DC4 to 20mA×1 (Resistive load Max.499Ω)	
Mass		Approx. 1.9kg	Approx. 2.2kg
Accessories（option）		Data communication cable (MHM-01) PC Adjustment software (MDTM)	

Table2. Standard specification (For Powder)

Type		MWLM-PR26HEx	
Code		MWLM-PR26H3 GEx/FEx/SEx/SPEx	MWLM-PR26H7 GEx/FEx/SEx/SPEx
Explosion-proof construction (TIIS)		Ex ia ⅡB T4 X	
Rating		Intrinsically safe circuit: Equipment Voltage 25.4V Equipment Current 86.8mA Equipment Power 551mW Internal inductance 0.7mH Internal capacitance 5nF	
Division of the danger point	Housing	Zone1, Zone2	
	Other than a housing	Zone0, Zone1, Zone2	
Power Supply(※1)		DC24V (Please supply from safety barrier/KFD2-STC4-Ex1.)	
Power consumption		Max.540mW	
Antenna		Horn(L200mm)	Horn(L440mm)
Mounting(※2)		G:G1 1/2 thread F:JIS5K65A flange S:JIS10K100A swiveling flange SP:JIS10K100A Standard swiveling flange	G:G1 1/2 thread F:JIS10K100A flange S:JIS10K100A swiveling flange SP:JIS10K100A Standard swiveling flange
Dead Zone		0.5m below the antenna	
Max Measurable Distance(※3)		35m	70m
Transmitting frequency		Approx. 26GHz	
Transmitting cycle		Every 83ms	
Bean angle(-3dB)		Approx.14° (Approx.28deg. side beam)	Approx.8° (Approx.16deg. side beam)
Resolution		1mm	
Allowable Fluctuation Rate		10cm／s	
Accuracy (※3)	Repeatability	Within 2m or less:±30mm Within 2m or more:±20mm or ±0.04% of measurement range (Whichever is greater)	
	Temp. error	0.06%／10K	
Ambient temp.(※4)		−20℃～＋50℃	
Measured fluid temp.		−40℃～＋100℃	
Allowable pressure		G:1MPa, F:250kPa, S:10kPa, SP:1MPa	
Protection (※5)	Housing	ADC	
	Boss	SUS304	
	Antenna	SUS316L	
Protection(※5)		IP67(Housing)	
Lead outlet		1-G1/2 (Applicable size:φ8～12mm)	
Output signal		DC4 to 20mA×1 (Resistive load Max.499Ω)	
Mass		G:app. 2.7kg, F:app.5.3kg, S:app.6.0kg, SP:app.9.0kg	
Accessories(option)		Data communication cable (MHM-01), PC Adjustment software (MDTM)	

※1) Power supply ripple voltage must be less than 0.2Vp-p.
Noise and surges should not be interfered. (Recommended)

※2) When mount on a short stand pipe, install the level meter so that the end of the antenna protrude from the short stand pipe.

※3) The measurement range and accuracy are guaranteed only when, antenna is pointed at an angle perpendicular to the material surface, temperature is normal (15℃),
permittivity is more than two at high pressure, and no any presence of airborne dust, vapor, and agitated foam.
If these conditions are not satisfied, the measurement range and accuracy may differ according to the measurement conditions.

※4) Ensure that freezing and/or condensing will not occur inside the electronic unit.

※5) The product meets the test of the Japanese Industrial Standards JIS C0920「Degrees of protection provided by enclosures」. (Refer to 5. Dimensions with respect to the application range)
Take care that water may enter and damage the equipment, if lead outlet not tighten firmly or loosen.
When the equipment operated in the presence of process gases and/or fluids, those materials may penetrate through resin of cone antenna and damage the equipment,
specially corrosive gases such as H_2S, HCl and HF.

4. System configuration

This level measurement system is configured by the level meter and a safety barrier (referring to the following page).
The level meter can be mounted at a dangerous place and a safety barrier can be mounted at a non-dangerous place.

Division of the dangerous spot in the danger place

Housing	Zone1, Zone2
Other than a housing	Zone0, Zone1, Zone2

⚠ **IMPORTANT**：Refer to the division of the dangerous spots also described in page 10.

- Output signal : DC4～20mA
- Resistive load : Max. 499Ω
- Applicable cable size : 0.3～1.25mm²(AWG22～16)
  (the size of the acceptable cable is max.1.25mm²)
- Ground wiring（D-class grounding） : 1.25 mm²

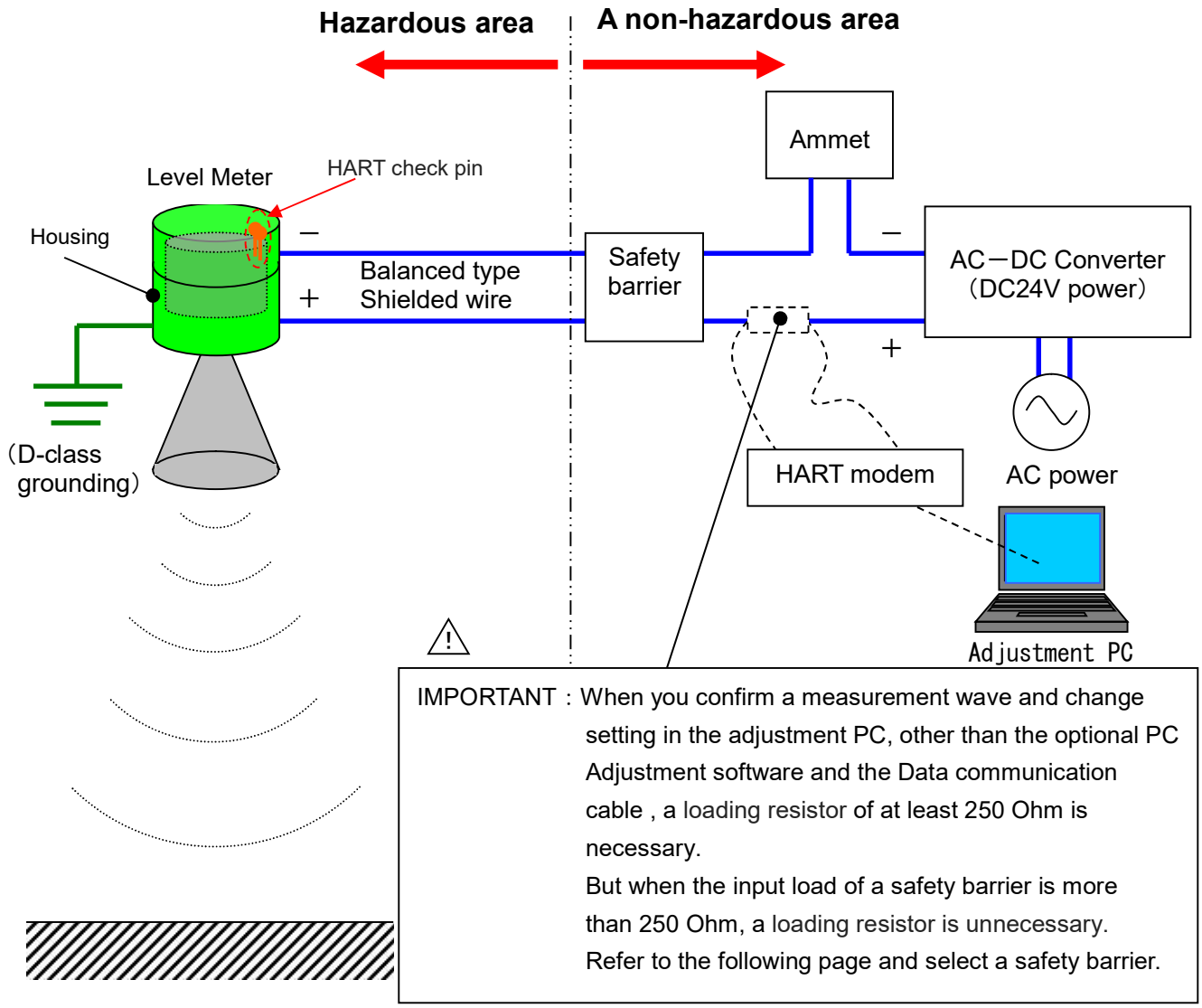

Fig. 1 System configuration example

⚠ **WARNING**：Do not connect the Data communication cable to the Adjustment communication check pin at a dangerous place.
Failure to observe this WARNING may result in an explosion because it is not explosion proof circuit.

・**Withstand voltage test**

Do not perform the withstand voltage test because the following withstand voltage test do not apply.

A test point of the withstand voltage(between the terminal 1 and the earth terminal, beween the terminal 2 and the earth terminals)

Test condition：Test voltage AC500V(effective value) must bemaintained for a mimute,
leakage current must be less than 5mA(effective value)

・**Selecting condition of a safety barrier**

Select a safety barrier passing the Type Examination only with it ,satisfying the following conditions and being isolated between the input and the output circuits.

(1) Safety holding rating

The maximum voltage Uo of an intrinsic safety circuit must be less than 25.4V.

The maximum current Io of an intrinsic safety circuit must be less than 86.8mA.

The maximum power Po of an intrinsic safety circuit must be less than 551mW.

(2) Performance sorting and group of electric apparatus

Performance sorting ia

Group of electric apparatus ⅡB, ⅡC

(3) Relation of permissible inductance(Lo) of an intrinsic safety circuit and permissible capacitance (Co) of an intrinsic safety circuit to inductance(Lw) and capacitance (Cw) of external wiring of an intrinsic safety circuit

Permissible inductance(Lo) of an intrinsic safety circuit ≧(0.7mH+Lw)

Permissible capacitance (Co) of an intrinsic safety circuit ≧(5nF+Cw)

[Recommended safety barrier]

Type:KFD2-STC4-Ex1(name of the maker:PEPPERL+FUCHS)

WARNING：The operation power supply of a safety barrier is DC24V.
The input load is more than 250 Ohm.
But when the adjustment PC is connected to the input terminal side, the configuration of the level meter and a safety barrier would not be an intrinsic safety circuit.
Therefore, connect the adjustment PC to the output terminal side.
The connection sample using the recommended safety barrier is described in page 14.

5. Dimensions (Units : mm)

【Code：MWLM-PR26H2 series】

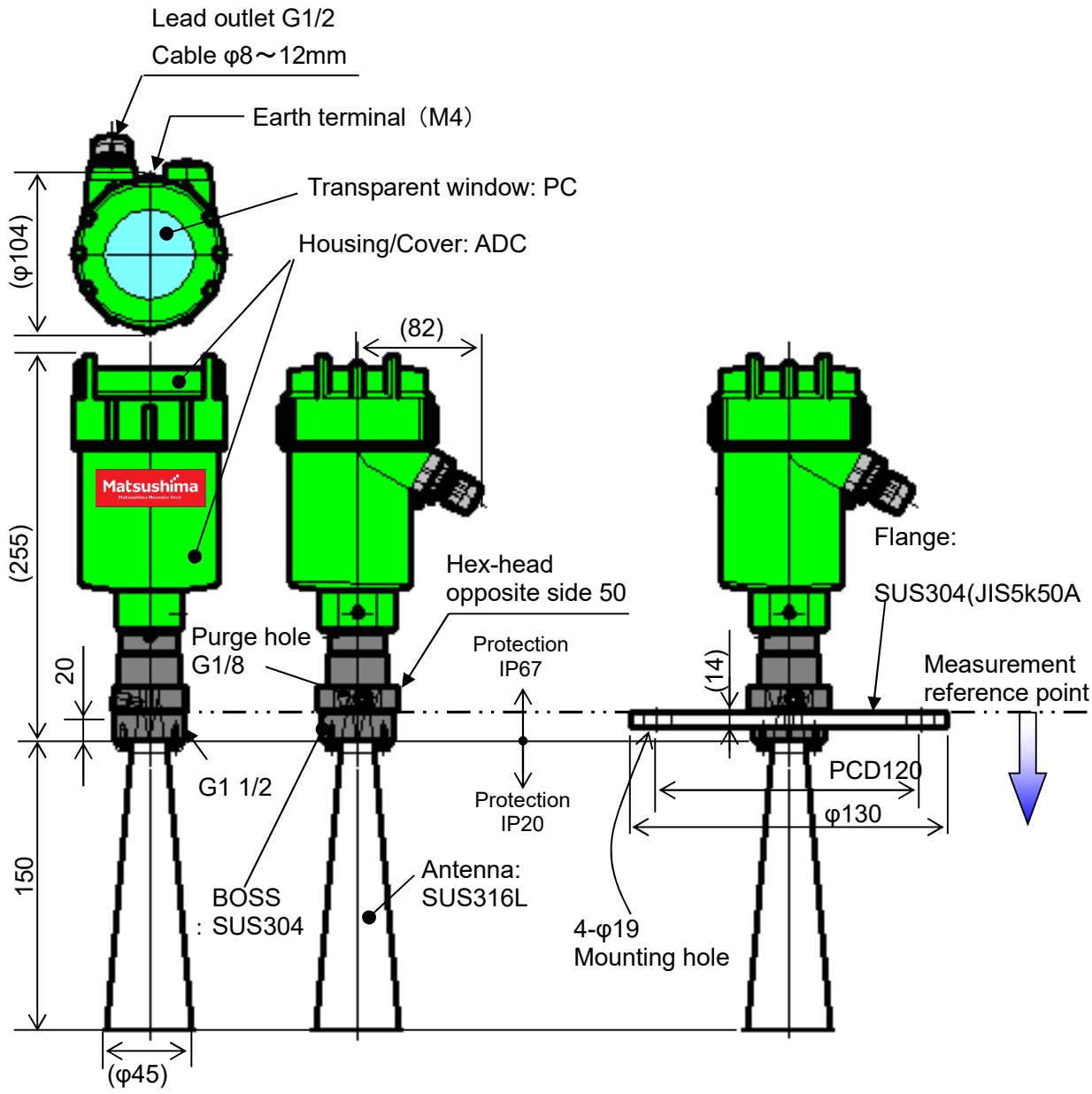

Fig. 2. External dimensions for liquid type

※Refer to external dimensions for measurement reference point.
Basically upper part of mounting compartment is measurement reference point.

※Protection grade IP20 is applied to the structure from the antenna mounting screw hole face to the antenna side.
When the closing plug mounted on the purge hole is removed and the air pipe is mounted, protection grade IP20 is applied to the structure from the purge hole to the antenna side.

【Code：MWLM-PR26H3 series】

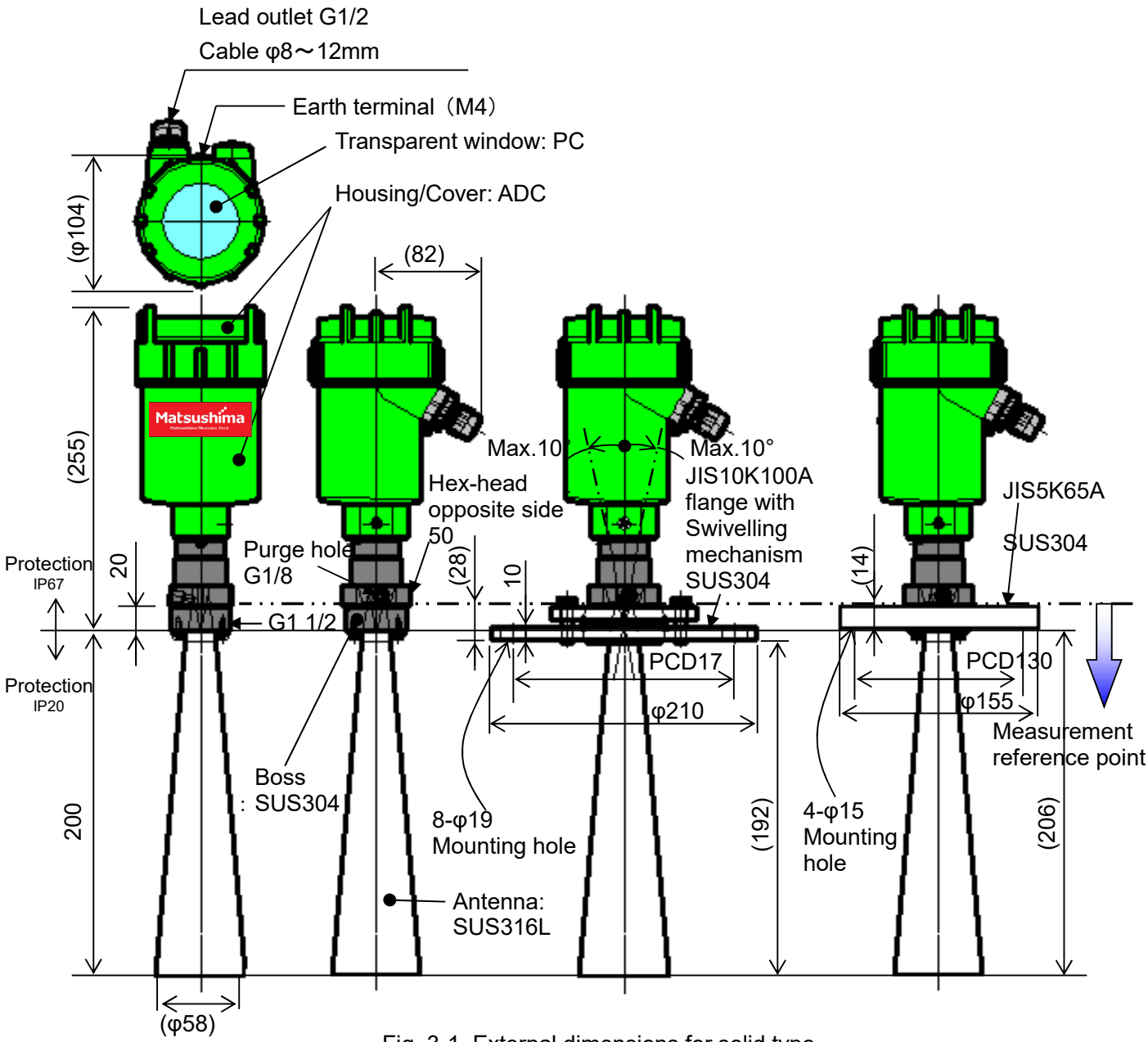

Fig. 3-1. External dimensions for solid type

※Refer to external dimensions for measurement reference point.
Basically upper part of mounting compartment is measurement reference point.

※Protection grade IP20 is applied to the structure from the antenna mounting screw hole face to the antenna side.
When the closing plug mounted on the purge hole is removed and the air pipe is mounted, protection grade IP20 is applied to the structure from the purge hole to the antenna side.

【Code：MWLM-PR26H7 series】

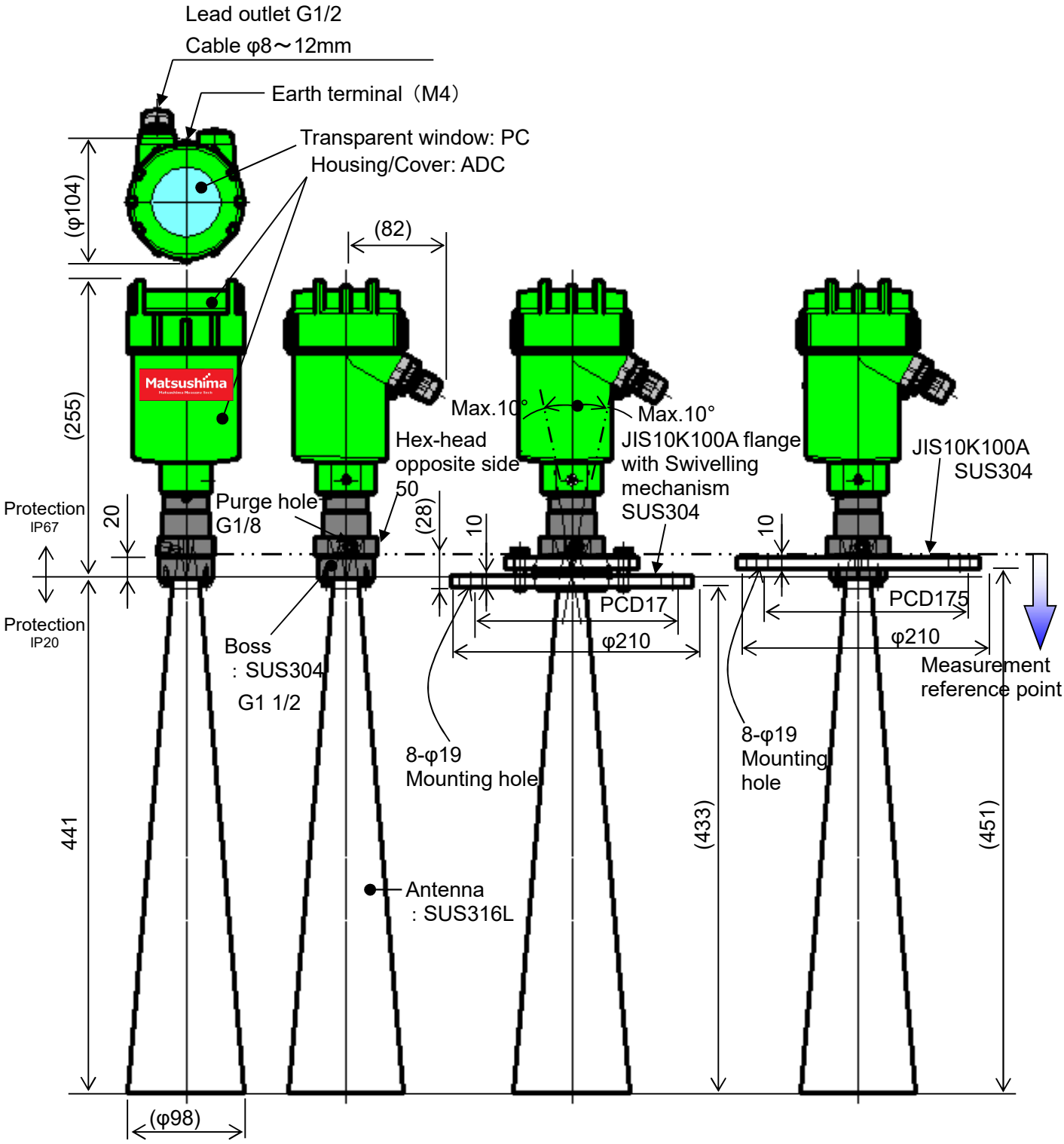

Fig. 3-2. External dimensions for solid type

※Refer to external dimensions for measurement reference point.
Basically upper part of mounting compartment is measurement reference point.

※Protection grade IP20 is applied to the structure from the antenna mounting screw hole face to the antenna side.
When the closing plug mounted on the purge hole is removed and the air pipe is mounted, protection grade IP20 is applied to the structure from the purge hole to the antenna side.

6. Installation

6-1. Division of the dangerous spot and temperature range

Code：MWLM-PR26H series

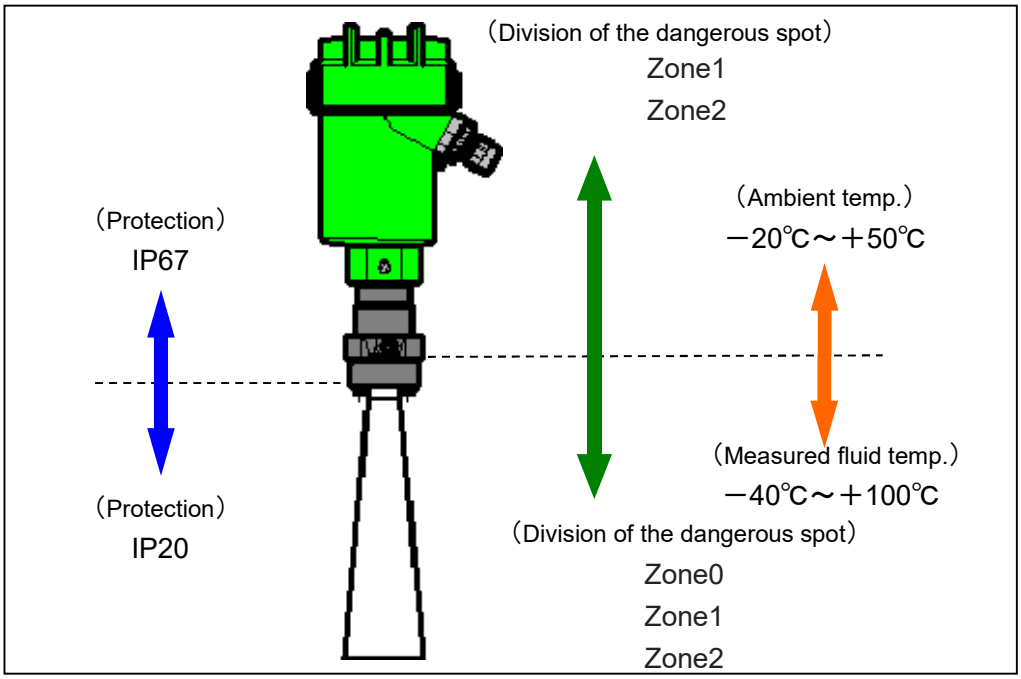

Fig.3.Division of the dangerous spot and temperature range

※Protection grade IP20 is applied to the structure from the antenna mounting screw hole face to the antenna side.

When the closing plug mounted on the purge hole is removed and the air pipe is mounted, protection grade IP20 is applied to the structure from the purge hole to the antenna side.

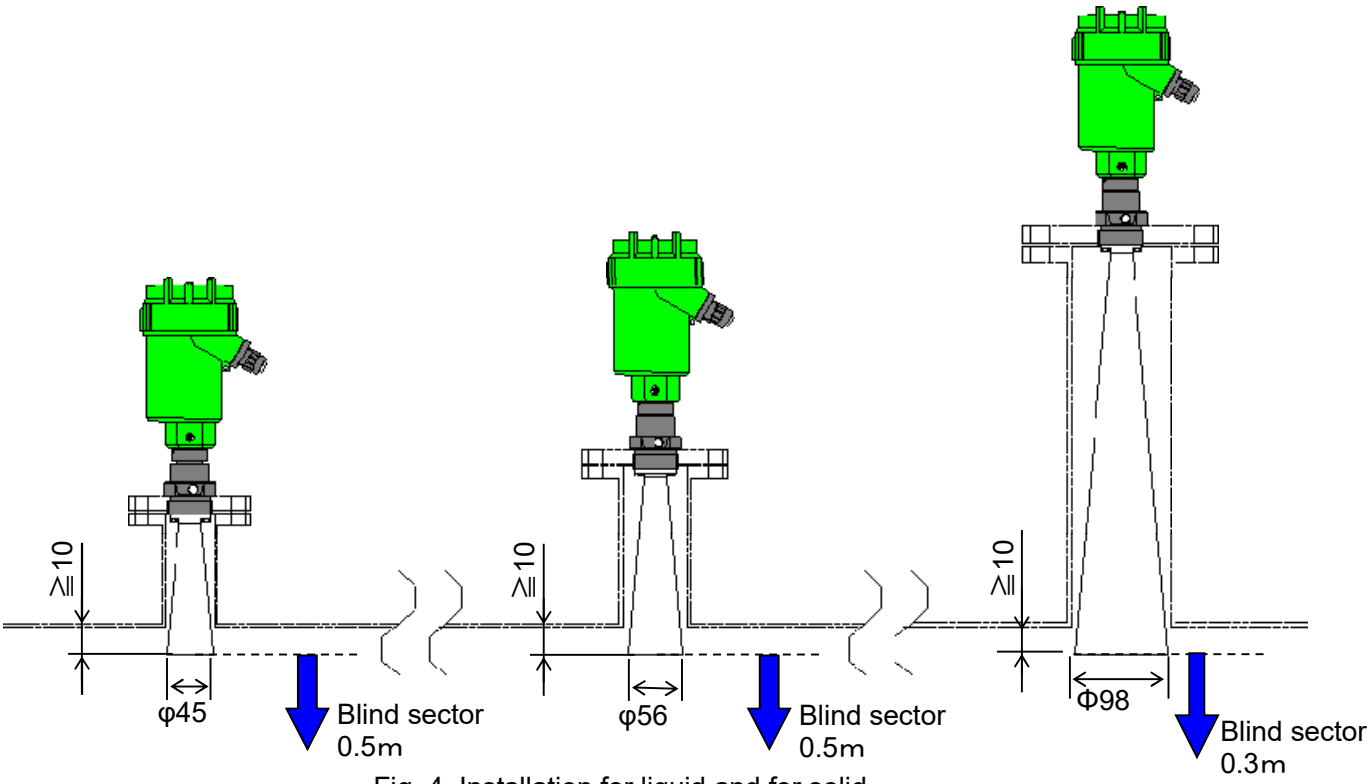

Fig. 4. Installation for liquid and for solid

- If material surface enter to the blind sector, a stand pipe shall be used to ensure that material surface can not reach the blind sector of the level meter. But if the material surface will not enter the blind sector, then stand pipe should not be used.
- If length of stand pipe is longer than required, such that antenna end is not protruded from stand pipe, then it causes malfunction of instrument.
- When required stand pipe length is longer than antenna, please use cone shape stand and ensure radiation angle including the side beam.
  Keep radiation free of interference from the stand pipe.

【Recommended height of stand pipe】

Solid: The end of the horn antenna must be protruded a minimum of 10mm from the stand pipe.
Liquid: The end of the antenna must be protruded a minimum of 25mm from the stand pipe.

【Calculation of radiation angle expansion】

Solid ：Distance from meas. reference point × tan16°＋φ98 (Antenna diameter)
Solid ：Distance from meas. reference point × tan28°＋φ56 (Antenna diameter)
Liquid：Distance from meas. reference point × tan48°＋φ45 (Antenna diameter)

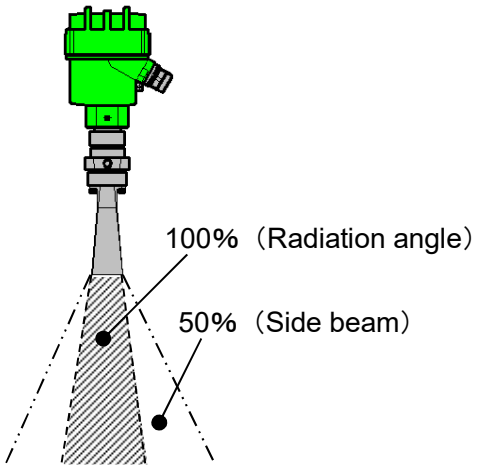

Fig. 5. Radiation angle and side beam reference

6-3. Mounting direction

・At the application with repose angle and the mounting position near the sidewall etc, the reflection intensity of Level Meter may weaken or the noise reflection is likely to occur. As a countermeasure, the change of mounting direction can improve it in some cases. Level Meter has an marking at the reference position of electric field direction on Adapter If the direction of electric field is adjusted based on this marking, the reflection intensity may increase or the noise reflection may reduce. Turn and adjust it to the direction where the reflection wave is the largest and the noise reflection is the least, checking the reflective condition.

Turn around the flange in order to change the dot direction.

Fig.6 Mounting direction

6-4. Installation precautions

・Set the value of 100%(20mA) level so that the blind sector is secured. Setting the 100%(20mA) level within the blind sector will cause a

malfunction of the instrument.

・Avoid too long stand pipe to prevent malfunction of the instrument.

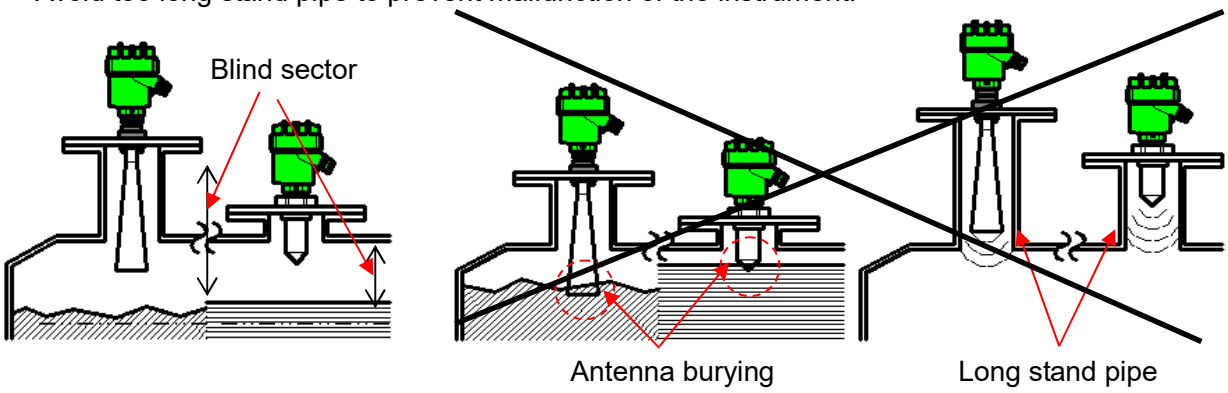

Fig. 7. Installation precaution (1)

・Do not install instrument close to inlet of material under measurement.

・Do not install any interfering instruments within the side beam, because reflections from beams, pipes, and other supports within the tank will cause false echoes.

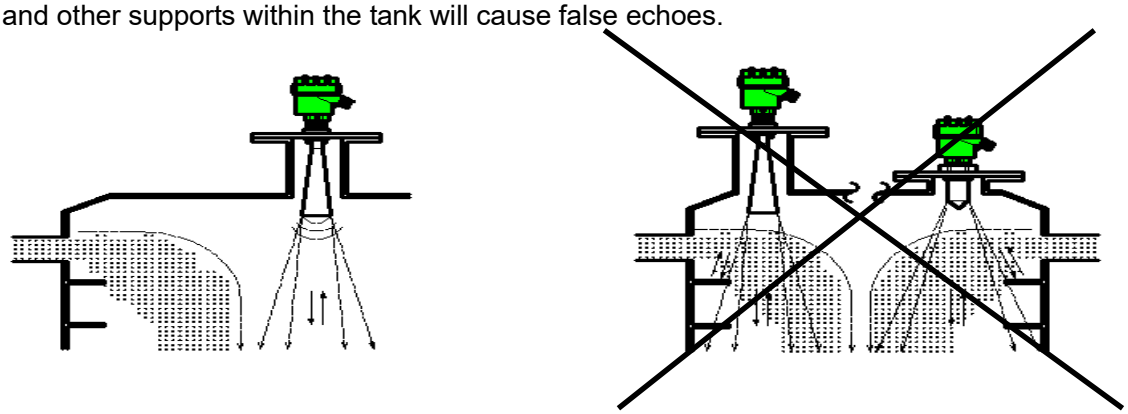

Fig. 8. Installation precaution (2)

・Provide shielding to minimize noise or unwanted reflections, when crossbeams, and other supports are installed within the tank.

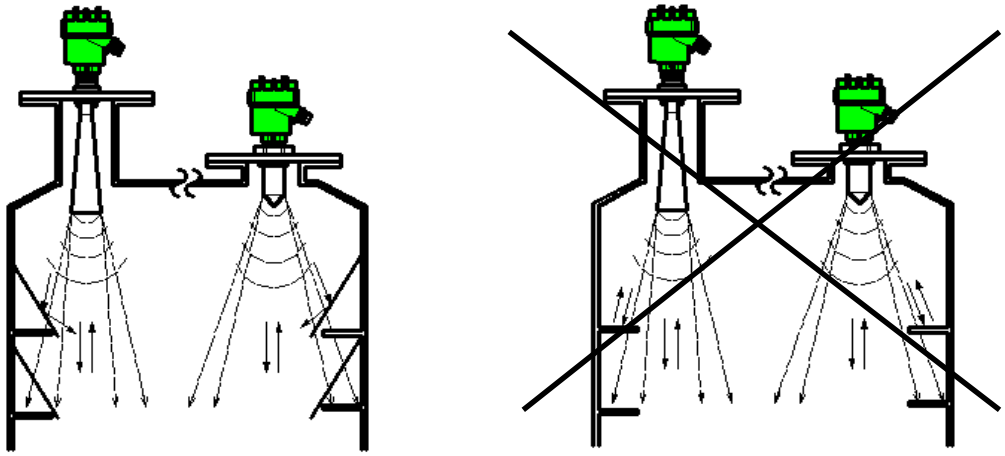

Fig. 9. Installation precaution (3)

【False reflections】

In environments where interfering signals are generated, level meter may indicate incorrect measurements results. False reflections up to a certain level of strength can be suppressed by executing the echo learning function. However, the level meter's installed position must be changed if true echoes cannot be received or if the reflection level (measured in dB) is extremely low. When there are obstructions such as crossbeams, pipes, or level switches in the tank, install the level meter in a position where there is no obstruction within its radiation 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 true echo from the surface of material differs depending on the level meter 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 true echo level.**

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

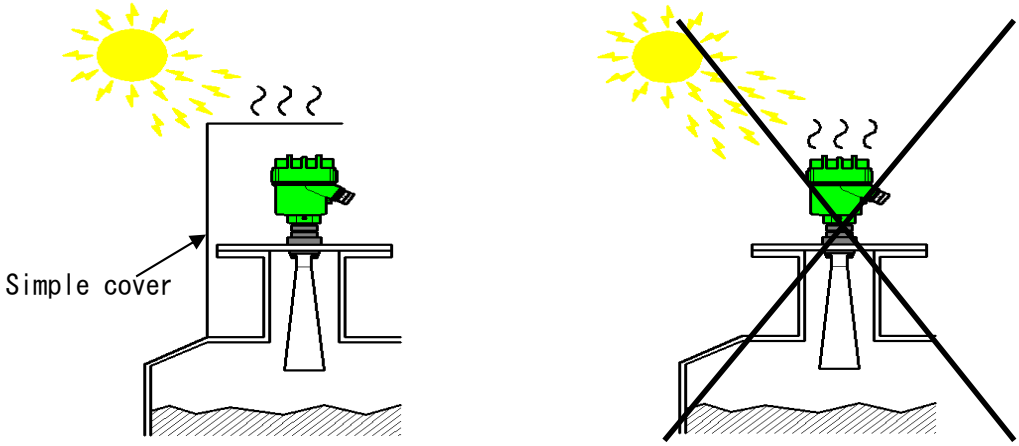

Fig. 10. Installation precaution (4)

・There is a structural equipment that the cone antenna goes out than the attaching portion when the horn antenna is detached by maintenance etc.
Please do not put the cone antenna part doing below after detaching the horn antenna.
The cone antenna might be damaged, and it influence the measurement.

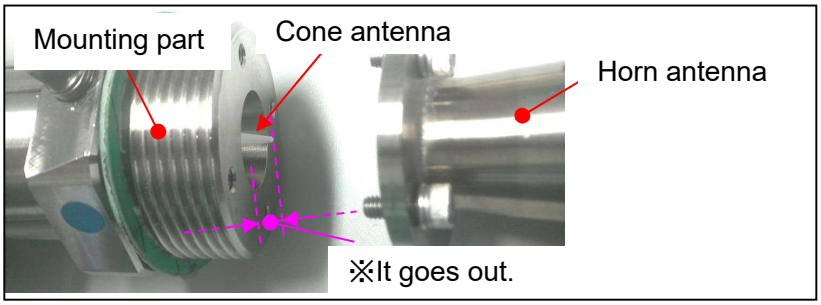

Fig11. The horn antenna was detached.

7. Wiring

7-1. Unscrew the cover. (Rotate counterclockwise)
7-2. Open the wire entry of terminal block by pushing on the actuating lever with flat screwdriver. (Recommended flat screwdriver: Axis diameter ϕ 3mm and blade tip size 2.6mm)
7-3. Insert wires as shown on the panel, positive (+) to terminal entry No.1 and negative (-) to terminal No.2. Please wire so that there is no mistake. Release actuating lever of the terminal.
7-4. Connect the ground wire to internal earth ground terminal.
7-5. Screw the cover on tightly.

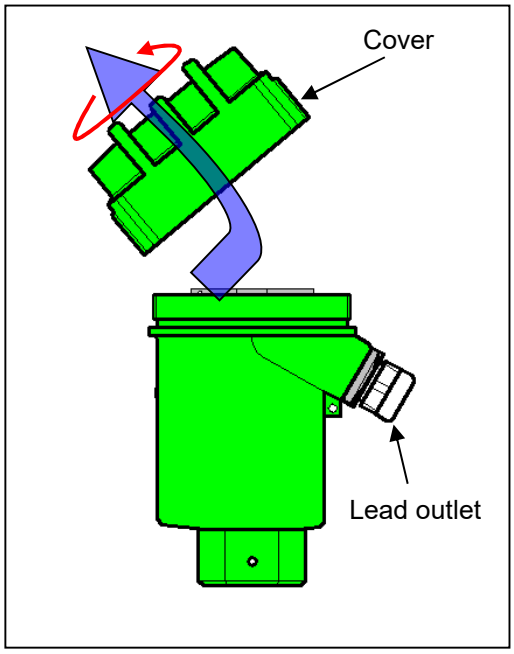

Fig. 12. Cover detaching

Important:
The size of the acceptable cable is max. 1.25mm² (0.3mm² to 1.25 mm²). (AWG22 to 16)

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.

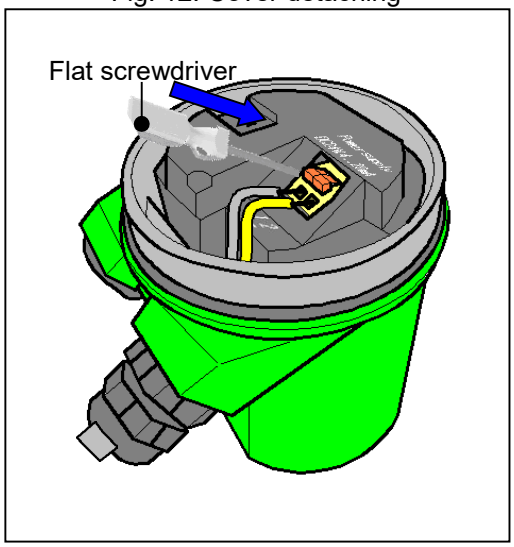

Fig. 13. Wiring technique

Warning:
Do not connect the Data communication cable to the Adjustment communication check pin at a dangerous place.

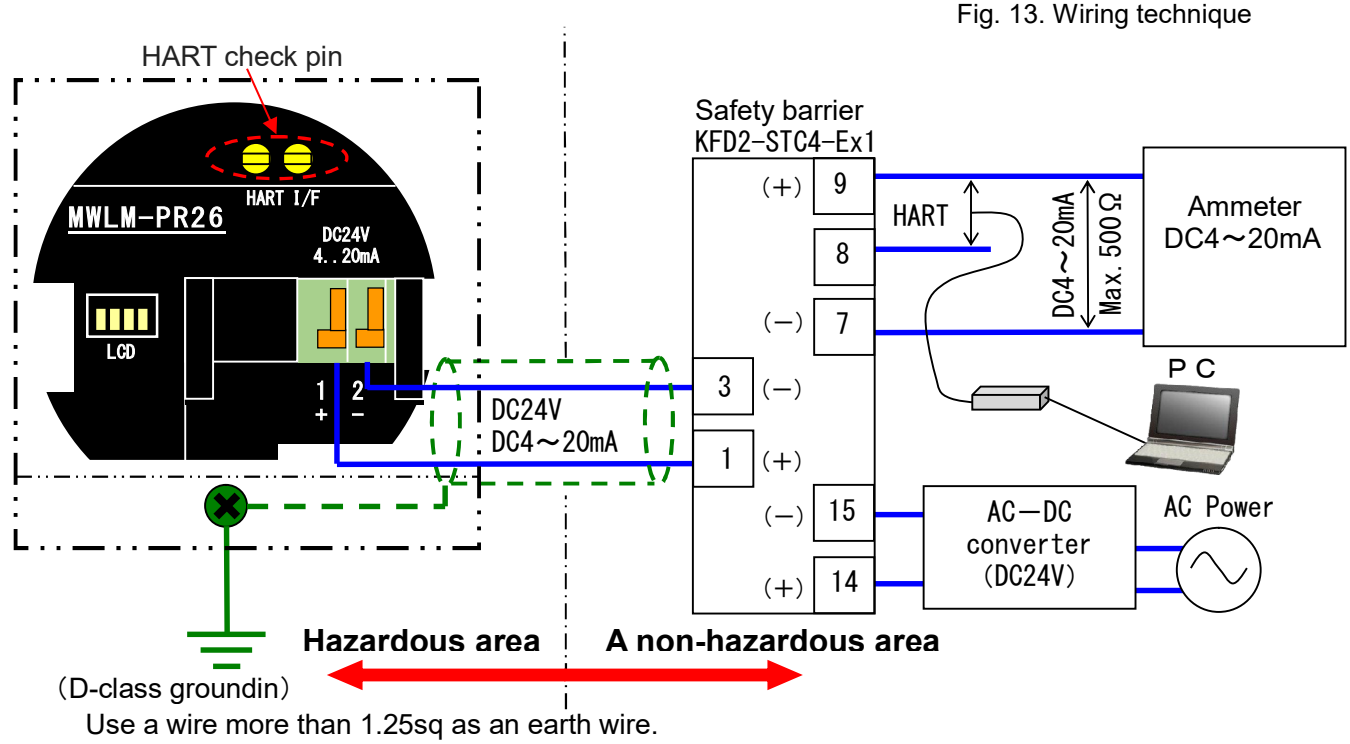

Fig.14. Connection example for KFD2-STC4-Ex1

9. Start - up

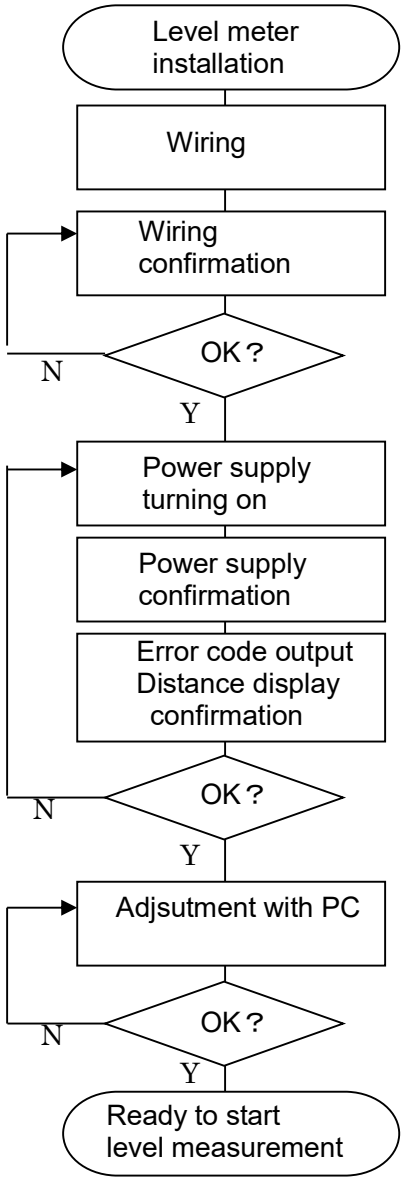

Fig.15. Start - up

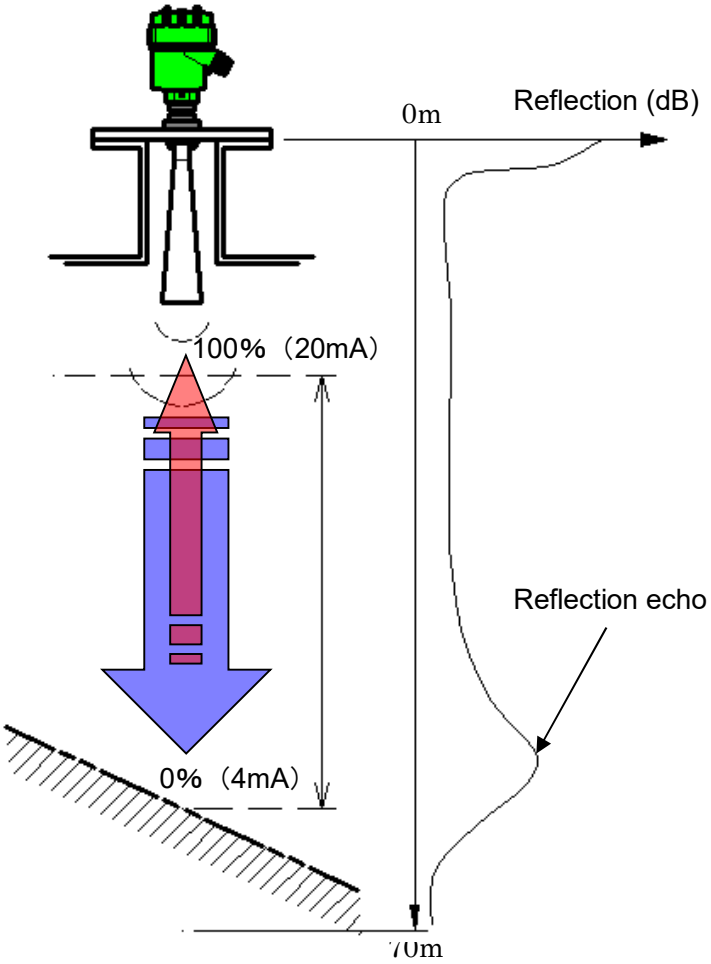

Fig. 16. Measurement range

※ "LCD adj. unit" ,"Software for PC adjustment" and "HART modem" are optional products.

※ For the error code details, please refer to “Instruction manual for LCD adjustment unit” and “Operating manual for adjustment software Matsushima DTM”.

11. Troubleshooting

If you encounter any problems, first check if they are described in this section, then execute suggested corrective actions.

Table 3. Troubleshooting

No.	Problem	Check the following	Corrective actions
1	Powered ON the device, but screen is blank	・Are wiring connections correct ? ・Check whether the power is supplied to the device?	・Correct the wiring ・Supply power to the device
2	Measured level reading higher than material level	・Are there any obstructions between antenna and material surface to be measured ? ・Are there any inlet streams of material under measurement within the radiation angle	・Execute echo learning to mask false echo from the obstacle ・Change the level meter position
3	Measured level reading lower than material level	・Check whether the material surface entered to the blind sector ?	・Change level meter installation

Table 4. Periodic inspection

No.	Item	Descriptions	Interval (standard)
1	Check of appearance	・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	・Clean the antenna (Solid: Inside, Liquid: Outside)	Every 6 to 12 months

Important: Standard periodic inspection interval differs depending on measurement condition and measuring material.