Guided Wave Radar Level Meter

Operating Instruction

Model: MDRA10



Contents

1. Product Overview 01
1.1 Principle 01
1.2 Output 01
1.3 Measuring Range 01
2. Introduction to Instrument 02
3. Mounting Instruction 04
3.1 Mounting Position 04
3.2 Rod Mounting 04
3.3 Coaxial Tube Mounting 04
3.4 Mounting Method 05
4. Wiring Mode 07
4.1 Supply Voltage 07
4.2 Installation Of Connecting Cable 07
4.3 Shielding And Wiring Of Cables 07
4.4 Connection Mode 07
4.5 Safety Guide 11
4.6 Protection Rating 11
5. Technical Parameters 12
6. Debugging 13
6.1 Programmer 13
6.2 PC software debugging 17
6.3 HART handheld programmer debugging 17
7. Dimensions 19
7.1 Shell Dimensions 19
7.2 Structural Dimensions 19
8. Linearity of Instrument 23
9. Transportation and Storage 26

1.Product Overview

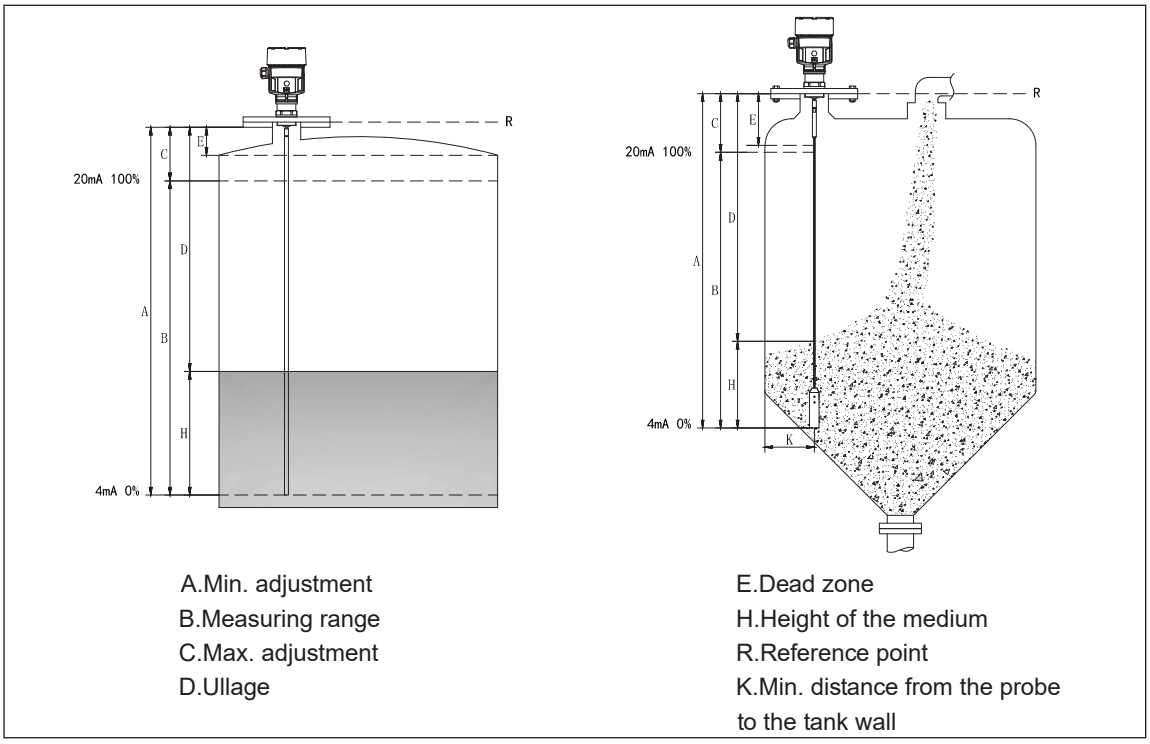
1.1 Principle

Guided wave radar is a measuring instrument based on the principle of time and travel. The radar wave runs at the speed of light, and the running time can be converted into a level signal by electronic components. The probe emits high frequency pulses which will be transmitted along the cable or rod-type probe. When the pulse encounters the surface of material, it will be reflected back and received by the receiver in the instrument and the distance signal will be converted into a level signal.

The reflected pulse signals are transmitted to the electronic circuit of instrument, and microprocessor processes the signal and identifies the echoes generated by the microwave pulses on the surface of material. The picking out of the right echoes is done via smart software. The distance E from the surface of material is proportional to the time travel T of pulse: D=C×T/2 (where, C is the speed of light), Since the distance E of empty tank is known, the level of the medium H is shown as follows: H=A-D.

1.2 Output

The echoes are set by inputting the empty tank height A(= zero point), the full tank height B (= full scale) and some application parameters, and meter will automatically adapt to the measurement environment by using application parameters, corresponding to the (4...20) mA output.



A.Min. adjustment
B.Measuring range
C.Max. adjustment
D.Ullage
E.Dead zone
H.Height of the medium
R.Reference point
K.Min. distance from the probe to the tank wall

Figure 1

1.3 Measuring Range

Top near blanking area is the min. distance between the highest plane of material and measurement reference point.

Bottom near blanking area is the distance that cannot be accurately measured near the bottom of cable.

The effective measurement distance is between the top and bottom near blanking area.

Note: The level of the material in the tank could only be properly measured when the material level exist between the top and bottom near blanking area.

2. Introduction to Instrument

 MDRA101 Cable-style	Characteristics: Cable probe, solid-type and liquid-type sensors are optional. Application: Level measurement of liquid and solid powder. Measuring range: 30m Process connection: Thread, flange Process temperature: -40~300℃ Process pressure: -0.1~4.0Mpa Accuracy: ±3mm Bluetooth version: V5.2 Display: Backlight function, Screen rotation function Frequency range: 100MHz-1.8GHz Output signal: 4~20mA/HART(V7.9) 24V DC 2-wire /4-wire system; 4~20mA/HART(V7.9) 220V AC 4-wire system; RS485 Modbus 6~26V DC Explosion-proof rating: Ex ia IIC T6 Ga Ex db IIC T6 Gb Protection rating: Stainless steel shell IP68; Aluminum shell IP68 Plastic shell IP67
 MDRA102 Rod-style	Characteristics: Rod-type probe. Application: Liquid level measurement in liquid storage tank. Measuring range: 6m Process connection: Thread, flange Process temperature: -40~300℃ Process pressure: -0.1~4.0Mpa Accuracy: ±3mm Bluetooth version: V5.2 Display: Backlight function, Screen rotation function Frequency range: 100MHz-1.8GHz Output signal: 4~20mA/HART(V7.9) 24V DC 2-wire /4-wire system; 4~20mA/HART(V7.9) 220V AC 4-wire system; RS485 Modbus 6~26V DC Explosion-proof rating: Ex ia IIC T6 Ga Ex db IIC T6 Gb Protection rating: Stainless steel shell IP68; Aluminum shell IP68 Plastic shell IP67
 MDRA103 Rod-type (No blind spot)	Characteristics: Blind spot free measurement, rod type, cable type, coaxial pipe type optional. Application: Low range liquid measurement. Measuring range: 3m Bluetooth version: V5.2 Display: Backlight function, Screen rotation function Process connection: Thread, flange Process temperature: -40~300℃ Process pressure: -0.1~4.0Mpa Accuracy: ±1mm Frequency range: 100MHz-1.8GHz Output signal: 4~20mA/HART(V7.9) 24V DC 2-wire /4-wire system; 4~20mA/HART(V7.9) 220V AC 4-wire system; RS485 Modbus 6~26V DC Explosion-proof rating: Ex ia IIC T6 Ga Ex db IIC T6 Gb Protection rating: Stainless steel shell IP68; Aluminum shell IP68 Plastic shell IP67

 MDRA104 High-temperature type	Characteristics: High temperature and pressure sensor, rod-type probe or coaxial tubular probe is optional. Application: Measurement of liquid level in high temperature and pressure liquid storage tank. Measuring range: 6m Process connection: Thread, flange Process temperature: -200~400℃ Process pressure: -0.1~40Mpa Accuracy: ±3mm Bluetooth version: V5.2 Display: Backlight function, Screen rotation function Frequency range: 100MHz-1.8GHz Output signal: 4~20mA/HART(V7.9) 24V DC 2-wire /4-wire system; 4~20mA/HART(V7.9) 220V AC 4-wire system; RS485 Modbus 6~26V DC Explosion-proof rating: Ex ia IIC T6 Ga Ex db IIC T6 Gb Protection rating: Stainless steel shell IP68; Aluminum shell IP68 Plastic shell IP67
 MDRA105 Anti-corrosion type	Characteristics: Rod-type PTFE anti-corrosion probe. Application: Corrosive liquid. Measuring range: 6m Process connection: Flange Process temperature: -40~200℃ Process pressure: -0.1~2.0Mpa Accuracy: ±3mm Bluetooth version: V5.2 Display: Backlight function, Screen rotation function Frequency range: 100MHz-1.8GHz Output signal: 4~20mA/HART(V7.9) 24V DC 2-wire /4-wire system; 4~20mA/HART(V7.9) 220V AC 4-wire system; RS485 Modbus 6~26V DC Explosion-proof rating: Ex ia IIC T6 Ga Ex db IIC T6 Gb Protection rating: Stainless steel shell IP68; Aluminum shell IP68 Plastic shell IP67
 MDRA106 Coaxial tube-type	Characteristics: coaxial tube probe. Application: Measurement of liquid level with low dielectric constant or liquid with surface fluctuation, complex structure in liquid tank. Measuring range: 6 meters Process fiting: Thread, flange Process temperature: -40~300℃ Process pressure: -0.1~4.0Mpa Accuracy: ±3mm Bluetooth version: V5.2 Display: Backlight function, Screen rotation function Frequency range: 100MHz-1.8GHz Output signal: 4~20mA/HART(V7.9) 24V DC 2-wire /4-wire system; 4~20mA/HART(V7.9) 220V AC 4-wire system; RS485 Modbus 6~26V DC Explosion-proof rating: Ex ia IIC T6 Ga Ex db IIC T6 Gb Protection rating: Stainless steel shell IP68; Aluminum shell IP68 Plastic shell IP67

3. Mounting Instruction

Mounting instructions below apply to rod and cable probe when it is used for solid powders and liquids. Coaxial tube probes could only be used for liquids.

3.1 Mounting Position

- Keep away from the discharge outlet and feed inlet as far as possible.
- For metal and plastic tanks, the device shall not touch the inner wall across the entire measuring range.
  The minimum distance between the cable or rod probe and the tank wall shall be ≥300mm.
- The probe bottom is about 50mm away from the tank bottom.
- The minimum distance between the probe and the obstacle in the tank shall not less than 300mm.
- If the container bottom tapered, the sensor can be installed in the center of the tank top so that the tank bottom can be measured.

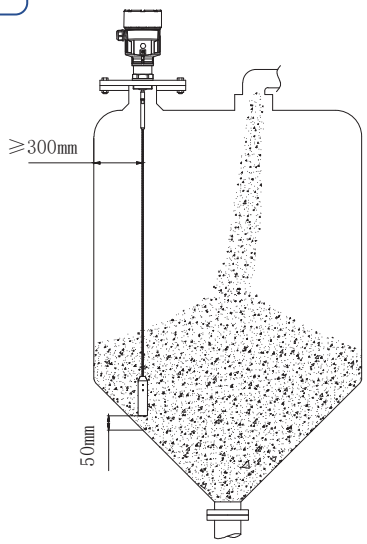


Figure 2

3.2 Rod Mounting

The rod radar mounting diagram is shown on the right and the rod radar is mainly used for the measurement of liquid level.

Characteristics:

- Any medium with a dielectric constant of ≥ 1.9 can be measured.
- It is generally used to measure the medium with a viscosity of ≤ 500 cst and which will not easily cause adhesion.
- The maximum range of the rod radar can reach 6 meters.
  It has a strong ability to suppress steam and foam, and the measurement will not be affected.

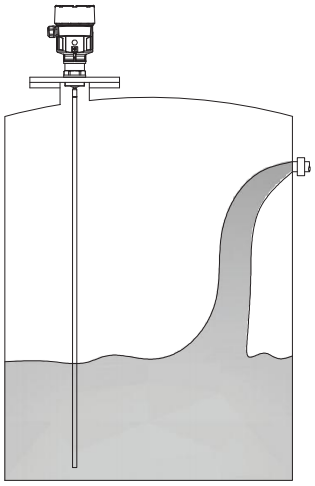


Figure 3

3.3 Coaxial Tube Mounting

The coaxial tube radar mounting diagram is shown on the right and the coaxial tube radar is mainly used for the measurement of liquid level.

Characteristics:

- The liquid materials with low dielectric constants can be measured by using
- the coaxial tube measuring method to ensure good and accurate measurement.
- Any medium with a dielectric constant of ≥1.6 can be measured.
- It is generally used to measure the medium with a viscosity of ≤ 500 cst and which will not easily cause adhesion.
- The maximum range of the coaxial tube radar can reach 6 meters.
- It has a strong ability to suppress steam and foam; thus, the measurement will not be affected.

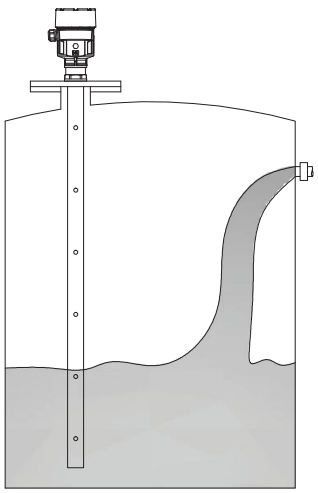


Figure 4

3.4 Mounting Method

Proper mounting can ensure the long-term reliable and accurate measurement of the instrument.

The instrument can be installed through screw thread fitting and the height of the thread installing tube shall not exceed 100mm. It can also be installed on a short tube. The diameter of the installing short-pipe shall be 2"-6" and the height of the installing short pipe shall be ≤100mm. If the instrument is installed on a longer short-pipe, fix the cable probe at the bottom or select the centering bracket to prevent contact between the cable probe and the end of short-pipe.

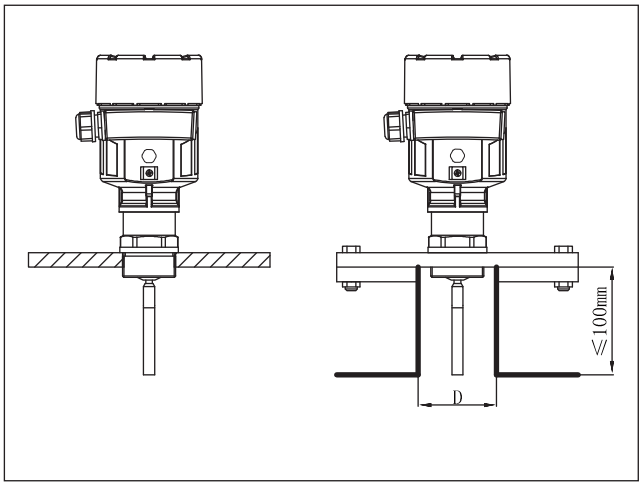


Figure 5

Mounting of DN200 or DN250 in short-tube

When the instrument needs to be mounted in a short tube with a diameter of more than 200mm, echoes will be generated on the inner wall of the short tube and caused measurement deviation if the dielectric constant of the medium is low. Therefore, for a short-tube with a diameter of 200mm or 250mm, the special flange with a“horn interface”shall be selected.

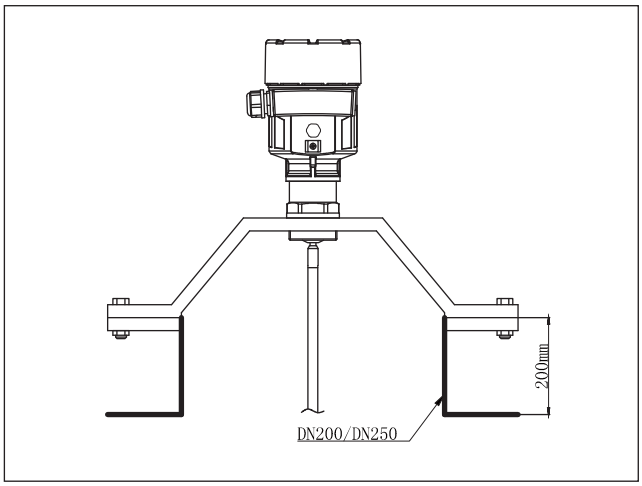


Figure 6

Precautions for mounting on plastic tank!

Regardless of cable or rod instrument, the process connection surface shall be metal in order to ensure the normal work of the instrument. When the instrument is installed on a plastic tank, the instrument shall be equipped with a metal flange if the tank top is also made of plastic or other non-conductive materials; the instrument shall be equipped with a metal plate if the threaded fitting is adopted.

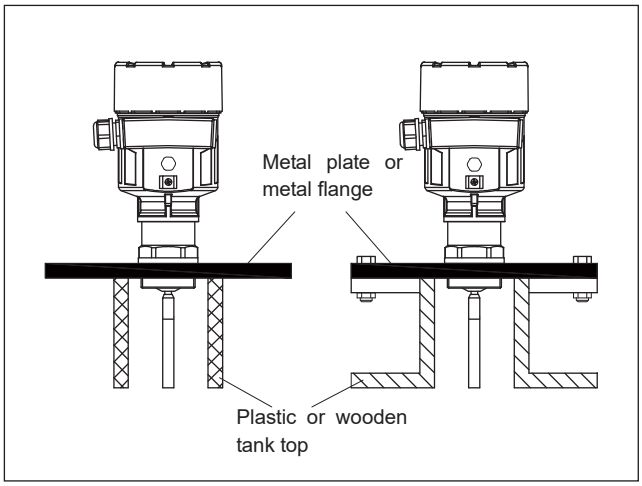


Figure 7

Distance between instrument probe and tank wall

The distance between the probe and tank wall should be as leat over 300mm, or 500 mm in the event of a concrete tank. Please make sure that the distance between the bottom of the probe and the bottom of the tank should be >50mm.

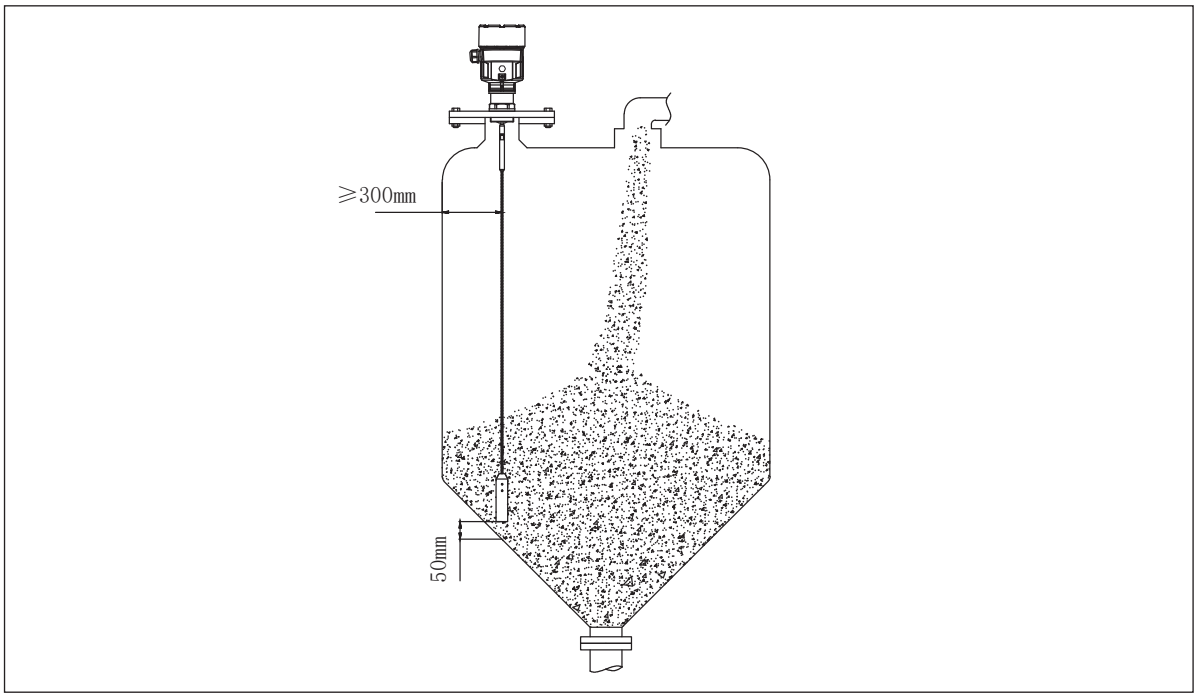


Figure 8

Precautions:

Avoiding the other devices in the tank contact to the microwave conductive parts. (as shown on the left)

The radar must not be mounted at the discharge outlet. (as shown on the right)

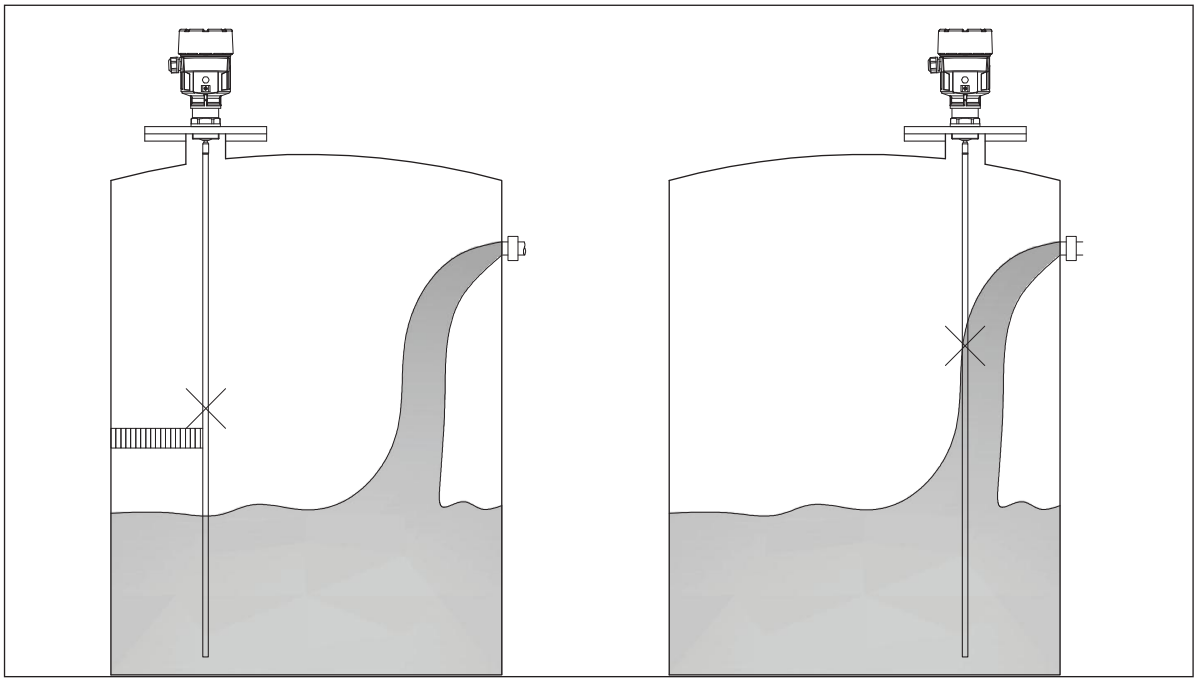


Figure 9

4. Electrical Connection

4.1 Supply Voltage

(4 ~ 20) mA/HART (two-wire system) Power supply 24V DC

The power supply and output current signal share a two-core shielded cable. For intrinsically safe type, a safety barrier must be added between the power supply and the instrument.

(4 ~ 20) mA/hart (four wire system) Power supply 24V DC

The power supply and current signal are separated, and two two-core shielded cables or one four-core shielded cable are used.

4.2 Installation Of Connecting Cable

Outside diameter of cable：6~9mm(M20×1.5) 3.5mm~8.7mm(½ "NPT)

Two core shielded cable is generally used for wiring.

(4 ~ 20) mA/hart (two-wire system) Two-core cables can be used for power supply cables

(4 ~ 20) mA/hart (four-wire system) Four-core cables can be used for power supply cables

4.3 Shielding And Wiring Of Cables

Ideally, the shielding wire is grounded at both ends. Note, however, that there will be ground compensation current through.When both ends are grounded, a capacitor with grounding potential can be connected at the grounding end (such as: switch cabinet).(e.g. : 1μF; 1500 v). Use grounding with as low resistance as possible. (Note: If meter is used in explosion-proof area,Because of the potential output, never use grounding at both ends)

4.4 Connection Mode

(1)Wiring mode of intrinsically safe single-cavity instrument

24VDC power supply, 4 ~ 20mA output

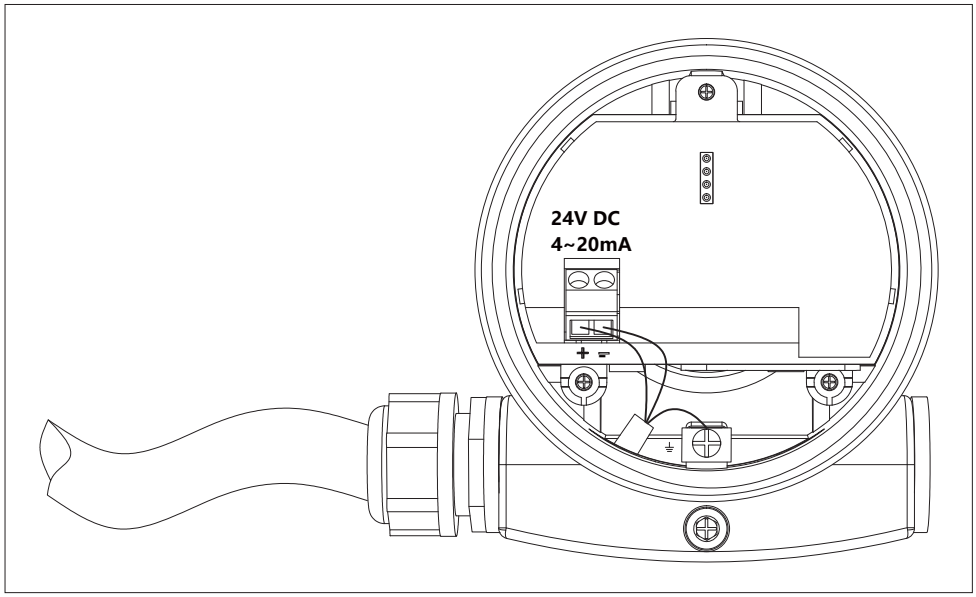


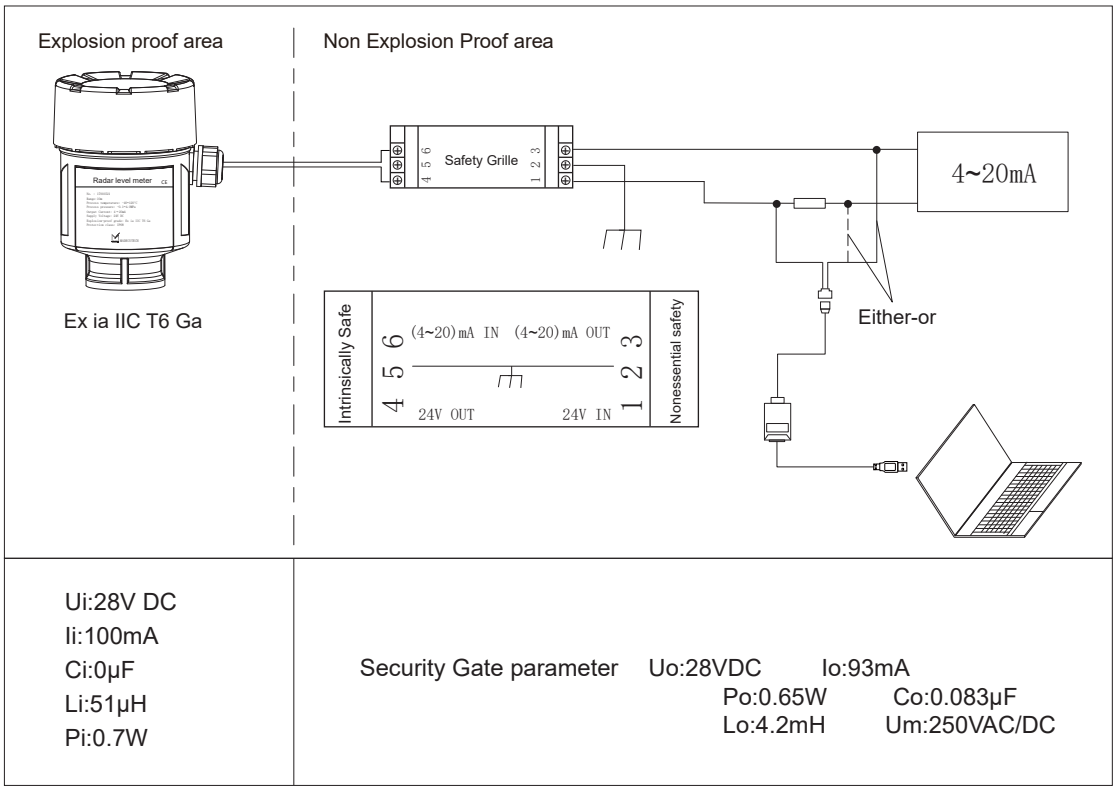
Figure 10 Two-wire connection

Explosion proof joint:

The explosion-proof type of this product is intrinsically safe. EXPLOSION-PROOF MARK: Ex ia II C T6 Ga, this product is suitable for Ex ia IIC T6 Ga explosion-proof class below the combustible medium level continuous measurement.

This product must be supplied with safety grille when in use. The Safety Grille is the related equipment of this product. The explosion-proof type is intrinsically safe. Explosion Proof Mark: [Ex ia Ga] IIC, power supply voltage 24V DC, short circuit current 100mA, working current (4 ~ 20)mA.

All cables shall be shielded with a maximum length of 500m from ins trument to Grille. Ui=28VDC, Ii=100mA,Pi=0.7W,Ci=0 μ F,Li=51 μ H. The radar level gauge must be connected to the earth when it is installed. No other associated equipment without explosion proof inspection shall be used.



Ui:28V DC Ii:100mA Ci:0μF Li:51μH Pi:0.7W	Security Gate parameter Uo:28VDC Io:93mA Po:0.65W Co:0.083μF Lo:4.2mH Um:250VAC/DC

Figure 11 Intrinsically safe type explosion-proof wiring

The distribution parameters of the connecting cables between the Grille and the level meter shall satisfy:

$$Uo \le Ui \quad Io \le Ii \quad Po \le Pi \quad Co \ge Cc + Ci \quad Lo \ge Lc + Li$$

Note：Uo:Maximum output voltage of security gate Io:Maximum output current of safety gate

Co:Maximum external capacitance of security gate Lo:Maximum External inductance of Safety Grille

Cc:Maximum allowable distributed capacitance of connecting cable

Lc:Maximum allowable distributed inductance of connecting cable

Ci:Maximum internal capacitance of level meter Li:Maximum internal inductance of level gauge

Precautions for explosion protection：

Do not allow to replace components or structure, so as not to affect the explosion-proof performance.

When this product is used in the“0”zone, the power supply transformer to the security grid must meet the requirements

The installation and wiring of the Safety Grille shall be carried out in accordance with the Safety Grille Operation Manual, and the Safety Grille shall be certified explosion-proof.

When this product is used in zone 0, measures should be taken to prevent ignition hazard due to impact or friction!

(2)Connection Mode of flameproof double-cavity instrument

220VAC/50Hz or 24V DC (OPTIONAL 12V DC) , 4 ~ 20mA output

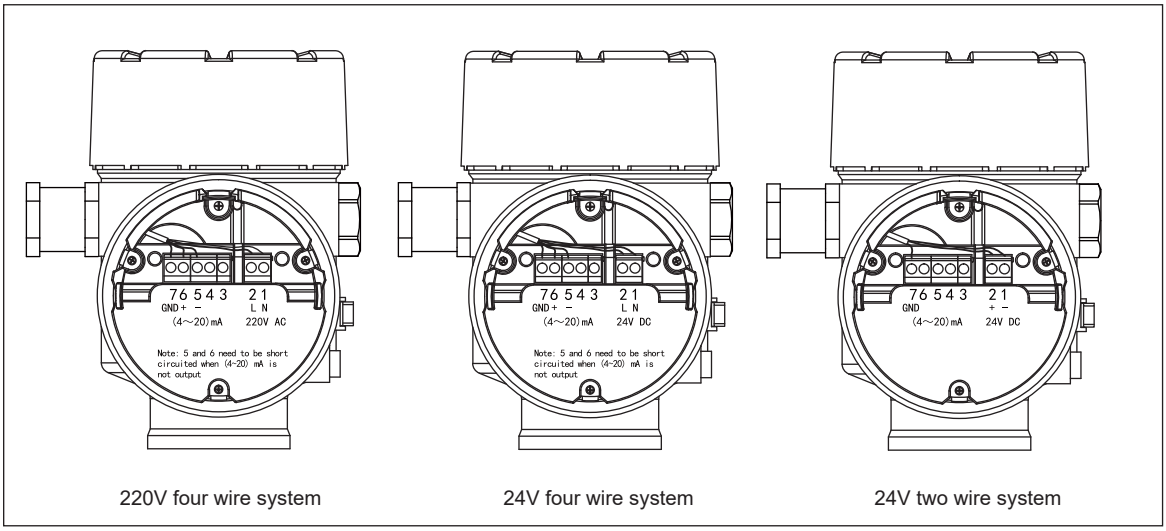


Figure 12

Flameproof connection:

The explosion-proof type of this product is explosion-proof type. EXPLOSION-PROOF MARK: Ex db IIC T6 Gb, this product is suitable for Exd IIC T 6 Gb explosion-proof class below combustible medium level continuous measurement.

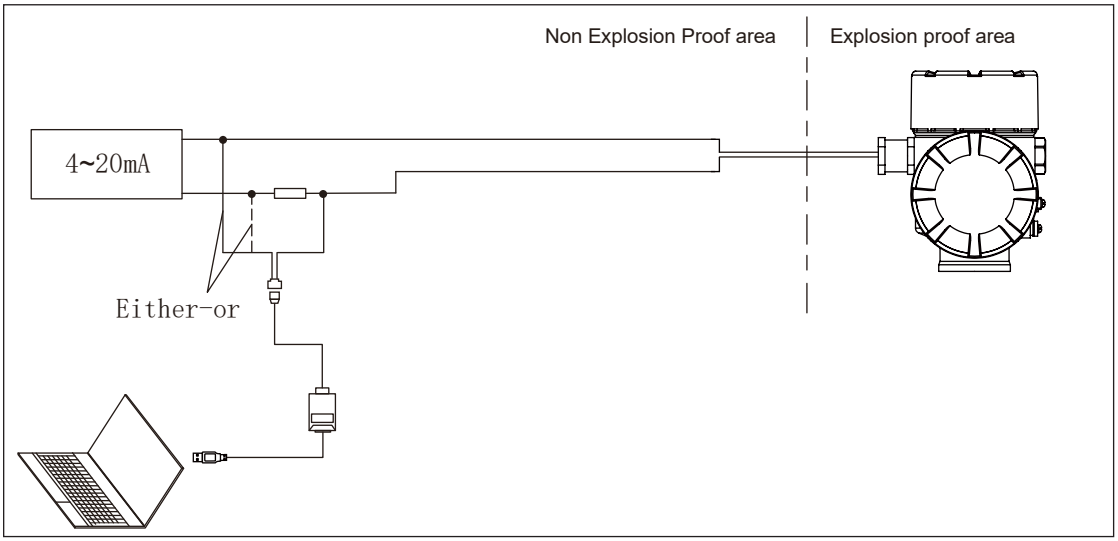


Figure 13 Two-wire wiring diagram of flameproof double-cavity instrument

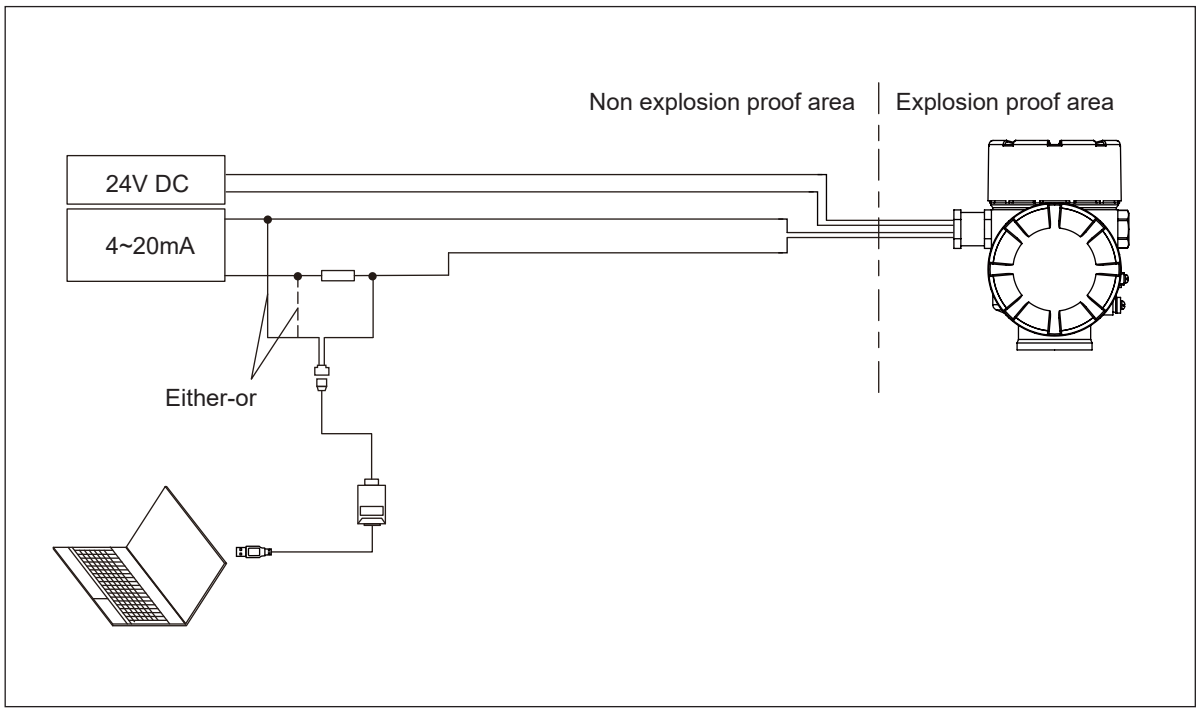


Figure 14 Four-wire connection of flameproof double-cavity instrument

(3)Display wiring mode next to the tank

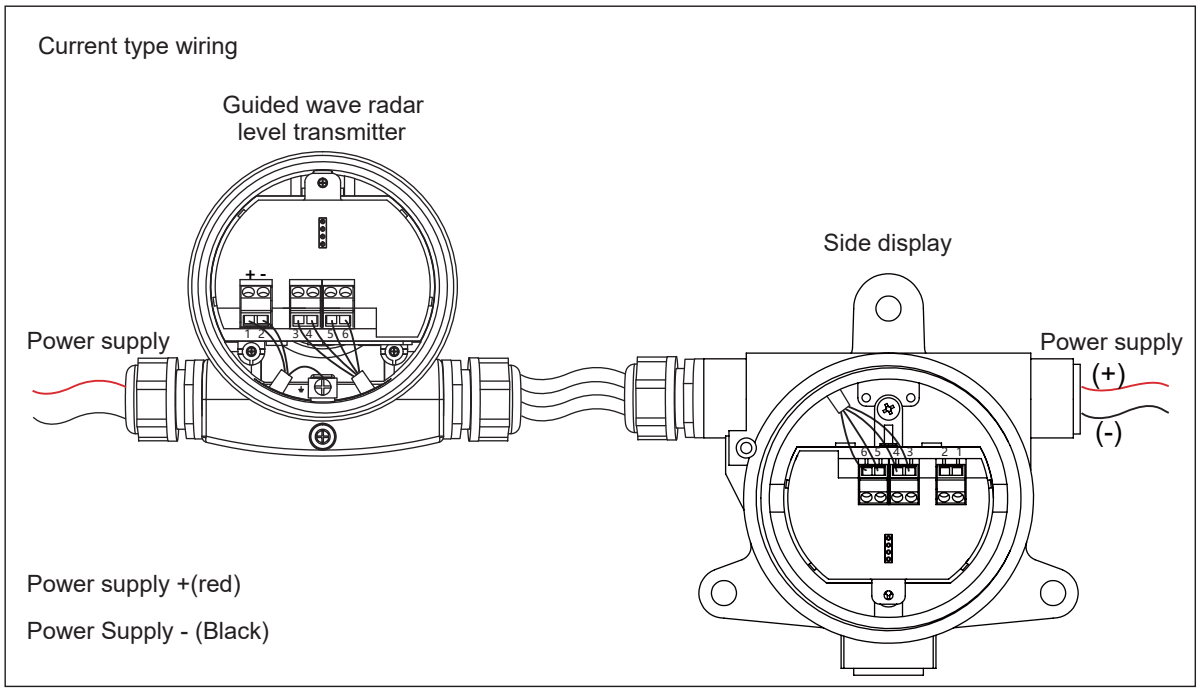


Figure 15

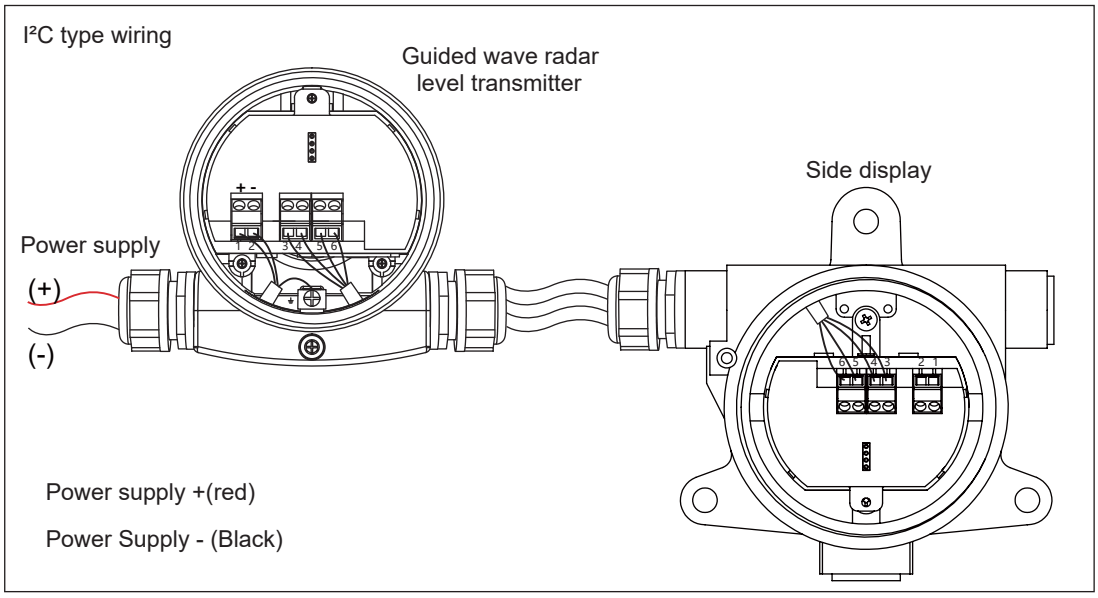


Figure 16

4.5 Safety Guide

All electrical connections must be made after turn o ffthe power. Please follow the instructions in the instrument manual!

- Please comply with local electrical installation procedures.
- Please comply with local health and safety regulations. All operation of the electrical components of the instrument must be carried out by professionally trained personnel.
- Please check the nameplate of the instrument to ensure that the product specifications are in line with your requirements. Please ensure that the supply voltage is in accordance with the requirements on the nameplate of the instrument.

4.6 Protection Rating

This instrument fully meet the protection level IP68 requirements, please ensure the waterproofcable sealing head.

Here's the picture:

How to ensure that the installation meets IP68 requirements:

- Please make sure the sealing head is not damaged

  Please make sure the cable is not damaged
- Please ensure that the cable used meets the requirements of the electrical connection specification by bending the cable downward before entering the electrical interface to ensure that water does not flow into the housing, See 1 ①
- Please tighten the cable seal head, See②
- Please tighten the unused electrical interface with blind plug, see③

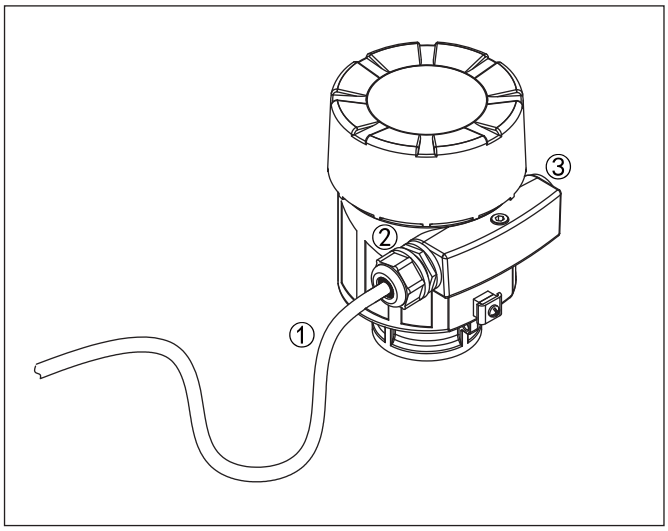


Figure 17

5.Technical Parameters

Parameters: Operating frequency: 100MHz-1.8GHz

Measuring range: Cable type: (0-30) m; Rod type: (0-3) m/ (0-6) m; Coaxial tube type: (0-6) m

Resolution: 1 mm

Sampling: Echo sampling 55 times/s

Response speed: > 0.2s (depending on specific service conditions)

Process connection: G1½ "A thread; G¾ "A thread(Rod-style only, no blind spots)

Flange DN50, DN80, DN100, DN150, DN200, DN250

power supply: Two-wire: 24V DC(±10%), Ripple voltage: 1Vpp

Power consumption: Max.0.54W

Four-wire: 24V DC(±10%) 220V AC(±10%)

Power consumption: Max.0.54W Max.2W

Shell material: Aluminum/Plastic (ABS)

Explosion-proof rating: Ex ia IIC T6 Ga/Ex db IIC T6 Gb

Two-wire wiring: The power supply and the signal output of the instrument share a two-core shielded cable.

Cable inlet: two M20*1.5 or ½ NPT (cable diameter 6-9mm)

Measuring distance: The following table lists the relationships between different types of measured media and measuring distance.

6.Debugging

6.1 Programmer

6.1.1 Key Function

The instrument is debugged by 4 keys on the programming module. The language of the debug menu is optional. After debugging, generally only for display, through the glass window can be very clear to read the measured value.

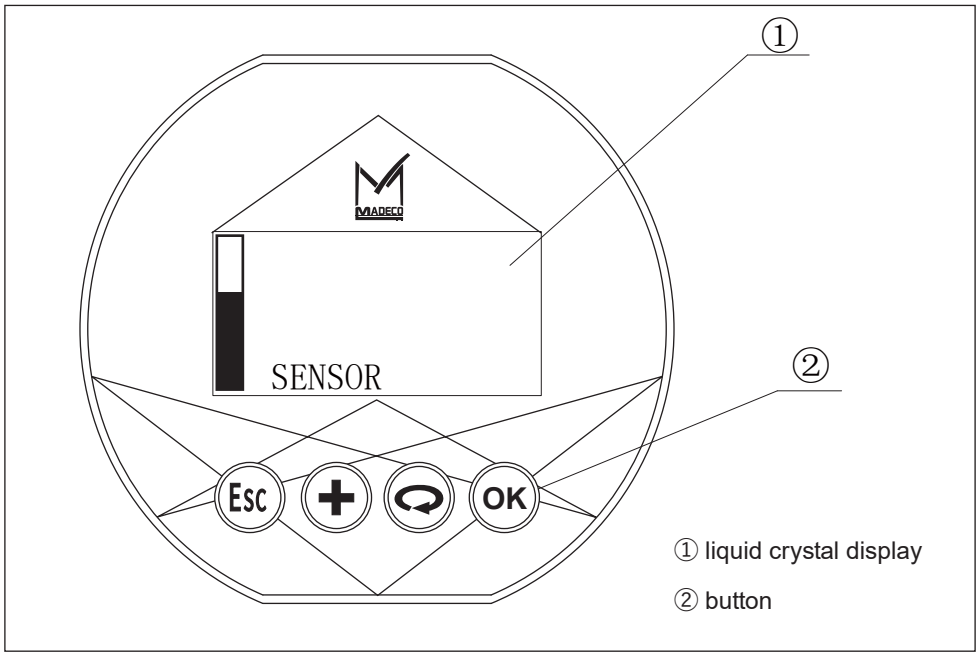


Figure 18

ESC Keys	-Exit the programming state; -Go to the upper level menu; -Gun the measurement/echo waveform switch.
+ Keys	-Modify parameter values; -Select display mode;
Keys	-Select programming item; -Select edit parameter bit; -Parameter item content display;
OK Keys	−Go to programming mode −Confirm programming item −Confirm parameter modification

6.1.2 Debugging Steps

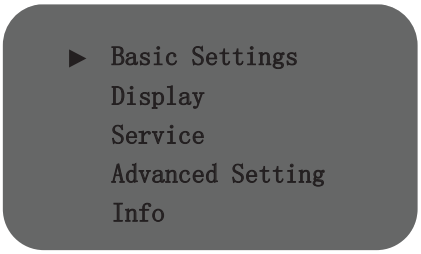
(1) Enter Main Menu

Press the OK key while the instrument is in operation mode to enter programming mode and display the programming main menu. After editing each paer, you must press the OK key to confirm; otherwise, the edit will be invalid. After completing the editing, press the ESC key to exit programming mode and return to operation At any time during programming, you can press the ESC key to cancel programming and exit the parameter programming state.

(2) Parameter Editing Method

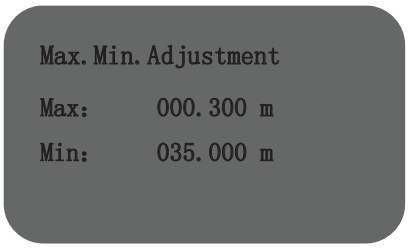
Character/Numeric Parameter Programming: When the menu enters the character/numeric programming state, the first digit of the parameter being edited isghlighted in black. At this point, press the + key to change the character/number of that digit until the desired character/number is reached. Press the ↻ key aghe character/number positions will be highlighted in black sequentially, allowing you to edit other positions. After editing is complete, press the OK key to confirm the changes. In the rnning state, press the OK key to enter the programming state, and the LCD will display the main menu.

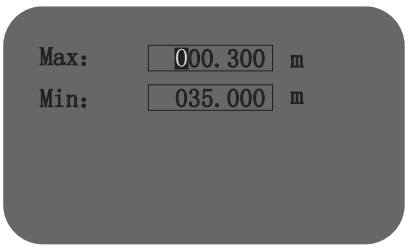
In the running state, press the OK to enter the programming state, and the LCD displays the main menu.



① Max.Min.Adjustment

Min.adjustment is used for range setting. It, together with the max.adjustment, determines the scale of thelinear relationship between the current output and the. In the main menu, press the OK key to enter the basic setting submenu.

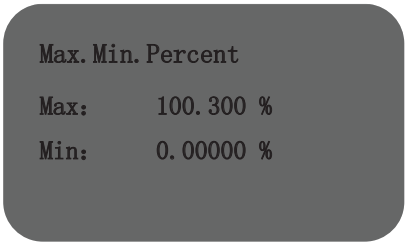


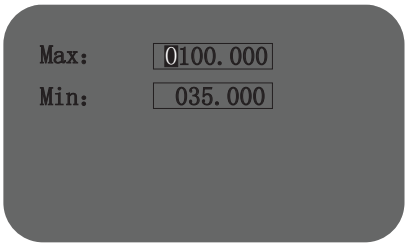


Press the OK key to enter the programming of max.min.adjustment, refer to the programming method of character /number parameters in the parameter editing method mentioned above to edit max.min.adjustment. When the editing is completed, press the OK key to confirm, press the ESC key to cancel the programming.

② Max.Min.Percent

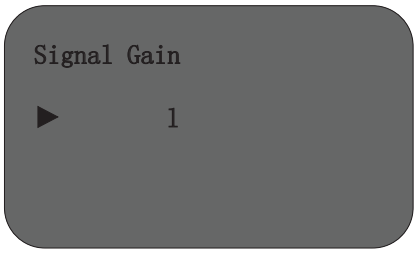
Press the OK key to enter the parameter editing state, use the ⊕ key to set the number, use the ⟲ key to select the editing number bit, and press the OK key to after editing.

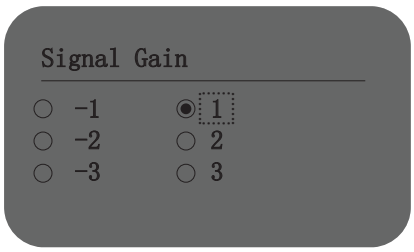




③Signal Gain

Signal gain is suitable for small on-site target signals. Adjust the signal gain to increase signal strength for identifying target signals. To enter signal gain adjustment, press the OK key to access the signal gain selection interface, and press the ⟲ key to select signal strength levels -1, -2, -3, 1, 2, or 3.

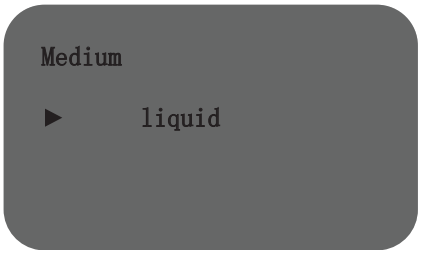


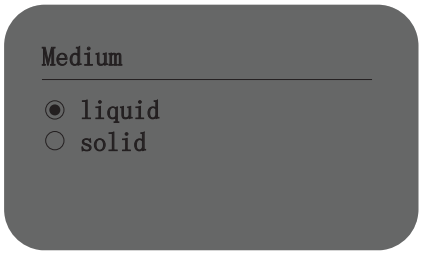


④ Medium

The medium menu is used to select between liquid and solid.

Press the OK key to enter the parameter selection state, use the ⟲ key to move the arrow to the required parameter item, such as liquid or solid, and press the OK key confirm after editing.

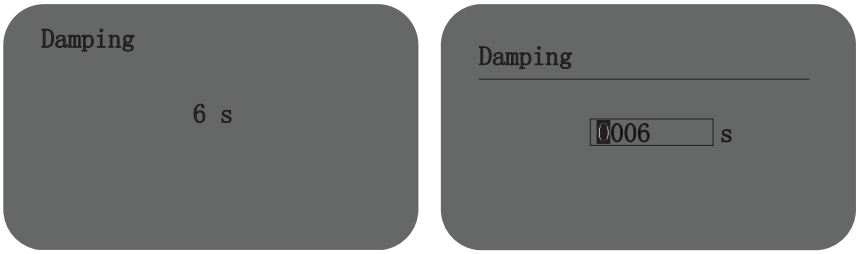




⑤ Damping

In order to improve the stability of the measured output value, a larger damping time can be set to achieve the stability of the measured value and increase the anti-inter ability.

Press the OK key to enter the parameter editing state, use the + key to set the number, and use the ↻ key to select the editing number bit.The damping time set to 6s by default, and the adjustable range is 0-1000s. after editing, press OK the key to confirm.



⑦ Cable Length

The cable length is the actual length of the sounding rod or the cable length.

Press the OK key to enter the parameter editing state, use the + key to set the number, use the ↻ key to select the editing number bit, and press the OK key to after editing.

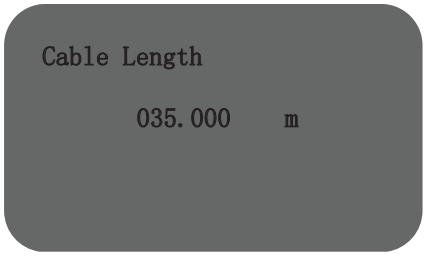
Press the OK key to enter the parameter editing state, use the + key to set the number, use the ↻ key to select the editing number bit, and press the OK key to after editing.



⑥ Max.min.Nearblank

When there is a fixed obstacle near the surface of the distance sensor that interferes with the measurement, and the highest material height will not reach the obstacle, the position blind area setting function can be used to avoid measurement errors;

When there is a fixed obstacle near the end of the probe that interferes with the measurement, and the lowest material height will not be lower than the obstacle, low-position blind zone setting function can be used to avoid measurement errors.



6.2 PC Software Debugging

Connect to host computer through Hart

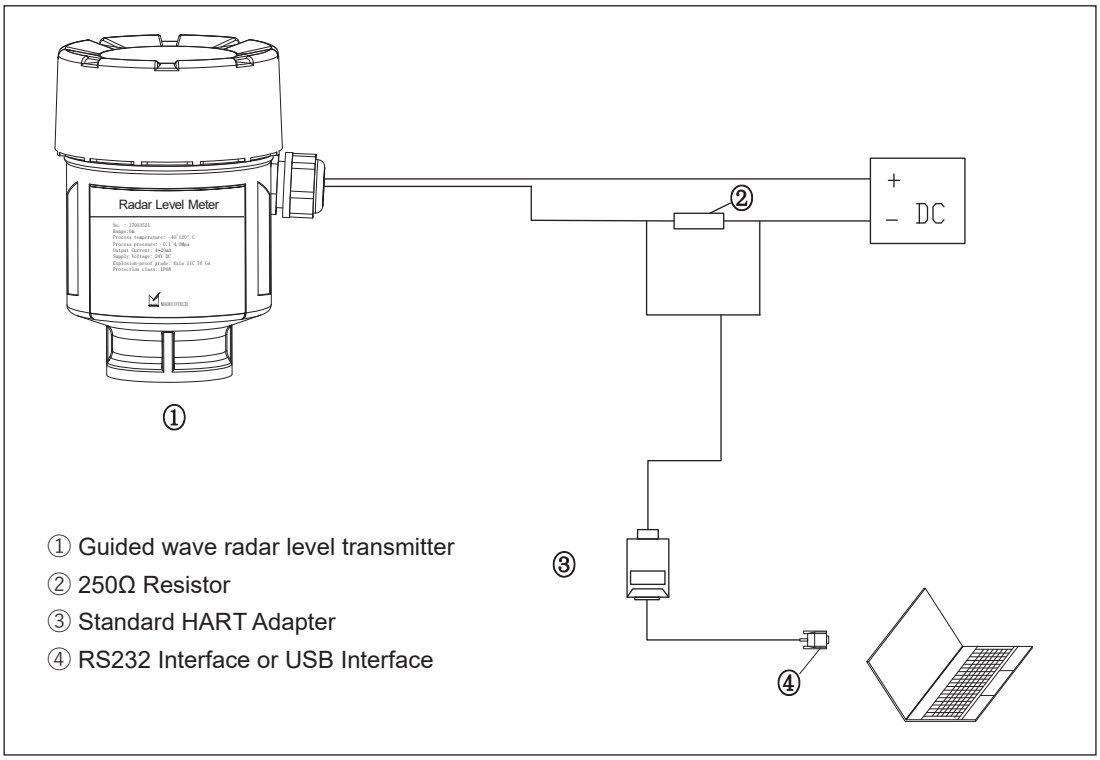


Figure 19

6.3 HART Handheld Programmer Debugging

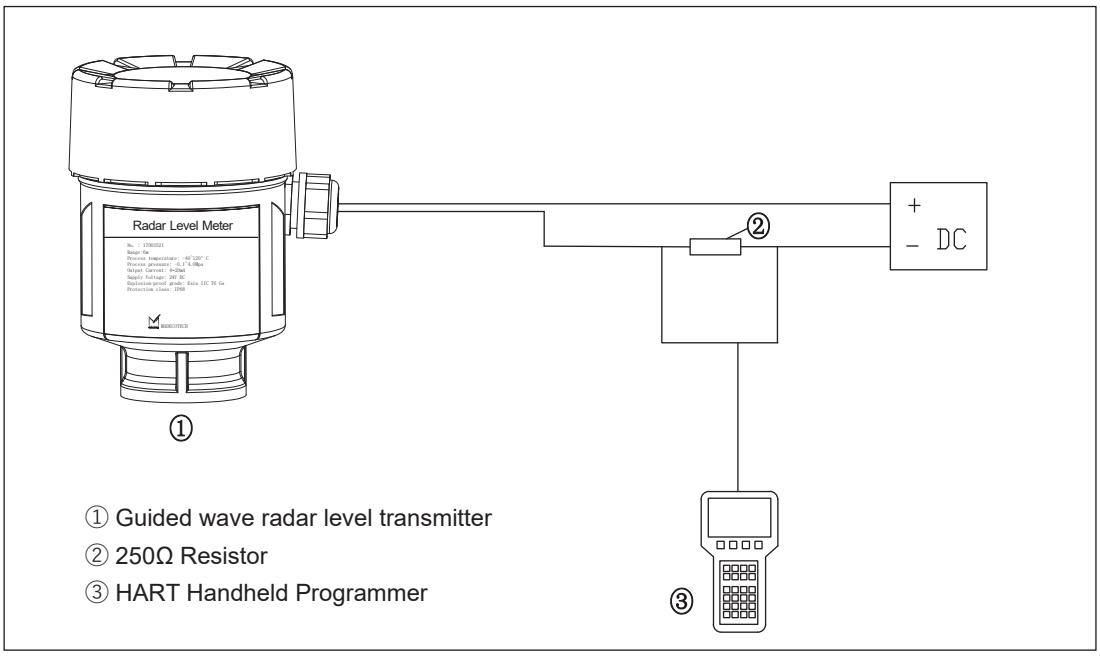
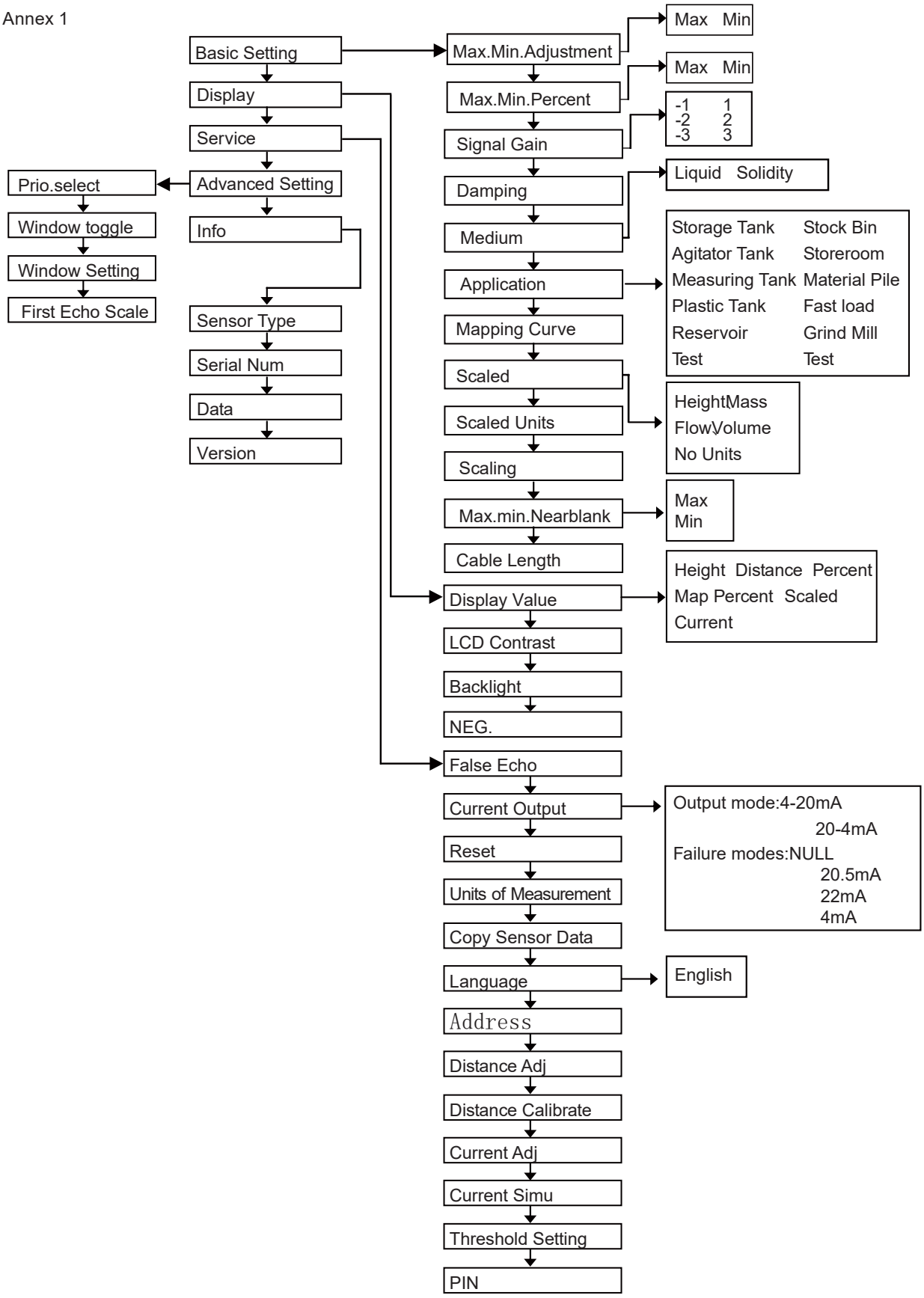


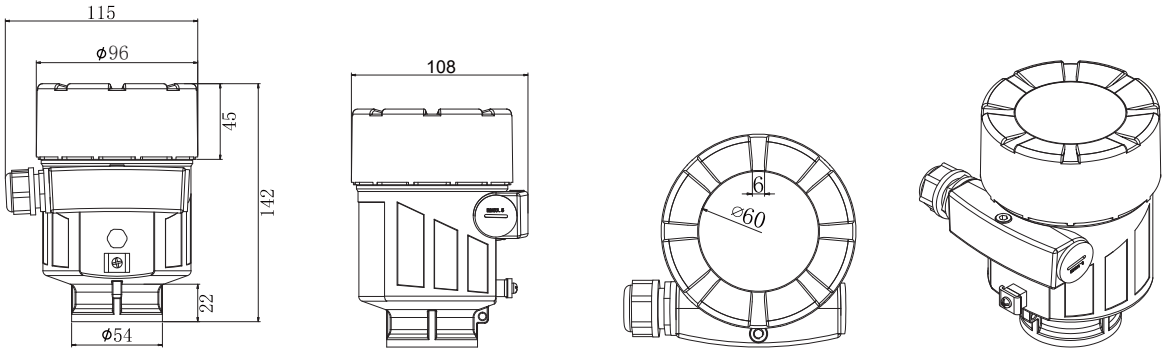
Figure 20

Annex 1


Basic Setting
Display
Service
Advanced Setting
Prio.select
Window toggle
Window Setting
First Echo Scale
Info
Sensor Type
Serial Num
Data
Version
Max.Min.Adjustment
Max.Min.Percent
Signal Gain
Damping
Medium
Application
Mapping Curve
Scaled
Scaled Units
Scaling
Max.min.Nearblank
Cable Length
Display Value
LCD Contrast
Backlight
NEG.
False Echo
Current Output
Reset
Units of Measurement
Copy Sensor Data
Language
Address
Distance Adj
Distance Calibrate
Current Adj
Current Simu
Threshold Setting
PIN
Max Min
Max Min
-1 1
-2 2
-3 3
Liquid Solidity
Storage Tank Stock Bin
Agitator Tank Storeroom
Measuring Tank Material Pile
Plastic Tank Fast load
Reservoir Grind Mill
Test Test
HeightMass
FlowVolume
No Units
Max
Min
Height Distance Percent
Map Percent Scaled
Current
Output mode:4-20mA
20-4mA
Failure modes:NULL
20.5mA
22mA
4mA
English

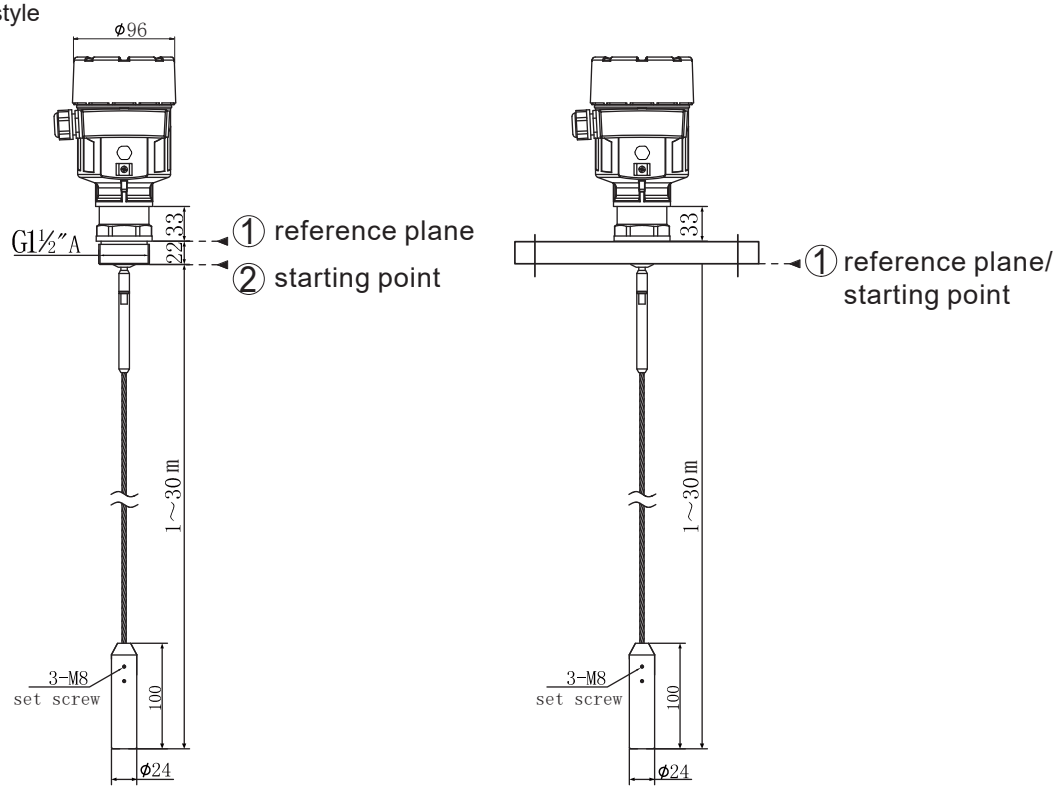
7.Dimensions(Unit:mm)

7.1 Shell Dimensions(Material: AL)

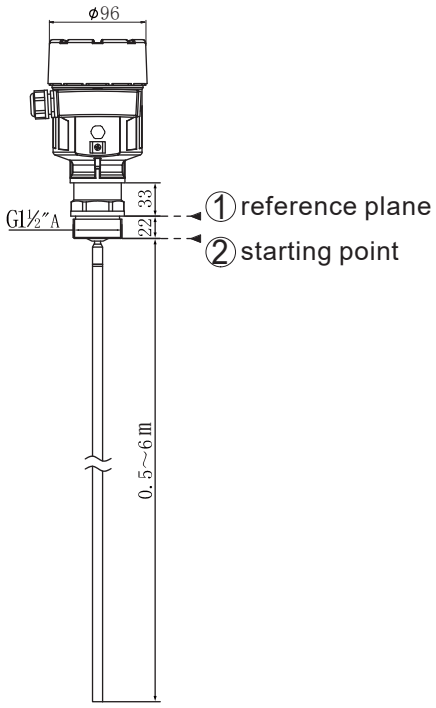


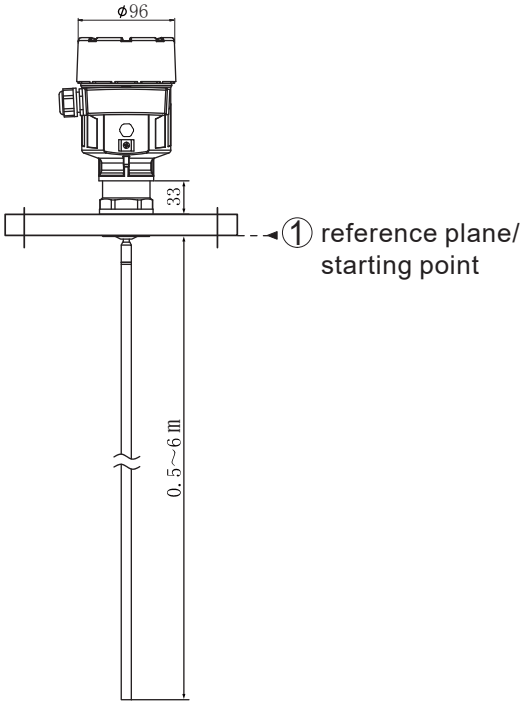
7.2 Structural Dimensions

Cable-style

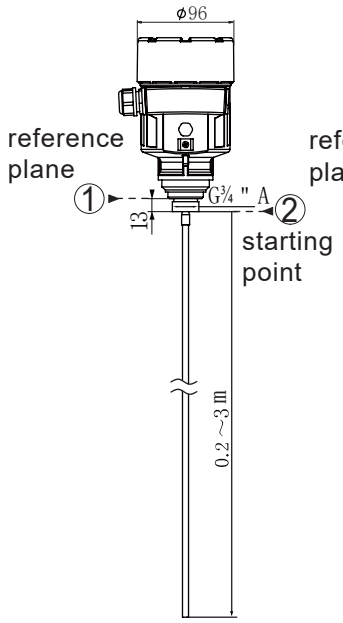


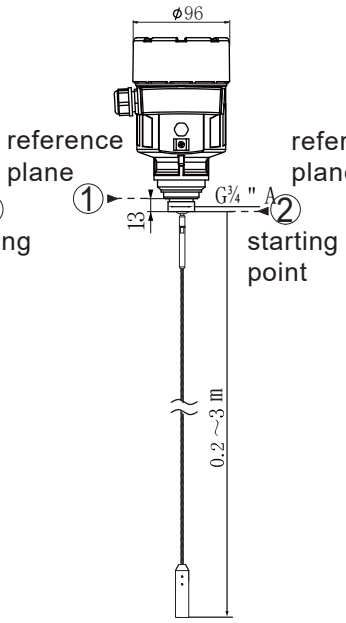
Rod-style

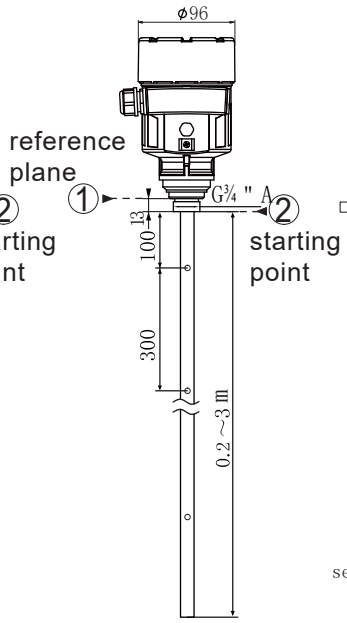


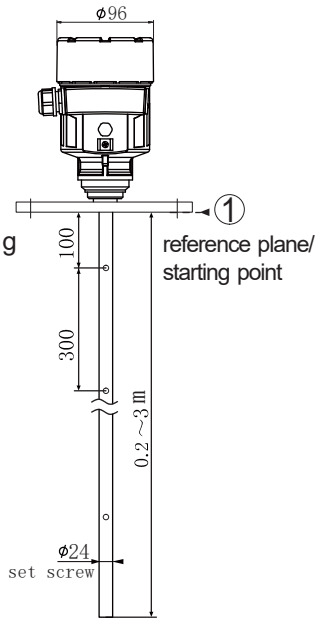


Rod-type (No blind spot)

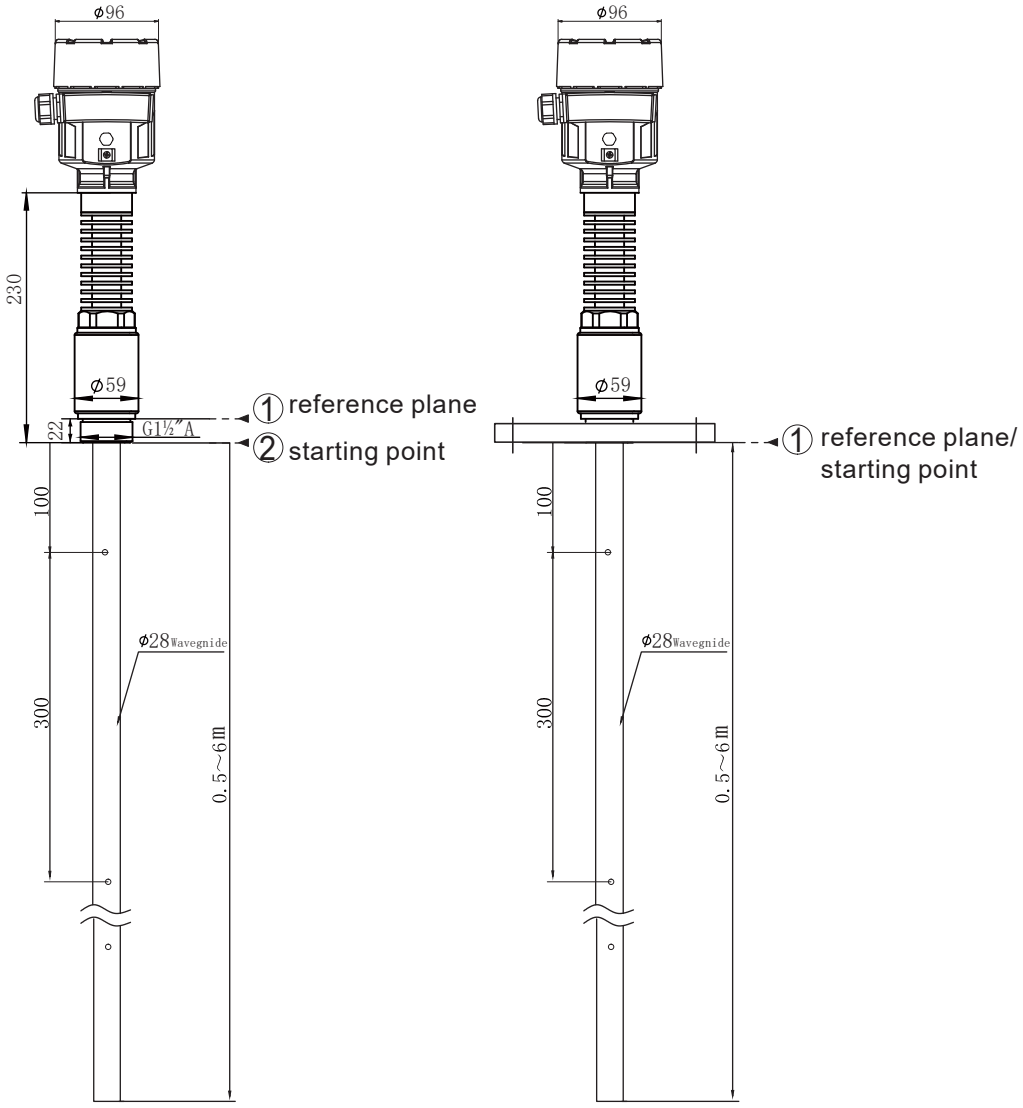




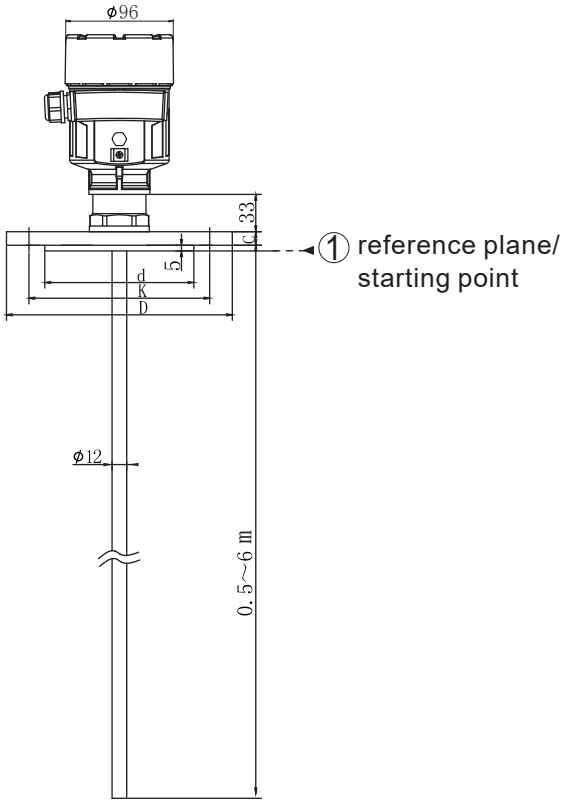




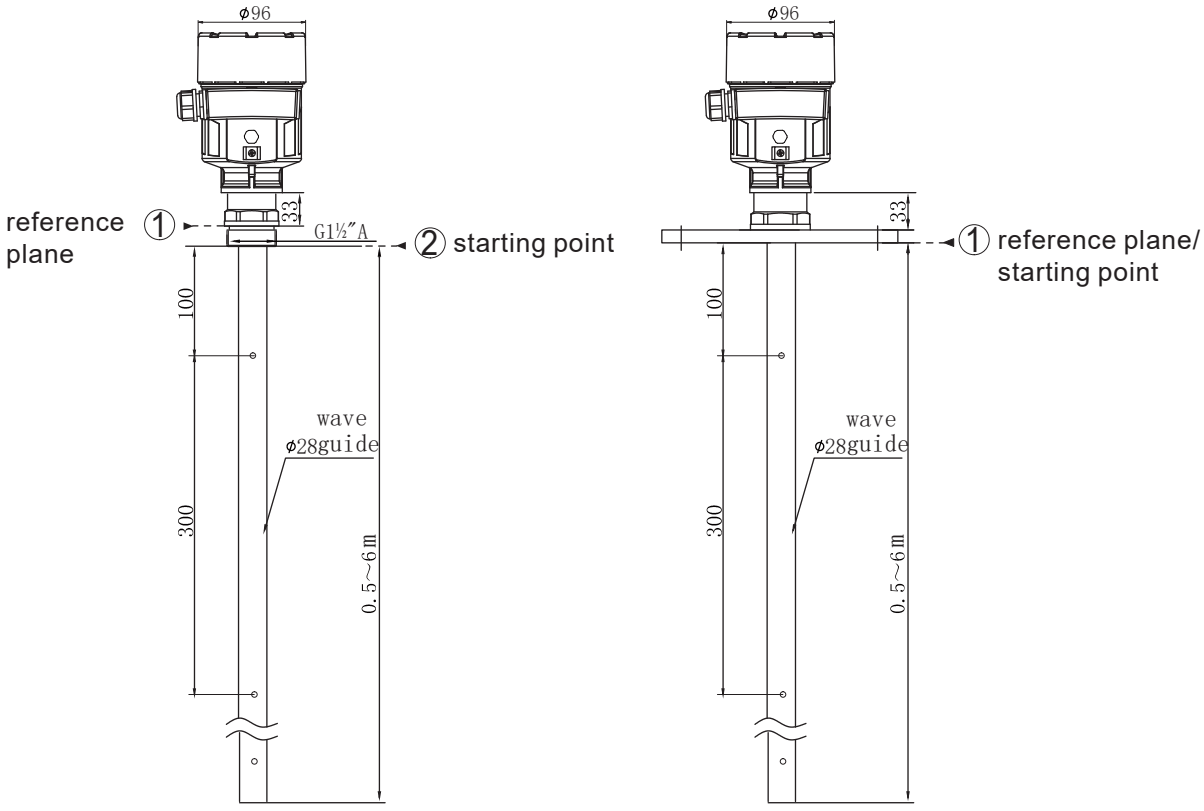
High-temperature type



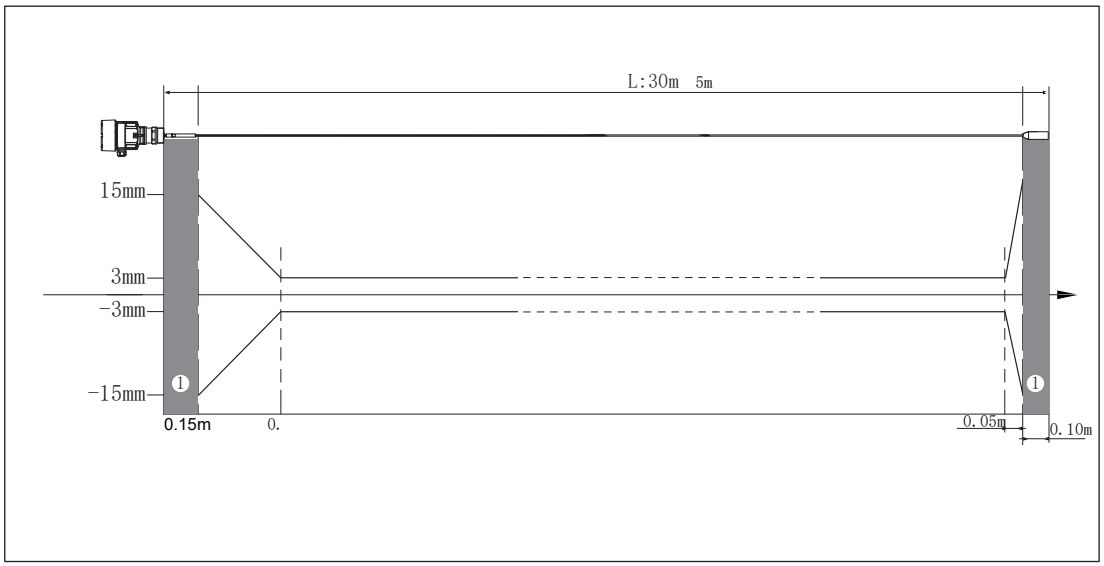
Anti-corrosion type



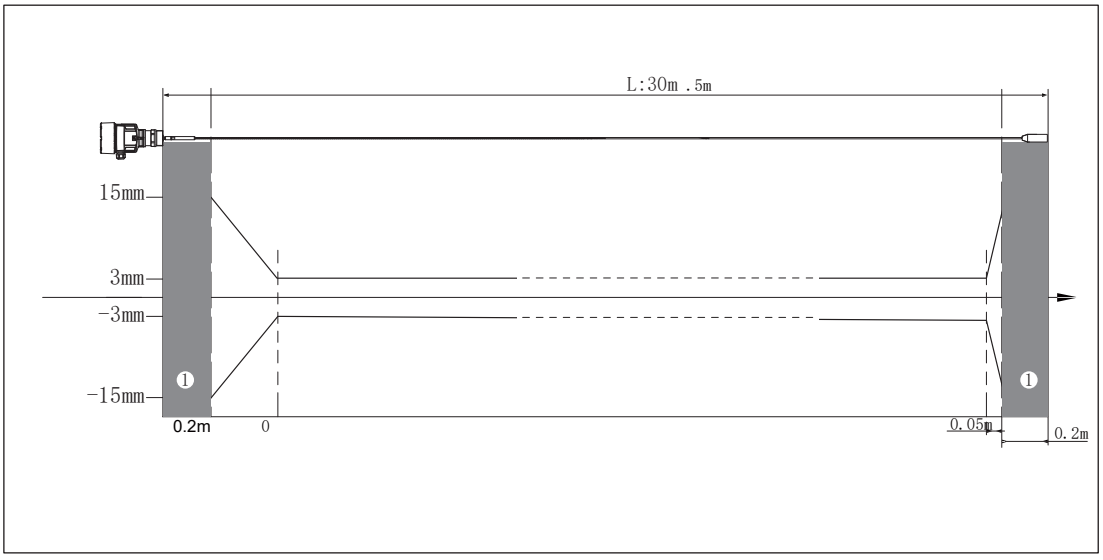
Coaxial tube-type



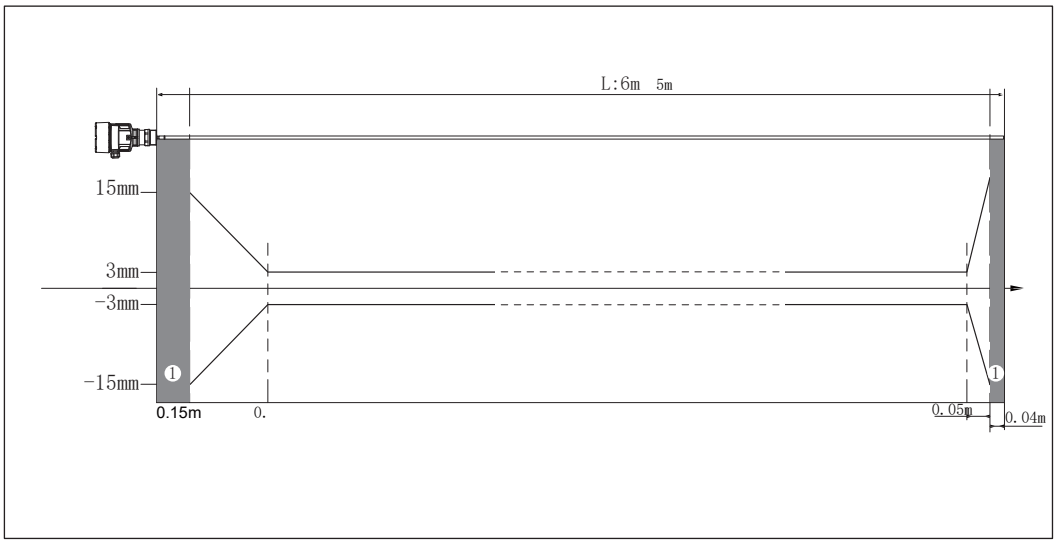
8. Linearity of Instrument



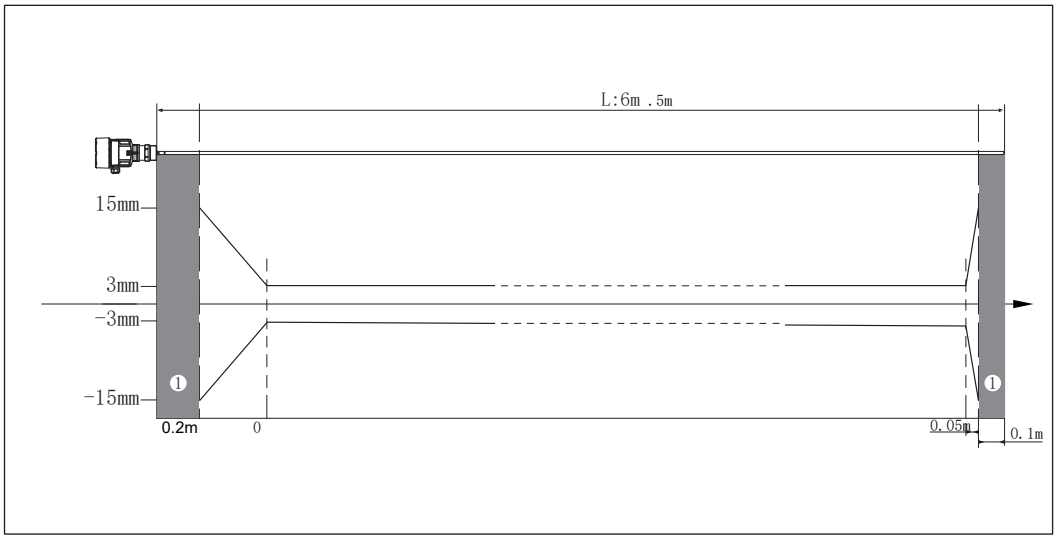
Measurement deviation of cable-type in medium “water”
① : Block distance - cannot be measured within this range
L: Cable length



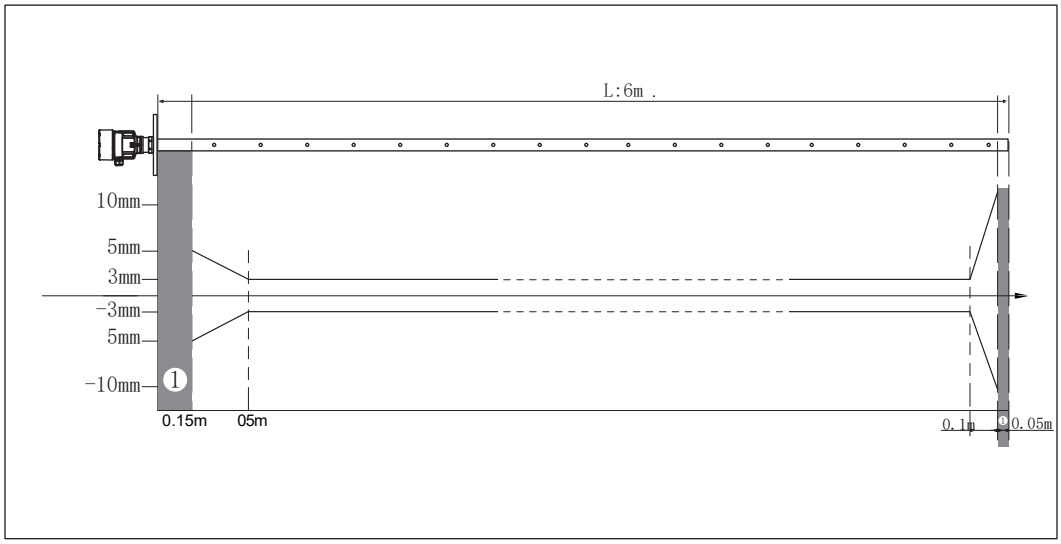
Measurement deviation of cable-type in medium “oil”
① : Block distance - cannot be measured within this range
L: Cable length



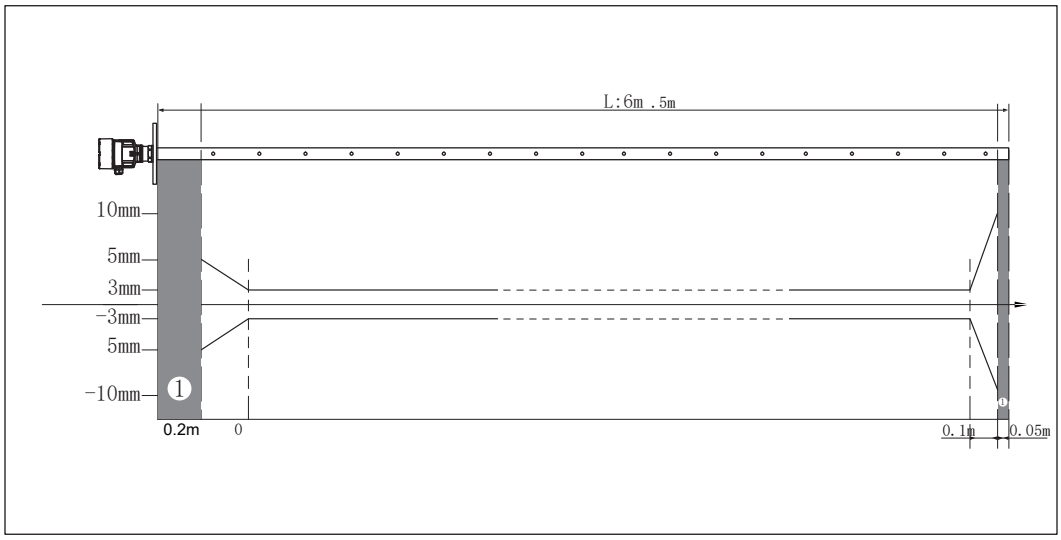
Measurement deviation of rod-style in medium “water”
① : Block distance - cannot be measured within this range
L: Probe rod length



Measurement deviation of rod-style in medium “oil”
① : Block distance - cannot be measured within this range
L: Probe rod length



Measurement deviation of tube-type in medium “water”
① : Block distance - cannot be measured within this range
L: Probe rod length



Measurement deviation of tube-type in medium “oil”
① : Block distance - cannot be measured within this range
L: Probe rod length

9. Transportation and Storage

transported or stored:

(1)The level meter should be transported in strict accordance with the products features and requirements from the specifications.

(2)The level meter should be stored in a dry and Well-ventilated room of -20~60 ℃, with relative humidity ≤80%. Remember not to store it with corrosive substances. The long-stored instruments shall be calibrated and checked before use or sale.