REV. 10/2024

Instrumation
Soluções Tecnológicas

RADAR LEVEL METER

SERIE RL 1082

Bluetooth

80GHz
FMCW

HART®
FIELD COMMUNICATIONS PROTOCOL

MANUAL DE INSTRUÇÕES

EN

ATENÇÃO !

LEIA TODAS AS RECOMENDAÇÕES PRESENTES NESTE MANUAL ANTES DE INICIAR A INSTALAÇÃO, EVITANDO ASSIM, O MANUSEIO INCORRETO, FALHA DO EQUIPAMENTO E ATÉ MESMO LESÕES PESSOAIS.

Content

1.Principle

Frequency modulated continuous wave (FMCW) is adopted for radar level instrument (80G). The antenna transmits the high frequency and frequency modulated radar signal.

The frequency of the radar signal linearly increases. the transmitted radar signal is reflected by dielectric to be measured and received by antenna. at the same time, the difference between the frequency of transmitted signal and that of the received signal is proportional to the measured distance.

Therefore, the distance is calculated by the spectrum derived from the analog-to-digital conversion frequency difference and the fast fourier transform (FFT)

2. Features

01 **Based** on self-aeveloped milimeter-wave radio frequency chip to achieve a more compact radio frequency architecture.

02 Higher signal-to-noise ratio, almost unaffected by level fluctuations.

03 The measurement accuracy is millimeter-level accuracy (1mm), which can be used for metrology-level measurement.

04 The measurement blind area is small, and the effect of measuring the liguid eve of small storage tanks is better.

05 The beam angle can reach 3 and the energy is more focused,effectively avoiding false echo interference.

06 High frequency signal, can effectively measure the level of medium with low dielectric constant (e>1.5).

07 The antenna adopts PTFE lens, which is effective anti-corrosion and anti-hanging material.

3. Technical Specification

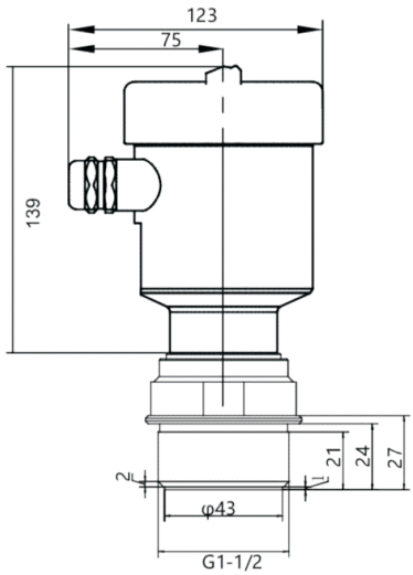
Picture							
Model	RL1081	RL1082	RL1083	RL1084	RL1085	RL1086	RL1087
Application	Slightly corrosive liquid, stirring, condensation	Slightly corrosive liquid, stirring, condensation	Strong dust, Solid, Block, Powder	Strong corrosive liquid, stirring, condensation	High temperature, strong corrosive liquid, stirring, condensation	Strong corrosive liquid, stirring, condensation	High temperature and high pressure liquid and solid
Process Connection	1.5" Thread, Flange	3.5" Thread, Flange	Flange with purging	Flange	Flange	Flange	Flange
Standard Process Temperature	-30~+100℃	-30~+80℃	-30~+100℃	-30~+75℃	-40~+200℃	-30~100℃	-40~+1000℃
Process Pressure	-0.1~0.3 MPA	-0.1~0.3 MPA	-0.1~0.3 MPA	-0.1~0.1 MPA	-0.3~2 MPA	-0.1~2 MPA	-0.5~3 MPA
Beam Angle	8°	3°	3°	5°	5°	8°	3°
Measuring Range	10m, 20m, 30m	10m, 20m, 30m, 80m, 120m	10m, 20m, 30m, 80m, 120m	10m, 20m, 30m, 80m, 120m	10m, 20m, 30m, 80m, 120m	10m, 20m, 30m	10m, 20m, 30m, 80m, 120m
Accuracy	±1 mm(≤30mm) ±3 mm(≥30mm)		±5 mm	±1 mm(≤30mm), ±3 mm(≥30mm)			
Wetted Parts	PTFE						Carbon steel, SS304, SS316
Blind zone	0.15m for 35m, 0.4m for 85m, 0.6m for 120m						
Frequency	76~81GHz, FM scanning frequency width 5GHz						
Ambient Temperature	-30~+70℃						
Shell Material	Cast Aluminium, SS304, SS316						
Power Supply	18~28 VDC, 85~865 VAC						
Signal Output	Two-wire / four-wire 4~20mA, HART / RS485 Modbus / Bluetooth						
Structurer	Compact, remote						
Ex-proof	Ex d IIC T6 Gb optional						
Protect Grade	IP67						
Language	English, Spanish, Russian, Portuguese, Korean						

4. Drawing

RL1081

Thread Connection

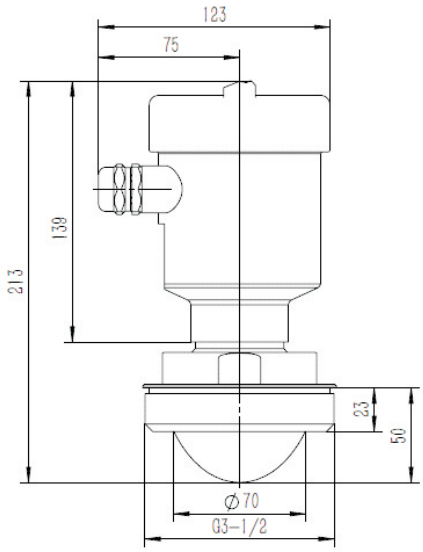
Flange connection



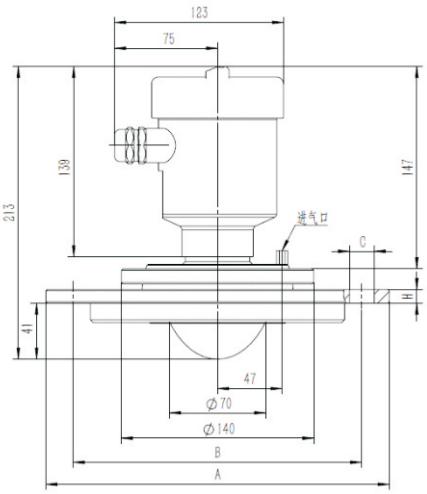
RL1082

Thread Connection

Flange connection

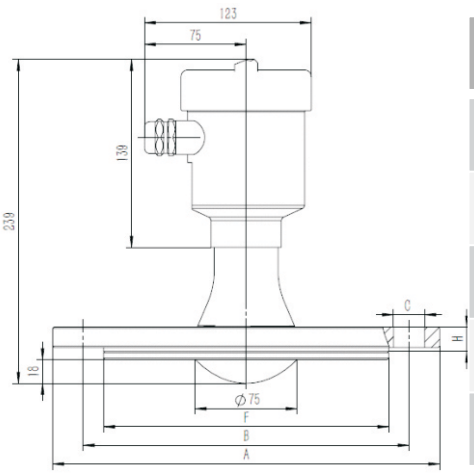


RL1083



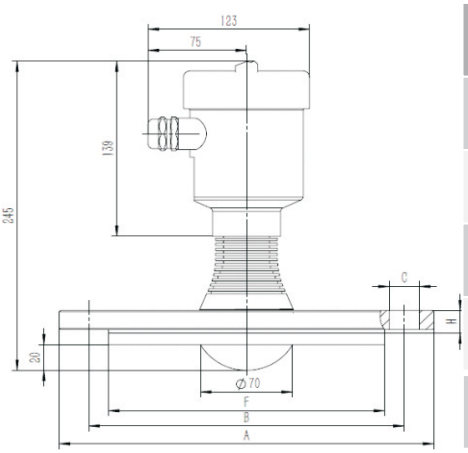
	A	B	C	H
DN80	190	150	4-φ18	15
DN100	210	170	4-φ18	15
DN125	240	200	8-φ18	17
DN150	265	225	8-φ18	17
DN200	320	280	8-φ18	19

RL1084



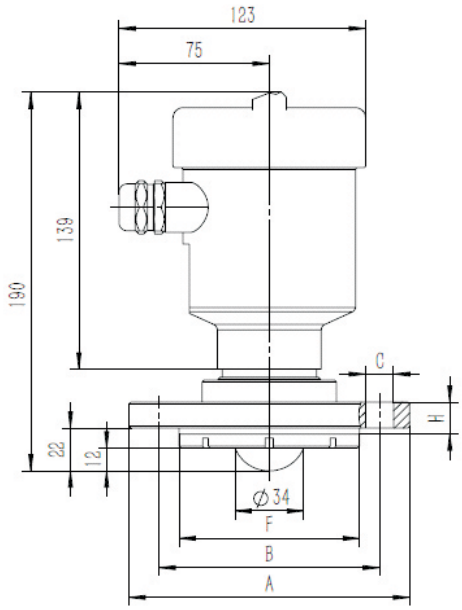
	A	B	C	F	H
DN80	φ190	φ150	4-φ18	φ128	18
DN100	φ210	φ170	4-φ18	φ148	18
DN125	φ240	φ200	8-φ18	φ178	20
DN150	φ265	φ225	8-φ18	φ202	20
DN200	φ320	φ280	8-φ18	φ258	20

RL1085



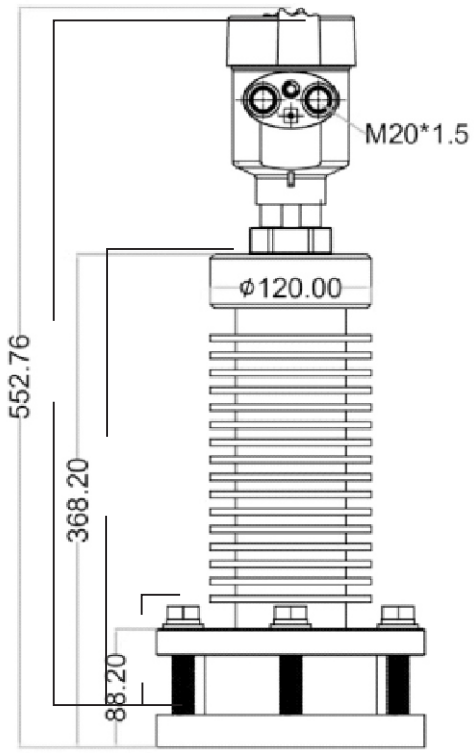
	A	B	C	F	H
DN80	φ200	φ160	8-φ18	φ138	20
DN100	φ220	φ180	8-φ18	φ158	22
DN125	φ250	φ210	8-φ18	φ188	22
DN150	φ285	φ240	8-φ22	φ212	24
DN200	φ340	φ295	12-φ22	φ268	26

RL1086



	A	B	C	F	H
DN80	φ140	φ110	4-φ14	φ90	16
DN100	φ160	φ130	4-φ14	φ110	16

RL1087



Safety Guidance

Please comply with the requirements of local electrical installation regulations!

Please abide by local regulations and requirements for personnel health andsafety.

All operations on the electrical components of the instrument must becompleted by formal trained professionals.

Please check the nameplate of the meter to ensure that the product specificationsmeet your requirements.

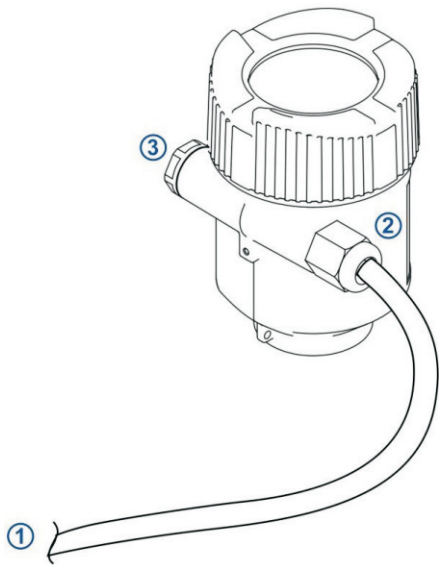
Please make sure that the power supply voltage isconsistent with the requirements in the nameplate.

Notice:

1. There shall be no obstacles in the area radiated by the transmitted microwave beam from the lower edge of the antenna to the dielectric surface to be measured.
2. It is necessary to avoid the facilities in the tank during installation, for example: human ladder, limit switch, heating equipment, supports, etc. If necessary, "Virtual Echo Learning" should be implemented.
3. Please note that the microwave beam should not intersect the charging material flow. During the installation of instrument, please also note that: the highest material level shall not enter the unmeasurable zone; the instrument shall be kept at a certain distance from the wall of tank.
4. The installation of instrument should enable the transmitting direction of antenna to be perpendicular to the dielectric surface to be measured as much as possible. The instruments should be grounded.

5. Protection Class

This instrument fully meets the requirements of protection class IP66/67. Please ensure the waterproof of the cable sealing head. Such as the following figure:



How to ensure that the installation meets the requirements of IP67:

Make sure that the sealing head is not damaged. Make sure that the cable is not damaged.

Make sure that the cable meets the requirements of the electrical connection specifications.

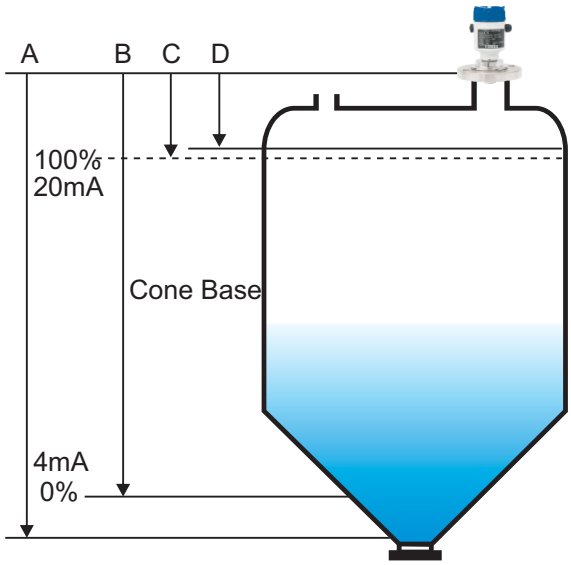
Before entering the electrical interface, bend the cable downward to ensure water will not flow into the shell, see ①

Please tighten the cable sealing head, see ②

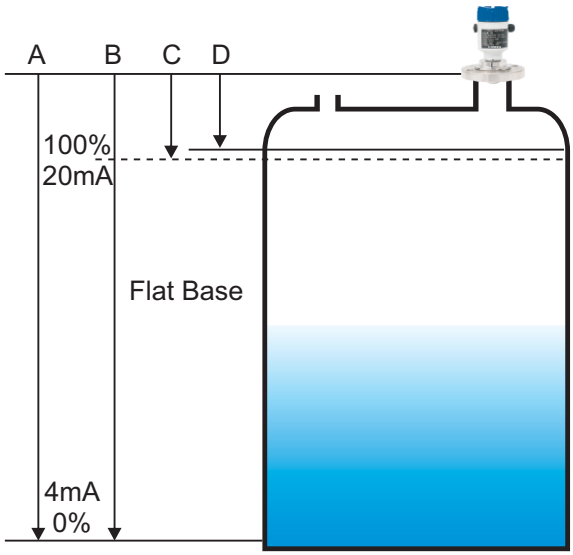
Please block the unused electrical interface with blind plug, see ③

6. Installation

6.1 Diagram



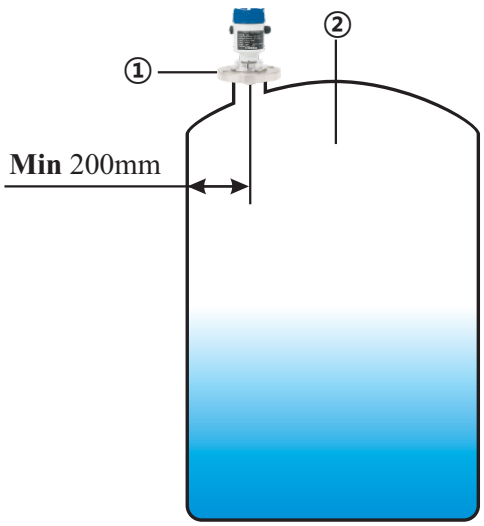
Ⓐ Range Setting Ⓑ Min. Adjustment
Ⓒ Max. Adjustment Ⓓ Blind zone



Ⓐ Range Setting Ⓑ Min. Adjustment
Ⓒ Max. Adjustment Ⓓ Blind zone

Note:
The reference surface for measurement: the bottom surface of the thread or the sealing surface of the flange.
When using radar level meter, make sure that the highest material level cannot enter the blind area of the measurement (the area shown in D (Blind Area) in the figure).
When setting the range parameter, be sure to include the height of the conical part of the tank (refer to A in the figure).

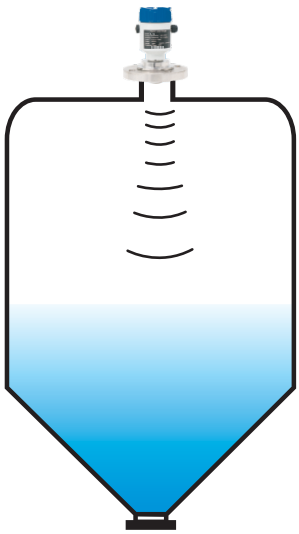
6.2 Installation Requirement



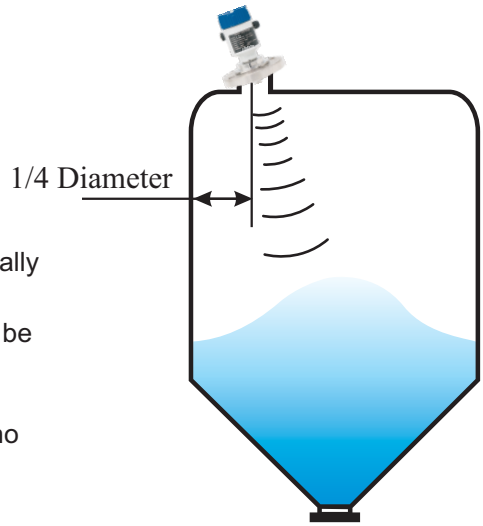
→ Installed at 1/4 or 1/6 of the diameter away from tank wall.

Note: The minimum distance from the tank wall should be 200mm.

Note: ① Datum plane
② The center of the container or symmetrical



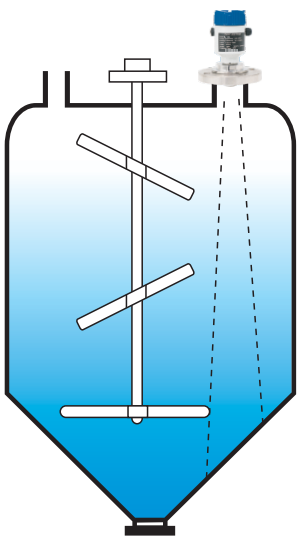
→ The top plane of the conical tank can be installed in the middle of the tank top, It is guaranteed to measure to the bottom of the cone.



→ When there is a stock in tank, the antenna should be vertically aligned with the material surface.

If the material level is uneven, level meter installation direction must be adjusted by universal flange.

The angle of the horn makes the horn aim at the material surface as much as possible. (Because the inclined solid surface will cause echo attenuation, Even the problem of signal loss)

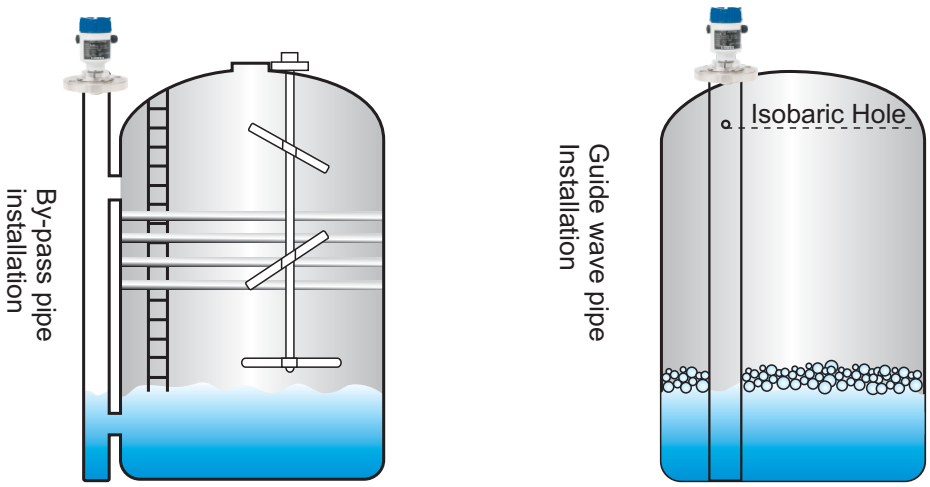


→ Stir

When there is stirring in the tank, keep the meter away from the stirrer if necessary. After installation, "false echo learning" should be carried out under agitation,

In order to eliminate the false echo effect generated by the stirring blade. If foam or waves rise due to stirring, the installation should use wave guide pipe.

Guide wave pipe installation



Use guide wave pipe installation (guide wave pipe or by-pass pipe), can avoid obstacles and foam influence.

Due to feeding, mixing or other process handlings in container, it will generate foam on the surface so signal will be attenuate.

If bubbles caused measurement errors, should install the sensor in the guide wave pipe, oruse guided wave radar level meter.

Measuring inside the guide wave pipe, the guide wave minimum diameter is 50mm.

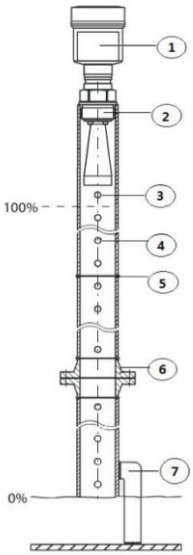
In the connection guide wave pipe, should avoid big cracks and welding. In addition, carry out "virtual False echo learning".

Note: while measure adhesive medium, should not use guide wave pipe.

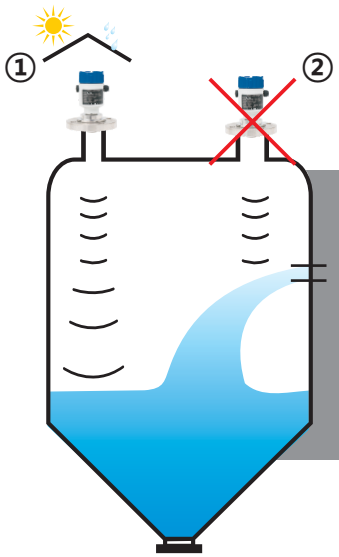
Design requirements for guide wave pipe

- Metal material, smooth inside the tube;
- Preferably stretched or longitudinal welded stainless steel pipe;
- The weld must be as flat as possible and coaxial with the hole;
- While using pre-welded flanges or extending the sleeves and using a ball valve, the transition pipe must be aligned on the inside and fix after accurate matching;
- The gap on the transition pipe is $\leqslant$0.1mm;
- Do not weld along the pipe wall. The inner wall of the guide wave pipe must remain flat and smooth. If user accidentally weld the inside, you should remove the uneven places and weld bead. Otherwise it will cause serious interference echo, so as to bring convenience to the attachment of the medium;

- Guide wave pipe must reach at least the desired minimum filling height because the measurement can only be carried out in the tube;
- Aperture ⩽5mm, any number single side or full pass;
- The antenna diameter of the sensor should be as consistent as possible with the inner diameter of the pipe;
- The diameter should be consistent throughout the length;



1. Radar sensor
2. Thread or flange
3. Exhaust hole
4. Isobaric hole
5. Welding seam
6. Butt welding flange with neck
7. Fixing of wave tube



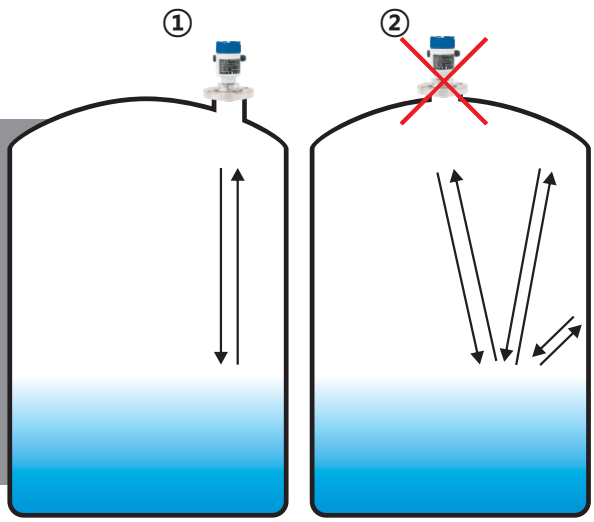
Typical wrong installation:

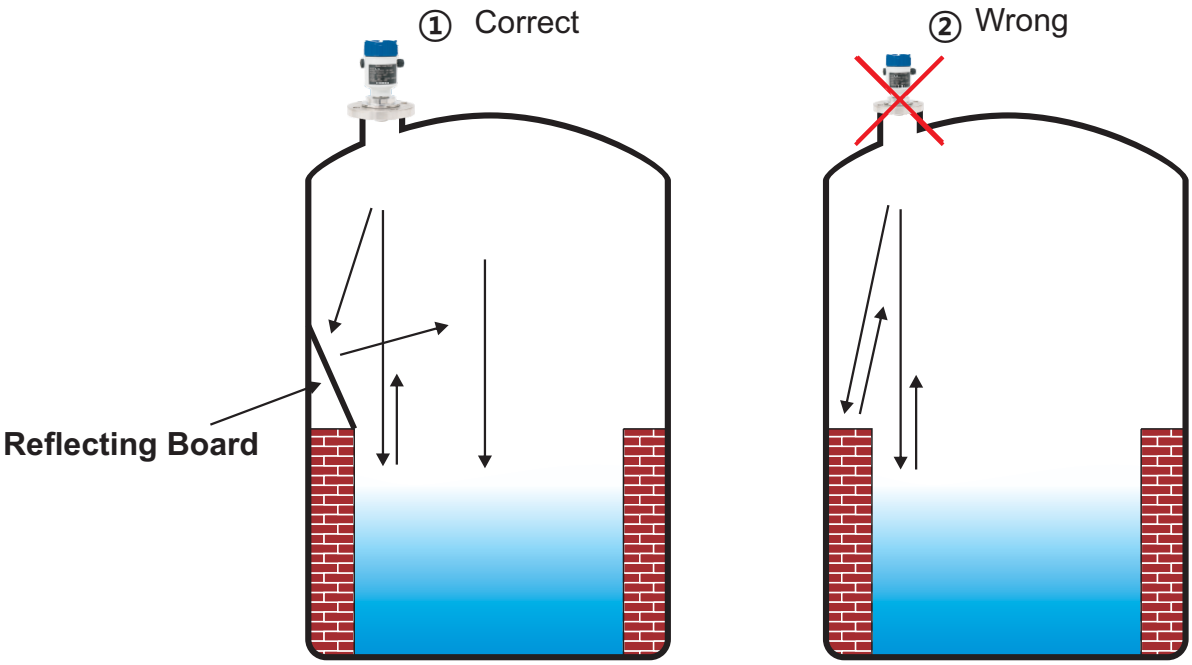
The conical tank cannot be installed above the inlet.
At the same time: when installing outdoors, user should take sun-shading and rain-proof measures

① Correct ② Wrong

The meter cannot be installed in the middle of an arched or round tank top. In addition to generate indirect echo, but also influenced by the echo, multiple echoes may be larger than the signal threshold of true echoes, because they can be concentrated through the top. Therefore, it cannot be installed in the central location.

① Correct ② Wrong

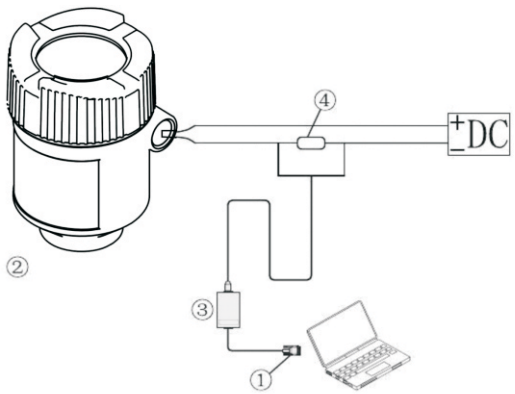




Deflect the obstacle signal away

When there are obstacles in the tank that affect the measurement, it is necessary to install a reflecting plate to measure normally.

7. Debugging



● **Computer Debugging**

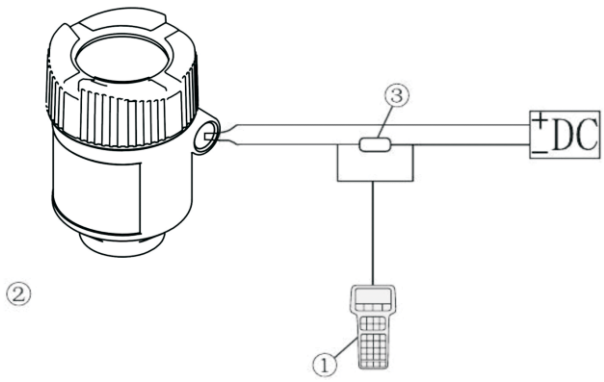
Connect with computer via HART

① USB

② Radar level meter

③ HART adapter

④ 250Ω Resistor



● **HART Hand-held Programmer**

① HART handheld programmer

② Radar level meter

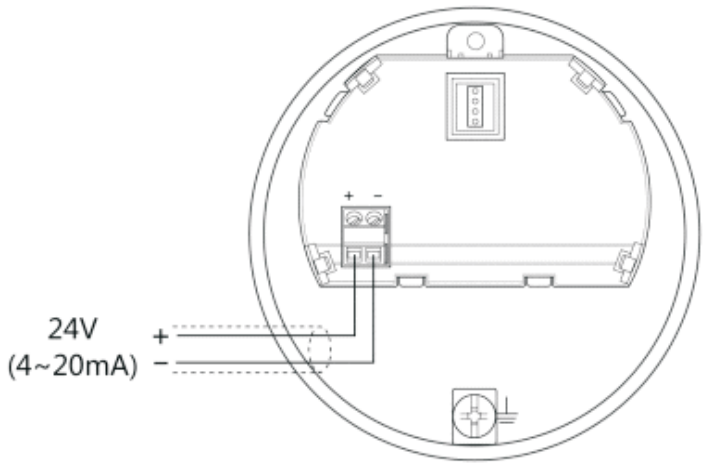
③ 250Ω Resistor

8. Voltage & Signal

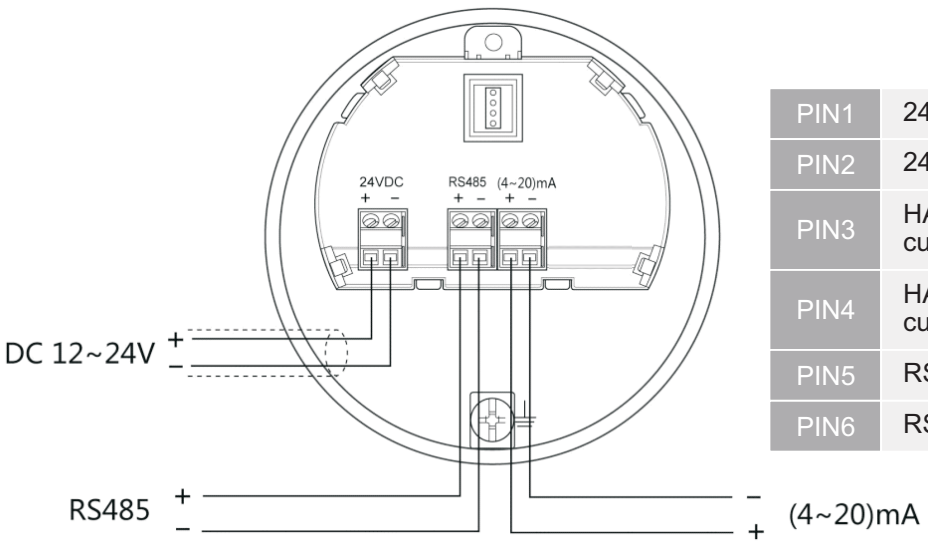
(4~20) mA / HART (two-wire system) power supply and output current signal share a two-core shield cable. Refer to the technical data for the specific power supply voltage range.
(4~20) mA (four-wire / six-wire) power supply needs to be supplied separately, power supply and current signal using a four-core shielding cable (current signal and RS485 interface can be output simultaneously, and output needs using a six-core shielding cable).
The RS485 / Modbus power supply shall be supplied separately, with a four-core shielded cable (The current signal and RS485 interface can be simultaneously output with a six-core shielded cable).

9. 24 VDC Wiring Diagram

4~20 mA Signal Output



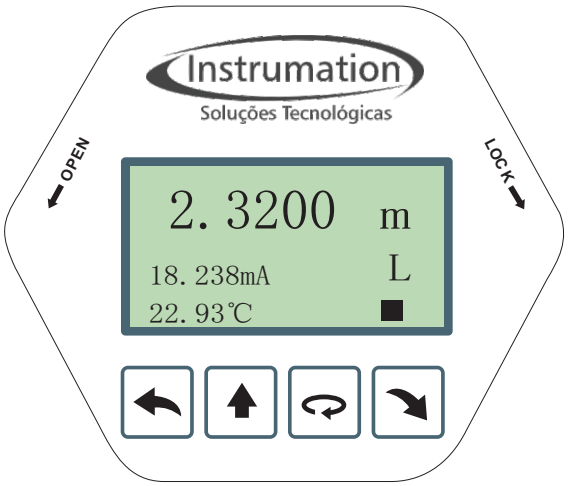
PIN1	24VDC (+)
PIN2	24VDC (-)



PIN1	24VDC (+)
PIN2	24VDC (-)
PIN3	HART (+), i.e. 4-20mA (+), 4-20mA current output positive terminal
PIN4	HART (-), i.e. 4-20mA (-), 4-20mA current output negative terminal
PIN5	RS485 (A), 485 communication output
PIN6	RS485 (B), 485 communication output

10. Operation

10.1 Button Function



↩	Exit programming Back to previous menu [hot key] Echo curve
↑	Change parameter value
↻	Select programming item Select edited value digit Parameter item content
↘	Enter programming status Confirm programming item Confirm parameter change

10.2 Key Description

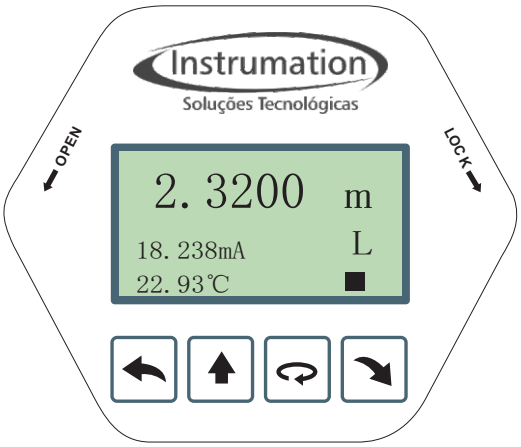
The product display module consists of 4 keys and 128×64 dot matrix display.

The display system has four display interface modes:

Run Mode	display the system operation status and current measurement data
Echo Mode	display the echo condition currently measured by the system
Setup Mode	set various data parameters for system operation
Input Mode of input data interface	input parameter values, numbers or characters

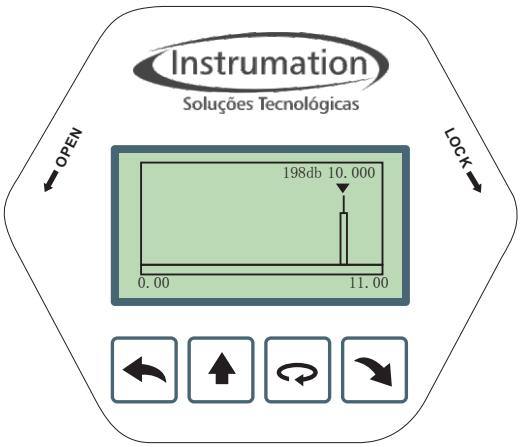
The functions of the 4 keys are different in different display modes

10.21 Button Function



Tagging	Function	Button
①	-Switch to enter the parameter setting interface	
②	-NULL	
③	-NULL	
④	-Switch to the echo curve interface	

10.22 Echo Mode



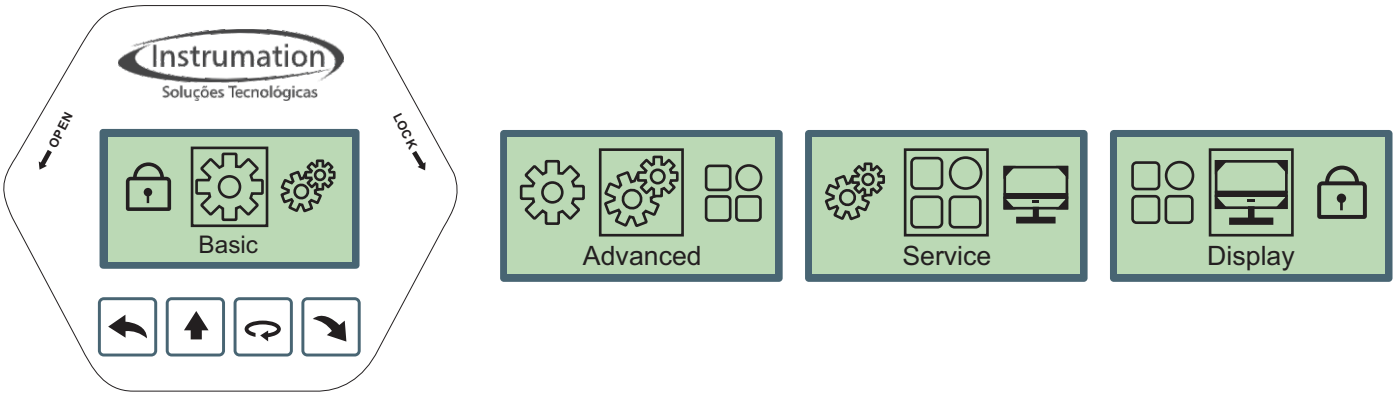
Tagging	Function	Button
①	-Switch to the operation measurement interface	
②	-NULL	
③	-Show/hide threshold curves	
④	-Segment display of echo curve	

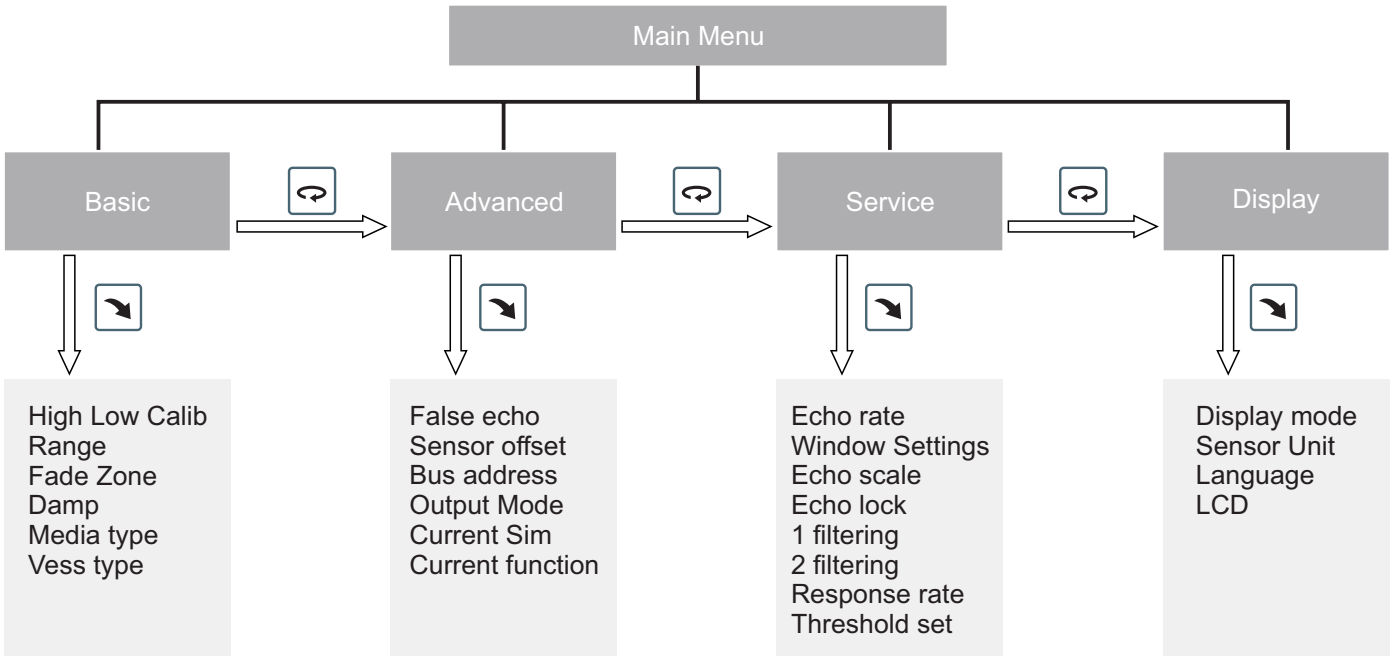
Note: 198 db figure indicates the maximum echo intensity within the range. For a good metal reflector, the echo intensity should be about 220 dB. If the echo intensity is less than 70dB, it indicates that the echo signal is weak, and technicians need to conduct corresponding troubleshooting.

10.23 Setup Mode

Tagging	Function	Button
①	-Switch to enter the parameter setting interface	
②	-NULL	
③	-NULL	
④	-Switch to the echo curve interface	

10.24 Main Menu





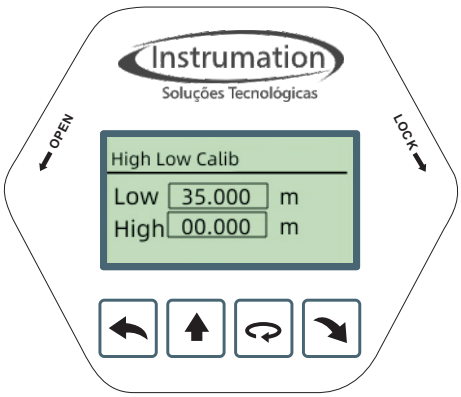
10.24 Menu Settings

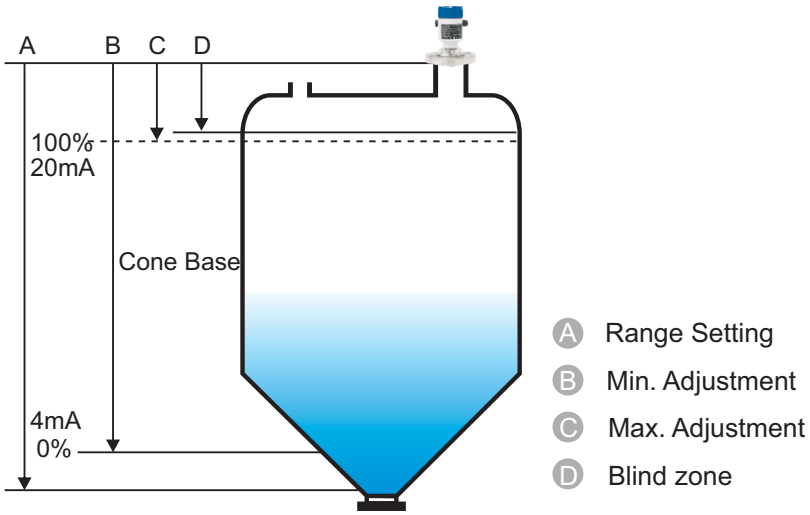
High Low Calib

Press [↘] to enter the basic menu option [High Low Calib]

[High/Low Setting] maps the corresponding relationship between measured value and current output (4-20mA). In the [Basic] menu, select [High Low Calib], press [↘] enter [High Low Calib], press to [↘] mplete the editing operation, and press [↖] to exit.

The high position corresponds to the full position, and the low position corresponds to the empty position, as shown in the following figure.

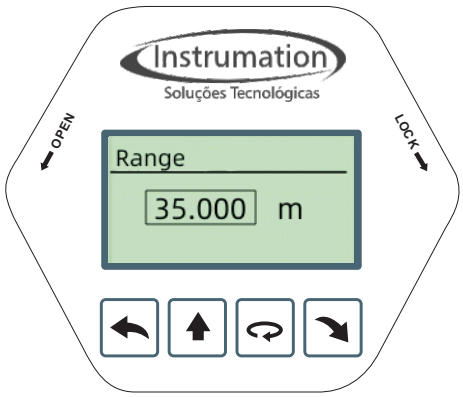




Range

Press [↘] to enter the basic setting menu option [Range]

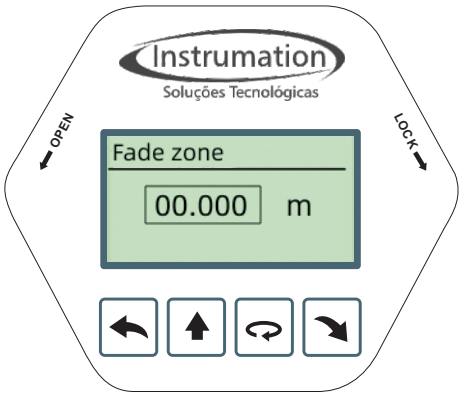
In order to get the correct results, it is necessary to set the measuring range of the instrument. Select the [Basic] menu and enter the [Range] option. If you need to modify the value, press the k[↘]o complete the editing operation, Press [↖] to exit.



Parameter range (m)	1~85	1~35	1~120
Default value (m)	85	35	120
Configuration	1.Blind zone: if the set range value is less than (blind zone+0.5), the range is automatically set to (blind zone+0.5) 2.4mA corresponding position, when the current output function is distance, the corresponding position of 4mA corresponds to the measuring range and is modified at the same time; Set quantity relationship: Blind zone+0.5≤range		
Note	The echo area greater than the range is not selected		

Fade zone

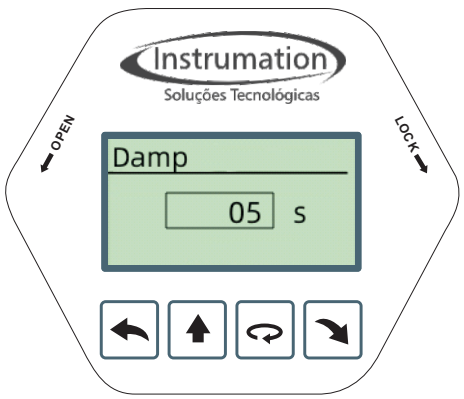
Enter the [Basic] menu, select [Fade zone], and press the key to enter the option editing blind zone range, as shown below. To modify the value, complete the editing operation according to the keyboard menu.



	85m (solid)	35m (liquid)	120nm (solid)
Parameter name	blind area		
Parameter range (m)	0~(range - 0.5)	0~(range - 0.5)	0~(range - 0.5)
Default value (m)	0	0	0
Configuration	If the value set for the blind zone is greater than (range - 0.5), the blind zone is automatically set to (range - 0.5)		
Option meaning	The echo area smaller than the blind area is not selected		

Damp

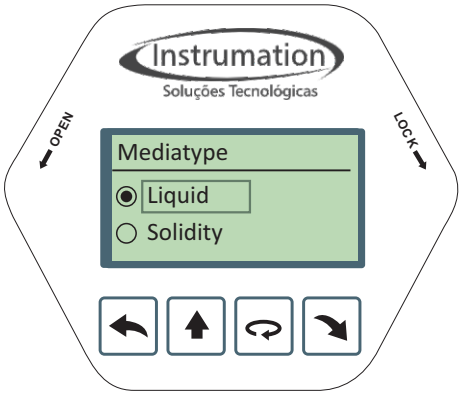
In order to improve the stability of the measured output value, a larger [Damp] can be set to achieve the stability of the measured value and increase the anti-interference ability. For example, if the damping time is 2 seconds, the measured object position will change step at time t. The measured output value will follow the actual position of the measured object 10 seconds later, enter the [Basic] menu, select [Damp], press , and the display is as shown below:



Parameter range	0~100
Default	5
Option meaning	Damping output, improving signal stability

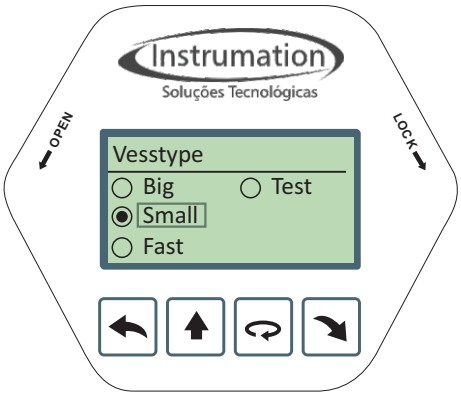
Media type

Enter the [Basic] menu, select [Media], press ↘ to enter the container type selection menu



Vess Type

Enter the [Basic] menu, select [Vess Type], and press ↘ to enter the container type selection menu.



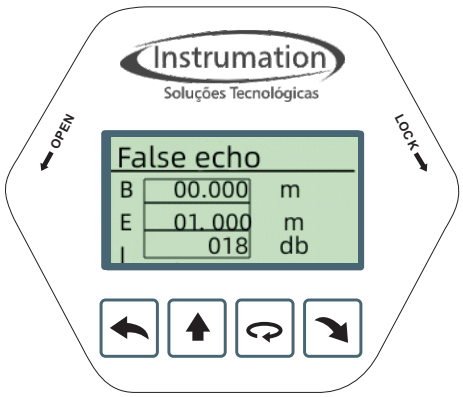
Big	This parameter pursues stable measurement output
Smal	Adapt to most working conditions
Fast	Suitable for working conditions requiring rapid measurement
Test	0 delay is suitable for infield test

10.25 Advanced settings menu operation

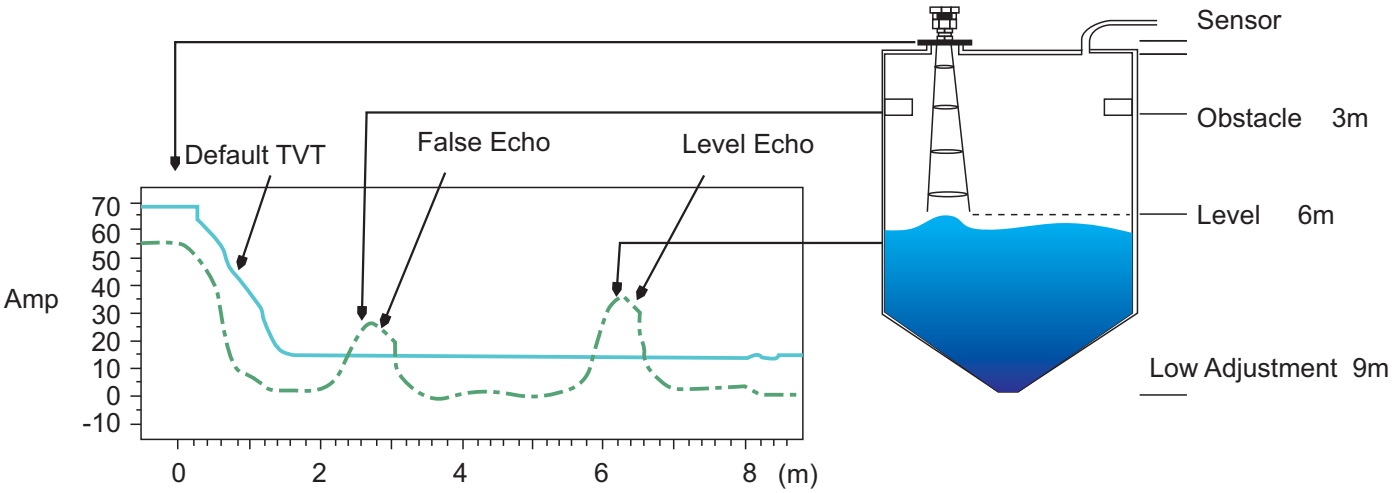
False echo

Press ↘ to enter the basic setting menu bar, and then press ↘ to enter the [Advanced] menu

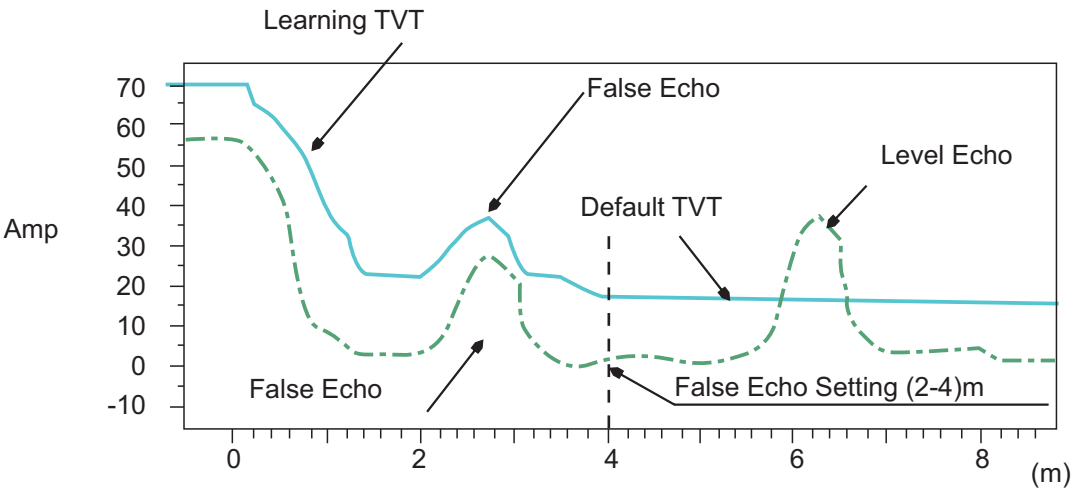
Press the ↘ key to enter the [False Echo] setting. The [False Echo] can learn the false echo in the container containing known obstacles, and form the background noise screening curve (threshold curve). Before learning the false echo, you need to set the [Threshold Mode] and [Threshold Area]. Press ↘ to complete the editing operation, and press ↖ to exit.The display is as follows:



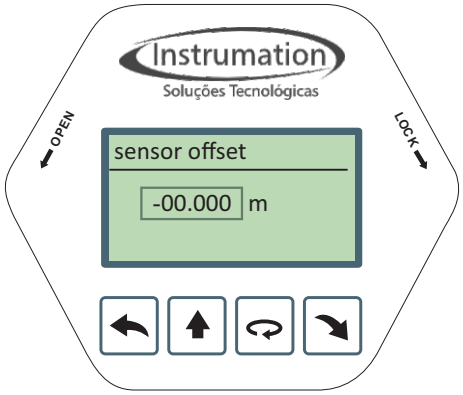
False Echo Curve Before Learning



False Echo Curve After Learning



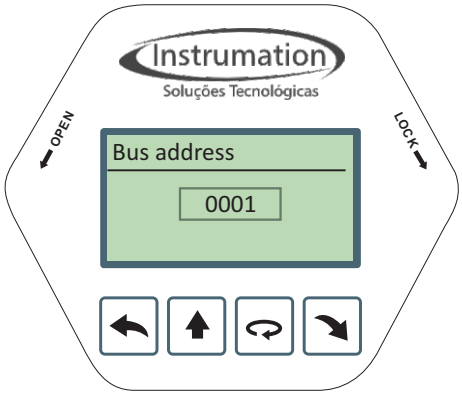
Sensor offset



Press ↘ to enter [Sensor Offset]

Set [Sensor Offset] to correct the deviation between the ideal measurement value and the actual measurement value.The settings have been completed before leaving the factory. Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:

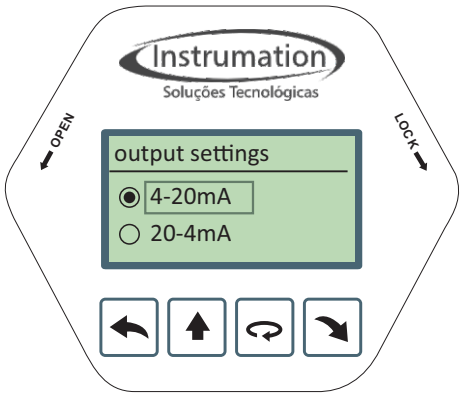
Bus address



Press ↘ to enter [Bus Address]

This function is only applicable to RS485 MODBUS communication. When two or more instruments are connected to the upper computer using HART communication interface, this function is required to set the instrument to multi-point working mode. Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:

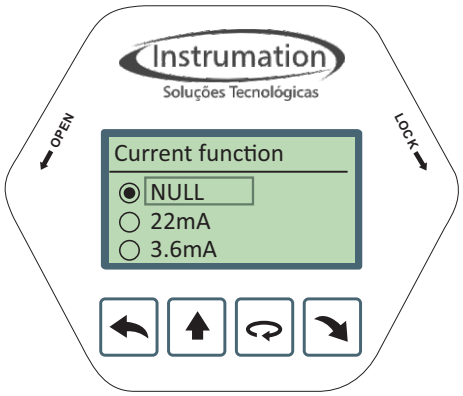
Output Mode



Press ↘ to enter [Output Mode]

Select the direction of [Current Output Mode] according to the customer's requirements, press ↘ to complete the editing operation, and press ↖ to exit.

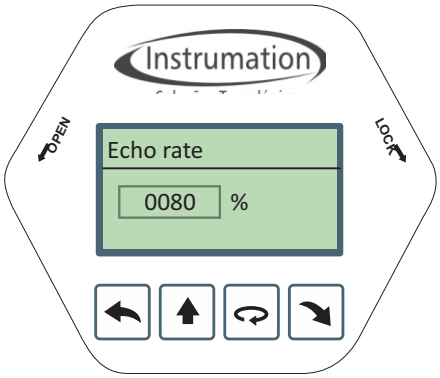
Current Sim



Press ↘ to enter [Current Simulation]

Set [Current Sim] to calibrate the error value of current output, which has been calibrated before leaving the factory. Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:

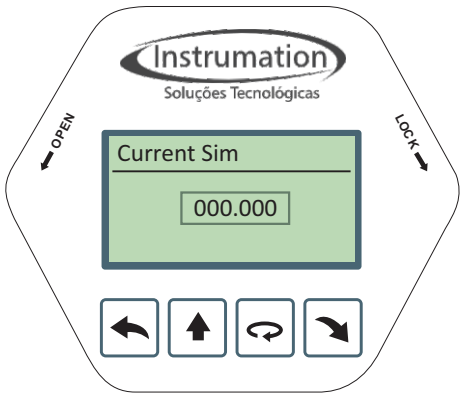
Current function



Press ↘ to enter [Current function]

Set [Current Function] to set the value of actual output current when the instrument encounters wave loss fault. Press ↘ complete the editing operation, and press ↖ to exit. The display is as follows:

Echo rate



Press ↘ to enter [Echo Rate]

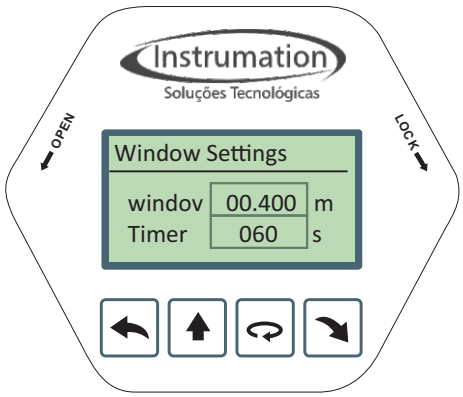
[Echo rate] is used to adjust the speed of waveform change. The larger the value, the slower the waveform change, and the more stable the waveform change. On the contrary, the smaller the value, the faster the waveform change. Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:

Window Settings

Press [↘] to enter [Window Setting]

[Window Setting] is used to search the front and rear range after waveform locking.After the current echo is locked, it will search for the strongest echo back and forth within the set range value. If the current echo is lost, or the echo of feeding and blanking is too fast, it will search for the strongest echo in the whole process and confirm the current echo.If the previously lost echo is recovered, the previously lost echo will not be confirmed.Time is the speed of arrow tracking.

Press [↘] to complete the editing operation, and press [↖] to exit. The display is as follows:

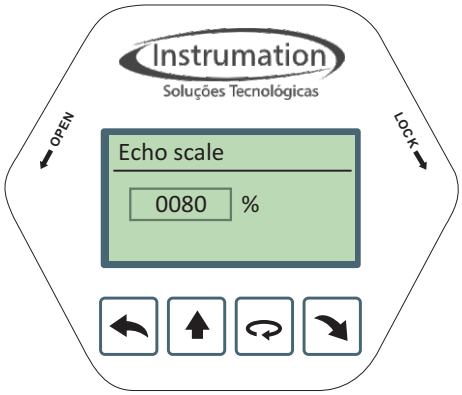


Echo scale

Press [↘] to enter the service setting menu option [Echo scale]

The percentage that the echo in the window is greater than the echo in the window

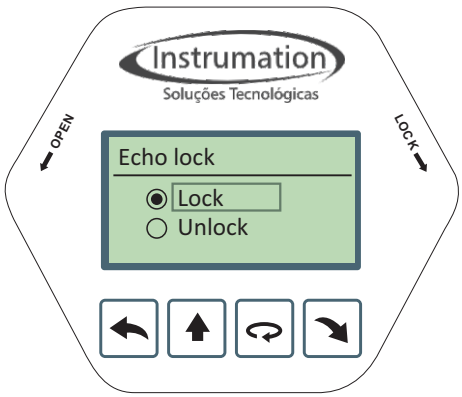
Select the [Service] menu and enter the [Echo Proportion] option. If you need to modify the value, press the [↘] key to complete the editing operation, and press [↖] to exit



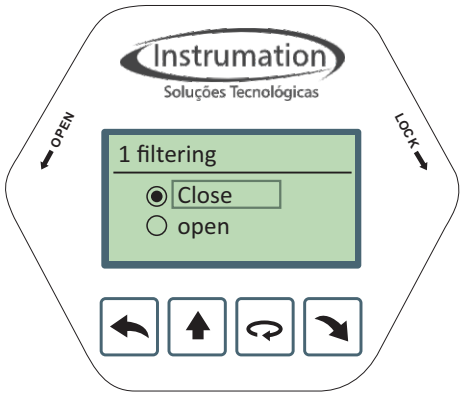
Echo lock

Press [↘] to enter [Echo Lock]

If locking is selected, the signal is searched within this window range (here the window range refers to the parameters set in the previous window).If you unlock it, you are looking for signals in the whole process.Press [↘] to complete the editing operation, and press [↖] to exit. It is shown as follows



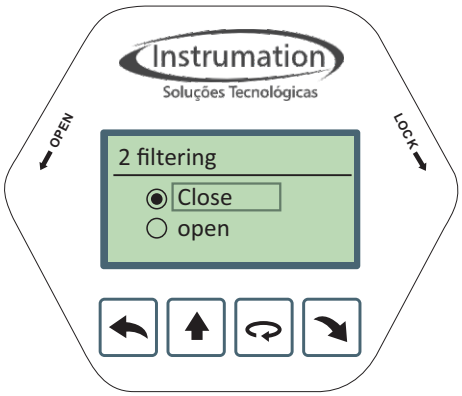
1 filtering



Press ↘ to enter [1 Filtering]

[Primary filtering] In the small range measurement environment, you can choose to turn it on or off according to the waveform. Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:

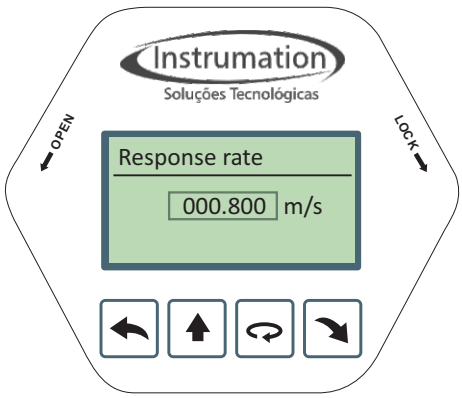
Secondary filtering



Press ↘ to enter [2 filtering]

[2 filtering] means that the interface filtering can be turned on or off according to the waveform in a large range measurement environment, and should not be used if the blind area is too small.Press to ↘ complete the editing operation, and press ↖ to exit. The display is as follows:

Response rate



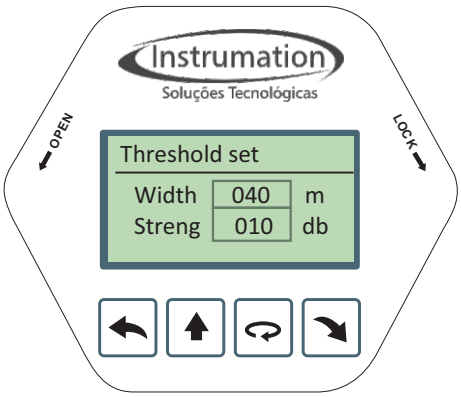
Press ↘ to enter [Response Rate]

[Response rate] is used to adjust the response rate of the instrument to the increase of the actual material level. When the rate and time settings change, the response rate automatically changes.Generally, the solid rate is set slightly higher and the liquid rate is set slightly lower.Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:

Threshold Setting

Press ↘ to enter [Threshold Setting]

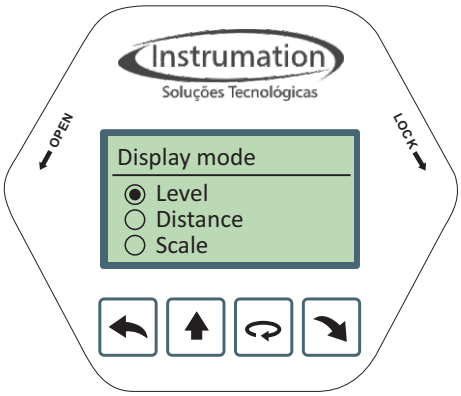
[Threshold setting] Set the threshold value of the effective echo. The larger the threshold value is set, the stronger the amplitude of the effective echo on site is required, which is conducive to eliminating the interference of small signal clutter.Press ↘ complete the editing operation, and press ↖ to exit. The display is as follows:



Display Mode

Press ↘ to enter [Display Mode]

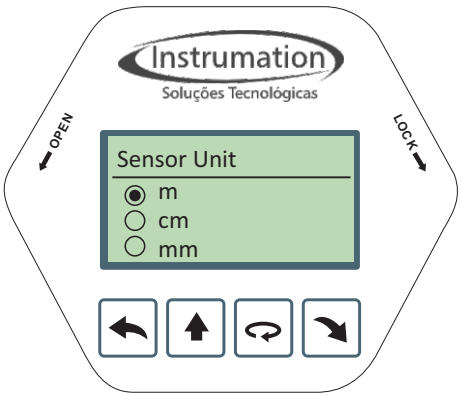
Set [Display Mode] to display three modes of empty height ratio of material level. Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:



Sensor Unit

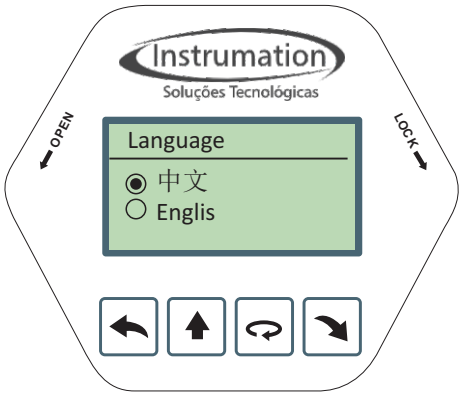
Press ↘ to enter [Sensor Unit]

Change the unit as required. The default unit is m. Press ↘ to complete the editing operation, and press ↖ to exit. The display is as follows:



Language

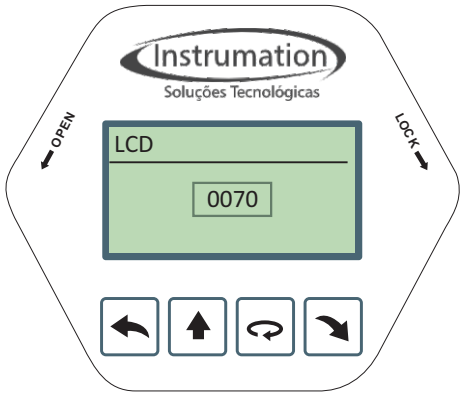
Press [↘] to enter [Language] to select English, Spanish, Russian, Portuguese and Korean, press [↘] complete the editing operation, and press [↖] to exit. The display is as follows:



LCD

Press [↘] to enter [LCD]

Set [LCD] to adjust the brightness of the display screen. Select [LCD], press [↘] to complete the editing operation, and press [↖] exit. The display is as follows:



11. Appendix: Glossary

1.Beam angle:

The beam width bounded by 3dB lower than the maximum value. The minimum beam angle is 3 °, as shown in the figure.

Range Resolution: Range resolution refers to the ability of radar to distinguish two objects close together. If the distance between two objects is less than the range resolution of the level radar, then the radar can only measure one distance value, which is not equal to the distance value of any one of the objects, but a combination of the distance values of the two objects. FM bandwidth B=5.1GHz, minimum distance resolution=C/2B ≈ 3cm.

Accuracy: if there is only one object and the object moves a small distance, whether the level radar can recognize the distance change. The index to distinguish the moving distance of a single object is called accuracy. The IF signal of is analyzed by its own algorithm, and the measurement accuracy is 0.1mm.

2.Ambient temperature:

The temperature of the ambient air in contact with the equipment enclosure.

3.Blind zone:

Refers to the measurement limit at the near end of the instrument. The instrument in the blind zone cannot measure

DB (decibel): unit representing signal amplitude.

Dielectric constant (DK): the ability of dielectric to store electric energy under the induction of electromagnetic field. It is often called the relative dielectric constant. The increase of dielectric constant is directly proportional to the increase of echo amplitude. The relative vacuum/dry air dielectric constant is 1.

4.Echo:

Reflected signal received by radar.

5.Transmission cone:

Extension of antenna beam angle.

6.False echo:

Any echo not generated by the desired target. In general, false echoes are generated by obstacles in the container.

7.Multiple echoes:

Multiple reflected echoes occurring at the target echo distance may be two or three times.

8.Polarization:

Attribute of emitted electromagnetic wave, describing the direction and amplitude of electric field vector that changes with time.

9.Range:

(1)Refers to the farthest measurement limit of the instrument;

(2) Special refers to the manually set farthest distance, beyond which the instrument will not consider when processing data.

10. Repeatability:

The deviation degree of the measurement results of the same reflection target measured multiple times under the same test environment.

11.Speed of light:

Symbol C, speed of electromagnetic wave (including electromagnetic wave and light in free space). The speed of light is 299792458 meters per second.

12.Threshold curve:

A curve that changes with time. As the threshold value, the echo exceeding it is considered valid.

Instrumation
Soluções Tecnológicas
Fone: +55 11 3459-3481
vendas@instrumation.com.br
www.instrumation.com.br