



ALIARADAR

Radar Level Transmitter

ARL5000 Series

Operation Manual



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1. Welcome

Sincerely thank you for buying Radar level transmitter!

This manual introduces the application, feature, function, installation and setup of Radar level transmitter level transmitter so that users can know, install, use and maintain this instrument.

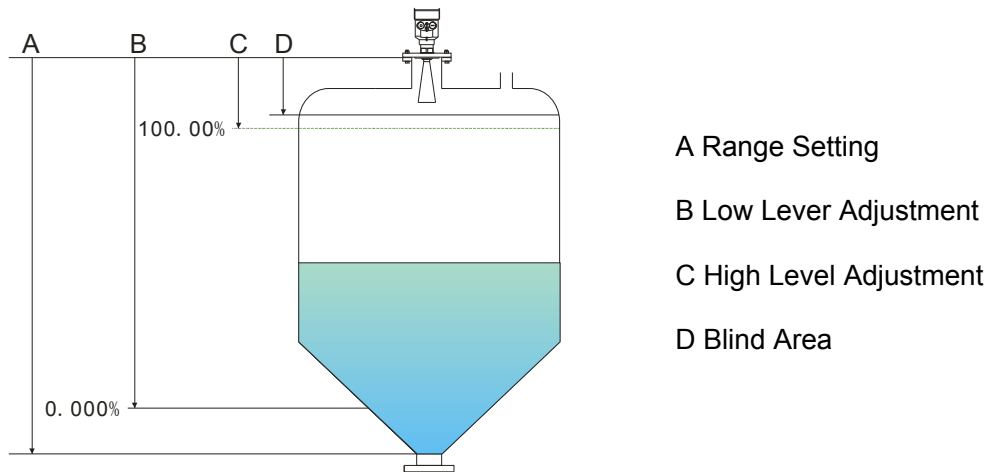
2. Overview

ARL5000 is characterized by 26G electromagnetic wave and the measurement will be not affected by the influence of noise, water vapor, temperature, pressure, dust, gas volatilization etc. With excellent anti-interference ability, it can work effectively in harsh environments.

Equipped with a new micro processor, ARL5000 is more ideal in rate signal analysis, processing capacity, which greatly improves the stability and accuracy of measurement. ARL5000 features in non-contact level measurement, simple structure and easy installation and it can be widely used in complicated working conditions such as reaction kettle, solid liquid silo, high temperature and high pressure.

3. Measuring Principle

The narrow microwave pulses are emitted via an antenna, reflected from the measured media surface and then received by antenna system again. The received signals are transmitted to electronic circuit and some are automatically converted to level signals. (The process, the electromagnetic wave reaches the target and is reflected back to the receiver, occurs instantly. because the microwave travels very fast.)





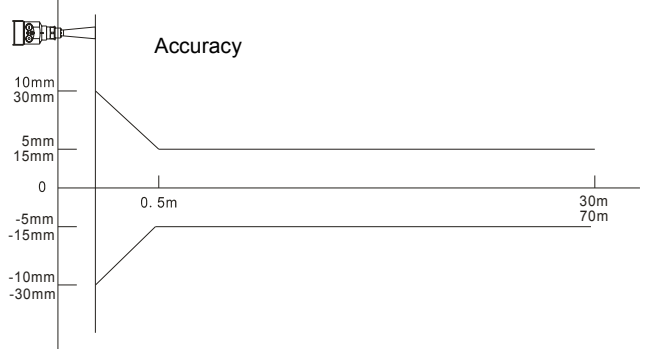
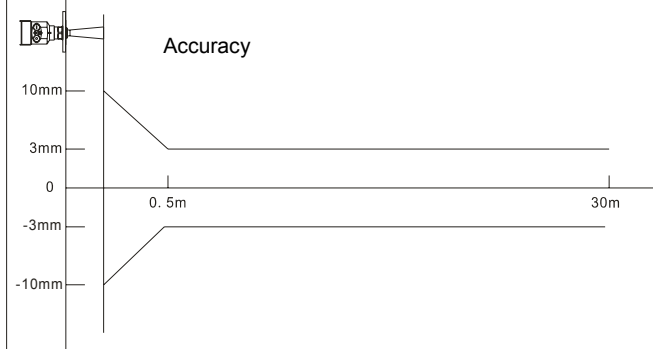
Measurement datum plane: Screw thread Bottom and Flange Sealing Surface



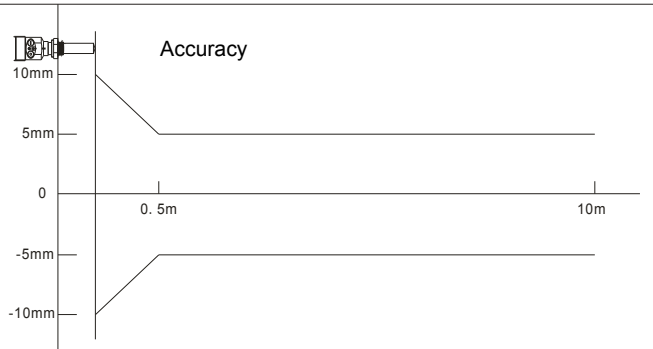
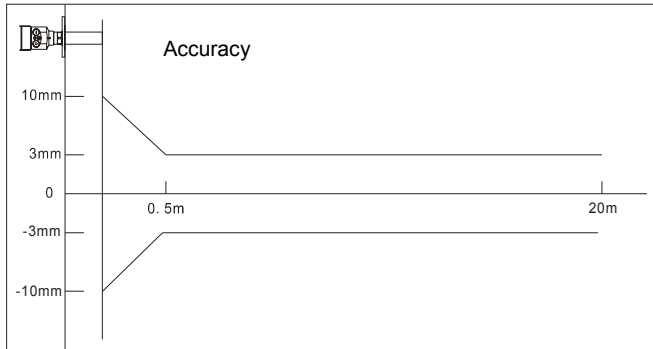
Note: When the radar level is used, please make sure that the highest material level can not reach the measuring blind are (As shown in D area).


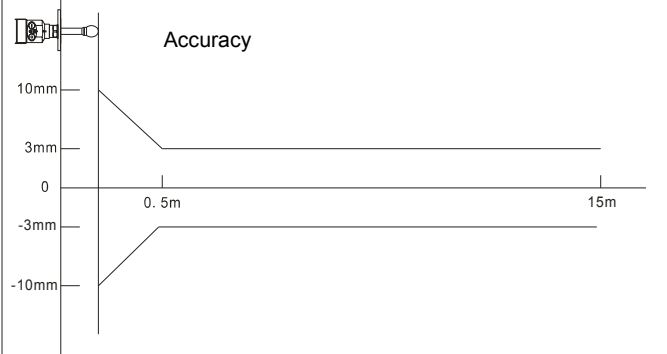

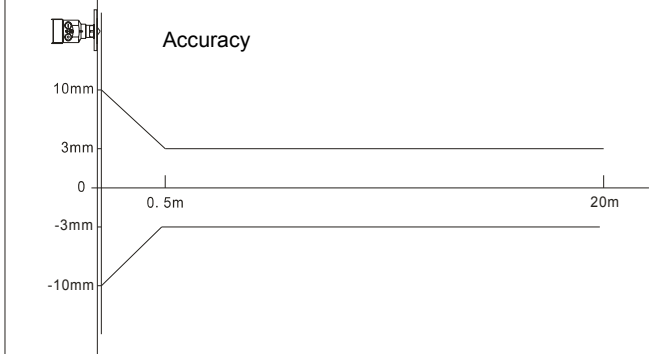
4. Features


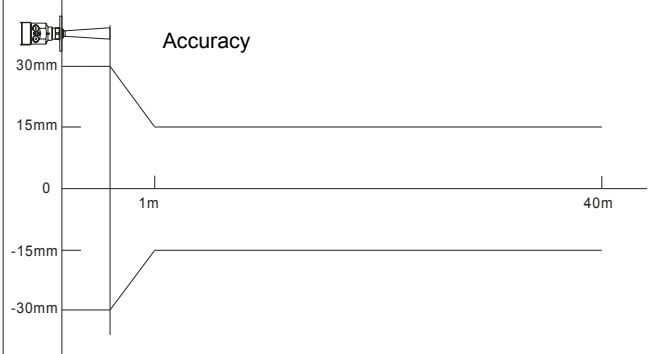
- Non-contact radar, free of wear and pollution
- Small measuring blind area, ideal for small tank measurement
- Not affected by working conditions such as corrosion, foam, noise, water vapor, dust, vacuum, etc.
- Small antenna, simple installation
- Shorter wavelength, better reflection on inclined solid surface
- High signal-to-noise ratio, excellent performance under fluctuating conditions
- High frequency, ideal for the measurement of solid and dielectric constant
- Small beam angle & focus energy to enhance radar echo capacity
- Support HART / RS485 communication for on-site debugging

5. Products

Type: A1 (30 m) / A2 (70 m)	Type: B
<p>Application: Rivers and Lakes Liquid</p> <p>Range: 0-30 m / 0-70 m</p> <p>Accuracy: +/-5 mm / +/-15 mm</p> <p>Temp. : -40~100 °C</p> <p>Pressure: Atmospheric</p> <p>Connection: Thread With Mounting bracket / Flange</p> <p>Antenna Material: S.S. 316L</p> <p>Flange Material: S.S. 304 / 316L (Optional)</p> <p>Beam Angle α: 8° / 6°</p> <p>Antenna Size: ϕ 96 / ϕ 121 mm</p> <p>Antenna Length: 290 / 610 mm</p> <p>Flange: DN100-DN150</p>	<p>Application: General Liquid</p> <p>Range: 0-30 m</p> <p>Accuracy: +/-3 mm</p> <p>Temp. : -40~130 °C (S) / -40~230 °C (O)</p> <p>Pressure: -1.0~16 bar</p> <p>Connection: Thread / Flange</p> <p>Antenna Material: S.S. 316L</p> <p>Flange Material: S.S. 304 (S) / 316L (O)</p> <p>Beam Angle α: 18° / 12° / 8° / 6°</p> <p>Antenna Size: ϕ 46 / ϕ 76 / ϕ 96 / ϕ 121 mm</p> <p>Antenna Length: 140 / 205 / 290 / 620 mm</p> <p>Flange: DN50-DN150</p>
	
	

Type: C1 (L:110) / C2 (L:210)	Type: D
<p>Application: Corrosive Liquid</p> <p>Range: 0-10 m</p> <p>Accuracy: +/-5 mm</p> <p>Temp. : -40~130 °C</p> <p>Pressure: -1.0~3.0 bar</p> <p>Connection: Thread / Flange</p> <p>Antenna Material: PTFE</p> <p>Flange Material: PP (S) / PTFE (O)</p> <p>Beam Angle α: 20°</p> <p>Antenna Size: ϕ 46 mm (Fixed)</p> <p>Antenna Length: 110 / 210 mm</p> <p>Flange: DN50-DN150</p>	<p>Application: Corrosive or Vapor Liquid</p> <p>Range: 0-20 m</p> <p>Accuracy: +/-3 mm</p> <p>Temp. : -40~130 °C</p> <p>Pressure: -1.0~10 bar</p> <p>Connection: Flange</p> <p>Antenna Material: PFA</p> <p>Flange Material: S.S. 304 + PFA (S) / S.S. 316L + PFA (O)</p> <p>Beam Angle α: 14°</p> <p>Antenna Size: ϕ 76 mm (Fixed)</p> <p>Antenna Length: 185 mm</p> <p>Flange: DN80, DN100</p>
	
	

Type: E	Type: F
<p>Application: Vapor Liquid Range: 0-15 m Accuracy: +/-3 mm Temp. : -40~130 °C Pressure: -1.0~10 bar Connection: Flange Antenna Material: S.S. 304 with PTFE Flange Material: S.S. 304(S) / S.S. 316L(O) Beam Angle α: 12° Antenna Size: ϕ 76 mm (Fixed) Antenna Length: 211 mm Flange: DN80-DN150</p>	<p>Application: Sanitary / Strong / Corrosive Liquid Range: 0-20 m Accuracy: +/-3 mm Temp. : -40~130 °C (S) / -40~200 °C (O) Pressure: -1.0~16 bar Connection: Flange Antenna Material: PTFE Flange Material: S.S. 304 + PTFE (S) S.S. 316L + PTFE (O) Beam Angle α: 18° / 12° Antenna Size: ϕ 46 / ϕ 76 mm Antenna Length: 13.5 / 35 mm Flange: DN50-DN150</p>
 	 

Type: H1 (ϕ 76) / H2 (ϕ 96) / H3 (ϕ 121)
<p>Application: Easily Condensed or Dust Process Vessels Range: 0-40 m Accuracy: +/-15 mm Temp. : -40~130 °C / -40~230 °C Pressure: -1.0~3 bar / -1.0~16 bar Connection: Universal Flange / Fixed Flange Antenna Material: S.S. 316L Flange Material: S.S. 304 (S) / S.S. 316L (O) Beam Angle α: 12° / 8° / 6° Antenna Size: ϕ 76 / ϕ 96 / ϕ 121 mm Antenna Length: 205 / 290 / 610 mm Purge Device: Option Flange: DN80-DN150</p>
 

6. Technical Parameters

- Measure Principle : Radar
- Measure Range : 0-70 m
- Display : 4 Digit LCD with Bargraph
- Resolution : 1 mm / 0.003 ft
- Accuracy : +/-3 mm... +/-15 mm
- Blind Area : The end of antenna
- Beam Angle α : 20° / 18° / 14° / 12° / 8° / 6°
- Measuring Interval : >1s (Dependent on configuration setting)
- Adjustment Time : >1s (Dependent on configuration setting)
- Ambient Temperature : -40~80 °C
- Relative Humidity : 0-95% RH
- Permittivity DK : >1.4
- Ambient Temp. Effect : 3 mm / 10 K, Max. 10 mm
- Gas Pressure Effect : 0.22 % (Air: 10 bar / 20 °C)
- Material
 - Antenna : PTFE / PFA / S.S. 316L
 - Process Connection : PP / PTFE / S.S. 304 / S.S. 316L / S.S +coated
 - Housing : Aluminum Alloy
- Process Connection : 1-1/2" NPT / G 1-1/2" Max. : 16 bar
 - : Flange (DN50-DN150) Max. : 40 bar
 - : Universal Flange (DN80-DN150) Max. : 3 bar
- Protection Class : IP67
 - : Explosion Proof, Ex d IIC T6
 - : Intrinsically Safe, Ex ia IIC T6
- Keypad : 4 internal keys for programming
- Unit : ft, in, m, cm, mm
- Process Temperature : -40~130 °C (Standard)
-40~230 °C (Optional)
- Process Pressure : -1.0~40 bar G (Max.)
- Max. Cable Length : 8 m (for single cavity housing)
- Power Supply : 16-26 VDC (2 wires)
: 24 VDC \pm 10% (4 wires)
: 90-253 VAC, 50 / 60 Hz (4 wires)
- Power Consumption : 22.5 mA / 1W (Max.)
- Current Output : 4-20 mA (2 wires, 4 wires)
Load : Rohm=(VDC-16) * 50
Resolution : 1.6 μ A
Alarm Current : No change / 20.5 mA / 22 mA / 3.9 mA
- Damping : 0-40 s
- Communication : HART signal (Compatible) (Standard)
: RS485 (MODBUS Protocol) (Optional)
- Data Storage : Operation parameters and totalization
date are stored by EEPROM for more
than 10 years
- EMI / RFI Effect : Follow SAMA PMC 33.1 from 20 to 1000
MHz and for field strengths up to 30 V/m
- Vibration Resistance : 20-2000 Hz, 1 (m/s²)²/Hz
- Cable Entry : Standard: M20, Option: 1/2" NPTF

7. Mounting

Please reserve enough installation space and try to avoid strong shock installation occasions.

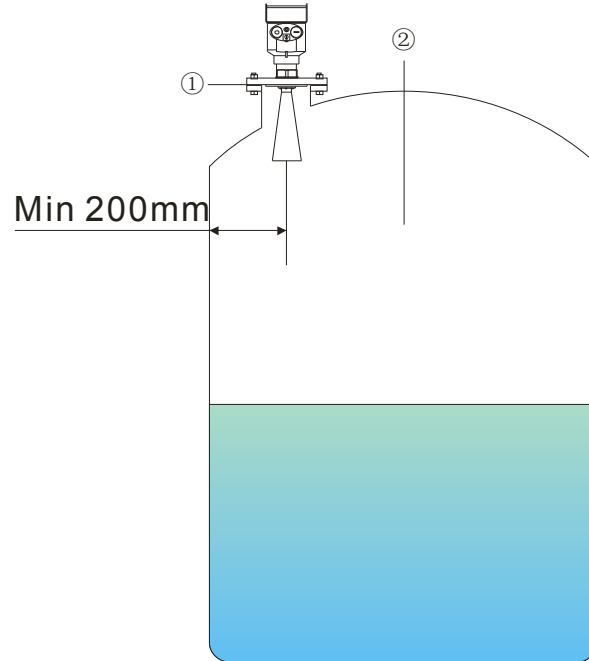
A. Vaulted Tank

Be installed in the 1/4 or 1/6 of the vaulted tank diameter

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

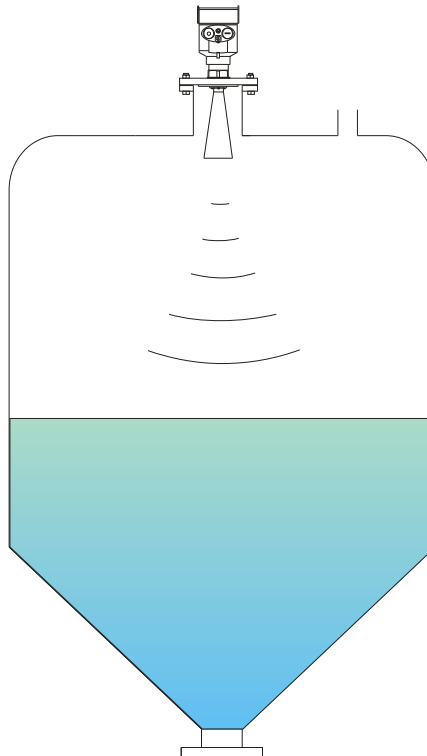
Note: ①Datum plane

②The tank center or axis of symmetry



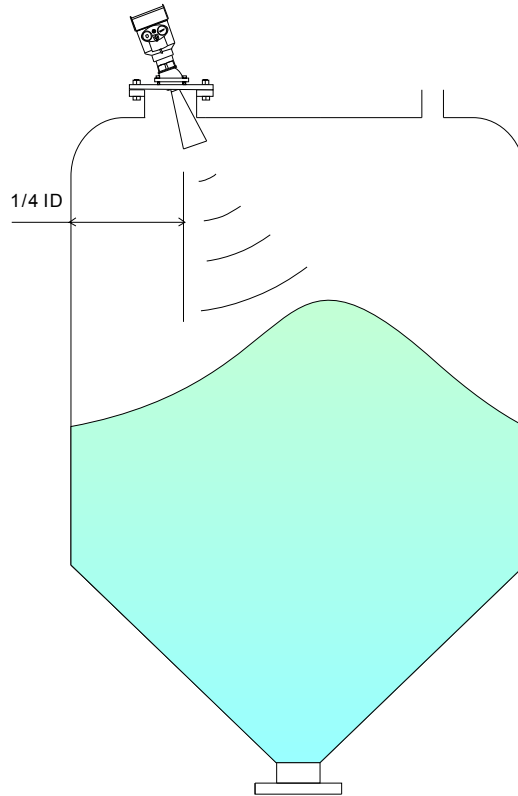
B. Tapered Tank

Be installed in the flat-top middle of tapered tank to ensure that the bottom of the tank is measured



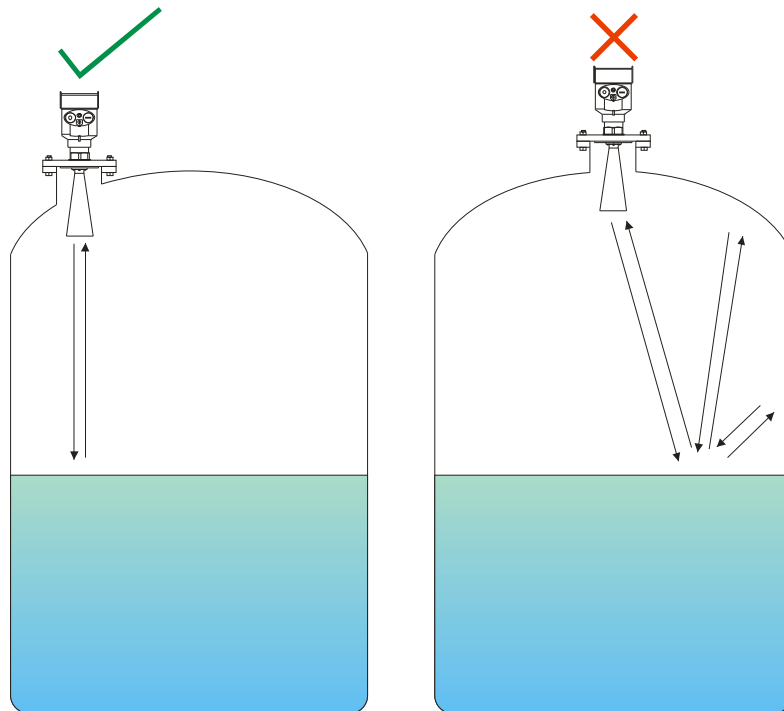
C. Stacking Tank

The antenna should be perpendicular to the material surface. If the material surface is not flat and the pile angle is large, a universal flange can be used to adjust the horn angle so that the horn can point at the material surface as much as possible.

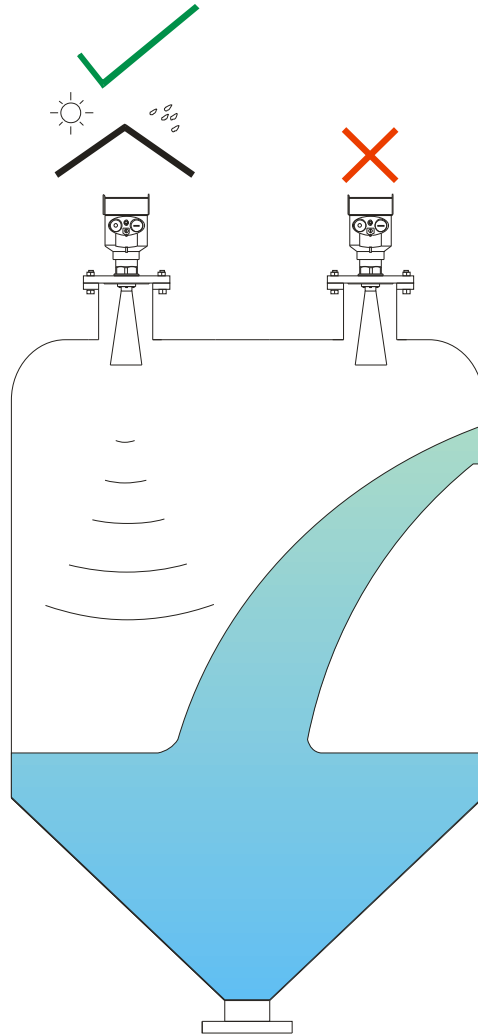


Note: Inclined solid surfaces will cause echo attenuation and even signal loss.

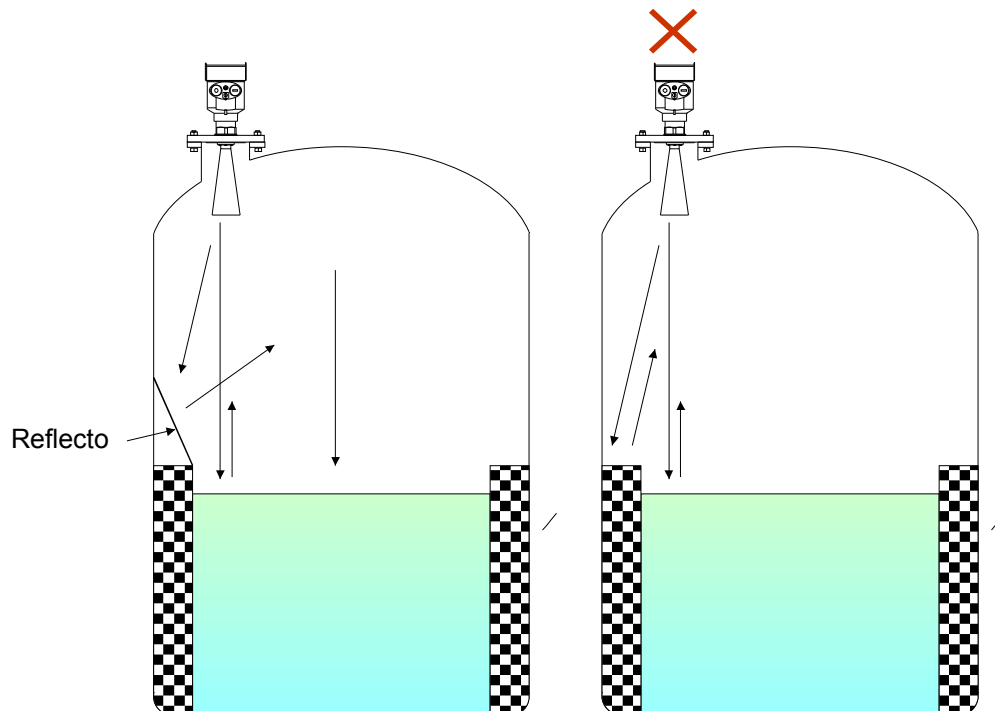
D. Be not installed in the middle of vaulted or round tank roof. Because multiple echoes can be concentrated at the top, and the echo signal may be larger than the signal threshold of the true echo.



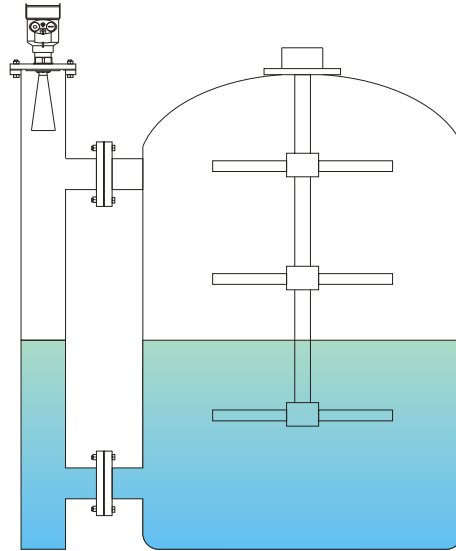
E. Be not installed above the material inlet or agitator, and outdoor protection measures are necessary such as sunshade, rainproof, etc.



F. If obstacle signals exist in the tank, a reflector can be added to refract them away to ensure normal measurement.



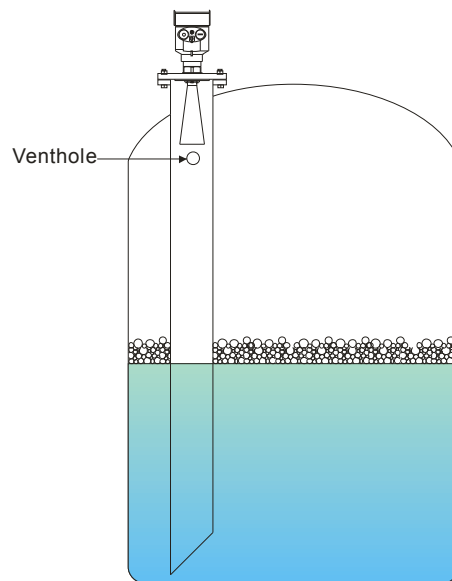
G. Interference occurs when there are obstacles, such as ladder, heating device, agitators, etc. in the area radiated by the emitted microwave beam. It is recommended the way of by-pass pipe installation.



By-pass Pipe Requirements:

- Metal tube (optional plastic liner): to prevent radar signals from penetrating the tube wall to generate interference echoes
- Pipe diameter in uniform, and the difference between horn antenna diameter and waveguide inner diameter should be as little as possible
- Keep waveguide pipe inner wall smooth, the average surface finish of $Rz \leq 6.3 \mu\text{m}$.
- The way of by-pass pipe installation can not be used for measurement of adhesive medium

H. The way of waveguide pipe installation is recommended for frothy liquid or big fluctuations of level in the tank.



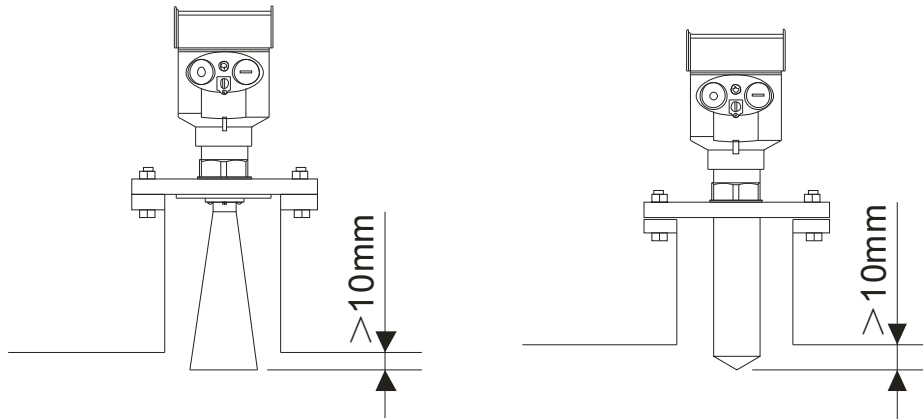
Waveguide Tube Requirements:

- Metal tube (optional plastic liner): to prevent radar signals from penetrating the tube wall to generate interference echoes
- Tube diameter in uniform, the difference between horn antenna diameter and waveguide tube inner diameter should be as little as possible
- Keep waveguide tube inner wall smooth, the average surface finish of $Rz \leq 6.3 \mu\text{m}$
- Equal pressure holes should be reserved to ensure the same liquid level inside and outside the waveguide tube
- The way of waveguide tube installation can not be used for measurement of adhesive medium
- Venthole diameter of 5-10 mm

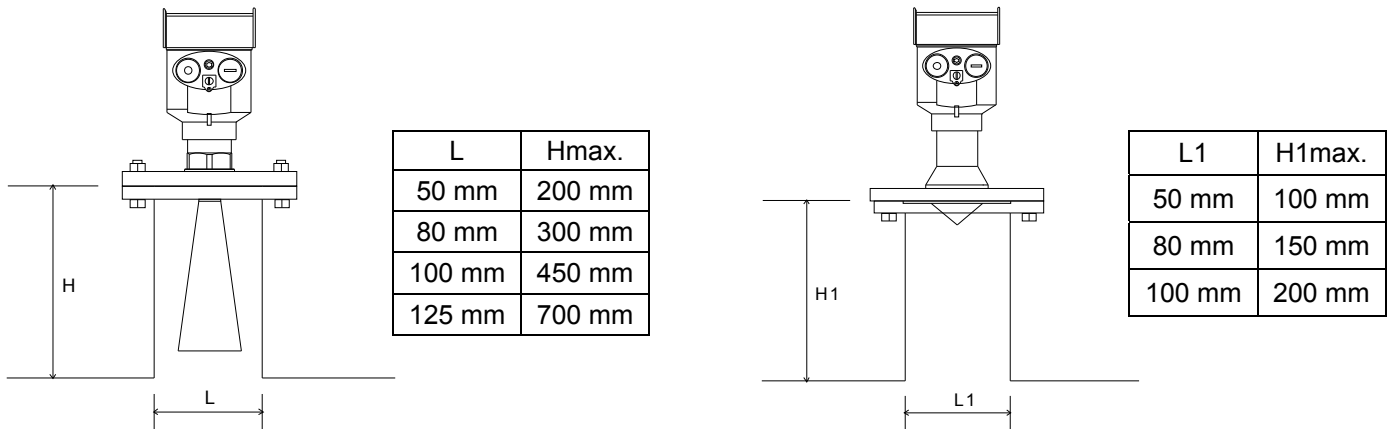
I. Nozzle Height Requirements:

The reflected wave generated by the end of the nozzle may affect the measurement result. So generally the horn antenna needs to stick out of the nozzle.

The nozzle height must ensure that the distance of antenna sticking into the tank can not be less than 10 mm.



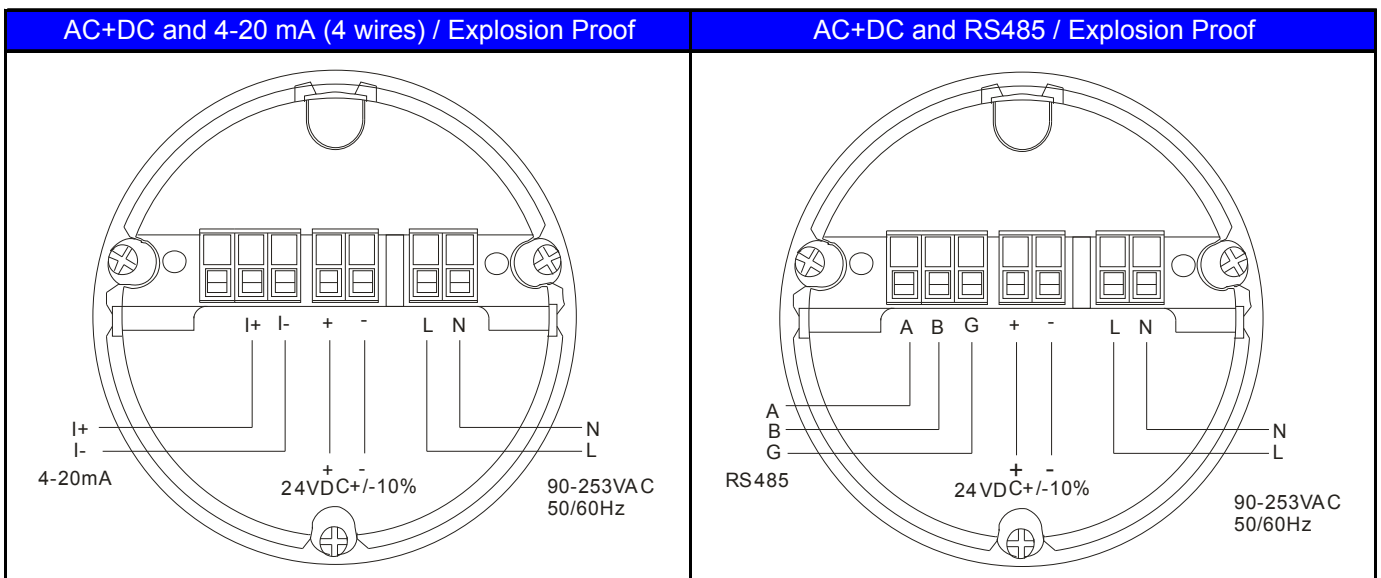
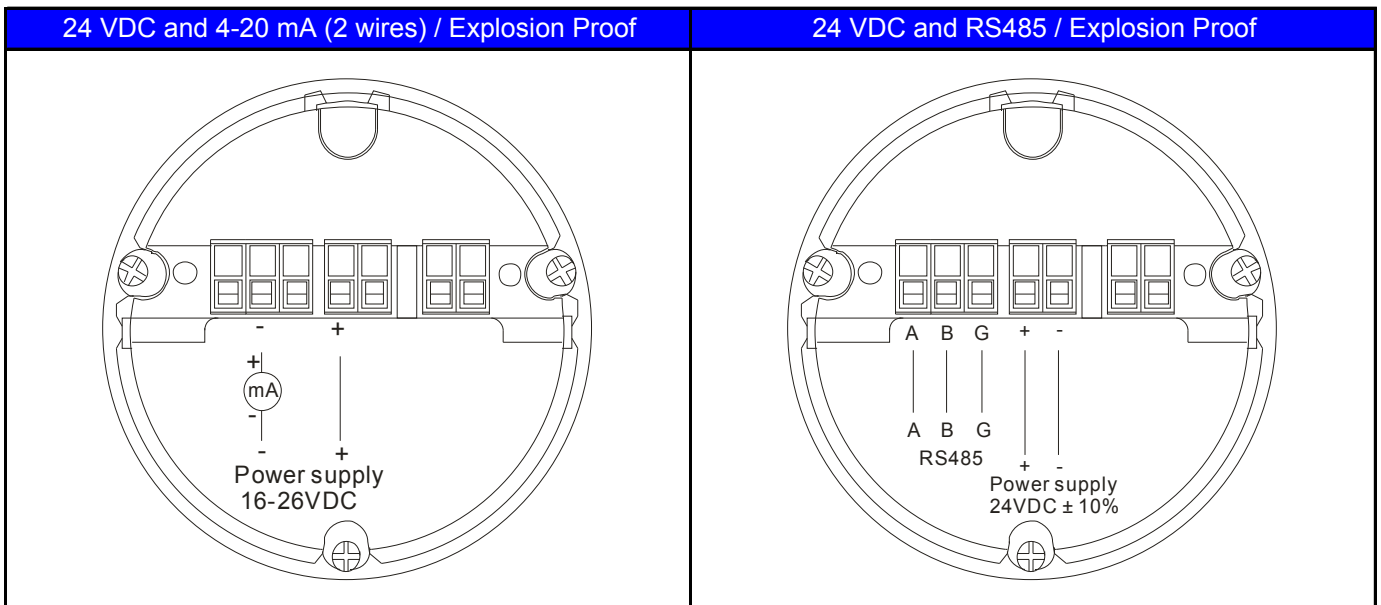
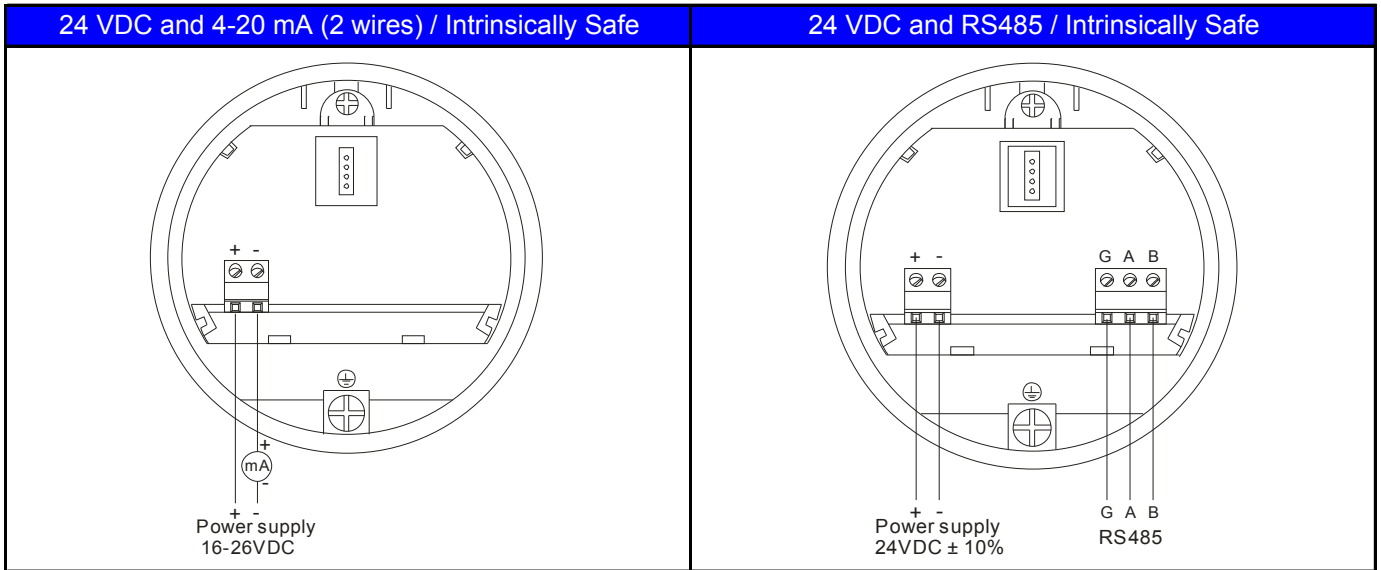
However, if the measured medium is with good reflective characteristics, the connected pipe can be longer than antenna length. And the standard connected pipe length is shown as below chart. In this case, the end of the connected pipe can never have burr and other protrusion and needed to be smoothed. If necessary, the 'False echo memory (false echo learning)' function can be used to remove weak reflection from the end of the connected pipe.



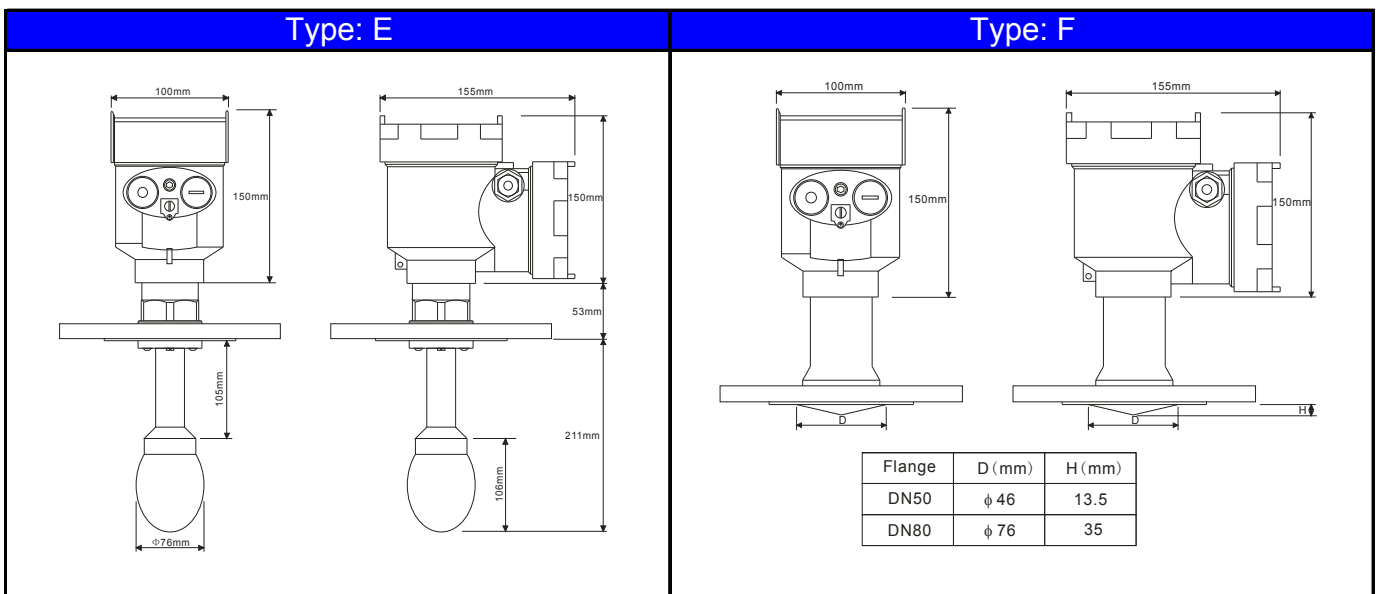
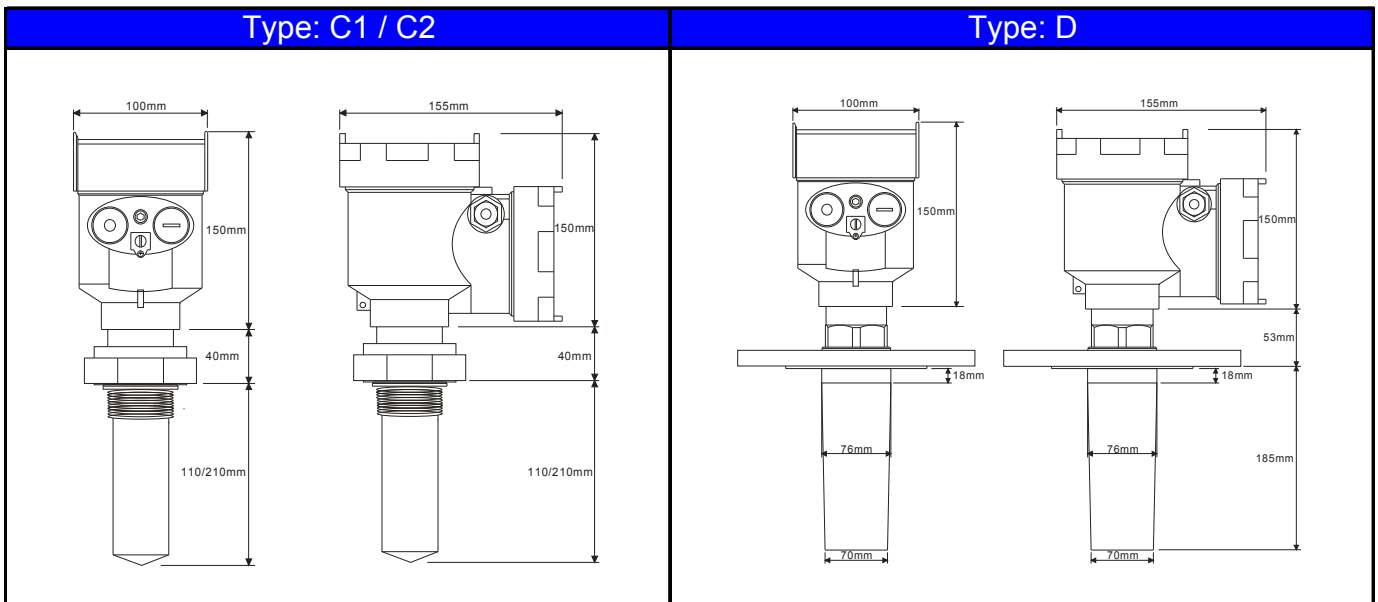
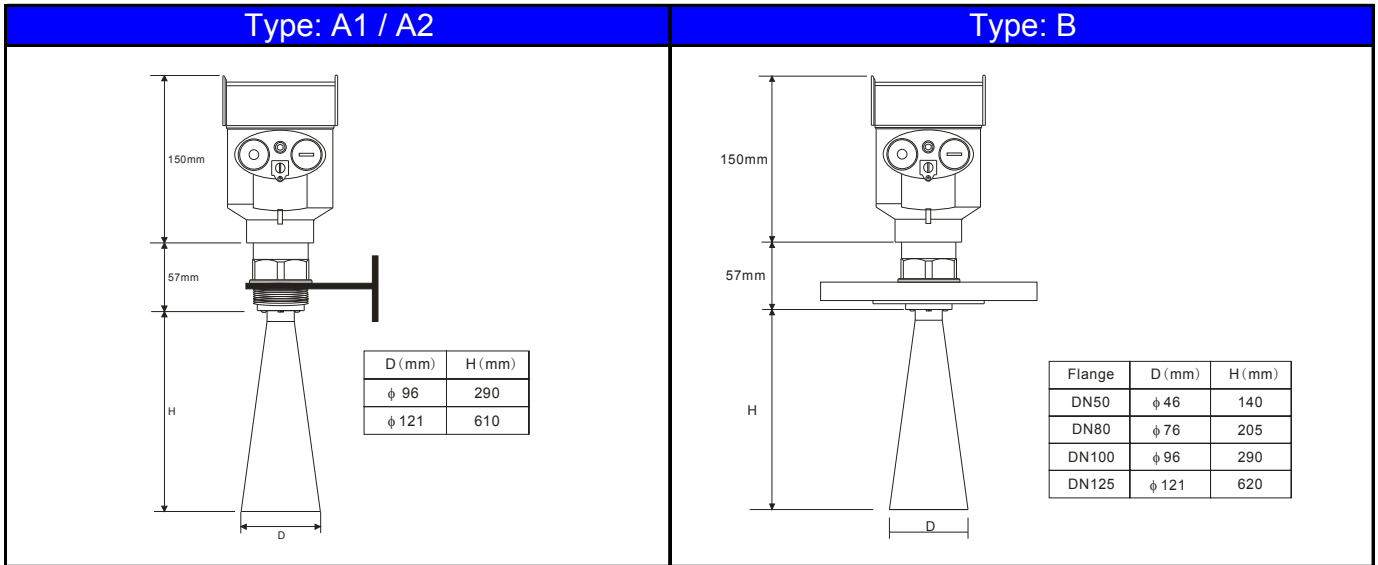
J. Avoid measured liquid level reaching the blind zone, resulting in incorrect measurement

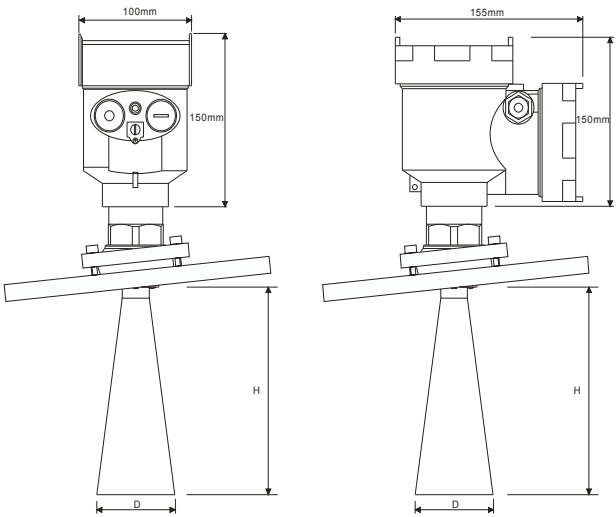
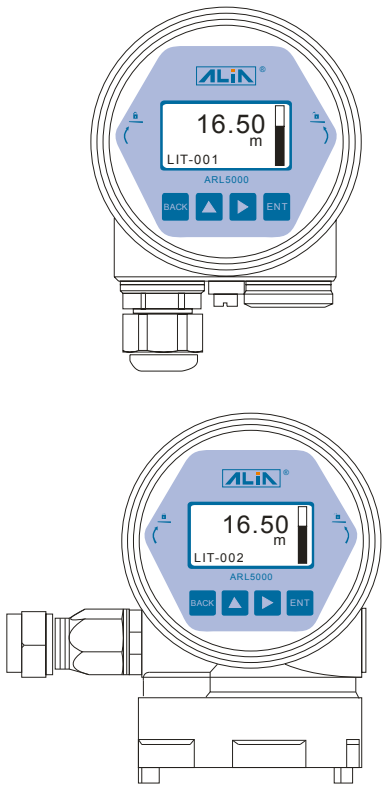
K. If the process temperature is high, an insulation layer must be added outside the tank to avoid electronics overheating inside the instrument due to heat radiation or heat convection, but the insulation layer must not exceed the device neck.

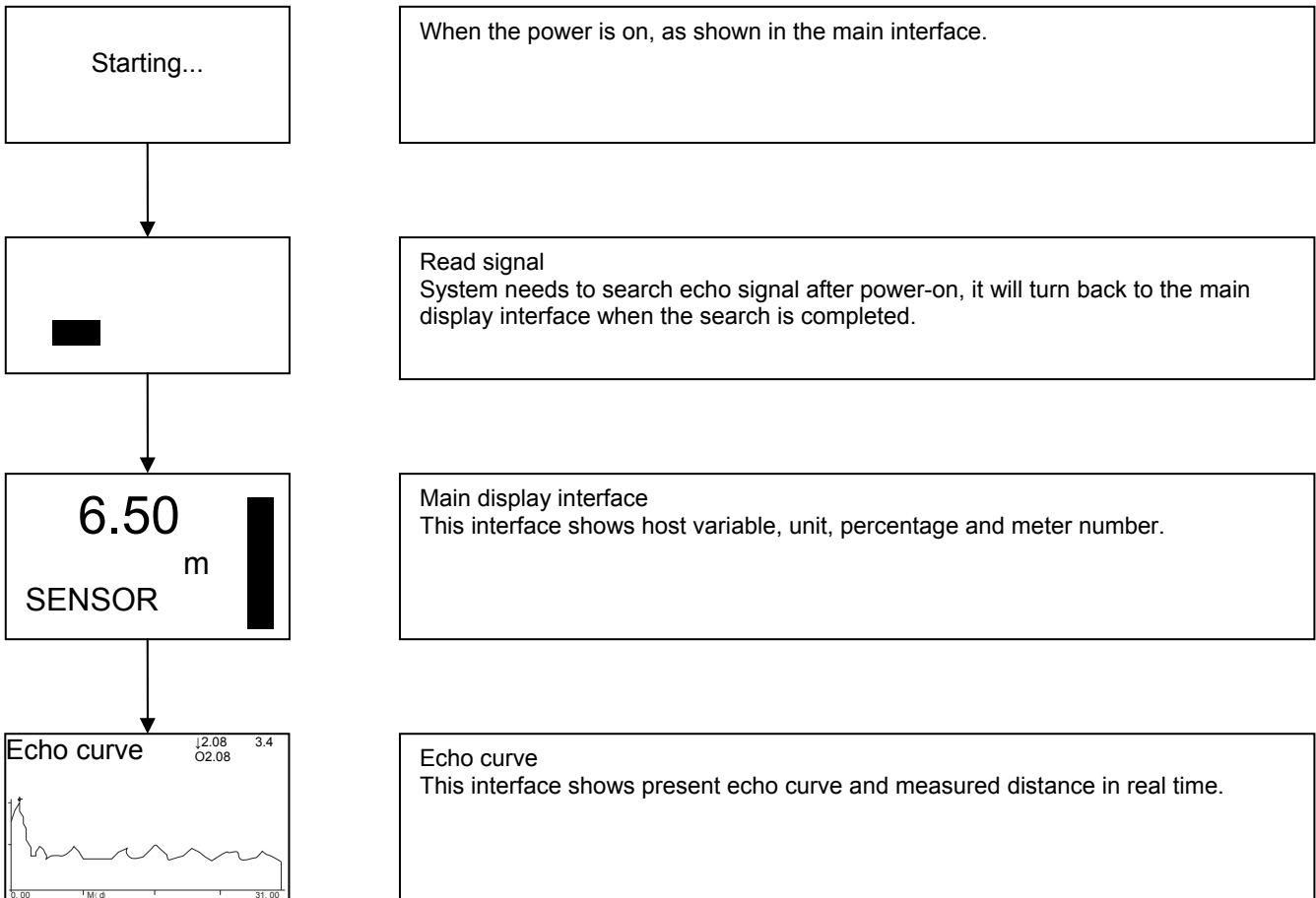
8. Electrical Connection



9. Dimensions



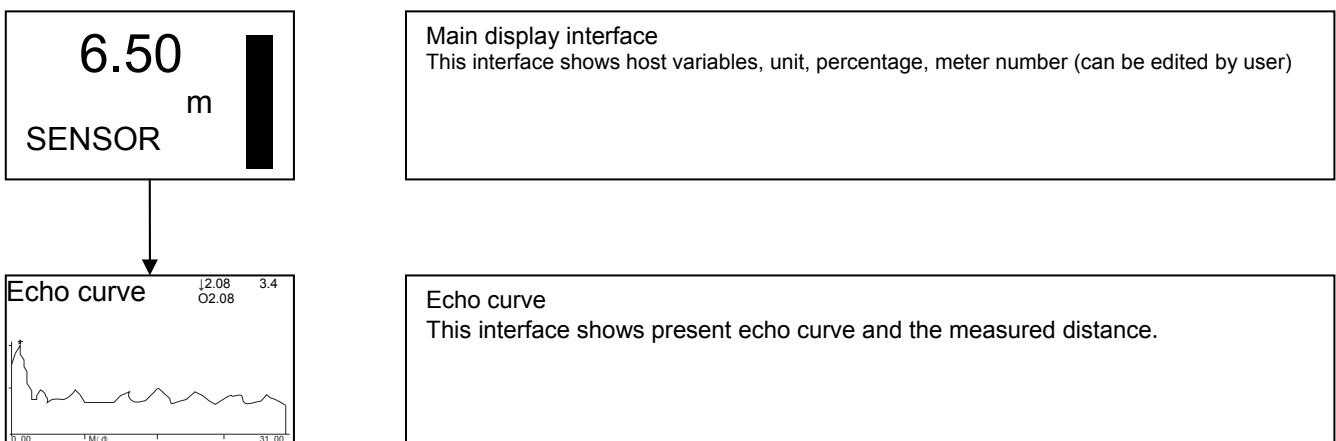
Type: H1 / H2 / H3		Display																
																		
<table border="1" style="margin: auto; border-collapse: collapse;"> <thead> <tr> <th>Type</th> <th>Flange</th> <th>D (mm)</th> <th>H (mm)</th> </tr> </thead> <tbody> <tr> <td>H1</td> <td>DN80</td> <td>φ 76</td> <td>205</td> </tr> <tr> <td>H2</td> <td>DN100</td> <td>φ 96</td> <td>290</td> </tr> <tr> <td>H3</td> <td>DN125</td> <td>φ 121</td> <td>610</td> </tr> </tbody> </table>			Type	Flange	D (mm)	H (mm)	H1	DN80	φ 76	205	H2	DN100	φ 96	290	H3	DN125	φ 121	610
Type	Flange	D (mm)	H (mm)															
H1	DN80	φ 76	205															
H2	DN100	φ 96	290															
H3	DN125	φ 121	610															



Note: If the start-up display keeps jumping in Starting...and progress bar interface, and can not start up normally. Then please check if power supply or wiring is wrong.

11. Display Mode

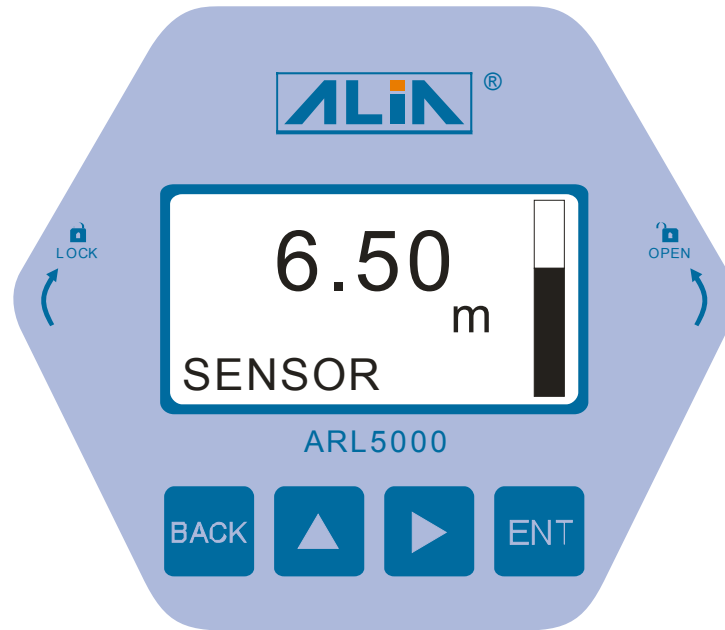
Two display modes are available.







Note:

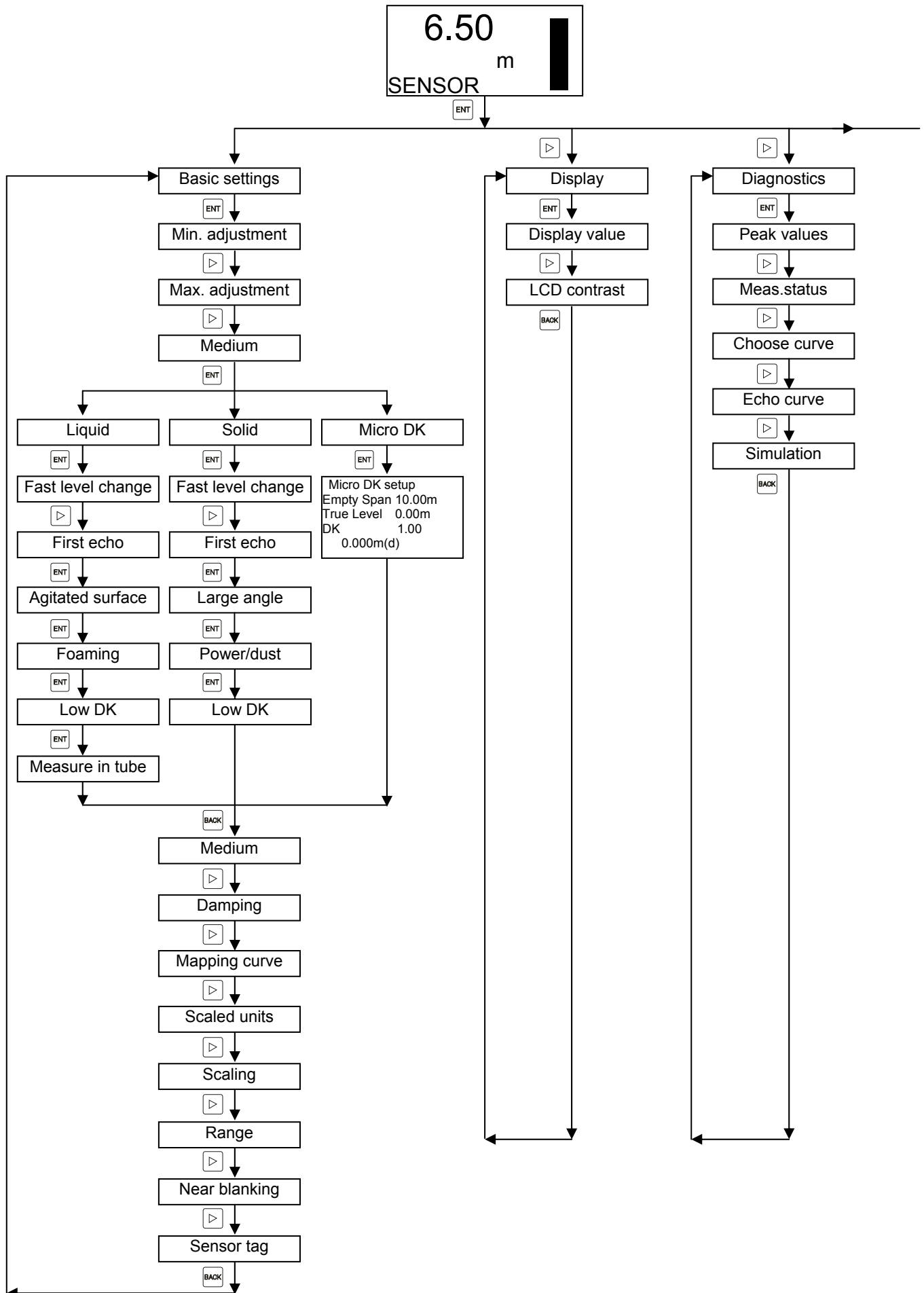
- If the alarm occurs, the main display interface will display alarm code, for example, e.g., E14 means weak echo or no echo, E11 means power problem, E15Room means storage issues.
- After five minutes of user inactivity, Echo curve interface will jump to main display interface.

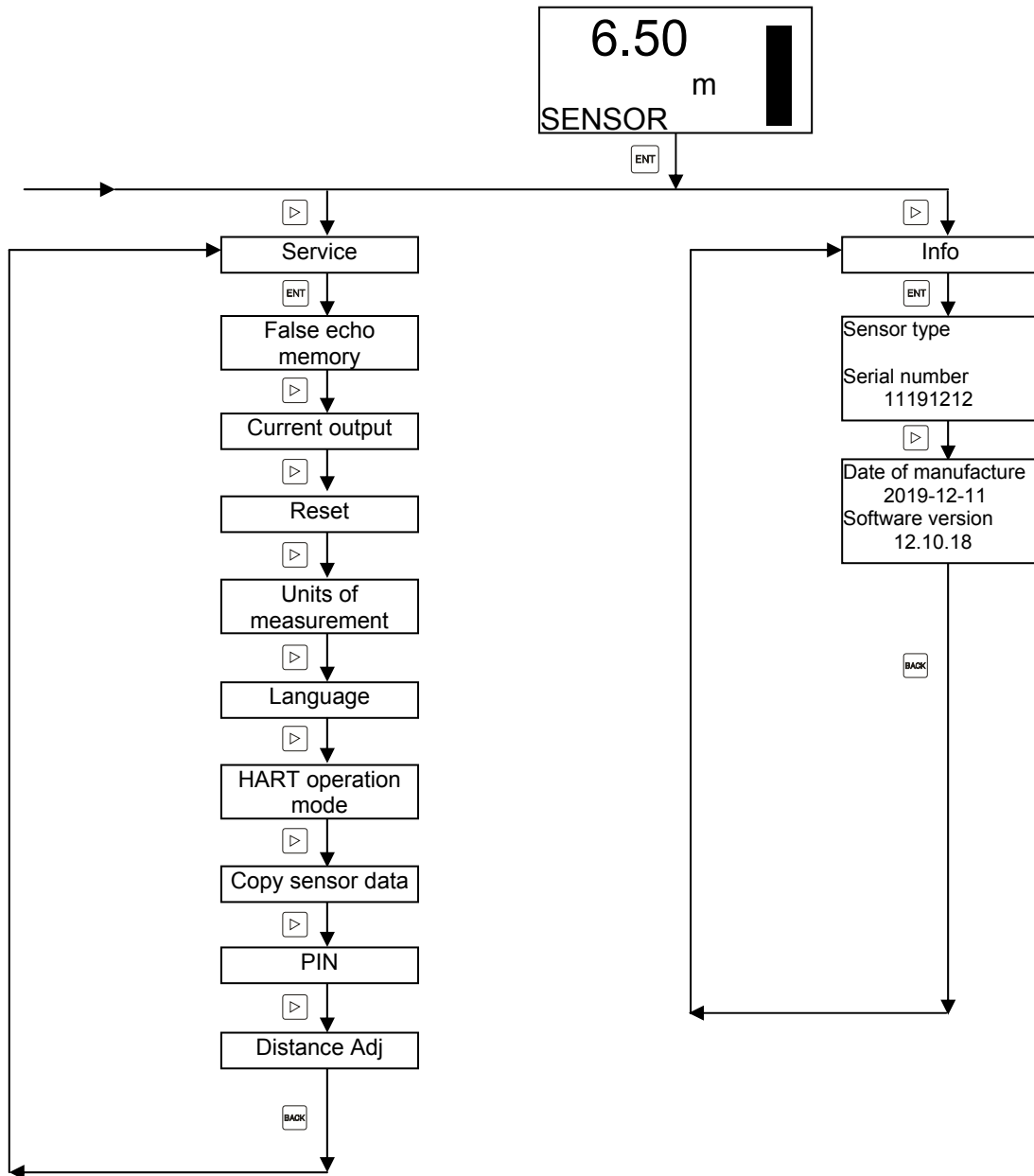
12. Keyboard Information



Name	Button	Function
Back key		---Exit out of edit state ---Interrupt input ---Return to the previous menu ---Switch measuring value / echo curve at run time
Up		---Change parameter value ---Chose display mode
Right		---Chose programming item ---Chose parameter position ---Display parameter content
Setting key		---Enter programming state ---Confirm programming item ---Confirm parameter modification

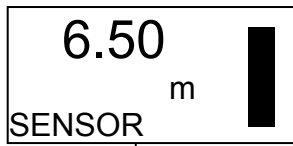
13. Menu List



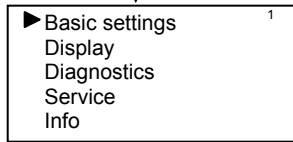


14. Menu Description

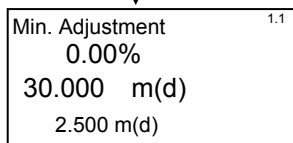
14.1 Basic Settings (Medium is Liquid)



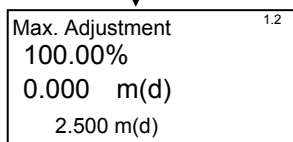
ENT



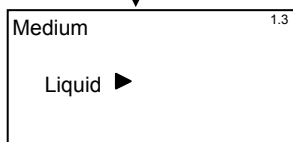
ENT



▶



▶



ENT

Main display interface

This interface shows host variables (level / distance etc.), units, sensor tag, and percentage bar, can also be switched to echo curve display.
Press **ENT** to enter the setting menu.

Basic settings

Basic settings include: Min. Adjustment, Max. Adjustment, Medium, damping time, mapping curve, scaled units, scaling, range setting, blind area and sensor tag.
Press **▶** to move the cursor, as the cursor is pointing at Basic settings, press **ENT** to enter Basic settings.

Min. Adjustment

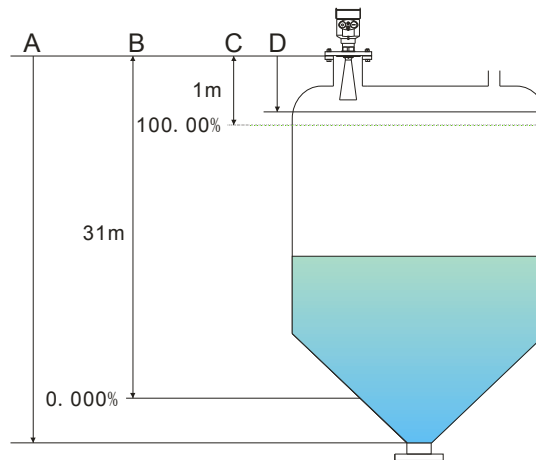
Min. Adjustment is used for range setting, referring to the distance from flange surface to the lowest level. Min. adjustment and max. Adjustment are used in range setting and determine the linear relation proportion of 4-20 mA output. Please set according to actual size of site installation.

Press **ENT** to enter the editing state, press **▲** and **▶** to set parameters, press **ENT** to save the setting.
Press **▶** to enter the next menu.

Max. Adjustment

Max. Adjustment, is used in range setting, refers to distance from the highest level to flange surface. It determines the linear relation proportion of 4-20 mA output with max. Adjustment. Factory default is 0.000 m.

E.g.:



B Min. Adjustment: The distance from the lowest liquid level to the flange surface is 31 m.

C Max. Adjustment: The distance from the highest liquid level to the flange surface is 1 m. Then: Set Min. Adjustment as 31.000 m and set Max. Adjustment as 1.000 m

Indicating: Level B indicates 4 mA output, level C indicates 20 mA output.

Press **ENT** to enter the editing state, press **▲** and **▶** to set the parameters, press **ENT** to save the parameters.
Press **▶** to enter the next menu.

Medium

Set measured medium, including liquid, solid, micro DK. It is factory setting and is not suggested to modify randomly.

Press **▶** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting and 1.3.1 setting interface will automatically jump out.
Press **▶** to enter the next menu.

Fast level change 1.3.1
No ▶



First echo 1.3.2
Normal ▶



Agitated surface 1.3.3
No ▶



Foaming 1.3.4
No ▶



Low DK 1.3.5
No ▶



Measure in tube 1.3.6
No ▶



Medium 1.3
Liquid ▶



Fast level change

Please check whether level change fast or not, and choose Yes or No. Yes refers to that level change fast and system has a higher speed of collecting signal frequency.

Press to enter the editing state, press and to choose, press to save the setting.

Press to enter the next menu.

First echo

First echo setting includes five types:

Normal: Do nothing to first echo (default value)

Small: Decrease first echo amplitude by 10dB

Big: Increase first echo amplitude by 10dB

Bigger: Increase first echo amplitude by 20dB

Biggest: Increase first echo amplitude by 40dB

Press to enter the editing state, press and to set, press to save the setting.

Press to enter the next menu.

Agitated surface

If liquid is chosen in Medium setting, the menu of 1.3.3 is "Agitated surface" setting, If level surface agitate greatly, please choose Yes, if not, choose No.

Press to enter the editing state, press and to choose, press to save the setting.

Press to enter the next menu.

Foaming

If liquid is chosen in Medium setting, the menu of 1.3.4 is "Foaming" setting, if level surface is with foam, please choose Yes, if not, please choose No.

Press to enter the editing state, press and to choose, press to save the setting.

Press to enter the next menu.

Low DK

If liquid is chosen in Medium setting, the menu of 1.3.5 is "Low DK" setting referring to the measuring setting for level DK in the range of 2-4, after choosing YES, user needs to input an accurate measured distance of empty tank, which is used to judge the tank bottom position to reduce reflection from the tank bottom.

Press to enter editing state, press and to choose and set parameters, press to save the setting.

Press to enter the next menu.

Measure in tube

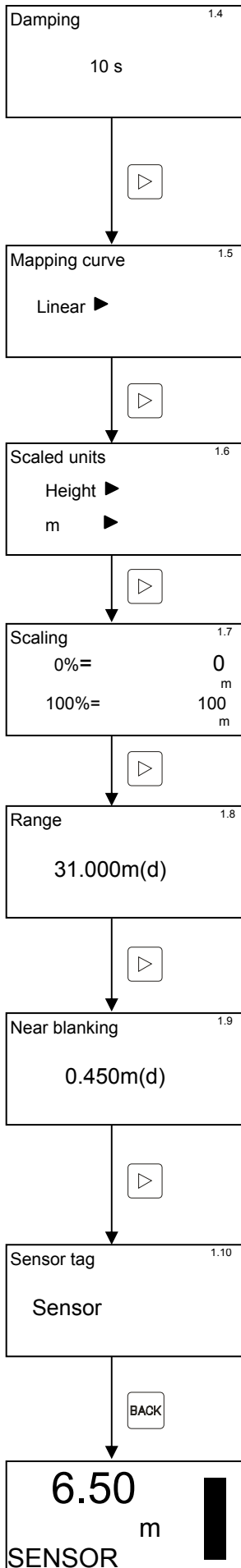
If liquid is chosen in Medium setting, the menu of 1.3.6 is "Measure in tube" setting, which is used for on-site waveguide tube. Users need to enter waveguide tube diameter.

Press to enter the editing state, press and to choose and set parameters, press to save the setting.

Press to return to Medium interface.

Medium

Press to enter the next menu.



Damping
 In order to suppress the fluctuation of the measuring value caused by the fluctuation of the liquid level, an appropriate damping time can be set to ensure sufficient response time on the measurement and allow the sensor to reflect the changed measurement value after the time delay. The factory default is set as 10s.
 Press **ENT** to enter the editing state, press **▲** and **▶** to set, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Mapping curve
 It is used in choosing linear or nonlinear mapping set by host computer. Linear is chosen as the default.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Scaled units
 Choose scaling and scaled unit, including Height, Volume, Mass, Flow, No units.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

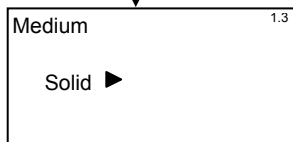
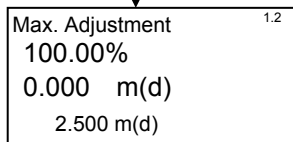
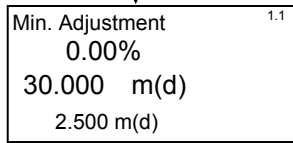
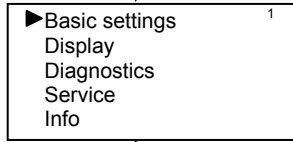
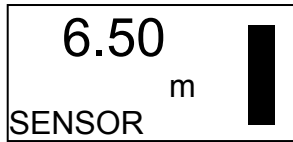
Scaling
 Scaling range setting
 Press **ENT** to enter the editing state, press **▲** and **▶** to enter parameters, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Measuring range
 The instrument measuring rang should be set so as to receive accurate results. It is factory setting and user is not suggested to change randomly.
 Press **ENT** to enter editing, press **▲** and **▶** to enter parameters, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Near blanking
 If there is a fixed obstacle near the sensor surface interfering with the measurement, and the maximum material height does not reach the obstacle, the setting of blind area range can be used to avoid the interference of the obstacle.
 Press **ENT** to enter the editing state, press **▲** and **▶** to input parameters, press **ENT** to save the setting.
 Press **▶** to enter the next me.

Sensor tag setting
 Main display interface will display sensor tag; users can set sensor tag to distinguish more than one radar level gauges.
 Press **ENT** to enter the editing state, press **▲** and **▶** to set, press **ENT** to save the setting.
 Double press **BACK** to return to the main display interface.

14.2 Basic Settings (Medium is Solid)

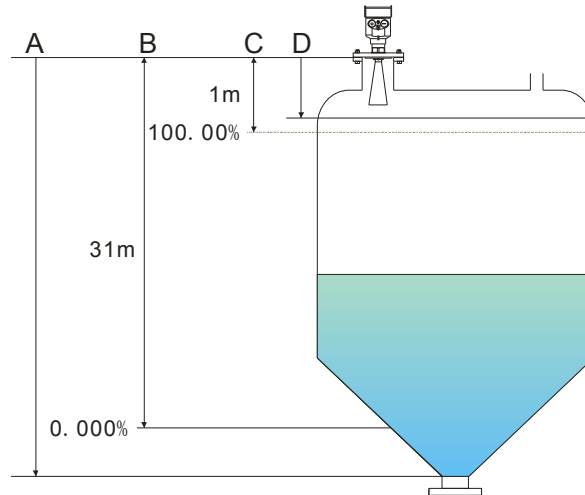


Main display interface
This interface shows host variables (level / distance etc.), units, sensor tag, and percentage bar, and can be switched to echo curve display.
Press **ENT** to enter the setting menu.

Basic settings
Basic settings Includes: Min. Adjustment, Max. Adjustment, Medium, Damping, Mapping curve, Scaled units, Scaling, Range setting, Blind area and Sensor tag.
Press **▶** to move the cursor, as the cursor is pointing at Basic settings, press **ENT** to enter Basic settings.

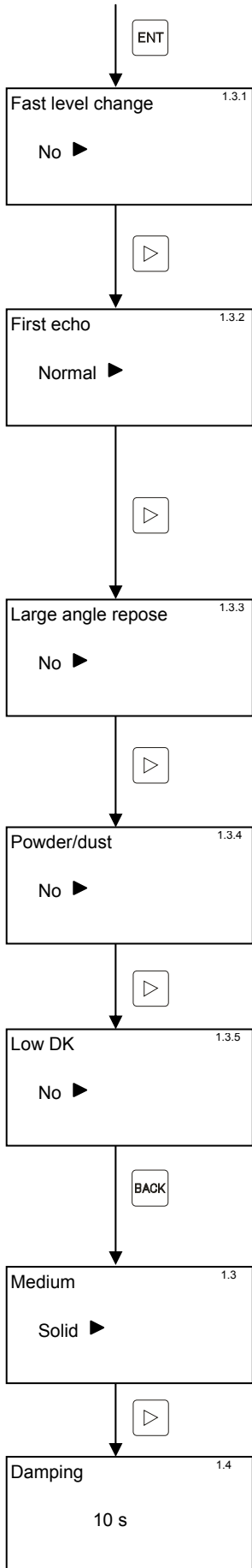
Min. Adjustment
Min. Adjustment is used for range setting, referring to the distance from flange surface to the lowest level. Min. Adjustment and Max. Adjustment are used in range setting and determine the linear relation proportion of 4-20 mA output.
Please set according to actual size of site installation.
Press **ENT** to enter the editing state, press **▲** and **▶** to set parameters, press **ENT** to save the setting.
Press **▶** to enter the next menu.

Max. Adjustment
Max. Adjustment is used in range setting, referring to distance from the highest level to flange surface. It determines the linear relation proportion of 4-20 mA output with Max. Adjustment. Factory default is 0.000 m.
E.g.:



B Min. Adjustment: The distance from the lowest liquid level to the flange surface is 31 m.
C Max. Adjustment: The distance from the highest liquid level to the flange surface is 1 m. Then: Set Min.Adjustment as 31.000 m and set Max. Adjustment as 1.000 m
Indicating: Level B indicates 4 mA output, level C indicates 20 mA output.
Press **ENT** to enter the editing state, press **▲** and **▶** to set the parameters, press **ENT** to save the parameters.
Press **▶** to enter the next menu.

Medium
Set measured medium, including liquid, solid, micro DK. It is factory setting and is not suggested to modify randomly.
Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting and 1.3.1 setting interface will automatically jump out.
Press **▶** to enter the next menu.



Fast Level change setting
 Please check whether level change fast or not, and chose Yes or No. Yes refers to that level change fast and system has a higher speed of collecting signal frequency.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

First echo
 First echo setting includes five types:
 Normal: Do nothing to first echo (default)
 Small: Decrease first echo amplitude by 10dB
 Big: Increase first echo amplitude by 10dB
 Bigger: Increase first echo amplitude by 20dB
 Biggest: Increase first echo amplitude by 40dB
 Press **ENT** to enter the editing state, press **▲** and **▶** to set, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

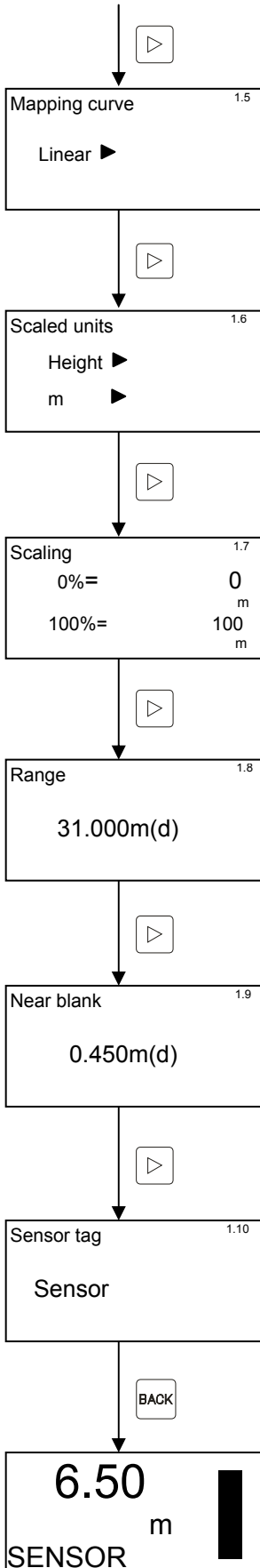
Large angle repose
 If solid is chosen in Medium setting, then the menu of 1.3.3 is “Large angle repose” setting, please choose Yes when the angle repose is large, otherwise choose No.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, then press **ENT** to save the setting
 Press **▶** to enter the next menu.

Powder / dust
 If the solid is chosen in Medium setting, then the menu of 1.3.4 is “Powder / dust” setting, please choose Yes when powder / dust is heavy, otherwise choose No.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Low DK
 If liquid is chosen in Medium setting, the menu of 1.3.5 is “Low DK” setting, which is used for the measurement of the solid DK value between 2-4. After choosing YES, user needs to input accurate empty height value of empty tank.
 Press **ENT** enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **BACK** return to Medium interface

Medium
 Press **▶** to enter the next menu.

Damping
 In order to suppress the fluctuation of the measuring value caused by the fluctuation of the liquid level, an appropriate damping time can be set to ensure sufficient response time on the measurement and allow the sensor to reflect the changed measurement value after the time delay. The factory default is set as 10s.
 Press **ENT** to enter the editing state, press **▲** and **▶** to set, press **ENT** to save the setting.
 Press **▶** to enter the next menu.



Mapping curve
 It is used in choosing linear or nonlinear mapping set by host computer. Linear is chosen as the default.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Scaled units
 Choose scaling and scaled units, including Height, Volume, Mass, Flow, No units.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

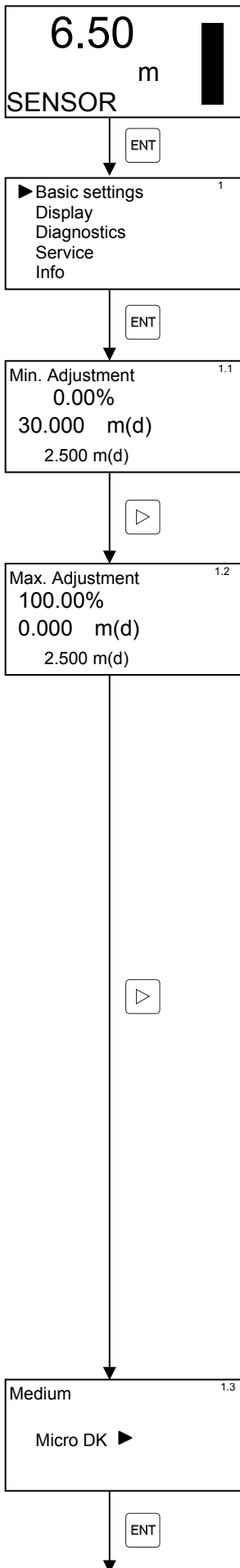
Scaling
 Scaling range setting
 Press **ENT** to enter the editing state, press **▲** and **▶** input parameters, and press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Measuring range
 The instrument measuring rang should be set so as to receive accurate results. It is factory setting and user is not suggested to change randomly.
 Press **ENT** to enter the editing state, press **▲** and **▶** to input parameters, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Near blank
 If there is a fixed obstacle near the sensor surface interfering with the measurement, and the maximum material height does not reach the obstacle, the setting of blind area range can be used to avoid the interference of the obstacle.
 Press **ENT** to enter the editing state, press **▲** and **▶** to input parameters, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Sensor tag
 Main display interface will display sensor tag; user can set sensor tag to distinguish many radar level gauges.
 Press **ENT** to enter the editing state, press **▲** and **▶** to set, press **ENT** to save the setting.
 Double press **BACK** to return to the main display interface

14.3 Basic Settings (Medium is Micro DK)



Main display interface
 This interface shows host variables (level/distance etc.), units, sensor tag, percentage bar, and can be switched to echo curve display.
 Press **ENT** to enter the setting menu.

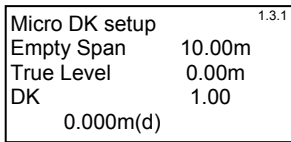
Basic settings
 Including: Low level adjustment, high level adjustment, material nature, damping time, output mapping, calibration value unit, calibration, range setting, blind area and sensor tag.
 Press **▶** to move the cursor, as the cursor is pointing to Basic settings, press **ENT** to enter Basic settings.

Min. Adjustment setting
 Min. Adjustment is used for range setting, referring to the minimum distance from flange surface to the lowest level. Min. adjustment and max. Adjustment are used in range setting and determine the linear relation proportion of 4-20 mA output. Please set according to actual size of site installation.
 Press **ENT** to enter the editing state, press **▲** and **▶** to set parameter, press **ENT** to save the setting.

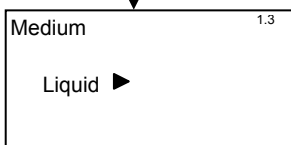
Max. Adjustment setting
 Max. Adjustment, is used in range setting, refers to distance from the highest level to flange surface. It determines the linear relation proportion of 4-20 mA output with max. Adjustment. Factory default is 0.000 m.
 E.g.:

B Min. Adjustment: The distance from the lowest liquid level to the flange surface is 31 m.
 C Max. Adjustment: The distance from the highest liquid level to the flange surface is 1 m.
 Then: Set Min.Adjustment as 31.000 m and set Max. Adjustment as 1.000 m.
 Indicating: Level B indicates 4 mA output, level C indicates 20 mA output.
 Press **ENT** to enter the editing state, press **▲** and **▶** to set the parameters, press **ENT** to save the parameters.
 Press **▶** to enter the next menu.

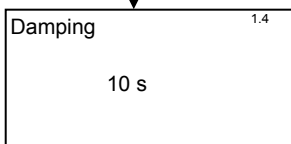
Medium
 Set measured medium, including liquid, solid, micro DK. It is factory setting and is not suggested to modify randomly.
 Press **ENT** to enter editing state, press **▲** and **▶** to choose, press **ENT** to save the setting and 1.3.1 setting interface will automatically jump out.



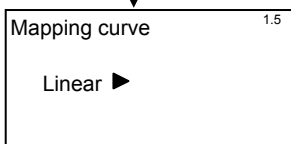
BACK



▶



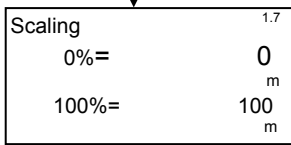
▶



▶



▶



▶

Micro DK setup
 If micro DK, generally used for dielectric constants of less than 1.4, is chosen in Medium setting. In this case, the medium surface is with weak direct echo or can not be measured; the material height can be measured by tank bottom reflection, user need to enter these following parameters:
 1. Measured distance in empty tank, the height from sensor to tank bottom
 2. Please input either the true material height or the dielectric constants, two of these parameters are related.
 The parameter setting above will directly affects the measurement accuracy. If "Micro DK" is chosen, according to the echo conditions, the system will directly adopt echo or the bottom reflection method to obtain the measurement result.
 Note: "Micro DK" should be chosen carefully; most of them are not suitable for radar measurement.
 Press **ENT** to enter the editing state, press **▲** and **▶** to input the parameters, press **ENT** to save the settings.
 Press **BACK** to return to Medium setting interface.

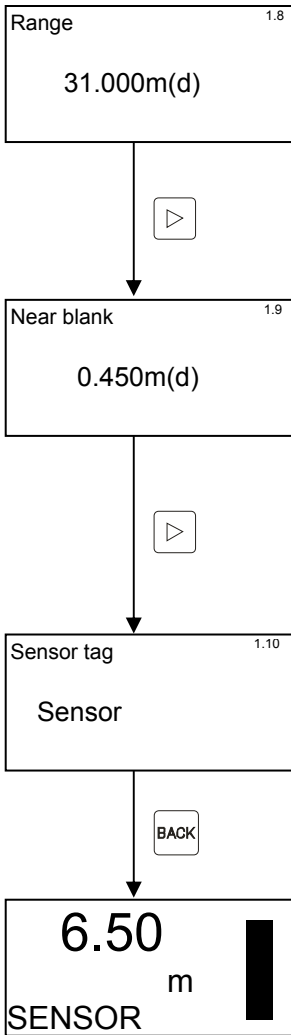
Medium
 Press **▶** to enter the next menu.

Damping
 In order to suppress the fluctuation of the measuring value caused by the fluctuation of the liquid level, an appropriate damping time can be set to ensure sufficient response time on the measurement and allow the sensor to reflect the changed measurement value after the time delay. The factory default is set as 10s.
 Press **ENT** to enter the editing state, press **▲** and **▶** to set, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Mapping curve
 It is used in choosing linear or nonlinear mapping set by host computer. Linear is chosen as the default.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Scaled units
 Choose scaling and scaled units, including Height, Volume, Mass, Flow, No units.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

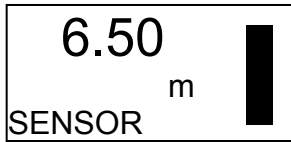
Scaling
 Scaling range setting
 Press **ENT** to enter editing state, press **▲** and **▶** to enter parameters, press **ENT** to save the setting.
 Press **▶** to enter the next menu.



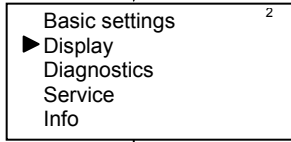
Measuring range
 The instrument measuring rang should be set so as to receive accurate results. It is factory setting and user is not suggested to change randomly. Press **ENT** to enter the editing state, press **▲** and **▶** to set parameters, press **ENT** to save the setting. Press **▶** to enter the next menu.

Near blank
 When there is a fixed obstacle near the sensor surface that interferes with the measurement, and the maximum material height does not reach the obstacle, the function of blind area range setting can be used to avoid the interference of the obstacle. Press **ENT** to enter the editing state, press **▲** and **▶** input parameters, and press **ENT** to save the setting. Press **▶** to enter the next menu.

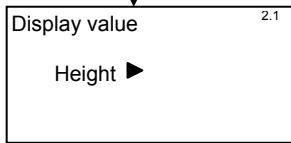
Sensor tag
 Main display interface will display sensor tag; user can set sensor tag to distinguish more than one radar level gauges. Press **ENT** to enter the editing state, press **▲** and **▶** to set, press **ENT** to save the setting. Double press **BACK** to return to the main display interface.



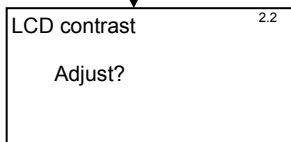
Main display interface
 This interface shows host variables (level / distance etc.), unit, sensor tag, percentage bar, and can be switched to echo curve display.
 Press **ENT** to enter the setting menu.



Display
 Display setting includes: display value, LCD contrast.
 Press **▶** to move the cursor, as the cursor is pointing at Display, press **ENT** to enter Display interface.



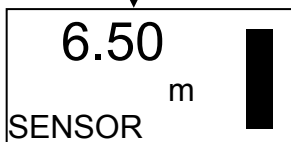
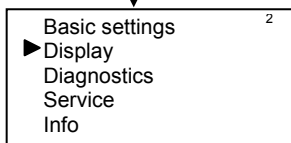
Display value
 Display value includes: Shut off, Distance, Height, Percent, Map Percent, Scaled, Current.
 Press **ENT** to enter the editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

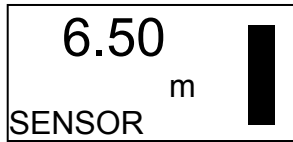


LCD contrast
 Press **ENT** to enter LCD contrast adjustment interface.

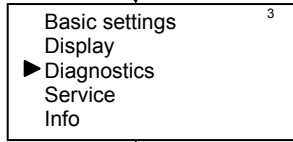


LCD contrast
 Press **▲** and **▶** to adjust, press **ENT** to save the setting and exit.
 Press **BACK** to return.

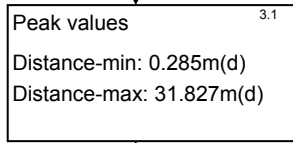




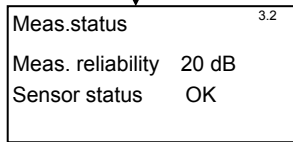
ENT



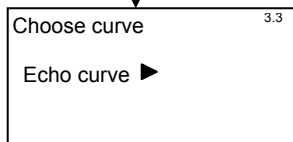
ENT



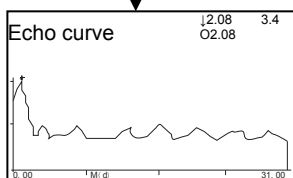
▶



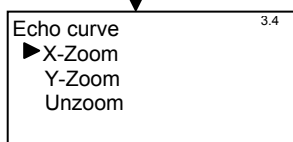
▶



▶



ENT



▶

Main display interface

This interface shows host variables (level / distance etc.), unit, sensor tag, percentage bar, and can be switched to echo curve display.
 Press **ENT** to enter the setting menu.

Diagnostics

Diagnostics function is used to complete the detection function of the instrument. Diagnostic items include: measuring peak value, measuring status, chose curve, echo curve, simulation.
 Press **▶** to move the cursor, as the cursor is pointing at Diagnostics, please press **ENT** to enter Diagnostics.

Peak values

This interface display peak value of measured distance in the measurement process. The parameters can be cleared from the 4.3 reset item in the service menu.
 Press **▶** to enter the next menu.

Measuring status

The measurement status indicates whether the sensor is working properly. If the signal is higher than 10dB and the sensor status displays OK, indicating normal operation at this time. If the signal is weaker than 10dB and the sensor status display E14 alarm, indicating that the weak echo signal is abnormal.
 Press **▶** to enter the next menu.

Choose curve

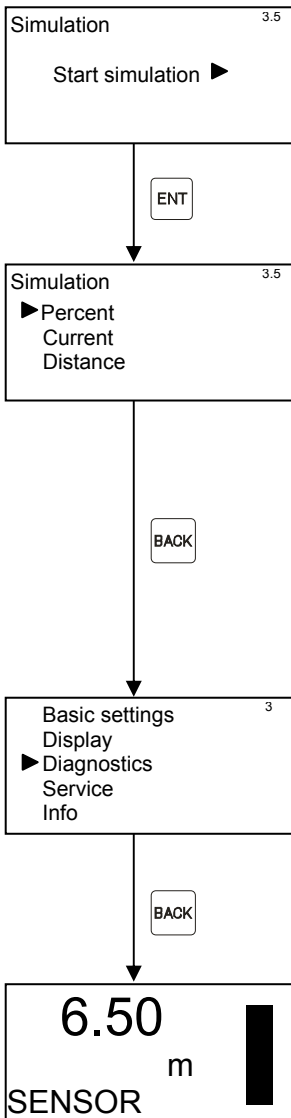
The function of echo curve display includes: Echo curve, False echo curve, Output trend.
 The factory default is set as Echo curve.
 Press **ENT** to enter editing state, press **▲** and **▶** to choose, press **ENT** to save the setting.
 Press **▶** to enter the next menu.

Echo curve display

The curve showed in this interface is determined by 3.3, if Echo curve is chosen in 3.3, then 3.4 will display Echo curve.
 Press **ENT** to enter curve editing menu.

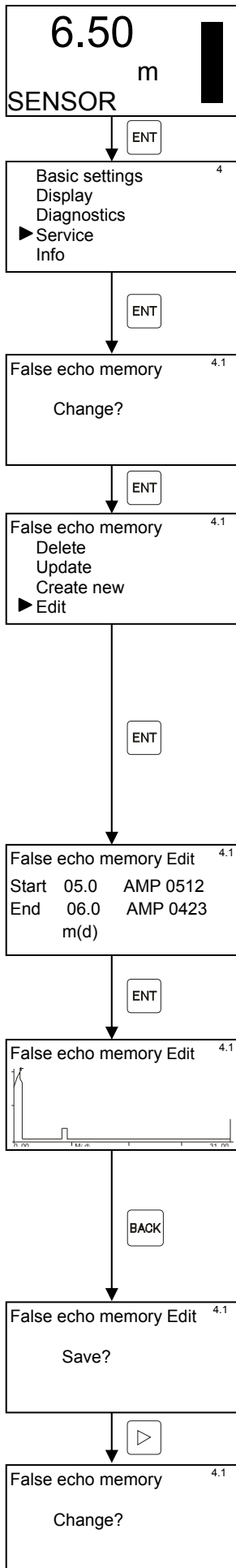
Curve display editing

Curve scaling is used to zoom in and out the curve on the time axis and amplitude for better observation. User can choose X- Zoom or Y-zoom.
 Press **▶** to move cursor, as the cursor is pointing at X-Zoom, Press **ENT** for zooming X axis. Press **▲** to return to the starting location, press **ENT** to confirm, and then press **▲** to move to the end location, press **ENT** to confirm, then the selected area will be zoom into full screen.
 Press **BACK** to return, and press **▶** to enter the next menu.



Simulation output function
 It refers to the simulation of 4-20 mA current signal output, which is used to check that the current output function of the instrument is normal, and can also be used for system debugging.
 Press **ENT** to choose.

Simulation output mapping
 Three of simulation output mapping modes are: Percent, Current, Distance.
 Percent: The given percent determines the current output, e.g. 20 mA is corresponding to 100%, and 4 mA is corresponding to 0%.
 Current: The given current value determines the current input, e.g. 16.6 mA is corresponding to 16.6 mA given.
 Distance: The given measured distance determines the current output. (The corresponding relationship between distance value and the current value is determined by 1.1 Min. Adjustment, 1.2 Max. Adjustment, and 1.5 Mapping curve)
 Press **▶** to move the cursor, as the cursor is pointing at Current, press **ENT** to enter Simulation output setting.
 Press **BACK** to return.



Main display interface
 This interface shows host variables (level / distance etc.), units, sensor tag, and percentage bar, can be switched to echo curve display.
 Press **ENT** to enter the setting menu.

Service
 This menu includes more professional functions for trained personnel. The service items include: False echo memory (false echo learning), Current output, Reset, Units of measurement, Language, HART operation mode, Copy sensor data, Password, Distance adjustment and Threshold setting.
 Press **▶** to move the cursor, as the cursor is pointing at Service, press **ENT** to enter the sub-menu of Service.

False echo memory
 False echo memory can be used to overcome the interference from fixed obstacles in the measurement range.
 Press **ENT** to enter False echo memory (false echo memory learning).

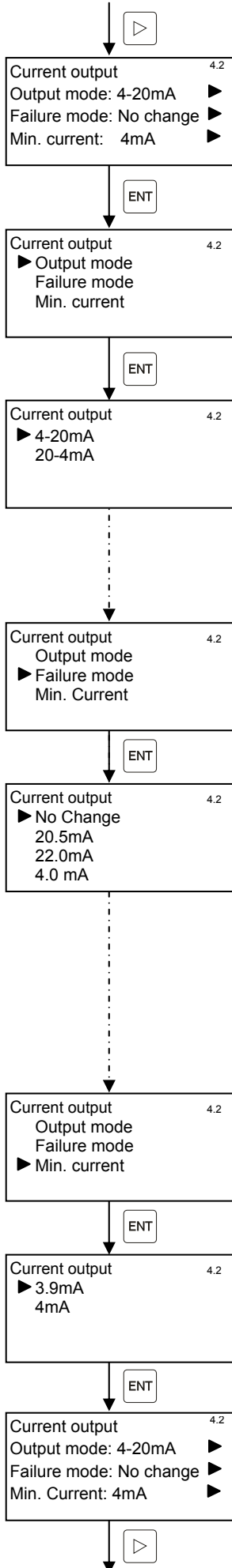
False echo memory
 The false echo setting includes the following four items:
 Delete: to delete the established false echo curve, and please restart the meter after deleting
 Update: to update present false echo curve
 Create new: to create new false echo curve, and the existing echo curve will be replaced
 Edit: refers to the editing or modification of the established false echo to adapt to special working conditions.
 Note: The above functions need to be operated by professionals

Use of Update and Create new:
 When interference occurs in the measurement, please chose Update or create new, enter real echo distance as system prompts and press **ENT** to confirm. And then LCD displays "changing", meaning that the instrument is memorizing the false echo, and after the memorizing, it will return to false echo setting interface. Generally, after the radar is installed and when the tank is empty, users can use Create new for echo memory.

The use of Edit: This operation requires professionals:
 After choosing Edit, the echo curve should be edited at two points each time. The starting point and end point are the coordinates of the editing curve, and the corresponding amplitude value is the value to be modified (Note: when the distance coordinate is input or modified, the subsequent amplitude value will also automatically update based on the currently saved data as a reference for amplitude value modification).

As shown on the left, if there is interference between the echo distance of 5m and 6m, we can adjust the signal by modifying the AMP values of these two points. After modification, users can press **ENT** to observe the curve; in this case, the interface will display the false echo curve after modification for reference. If it does not meet the requirements, you can return to the above editing interface to continue editing. When you confirm that the false echo editing has reached the working condition requirements, you can press **BACK** again to exit the false echo editing menu.

Save false echo editing
 Press **ENT** to save the false echo editing, press **BACK** to discard the current changes.



Current output
The settings of current output modes include: Output mode、Failure mode、Min. Current.
Press to set.

Output mode
Press to move the cursor, when the cursor is pointing at Output mode, press to enter Output mode to choose.

Output mode
Output mode is used to choose 4-20 mA or 20-4 mA.
4-20 mA: low material level is corresponding to 4 mA; high material level is corresponding to 20 mA.
20-4 mA: low material level is corresponding to 20 mA; high material level is corresponding to 4 mA.
The factory default is set as 4-20 mA.
Press to confirm and exit, and please choose Failure mode to enter again.

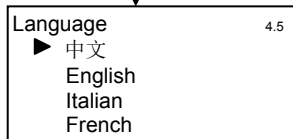
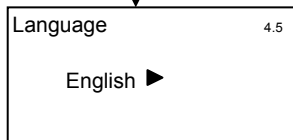
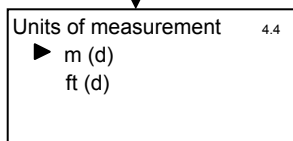
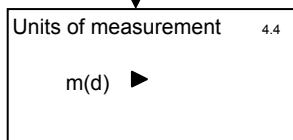
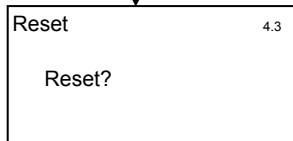
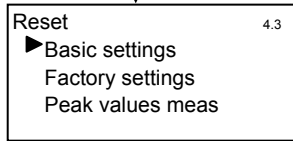
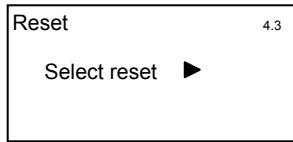
Failure mode
Press to move the cursor, when the cursor is pointing at Failure mode, press to enter Failure mode to choose.

Failure mode
The fault mode is used for choosing the current output in the state of failure alarm, as follows:
No Change: Indicates that the current output remains unchanged when failure alarm occurs.
20.5 mA: Indicates that the current output is fixed at 20.5 mA when failure alarm occurs.
22.0 mA: Indicates that the current output is fixed at 22.0 mA when failure alarm occurs.
4.0 mA: Indicates that the current output is fixed at 4.0 mA when failure alarm occurs.
Press to confirm and exit, choose Failure mode to enter again.

Min. current
Press to move the cursor, as the cursor is pointing at Min. Current, press to enter Min. Current to choose.

Min. current
Choose 3.9 mA or 4.0 mA for the minimal output current.
Press to confirm and exit.

Current output setting
Press to enter the next menu.



Reset
Press ▶ to choose reset function.

Reset function
Reset function is used to reset instrument parameters; here are three of the reset functions:
Basic settings: to restore factory default setting for all parameters in the Basic setting.
Factory settings: to restore factory default setting for all parameters in the instrument.
Peak values meas: To zero the measuring peak values in the diagnosis.
Press ▶ to move the cursor to choose reset function on the demand, press ENT to confirm the setting.

Reset function confirmation
Press ENT to reset, press ESC to discard the reset setting and exit.

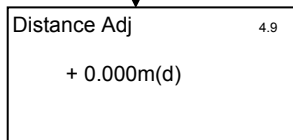
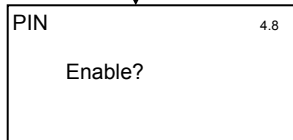
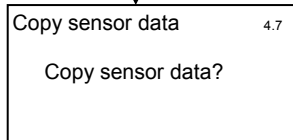
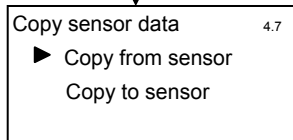
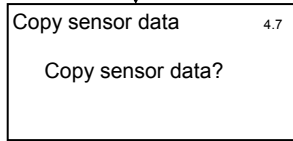
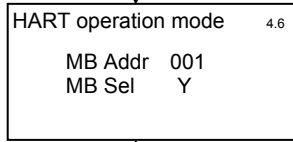
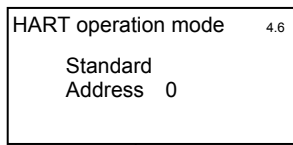
Reset function
Press ▶ to enter the next interface

Units of measurement
User can choose metric m (d) or imperial ft (d).
Press ENT to enter Units of measurement.

Units of measurement
The factory default is set as m (d).
Press ▶ to move the cursor, as the cursor is pointing at m (d), press ENT to confirm and exit.
Press ▶ to enter the next interface

Language
User can choose Chinese, English, French or Italian.
Press ENT to choose language.

Language
The factory default is set as English.
Press ▶ to move the cursor, as the cursor is pointing at English, press ENT to choose and return.
Press ▶ to enter the next interface.



HART operation mode

The factory default is set as Standard, Address 0.
If the Hart communication is connected with two or more instruments, the HART working mode needs to be set to the multi-point operation mode. The address can be set from 1 to 15, and the working current is 4 mA.
Press to set.

HART operation mode

If the instrument is needed to connect with MODBUS communication, user can set MODBUS address in this interface, and MB Sel is set as Y
Press to enter the editing state, press and to modify and press to save the setting.
Press to enter the next menu.

Copy sensor data

This function is used to protect the instrument parameters. After the instrument parameters are set by technicians according to the working environment, user can use the sensor copy function to save the parameters set. If the instrument parameters are accidentally modified, they can be recovered by the sensor copy function.
Press to set.

Copy sensor data

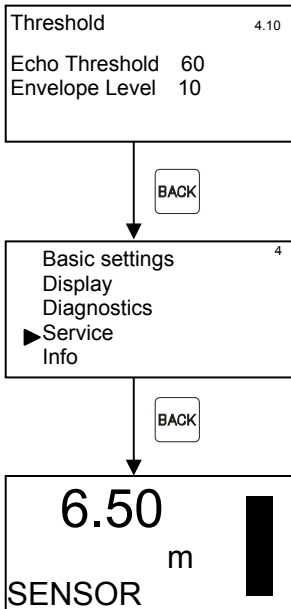
Copy sensor data includes two submenu: Copy from sensor and Copy to sensor.
Press to move the cursor, press to copy the data, it will automatically return after the copying is completed.

Password (Note: If user needs to enable the password, please record the password to avoid forgetting)

The password is used to protect the instrument parameters. After the password function is enabled, user needs to enter the password when changing any instrument parameters. Once the correct password is entered, the password protection function will be cancelled within a limited time, and the instrument parameters can be modified.
Press to enable the password, and input the password needed to set, and users can press to cancel the password set.

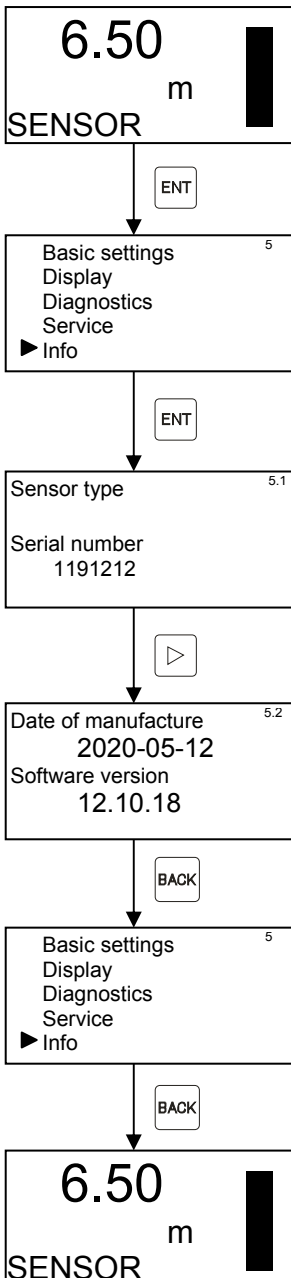
Distance adjustment

The distance adjustment is used to modify measurement error of the instrument; the value is the difference between the actual measured distance and the displayed measured distance.
Press to enter the editing state, press and to input the parameters, press to save the parameters.
Press to enter the next menu.



Threshold setting (Note: this menu needs to be set by professionals)
 The threshold setting is used to set the threshold value of the effective echo. The larger the threshold set, the stronger the effective echo amplitude needed on the site, which is more conducive to removing small signal clutter interference. But please note: If the modified threshold is bigger than the effective echo amplitude, it will cause misunderstanding wave result.
 This menu includes the echo threshold and the envelope level. The default of the echo threshold amplitude is set as 60mV, and the envelope level is set as 10mV by default.
 Press **ENT** to enter the editing state, press **△** and **▷** to set, press **ENT** to save the setting.
 Press **BACK** to return.

14.7 Information Menu



Main display interface
 This interface shows host variables (level / distance etc.), units, sensor tag, and percentage bar, can be switched to echo curve display.
 Press **ENT** to enter the setting menu.

Information
 Information items include: sensor serial number, date of manufacture and software version.
 Press **▷** to move the cursor, as the cursor is pointing at Info, press **ENT** to enter info submenu.

Sensor type and serial number
 Sensor type serial number is by factory default, users can not change.
 Press **▷** to enter the next menu.

Date of manufacture and Software version
 Date of manufacture and Software version are set as factory default, users can not change.
 Press **BACK** to exit Info menu.

15. MODBUS-RTU Protocol

15.1 Protocol Introduction

ARL5000 applies this standard MODBUS-RTU mode.

MODBUS: MODBUS-RTU mode

Baudrate: 9600 bps

Parity: None

Databit: 8

Stopbit: 1

Communication address: 01-127

Function Code: 03, to read Register value.

Function Code: 06, to modify Register value.

15.2 Input Register Table

No.	Name	Function Code	Data type	Address	Data Length	Unit
1	Measured distance	03	Float	0x0000	0x0001	CM
2	Measured distance	03	Float	0x0001	0x0001	MM
3	Level distance	03	Float	0x0002	0x0001	CM
4	Level distance	03	Float	0x0003	0x0001	MM
5	Measuring status	03	Float	0x0004	0x0001	Hexadecimal signal strength (dB)
6	Upper range value	03/06	Float	0x0005	0x0001	CM
7	Blind area	03/06	Float	0x0006	0x0001	CM
8	Min. Adjustment	03/06	Float	0x0007	0x0001	CM
9	Max. Adjustment	03/06	Float	0x0008	0x0001	CM

15.3 Examples

1. Read 10 Register values from 0x0000:

Sending Command:

(MODBUS Address) + (Function Code) + (Register Address) + (Register Length) + (CRC Check Code)
 01 03 0x0000 0x000A Automatic generation

Receiving data:

(MODBUS Address) + (Function Code) + (Data Digit) + (Register Data) + (CRC Check Code)
 01 03 14 XX--XX (20byte) Automatic generation

2. Modify the instrument parameters; the upper range of modification is 10 m (1000 cm)

Sending Command:

(MODBUS Address) + (Function Code) + (Register Address) + (Register Data) + (CRC Check Code)
 01 06 0x0005 03E8 Automatic generation

Receiving Data:

(MODBUS Address) + (Function Code) + (Register Address) + (Register Data) + (CRC Check Code)
 01 06 0x0005 03E8 Automatic generation