Ultrasonic Level Sensor

Operating Instructions and Settings for Part Numbers LLUSCS01-520x and LLUSCS02-530x

LLUSCS01 Integrated Ultrasonic Level Sensor

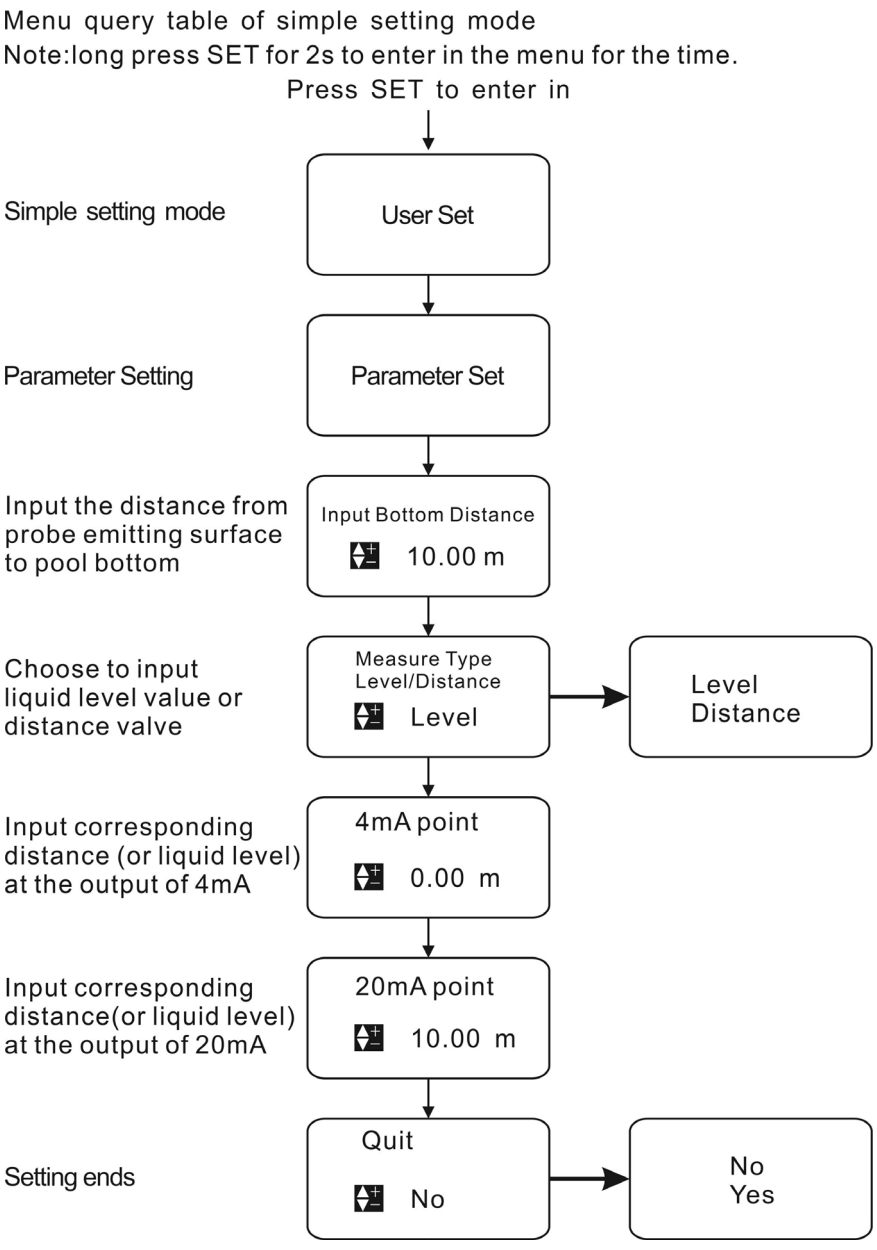
LLUSCS02 Ultrasonic Level Sensor & External Gauge

PANEL DESCRIPTION

There are three buttons on the panel, via which the meter can be adjusted. The measured values are displayed on the LCD screen after the adjustment.

SET Button	▼ ▲ Buttons
• Enter menu item • Confirm menu item • Confirm parameter modification	• Move cursor • Choose menu item • Modify parameter

(1) After turning the power of the meter on**,** long press the set button (SET) for 2s to enter in the main menu**.** The menu modes include **expert setting mode** and **simple setting mode**.
The menu query table of simple setting mode is as shown in the table below.



The menu query table of **expert setting mode** is shown under **Menu Interface & Operating Instructions** section. .

(2) **Select Measuring Mode**: Measuring modes are divided into **distance measuring mode** and **material level measuring mode**. And the factory default is **material level measurement**.

(3) Input **probe height value** to "**reference zero point**" (probe height is the distance from probe emitting surface to tank bottom or pool bottom).

①Under **distance measuring mode**, setting of **reference zero point** is not required and the positions of **maximum of measuring range** and **minimum of measuring range** are as shown in **Fig. 1.1**.

②Under **material level measuring mode**, the positions of **reference zero-point, maximum of measuring range** and **minimum of measuring range** are as shown in **Fig. 1.2**.

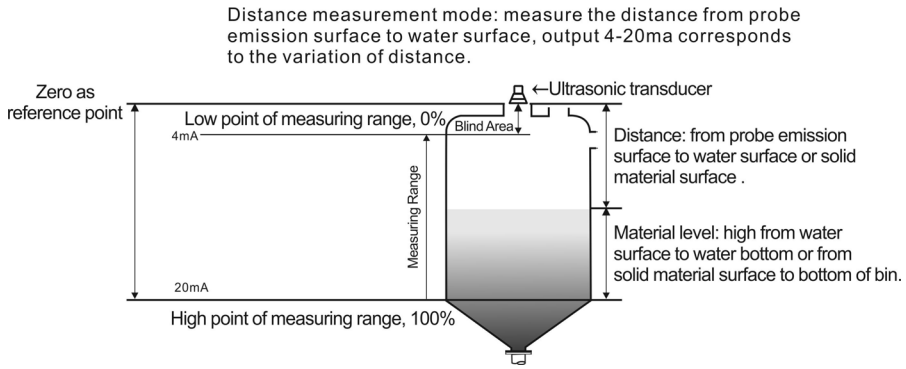
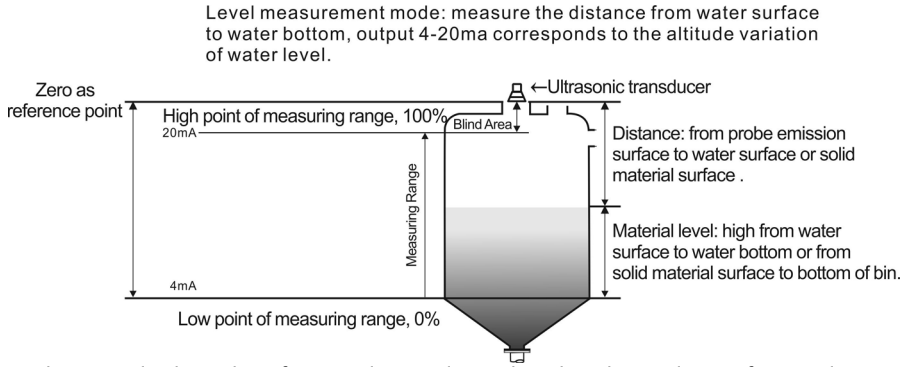


Fig. 1.1 Diagram of Distance Measurement

Fig. 1.2 Diagram of Material Measurement Level

Minimum of measuring range: it is the value of distance between the reference plane to the position, which is positive when the minimum of measuring range is above the reference plane and negative when the minimum of measuring range is below the reference plane. The output current is 4mA when the liquid level is at such position.

Maximum of measuring range: it is the value of distance between the reference plane to the position, which is positive when the



maximum of measuring range is above the reference plane and negative when the maximum of measuring range is below the reference plane. The output current is 20mA when the liquid level is at such position.

(4) **Operating with relay**: enter in the alarm settings and set three parameters:

① **Alarm mode**: select high level alarm, low level alarm or off.

② **Alarm value**: high level alarm: alarm given when the liquid level is above the alarm value

Low value alarm: alarm given when the liquid level is below the alarm value.

③ **Return difference value**: it is used to prevent the repeated switching of alarm switch near the alarm point caused by measurement error.

High level alarm state: alarm cancelled when the liquid level is less than (alarm value - return difference value)

Low level alarm state: alarm cancelled when the liquid level is greater than (alarm value + return difference value)

(5) Please set the options of probe selection, parameter correction and algorithm selection under the instruction of professional technicians.

(6) The installed equipment must be grounded properly and independently and should not share the public grounding with electrical cabinet or meter box.

(7) **Suggestions**: when the ultrasonic level meter is connected to the frequency converter, PLC and other equipment with interference; the power supply part must be added with an isolated transformer, signal part must be added with signal isolator and reliable grounding must be provided.

★ The signal line must not be wired in the same casing with the power line, and it must be installed independently through metal tube or far from the power line. If the signal line is not installed through tube independently, it must be kept at least 1m away from the power line.

Diagram description:

★ This is an important prompt which must be carefully read and strictly followed as per the requirements.

▲ This is a common prompt which needs to be carefully read to avoid difficulty during use.

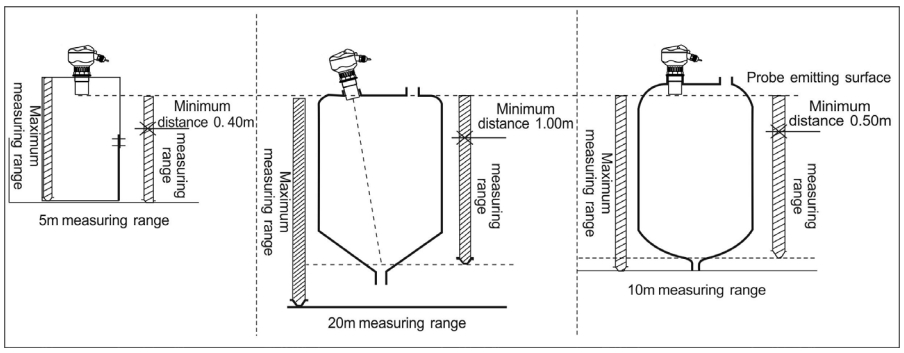
MAIN TECHNICAL INDICATORS

Function	Integrated Type	Separate Type
Measuring range	5m, 10m,	5m, 10m,
Measurement accuracy	0.5%	0.5%
Resolution ratio	3mm or 0.1% (whichever is greater)	3mm or 0.1% (whichever is greater)
Display	English LCD	English LCD
Analog output	2-line system, 4~20mA/ 250Ω load	4-line system 4~20mA/ 510Ω load
Power supply	24VDC	24VDC 120mA
Ambient temperature	Display instrument: -20~+60ºC Probe: -20~+80ºC	Display instrument: -20~+60ºC Probe: -20~+80ºC
IP grade	Display instrument: IP66, probe: IP68	Display instrument: IP65, probe: IP68
Probe cable	N/A	
Product power Consumption	2.4 W	

INSTALLATION GUIDE

Terminology

① Measuring range: the meaning of measuring range is very important for meter type selection. Please refer to the diagram below:



② Emitting angle and false echo:

Ultrasonic wave beam is gathered by the probe. The emitting of impulse wave beam is like the light beam of a flashlight. The further it is from the probe, the greater the diffusion area is.

Any objects within the range of emitting angle, such as pipe, support, weld joint, reinforcing rib, mixing propeller, and hanging object, will lead to strong false echo, especially the objects within the range of emitting angle that are near the probe.

For example, the false echo caused by the pipe at 6m from the probe is 9 times stronger than that caused by the same pipe at 18m from the probe.

★Try every effort to make the sensor axis perpendicular to the medium surface and avoid any other object within the range of emitting angle, such as pipe and support.

Selecting measuring range

Measuring range is decided by the range of ultrasonic probe which is subject to the site working environment, object to be measured and temperature, etc. Decide the measuring range needed based on the table below:

Liquid Surface	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
Stable	0dB	0%	Magnification is unnecessary
Ripple	5...10dB	50～67%	1 time the measuring range
Major fluctuation (for example, there is mixing blade)	10...20dB	90%	3 times the measuring range

Solid Material Surface	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
Hard, rough (such as granular rubber)	40dB	99%	10 times the measuring range
Soft (such as pulverized coal, cement, and coal ash	40...60dB	99～99.9%	Use not recommended

With Dust	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
None	0dB	0%	Magnification is unnecessary
Little	5dB	50%	1 times the measuring range
Much	5...20dB	50～90%	3 times the measuring range

With feedstock	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
None	0dB	0%	Magnification is unnecessary
Little	5...10dB	50～67%	1 times the measuring range
uch	10...40dB	67～99%	3 times the measuring range

With Mist	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
None	0dB	0%	Magnification is unnecessary
Little	5...10dB	50～67%	1 times the measuring range
Much	10...20dB	67～90%	3 times the measuring range

With Steam	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
None	0dB	0%	Magnification is unnecessary
Little	5...10dB	50～67%	1 times the measuring range
Much	10...20dB	67～90%	3 times the measuring range

Temperature difference between Probe and Medium Surface	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
≤20℃	0dB	0%	Magnification is unnecessary
≤40℃	5...10dB	50～67%	1 times the measuring range
≤80℃	10...20dB	67～90%	3 times the measuring range

The calculation method of signal attenuation is to add all signal attenuation amounts if there are several conditions on site.

With little feedstock	5...10dB
With little steam	5...20dB
Temperature difference between probe and medium surface ≤40ºC	5...10dB
Total	minimum: 15dB, maximum: 40dB

Under such circumstances, if the actual maximum measuring range is 5m, ultrasonic level meter with measuring range of 50m should be selected for the measurement.

INSTALLATION OF THREAD AT THE BOTTOM

▲ It is recommended to use plastic flange to connect with the sensor during the installation.

◆ Installation of thread is illustrated as follows:

<table>
<tr><td>1. Install a flange on the object to be measured
  </td><td>2. Place a spacer of the same inner diameter on the flange
  </td></tr>
<tr><td>3. Align the transducer with flange hole
  </td><td>4, Place the transducer in flange hole
  </td></tr>
<tr><td>5. See from the flange bottom
  </td><td>6. Place a spacer of the same inner diameter under the flange
  </td></tr>
<tr><td>7. Tighten nuts to fix the transducer
  </td><td>8. Transducer installed
  </td></tr>
</table>

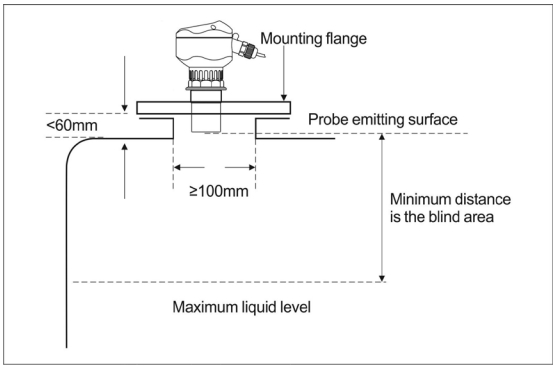
▲Installation on the tank, pool, cover plate and support is the same as above.

★ After probe installation, the probe emission surface must be exposed from the cover plate or waveguide, and it should not be in the cover plate or waveguide.

LIQUID MEASUREMENT

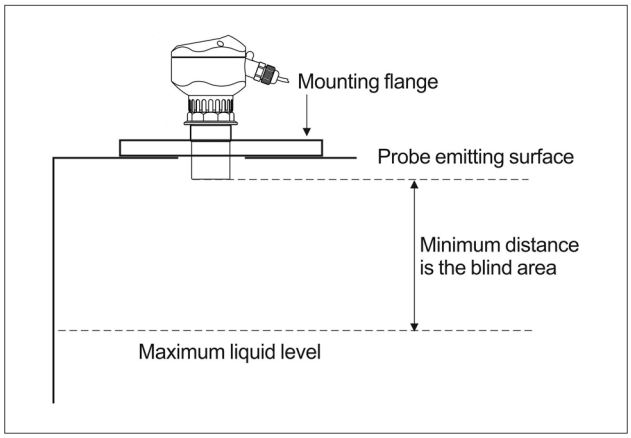
Flat-Top Tank

Normally, the flat-top tank comes with a short connecting pipe with a datum plane that forms the undersurface of the flange. If the connecting pipe length is ≤60mm, inner diameter is ≥100mm and inner wall is smooth and free of burr and bulges, the measurement can be carried out if the emitting surface of installed probe is 3cm below the flange undersurface.

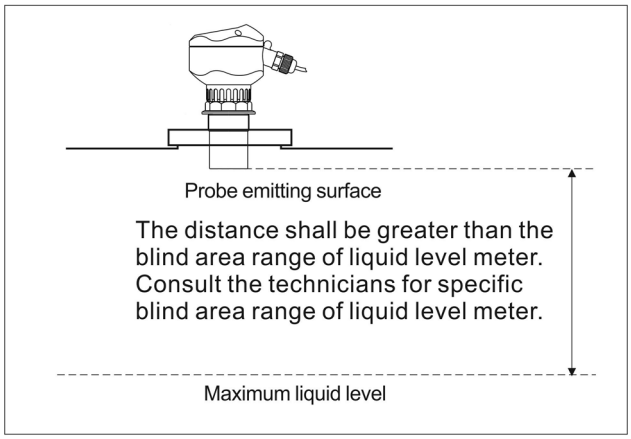


Flange installation in a short connecting pipe

The most ideal installation is to directly install the meter on the flat-top container without using the connecting pipe and the round opening on the container is good enough to fix the mounting flange or cardan joint. The probe emitting surface is below the datum plane.

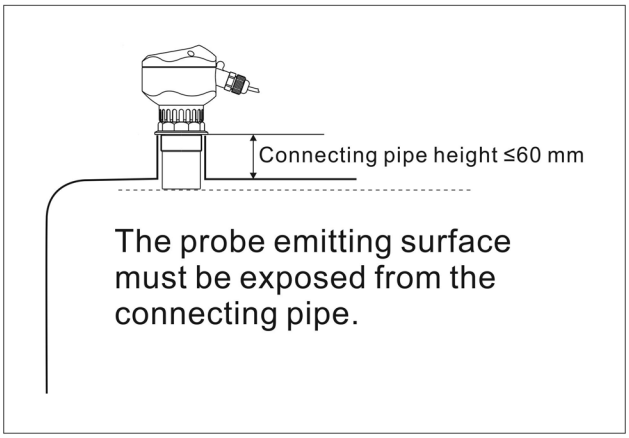


Flange-type (locking flange) installation on the flat-top tank



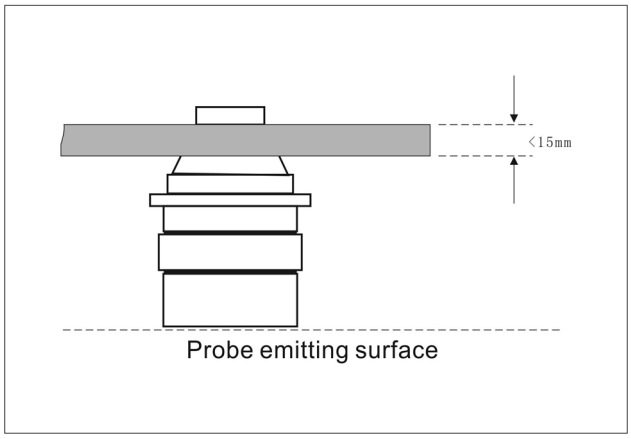
Flange-type installation on the flat-top tank without connecting pipe

In case of installation on nipple joint that is similar to a probe, the inner diameter of connecting pipe should be identical to the external thread and the probe emitting surface must be exposed for at least 1cm from the connecting pipe and it should not be inside the connecting pipe.



Probe installation on nipple joint

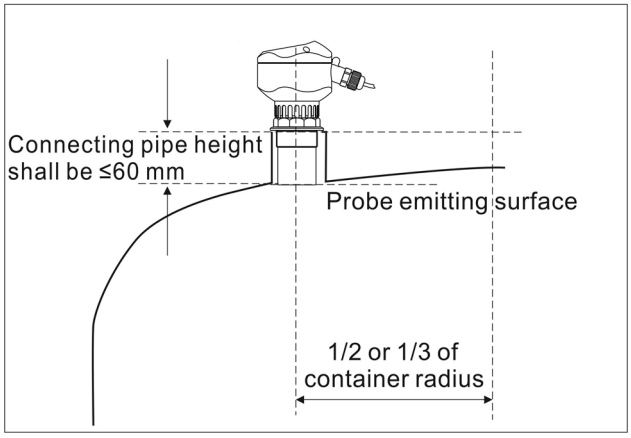
Similarly, the other type of sensor can be installed via top hoisting thread and the dimensions of hoisting thread include M30×1.5, M32×1.5 and M38 ×1.5.



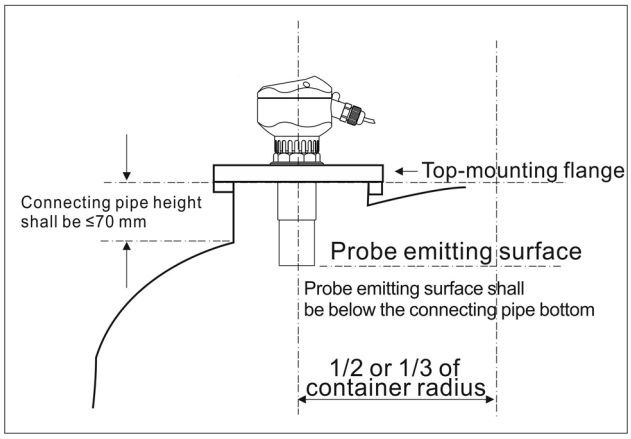
Hoisting thread connection at the separate type probe top

Arch Tank Top

For arch tank, it's better not to install the meter in the middle of the tank top. Instead, the meter should be installed at 1/2 or 2/3 of the tank top radius (under the premise that certain distance from the tank wall is met). The arch tank top is like convex lens to the ultrasonic pulse. If the probe is installed at the focus of convex lens, it will receive false echoes. Therefore, the sensor should not be installed in the middle of the arch tank top.



Installation on nipple joint – arch tank top



Installation on flange – arch tank top

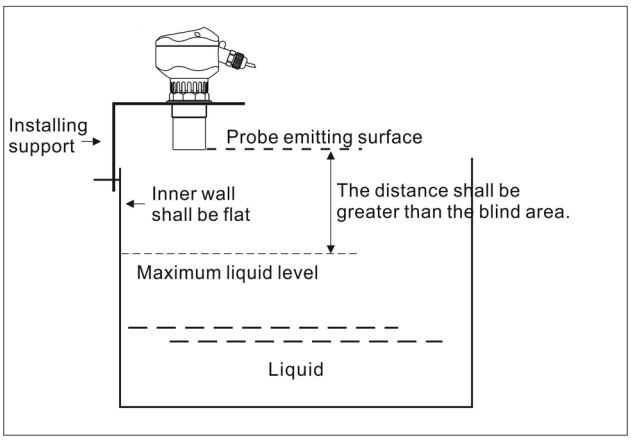
For most arch tanks, the length of connecting pipe plus flange on the top is 150-180mm. But the part below the probe thread of ultrasonic level meter is not long enough (elongated probe is available for customization to make sure the probe emitting surface is below the connecting pipe bottom). In this case, the proportional relation between the diameter and length of connecting pipe should be noted.

S/ N	Length of Connecting Pipe	Minimum Inner Diameter of Connecting Pipe	Remarks
1	150mm	100mm	The inner wall of connecting pipe is free of burr and bulges and vertical and the weld joint should be polished. The connection of connecting pipe and tank top should be outwards polished at an oblique angle of 45º.
2	200mm	150mm	
3	250mm	180mm	
4	300mm	220mm	
5	400mm	280mm	

Open Container

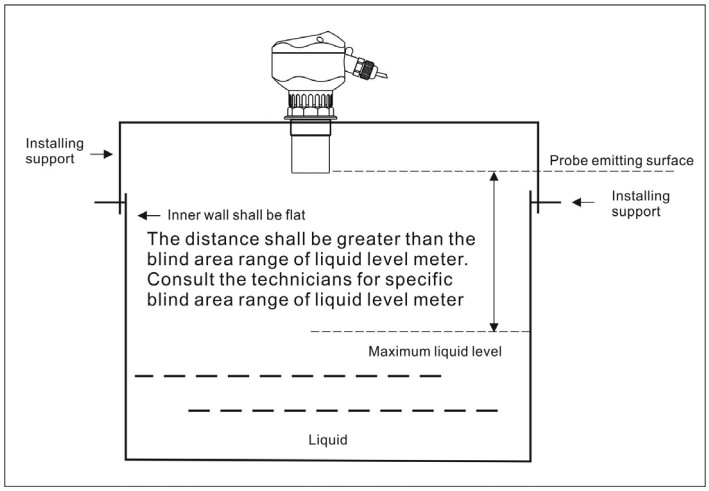
For open container, the support should be used for installation. The bearing capacity of support should be noted and certain distance must be kept between the sensor and container wall. If the upper part and lower part of the open container or stock bin inner wall are flat and free of hanging objects and any other objects; the distance between the sensor and container wall is detailed as follows:

Maximum Measuring Range	Minimum Distance to Wall	Maximum Measuring Range	Minimum Distance to Wall	Maximum Measuring Range	Minimum Distance to Wall
5m	0.5m	10m	1.0m	15m	1.5m
20m	2.5m	30m	3.5m	40m	5m
50m	6m	60m	7m	70m	8m



Installation on open container – with top against the support at one side

As the open container has no focusing effect, the sensor can be installed in the middle of the container.

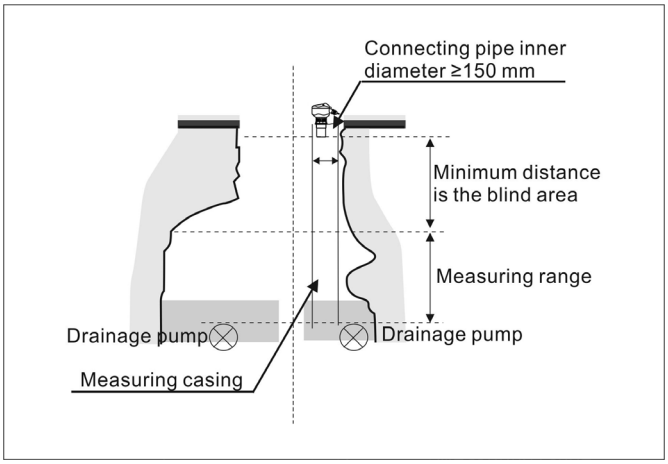


Installation on open container – with support at the top middle part

Draining Well and Common Well

Normally, the wellhole and wellhead of drainage well are narrow, and the well wall is uneven, which makes it difficult to conduct ultrasonic measurement. This can be solved by installing a section of connecting pipe or a whole measuring casing. Attention should be paid to the fact that the blind area will be enlarged for about 50~100% after the sensor is put into the connecting pipe. So the factors for blind area expansion should be considered.

Thus, when the connecting pipe is used, if the original probe blind area is 0.50m, it will be enlarged to 1.00m after the probe is put into the connecting pipe.



Connecting pipe and measuring casing used for drainage well measurement

For common well (including water source well and deep well), normally the diameter is small and the best measuring effect can be reached by installing measuring casing. The inner wall of measuring casing must be smooth (PVC and PE pipe can be used) and the inside diameter should be ≥150mm (measuring range within 4m). The manufacturer should be contacted for connecting pipe longer than 4m. The measurement can be carried out as long as the measuring casing is clean and free of attached medium and internal joint.

The measuring casing should be soaked in the medium all the time, which can ensure the accurate measurement within the measuring casing.

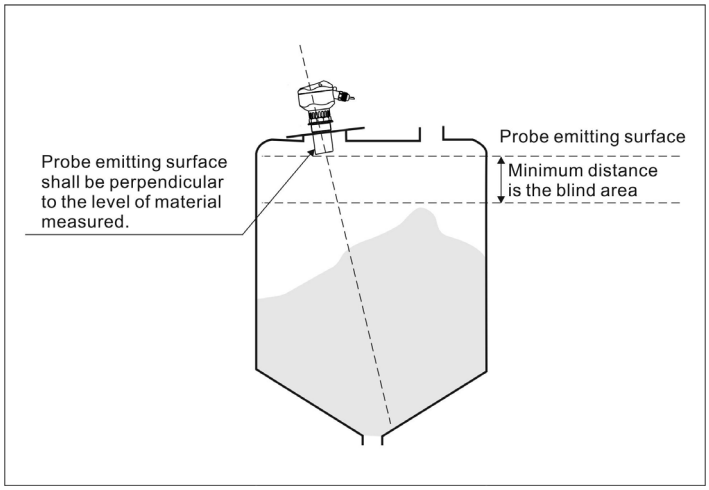
SOLID MEASUREMENT

Flange Installation

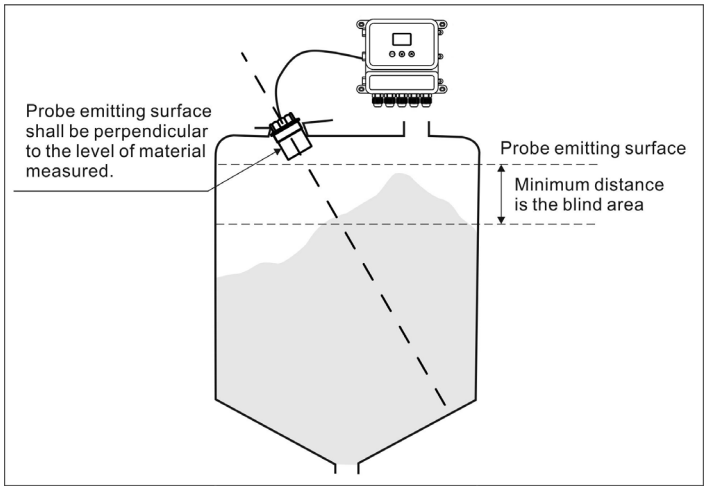
Like liquid medium measurement, the meter can be installed on the counter flange of container connecting pipe. The solid reflecting surface is different from that of the liquid, and it is not a plane, which should be considered during installation. The probe emitting surface should be perpendicular to the surface of solid to be measured and the probe should be exposed from the connecting pipe.

At the solid measurement site, in most cases, probe inside the connecting pipe will lead to pulsating of measured data or “wave loss”.

To solve the problem, the universal flange can be used. In this case, the probe emitting surface can easily be aligned to the reflecting surface of the solid to be measured merely by rotating the flange.



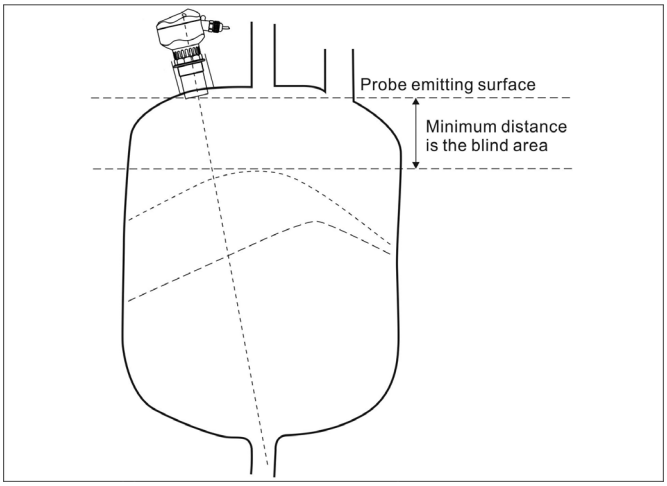
Integrated-type sensor installed on container flange



Separate-type sensor installed on container flange

Installation via Nipple Joint

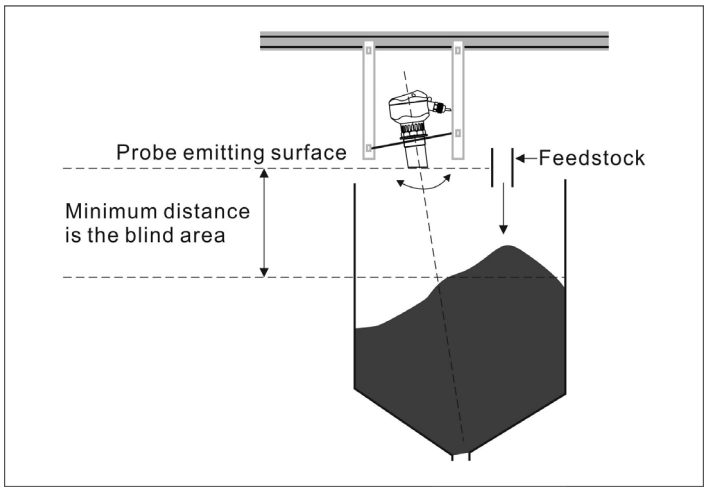
During installation via nipple joint, the probe must be exposed for at least 2cm above the connecting pipe bottom.



Integrated-type sensor – installation via nipple joint

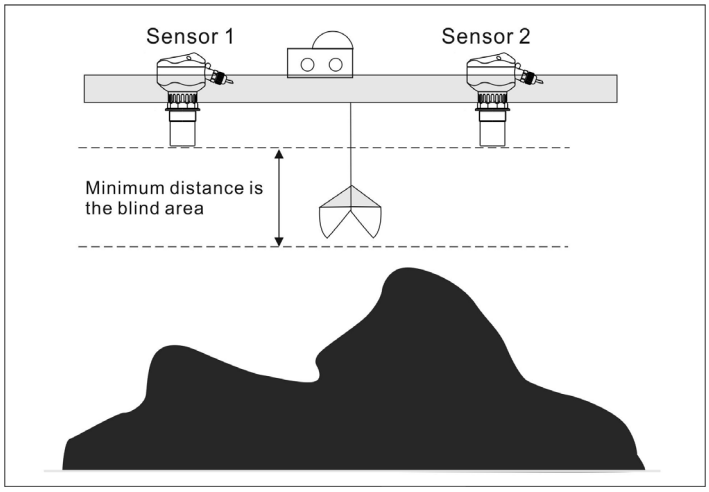
Doorframe Installation

Doorframe installation is ideal for the open container and the axis of connecting pipe must be aligned to the container opening or perpendicular to the medium surface.



Integrated-type sensor – doorframe installation

During installation for material piles in open air, several meters are required for measurement. The meters can be fixed on the hoist frame and sensor probe should be aligned to a medium surface.



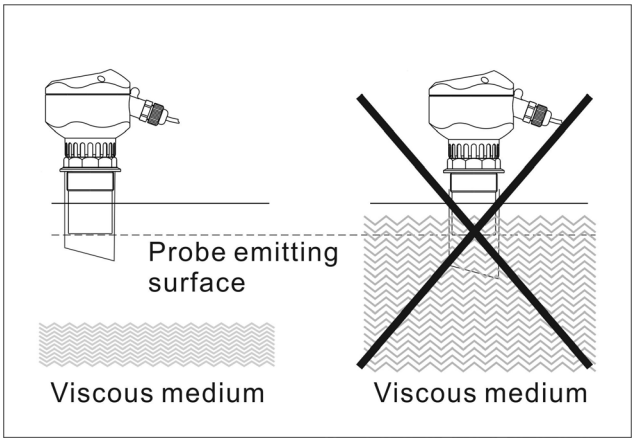
Measurement of material pile in the open air – installation on hoist frame

Extending the connecting pipe for measurement

A minimum distance must be kept between the probe of ultrasonic level meter and surface of measured medium, which is normally called the blind area. However, if the minimum distance cannot be ensured on site in some cases, an extended connecting pipe should be installed on the container.

Extending the connecting pipe for liquid measurement

The inner wall of the connecting pipe must be kept as smooth as possible. The connecting pipe cannot be soaked in the medium to prevent it from getting damaged or affecting to the inner wall of the pipe.

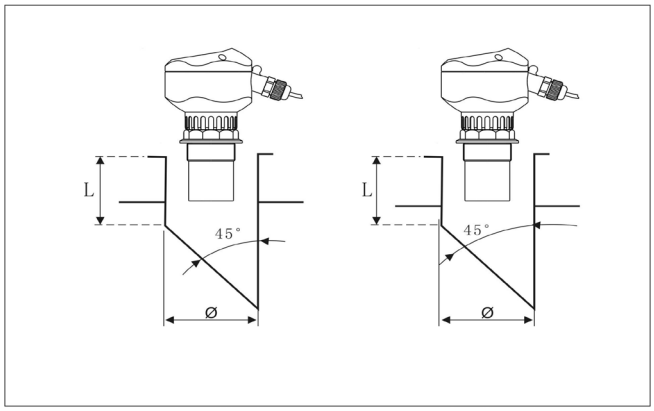


Connecting pipe cannot be soaked in the viscous medium

If the medium is non-adhesive, the extended connecting pipe can be soaked in it for a long time (as long as the pipe is not corroded by the liquid and no impurities come in contact with its inner wall). In this way, measurement can be more accurate.

The inner diameter of connecting pipe should be as great as possible and the inclined cut must be smooth. The relationship between the height L and inner diameter φ of connecting pipe is shown below:

S/N	Length (L) of Connecting Pipe	Minimum Inner Diameter（φ）of Connecting Pipe	Remarks
1	150mm	100mm	The inner wall of connecting pipe should be free of burr and bulges, vertical and the weld joint must be polished. The connection of connecting pipe and tank top should be polished outwards at an oblique angle of 45º.
2	200mm	120mm	
3	250mm	150mm	
4	300mm	180mm	
5	400mm	240mm	



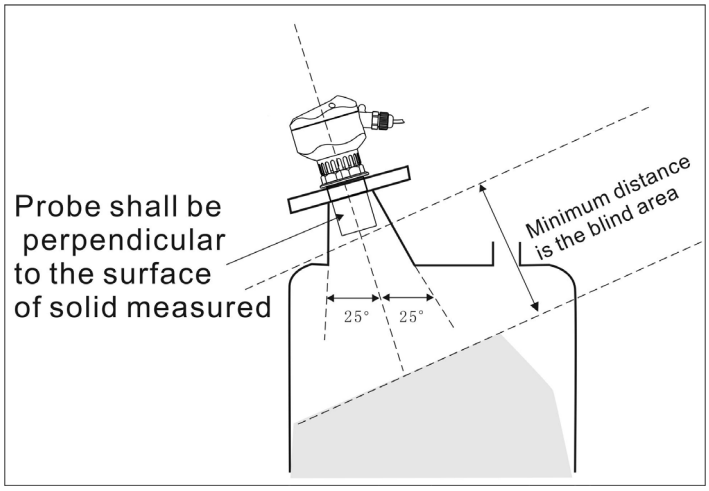
Extended connecting pipe not soaked in the medium

If the extended connecting pipe is installed all the way through the tank from top to the bottom, the relationship between the inner diameter of connecting pipe and sensor measurement distance will be as follows.

Maximum Measuring Range	Minimum Inner Diameter of Connecting Pipe	Maximum Measuring Range	Minimum Inner Diameter of Connecting Pipe
5m	150mm	10m	200mm
15m	250mm	20m	300mm

Extending the connecting pipe for solid measurement

Measurement of solid medium is different from that of liquid. The conical extended connecting pipe with an angle of 25°~30° should be used.

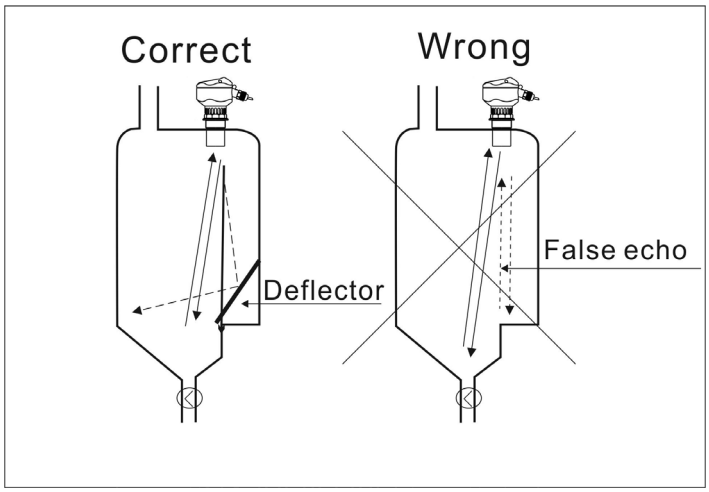


Extended connecting pipe for solid medium measurement

Devices and installation in the container

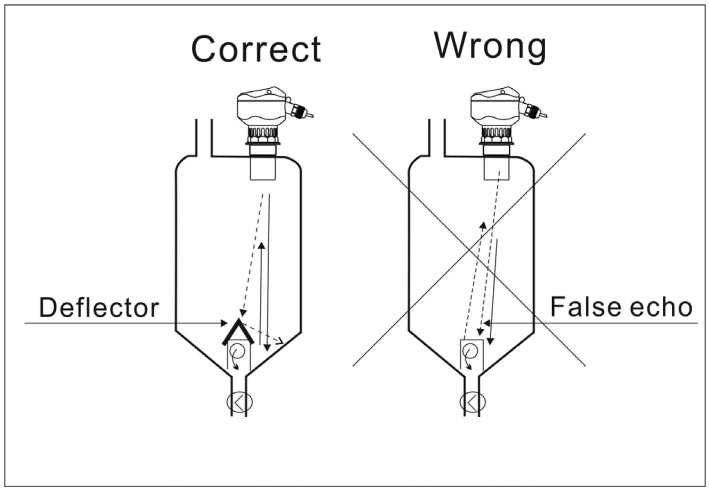
★ Generation of false echo must be avoided during the installation.

During sensor installation, it should be ensured that the ultrasonic wave beam is not blocked by other devices or feedstock. The bulges on the plane or stair-like barriers in the container will have a great impact on the measurement and a deflector can be provided on the embossment to reflect any false echo to ensure accurate measurement.



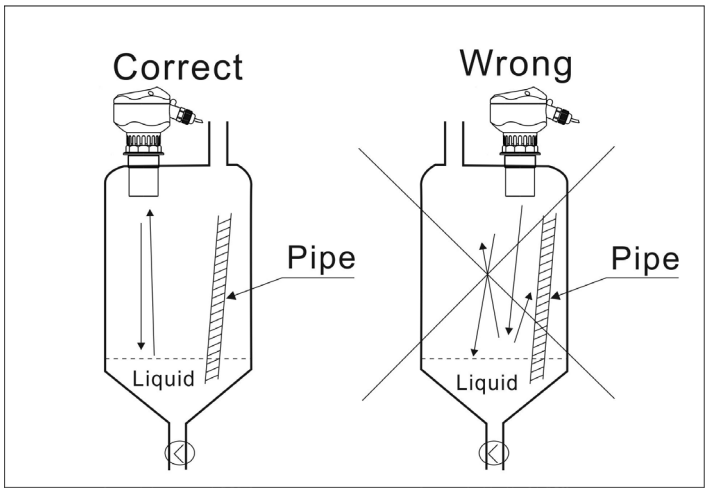
Stair-like barriers in the container – inclined deflector needed to reflect false echo

If the upper surface of the object at the lower part of the container is plane, the inlet for various media must be covered with a deflector set at certain angle.



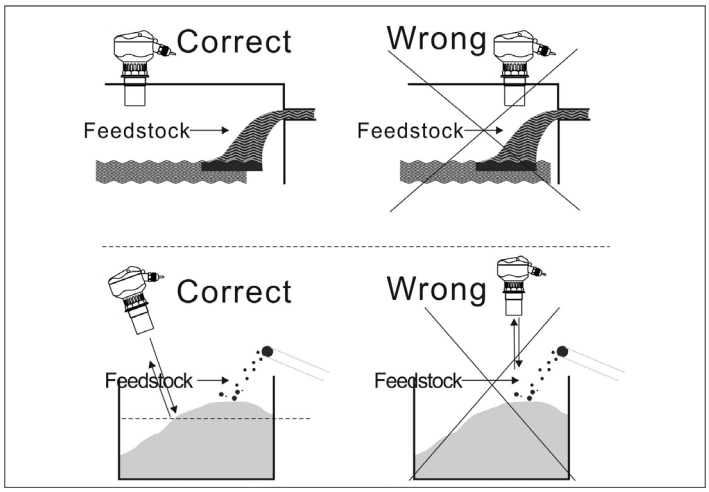
Flat-top bulge at the bottom of the container – deflector required

The devices in the container such as pipe and support will affect the measurement. For accuracy of measuring points, it must be ensured that no other devices are within the diffusion range of ultrasonic wave signal.



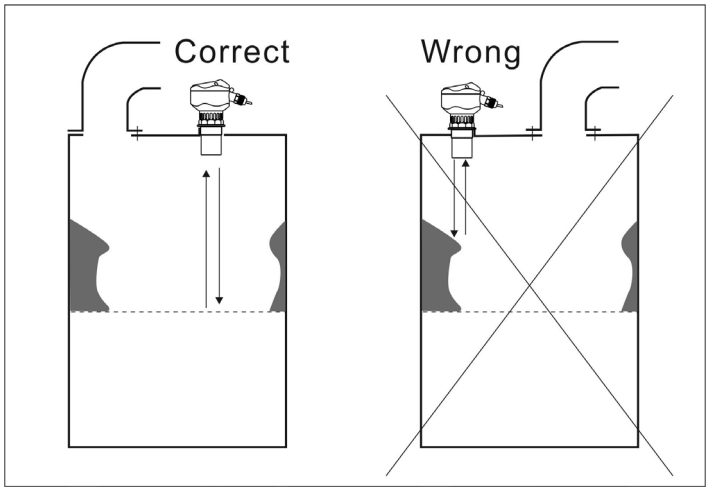
Barrier in the container - pipe

The sensor should not be installed in or above the charging feedstock flow and it should be kept at a distance from the feed inlet.



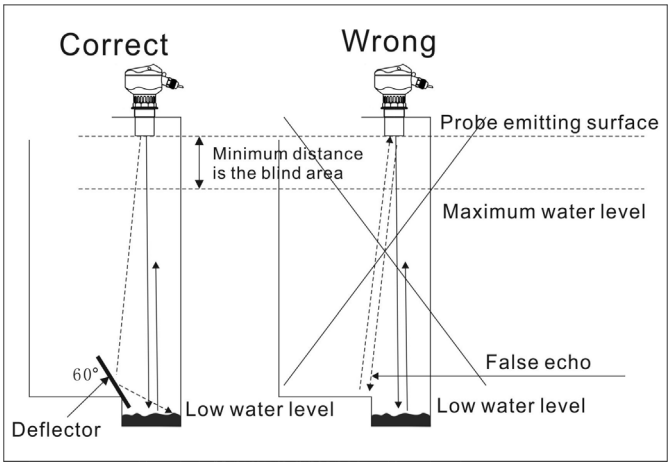
Sensor should not be installed in or above the charging feedstock flow

In the case of viscous medium such as crude oil, mud, asphalt or cement, the medium in the container may lead to strong false echo if the sensor is installed close to the container wall. Therefore, certain distance must be kept between the sensor and the container wall.



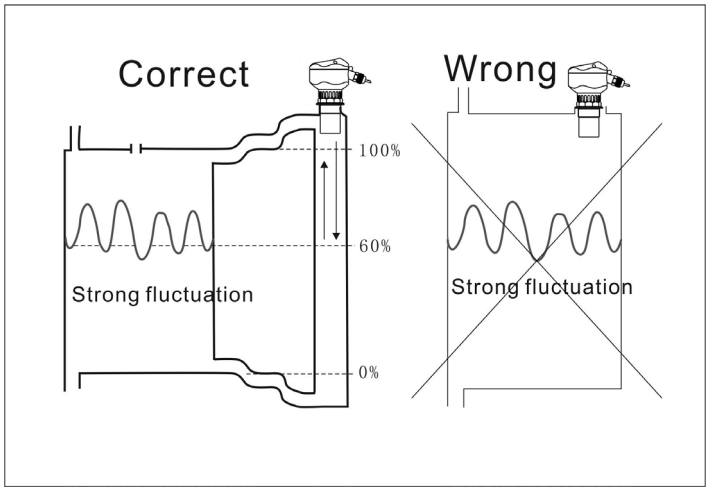
Attachment on container wall – certain distance must be kept from the attachment

In the water storage pool, the installation height is generally decided based on the maximum water level. The distance between maximum water level and probe must be noted. If the objects with elevation difference at the pool bottom are exposed in case of low water level, the edge should be covered with a deflector.



Barriers at the pool bottom – reflect with a deflector

If there is strong eddy or vortex in the container, such as eddy caused by the stirrer or strong chemical reactions, the measurement can be difficult. The ideal method is to install the sensor probe in the waveguide or by-pass pipe for measurement.

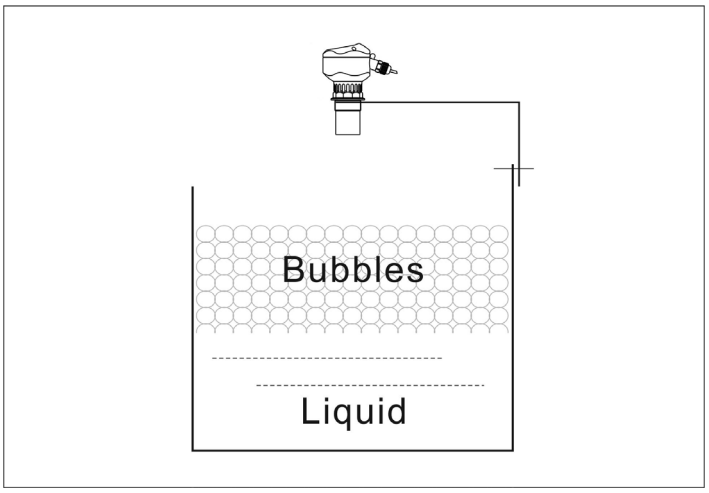


Great fluctuation at medium surface – use by-pass pipe or waveguide for measurement

Common installation errors

① Bubble: if the bubbles on the medium surface are large and the bubble layer is thick, measuring error is likely to take place and the reflected ultrasonic wave may not be received. Measures should be taken to prevent the generation of bubbles, or the sensor must be installed in the by-pass pipe for measurement.

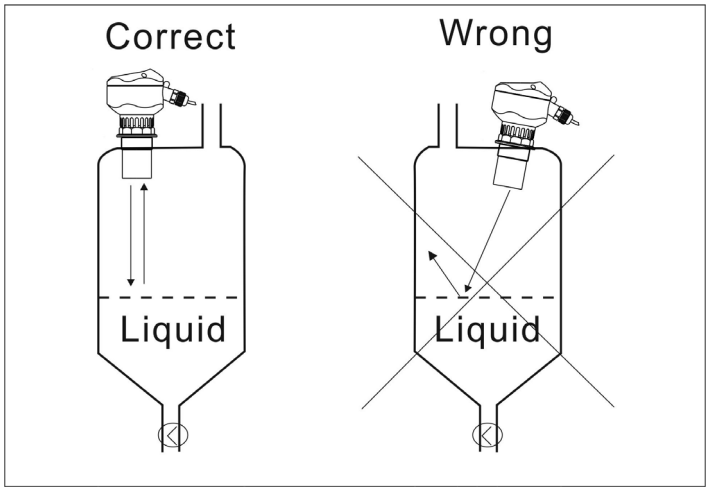
Other measuring meters can also be used, such as radar liquid level meter or magneto strictive liquid level meter.



Occasions when bubbles are generated

② Incorrect installation direction of the sensor

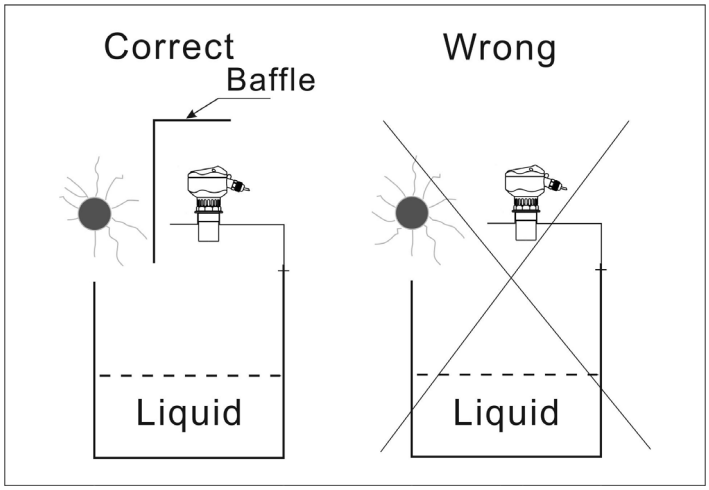
If the sensor is not aligned to the medium surface, the measuring signal will be weakened. To ensure the best measurement effect, the axis of sensor should be aligned to the surface, i.e., perpendicular to the surface of measured interface.



Sensor probe should be perpendicular to medium surface

③ Installed at positions with great temperature change

Measurement error is likely to take place at positions with great temperature change, such as a place with strong sun illumination. The error will increase by 2-4% based on original measurement accuracy. Therefore, sun louver should be installed to solve the problem.



Great temperature change – add sun louver or meter box

④ Minimum distance to medium less than the blind area

If the distance from probe to maximum level of the medium is less than the blind area of the meter, the measured values are likely to be wrong.

⑤ Sensor is too close to the container wall

If the sensor is installed too close to the container wall, strong false echo will be generated. The uneven inner surface of the container wall, attached medium, rivet, screw, reinforcing rib and joint weld on the container inner wall will lead to strong false echo which will be loaded on the effective echo signals. Therefore, the maximum distance should be measured based on the requirements to keep the distance between the sensor and container wall, which is detailed as follows:

Maximum Measuring Range	Distance to Wall	Maximum Measuring Range	Distance to Wall	Maximum Measuring Range	Distance to Wall
5m	0.5m	10m	1.0m	15m	1.5m
20m	2.5m	30m	4m	40m	5m
50m	6m	60m	7.2m	70m	8.5m

Under worse measuring conditions, the distance between the sensor and the container wall should be increased until no false echo occurs.

ELECTRIC WIRING DIAGRAM

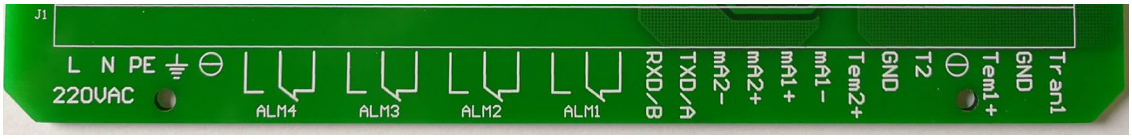
★ Prompt: make sure the connecting cable between the probe and meter body of separate-type ultrasonic level meter is long enough in advance. Connection with other cable for extension on site is prohibited as it will affect the signal transmission quality and strength.

★ During power line connection, AC power line should not be connected to any other terminals except AC terminals. Otherwise, the meter circuit or components and parts are likely to be burnt.

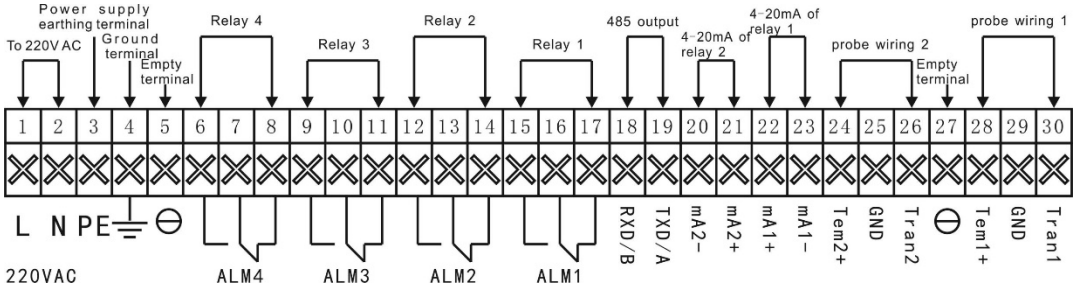
★ 485, 232 and 4-20ma output terminals should not be short-circuited as it will lead to burning of internal circuits.

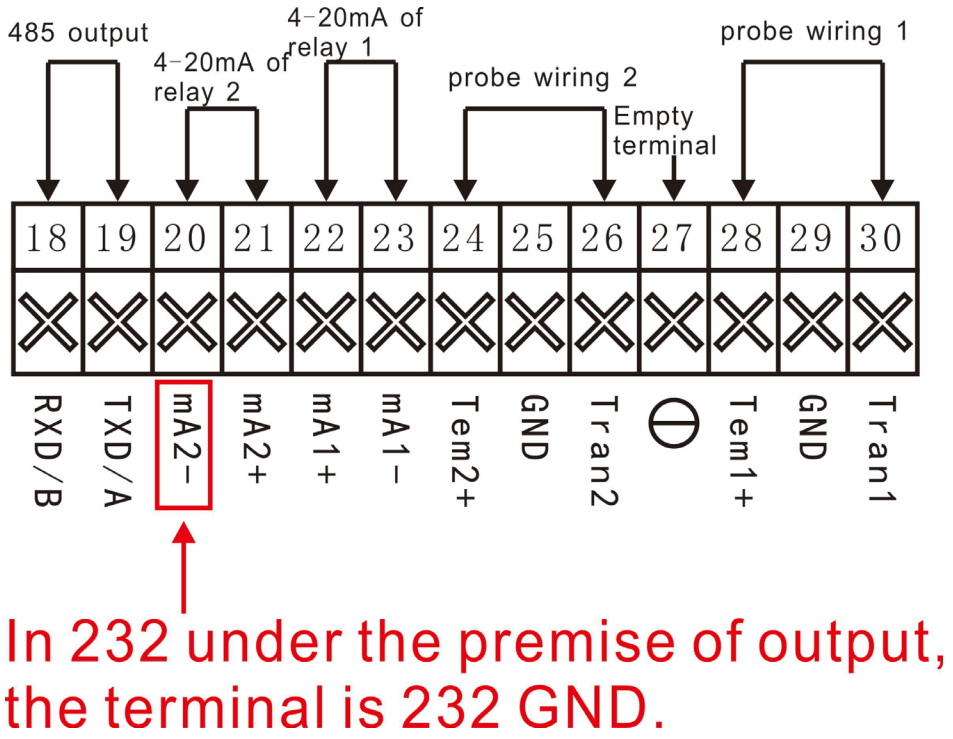
The cables connecting the sensor and main equipment should not be put in a casing with any alternating current. If it cannot be prevented, the cables of sensor should be protected by a cable conduit to completely shield the electromagnetic interference caused by alternating current.

ANTI-INTERFERENCE ELECTRIC WIRING DIAGRAM OF STANDARD SINGLE-PROBE SEPARATE-TYPE ULTRASONIC LEVEL METER:

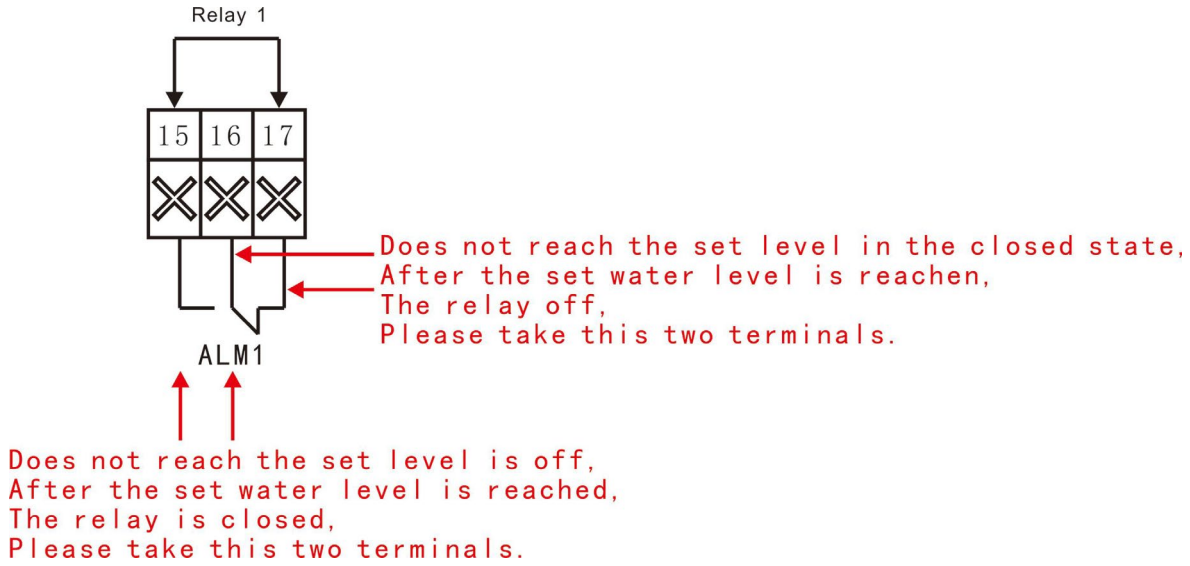


232 OUTPUT WIRING METHOD





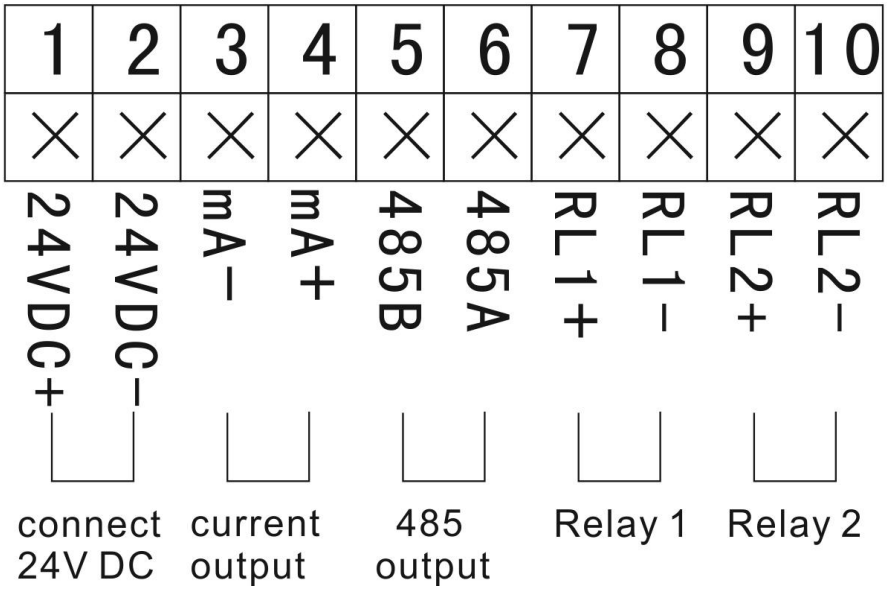
WIRING METHOD OF RELAY OUTPUT



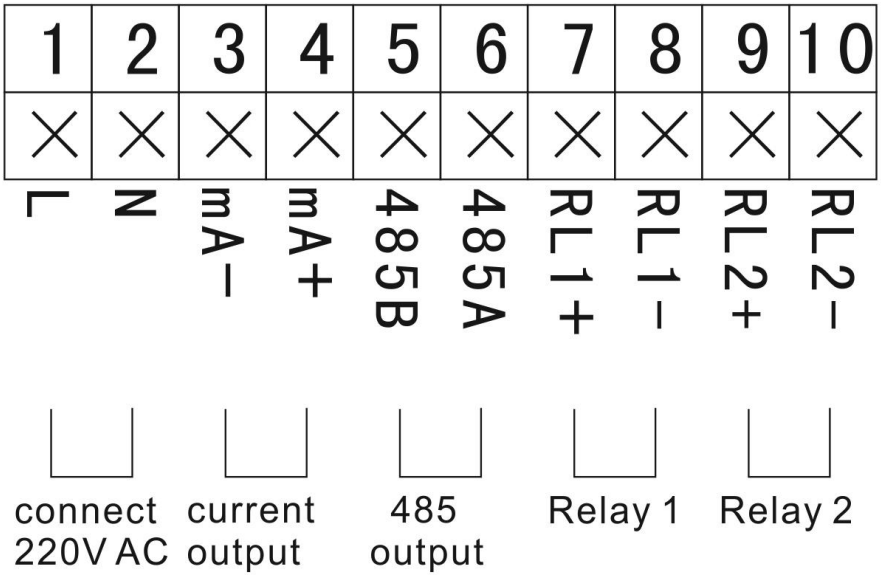
Wiring Diagram of Integrated Type:

◆Enhanced integrated type with four-wire system

Electric Wiring Diagram of Enhanced Integrated Type with Four-wire System



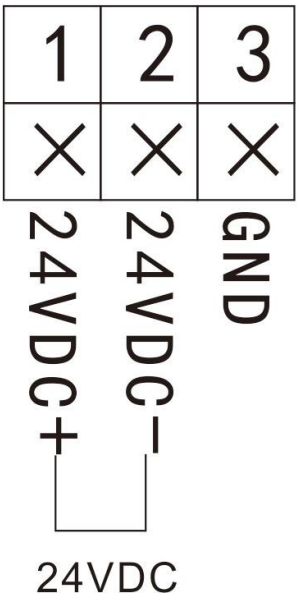
24VDC Power Supply Wiring Diagram of Four-wire System



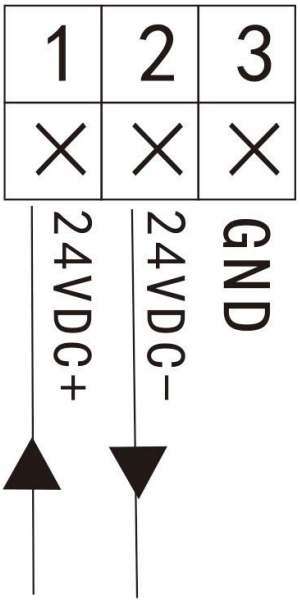
220VAC Power Supply Wiring Diagram of Four-wire System

◆**Enhanced integrated type with two-wire system**

Electric Wiring Diagram of Two-wire System

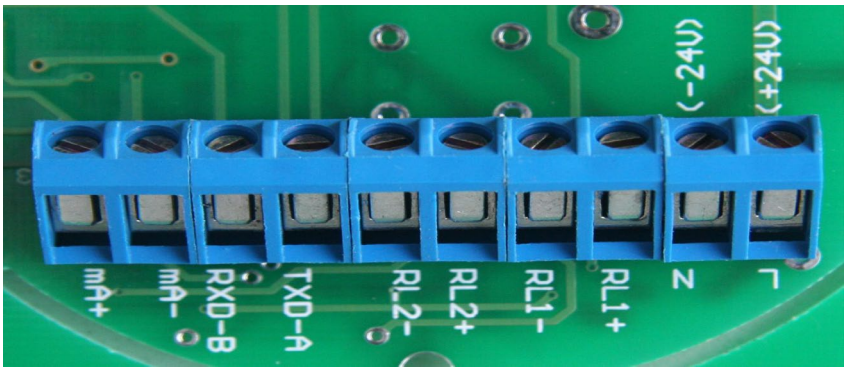


Wiring Diagram of Two-wire System

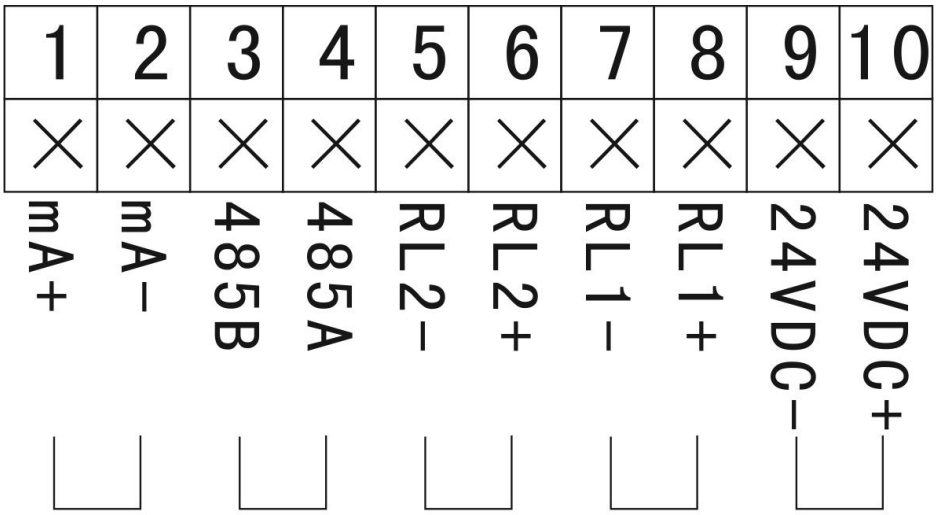


Ampere Meter Diagram of Two-wire System

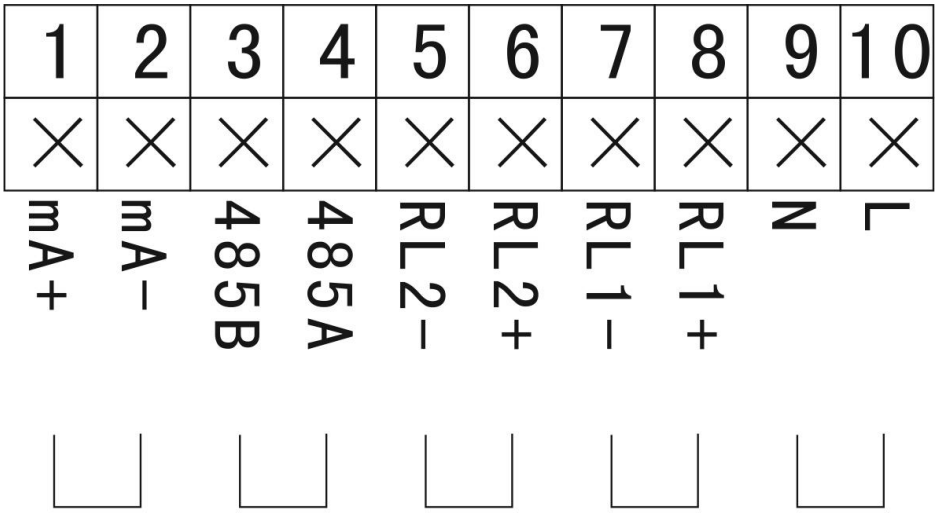
◆Explosion-proof integrated type with four-wire system



Electric Wiring Diagram of Explosion-proof Integrated Type with Four-wire System



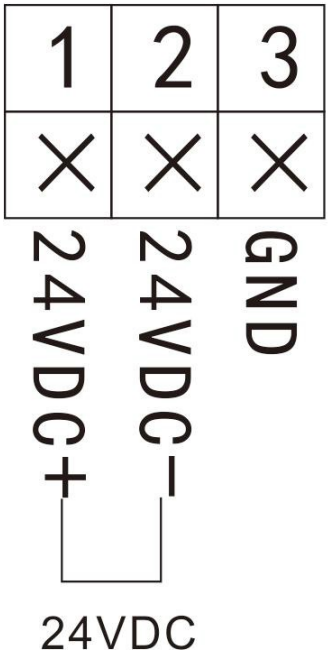
24VDC Power Supply Wiring Diagram of Four-wire System



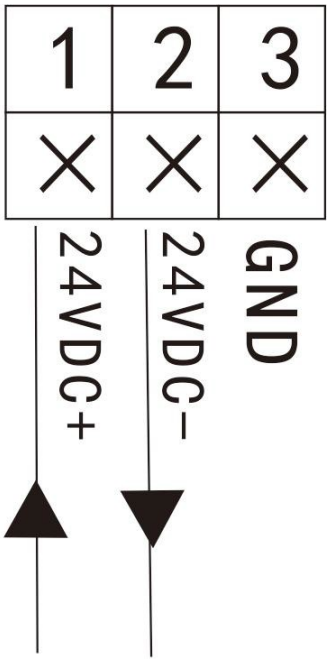
20VAC Power Supply Wiring Diagram of Four-Wire Sys

◆**Explosion-proof integrated type with two-wire system**

24VDC Electric Wiring Diagram of Explosion-proof Integrated Type with Two-wire System



Wiring Diagram of Explosion-proof
Integrated Type with Two-wire System



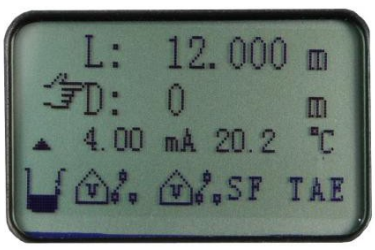
Connection of Explosion-proof
Integrated Type with and Ampere Meter

SETTINGS

Introduction of Interface of Operation Mode

Two working modes - **operating** and **setting modes** - are provided for this series of ultrasonic level meter. After being powered on and initialized, the level meter will enter in the operating mode automatically and start to measure data. Measurement at the time is under material level measurement mode and the relative output is 4~20mA. Output current is in direct proportion to the material level.

The interface of ultrasonic level meter under operating mode is as follows:

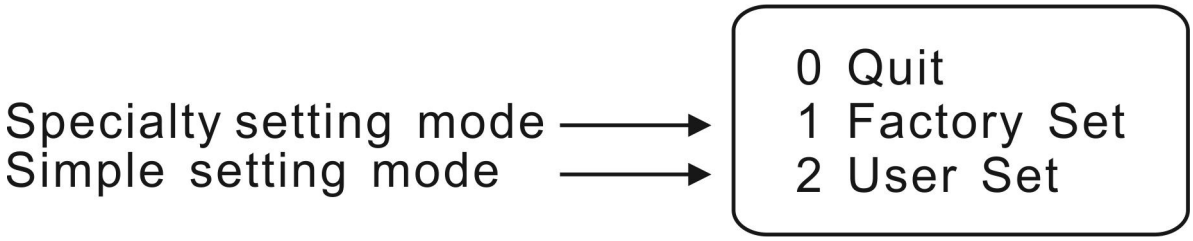


English Display Interface

Menu Interface & Operating Instructions:

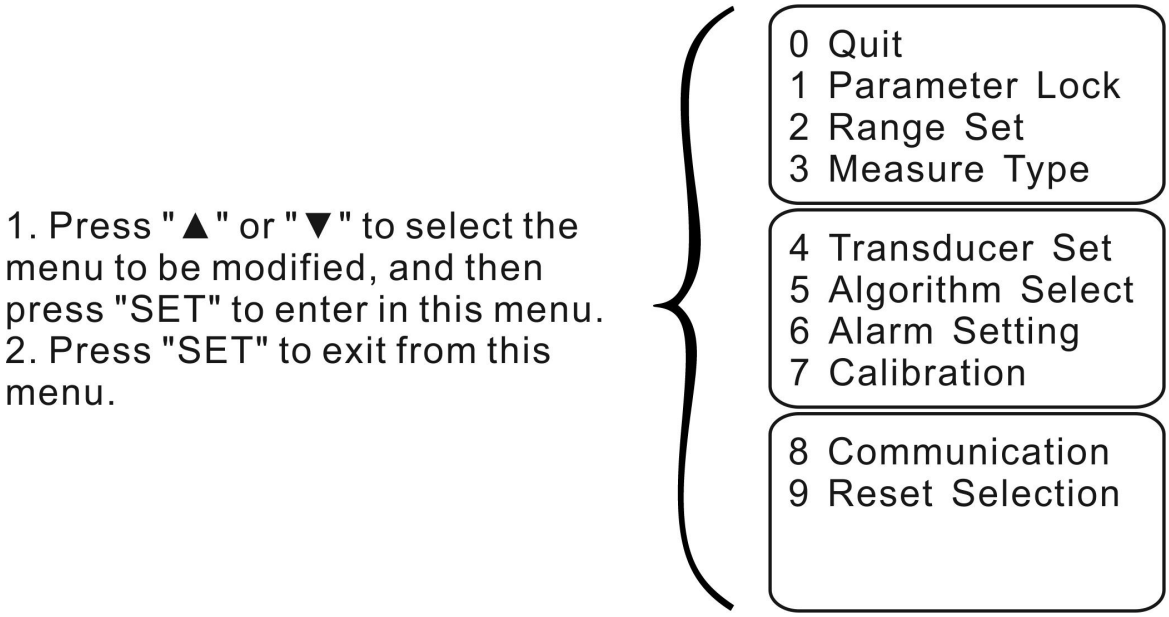
- The menu modes include **expert setting mode** and **simple setting mode**.
- See the homepage for menu query table of simple setting mode.
- See the appendix for menu query table of expert setting mode.
- Menu interface of expert setting mode and operating instructions are shown below:

① Press SET in operating mode interface to enter in the “Mode selection” main menu:

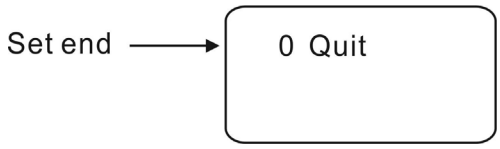


② Descriptions of the main menu items:

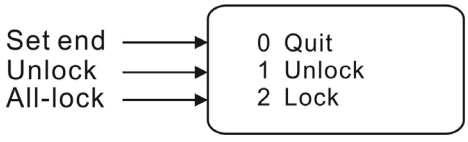
◆ Interface of the main menu with unlocked parameters:



◆ "0 Set end"
Chose this item, and press SET to exit to the operating mode interface.



◆ Interface of the main menu with locked parameters:

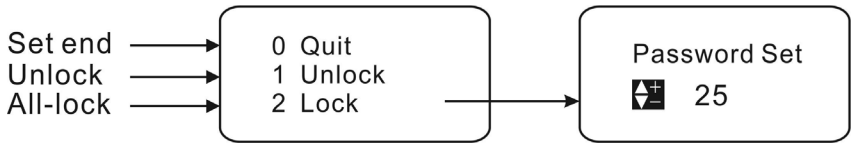


◆ “1 Parameter locking”
To prevent random changes of the parameters being made by someone other than the user, the menu can be locked (and unlocked) with passwords. The initial password of the level meter is 25, and users can change the initial password and set their own passwords randomly. **Tip**: It is recommended to remember or safely note the password. In case the password is lost or forgotten, the user can contact the manufacturer.

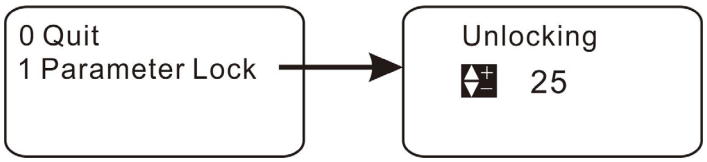
Descriptions：

Unlock: unlock, and all parameters of the menu can be changed randomly.

All-lock: the changes can be made only after entering password.



★ If the parameters are locked, press SET and enter in the unlocking interface for parameter locking:



◆ “2 Range Set”

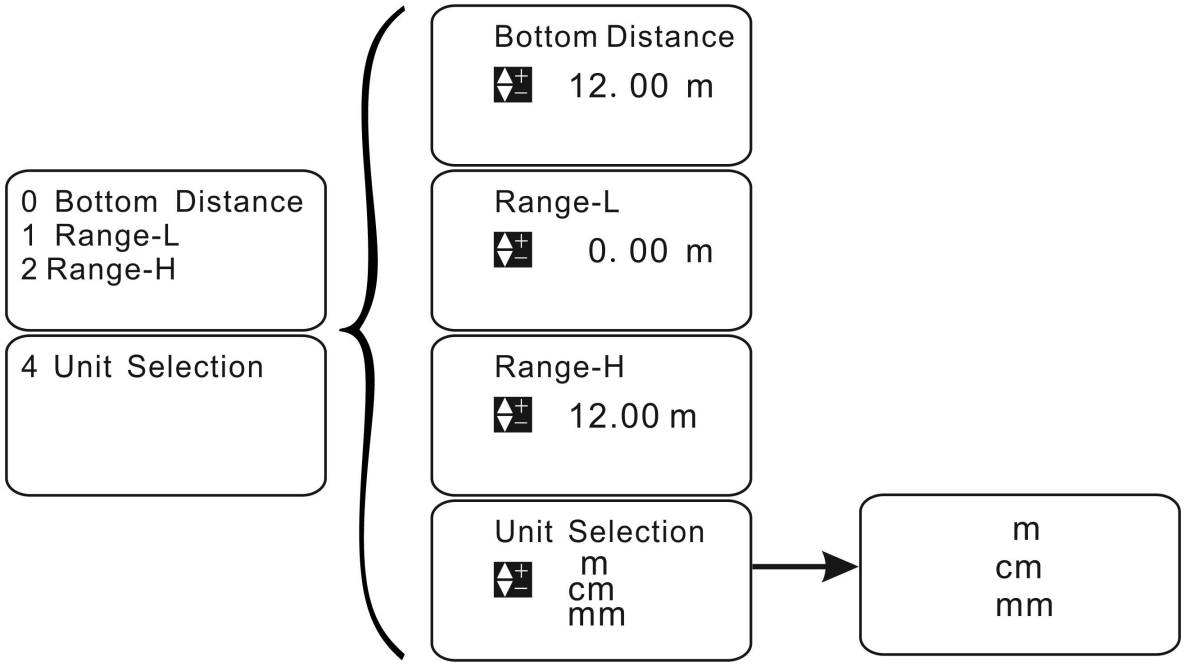
Setting reference zero-point, low range point, high range point and display unit:

1. Bottom Distance (Reference zero point): set the reference zero point of the level meter, and this value is only useful for material level measurement; the factory default is the maximum range.

2. Range-L (Low range point): set the output measurement value relative to 4mA of the level meter, and the factory default is 0.

3. Range-L (High range point): set the output measurement value relative to 20mA of the level meter, and the factory default is the maximum range.

4. Unit Selection (Display unit): there are three optional units, including m, cm and mm, wherein m stands for meter, cm for centimeter and mm for millimeter. The factory default is m.



◆ **“3 Measuring mode”**

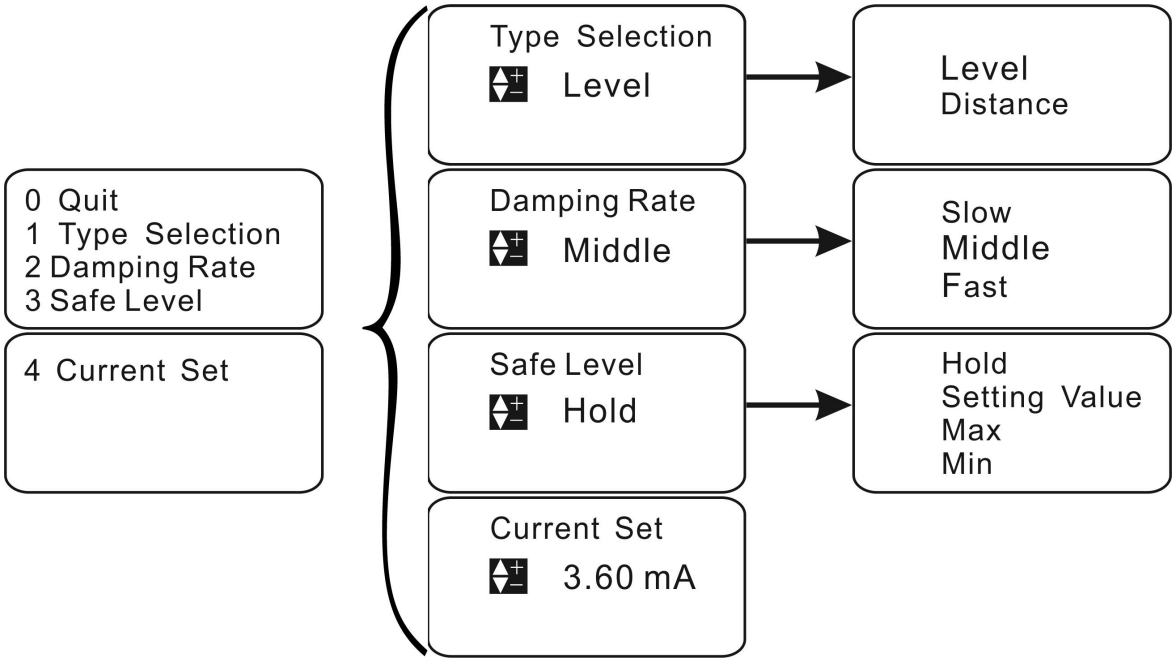
1. **Type Selection (Select mode)**: there are two optional items, i.e., distance measurement and material level measurement.
   Distance measurement: the display value is the distance from the probe to the surface measured.
   Material level measurement: the display value is the distance from the bottom to liquid surface, i.e., liquid level height.
   The factory default is material level measurement.

2. **Damping Rate (Response rate):** there are three optional items, i.e., slow speed, medium speed, and fast speed.
   Slow speed: the response rate is slow and measuring accuracy is high, not easy to be disturbed.
   Medium speed: the parameters are between those for slow speed and fast speed.
   Fast speed: the response rate is fast and measuring accuracy is low, very easy to be disturbed. The factory default is medium speed.

3. **Safe Level (Safe material level)**: there are four optional items, i.e., remaining, minimum value, maximum value and setting value.
   Remaining: the display value is the final measured value before wave loss, and the current is the corresponding value.
   Minimum: the display value is 4mA after wave loss, and the current 4mA.
   Maximum: the display value is 20mA after wave loss, and the current 20mA.
   Setting value: the display value is the final measured value after wave loss, and the current output is the setting value of setting current. The factory default is the remaining value.

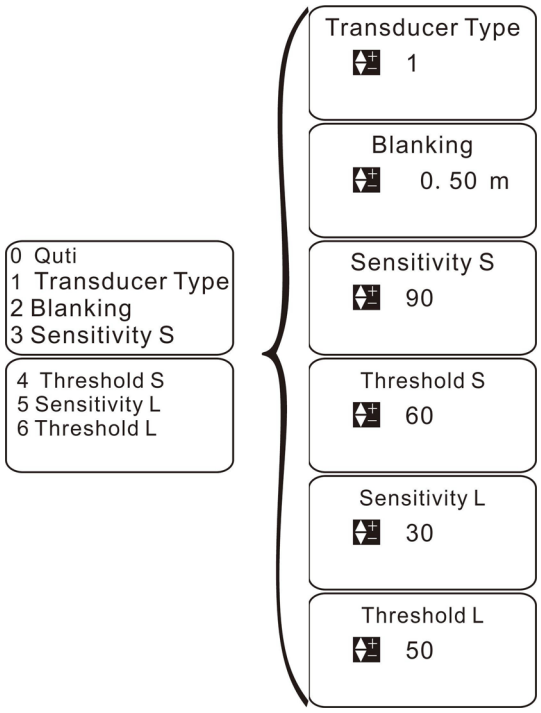
4. **Current Set (Set current):** set the output current after wave loss, which should be more than 3.6mA and less than 22mA and become invalid in case of remaining/minimum/maximum values on reselection. The factory default is 3.6mA.

5.

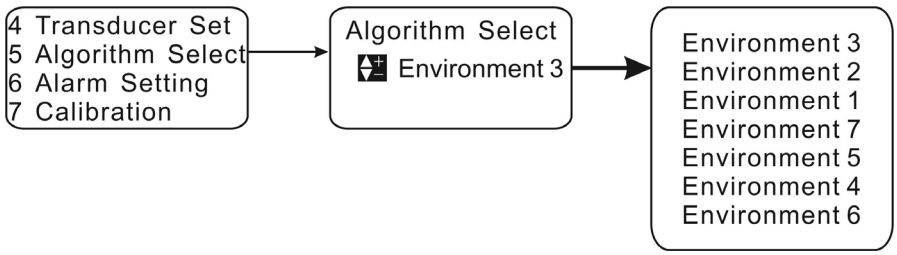


◆"4 Transducer Set (Set probe)" (do not modify this parameter)

1. Select probe and set relevant parameters.
2. **Transducer Type (Probe selection):** 1~9 options. Select the probe according to label on it. Factory default is 5.
3. **Blanking (Blind area setting):** set near-end blind area of probe; and factory default varies with the matched probe.
4. **Sensitivity S (Short sensitivity):** to be modified under the guidance of professional technical personnel only.
5. **Threshold S (Short threshold value):** to be modified under the guidance of professional technical personnel only.
6. **Sensitivity L (Long sensitivity):** to be modified under the guidance of professional technical personnel only.
7. **Threshold L (Long threshold value):** to be modified under the guidance of professional technical personnel only.



◆ **"5 Algorithm Select (Set probe)" (do not modify this parameter)**
Algorithm Select (Select algorithm): there are seven options, including special environment 1, special environment 2, special environment 3, special environment 4, special environment 5, special environment 6, and special environment 7.



◆**"6 Alarm setting"** Set alarm relay.

Alarm 1 mode: closed mode, low-level alarm and high-level alarm are optional. Closed: relay 1 is out of service; low-level alarm: relay 1 sends low-level alarm signal; and high-level alarm: relay 1 sends high-level alarm signal. Factory default is closed mode.

Alarm 1 value: the unit is m and factory default is 0.

Alarm 1 Diff (Alarm 1 return difference): the unit is m, and after being triggered, the alarm can be canceled only after the measured value reaches the alarm value +/- alarm return difference. Factory default is 0.

Setting method of alarm 2/3/4 mode is the same as above.

Example: (how to use a relay to control startup/shutdown of water pump)

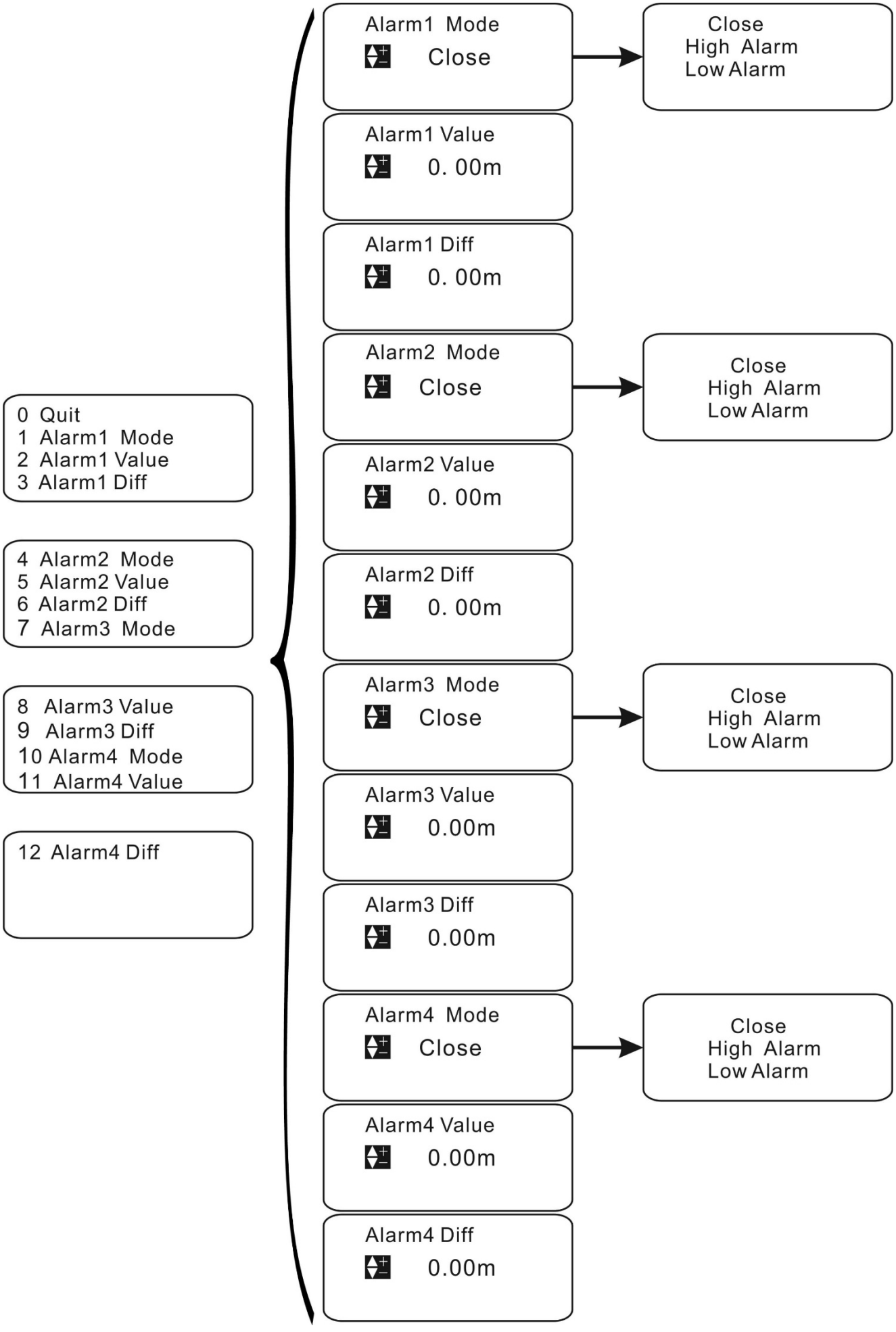
Through alarm return difference, one relay can control the whole working process of water pump from low level to high level.

For water drainage: when water level is below 1m, water pump stops draining; when water level rises to 5m, water pump start to drain water. Detailed settings are shown below:

Alarm 1 mode: high-level alarm. Alarm 1 value: 5.00m; alarm 1 return difference: 4.00m.

For water supply: when water level is below 1m, water pump starts to feed water; when water level rises to 5m, water pump stops feeding water. Detailed settings are shown below:

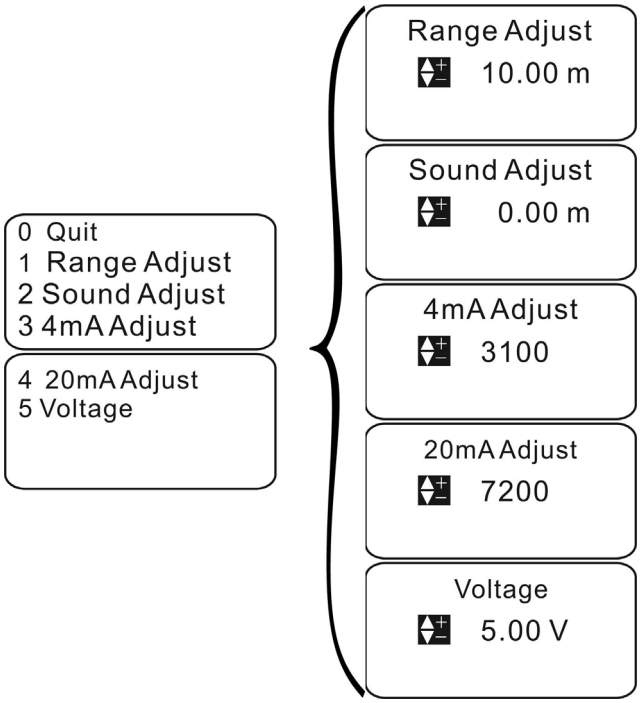
Alarm 1 mode: low-level alarm. Alarm 1 value: 1.00m; alarm 1 return difference: 4.00m.


0 Quit
1 Alarm1 Mode
2 Alarm1 Value
3 Alarm1 Diff
4 Alarm2 Mode
5 Alarm2 Value
6 Alarm2 Diff
7 Alarm3 Mode
8 Alarm3 Value
9 Alarm3 Diff
10 Alarm4 Mode
11 Alarm4 Value
12 Alarm4 Diff
Alarm1 Mode
Close
Close
High Alarm
Low Alarm
Alarm1 Value
0. 00m
Alarm1 Diff
0. 00m
Alarm2 Mode
Close
Close
High Alarm
Low Alarm
Alarm2 Value
0. 00m
Alarm2 Diff
0. 00m
Alarm3 Mode
Close
Close
High Alarm
Low Alarm
Alarm3 Value
0.00m
Alarm3 Diff
0.00m
Alarm4 Mode
Close
Close
High Alarm
Low Alarm
Alarm4 Value
0.00m
Alarm4 Diff
0.00m

◆"7 Calibration (Parameter correction)" (do not modify this parameter)

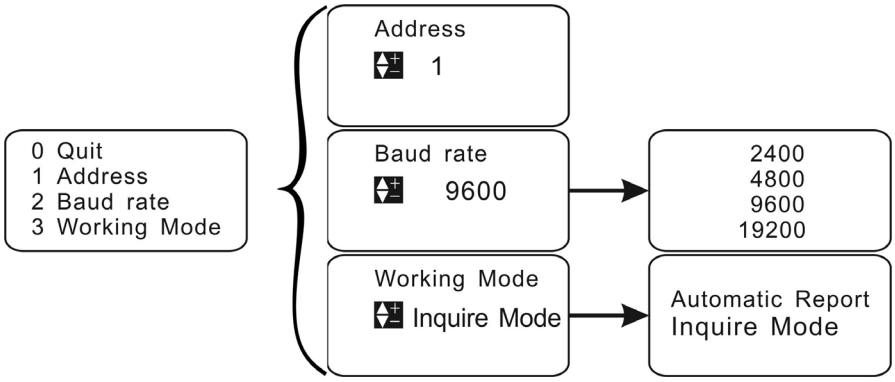
Carry out correction of range, sound velocity, current output, and reference level.

1. **Range Adjust (Range correction):** after input of the actual value, the system will correct the range automatically. Factory default is the measured value.
2. **Sound Adjust (Sound velocity correction):** after input of the actual value, the system will correct the sound velocity automatically, applied when gas composition is not air. For example, propagation velocity of sound is different in places with gasoline, acetone, ethyl alcohol and other volatile gas, so correction is necessary.
3. **4mA Adjust (4mA correction):** keep modifying the value until the actual output current reaches 4mA. Factory default is 3100.
4. When multimeter is connected to 4-20ma positive pole in series, this number should be increased or decreased by 1 so that 4mA correction can be realized.
5. **20mA Adjust (20mA correction):** keep modifying the value until the actual output current reaches 20mA. Factory default is 7200.
6. **Voltage (Reference level):** input the measured voltage at relevant test point. Factory default is 5.00.



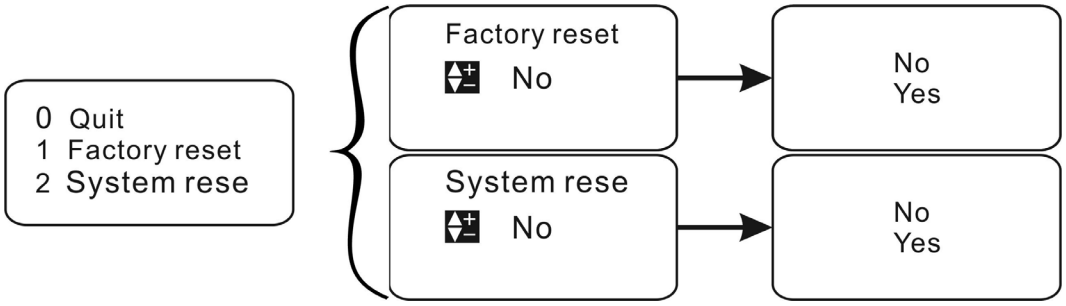
◆ "8 Communication setting"

1. **Address (Communication address):** select communication address; and the default is 1.
2. **Baud rate:** select communication frequency among 2400, 4800, 9600 and 19200; and the default is 9600.
3. **Working Mode (Operating mode):** select communication operating mode between "Automatic report mode" and "Inquiry mode"; and the default is "Automatic report mode".



◆ "9 Reset options"

1. **Factory reset:** Yes: restore factory settings so that setting error can be resolved.
   No: exit. Factory default is No.
2. **System reset:** Yes: restore system settings.
   No: exit. Factory default is No. (Do not modify this item.)



FAULTS AND HANDLING

If all wirings are normal through inspection in case of a fault and the ultrasonic level meter is grounded, you can keep pressing "▲", then press "SET" to show echo menu. Take a photo of the echo menu and contact the manufacturer. This can aid in determining the possible electromagnetic interference, false echo, situation of entering a blind area, no echo signal received and other faults.

Faults	Causes	Handling
Level meter does not work.	Power supply is not well connected.	Inspect power line.
Level meter does not display data.	1. Power supply is not well connected. 2. Wiring between LCD and mainboard falls off or comes loose. 3. The LCD is damaged.	1. Inspect power line. 2. Inspect the wiring and connect it again. 3. Maintain it in the factory.
Level meter works but there is no change of trumpet icon (▲) on the LCD, which means that the system is in wave loss state.	1. The measured area is beyond the measuring range of level meter. 2. The measured medium has strong disturbance, vibration, or heavy dust. 3. There are strong interference sources around such as frequency converter and motor. 4. The probe is not aligned to the measured surface. 5. There are redundant objects in the measured space, such as support rod and feed opening. 6. The liquid level is in a blind area. 7. The measured medium is soft powder or there is foam on liquid surface.	1. Replace the level meter with a level. 2. meter with greater measuring range. 3. The meter will restore the normal measurement automatically after the measured medium gets back to calm. 4. Check surrounding environment and realize good electromagnetic shielding. Do not share one power supply with frequency converter and motor, and make it grounded reliably. 5. Reinstall probe and make it perpendicular to liquid surface. 6. Select an appropriate position for installation and prevent an interfering object. 7. Raise the installation position of probe. 8. Check whether the medium is powder. If so, consult the manufacturer.

Ultrasonic Level Meter MODBUS Communication Protocol Version V1.4

MODBUS—RTU communication protocol

1. The hardware is adopted with RS-485, master-slave half-duplex communication, that is, the host calls the slave address, and the slave answers.
2. Data frame: 10 digits, 1 start bit, 8 data bits and 1 stop bit, without verification.
3. Baud rate: 2400, 4800, 9600 and 19200 (9600 by default).
4. Function code 03H: Read register value Data sent by the host:

1	2	3	4	5	6	7	8
ADR	03H	High-order byte of initial register	Low-order byte of initial register	High-order byte of register number	Low-order byte of register number	Low-ord er byte of CRC code	High-ord er byte of CRC code

The first byte, ADR: address of slave machine (=001~254)
The second byte 03H: Read the register value function code
The third and fourth bytes: the start address of the register to be read
The fifth and sixth bytes: the number of the register to be read
The seventh and eighth bytes: CRC16 verification from byte 1 to byte 6

When the slave machine receives correctly, it will send back following values:

1	2	3	4、5	6、7		M-1、M	M+1	M+2
ADR	03H	Total number of bytes	Register data 1	Register data 2	。。。	Register data M	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address of slave machine (=001~254)
The second byte 03H: Return to read function code.
The third byte: Total number of bytes from 4 to M (included)
Byte from 4 to M: Register data.
The M+1 and M+2 bytes: CRC16 verification from byte 1 to byte M

When the slave machine does not receive correctly, it will send back following values:

1	2	3	4	5
ADR	83H	Information code	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address code of slave machine (=001~254)
The first byte 83H: Register value reading error.
The third byte information code: See the table of information code.
The fourth and fifth bytes: CRC16 verification from byte 1 to byte 3

5、Function code 06H: Write a single register data

Data sent by the host:

1	2	3	4	5	6	7	8
ADR	06	High-order byte of register address	Low-order byte of register address	High-order byte of data	Low-order byte of data	Low-order byte of CRC code	High-order byte of CRC code

When the slave machine receives correctly, it will send back following values:

1	2	3	4	5	6	7	8
ADR	06	High-order byte of register	Low-order byte of register	High-order byte of data	Low-order byte of data	Low-order byte of CRC code	High-order byte of CRC code

When the slave machine does not receive correctly, it will send back following values:

1	2	3	4	5
ADR	86H	Error information code	Low-order byte of CRC code	High-order byte of CRC code

The first byte, ADR: address code of slave machine (=001~254)
The first byte 86H: function code of writing error of register number
The third byte information code: See the table of information code
The fourth and fifth bytes: CRC16 verification from byte 1 to byte 3

6、Function code 10H: Write multiple register numbers in succession Data sent by the host:

1	2	3	4	5	6	7
ADR	10H	High-order byte of initial register address	Low-order byte of initial register address	High-order byte of register number	Low-order byte of register number	Total number of data bytes

8、9	10、11	N、N+1	N+2	N+3
Register data 1	Register data 2	Register data M	Low-order byte of CRC code	High-order byte of CRC code

When the slave machine receives correctly, it will send back following values:

1	2	3	4	5	6	7	8
ADR	10H	High-order byte of initial register address	Low-order byte of initial register address	High-order byte of register number	Low-order byte of register number	Low-order byte of CRC code	High-order byte of CRC code

When the slave machine does not receive correctly, it will send back following values:

1	2	3	4	5
ADR	90H	Error information code	Low order byte of CRC code	High order byte of CRC code

The first byte, ADR: address code of slave machine (=001~254)
The first byte 90H: function code of writing error of register number
The third byte information code: See the table of information code.
The fourth and fifth bytes: CRC16 verification from byte 1 to byte 3

6、Register Definition Table: (Note: Register address coding adopts hexadecimal system.)

Register address	Description	Read Only	Register address	Description	Read Only
0000	Distance/Level instantaneous value (2 bytes MSB first)	√	0001	Analog output instantaneous value (2 bytes MSB first)	√
0002	Instantaneous temperature (2 bytes MSB first)	√	0003	Reserved	
0004	Reserved		0005	Reserved	
0006	Reserved		0007	Reserved	
0008	Reserved		0009	Reserved	
000A	Reserved		000B	Reserved	
000C	Reserved		000D	Reserved	
000E	Reserved		000F	Reserved	
0010	Reserved		0011	Reserved	
0012	Reserved		0013	Reserved	
0014	Reserved		0015	Reserved	
0016	Reserved		0017	Reserved	
0018	Reserved		0019	Reserved	
001A	Reserved		001B	Reserved	
001C	Reserved		001D	Reserved	
001E	Reserved		001F	Reserved	
0020	Reserved		0021	Reserved	

0022	Alarm 1 value (2 bytes MSB first)	0023	Alarm 1 Diff (2 bytes M S B first)
0024	Alarm 2 value (2 bytes M S B first)	0025	Alarm 2 Diff (2 bytes MSB first)
0026	Alarm 3 value (2 bytes MSB first)	0027	Alarm 3 Diff (2 bytes MSB first)
0028	Alarm 4 value (2 bytes M S B first)	0029	Alarm 4 Diff (2 bytes MSB first)
002A	Bottom Distance (2 bytes M S B first)	002B	Range-H (2 bytes M S B first)
002C	Range-L (2 bytes MSB first)	002D	Current set (2 bytes M S B first)
002E	Blanking (2 bytes MSB first)	002F	Reserved
0030	Reserved	0031	Reserved
0032	Reserved	0033	Reserved
0034	Reserved	0035	Reserved
0036	Reserved	0037	Reserved
0038	Reserved	0039	Reserved
003A	Reserved	003B	Reserved
003C	Reserved	003D	Reserved
003E	Reserved	003F	Reserved
0040	Reserved	0041	Reserved
0042	Reserved	0043	Reserved
0044	Reserved	0045	Reserved
0046	Reserved	0047	Reserved
0048	Reserved	0049	Reserved
004A	Reserved	004B	Reserved
004C	Reserved	004C	Reserved
004E	Reserved	004F	Reserved
0050	Reserved	0051	Reserved
0052	Reserved	0053	Reserved
0054	Reserved	0055	Reserved
0056	Reserved	0057	Reserved
0058	Reserved	0059	Reserved
005A	Reserved	005B	Reserved
005C	Alarm 1 mode Alarm 2 mode	005D	Alarm 3 mode Alarm 4 mode
005E	Type Selection Unit selection	005F	Algorithm selection Safe level
0060	Transducer Typ Damping Rate	0061	Factory reset System reset
0062	Baud rate Working mode	0063	Reserved
0064	Reserved	0065	Reserved
0066	Reserved	0067	Reserved
0068	Reserved	0069	Reserved
006A		006B	Phenotype character Meter address

REMARKS:

a) It is indicated by 2 bytes, MSB: **(Note: floating-point numbers are rounded by 100 and expressed in hexadecimal)**

- The returned distance or level value is expressed in cm.

Example: The current instrument address is 1.
Send: **01 03 00 00 00 01 84 0A**
Return: **01 03 02 b9 88**
The two red bytes indicate that the current measurement is 0.16 m (0x0010)

Notes:
Positive and negative identifications: when the measured value and temperature are positive, the highest significant bit of the high byte is 0; when it is negative, the highest significant bit of the high byte is 1.
Example: When the current measurement is -0.16 m, figures 01 03 02 return.

b) Measuring mode: 0 -- measuring distance; 1 -- measuring material level
Safe level: =0, hold; =55, minimum; =AA, maximum; =A5, set value
Alarm mode 1, 2, 3, 4: 0 -- close; 1 -- low alarm; 2 -- high alarm
Type Selection: = 0, mm; = 1, cm; = 2, m
Algorithm selection: 0 - special environment 1; 1 -- special environment 2; 2 -- special environment 3; 3 -- special environment 4; 4 – special environment 5; 5 -- special environment 6; 6 – special environment 7
Transducer Type: 0 -- option 1; 1 -- option 2; 2 -- option 3; 3 -- option 4; 4 -- option 5; 5 -- option 6; 6 -- option 7; 7 -- option 8; 8 -- option 9;
Damping Rate: 0 -- slow; 1, medium speed; 2 - fast;
Factory reset: 0-No; 1-Yes; System reset: 0-No; 1-Yes;
Baud rate: 0-2400; 1-4800; 2-9600; 3-19200
Working mode: 0 -- automatic report mode; 1 -- Inquire Mode

c) Regional read-write operation of register
The first region: 0010 — 0021 read only
The second region: 0022 — 005B read-write
The third region: 005C — 004B read-write
Within the same region, a parameter can be read (or write) at a time, and all parameters in the region can be read (or write) in batch. It is not allowed to read and write parameters cross regions.

d) All reserved registers are currently undefined, reserved for upgrade compatibility.

7、Information code table

Information code	Indication
01H	Invalid function code
02H	Invalid data address
03H	Invalid data value
04H	CRC16 verification error
05H	Correct reception
06H	Reception error
07H	Parameter error