Ultrasonic Level Sensor

(split type HCUS-600)

Operating Manual

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Version:HCCK-UL3.0

Notes:

As the product is renewed continuously, it cannot be ensured that the product manual and installation manual are in line with the latest product. The Company cannot inform every client of the change (if any) in product itself and its operation instructions. Please directly contact the corporate sales personnel for any needs. The change includes but is not limited to the following:

1. Product blind area, performance parameters, functions, structure, shape, color, etc.
2. Software functions, structure, display mode, operating habit, etc.
3. Any operation on the hardware must be conducted after power off. Failures, like short circuit, caused by power-on operation are beyond the range of warranty.
4. The uncapping operations must be conducted after power off and no liquid is allowed to enter in the meter. Any failure caused by the entering in of liquid is beyond the range of warranty.

Graphic Illustration:

★ **Important notes, please read carefully and follow it strictly.**

▲ **General notes, please read carefully in order to avoid confusion.**

1. Introduction:

Ultrasonic level sensor (for liquid or material level measurement), it is non contact type level measuring instrument with high precision and reliability, easy to maintain and with better cost performance . It could satisfy many applications without contact with mediums.

2. Simple Setting

Because the installation conditions are different due to each project, so before using , we need to know some basic information: measuring range, zero point, full range, working conditions in tank and etc. So we must do configurations before installation of sensor. Please refer to the simple settings on next.

The ultrasonic sensor produced by HCCK, under normal conditions, only need to do some basic and simple configurations to set some parameters following the instructions , then it will be ok for used normally in applications.

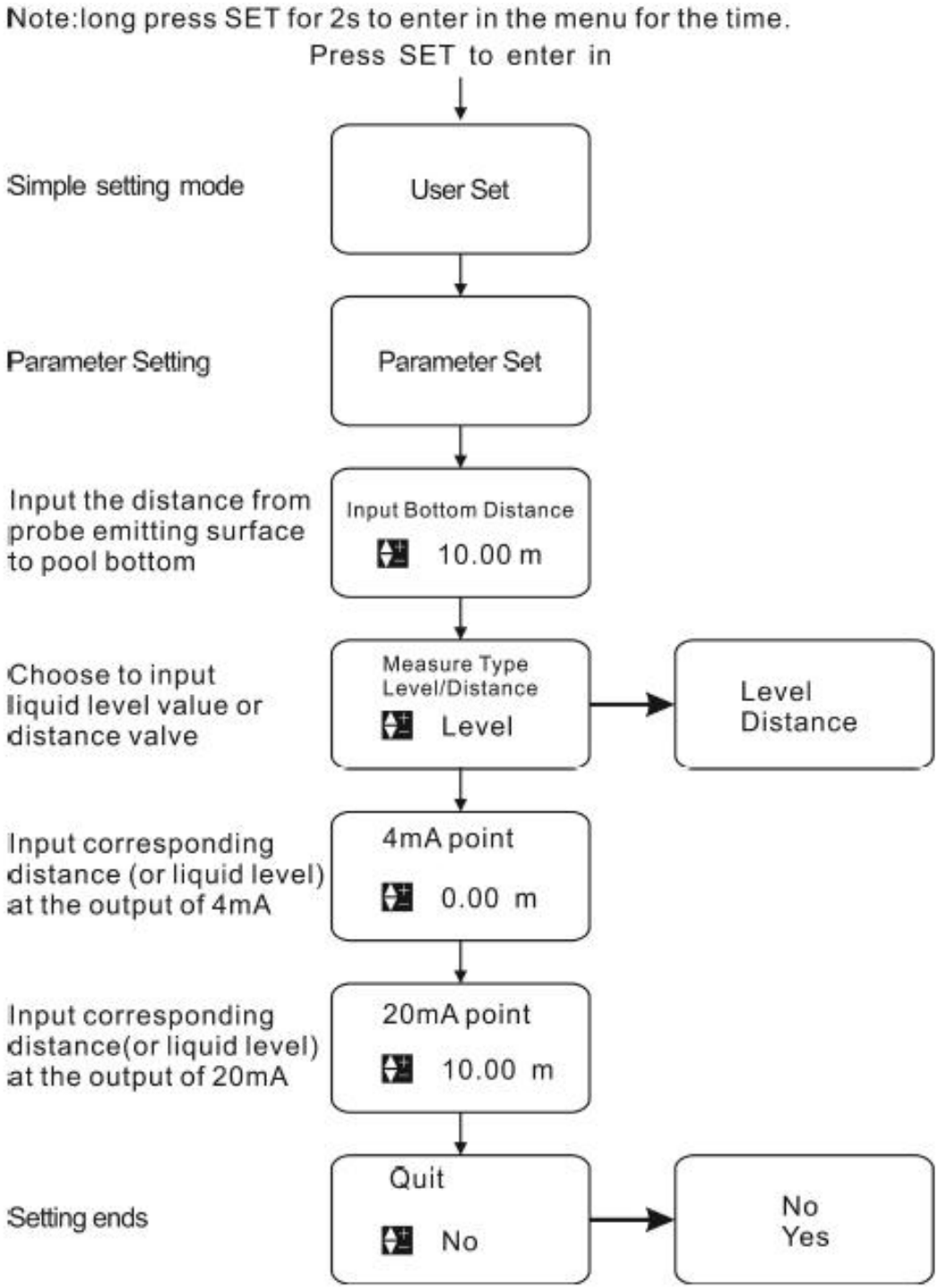
Button Functions:

1. Enter into menus; 2. Quit the menu; 3. Confirm the parameters change.

1. Move the cursor; 2. Modify the parameter; 3. Choose menu

2.1 Enter into menu

Long press the set button (SET) for 2s to enter in the main menu.
The menu modes include expert setting mode and simply setting mode.
The menu query table of simple setting mode is as shown in the table below.



2.2 Select the measuring mode

Measuring modes are divided into distance measuring mode and material level measuring mode. And the factory default is material level measurement.

2.3 Input the probe height value

Input probe height value to “reference zero point” (probe height is the

distance from probe emitting surface to tank bottom or pool bottom).

2.4 Diagram of distance mode and level mode

Under distance measuring mode, setting of reference zero point is meaningless and the positions of maximum of measuring range and minimum of measuring range are as shown in Fig. 1.1.

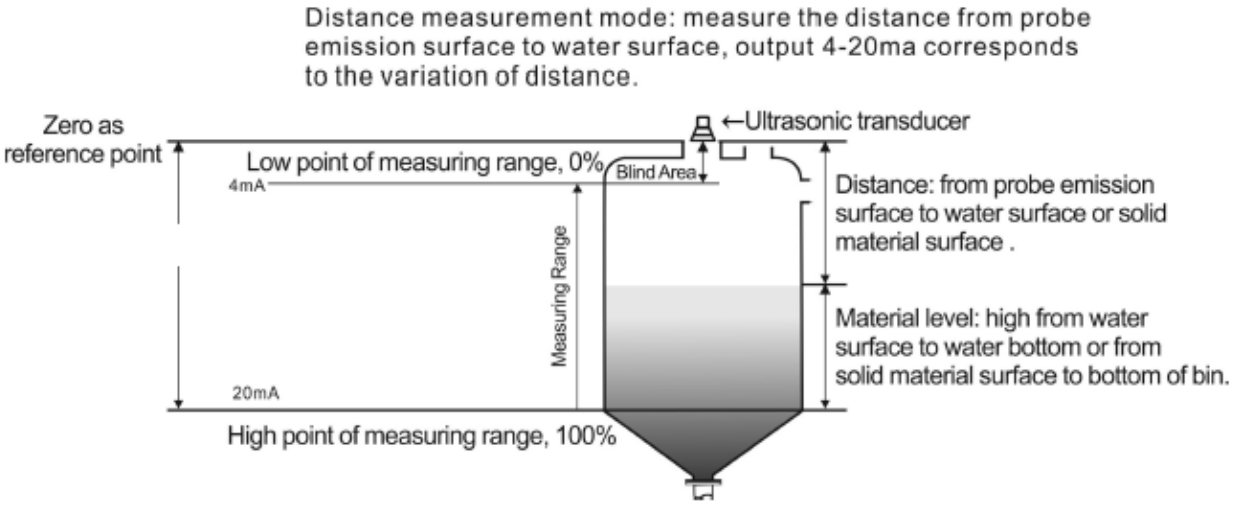


Fig. 1.1 Diagram of Distance Measurement

Under 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.

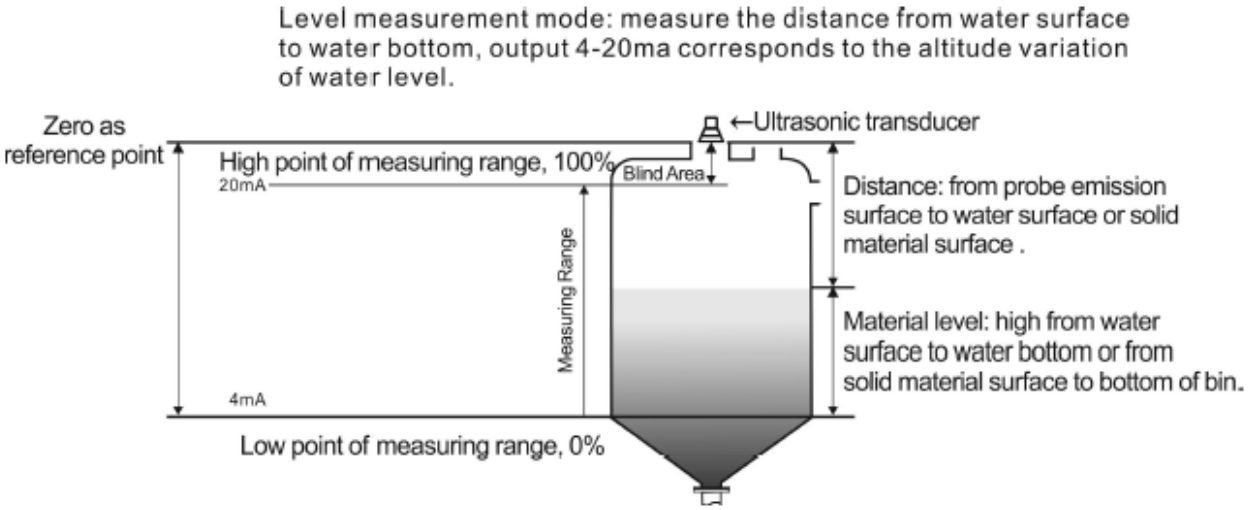


Fig. 1.2 Diagram of Material Measurement Level

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.

2.5 Anti-interference measures

The installed equipment must be grounded truthfully and independently and shall not share the public grounding with electrical cabinet or meter box.

Suggestions: when the ultrasonic level meter is connected with the frequency converter, PLC and other equipment with interference, the power supply part shall be added with isolation transformer, signal part shall be added with signal isolator and reliable grounding shall be provided.

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

3. Main technical parameters

Function	Parameters
Measuring range	5m, 10m, 15m, 20m,30m,
Accuracy	0.5%-1.0%
Resolution	3mm or 0.1% (whichever is greater)
Display	LCD
Analog output	4-line system, 4~20mA/ 510Ω load
Relay	4 groups (i.e. AC 250V/ 8A or DC 30V/ 5A) optional, state programmable
Power supply	Standard 24V DC Optional: 220V AC +15% 50Hz or 12V DC
Ambient temperature	Display instrument:-20~+60 ℃ Probe: -20~+80 ℃
Communication	4-20mA or RS485 or 4-20mA+RS485
IP grade	Display instrument: IP66, probe: IP68
Probe installation	Due to range and probe type
Product power consumption	The power supply of separate type is 24V power and the electricity consumed for such type is 100mA without relay, 120mA with a replay, 145mA with 2 relays, 170mA with 3 relays and 190mA with 4 relays. Specific power consumed is shown in below: 24×100mA=2.4W for separate type without relay; 24×120mA=2.9W for separate type with one relay;

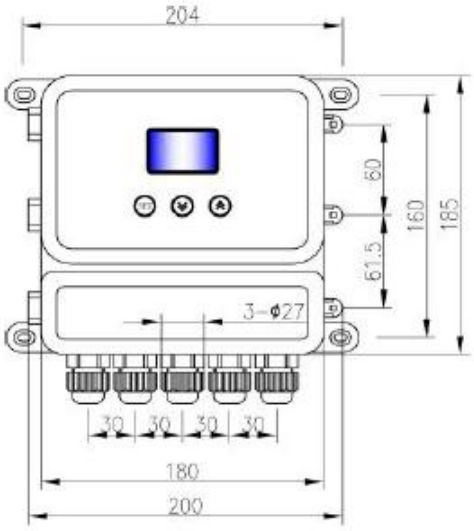
	24×145mA=3.5W for separate type with 2 relays; 24×170mA=4.1W for separate type with 3 relays; 24×190mA=4.6W for separate type with 4 relays;
Probe cable length	10m default, max can be 30m

4 . Installation Guide

4.1 Dimensions:

The split type ultrasonic level sensor dimension drawing :

Object Picture



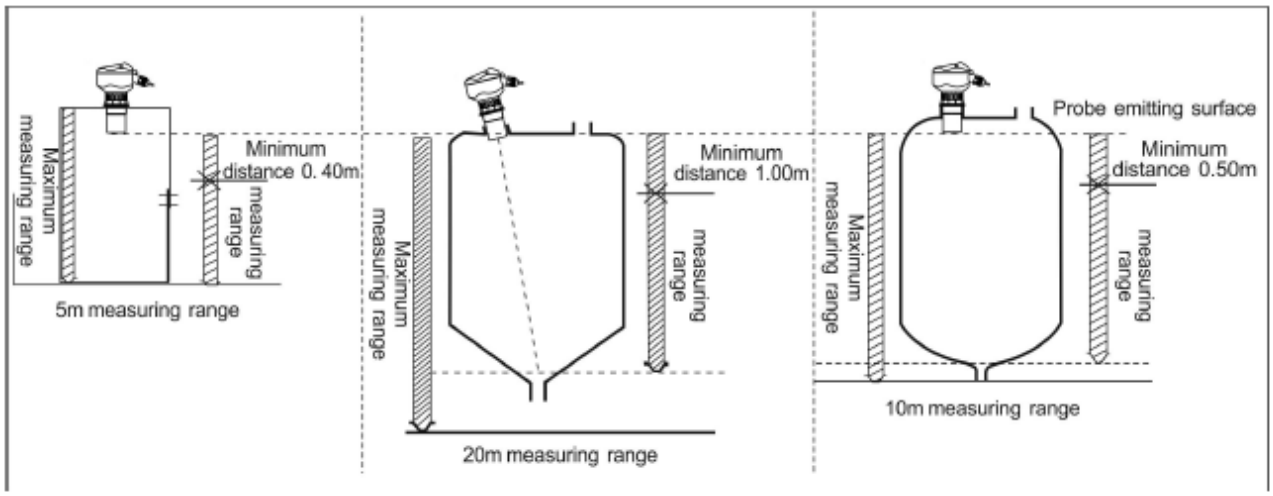
Structural Drawing

★ Cable length default is 10m , can be customized into 30m maximum normally in order to get better performance of level sensor.

4.2 Installation guide

4.2.1 Understand terminology

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



Ultrasonic wave beam is gathered by the probe. The emitting of impulse wave beam is like the light beam of 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, specially the objects within the range of emitting angle which 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.

4.2.2 Select 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 times of the measuring range
Major fluctuation (for example, there is mixing blade)	10...20dB	90%	3 times of the measuring range

Solid Material Surface	Attenuation Multiple	Attenuation Percentage	Magnification of Measuring Range
Hard, rough (such as granular rubber)	40dB	99%	10 times of 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 of the measuring range
Much	5...20dB	50～90%	3 times of 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 of the measuring range
Much	10...40dB	67～99%	3 times of 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 of the measuring range
Much	10...20dB	67～90%	3 times of 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 of the measuring range
Much	10...20dB	67～90%	3 times of 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 of the measuring range
≤80℃	10...20dB	67～90%	3 times of 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 ≤40° C 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 shall be selected for the measurement.

4.2.3 Installation of thread at the bottom

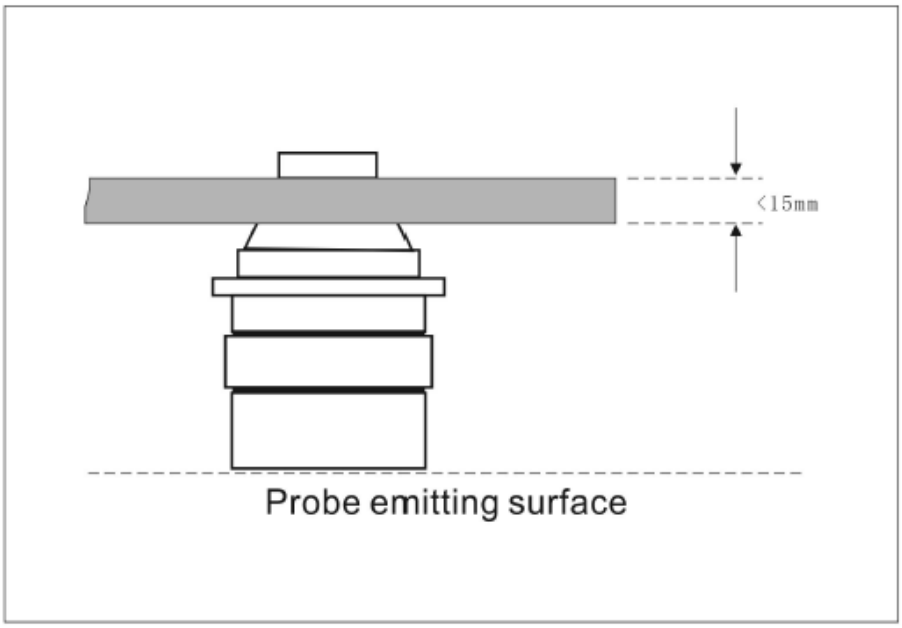
▲It is recommended to use plastic flange to connect with the sensor during the installation.

1. Install a flange over the top of the medium to be measured

2. Put 2pcs washers up and down of the flange with same dimension.

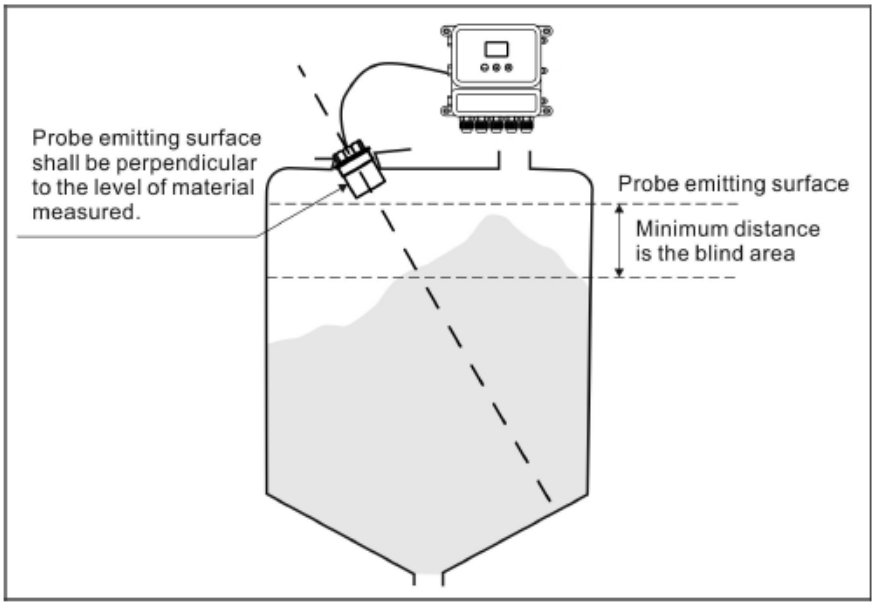
★After probe installation, the probe emission surface must be exposed from the cover plate or waveguide and it shall not be in the cover plate or waveguide.

Also the separate type sensor can be installed via top hoisting thread and the dimensions of hoisting thread includes M30×1.5, M32×1.5 and M38 ×1.5.



4.2.4 Application Measurement

Normally the ultrasonic level sensor is used for liquid measurement, but same like liquid mesurement, sometimes we can use it for solid applications also in simple conditions. Just need to adjust the probe to aim to the surface directly and try to get 90 degree of angle will be ok.



Separate-type sensor installed on container flange

4.3.4 How to extend the connecting pipe for measurement

A minimum distance shall 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 shall be installed on the container.

4.3.4.1 How to extend the connecting pipe for liquid measurement

The inner wall of the connecting pipe shall be kept smooth if possible. The connecting pipe cannot be soaked in the medium to prevent medium from polluting the connecting pipe or attaching to the inner wall of the pipe.

If it is non-adhesive medium, the extended connecting pipe can be soaked in the medium for a long time (as long as the pipe is not corroded by the liquid and no impurities are attached to the inner wall of the pipe). In this way, the measurement can be more accurate as it is not affected by other devices in the container.

The inner diameter of connecting pipe shall be as great as possible and the inclined cut shall be smooth. The relationship between the height L and inner diameter φ of connecting pipe is as 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 is free of burr and bulges and vertical and the weld joint shall be polished. The connection of connecting pipe and tank top shall be outwards polished at an oblique angle of 45°.
2	200mm	120mm	
3	250mm	150mm	
4	300mm	180mm	
5	400mm	240mm	

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 is shown 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

Where there is viscous medium in the container, such as crude oil storage tank, mud tank, asphalt tank and cement mixing tank, if the sensor is installed close to the container wall, the medium attached to the container wall will lead to strong false echo. Therefore, certain distance must be kept between the sensor and the container wall.

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 shall be covered 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.

4.3.5.2 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 even unable to be received. Measures shall be taken to prevent the generation of bubbles or the sensor shall be installed in the by-pass pipe for measurement.

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

② Incorrect installation direction of the sensor

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

③ Installed at positions with great temperature change

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

④ Minimum distance to medium less than the blind area

If the distance form probe to maximum level of the medium is less than the blind area of the meter, the measured values are 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 shall 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 shall be enlarged until no false echo occurs.

4.4 Electrical wiring diagram

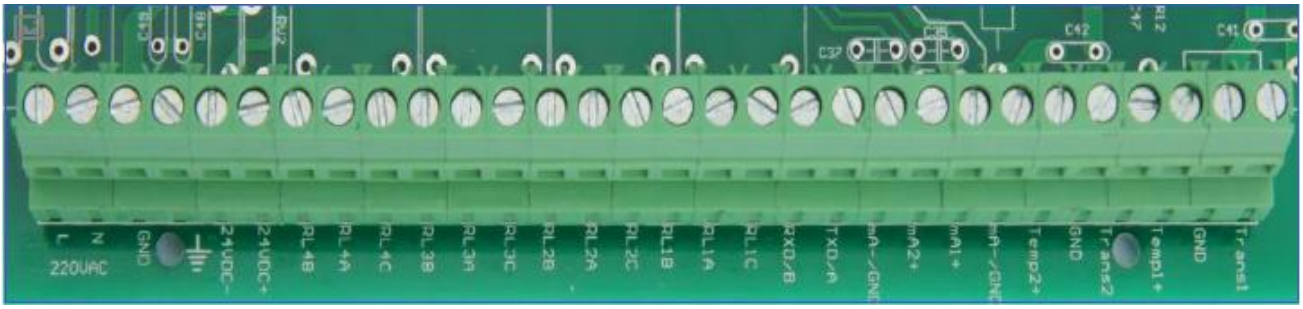
★ Make sure the connecting cable between the probe and meter body of separate-type ultrasonic level meter is long enough in advance. Connection with other cable for extension on site is not allowed as it will affect the signal transmission quality and strength.

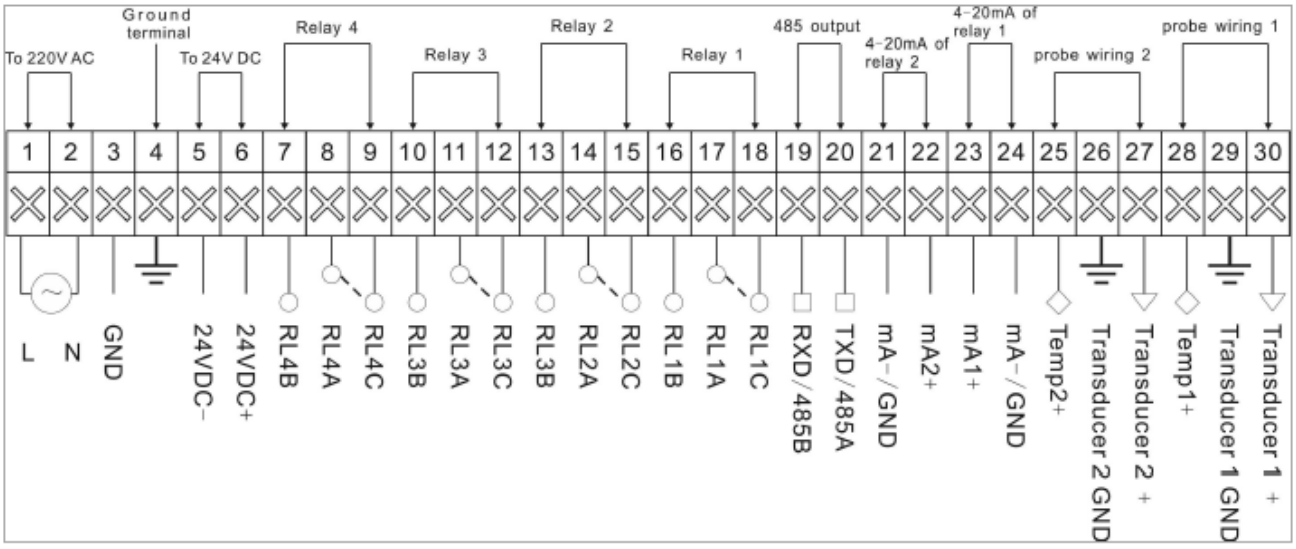
★ During power line connection, AC power line shall not be connected to any

other terminals except AC terminals. Otherwise, the meter circuit or components and parts will be burnt.

The cables connecting the sensor and main equipment shall not be put in a trun king with any alternating current. If it can not be prevented, the cables of senso r shall be protected by a cable conduit to completely shield the electromagnetic interference caused by alternating current.

Wiring diagram:





Wiring method:

Grounding: first make sure the grounding terminal of the meter is actually grounded and the meter does not share ground terminal with other equipment and then connect terminal 4.

Transducer: Red wire: connected to Trans1 (transducer);

Blue wire: Temp 1 + temperature sensor +

Black wire: GND (ground wire)

Current output: “current +” connected to mA1 +;

“current -” connected to mA- /GND

Relay: RLlnA and RLnB are normally open;

To ensure the default state of relay is “normally open”, RLlnA and RLnB shall be connected.

RlnA and RLnC are normal closed.

To ensure the default state of relay is “normally closed”, RLlnA and RLnC shall be connected.

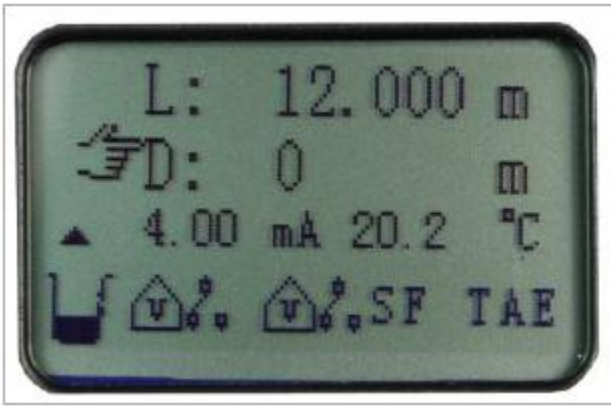
Power line: AC: connected to L and N

DC: 24V DC connected to 24V DC+ and 24V- connected to 24V DC-.

4.5 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:



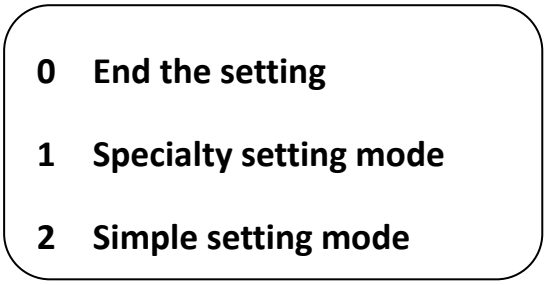
5. Menu interface & Operation instructions

The menu modes include expert setting mode and simply setting mode.

See the homepage for menu query table of simply setting mode.

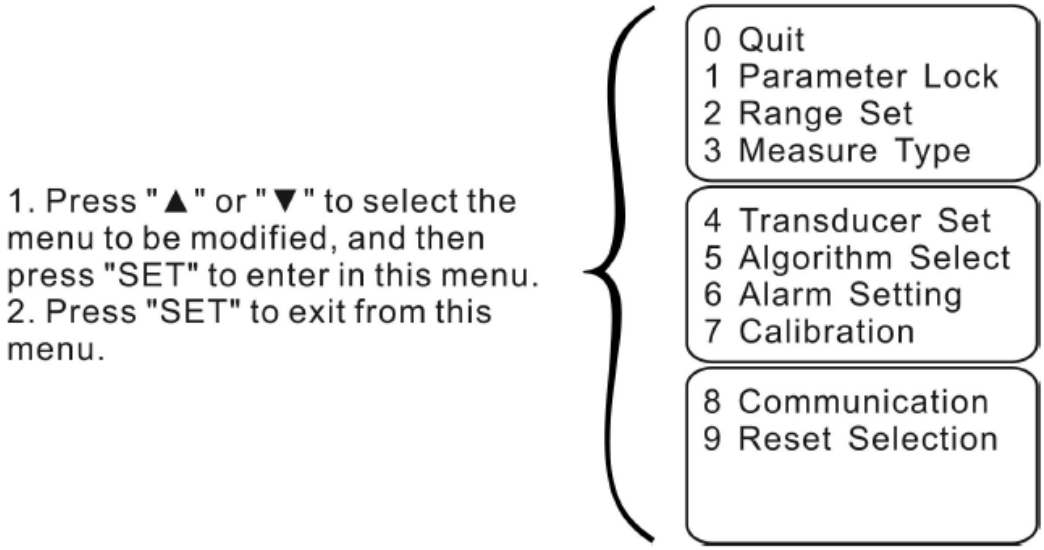
See the appendix for menu query table of expert setting mode.

Menu interface of expert setting mode and operating instructions are shown below:



Enter into the “1 specialty setting mode” main menu:

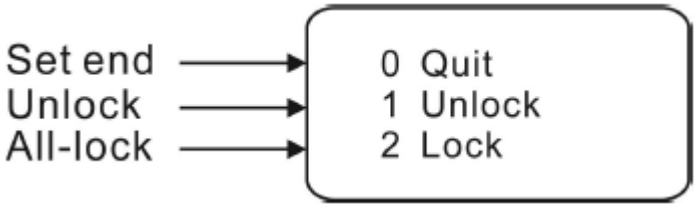
◆ Interface of the main menu with unlocked parameters:



◆"0 Set end"

Chose this item, and press SET to exit to the operating mode interface.

◆ Interface of the main menu with locked parameters:



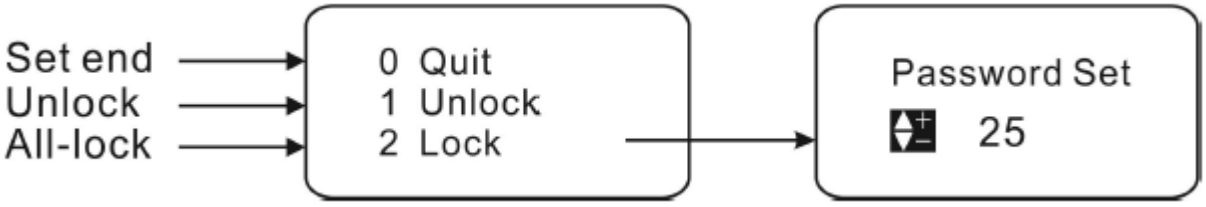
◆ “1 Parameter locking”

If you do not want other people to make random changes of the parameters, you can lock the menu, and the menu can be 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 (tips: please remember your own password, otherwise you need to contact with the manufacturer).

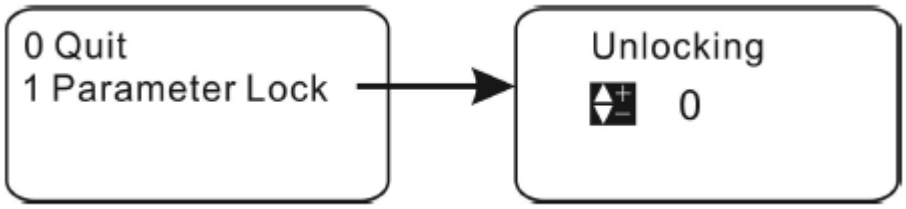
Descriptions：

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

All-lock: for the conditions, 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 ”

Set reference zero point, low range point, high range point and display unit.

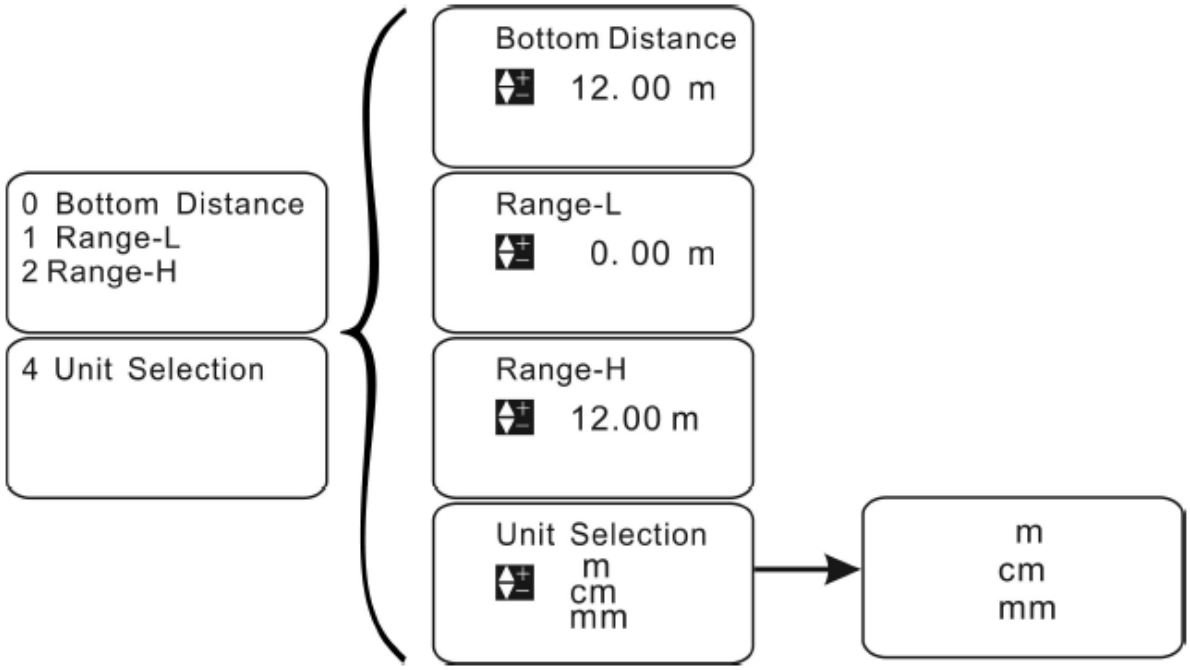
1 Bottom Distance(Reference zero point): set the reference zero point of the level meter, and this value is only useful for material level measurement; the factory default is the maximum range.

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.

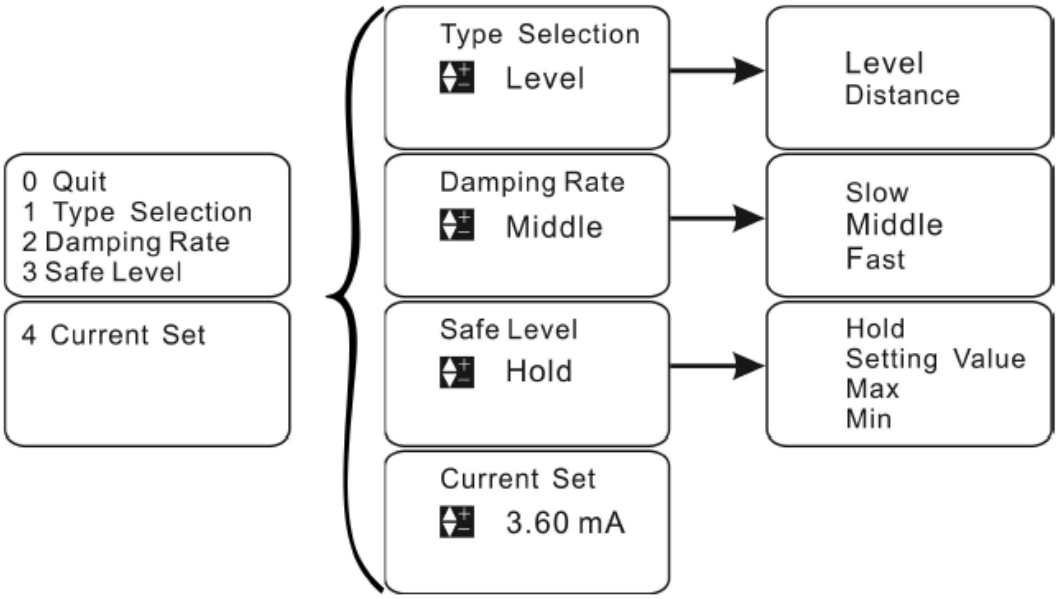
Remaining: the display value is the final measured value before wave loss, and the current is the corresponding value;

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 shall 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.



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

◆"5Algorithm Select(Set probe)" (do not modify this parameter)

◆"6Alarm 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)

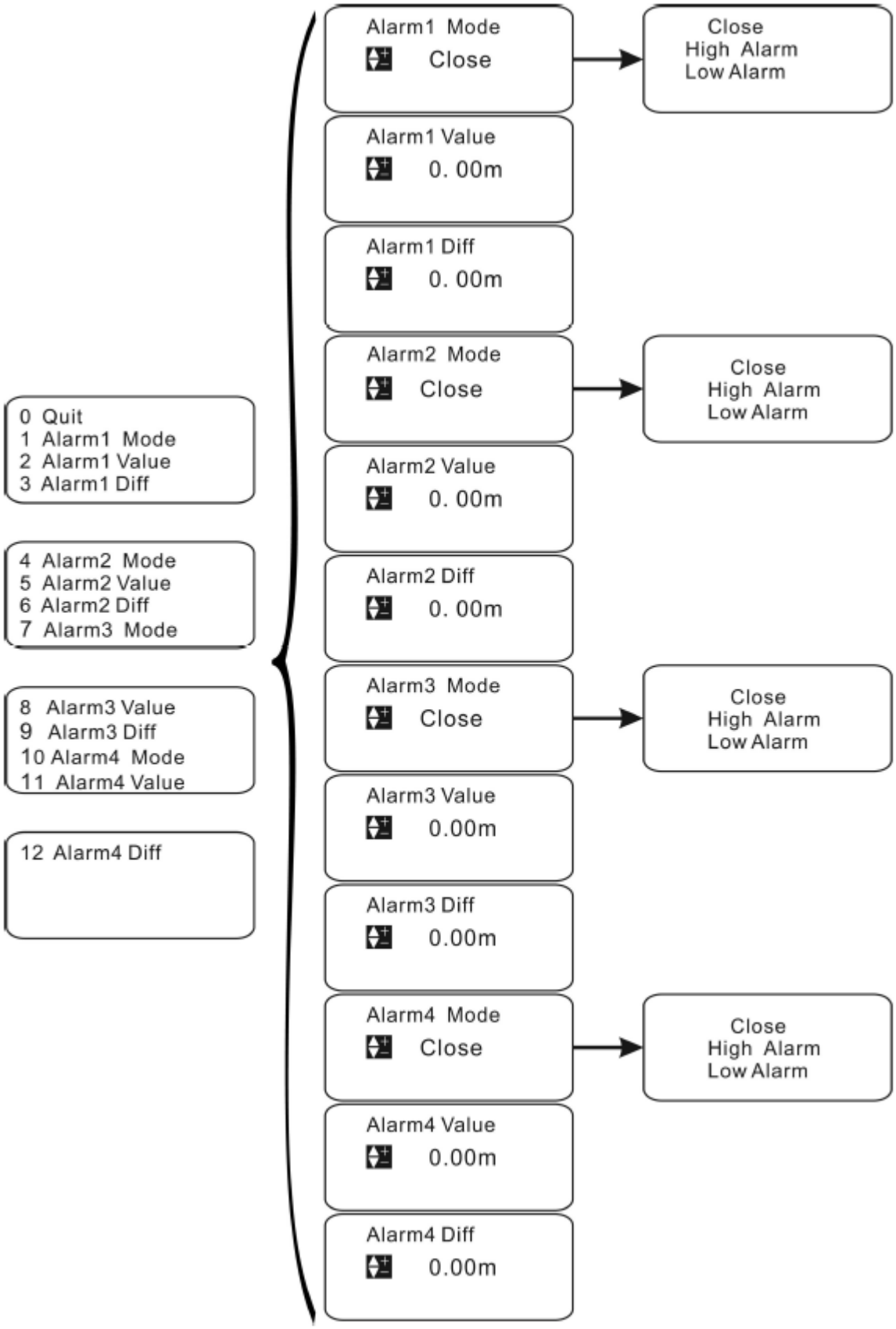
Through alarm return difference, one relay can control the whole working process of water pump from low level to high level.

For water drainage: when water level is below 1m, water pump stop 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 start to feed water; when water level rises to 5m, water pump stop 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

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

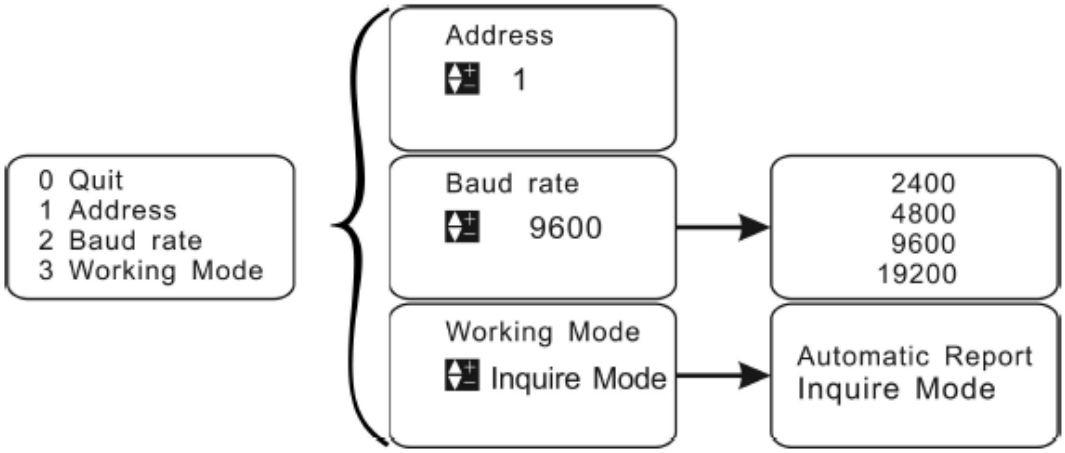
Carry out correction of range, sound velocity, current output and reference level.

◆ **"8Communication 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".

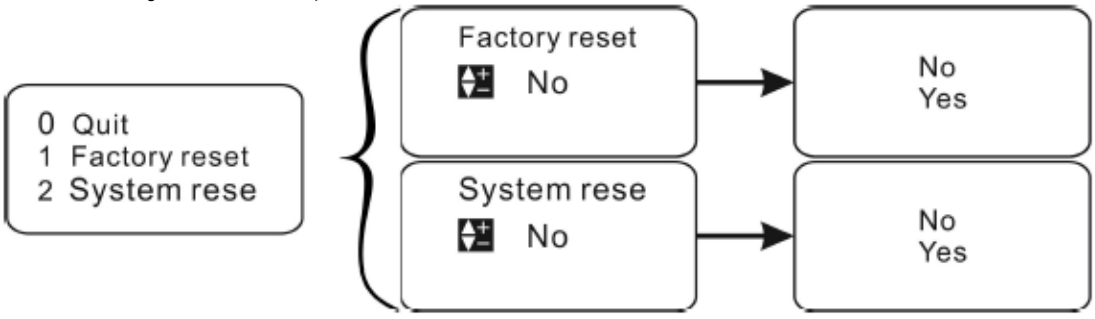


◆ **" 9Reset options"**

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.)



6. Faults and Handling

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 meter with greater measuring range. 2.The meter will restore the normal measurement automatically after the measured medium gets back to calm. 3.Check surrounding environment and realize good electromagnetic shielding. Do not share one power supply with frequency converter and motor, and make it grounded reliably. 4.Reinstall probe and make it perpendicular to liquid surface. 5.Select an appropriate position for installation and prevent an interfering object. 6.Raise the installation position of probe. 7.Check whether the medium is powder. If so, consult the manufacturer.

APPENDIX 1: MODBUS PROTOCOL OF ULTRASONIC SENSOR

MODBUS—RTU Communication Protocol

1、 The hardware uses RS—485，master-slave half duplex communication，the master calls the slave by address, And slave to give feedback for the access communication.

2、 Data frames 10 bits， 1 start bit, 8 data bits and 1 stop bit. No check bit.

Baud rate: 2400 4800 9600 19200（default 9600）

3、 Function code: 03H： read register value

Master sends：

1	2	3	4	5	6	7	8
ADR	03H	Start register higher bytes	Start register lower bytes	Number of register higher bytes	Number of register lower bytes	Lower byte of CRC code	Higher byte of CRC code

1st byte ADR ： address code of slave （=001~254）

2nd byte 03H ： function code of read register value

3rd、4th bytes ： The starting address of the register to be read

5th、6th bytes ： number of registers to be read

7th、8th bytes ： CRC code 16 bits of check bytes from 1 to 6.

When receive correctly, the slave returns:

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	Lower byte of CRC code	Higher byte of CRC code

1st byte ADR： address code of slave （=001~254）

2nd byte 03H： return read function code

3rd byte ： total number of bytes from 4 to M (includes 4 and M)

4th to M th bytes： registers data

M+1,M+2 bytes： CRC code of 16 bits of check bytes from 1 to M.

When receive error, it returns :

1	2	3	4	5
ADR	83H	Information code	CRC code lower bytes	CRC code higher bytes

1st byte ADR： address code of slave （=001~254）

2nd byte 83H： error reading register value

3rd byte information code : refer to information code list.

4th、5th bytes : CRC code of 16 bits of check bytes from 1 to 3.

4. Function code 06H：write single register value

Master sends：

1	2	3	4	5	6	7	8
ADR	06	Higher bytes of register address	Lower bytes of register address	Higher bytes of data	Lower bytes of data	CRC code lower bytes	CRC code higher bytes

When slave receive correctly, it returns：

1	2	3	4	5	6	7	8
ADR	06	Higher bytes of register address	Lower bytes of register address	Higher bytes of data	Lower bytes of data	CRC code lower bytes	CRC code higher bytes

When receive error, it returns：

1	2	3	4	5
ADR	86H	Error information code	CRC code lower bytes	CRC code higher bytes

1st byte ADR： address code of slave （=001~254）

2nd byte 86H： error writing register value function code

3rd byte information code： refer to information code list.

4th、5th bytes： CRC 16 bits check code from byte 1 to 3.

5. Function code 10H：continuously write multiple registers values

Master sends：

1	2	3	4	5	6	7
ADR	10H	Higher byte of start register	Lower bytes of start register	Number of registers higher bytes	Number of registers lower bytes	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	CRC code lower bytes	CRC code higher bytes

When slave receive correctly, it returns：

1	2	3	4	5	6	7	8
ADR	10H	Higher byte of start register	Lower bytes of start register	Number of registers higher bytes	Number of registers lower bytes	CRC code lower bytes	CRC code higher bytes

When receive error, it returns：

1	2	3	4	5
ADR	90H	Error information code	CRC code lower bytes	CRC code higher bytes

1st byte ADR： address code of slave （=001~254）

2nd byte 90H： function code of error writing register value

3rd byte information code： refer to information code list

4th、5th bytes： CRC 16 bits check code from byte 1 to 3.

6. Register definition table：（Note：The register address is coded in hexadecimal）

Register address	Content description	Read only	Register address	Content description	Read only
0000	Distance/level instantaneous value (2 bytes, higher byte first)	√	0001	Analog output instantaneous value (2 bytes, higher byte first)	√
0002	Temperature instant value (2 bytes, higher byte 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(2 bytes, higher byte first)		0023	Difference of alarm 1(2 bytes, higher byte	
0024	Alarm 2(2 bytes, higher byte first)		0025	Difference of alarm 2(2 bytes, higher byte	
0026	Alarm 3(2 bytes, higher byte first)		0027	Difference of alarm 3(2 bytes, higher byte	
0028	Alarm 4(2 bytes, higher byte first)		0029	Difference of alarm 4(2 bytes, higher byte	
002A	Reference zero(2 bytes, higher byte first)		002B	High point of range(2 bytes, higher byte	

002C	Low point of range(2 bytes, higher byte first)		002D	Current setup(2 bytes, higher byte first)	
002E	Blind area setup(2 bytes, higher byte 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 mode 1 alarm mode 2		005D	Alarm mode 3 alarm mode 4	
005E	Measuring mode unit option		005F	Algorithm option safe level	
0060	Probe type response speed		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	Sensor type character √ instrument address	

Notes：

1. 2 bytes 16 bits expression, higher byte first (note: Floating-point numbers are expressed in hexadecimal notation when they are rounded by 100)

   The distance or level returned is in cm.

   For example: if address of sensor is 1 ,

   Sending : 01 03 00 00 01 84 0A

   Returns : 01 03 02 00 10 b9 88

   Bytes in red means the measuring level at present is 0.16m (0*0010)

Remarks: Positive and negative identification bit: when measuring value and temperature is positive, top bit of higher byte is 0; when it is negative, top bit of higher byte is 1.

For example: when measuring level is - 0.16m, it returns : 01 03 02 80 10 E8 06

2. Measuring mode: 0 - distance ; 1 - level .

   Safe level : =0, hold; =55, min; =AA, max; =A5, set value.

   Alarm mode 1、2、3、4：0 - off; 1 - low level alarm; 2 - high level alarm.

   Unit options: =0, mm; =1, cm; =2, m.

   Algorithm option: 0 - special condition one; 1 - special condition two; 2 - special condition three; 3 - special condition four; 4 - special condition five; 5 - special condition six; 6 - special condition seven.

   Probe 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.

   Response speed: 0 - slow ; 1 - medium ; 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 - auto report mode ; 1 - query mode.

3.

Registers are partitioned to perform read and write operations.

1st area: 0010 - 0021 read only

2nd area: 0022 - 005B read and write

3rd area: 005C - 006B read and write

In same area, could read (or write) a parameter at single time, also could batch read (or write) all parameters in same area, read/write operations across regions are not allowed.

4. All the reserved register currently undefined, save compatibility for future upgrades.

7. Information code list :

code	meaning
01H	illegal function code
02H	illegal data address
03H	illegal data value
04H	CRC16 check error
05H	Receive correctly
06H	Receive error
07H	Parameter error