Non-intrusive Level Switch (Mode C) Software 3.0.11

Manual Book(Ver: 4.0)

MC Shaan01000373 号

Enterprise Standards：Q/SK 001-2020

PA 13L169-61

SHAANXI SHENGKE ELECTRONIC

TECHNOLOGY CO.,Ltd

1. Instrument Warranty and Service Scope

From the date of shipment, the instrument mainframe is guaranteed for one year, and the instrument repair and maintenance are guaranteed for half a year. This guarantee is limited to the instrument users of the original factory purchaser or designated distributor and is not applicable to any instrument users who use the instrument incorrectly for human reasons, modify, neglect or cause damage by accident or abnormal use.

Free maintenance is provided for faulty instruments returned within the scope of warranty. To obtain the warranty service, please contact the after-sales service department and attach the fault description. With the permission of the company, the instrument will be sent to the after-sales service department.

Report errors

If the instrument has passed the warranty period or is confirmed that the failure of the instrument is caused by misuse, modification, negligence, accident and abnormal use, the maintenance cost budget will be provided according to the relevant maintenance fee standards and will be maintained after approval. After the instrument is repaired, it will be sent back to the customer, who will pay for the maintenance and transportation. (Attached: Warranty Policy)

2.　Opening Inspection and Cautions

2.1 **Open Box Audit**

- Manual book
- Qualification Certificate
- Packing list
- Mainframe
- Check the name, model, etc. on the nameplate
- Check whether the shell is in good condition and observe whether the window glass cover is broken.
- Check random items according packing list

Check the correctness and completeness of the instrument specifications, models and accessories according to the instrument packing list. If you have any questions, please contact the customer service center in time for the change.

2.2 **Attentions**

- Please read the instruction before installing the instrument.
- Modifications due to product upgrades are subject to change without prior notice. Please refer to the actual product.

3.　Storage and Transportation

3.1 Storage Conditions

- –40 ～ +60 ℃Storage Temperature: - 40 ~+60 Temperature

- Use original packaging

3.2 Transport the Product to the Work Place

- Transport level switch to work place or process connection with original packaging

- During transportation and storage, collision, moisture and chemical erosion should be prevented.

4. Product Introduction

4.1 Product Overview

Non-intrusive level switch (hereinafter referred to as level switch) is a new type of liquid level monitoring and alarming device. It is mainly used for monitoring tank level, alarming the upper and lower limits or monitoring the existence of medium in pipeline (dry state protection). It can be used for liquid level process control in pharmaceutical, petroleum, chemical, power, food and other industries.

The liquid level switchis flameproof and can be directly used in flammable and explosive occasions. It is widely used in high-pressure and atmospheric tank alarm system in medicine, petroleum, chemical industry, power, food and other industries. The product is installed by sticking type, without moving the tank and fire. It is safe and reliable in use, with high sensitivity, and its comprehensive performance has advanced domestic and international level, which provides a strong guarantee for safe production.

4.2 **Technical Parameters**

Output signal	relay output (contact is passive node)
Relay capacity	DC 30V 6A、AC 250V 6A
Repeatability error	±3cm
Measurable wall thickness	≤ 60mm
Power	3 W
Communication	RS-485、Infrared、Modbus
Main engine operating ambient temperature	-40℃～+70℃
Environmental humidity	（15%～100%）RH
Power Supply	DC 24V
Electrical Interface Specification	M20×1.5
Material	Cast Aluminum
Shell Protection Level	IP67
Explosion-proof mark	ExdII CT6
Probe Shell Material	Cast Aluminum,Stainless Steel
The probe is operated at ambient temperature	－ 50 C to ＋ 100 C (normal temperature type)
Host Weight	2KG

Main engine outline size	158 mm long, 112 mm wide and 148 mm high
Main engine base hole diameter	M5

4.3 Application Scope

4.3.1 Container under Test

The vessel wall at the installation of sonar probe should be made of hard material which can transmit signals well. For example: carbon steel, stainless steel, various hard metals, fiberglass reinforced plastics, epoxy resin, hard plastics, ceramics, glass, hard rubber and other materials or other composite materials. The inner and outer surfaces of the vessel wall should be flat. If the vessel wall is made of multi-layer materials, the layers should be in close contact with each other without air bubbles or gas sandwiches. For example: vulcanized hard rubber lining, epoxy resin lining, stainless steel lining, titanium lining.

4.3.2 Medium Temperature Requirements

The permissible temperature range of the probe is -50 ~100 C (normal temperature type) and 60 ~200 C (high temperature type). Because the probe is close to the wall of the container, the temperature of the probe is similar to that of the wall of the container, so the temperature of the measured medium is generally required to be within - 50 ~200 C.

4.3.3 Instrument Environment Temperature

The ambient temperature range of the main engine of the liquid level switch is -40 ~80 C. In the northern area, it is recommended to use instrument protection box. In the areas with strong direct sunlight, it is suggested to install the instrument in a shady place or use a sunshade, which can avoid

the excessive temperature in the instrument caused by the sun exposure, and also can provide good ventilation and heat dissipation.

4.3.4 Explosion-Proof, Anti-Corrosion and Protection Grade

The external level switch adopts the explosion-proof and anti-corrosion structure of aluminum alloy casting seal, epoxy spraying on the surface. It is suitable for harsh environment with explosive mixture gas, medium concentration corrosive gas and 0-95% humidity range.

Non-intrusive level switch Explosion-proof grade：ExdIICT6。

Anti-corrosion grade：WF1 Outdoor intermediate corrosion protection

Protection grade：IP65、IP67

5. Level Switch Dimension

5.1 Level Switch Mainframe Dimension

液位计主机 mainframe（4 holes）

Mainframe（2 holes）

Figure 1 Dimension of mainframe（unit：mm）

5.2 Sensor Probe Dimension

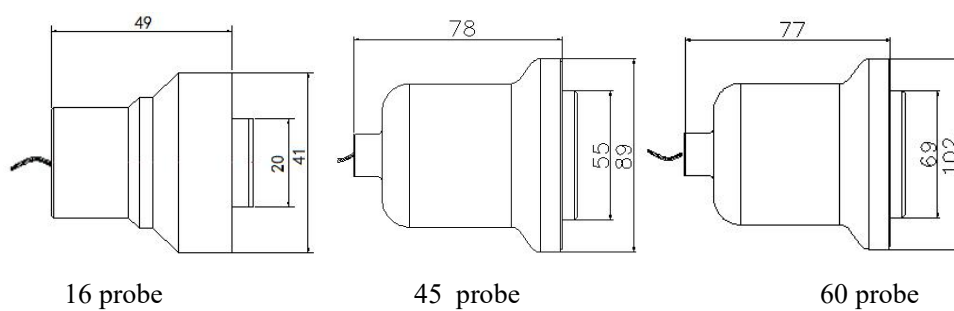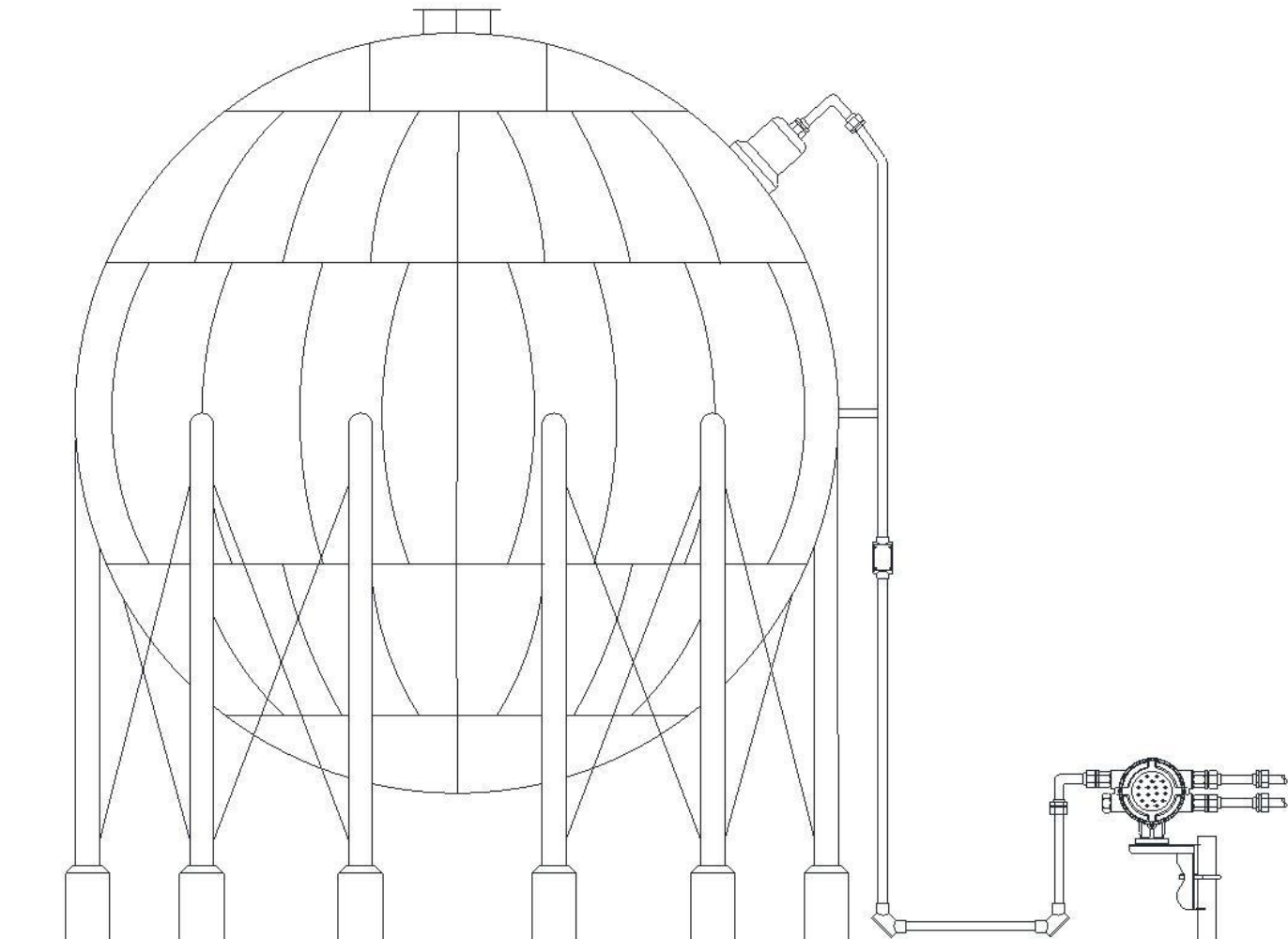16 probe   45 probe   60 probe
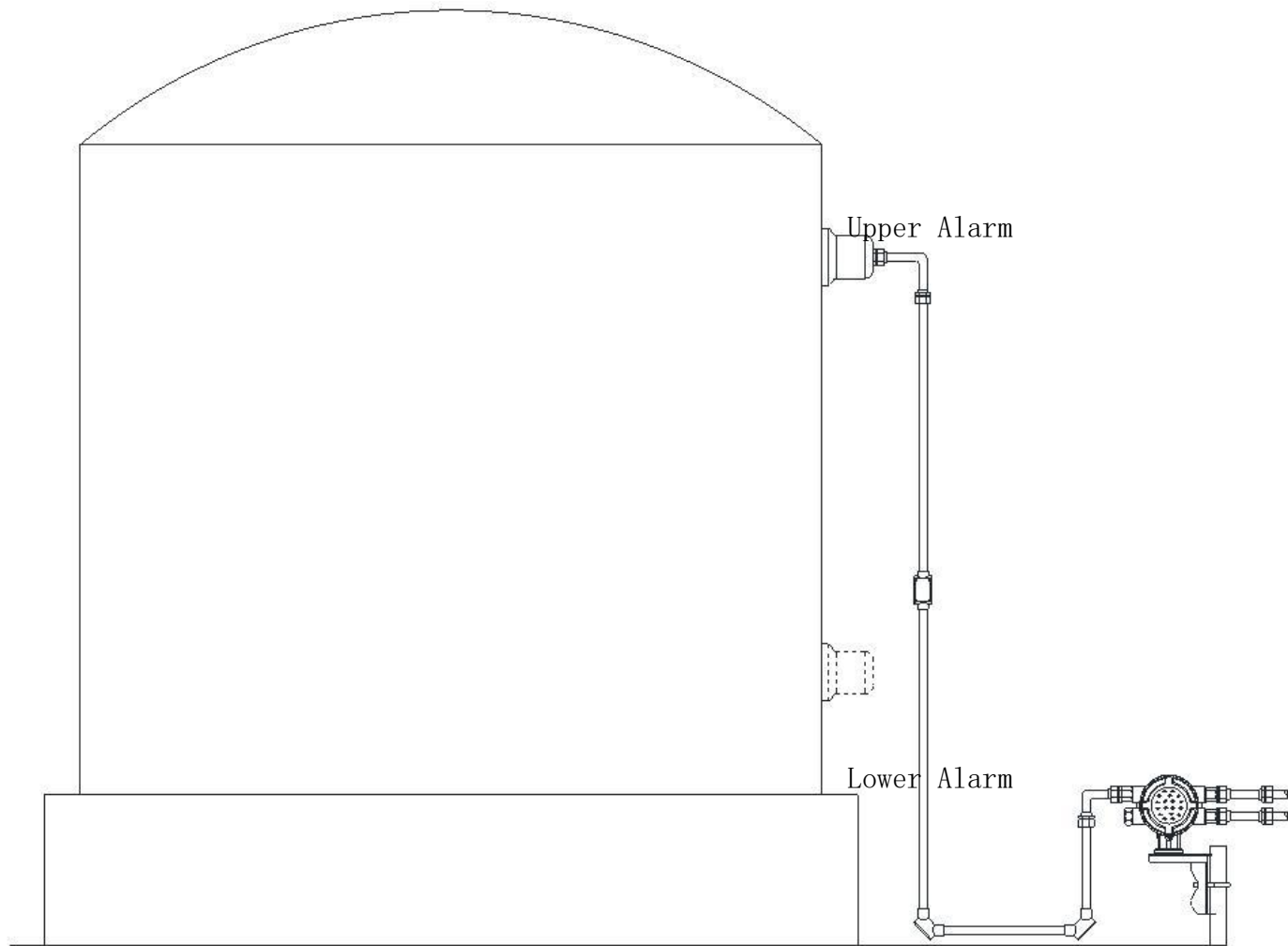
Figure 2   Dimension of probe（unit：mm）

6.　Instrument Installation

6.1 **Instrument Installation**

6.1.1 **Schematic diagram for assembly of level switch**
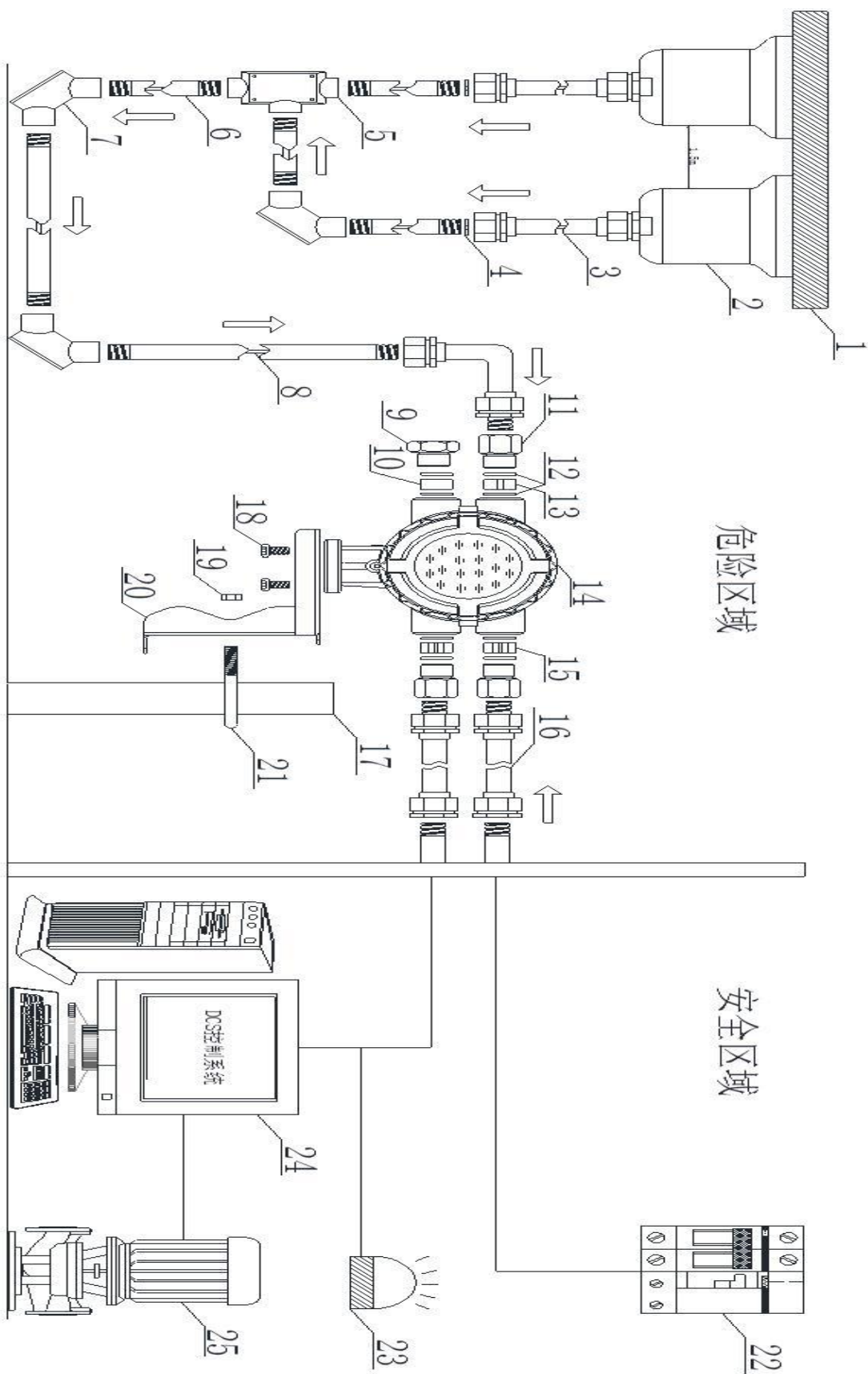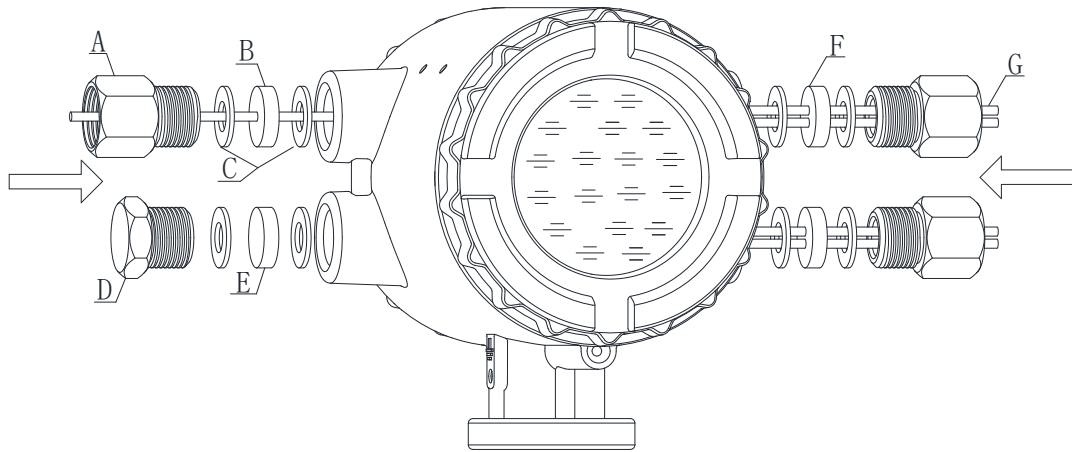

3-1Level Switch for Spherical Tank

3-2Level Switch for Vertical Tank

6.1.2 Schematic diagram of pipeline connection of level switch

危险区域

安全区域

DCS控制系统

Drawing of liquid level switch

6.1.3 Detailed List of Level Switching Equipment

No.	Name	Specification	Quantity	Graphical Indication	Remarks
1	Storage tanks (wall)				
2	Fixed seat		1		
3	Explosion-proof Flexible Tube		1		User-provided
4	Gasket		1		
5	Direct threading boxes		Some		User-provided
6	Galvanized pipes		Some		
7	Bend-through threading boxes		Some		
8	Signal Cable Optional		optional		
9	Stainless steel plug	M20*1.5	1	D	
10	Sealing gasket	non-porous	1	E	
11	Converter connector	M20*1.5	3	A	optional
12	Gaskets		8	C	
13	Seal gasket	1 hole	1	B	
14	Switch host	SK-WK	1		
15	Sealing gasket	2 Holes	2	F	
16	Explosion-proof flexible tubes		3		User-provided
17	2 inch riser		1		
18	Inner hexagonal scre	M5	4		
19	Nuts	M8	2		
20	Switch Bracket		1		
21	U-Card		1		
22	24V Power Supply		1		User-provided
23	Alarm lights		1		
24	Main Control Room (Control System)				
25	Pump body/valve				
A	Locking Joint	M16			Installation and Use of Bellows
B	Bellows	Φ13			
C	Fast socket	M20			

7.   Instrument Installation and Debugging

7.1 **Preparations Before Installation**

- Before debugging, it is necessary to ensure that the liquid level in the tank is higher than 1 m and the liquid level meets the calibration conditions of diameter.
- Understand the internal structure and pipeline arrangement of the tank, and obtain the information of tank diameter, measurement range, wall thickness, etc.
- Tools：slotted screwdriver（3*75mm），wire stripper（7mm²），handmade knife，adjustable wrench（≥10 inches），inner hexagon spanner（M5），DC 24V power supply。
- After the tool is ready, the product is checked and the packing list is checked to determine whether the material is complete.

7.2 **Probe Installation Position Selection**

According to the equipment diagram of storage tank, the optimum installation point of probe is selected.

- Basic Principles of Probe Installation

  The probe is installed as far away as possible from the inlet and outlet and the weld.

7.3 **Probe Installation and Debugging Procedures**

7.3.1 **Installation and Debugging of Measuring Probe**

- Polishing Tank Wall Surface

  After selecting the installation position of the probe (removing the protective material of the tank at the installation), the surface of the tank wall is polished and cleaned with sandpaper. It is required to polish a circular surface not less than the diameter of the probe base. The surface should be smooth and smooth, free of oil pollution and fine particles.

As shown in step 1:
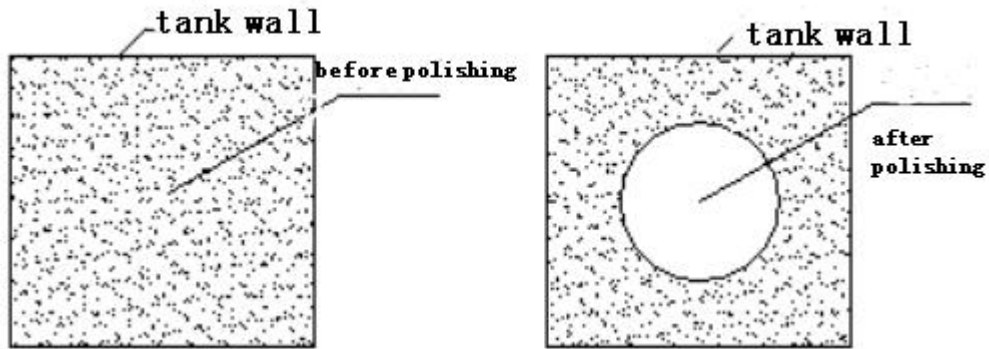
Step 1 :Sandpaper polishing tank wall

● Silicone grease

Remove the probe from the probe base and apply a layer of silicone grease (1-2mm thick) evenly on the front surface of the probe and on the polishing surface of the tank wall.
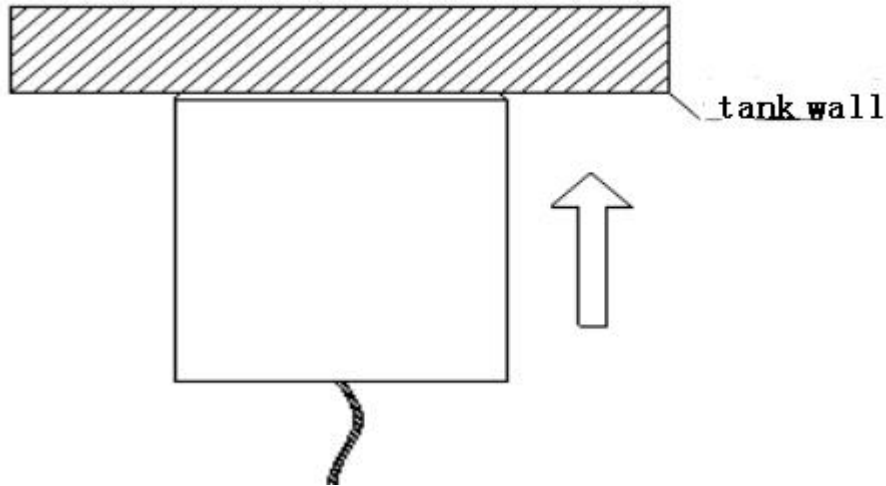
As show in step 2

Step 2:Remove probe and apply silicone grease

● Installation of Measuring Probe

The probe is attached to the smooth area after polishing, then the probe is pressed by force and rotated slowly.

As show in step 3:

Step 3 The probe is close to the wall of the tank

Probe falling to the ground may cause permanent damage, we must do a good job of protection measures.

Silicone grease can make the probe directly adsorbed on the tank wall. In order to prevent the falling of the probe, it can be gently held by the hand, or the probe line of the probe side should be temporarily fixed at the installation site to prevent the probe from falling to the ground. If the probe installation position is very low, soft foam foam can be placed underneath it, so as to avoid the probe falling directly to the ground.

● Wires Connection

DC 24V power supply is connected to "24V" orange terminal, measurement probe is connected to "T/R" terminal (when composite probe is connected to red single-core shielding wire), core wire is positive, shielding layer is negative, do not reverse. The terminal is shown in figure 3.

● Probe Base Installation

After confirming that the quality of the echo waveform meets the requirements, the fixed seat of the probe is slowly moved upward on the outside of the probe and gently adsorbed on the tank wall; the probe should not be touched during the adsorption process.
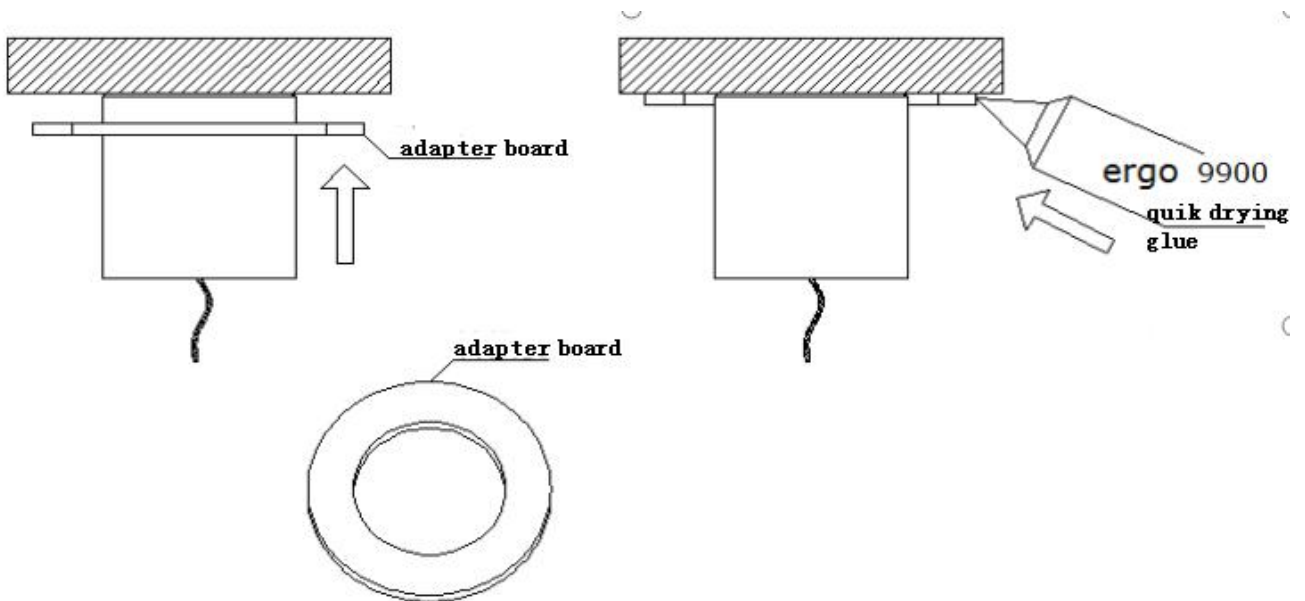
As shown in step 4:
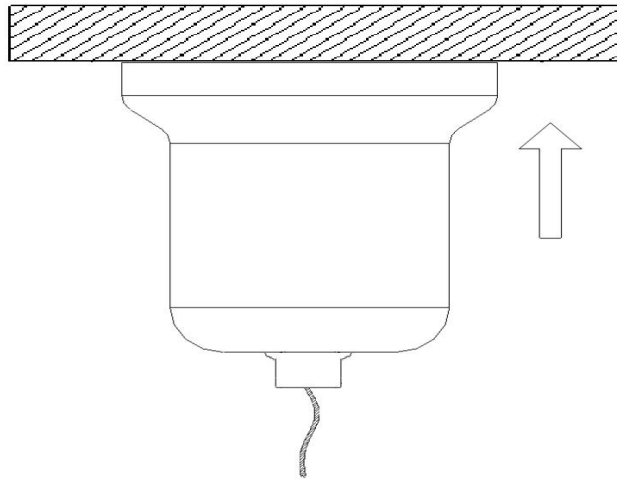
Step 4 install probe base

For the non-ferromagnetic tank wall, the probe base can be installed by adding adapters, and the ferromagnetic adapter can be bonded to the tank wall. After the glue solidifies completely, the probe base can be adsorbed on the adapter.

As shown in step 5:

Step 5 Install adapter board and apply quick-drying glue

Figure 6 installation of liquid level switch

Note: The installation and laying methods of spherical tank, horizontal tank and vertical tank can be shown with reference to figure 6.

Attention:

When threading, pay attention to protecting the probe. Do not force or move the

probe.

Take care to protect the cables. Do not scratch or cut them.

8.   InstrumentDebuggingParameterDescription

8. 1 Parameter setting man-machine interface

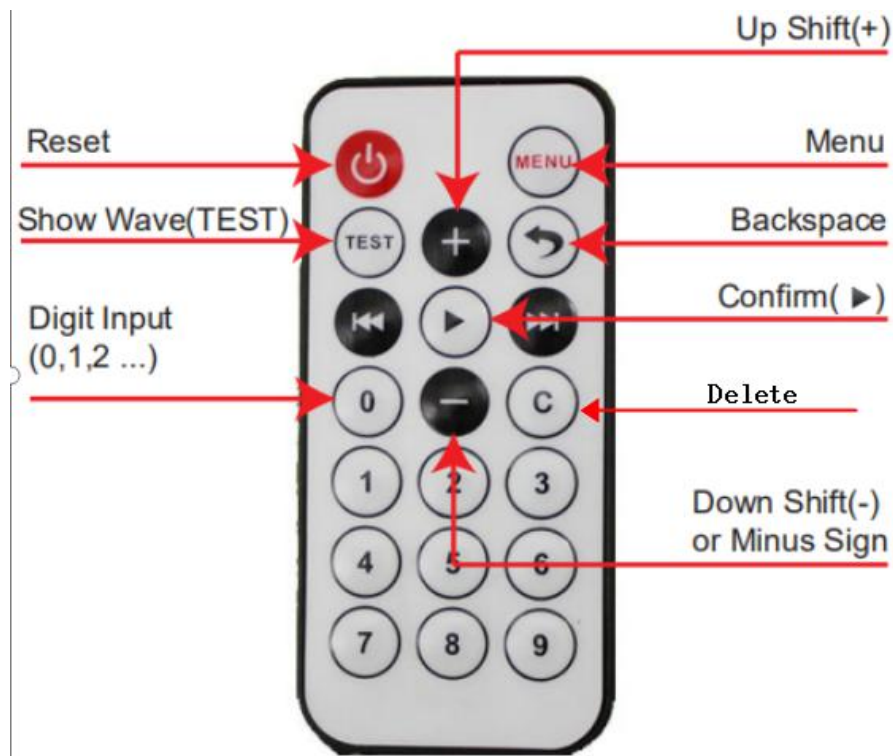The instrument uses infrared remote controller to set parameters. The key functions are as follows:

Figure 4   IR

Controller Key Description

1、Reset/restart：；reset or restart the instrument;

2、Menu：Open the menu, check and change the working parameters.

3、Test：Display real-time echo wave and parameters of the

instrument and assist in debugging and diagnosis.

4、Backspace： Under the menu or waveform interface, return to the main working interface.

5、All of the other button are used to edit the con-figs

8.2 **Main Screen Description**
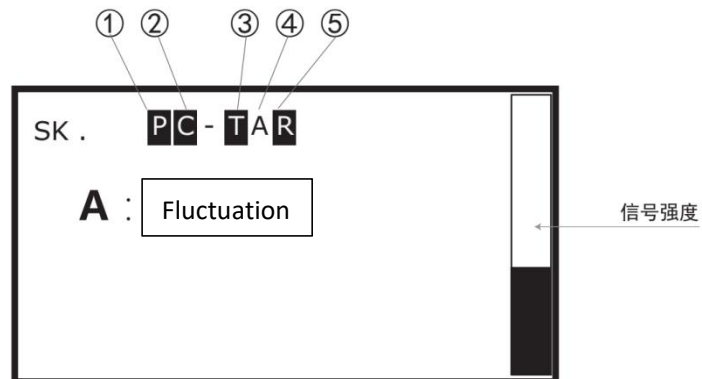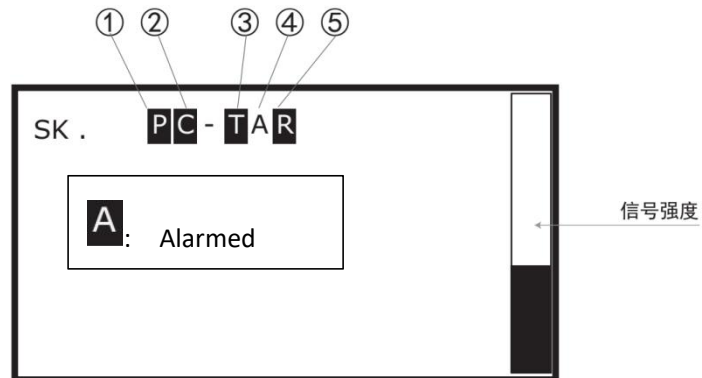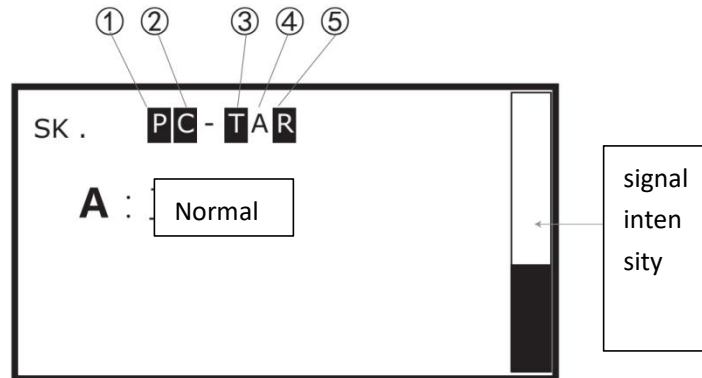
① ![P]485 is proprietary protocol![M]485 is Modbus protocol

② ![C]Working mode C

③ ![T]Instrument is disturbed by outside and reset automatically
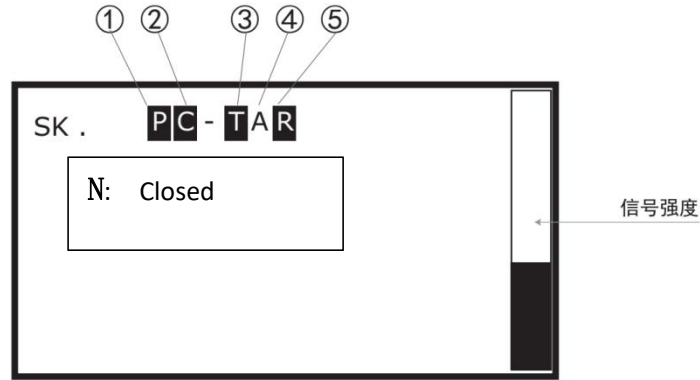
④ ![A] Means safe status, and indicates as Normal ![A] Means alarmed status, and indicates as Alarmed.

⑤ ![R]Infrared function of the system is disturbed and prohibited.

A: The output status of point A is displayed. The list of valid states is as follows.

⑥ Fluctuation: The instrument works normally and the liquid level has reached the alarm point

⑦ Closed: Instrument works without Base Para of High/Low Alarm Thresholds, need to set its up first.

Statement	Explaination
Normal	The instrument works normally and is in an unannounced state.
Alarm	The alarm instrument works normally and is in the alarm state.
Fluctuation	The instrument works normally and the liquid level has reached the alarm point
Turn off	The instrument works normally and point A is closed.
Failure	Failure of instrument calibration, failure of normal operation and invalid output result

Exceptions	system abnormalities, can not work properly, the output results are invalid
Unknown	Unknown state, instrument can not work properly

D：System delay

S：Key System Parameters

E：Key System Parameters

G：Key System Parameters

8.2.1 Instrument operation

8.2.2 Working Characteristics of Mode C

C mode operation requires one probe, and can monitor one level point. The installation point is same as the monitor point

8.2.3 Main Parameters Setting

a）Connect the instrument on power or battery.

b) Press MENU →C Mode→*C Mode, shows OK!

c) Back to Mode→C Mode

d) Chose the High/Low Alarm Threshold→input diameters, unit is millimeter →OK!

d）Back to DEVICE INFO and enter→CHECK PWD→ input 666666→CORRECT PWD OK!

e）Press MENU→SYSTEM BASIC→DEFAULT SPEED(VSONIC)→input vsonic of medium, unit is M/S→OK!

f）Enter MEASURE RANGE→input number=diameter × 1.3, unit is millimeter →OK!

g) Press MENU→MAIN SENSOR BSC→FREQUENCY→input the best frequency (to find the best echo),generally, the Frequency range should be from 100kHz to 300kHz. You may repeat this procedure several times→OK!

h) Press MENU→DIAGNOSIS→SIGNAL SMOOTH→input a number between 100 to 1000
(the bigger number means more smooth curve; the bigger tank needs bigger number)
→OK!

A good waveform with good echo and smooth curve may be like

this:

And the main screen after para setting should be like this:
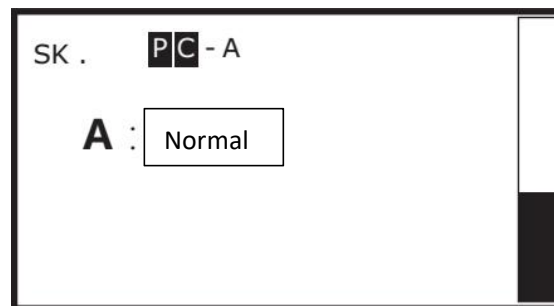
8.2.4 Main Parameters Descriptions (the other paras no shown on this form please ignore them)

	Parameters	Descriptions	Functions	Modification Suggestions
Menu	C MODE	Level switch works as C mode	/	
C MODE	A High Alarm Threshold	The actual measure range of the probe. (basically same as the tank's diameters)	Setting this para when install the probe on the high position to monitor the high level alarm.	Modify every time

		Unit:MM		
	A Low Alarm Threshold	The actual measure range of the probe. (basically same as the tank's diameters) Unit:MM	Setting this para when install the probe on the low position to monitor the low level alarm.	Modify every time
	Lower Threshold	The lower limit of the effective range of the echo. The default is 6.	The echo distance should be above (diameter*4/10),otherwise the echo is useless.	No modification recommended
	Higher Threshold	The lower limit of the effective range of the echo. The default is 16.	The echo distance should be above (diameter*16/10),otherwise the echo is useless.	No modification recommended
DEVICE INFO	CHECK PWD	Input 666666 to enter the advanced paras setting	/	
MAIN SENSOR BSC	FREQUENCY	The working frequency of level switch's probe.	Base on the different working condition, chosing the most suitable frequency.	Modify every time
MAIN SENSOR ADV	GAIN TYPE-AGC(adv)2	Echo signal intensity auto adjustment mode	Automatically adjust signal strength according to echo strength	Cannot be modified
	POWER LEVEL	Transmitted signal strength level.	The more complicated the working condition is, the larger the power range is (the minimum value is 1, the maximum and default value is 4)	No modification recommended
SYSTEM BASIC	DEFAULT SPEED	VSONIC of medium	Input according to medium type, for example: water 1485m /s, propane 800m /s	Modify every time
	MEASURE RANGE	The maximum measuring distance of the probe, the input	Set the maximum measuring distance of the probe	Modify every time

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|		value is equal to 1.3 times of the tank's diameter		
	FILTER LENTH	Damping time, default value is 200.	The larger the filter length, the slower the alarm response and the more stable the function, and vice versa.	No modification recommended
SYSTEM ADV	LEVEL STRAGEDY	Default: display DEAD 0	/	Cannot be modified
DIAGNOSIS	SIGNAL SMOOTH	Smoothness of waveform	The larger the input value, the smoother and more stable the waveform, but the larger the blind area. vice versa.	Modify every time
	SYSTEM DAMP COEF	Same as "FILTER LENTH"	/	Cannot be modified

9. Electrical connection

9.1 Level Switching Power Supply

Rated operating voltage: DC 24V

Voltage allowable range: DC, [20, 28] V

Rated power: 3W

9.2 Terminal of Level Switch
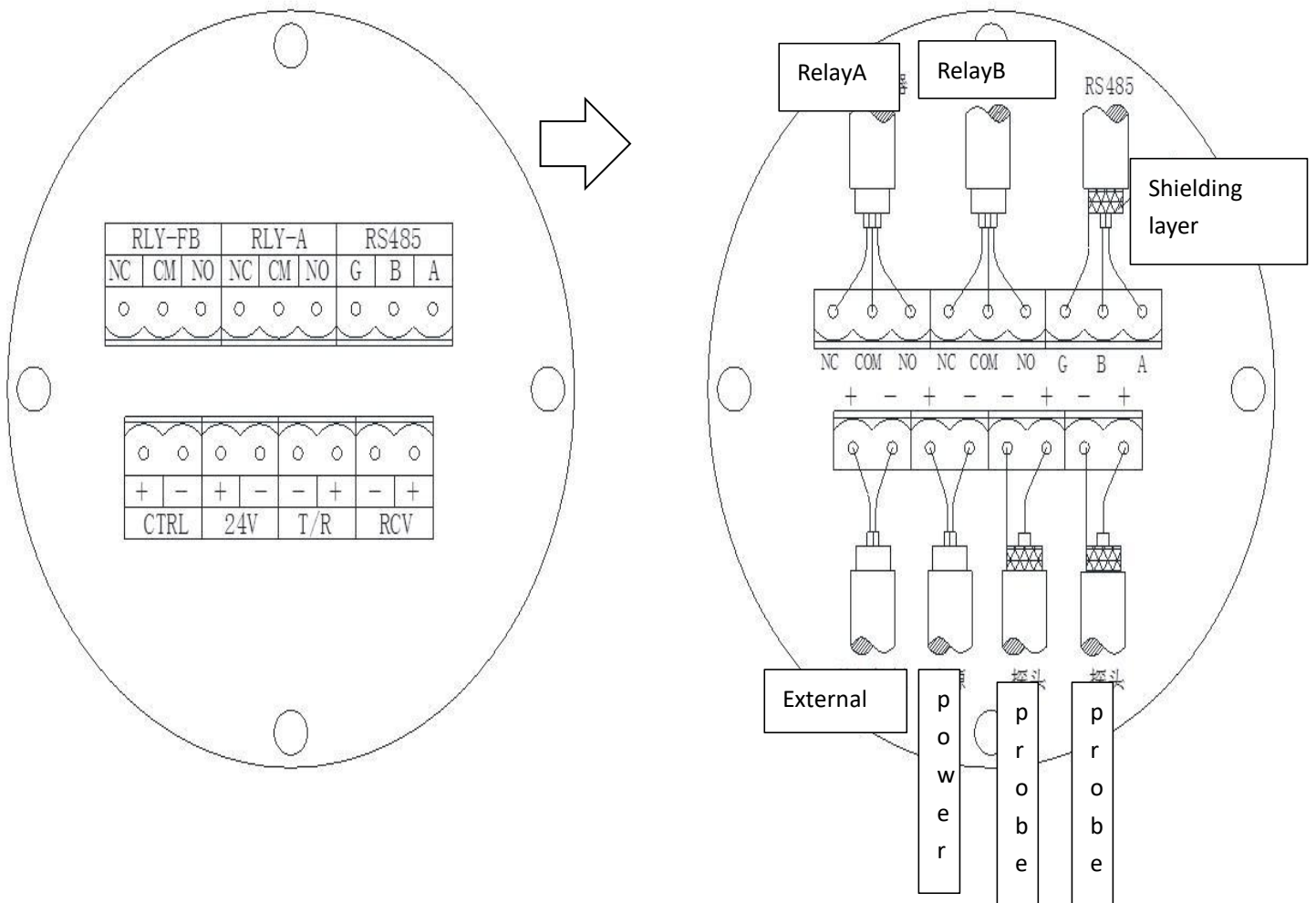
Terminal Name	Functions
24V(+)	24V power +
24V(-)	24V power -
RS485(A)	RS485Communication A Terminal
RS485(B)	RS485Communication B Terminal
RS485(G)	RS485Communications Place
T/R (+)	Emission probe connection terminal+
T/R (-)	Emission probe connection terminal-
RCV (+)	Receiving probe connection terminal+
RCV (-)	Receiving probe connection terminal-
RLY_A (NC)	A-Point Relay Usually Closed End
RLY_A (CM)	A-point relay common end
RLY_A (NO)	A-point relay often starts
RLY_FB (NC)	Normal Closed End of Instrument Fault Output Relay
RLY_FB (CM)	Common End of Instrument Fault Output Relay
RLY_FB (NO)	Instrument fault output relay often starts
CTRL (+)	External control terminal+
CTRL (-)	External control terminal-

10. Appendix 1

Explaination of ModBus Protocol for External Layer Switch

1：Read parameters, using command 0x04
Register List：

Register Address	Register Description	Data Type	Note
0001H	A relay	16-bit unsigned integer (0-65535)	0 represents no alarm, non-zero represents alarm
0002H	B relay	16-bit unsigned integer (0-65535)	0 represents no alarm, non-zero represents alarm

2：Read or set parameters, read using 0x03 command, set using 0x10 command
Register List：

Register Address	Register Description	Data Type	Note
0003H	Damping	16-bit unsigned integers	
0004H	Baud rate	16-bit unsigned integers	bps
0005H	Range	16-bit unsigned integers	The unit is mm [10, 50000]

Note：1、The default address of the device is 1 and the initial baud rate is 9600.
    2、The device address and initial baud rate can be modified through the instrument menu.