60GHZ RADAR LEVEL

TRANSMITTER

(2021 VERSION)

DANDONG VIRTUE RIVER TECHNOLOGY CO., LTD
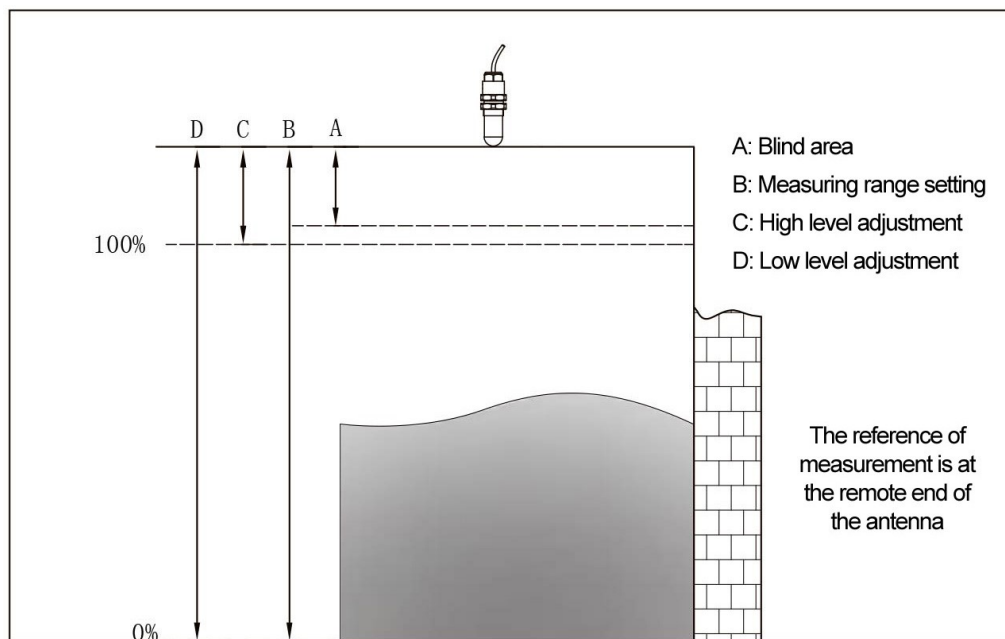
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1. Overview

1.1. Brief Introduction

60GHz Radar water level meter is a type of highly accurate radar water level measuring meter which uses 60GHz millimeter radar waves as carrier signals, and the measurement accuracy of millimeter level has been achieved on basis of the leading patent sensor technology and the time resolution in microseconds. Therefore, this type radar level transmitter works more accurately and stably. Due to its excellent robustness, it could not be affected by the noise, dust, color, direct sunlight or scattering light and other any natural interference source.

1.2. Working Principle

High frequency radar emits relatively narrow microwave pulses which is transmitted down via radar's antenna. These microwave pulse will be reflected as soon as they arrive and touches the surface of the measured medium (i. e, they are called the echo pulses), these echo pulses are received again by the antenna system from which they are transmitted to the electronical circuits section where they are automatically converted into water level signals. (The flying time of the microwaves, back and forth from their remittance to their arrival at the target, from their being reflected at the target to their receiving at the receiver, happens instantaneously, because the velocity of microwave transmission is extremely fast)

A: Blind area
B: Measuring range setting
C: High level adjustment
D: Low level adjustment

The reference of measurement is at the remote end of the antenna

Note: Please ensure that the highest possible water level can never enter into the radar level transmitter's up dead zone (As the "A" shown at the above picture).

1.3. Features

The emission frequency of VRPWLR601 radar water level transmitters is up to 60GHz. They feature as below:

■ Non-contact measurement, no abrasion, no pollution;

■ The antenna dimension is small, it is easy for the instrument to be installed;

■ Small beam angle makes the signals' energy concentrated so that the echo return strength could be reinforced, meanwhile, it is helpful for the signal beam to avoid interference;

■ Be hardly affected by the corrosion and foam from the measured liquid;

■ Be hardly affected by the change of the vapour, temperature, and pressure in the air;

■ High signal-to-noise ratio, the better performance can be maintained even though under the fluctuant situation.

2. Technical data

	Features: stable performance, with function of angle measuring, easy installation, high precision, strong anti-interference ability, small and lightweight, with serial debugging, low power consumption, small beam angle.
	Application range: Agricultural irrigation, urban underground sewage water level measurement, rainwater pipeline water level measurement, monitoring of accumulated water on urban roads and especially on the roads under bridges.
	Measuring range: 7m (For VRPWLR601) 12m (For VRPWLR602)
	Accuracy: +/-2mm
	Working voltage: 6 – 30 V DC
	Process connection: Thread G1/4"A, "T" mounting bracket, or flange
VRPWLR601/602	Ambient temperature: -40℃ - +70℃
	Process pressure: Atmospheric
	Repeatability: +/-1mm
	Housing material: ABS
	Material of antenna: ABS
	Working frequency: 60GHz
	Signal output: digital signals (via RS485, MODBUS, 6-30V DC)
	Enclosure protection grade: IP68

VRPWLR601-L/602-L	Features: stable performance, with function of angle measuring and spirit level, easy installation, high precision, strong anti-interference ability, small and lightweight, with serial debugging, low power consumption, small beam angle.
	Application range: Agricultural irrigation, urban underground sewage water level measurement, rainwater pipeline water level measurement, monitoring of accumulated water on urban roads and especially on the roads under bridges.
	Measuring range: 7m (For VRPWLR601-L) 12m (For VRPWLR02-L)
	Accuracy: +/-2mm
	Working voltage: 6 – 30 V DC
	Process connection: Thread G1/4"A, "T" mounting bracket, or flange
	Ambient temperature: -40℃ - +70℃
	Process pressure: Atmospheric
	Repeatability: +/-1mm
	Housing material: Metal
	Material of antenna: ABS
	Working frequency: 60GHz
	Signal output: digital signals (via RS485, MODBUS, 6-30V DC)
	Enclosure protection grade: IP68

3. Installation guide

Please note the items as below to ensure the instrument to be installed properly:

■ Reserved a sufficient space for installation

■ Avoid the instrument being installed at any place where there is strong vibration

■ Keep the signal beams away from any possible obstacle

■ Ensure that the possible highest water level could never enter the dead zone of the radar at any

   case

3.1. Installation position:

When installation, to calculate the length of the mounting arm of the installation bracket according to both the beam angle and the mounting height of the meter. The smallest distance from the mounting position to the support pole of the installation bracket should be no less than 200mm. Shown as the figure on right.
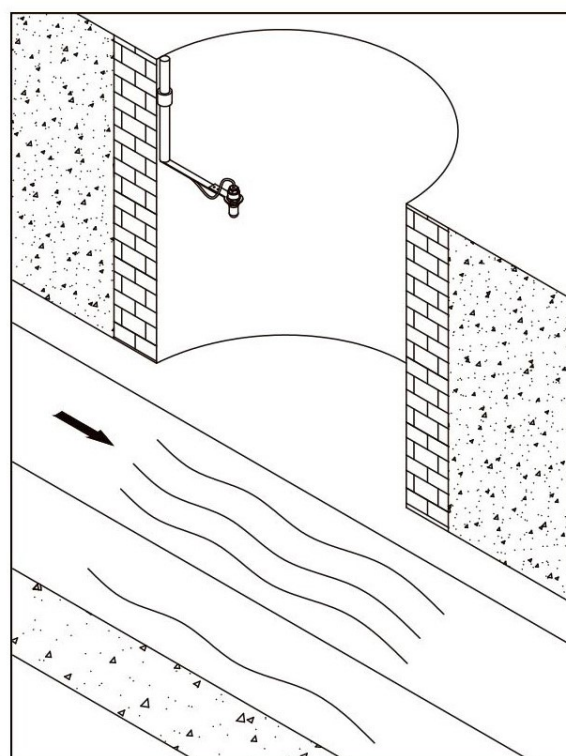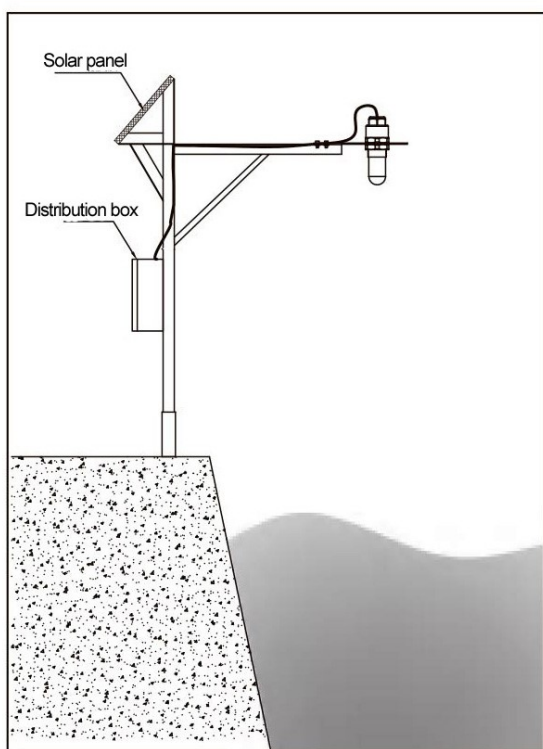
3.2. Installation modes:

3.2.1. Installation to a vertical pole (suitable for water level measurement in an open trapezoidal channel, please refer to the picture above on lower right)

3.2.1. Installation at the wall of a well (refer to the picture below on lower left)
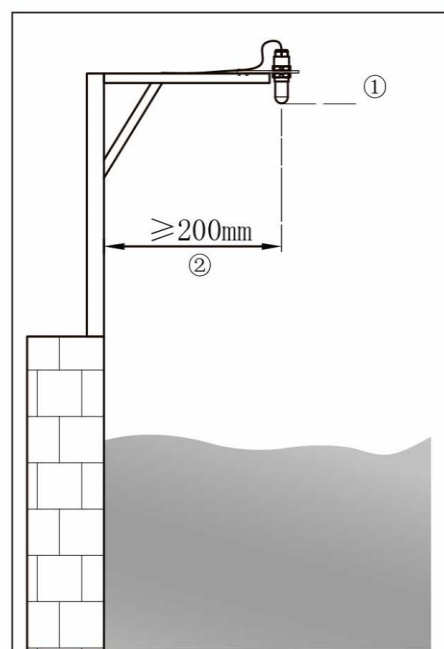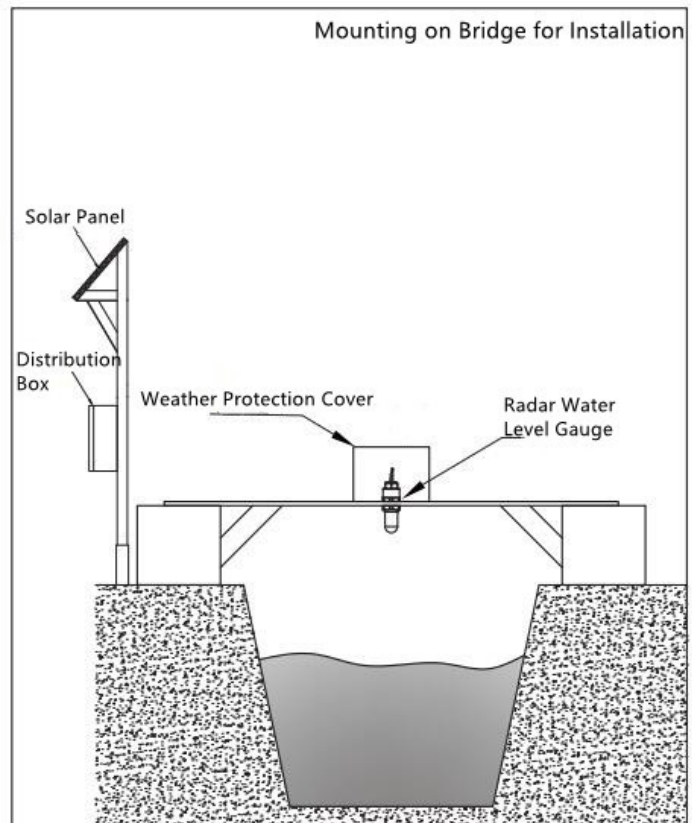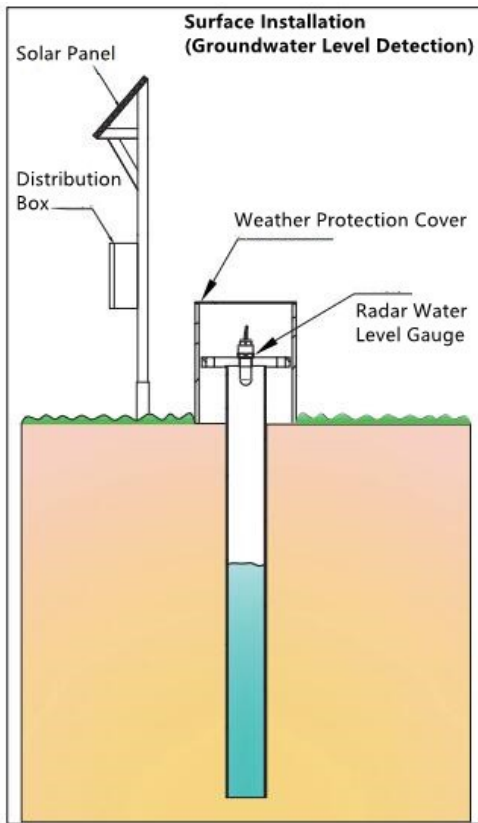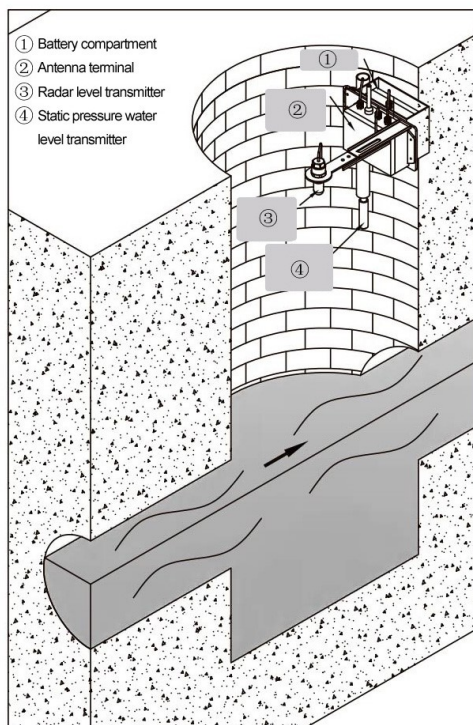

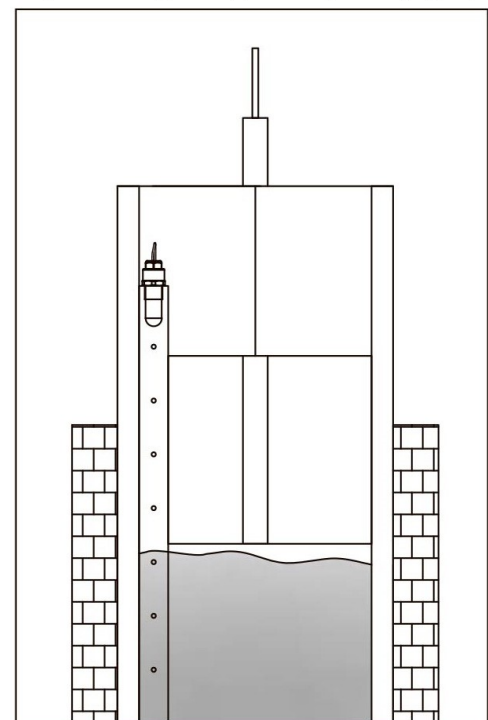Note: ① Reference plane
② Length of the bracket arm

3.2.3. Installation on ground (Suitable for monitoring underground water level, refer to the picture on top left next page)

Surface Installation (Groundwater Level Detection)

Mounting on Bridge for Installation

3.2.4. Installation on a mounting bridge (Refer to the picture above on right, be suitable for the water level measurement in a channel)

① Battery compartment
② Antenna terminal
③ Radar level transmitter
④ Static pressure water level transmitter

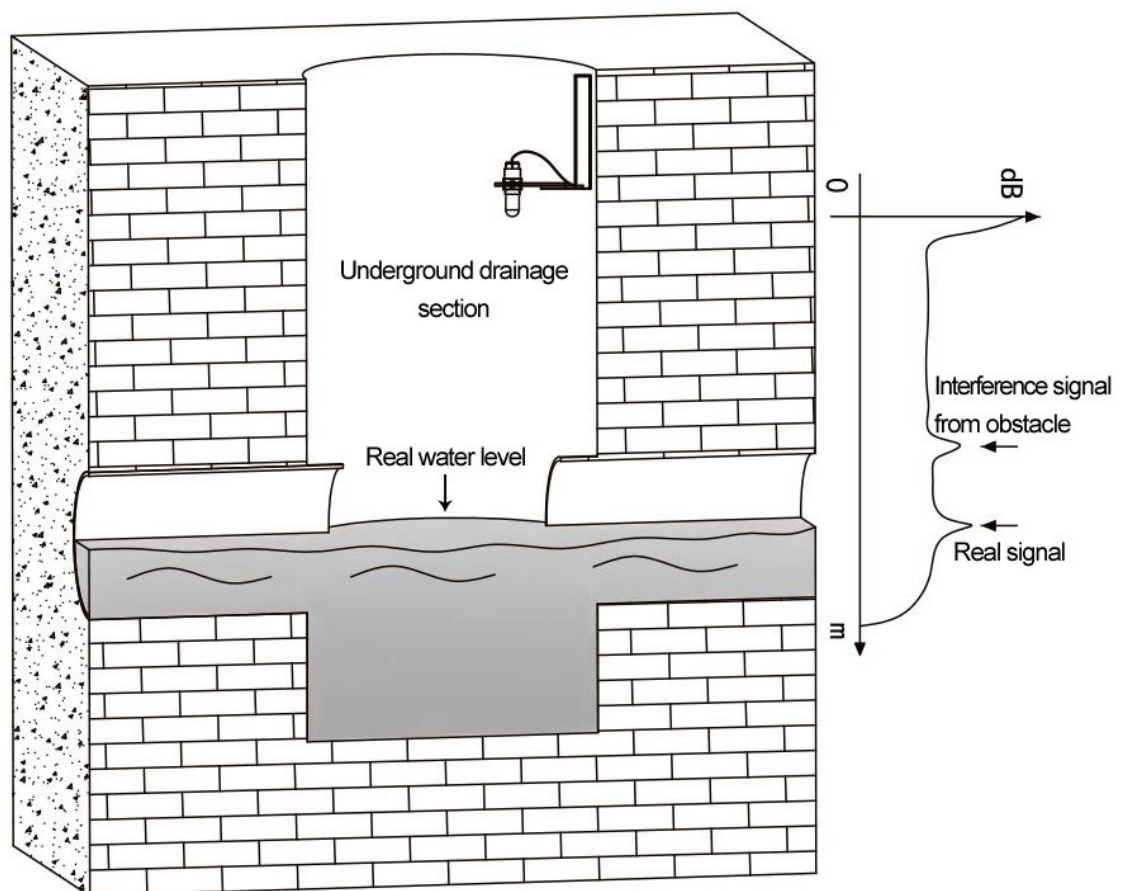Agricultural Irrigation application (Drainage gate)

3.2.5. Installation at a sluice gate of agricultural irrigation channel (refer to the picture on above page at lower right)

3.2.6. Installation at wall of an inspection well of   (Refer to the picture on above page at lower left)

3.3. False echo curve memory

If there are obstacles in the radiation area of the emitted signal wave beam, such as the well wall or inner steps, etc. It will cause interferences, resulting in measurement error (please refer to the picture below on right). If so, a "false echo memory" needs to newly created to remove the interferences to measurement. To get a correct water level echo, an envelope can be used to cover the signals from the initially emitting point to the point before the true signal, meanwhile, the range what is covered is stored and defined as "false echo signals". So, the instrument can get the correct signals from the real water level.

(Please refer to the curves on the top of the next page)

Curve of normal water level echo

The false echo memory function can be used to eliminate the interference caused by false echo
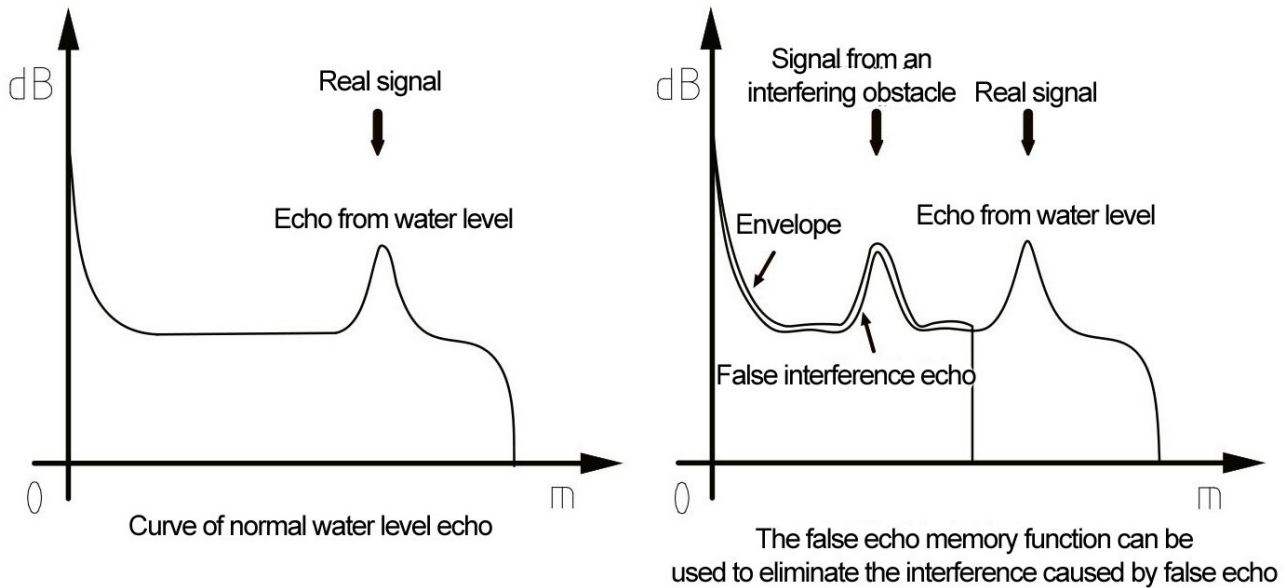
4. Electronical connection

4.1. Power supply and communication

Power supply: 6 - 30V DC

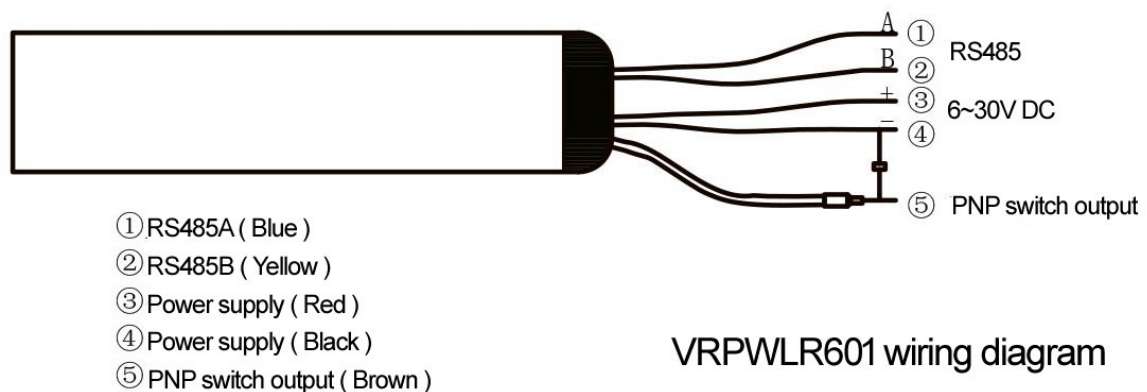Isolated RS485, supports Modbus communication protocol

4.2. Cable connection

Cable entry: Insulated cable entry

Cable outer diameter: 6.2mm

Fiver core cables are generally used for cable connection, and they should be shielded due to electromagnetic interference is normally generated by electric driver, the power supply wire or the emission equipment.

4.3. Wiring mode

①RS485A (Blue)
②RS485B (Yellow)
③Power supply (Red)
④Power supply (Black)
⑤PNP switch output (Brown)

VRPWLR601 wiring diagram

4.4. Safety guidance

■ All the electronical connection must be performed under the power-off, please follow the guidance of the instrument manual.

■ Please comply with the requirements of the local electrical installation code.

■ Please abide by local requirements for personnel health and safety regulations. All operation on the electrical components of the instrument must be completed by a formally trained professional.

■ Please check the name plate of the meter to ensure the specification of the product provided conform to your requirements. And be sure that the voltage of the power supply provided is in accordance with the one which is required on the name plate.

5. Technical parameters

General Description	Measuring range	7m/12m
	Dead zone	≤ 0.2m
	Working frequency	60 GHz
	Corresponding delay	About 1 second (Depends on the parameters setting)
Electrical Parameters	Working voltage	6 – 30 V DC
	Communication protocol	RS485 MODBUS
	Allowable ripple	＜ 100Hz　Uss ＜ 1V
		(100-100K) Hz　Uss ＜ 10mV
Cable Parameters	Cable entry/ Plug	Insulated entry (cable outer diameter 6.2mm)
Mechanical Features	Process connection	G1"A
	Enclosure protection grade	IP68
	Material of housing	ABS/Metal
	Material of antenna	ABS
	Gross weight	About 155g
Surrounding Environment	Storage and transportation temp.	-40 - +70℃
	Working temperature	-40 - +70℃
	Relative humidity	＜ 95%
	Resistance to vibration	Mechanical vibration 10m/s², (10~150) Hz

6. Debugging

6.1. Serial communication debugging

Hardware interface: RS485

Communication protocol: Modbus

Baud rate: 9600 (adjustable)

Data format: 8N1(adjustable)

Check CRC16: multinomial A001

6.1.1. Information frame format and description

1. Host demand format is consisted of slave address, function code, register starting address, read points and CRC code, it shows as table1 below:

	Station number (1B)	Function code (1B)	Register starting address (2B)	Read points (2B)	CRC (2B)
Host sends	01	03	00 XX	00 XX	XX XX
	Station number (1B)	Function code (1B)	Register starting address(2B)	Storage data (2B)	CRC (2B)
	01	06	00 XX	XX XX	XX XX

Table 1: Host demand

6.1.2. Host demand detailed description

■ Station number: Slave address (0 - 99)

■ Function code: "03" reads the value of register address; 06 changes the value of register Address.

■ Register starting address: two bytes, for detailed description, please refer to table 3.

■ Read points: two bytes, set it into 0001 when read 16-bits integer data; While, set it into 0002 when read 32-bits integer data.

■ Store data: two bytes, convert the stored data to hexadecimal, with the high byte in front and the low byte behind.

■ CRC: Check code, two bytes

Slave responses in two formats, the format consists of station number, function code, data length, data section and CRC code when the function code is 03. Shown as the table 2, the format is as the same as the frame of the host command when the function code is 06. Shown as the table 1，i. e,

repeat the command sent from the host.

Slave response	Resting stage	Station No (1B)	Function code (1B)	Returned data length	Data (nB)	CRC (2B)
	T1 T4	01	03	n	XX XX XX XX	XX XX XX XX

Table 2: Function 2 Slave response

- Station No (Address): One byte, return the address sent by the host
- Function code: One byte, return the function code sent by the host
- Response data bytes number: The data bytes number that follow
- Data: Return data according to the host demand, the high bytes are in the front; the low bytes are in the behind;
- CRC: check code, two bytes

The register address detailed description: the data in registers 0X0000 - 0X0003 are signed integer data and are currently measured value; 0X0001 is the instrument's current status which indicates whether there is a fault. 0X0011 - 0X0014 are slave's installation range, dead zone, zero point and full point of water level.

Register address	Description (Non-continuously reading)
0X0000	Read the current distance value of the instrument, the unit is cm (only read)
0X0001	Read the current distance value of the instrument, the unit is mm (only read)
0X0002	Read the current water level value of the instrument, the unit is cm (only read)
0X0003	Read the current water level value of the instrument, the unit is mm (only read)
0X0010	Read the measurement status (only read); "=0" means normal, ">0" means error
0X0011	Slave measuring range, the unit is cm (read and write)
0X0012	Slave dead zone, the unit is cm (read and write)
0X0013	Slave low position adjustment, the unit is cm (read and write)
0X0014	Slave high position adjustment; the unit is cm (read and write)

Table 3 Description of resister address

6.1.3. Examples

a. Read the water level value of the instrument, the unit is mm

Data sent by the host: 01 03 00 03 00 01 CRC16/01 03 00 03 00 02 CRC16

Response of the instrument: 01 03 02 XX XX CRC16/01 03 04 XX XX XX XX CRC16

b. Change the instrument's parameters, the changed measuring range is 10m (1000mm)

Data sent by the host: 01 06 00 11 03 e8 XX XX

Response of the instrument: 01 06 00 11 03 e8 XX XX, which indicates that the change is successful. When the return value is different, it means that the change is unsuccessful or the pre-set data exceeds the limit.

6.1.4. Examples of communication protocols
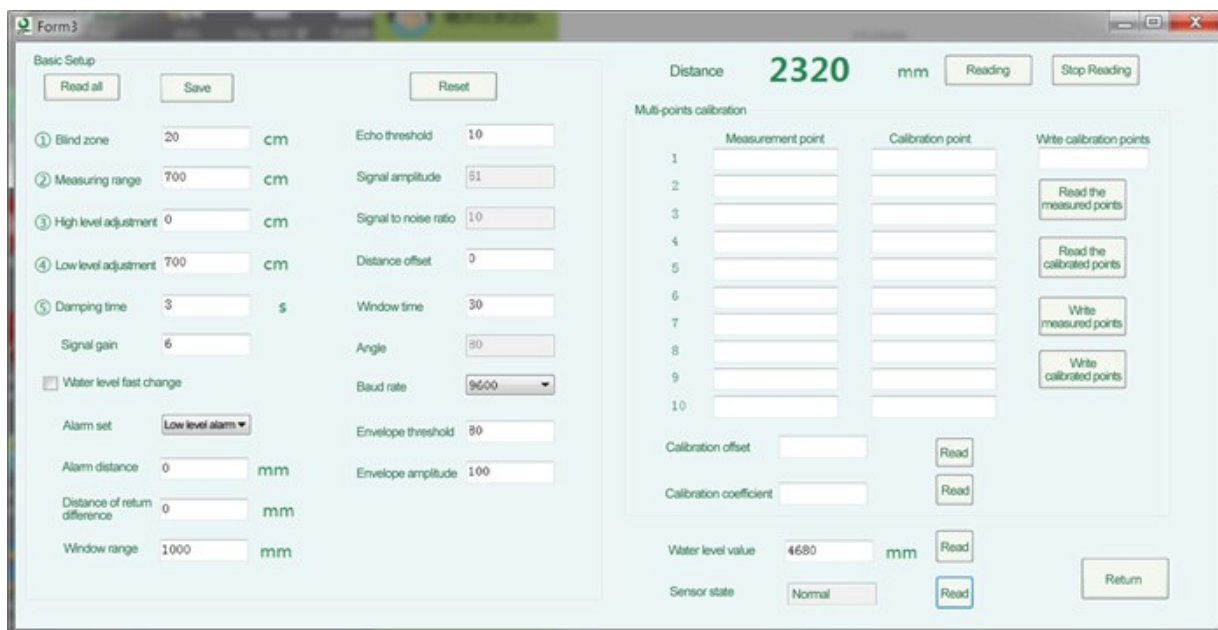
The commands sent by the host when water levels and distances are read under different station number addresses.

Station No.	Function code	Start address	Read points	Check code	Meaning
01	03	0000	0002	c40b	Read the distance, the unit is cm
01	03	0001	0002	95cb	Read the distance, the unit is mm
01	03	0002	0002	65cb	Read the water level value, the unit is cm
01	03	0003	0002	340b	Read the water level value, the unit is mm
02	03	0000	0002	c438	Read the distance, the unit is cm
02	03	0001	0002	95f8	Read the distance, the unit is mm
02	03	0002	0002	65f8	Read the water level value, the unit is cm
02	03	0003	0002	3438	Read the water level value, the unit is mm
03	03	0000	0002	c5e9	Read the distance, the unit is cm
03	03	0001	0002	9429	Read the distance, the unit is mm
03	03	0002	0002	6429	Read the water level value, the unit is cm
03	03	0003	0002	35e9	Read the water level value, the unit is mm
04	03	0000	0002	c45e	Read the distance the unit is cm
04	03	0001	0002	959e	Read the distance, the unit is mm
04	03	0002	0002	659e	Read the water level value, the unit is cm
04	03	0003	0002	345e	Read the water level value, the unit is mm

6.2. The debugging software of PC

The meter can communicate with a computer software through RS485 to USB interface, as shown in Figure 1 below: The interface after the software is successfully connected the meter.

You can observe the measurement of the instrument in real time, and read the waveform curve of the instrument and build false wave storage.

Figure 1

Parameter setting interface:

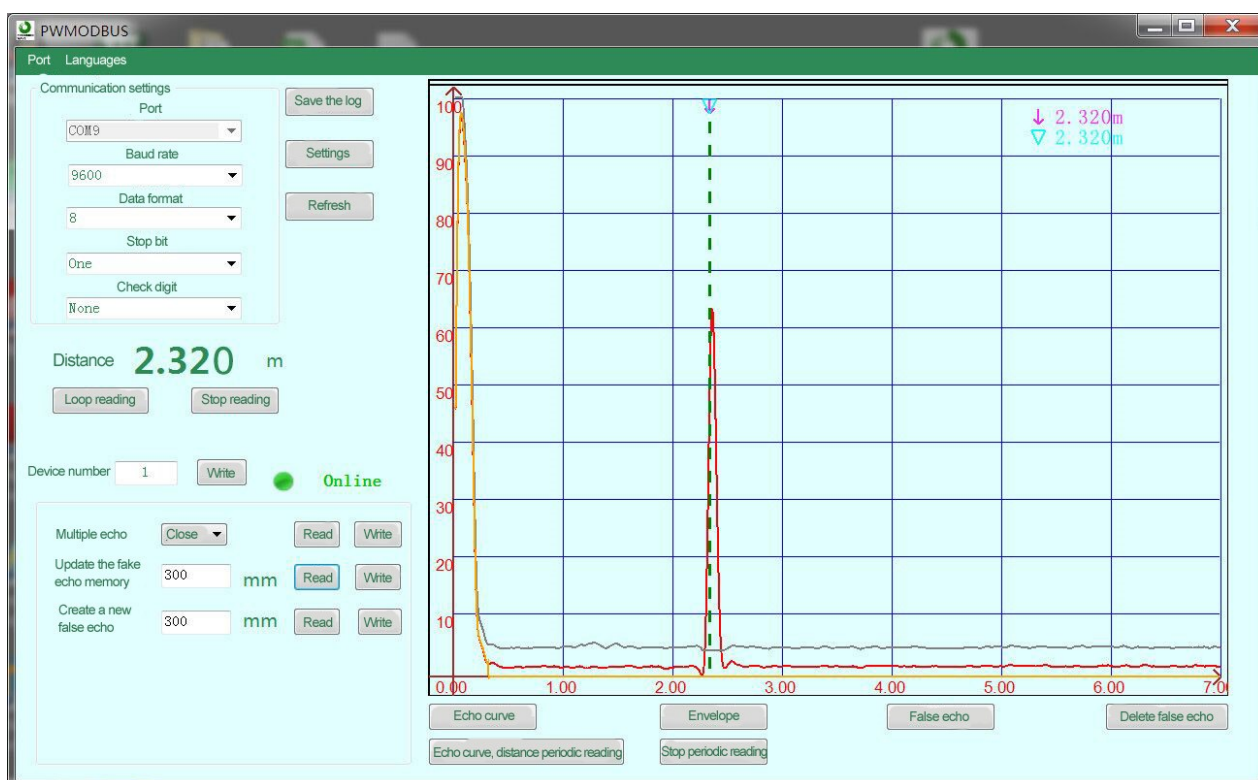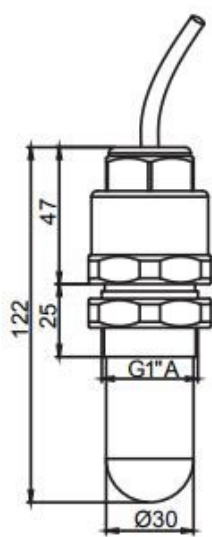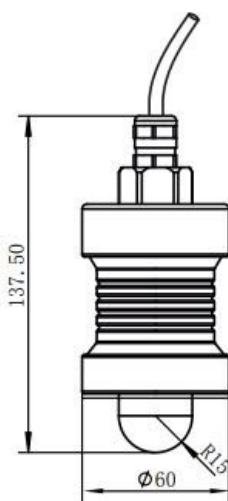Adjust the parameters of the instrument and carry out multi-point calibration, as shown in Figure

Figure 2
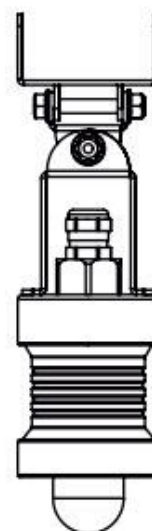
7. Dimensions (the unit is mm)

The instrument's dimensions are shown as the figure right at the top of next page
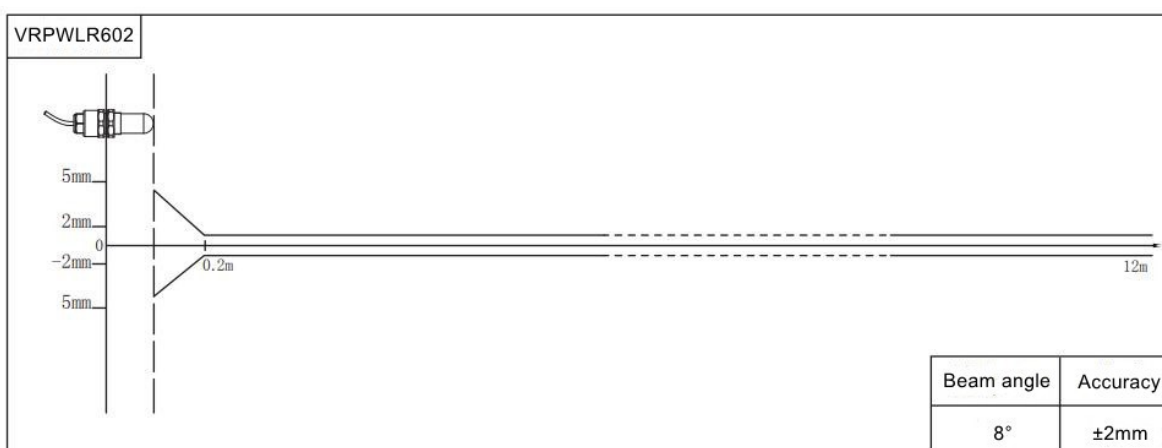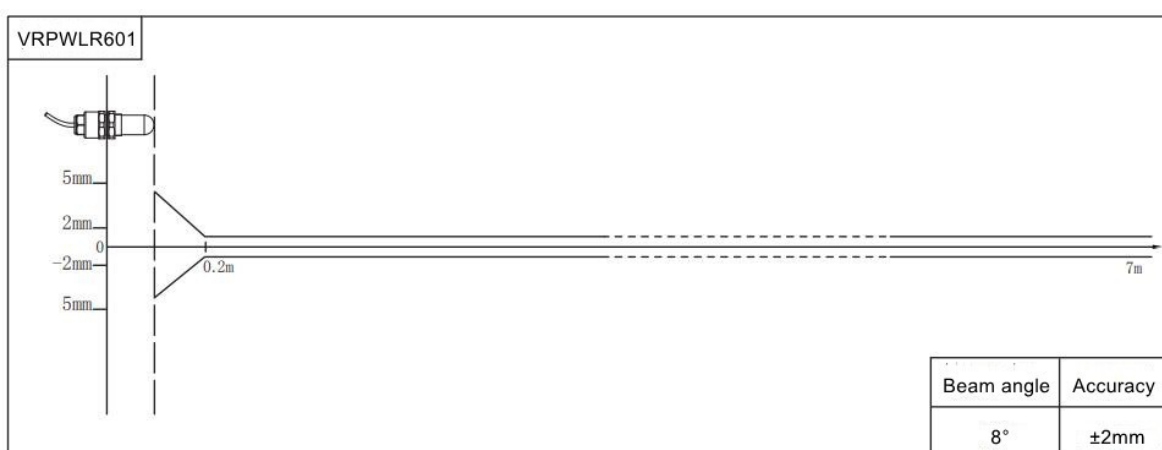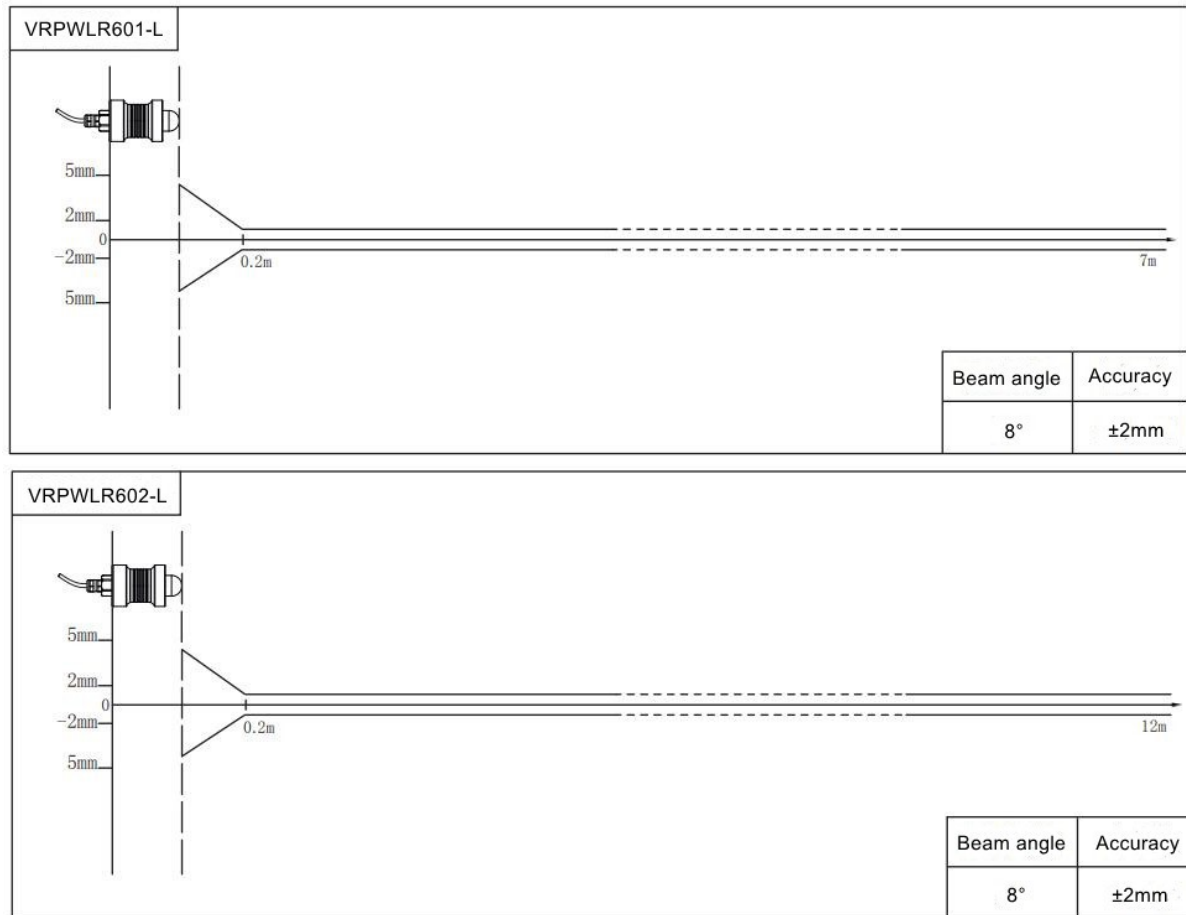
VRPWLR601/602

VRPWLR601-L/602-L

VRPWLR601-L/602-L with Universal Joint Hanger

8. Linearity and beam angle

VRPWLR601

Beam angle	Accuracy
8°	±2mm

VRPWLR602

Beam angle	Accuracy
8°	±2mm

VRPWLR601-L

Beam angle	Accuracy
8°	±2mm

VRPWLR602-L

| Beam angle	Accuracy
8°	±2mm

8.Transportation and storage:

In addition to the requirements of JB/T 9329, this water level transmitter shall be transported and stored in accordance with the following requirements:

1. This water level transmitter should be transported strictly in accordance with the characteristics of the product and the requirements of the manual during the transportation.

2. The water level gauge should be stored in a dry and ventilated room with the ambient temperature of (- 40～ +70℃) and the relative humidity of not more than 80%. Please keep the instrument away from those corrosive substances. Those instruments that have been stored for a long period of time should be tested before they can be sold or used.
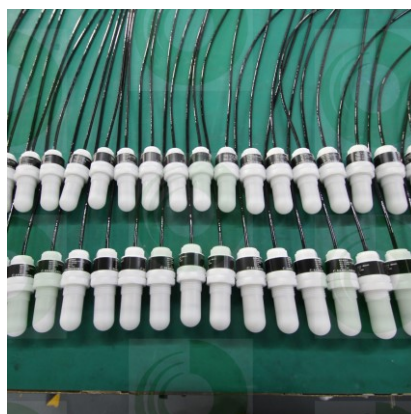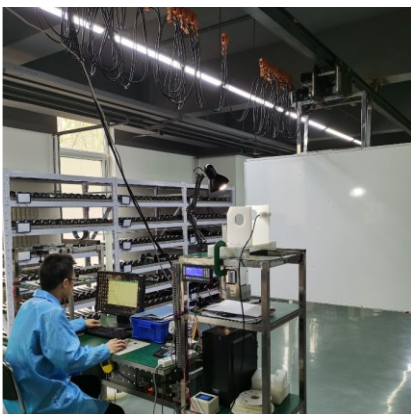
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