

Ultrasonic Level Sensor DF550

Datasheet



V3.2
Date 2017-2-22

Change Notes

- V 3.2 Add features, applications, connection diagram, update video link
- V 3.1 Add 30cm version, Adding PVDF version
- V 3.0 Change Naming Rules
- V 2.5 Adding notes for underground tank installation.
- V 2.4 Adding action to prevent blind area; adding video link; adding tank height configuration.

Index

1 Overview.....	4
2 Features.....	4
3 Application.....	4
4 Specification.....	6
5 Mechanical Drawing.....	7
6 System Diagram.....	8
7 Test Report.....	9
7.1 Device.....	9
7.2 Data.....	9
7.3 Conclusion.....	9
8 Interface Definition.....	10
8.1 Connection with Other Device.....	10
8.2 Quick Start for Standard Version.....	15
8.3 Quick Start for GPRS/3G Version.....	16
8.4 Quick Start for Wifi/Zigbee Version.....	18
8.5 Blind Area Prevent.....	21
8.6 Tank Height Configuration.....	22
8.7 Underground Tank Installation.....	22
9 Anti-erosive Version.....	24
10 Protocol.....	24
11 Model Naming Rules.....	24
12 Package.....	25
13 Video Link.....	25
14 Problem Solving.....	26
15 Certificates.....	30
16 Contact with us.....	30

1 Overview

The F550 is ultrasonic level (distance) sensors which measure the air height directly and calculate the liquid or solid height based on the total height of the container (distance).

The resolution is 1mm or 0.1%FS (the bigger value).

It is applicable for the close container or open container. Furthermore it can calculate the volume of the container or the liquid. As with RS485, it is easy to integrate into the embedded system or SCADA.

In order to realize remote monitoring, there are wireless versions for F550, including Bluetooth, zigbee, Wifi, GPRS, 3G,LoRa, and NB-IoT.



2 Features



Ultrasonic Contactless
30cm-30 meters range



Compatible with
IOT platform



Wireless options
GPRS/Wifi/Zigbee



Erosive options
for chemical container

3 Application



12 Meters Bitumen Tank



2.5 Meters Diesel Tank



2 Meters Underground Tank



Food Garner



Intelligent Trash



River Level



Human Height



Parking Occupation



Robot Distance

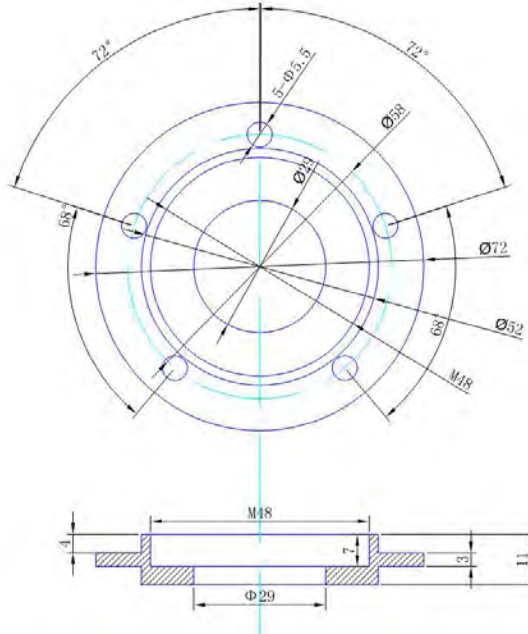
- On-line stock
- Fuel station storage
- Farm storage
- River/sewage level measurement
- Manufacturing process distance detection
- Recycle tank fill detection
- Parking occupation
- Human height measurement

4 Specification

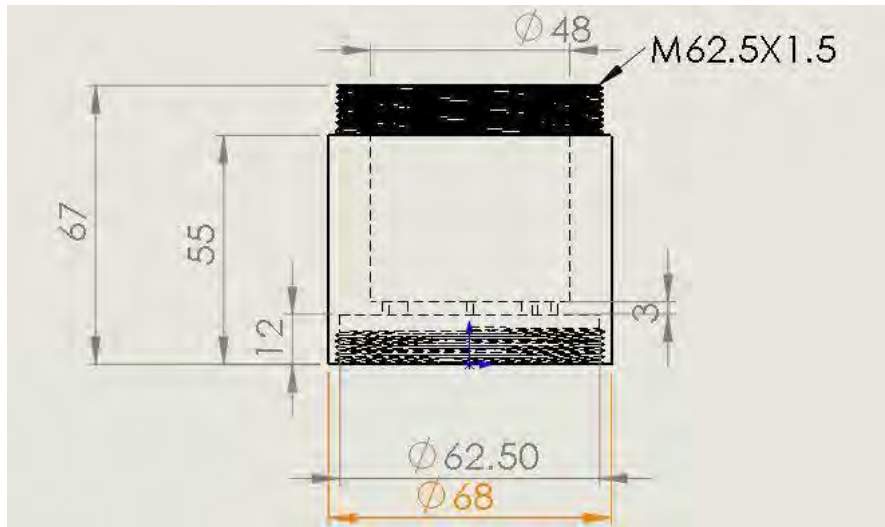
Measurement Range	0~ 30meters (for different model)
Blind Area	0.3 meter version: 3cm 2 meter version: 20cm. 5 meter version: 25cm. 12 meter version: 75cm. 30 meter version: 150cm.
Resolution	1mm or 0.1%FS, the bigger one
Beam Angle	8~11°
Power Supply	10-32V DC
Output Signal	RS485, RS232, 0-5V, 4-20mA, TCP
Protocol	Modbus RTU/ Dingtek IOT/Dingtek GPS /Thingspeak/Customized
Operating Temperature	-20~70°C
Storage Temperature	-40 ~ 85°C
Shell Material	Polyamide
Transducer Material	Polyamide, (PVDF for erosive environment)
Media	Solid or liquid (not applicable for strong acid or strong base)
Protection Rank	IP66
Mounting	Flange/Screw
LED Display	Optional
Battery	Optional
Wireless	Optional for bluetooth, zigbee, wifi, GPRS, WCDMA, LoRa, NB-IOT.
Dimension	Standard version: 70mm(H)*72mm(W)*72mm(L) or zigbee/wifi/GPRS/UMTS version: 115mm(H)*72mm(W)*72mm(L)

5 Mechanical Drawing

30cmversion: M30*80mm

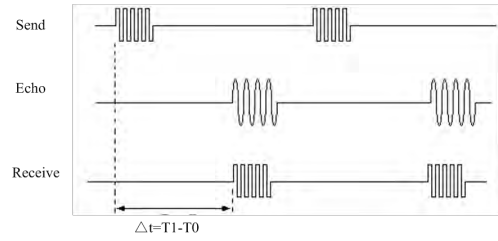
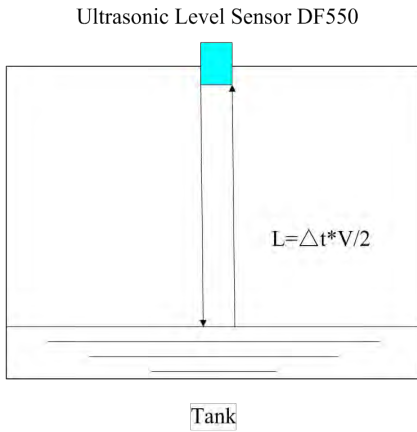


2/5 meters version



12 meters version

6 System Diagram



7 Test Report

7.1 Device

F550, zigbee module, water disk



7.2 Data

Ideal data	Measured data 1	Measured data 2	unit cm
205.0	205.0	205.1	
185.0	184.6	184.9	
165.0	165.0	165.2	
145.0	145.0	145.0	
125.0	124.5	124.8	
120.0	119.6	120.0	
105.0	104.4	104.7	
85.0	84.8	84.8	
65.0	64.9	65.1	
50.0	50.0	50.2	

7.3 Conclusion

Resolution +-6mm, +-0.3%FS

Repeatability 4mm, +/-0.2%FS

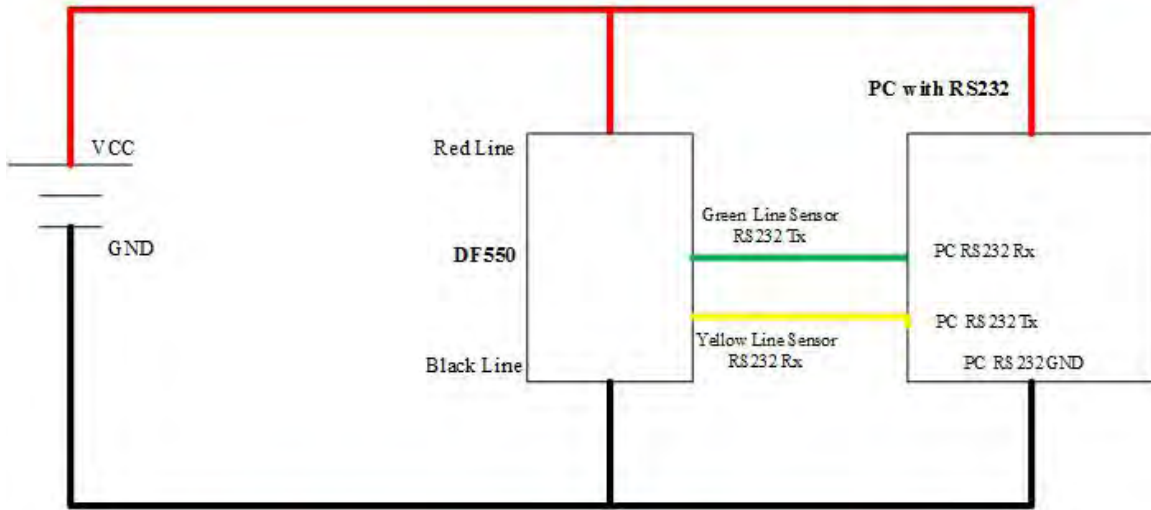
8 Interface Definition

Wire	Function	Remark
Red	Power	10~32VDC
Black	GND	Ground
Yellow	RXD/B	RS232 Rx, connect with pc RS232 Tx; or RS485 B
Green	TXD/A	RS232 Tx, connect with pc RS232 Rx; or RS485 A
Blue	Analog output	0-5V or 4-20ma

Notes: If there are label on sensor for pin definition, please act as the label shows.

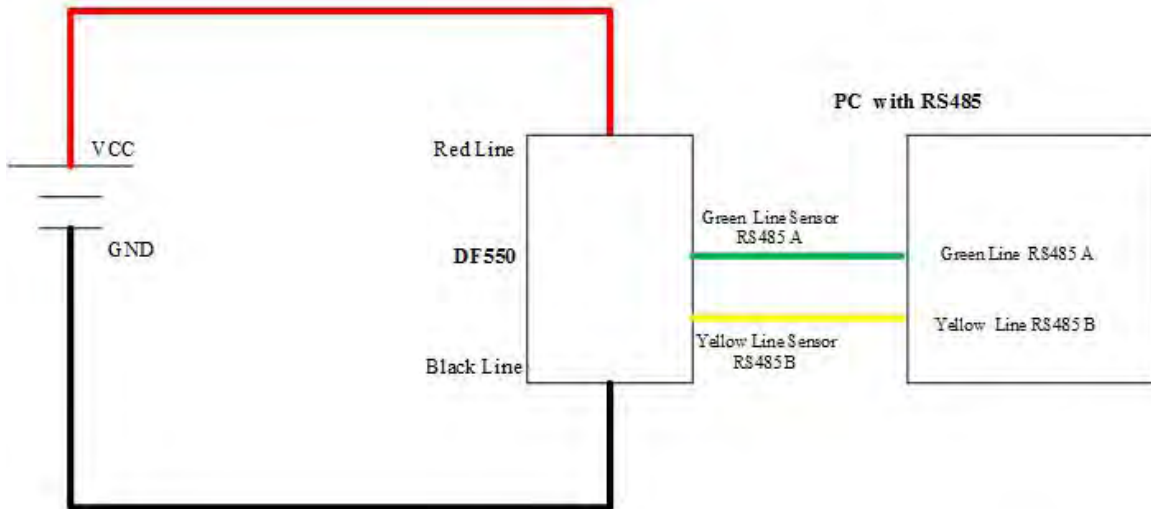
8.1 Connection with Other Device

DF550 connection with PC by RS232

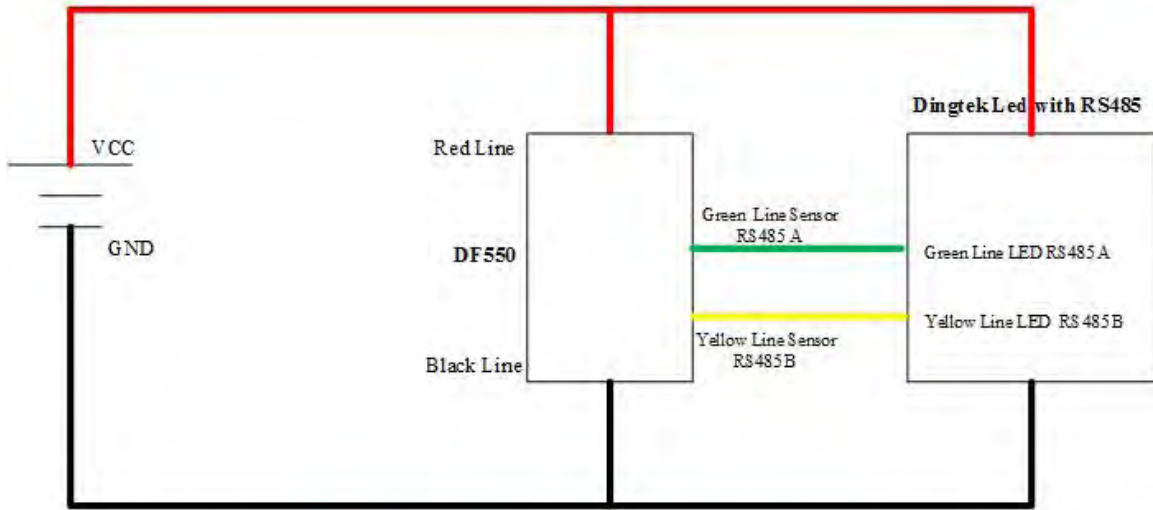


Notes: The sensor should use same RS232 ground line with the PC RS232.

DF550 connection with PC by RS485

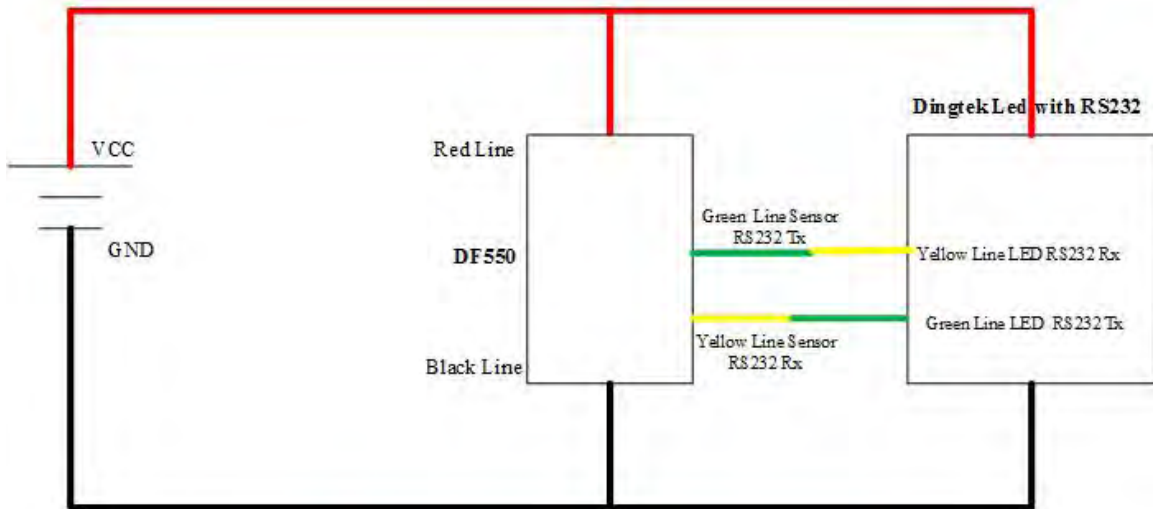


DF550 connection with Dingtek Led by RS485



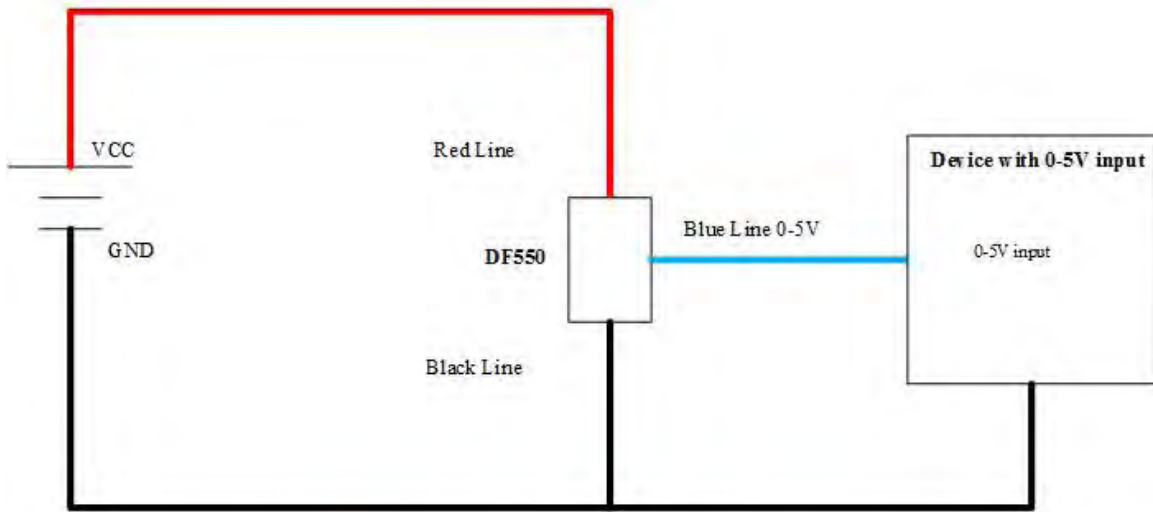
Notes: The sensor should use same ground line with the LED.

DF550 connection with Dingtek Led by RS232



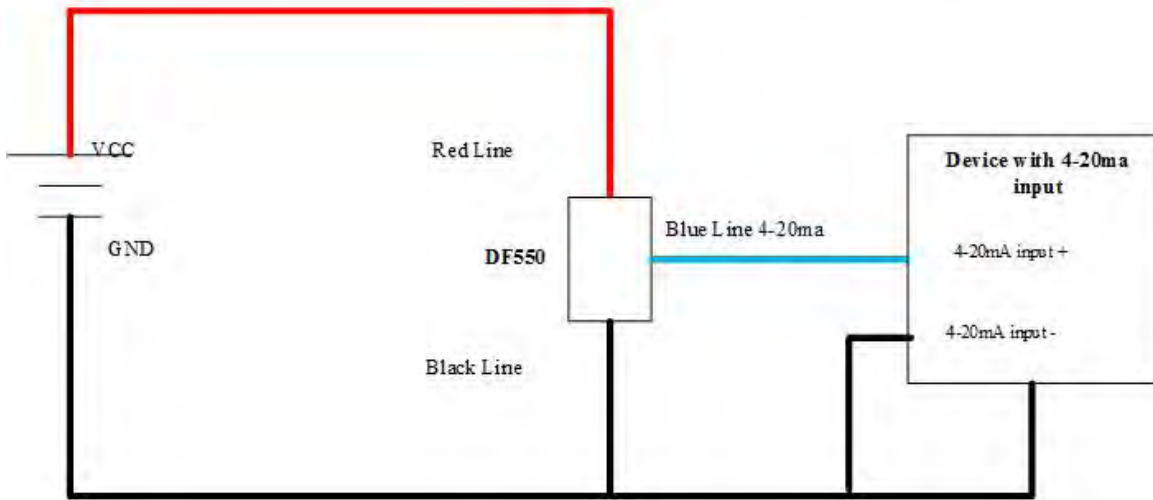
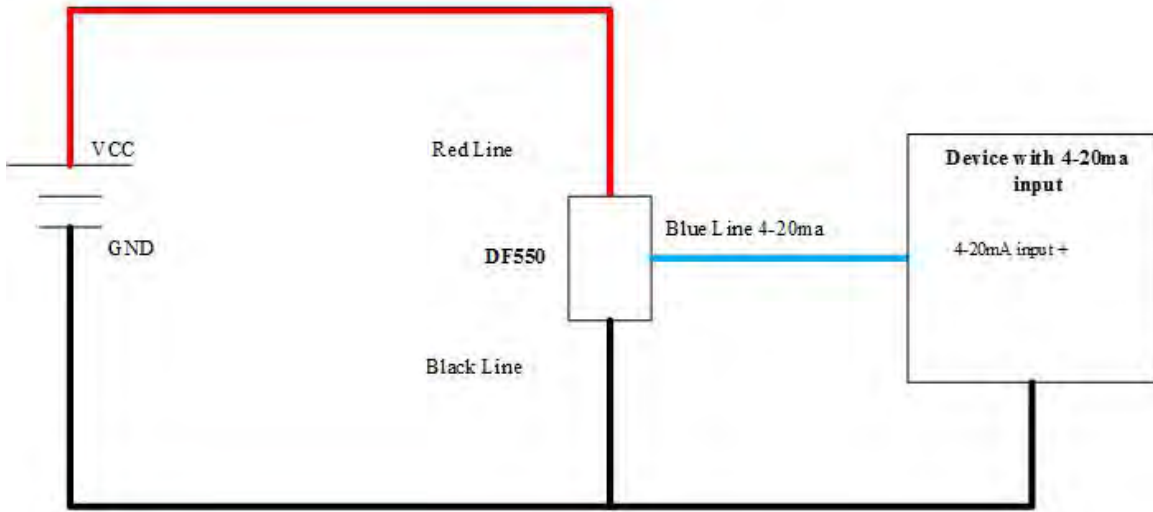
Notes: The sensor should use same ground line with the LED.

DF550 connection with other device by 0-5V



Notes: The sensor should use same ground line with the device.

DF550 connection with other device by 4-20ma



8.2 Quick Start for Standard Version

Applicable for RS232, RS485, 0-5V, 4-20ma output

Step 1: Part List

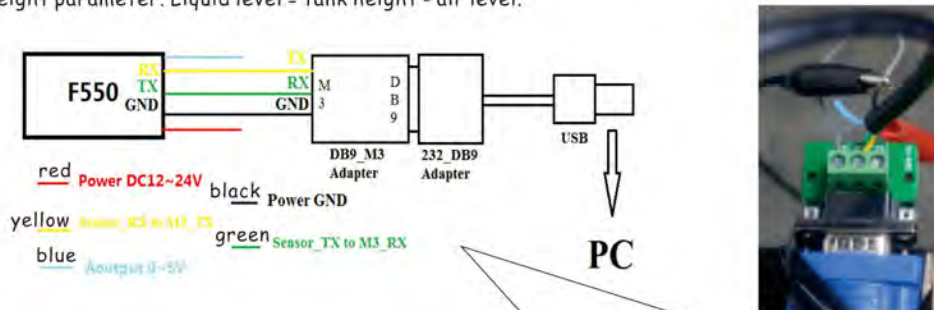
Standard package:



Those are not included in standard package. (Only for RS232 output sensor.)

Step 2 Configure Tank Height

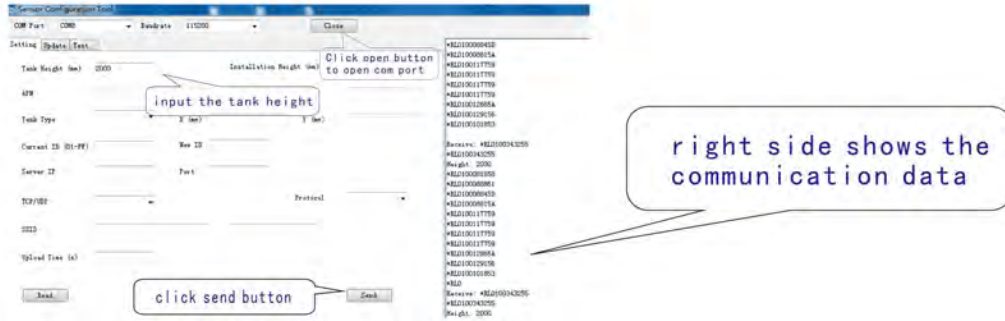
Before installing on tank, configure the real tank height (from tank bottom to sensor). Otherwise, the default tank height will be valid. The air level does not effect.the liquid level is effected by the tank height parameter. Liquid level = tank height - air level.



Connect the sensor with pc, If RS232 version, use the usb/RS232 and DB9/terminal3 connector to connect.
 Green Line (Sensor TX) to PC RS232 RX;
 Yellow Line (Sensor RX) to PC RS232 TX.
 Red line to power DC 12-24V.
 Black Line (Sensor Ground) to PC RS232 GND as well as Power GND.

If Rs485,connect Green Line to A+, Yellow Line to B-. DO NOT SHORT-CIRCUIT power lines and signal lines. It may damage the sensor.

Command \$SH0100200042 to the sensor to set tank height to 2000mm.
 \$SH is command header, 01 is sensor id, 002000 is tank height in mm.42 is checksum. use Dingtek software to configure the parameter.



Step 3 On-field Installation

1. drill hole and install the sensor according to the gasket/screw size. Make sure it safe to drill.
2. Open tank, use frame to fasten the sensor.
3. Flexible wire is not recommended as the vibration of sensor maybe result in value fluctuation.

(Sensor MUST be vertical to liquid/solid level. it maybe result in non data. Ultrasonic beam is diffused at angle $\pm 7/8^\circ$. make sure there is no item other than air in the middle way from the sensor to the liquid/solid level)

Installation of Ultrasonic Level Sensor DF 550

(make sure the sensor is higher the blind area+maximum level. Maybe consider lift sensor)

Sensor is with blind area for the
 0-20cm for 2 meters version
 0-25 cm for 5 meters version
 0-75cm for 12 meters version

8.3 Quick Start for GPRS/3G Version

Step 1: Part List

Standard package:



1* DF550 sensor



1 * gasket (PTFE)
5 * screw



For the 1st order,
offer 1*USB/RS232 convertor,



1* DB9/Pln3 connector.
(Only for RS232 output sensor.)

Step 2: Open Top Cover



Must loose the top connector,
open the top cover. (Attention that!)

Step 3: Sim Card Installation



Aware of the sim card triangle.
Insert the sim card to be locked by the case.

Step 4 Power On

Red wire to 12/24VDC+, Black wire to GND.

DO NOT SHORT-CIRCUIT power lines and signal lines. It may damage.

Power on: if the sim card is correct, led light will be blinking (1s on, 1soff).

Otherwise, there is error.

Step 5 Configure APN

If APN configuration successfully, LED will be blinking quick. (0.5s on, 0.5s off)

Send sms \$GA01safaricom; saf; data; 50 to the sim card.
\$GA is command header; 01 is sensor id, safaricom is APN, saf is APN user, data is APN password, " ; " is seperator, 50 is checksum. It does not validate for SMS. (For RS232 or 485, it will verify checksum.)

If user or password is blank, just leave blank.
E.g: \$GA01cmnet;50 for China Mobile sim card. (configure server ip, port optional)
The sensor get the command, it will reply.



Step 6 Online Test

DF550

Checked ID: 118541
 Author: @dingtek
 Address: Public

WiFi Version: 0.0.1
 ZigBee Version: 0.0.1

Data Export

MAP_LAB / 118541
 MAP_LAB / 118541

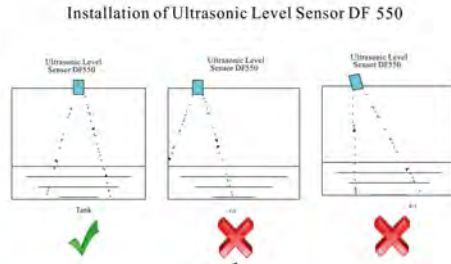
If ready for 3rd party platform, it will be online after power on and APN setting.

Please contact Dingtek for the platform info.

Step 7 On-field Installation



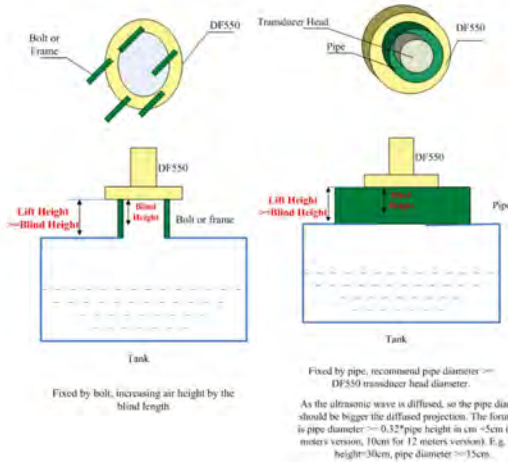
Covered tank, drill hole and install according to the gasket/screw size. Make sure that it is safe to drill.



Sensor is with blind area for the 0-20cm for 2 meters version, 0-25 cm for 5 meters version, 0-75cm for 12 meters version.

Open tank, use frame to fasten the sensor. Flexible wire is not recommended as the vibration of sensor maybe result in value fluctuation.

The sensor MUST be vertical to the level. The ultrasonic beam is diffused at angle $\pm 7/8^\circ$, so make sure that there is no other objects between the sensor and the liquid/solid level.



(make sure the sensor is higher the blind area+maximum level. Maybe consider lift sensor)

Step 8 On-field Configuration

Sensor directly measure the air level, we want the liquid/solid level usually.

So configure the tank height by SMS. Send SMS \$SH0100200042 to sim card, set tank

height (from tank bottom to sensor transducer) as 2000mm. \$SH is header, 01 is sensor id, 002000 is height in mm, 42 is checksum, it does not validate for SMS.

(For RS232 or 485, it will verify checksum.)

If want to set to 5500mm, command is like \$SH0100550042

8.4 Quick Start for Wifi/Zigbee Version

Step 1: Part List

Standard package:



1* DF550 sensor



1 * gasket (PTFE)
5 * screw



For the 1st order,
offer 1*USB/RS232 converter,

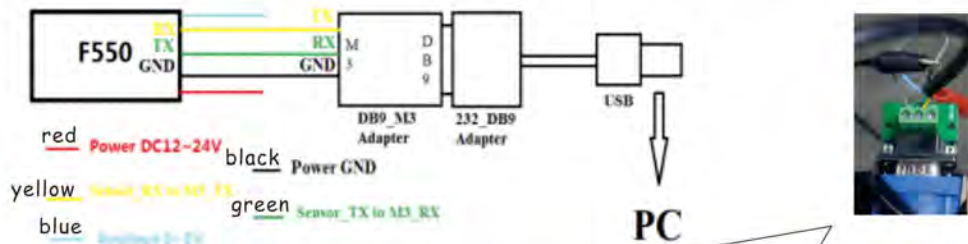


1* DB9/Pin3 connector.
(Only for RS232 output sensor.)

(Zigbee version, should also purchase our Zigbee Gateway with USB port to connect with PC.)

Step 2 Configure Parameter

Before installing, should configure the real tank height (from bottom to sensor). Liquid level is effected by the tank height parameter. Liquid level = tank height - air level.



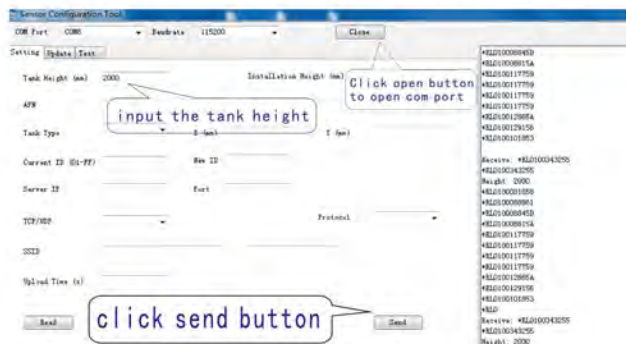
Connect sensor with pc, If RS232 version, could use the usb/RS232 and DB9/terminal3 connector to connect. Green Line (Sensor TX) to PC RS232 RX; Yellow (Sensor RX) to PC RS232 TX. Red to power DC 12-24V. Black (Sensor Ground) to PC RS232 GND as well as Power GND.

If Rs485, please connect Green to A+, Yellow to B-. DO NOT SHORT-CIRCUIT power lines and signal lines. It may damage.

Command \$SH0100200042 to set tank height to 2000mm.

\$SH is command header. 01 is sensor id, 002000 is tank height in mm. 42 is checksum.

Recommend user to use Dingtek software to configure the parameter.



right side shows the communication data

(Wifi version, should configure Wifi access point name and password as well as server ip and port. Recommend user to use Dingtek software to configure.)

Step 3 Pre-installation Test

Zigbee version, Connect zigbee gateway, run software or use other com port software to listen on the gateway com port.

Wifi version, run software, Listen on the port on the server. If version for 3rd party IOT platform, login with user name and password. Power on, data show on software or platform

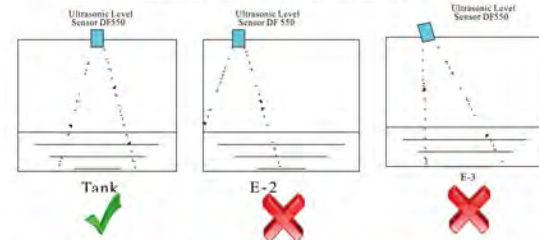


Step 4 On-field Installation

1. drill hole and install sensor according to the gasket/screw size.
2. Open tank, use frame to fasten sensor.
3. Flexible wire is not recommended as the vibration of sensor maybe result in value fluctuation.

(Sensor MUST be vertical to the level. Maybe non data. As the ultrasonic beam is diffused at angle $\pm 7/8^\circ$. So make sure that there is no object between sensor and the liquid/solid level)

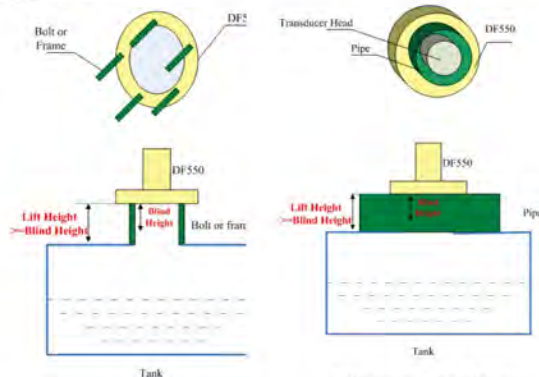
Installation of Ultrasonic Level Sensor DF 550



(make sure the sensor is higher the blind area+maximum level. Maybe consider lift sensor)

(If can not connect wifi access point or zigbee gateway, short the distance from sensor to wifi access point or zigbee gateway. (For zigbee, also can be resolve by adding other zigbee sensor in the middle way to realize the relay mode.)

Sensor is with blind area for the 0-20cm for 2 meters version



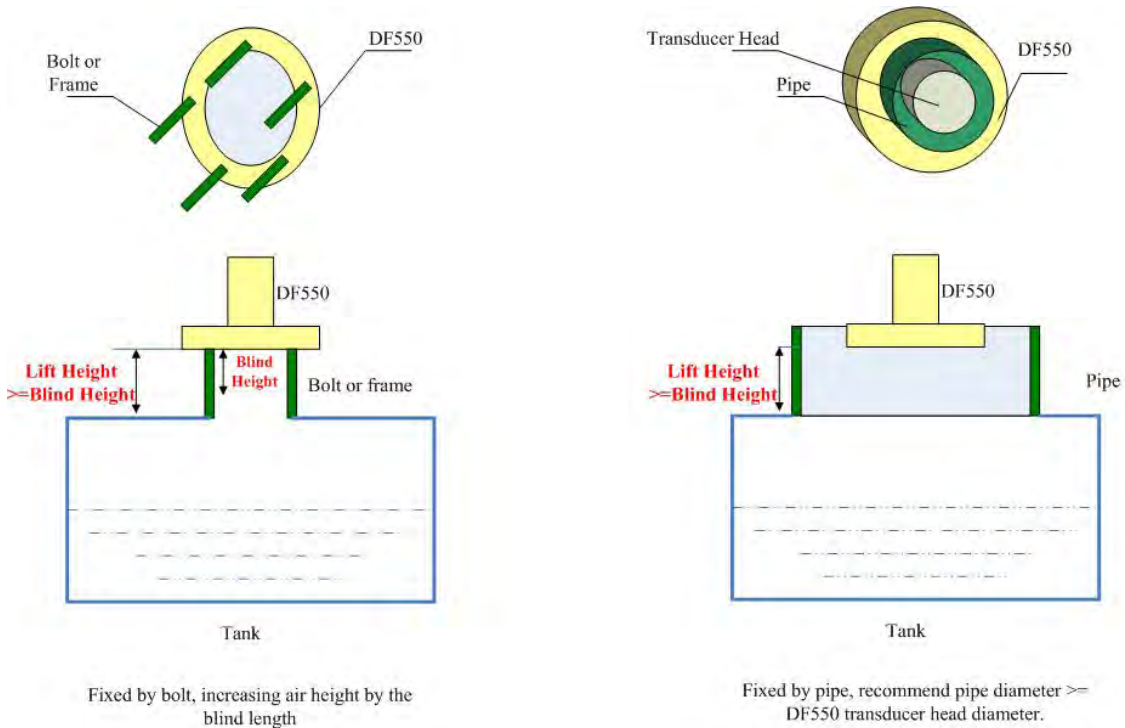
Fixed by bolt, increasing lift height by the blind length

Fixed by pipe, recommend pipe diameter \geq DF550 transducer head diameter.

As the ultrasonic wave is diffused, so the pipe diameter should be bigger the diffused projection. The formula is pipe diameter $\geq 0.32 \times$ pipe height in cm $\div 5$ cm (for 5 meters version, 10cm for 12 meters version). E.g. pipe height: 30cm, pipe diameter ≥ 15 cm.

- 0-20cm for 2 meters version
- 0-25 cm for 5 meters version
- 0-75cm for 12 meters version

8.5 Blind Area Prevent



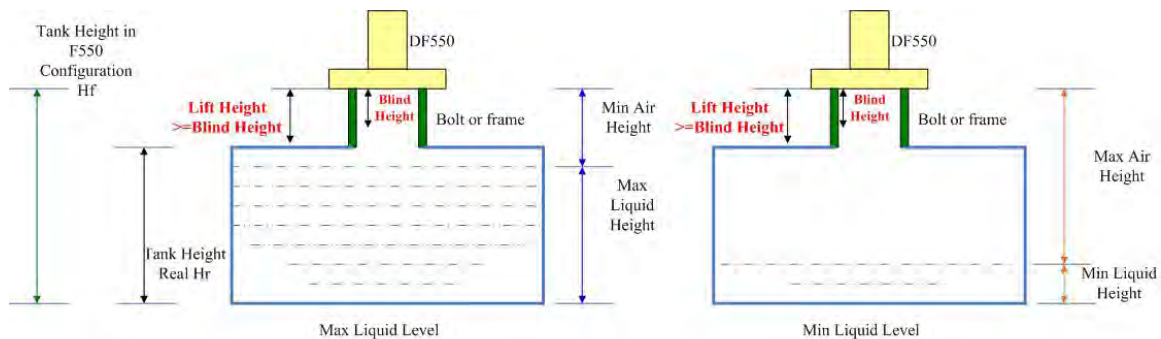
As the ultrasonic wave is diffused, so the pipe diameter should be bigger the diffused projection. The formula is pipe diameter $\geq 0.32 \times$ pipe height in cm $+ 5$ cm (for 5 meters version, 10cm for 12 meters version). E.g. pipe height=30cm, pipe diameter ≥ 15 cm.

To prevent the blind area, we recommend that the user lifts the sensor more higher than the maximum level height plus the blind area. As a result, the liquid level is covered by the measurement range of the sensor. For example, for the 2 meters version, the blind area is 20cm, so user should install the sensor more 20cm than the maximum liquid level. Of course, if the tank top shell is already more 20cm than the liquid level, there is no need to lift any more.

The user can use bolt or pipe to act as the frame to fix the sensor. Only if the pipe diameter is bigger than the transducer diameter, then the result will not be affected by the pipe. **No need to consider of the ultrasonic beam interfere with the pipe side wall.** Only if the interface is vertical to the sensor head (horizontal to the sensor axle), it will effect the ultrasonic echo.

In part 7.3, there are installation demo photos.

8.6 Tank Height Configuration



Tank Height in F550 parameter $H_f = \text{Tank Height Real Hr} + \text{Lift Height HI} = \text{Min Air Height} + \text{Max Liquid Height} = \text{Max Air Height} + \text{Min Liquid Height}$

Example: Tank Height Real Hr = 450mm, Lift Height=250mm. Tank Height in F550 should be set as $H_f=700\text{mm}$. Sensor ID is 01.
Max liquid height=440mm, Min Liquid height = 0mm. Then liquid range is 0-440mm. Air range is 260-700mm.

For RL command (Read Liquid Level), the sensor output is *RL0100001XX to *RL01000440XX. XX is the checksum.

For RP command (Read Liquid Level Percent), the sensor output is *RP01000001XX to *RP01000629XX. (440/700=62.9%).

For RA command (Read Air Level), the sensor output is *RA01000260XX to *RA01000700XX.(260-700mm)

For 4-20mA, the sensor output is 4-14.1mA.

If the user input min Air Height in the F550 configuration, the RP output will cover the 0.1-100.0% as well as the 4-20ma.

Tank Height in F550 parameter $H_f = \text{Tank Height Real Hr} + \text{Lift Height HI} = \text{Min Air Height} + \text{Max Liquid Height} = \text{Max Air Height} + \text{Min Liquid Height}$

Example: Tank Height Real Hr = 450mm, Lift Height=250mm. Tank Height in F550 should be set as $H_f=700\text{mm}$. Sensor ID is 01.

Max liquid height=440mm, Min Liquid height = 0mm. Then liquid range is 0-440mm. Air range is 260-700mm.

For RL command (Read Liquid Level), the sensor output is *RL0100001XX to *RL01000440XX. XX is the checksum.

For RP command (Read Liquid Level Percent), the sensor output is *RP01000001XX to *RP01000629XX. (440/700=62.9%).

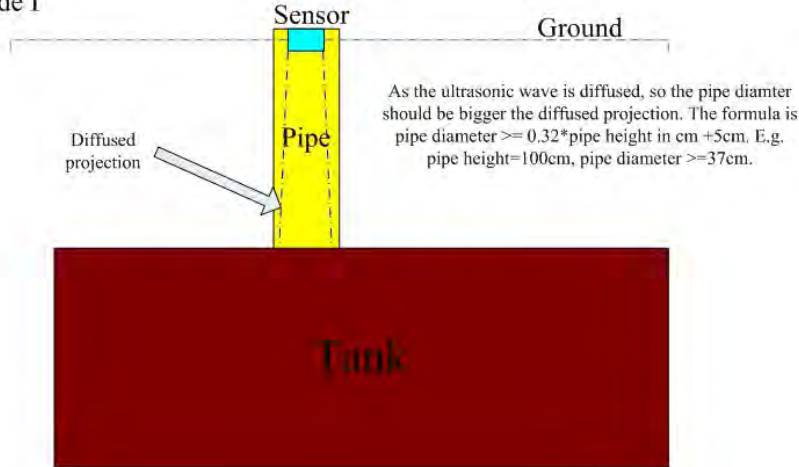
For RA command (Read Air Level), the sensor output is *RA01000260XX to *RA01000700XX.(260-700mm)

For 4-20mA, the sensor output is 4-14.1mA.

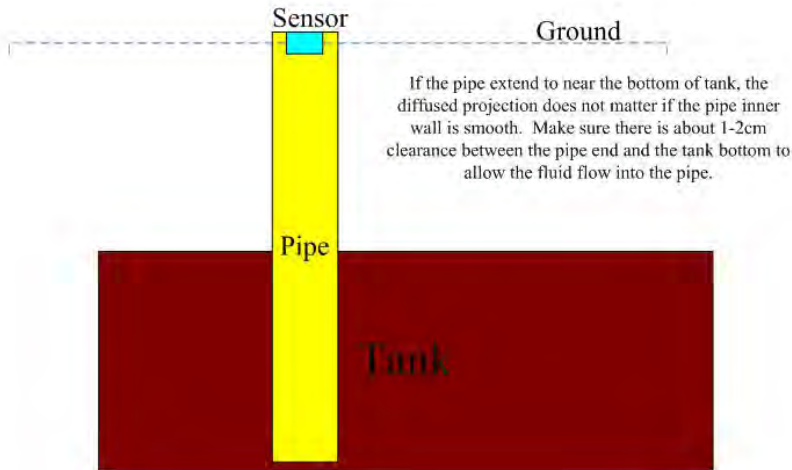
If the user input min Air Height in the F550 configuration, the RP output will cover the 0.1-100.0% as well as the 4-20ma.

8.7 Underground Tank Installation

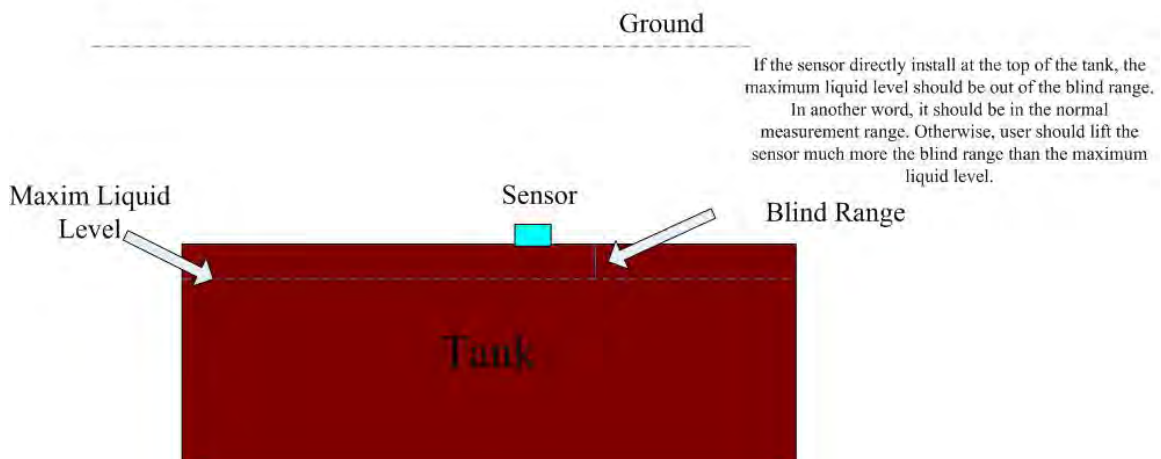
Mode I



Mode II



Mode III



9 Anti-erosive Version

For some special environment, like erosive liquid or air, the sensor has anti-erosive version. The transducer is made by PVDF(Polyvinylidene Fluoride). The o ring is made by PTFE (Polytetrafluoroethylene).

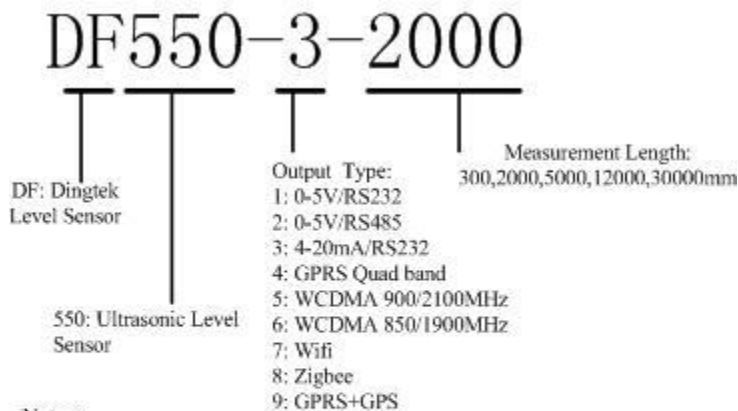
10 Protocol

The sensor is ready for Dingtek GPS/Dingtek IOT/Thingspeak IOT/Modbus protocol. And open for customized version.

Please contact with Dingtek about the protocol issue. Usually it is disclosed based on confidentiality agreement.

Notes: The protocol maybe update without notification. Please contact with us for the latest protocol.

11 Model Naming Rules



Notes:

1-3 is lonely sensor without wireless subversion.

4-9: wireless subversion.

If select the zigbee version, the zigbee gateway from Dingtek(usb interface to pc) is necessary.

If select the wifi version, only if wifi signal covered area, it can work.

12 Package



Size: 21*14*11cm Weight: 1KG

13 Video Link

Test with pipe in air to show no effect of pipe interfere.

<https://youtu.be/QQczHxn3r5k>

DF550 ultrasonic level sensor test on moving tank platform

<https://youtu.be/lh4-vLcaTRM>

Ultrasonic Level Sensor for Human Height Measurement

<https://youtu.be/5RtCo6VkDZ0>

F550 Ultrasonic level sensor How to send protocol to your DF550

https://youtu.be/f_x7SCPniwg

14 Problem Solving

Problem	Reason	Resolving
After connection with PC, no data received	Ground line not connected together	connect the RS232 ground of pc with sensor ground line
	RX/TX wrong connected	switch rx/tx
	baudrate wrong	try 9600 or 115200 bps, one will work
	data bit, start bit wrong	8 databit, 1 start bit, no checksum
	PC RS232 driver error	reinstall rs232/usb driver, make loop test: connect pc rs232 rx with tx, send AB, will get AB
	PC RS232/usb error	make loop test: connect pc rs232 rx with tx, send AB, will get AB. If failed, please change new RS232/usb.
After connection with pc, there is data received while power on, but send data to sensor, no reply.	PC RS232 Tx error	make loop test: connect pc rs232 rx with tx, send AB, will get AB. If failed, please change new RS232/usb.
	request command format error	please act as the protocol listed command and format
	Without return and new line	Check their is return and new line at end of request. in hex it is 0x0D 0A
	ID wrong	check the printed info while power on, there is id listed. Or use 00 as the id to broadcast, any sensor will reply.
	Character error	All character is in english, do not use other language character or symbol
After connection with pc, there is data received, but it is in mess.	Ground line not connected together	connect the RS232 ground of pc with sensor ground line
	baudrate wrong	9600 or 115200 bps
	data bit, start bit wrong	8 databit, 1 start bit, no checksum
	PC RS232 driver error	reinstall rs232/usb driver, make loop test: connect pc rs232 rx with tx, send AB, will get AB
	PC RS232/usb error	make loop test: connect pc rs232 rx with tx, send AB, will get AB

liquid height correct, but no volume data	Tank type, X, Y size not configure	Configure tank type, x, y size according to protocol listed
The liquid/solid level data on RS232 is with fixed error	tank height error	The liquid/solid level is calculated by formula liquid/solid height= tank height - air height. If with fixed error, the user should modify the tank height to match the real height.
Liquid level change, but output data in RS232 wait for several minutes to update	Filtering mode enabled	Default is with filtering mode to prevent sudden change of level. If user want instant refresh, please change to realtime mode (remove filtering mode) by command SM.
RS232 output data not stable	sensor fixing is not stable	Please do not use flexible thing like rope to hang the sensor. Recommend to use frame or flange to fasten
	other item block the signal	if there is some thing under the sensor nearly, it should effect wrong echo signal. recommend to make it clear under the beam zone of the sensor
	end of pipe	At end of pipe, there is out of order signal. recommend the pipe end is in the solid or liquid, not in the air.
4-20ma output, but not reach 20ma even it is full level	installation height issue	please configure installation height to make sure the full level equal the tank height- installation height. After that, 20ma can be reached while full level.
Send sms to sensor, but no reply	SMS format error	check the protocol, act as protocol said to build sms and send to sensor. For sms, the checksum is not verified, so you can use random character as the checksum.
	Sim card out of money	Pay money to the sim card
	Sim card is not activated	Activate sim card
	Sim card is not enabled with sms	Enable sms function
	Sim card format is wrong	for GPRS version, it support GPRS/GSM card, cdma card is not feasible. For WCDMA version, it works for 1900Mhz or 2100Mhz, please check your simcard and sensor version.
	Sim card is not inserted correctly	insert the sim card according to manual, take care of the triangle orientation.

	Sensor not power on	Power on sensor, power supply is 10-32VDC
	sms is blocked by cell phone software	check the blocked list of cell phone software
Sms replied, but not get data on platform	APN not correct	check apn, apn user, password, configure by sms again. make sure get correct reply
	Server ip and port wrong	check ip, port, configure by sms again. make sure get correct reply.
	Id wrong	if monitor at gps tracking platform, reconfigure the id.
	key wrong	if thingspeak platform, reconfigure the key
	channel wrong	check the channel which is listed at the sensor label
	GPRS data disabled	Check with the sim card supplier, make sure the gprs data business enabled
	Test area with weak gprs signal	Change to other area with strong gprs signal covered
RS232 correct, 0-5V output can not reach 5V while full tank	tank heigh wrong	default tank height is 1 meters or 2 meters. If want 5V at full tank, set tank height by RS232 or sms
	the wire with volt lost	take consideration of the volt lost at the 0-5v wire
Sensor vertical to liquid/solid level, but always zero on RS232	out of measurement range	use the sensor version which can cover the measurement range. Some time, smoke or smog can weak the measurement range.
	Blind area	the liquid/solid level should be out of the blind area.
	not vertical to the level	sensor should be vertical to the liquid/solid level. The error should be less than the beam angle.
	out of temperature	sensor should work at the temperature range -20~+70°C
transducer on tank, data non zero, but no change	not enough time	For filtering mode version, it need several time to be non zero data
	some item block signal under the sensor	make the beam area under the sensor clear enough without other item except air.

Rs232 work, but wifi not connected	wifi ssid and password issue	configure the wifi ssid and password as the protocol listed. Then power off and power on the sensor. Wait several minutes it will join the wifi network. For quick test, user can use the cell phone wifi to simulate the final wifi network
wifi connected, but no data on the platform	Server ip and port wrong	check ip, port, configure by sms again. make sure get correct reply.
	Id wrong	if monitor at gps tracking platform, reconfigure the id.
	key wrong	if thingspeak platform, reconfigure the key
	channel wrong	check the channel which is listed at the sensor label
	Test area with weak gprs signal	Change to other area with strong gprs signal covered
zigbee connected, but no data on the zigbee gateway	gateway wrong	please use our recommend gateway
	gateway driver wrong	use the recommend driver to install the driving software of the gateway
	too far from the sensor to gateway	near the sensor and gateway
At beginning sensor works, some days later, zero data	power issue	check the power line
	connection error between sensor and tracker	check the connection between sensor and tracker
sensor work with pc, but not work with other device by rs232 or rs485	other device does not integrate sensor protocol	confirm with device supplier to support sensor protocol
	not send request	some verion need device to send request to sensor, then sensor reply. confirm with device supplier to support sensor protocol. Or check with Dingtek to update to automatic output version
sensor data correct, but not gps data	gps not fixed	sensor should be outside, and the top upward to opensky
sensor gps data is not local time	gps time is for zero time zone	user should adding the difference between the zero time zone and local country

15 Certificates



16 Contact with us

E-mail: service@dingtek.com

Website: www.dingtek.com (english) www.dingtek.com.cn (chinese)