UFS270 User Guide

For GVXXX-Series Devices

ACCEUFS270UG001

Version: 1.01

Ultrasonic Fuel Sensor 270

International Telematics Solutions Innovator

www. queclink .com

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0. Revision history

Revision	Date	Author	Description of change
1.00	2014-11-22	Cid Xu	Draft Version
1.01	2015-01-06	Cid Xu	Release Version Added Cover Picture； Updated Figure 7； Added Figure 2; Added Chapter 4.5, 5.3 and 5.4;

1. Introduction

This document is designed to introduce the upgraded version ultrasonic fuel sensor --- UFS270 and offer users instructions on how to install the fuel sensor correctly.

2. Product Introduction

2.1. Product Parts List

Table 1: List of Standard Components

No.	Component	Quantity	Unit	Reference
1	Signal Control Box	1	set	
2	Ultrasonic Sensor Detector	1	piece	
3	Signal Extension Wire	1	piece	Default 8m.
4	User Interface Wire	1	piece	Including power and data wire
5	Double-sided Sticky Tape	1	piece	
6	Ultrasonic Couplant	1	bottle	
7	1.2M Cable Ties	2	piece	
8	15CM Cable Ties	10	piece	
9	Abrasive Paper	1	piece	

Table 2: List of Optional Components

No.	Component	Unit	Reference
1	UFS270 Diagnostic Tools	set	LED Display with Connection Wire
2	LOCTITE 380 Glue	bottle	

The product is composed of items below:

Figure **1**: Ultrasonic Fuel Sensor 270 Parts List

Figure **2**: UFS270 Diagnostic Tools

2.2. Technical Parameters

Table 3: List of Standard Components

Items	Parameters	
Operating Voltage	9 - 36VDC	
Max Power Consumption	0.8W/12VDC	
Operating Temperature	-40℃ ~ +85℃	
Working Humidity	5% ~ 90%	
Measurement Range	It depends on the material and thickness of the vessel. The range is about 5~200cm for 5mm steel plate.	
Pressure Range	≤0.8kg or 0.8MPa	
Accuracy of Liquid Measurement	±0.5%	
Connection	Providing Analog Voltage Output and RS232	
Working Environment	Moisture-proof (detector) acid-resistant (detector) anti-interference flame retardant (detector) anti-vibration (detector)	
IP Rating	IP66 (detector)	
Output Interface		
Interface	**Parameter**	**Connection**
Analog Output	Output voltage range: 0 - 5.0V.	Voltage output Ground
RS232 Interface	Baud rate: 19200, Check Bit: None, Data Bit: 8, Stop Bit: 1, Flow Control: None. Automatically output fuel level (unit 0.1mm) every 10 seconds	TXD RXD Ground

2.3. Product Feature

2.3.1. High Accuracy

The measurement resolution of the fuel level is 0.1 mm and measurement accuracy is ±0.5%. The sensor automatically performs the temperature compensation in the range from -40℃ to 85℃. This ensures the measurement accuracy even when the environment temperature is extreme high or low.

2.3.2. Better Long Term Stability

The fuel sensor adopts the method of ultrasonic measurement, a non-contact measurement that is different from the current widely used direct contact method such as the fuel float sensor, fuel pressure sensor and magnetic fuel sensor, so as to avoid corrosion and pollution by the fuel and keep excellent long-term stability of the measurement.

2.3.3. Easy Installation and Maintenance

The sensor is installed at the bottom of the fuel tank, which requires no change to the original fuel tank measuring system and the fuel tank. This allows the original vehicle fuel

gauge to work undisturbed and no warrant issue.

2.3.4. Environmentally Friendly

The non-contact measurement does not require making hole to the fuel tank or modifying the fuel tank and thus avoids the fuel contamination.

2.3.5. Reliability

It can work perfectly in harsh environments.

2.4. Advantage Over Other Fuel Sensors

2.4.1. Capacitive Fuel Sensor

This type of fuel sensor is susceptible to sticky grease stains and causes measurement error. It has potential risk of producing electrical spark. Drilling installation causes pollution and warranty issue.

2.4.2. Resistive Fuel Sensor

This type of fuel sensor uses mechanical method to measure fuel level. It is easy to get big measurement error and delay. It is vulnerable to corrosion and pollution because of long-term exposure to the fuel, which will lower the measurement accuracy. Drilling installation is used.

2.4.3. Fuel Flow Meter

This type of fuel sensor is difficult to install as it has to truncate the original fuel pipe. It can measure the fuel consumption, but not the amount of refuelling, which makes it inconvenient for measurement and management.

2.4.4. Reed Switch Fuel Sensor

This type of fuel sensor has low accuracy and is very easy to be influenced by the measurement media and temperature fluctuation caused by power voltage. Its components are vulnerable to magnetization. The measurement result is greatly influenced by fluctuations in the fuel level and grease. It is impossible for field installation according to the height of the fuel tank.

2.4.5. Fuel Float Sensor

This type of fuel sensor can only be used for vague indication and cannot be used for fuel metering. It is vulnerable to grease stain, power supply, mechanical structure and lubrication, which will cause problem of stability to the output value.

2.5. Applications

The product applies to various types of vehicles including logistics vehicles, taxis, buses and passenger cars. It can measure the vehicle refuelling and fuel consumption and thus prevent the fuel theft, avoid resource waste, improve operating efficiency, enhance the traffic safety, and strengthen the operation and management of fleets.

3. Principle Analysis

This chapter mainly illustrates the principle of the ultrasonic fuel sensor and the common fuel sending units and partitions.

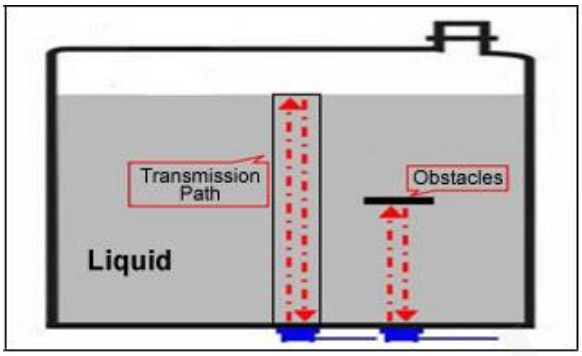


Figure 3: Principle Diagram

3.1. Principle

Liquid level in a container is measured by coupling the transducer to the bottom of the container using couplant. The transducer generates a short ultrasonic sound pulse which is transmitted through the container wall and into the liquid. The pulse travels up through the liquid until it reaches the surface where it is reflected and returns back through the liquid to be received by the transducer. The liquid level then could be calculated by the round-trip transit time and the sound velocity in the liquid.

According to the principle, the depth of the liquid calculated in this method could be wrong if the ultrasonic wave is reflected before the due time when there are obstacles in the transmission path. Therefore, users should avoid obstacles that could hinder the transmission of ultrasonic wave such as common fuel sending units, supply tubes, return tubes and partitions inside the fuel tank.

3.2. Obstacles in Fuel Tank

Figure 4: Obstacles in Fuel Tank

4. Installation Guide

This chapter deals with the installation procedure of the square and round fuel tank.

4.1. Description of Signal Control Box

Figure 5: Signal Control Box Interface

4.1.1. User Interface Definition

Table 4: User Interface Definition

Pin	Function	Statement
1	Positive Power	9 ~ 36VDC
2	Negative Power	
3	NC	Reserve
4	NC	Reserve
5	TXD	RS232 TX
6	RXD	RS232 RX
7	NC	Reserve
8	NC	Reserve
9	NC	Reserve
10	NC	Reserve
11	AOUT	Analog Output
12	GND	Reference Ground

4.1.2. LED Indicator Light Definition

LED 1:

Green light flashes slowly: Detector is normal

Red light flashes slowly: Detector is abnormal (detector off)

LED 2:

Green light flashes slowly: Power supply is normal

Red light flashes slowly: Analog quantity output is abnormal

4.1.3. Ultrasonic Detector Socket

The socket connects detector Signal Extension Wire and then Detector.

4.2. Description of User Interface Wire

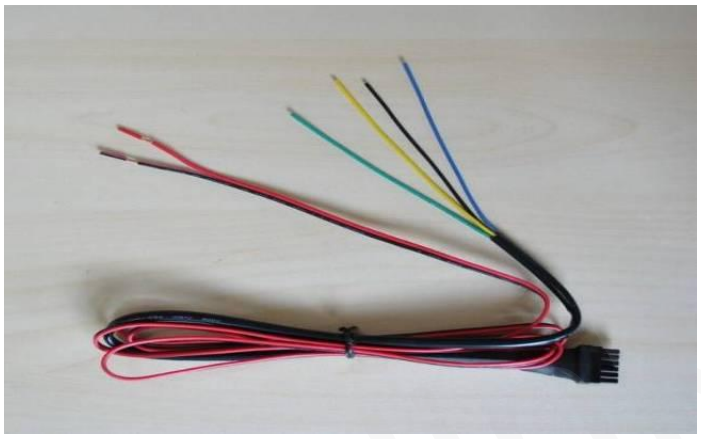


Figure 6: User Interface Wire

Table 5: Description of User Interface Wire

Pin	Wire Colour	Function	Statement
1	Red	Positive Power	9 ~ 36VDC
2	Black	Negative Power	
5	Yellow	TXD	RS232 TX
6	Blue	RXD	RS232 RX
11	Green	AOUT	Analog Output
12	Black	GND	Reference Ground

4.3. Description of UFS270 Diagnostic Tools

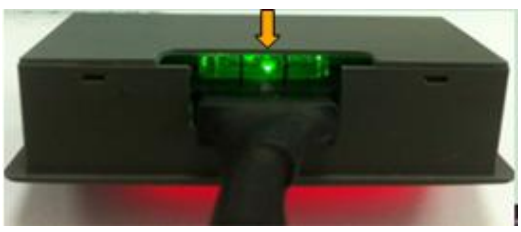
4.3.1. LED Display Description

Front Surface:

It displays some digits on the screen, when you connect the display screen with the detector correctly.

This digit shows the liquid height. As shown in the screen, the liquid height is 15.9CM.

Back:



The green part is a level tester. If the bubble is in middle, it means the fuel tank is horizontally placed.

4.3.2. Button Description

Button1: Long press Button1 to access loose installation mode.
Button2: Long press Button2 to quit from installation mode.
Button1 and Button2: Keep pressing both Button 1 and 2, no matter long pressing or short pressing, to enter strict installation mode.
** **Long Pressing**: press more than 2.4 seconds and release.
** **Short Pressing**: press more than 0.8 seconds and release.

4.3.3. Description of Strict Installation Mode

The screen shows different digits every 2 seconds after you go into strict installation mode. One is liquid height, and the other is situation code:

Liquid Height

Situation Code (0, 1, 2)

When it is suitable, the situation code is 2.

4.3.4. Description of Loose Installation Mode

The screen shows different digits every 2 seconds after you go into loose installation mode. One is liquid height, and the other is situation code:

Liquid Height

Situation Code (0001, 1001, 2001)

When it is suitable, the situation code is 1001 or 2001.

4.4. Installation Procedure

4.4.1. Installation Procedure

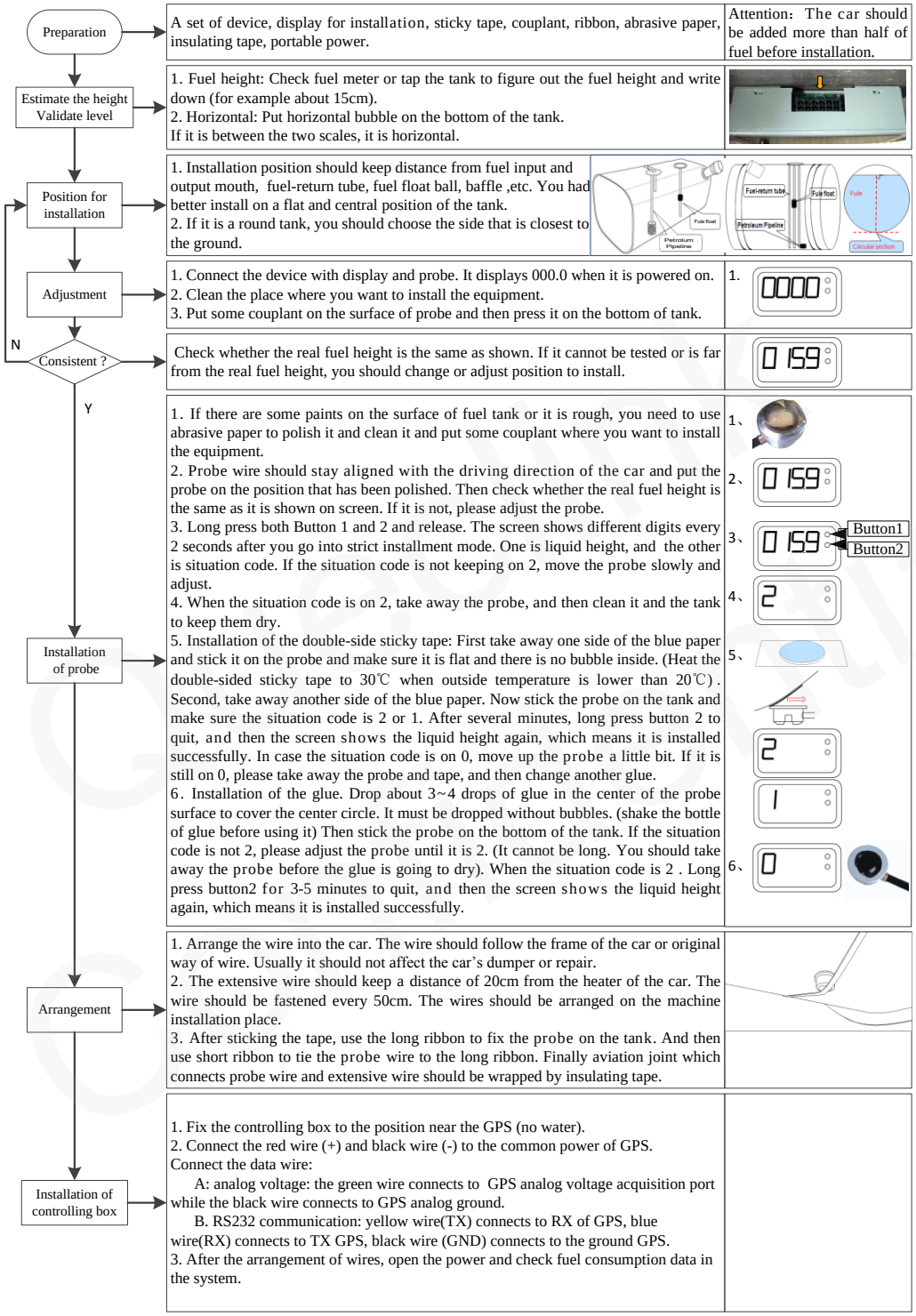


Figure 7: Installation Procedure

4.4.2. Use Diagnostic Tools to Help Install and Access Strict Installation Mode

Strict Installation Mode: Only when all parameters from detector meet the requirement and reserve margin, the LED display will show situation code 2, which means you go into Strict Installation Mode.
Loose Installation Mode: Only if the parameter of liquid height from detector can meet requirement, the situation code will show 1001 or 2001, which means you go into Loose Installation Mode.

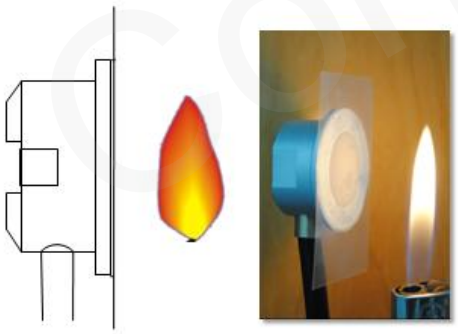
By the parameters of ultrasonic detector and liquid height, software will self-adaptively determine whether to go into strict or loose installation mode. The situation code shows the detector installation status. When the situation code is 2 or 2001, it means installation status is good. When it is 1 or 1001, it means the installation status is not so good, and can only be used. If it is 0 or 0001, it means the detector has not been installed well, and need be re-installed. After completing the installation, you should press [Button 2] to quit the installation mode and finish all steps.

4.4.3. Fix the Detector

There are two ways to fix the detector, by using Double-sided Sticky Tape or LOCTITE 380 Glue
Double-sided Sticky Tape: can be used for aluminum-alloy, steel and plastic fuel tank.
LOCTITE 380 Glue: only for ferrous and galvanized sheet fuel tank.

4.4.4. Installation Notes

- **When installing the probe, please ensure that the probe wire stay aligned with the driving direction of the car.**
- The tank must be full or more than half of fuel before installation.
- It is better to heat the Double-sided Sticky Tape to 30℃ when outside temperature is lower than 20℃. Temperature resistance of the tape is from - 40℃ to 105℃.



- Please shake the bottle of LOCTITE 380 Glue before using it. When the outside temperature is lower than 20℃, you should heat the surface of detector or fuel tank to more than 30℃. This glue can be solidified in 5-10 minutes. And the remaining glue should be stored in lower temperature 0~5℃.
- When using analog output, the analog ground (black wire) needs to be connected with the ground wire of Tracker.

- When using serial port, TX, RX, GND should be connected with Tracker.
- All connect nodes of wires and connectors should be wrapped by insulating tape.
- It is not suitable to install the detector, when the fuel is less than half or the tank is not horizontal, which will cause some detection error.
- Control box and detector cannot be changed, after you enter installation mode and exit successfully. If you need to change, you should enter installation mode again, and then the detector and control box can re-adjust to use the suitable parameters.

4.4.5. Common Problems and Guides

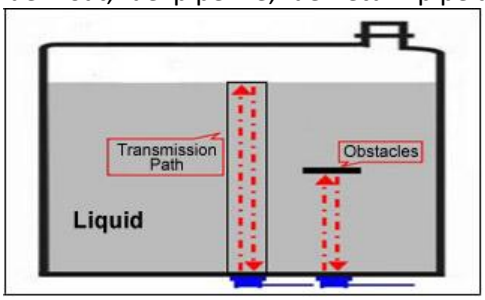
Table 6: Common Problems and Guides

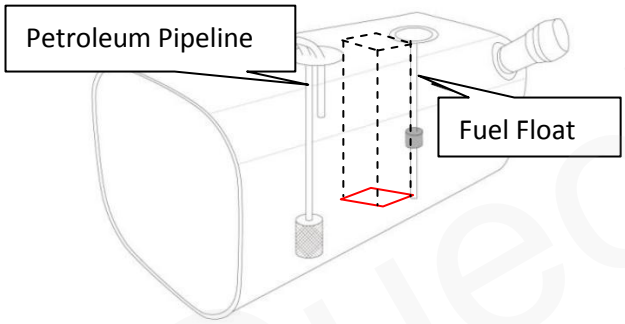
Problem	Guide
LED1 and LED2 don't work at the same time	Check the power of sensor, and the correct voltage is 12V or 24V.
LED1 flashes red light	Please check if the detector is fixed or not. Please check if the liquid height is more than 5cm or not.
LED2 flashes red light	Disconnect with Tracker and check the green wire of user interface.
LED2 doesn't work	Please check if the power input is about 12V or 24V. If not, please provide 12V or 24V power supply.
Screen doesn't work	Make sure the display is connected to sensor host and is being charged.
Liquid height parameter flutter	Please check if the liquid height is lower than 5cm or not.
Liquid height parameter shown on screen is different from actual parameter	By default, the software of sensor uses the ultrasonic spreading speed in fuel to measure liquid. If the liquid to be measured is water, you need to change the software setting or parameter on display. The water height is about the fuel height*1.1.
The height does not change after adding or reducing fuel	1. Please check if software has done the self-adapt action in installation process. 2. Please check if the liquid height has changed more than 3CM.
No curve tracing of fuel consumption on monitoring platform	1. Please check if the connection of USB is right and if the tracker supports the fuel consumption. 2. Please check if the monitoring platform demarcates the fuel quantity. 3. Please use computer serial port to read parameter configuration and check it, and you can also configure the parameter again through serial port. 4. If you use the analog output, you can measure the voltage between red wire and black wire. Please make sure the liquid height is correct according to formula conversion.
Curve tracing stops moving.	If it displays 000.0 when the LED display is connected, please check the detector, power wire and power. While the LED display shows 000.0, but the power supply is ok, please check the situation code. If the code is 0, please check the installation of the detector. 3. If the real liquid height is the same as shown, please make sure that your vehicle is at horizontal level. After that, please enter installation mode, redo the self-adapt when the situation code is 2 or 1, and then quit. (Attention: The liquid height must be more than half of fuel when you enter installation mode).
Curve tracing changes up and down abnormally	Connect the LED display and enter the installation mode, to make sure the detector is fixed well.

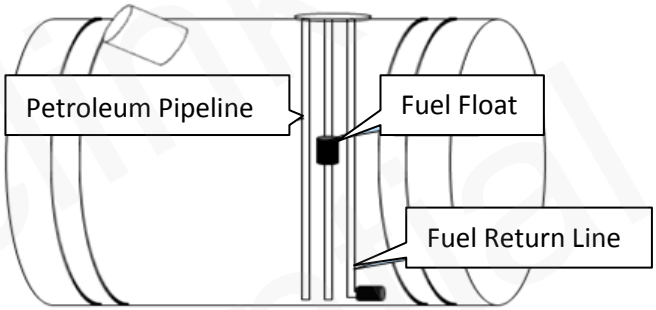
4.5. Detailed Installation Guide

4.5.1. Precautions Before Installation

As figures below, during installation, you should avoid obstacles in the fuel tank, such as fuel float, fuel pipeline, fuel return pipe and baffle plate inside the tank.







4.5.2. Installation Tools Preparation

- A set of UFS270
- A set of UFS270 Diagnostic Tools
- A bottle of Ultrasonic Couplant
- An uninterruptible power supply (UPS)
- Cable Ties
- Abrasive Paper
- Appropriative Double-sided Sticky Tape or Glue
- Insulating Tape
- Screwdriver and Needle-nose Pliers

4.5.3. Check the Tank for Levelness and Fuel Level

Check fuel level of the tank: Check the fuel meter or knock on the tank wall to estimate the fuel level height and then record the value.
Check the tank for levelness: Before installing the ultrasonic sensor, the vehicle should be parked on the flat ground and keep in stationary situation. The levelness can use the level meter to check, as figure below, if the bubble is not in the centre. Please move your vehicle to the suitable environment.

4.5.4. Observe Fuel Tank Surface

Square Fuel Tank

Observe the locations of the obstacles such as the fuel sending unit, supply tube and return tube on the surface of the fuel tank.

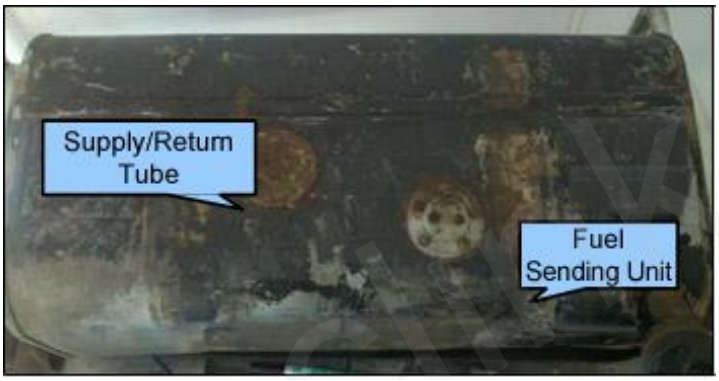
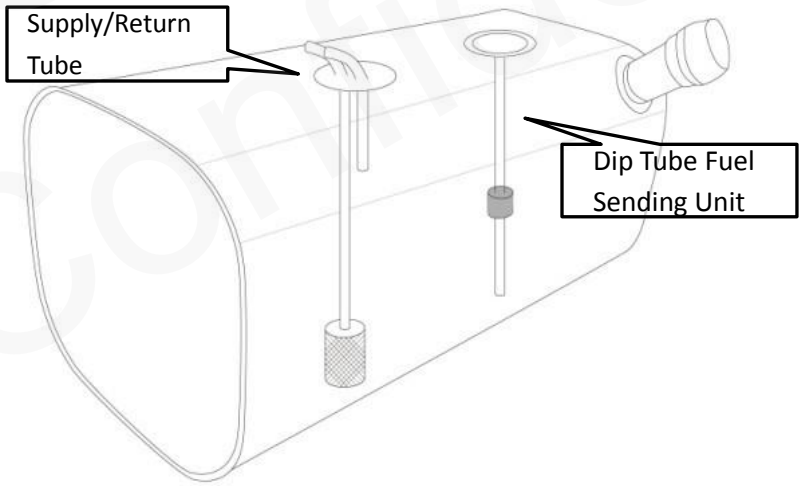


Figure 8: Surface of Square Fuel Tank

Users can judge the locations and structures of the obstacles inside the fuel tank by observing them on the surface.



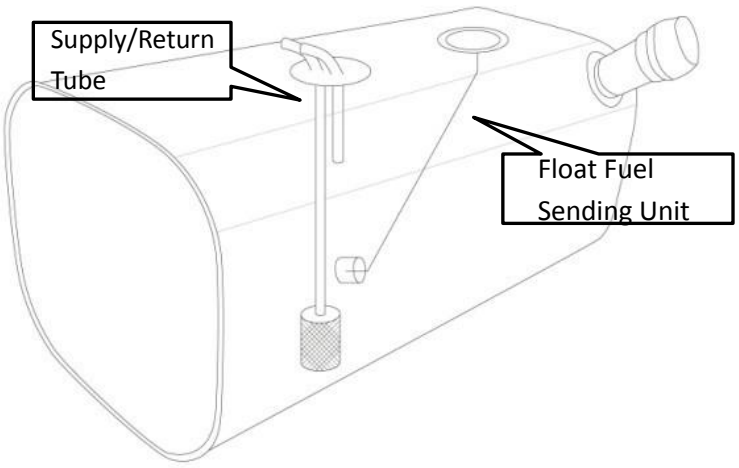


Figure 9: Locations and Structures of Obstacles in Square Fuel Tank

Round Fuel Tank

Observe the locations of obstacles such as the fuel sending unit, supply tube, and return tube.

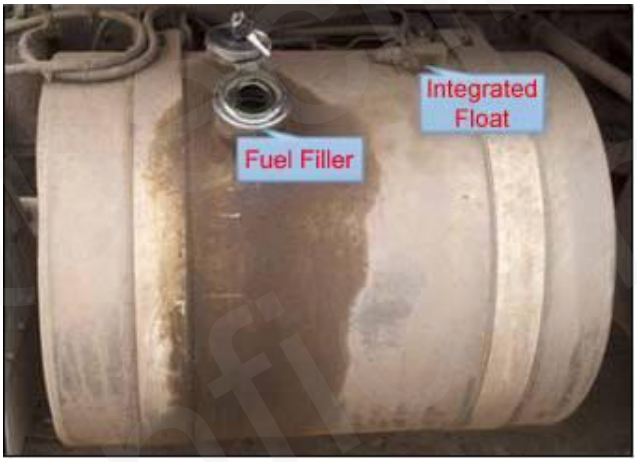


Figure 10: Surface of Round Fuel Tank

Judge the structures and locations of obstacles inside the fuel tank based on the observation of those obstacles on the surface.

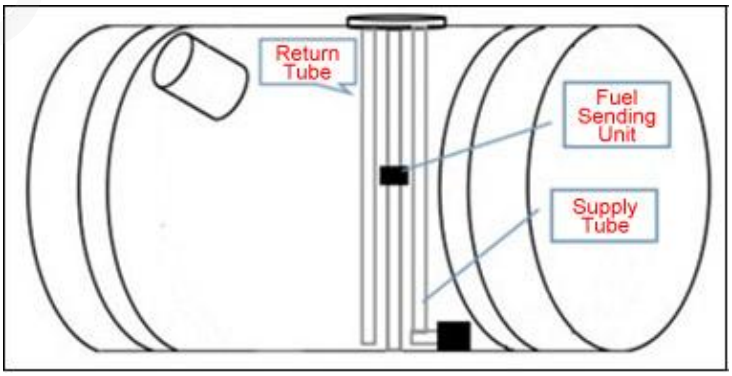
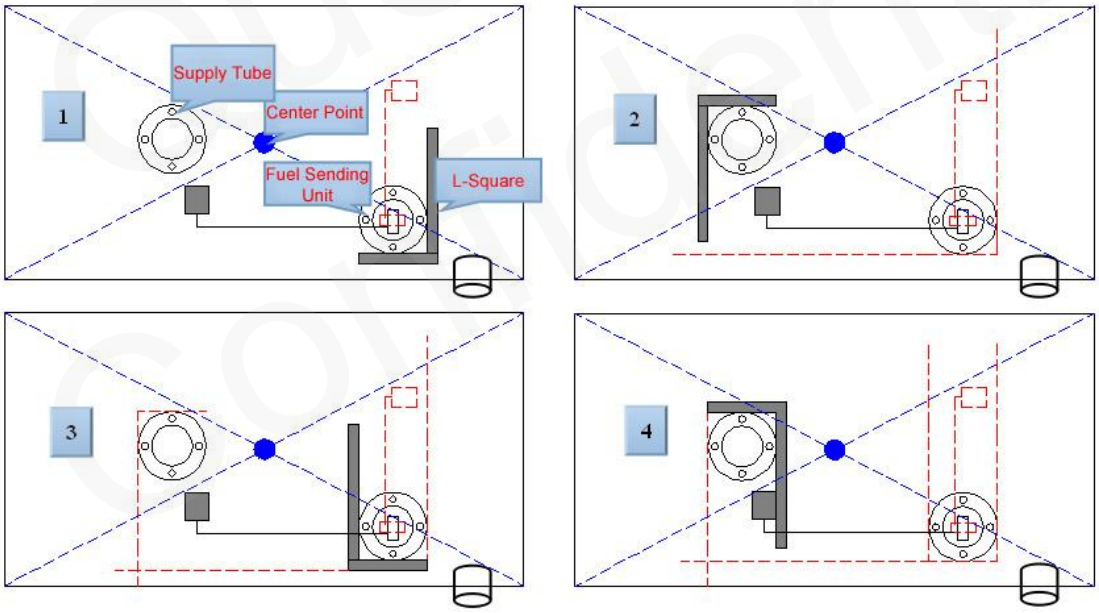


Figure 11: Locations and Structures of Obstacles in Round Fuel Tank

4.5.5. Locate the Installation Area

Square Fuel Tank

According to the principle of the ultrasonic fuel sensor, the gauged liquid depth could be wrong if the ultrasonic wave is hindered by the obstacles such as supply or return tube and fuel sending unit. Therefore, the area covering the fuel sending unit and supply or return tube at the top of the fuel tank can not be used for installation. Meanwhile, the detector should be installed close to the center of the fuel tank in order to minimize the interference. As shown in below figure, select an area with 20CM X 20CM in the center of the fuel tank as the installation area after lining out the area not suitable for installation. The installation area can be bigger or smaller, depending on the actual situation of the fuel tank. If the obstacles are located right in the center of the fuel tank, please select an area near the center without obstacles to install the detector.



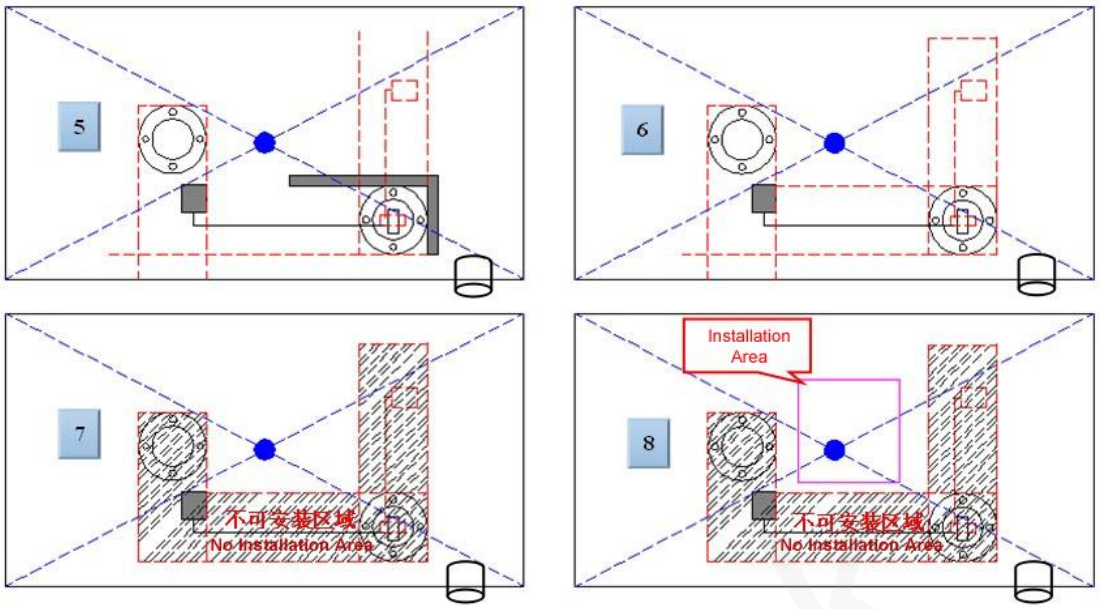


Figure 12: Locate the Installation Area

Note: the installation area must avoid the possible area with fuel sediments, that is, the prominent surface of the fuel drain bolt. As shown below, the old detector on the left is a faulted one because of the fuel sediments.

Figure 13: Fuel Drain Bolt

Please make sure that the installation area does not obstruct the installation of the stainless steel hose clamp.

Round Fuel Tank

The installation area of the round fuel tank is different from that of the square one. Only the location of the tangent can reflect the true depth of the liquid. Therefore, the detector must be installed on the tangent section perpendicular to the liquid surface and avoid obstacles in order to ensure the precision and stability of gauged data. Locate the installation area as shown in below figure.

The selection of the tangent location: spread water on the surface of the fuel tank and the water will flow along the surface to the lowest point to drop which is the tangent location perpendicular to the liquid surface.

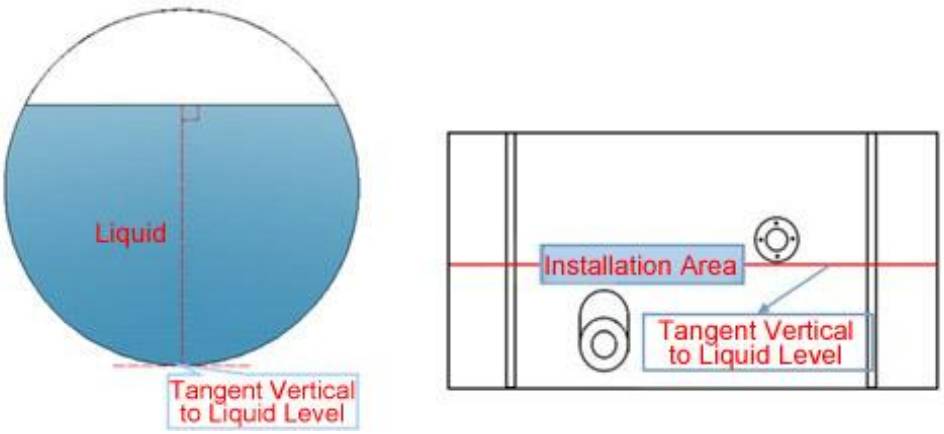


Figure 14: Installation Area of Round Fuel Tank

Please avoid selecting installation location that will hinder the installation of the stainless steel hose clamp.

4.5.6. Test the Installation Area

1. Wipe cleans the installation area.

2. Connect the Signal Control Box, Diagnostic Tool and Ultrasonic Sensor Detector.
This time the screen should show “000.0”.

3. Daub ultrasonic coupling onto the surface of ultrasonic probe, press the probe to the bottom of the tank, and then move position appropriately.

If the numerical value on screen is very close to the actual height, then go to the next step.
If not, you need to re-locate installation area.

4.5.7. Install the Probe

1. Wipe cleans the installation area again. If the tank is coated with paint, please clean the paint in installation area.

2. Daub ultrasonic coupling onto the surface of ultrasonic probe again, press the probe to the bottom of the tank, and confirm the numerical value on screen is consistent with the actual fuel surface height once again.
If not, you need to re-locate installation area till consistent.

3. Maintain good contact between the probe and the tank, and press button1 and button2 at the same time.
Keep pressing the two buttons for more than 2 seconds and release them, and now the screen will flash between two digits. One is the height value (e.g. “015.7”), and the other

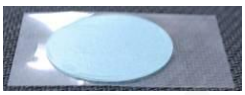
one will change among “0”, “1” and “2”.


4. When the screen does not flash, and keeps showing “2” only, please mark this position and then remove the probe.
If the screen does not keep showing “2”, please adjust the position of the probe slowly, until the screen keeps showing “2”.

5. After removing the probe, the screen should show “000.0” again. Now wipe clean the installation area. Please ensure the contact surface is clean and dry.

6. Use the double-sided tape to install the probe:

1) When the environment temperature is below 20℃, the tape surface needs to be preheated up to 30℃ or above.



2) Tear up the blue centrifugal paper and glue the tape onto the surface of probe. Please ensure that there is not any air bubble in the bonded area, and then keep pressing the contact surface to make sure the tape and the probe surface is bonded closely.

3) Tear up the transparent centrifugal paper and paste the ultrasonic probe to the bottom of fuel tank. Press and hold it for a few minutes (at the same time, need make sure the screen shows “2” or “1”).
* When installing the probe, please make sure the probe line is towards the front direction of car.

Then press button2 and hold it for 2 seconds. When the screen shows correct fuel height value, it means the installation is successful.

If the screen always shows “0”, please remove the double-sided tape, and try to use the glue to install again.

7. Use the special glue to install the probe：

1) Please shake the glue bottle vigorously before using, and drop a few glues on the surface of probe.

2) Paste the ultrasonic probe to the bottom of fuel tank, and press and hold it for a few minutes (at the same time, need make sure the screen shows “2” or “1”).

* When installing the probe, please make sure the probe line is towards front direction of car.

If the screen always shows “0”, please adjust the position of the probe slowly, until the screen keeps showing “2”.

5. System Connection

System connection includes correct wiring and installation of the signal control box.

5.1. Wiring

- Wire along the vehicle frame for future maintenance.
- Don't affect the vehicle's functions of dump bucket and vehicle head maintenance.
- The detector and the extension wire should be wrapped with tape for the purpose of water resistance, and fix them on the stainless steel hose clamp with plastic cable ties. Please refer to below figure.

Figure 15: Wiring

- The extension wire should have at least 20cm distance from the heating and movable parts.
- The extension wires should be fastened every 50cm with cable ties and trim the unwanted parts with the diagonal cutting pliers.
- The extension wire should not be tripped over by any movable part.

5.2. Installation of the Control Box

The control box should be fixed on the installation surface of the vehicle with Velcro. Install it on the horizontal surface and fasten it with cable ties.

The interface definition of the control box please refers to 4.1.1.

- Power interface: connect to the vehicle’s battery.
- Tracker interface: connect to Tracker device as shown in Table 7.
- Ultrasonic interface: connect to the extension wire.

Fix the control box on the vehicle with Velcro. Meanwhile, fasten the unused harnesses together and fix them on the vehicle. The unused harnesses should not be left in chaos.

Table 7: Connection with GV300

Fuel Sensor	PIN Name	Color	Connect to GV300	Color
Power Interface	Positive	Red	PIN 11 PWR	Red
	Negative	Black	PIN 6 GND	Black
Tracker Interface	TX	Yellow	PIN 4 RXD	Green or Pink
	RX	Blue	PIN 5 TXD	Black and White
	Ground	Black	PIN 6 GND	Black

Figure 16: Connection with GV300

5.3. The Scene Diagram

Figure 17: The Scene Diagram

5.4. Fuel Value Calibration

The fuel level value detected by UFS270 is the height of fuel in the tank. In order to convert the height into the remaining fuel percentage in the tank or the detailed fuel load (unit: liter), you should use the function of AT+GTFSC.

AT+GTFSC is designed to configure fuel level calibration scale. The introduction of parameters for GTFSC, please refer to @Track Air Interface Protocol.doc. You need to enable the Bit 3 and Bit 4 of ERI Mask in AT+GTFRI when you use the function of GTFSC.

First, you should configure the value of Max Tank Volume (unit: liter). For example, the Max Tank Volume of the tank is 77 liters. Then configure Num of Node to be 11. Node N Value represents the fuel height detected by UFS270, and Node N Percentage stands for the fuel percentage corresponding to the fuel height detected by USF270. For example, if the fuel height detected by UFS270 is 0, then the corresponding fuel percentage is 0%. If the fuel height detected by UFS270 is 227.3mm, then the corresponding fuel percentage is 100%.

The correspondence between fuel height detected by UFS270 and fuel percentage should be configured according to the characteristics of the fuel tank.

An example in the following table:

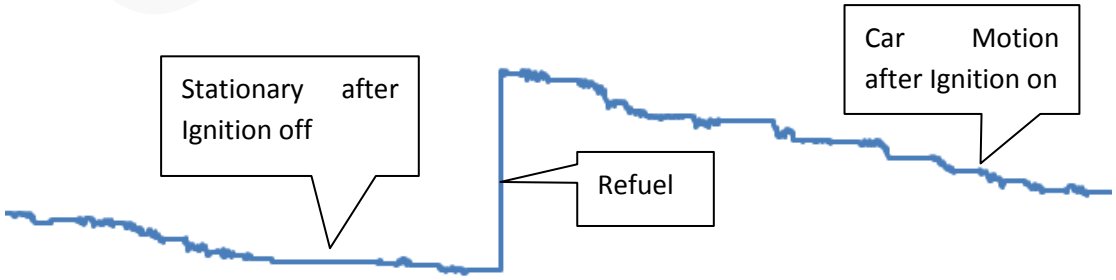
Node N Value (unit: 0.1mm)	Node N Percentage (unit: %)
0	0
775	20
848	25
938	30
1019	35
1106	40
1274	50
1522	60
1666	70
2037	90
2273	100

The command got finally is:
AT+GTFSC=gv300 ,,0,4,1,77,,11,0,0,775,20,848,25,938,30,1019,35,1106,40,1274,50,1522,60,1666,70,2037,90,2273,100,,,,,,,,,1,20,0,100,,0,,,,,,,,,2,20,0,100,,0,,,,,,,,,3,20,0,100,,0,,,,,,,,,4,20,0,100,,0,,,,,,,,0001$

In the message of +RESP:GTERI, 04DF is the fuel height detected by UFS270, 48.4 is the remaining fuel percentage, and 37.3 is the remaining fuel in the tank.
+RESP:GTERI,0E0402,869158005181306,gv320-GL8,00000019,13719,10,1,1,42.2,85,-3.0,121.396035,31.207823,20141126111221,0460,0000,1824,C3C3,00,624.1,,335,,90,220100,1,04DF,1,4,48.4,37.3,0,20141126111223,725F$

5.5. Test Application

Connect UFS270 to GV300 and install them in the car for test. Then set GTFRI report interval to 10S and enable ERI Mask Bit0. In this case, GV300 will report one +RESP:GTERI message every 10S. We can extract fuel level data from the message and convert them into diagram:



6. Attention

- Pay attention to your own safety during installation.
- Connect cables to the positive and negative of batteries in the correct way. The power interface should not contact other circuits and metal parts of vehicles. Don't cut or connect circuits arbitrarily in the vehicles.
- Take some shock-absorbing measures when fixing the signal control box if possible.
- After installation is completed, record the vehicle model, materials and shape of the fuel tank, and installation location among others as reference for after-sales service. The record form is in the appendix.

7. Appendix

Table 8: Record Form

No.	License Plate No.	Vehicle Brand	Vehicle Picture	Material of Fuel Tank	Fuel Tank Shape (Picture)	Fuel Tank Specifications	Installation Location (Picture)
1							
2							
3							