UFS301 User Guide

For GVXXX-Series Devices

ACCEUFS301UG001

Version: 1.00

Ultrasonic Fuel Sensor 301



International Telematics Solutions Innovator

www. queclink .com

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0. Revision History

Revision	Date	Author	Description of Change
1.00	2023-10-26	Roger Wang	Initial Version

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1. Introduction

This document is designed to introduce the upgraded version ultrasonic fuel sensor --- UFS301 and offer users instructions on how to install the fuel sensor correctly.

UFS301 is a vehicle fuel monitoring device which is designed for the fuel management needs of company fleet. This product is suitable for diesel fuel tank. This sensor can be used to prevent fuel theft, optimize the operating costs, improve the driver's driving behavior and assist with fuel statistics in fleet management decision making, etc. The sensor is equipped with a high precision ultrasonic probe, which can detect the fuel level in the fuel tank. Fuel data will be sent to the server via GPS tracker, and then used to generate fuel report.

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2. Product Introduction

2.1. Product Parts List

Table 1: List of Standard Components

No.	Component	Quantity	Unit	Reference
1	Ultrasonic Sensor Probe	1	piece	 Probe size: Φ33mm Probe height: 12.7mm Wire length: 1 M
2	Signal Extension Wire	1	piece	 Wire length: 8m
3	Fuse Wire	1	piece	
4	Sealing Ring and Protective Holder	1	kit	
5	Cushion Gasket	1	piece	
6	Hose Clamp	1	piece	
7	Butter+ Coupling Agent	1	kit	

Table 2: List of Optional Components

No.	Component	Unit	Reference
1	UFS301 Diagnostic Tools	set	

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2.2. Technical Parameters

Table 3: List of Standard Components

Items	Parameters	
Operating Voltage	9 – 36 VDC	
Max Power Consumption	0.36W/12VDC	
Operating Temperature	-30℃ ~ +80℃	
Storage Temperature	-40℃ ~ +85℃	
Working Humidity	5% ~ 90%	
Measurement Range	3cm~100cm (For 0# Diesel Fuel in stainless steel / aluminum fuel tanks with thickness of less than 5mm) 5cm~100cm (For Water in stainless steel / aluminum vessels with thickness of less than 5mm)	
Accuracy of Liquid Measurement	±0.5%	
Resolution of Liquid Measurement	0.1mm	
Certification	CE / RoHS / CNEX ATEX	
IP Rating	IP67	
Output Interface		
Interface	**Parameter**	**Connection**
RS485 Interface	Baud rate: 115200; Check Bit: None; Data Bit: 8; Stop Bit: 1; Flow Control: None. Automatically output fuel level (unit: 0.1mm) every 10 seconds	RS485-A RS485-B Ground

Note 1: The tank wall should be solid. The thicker the tank wall is, the weaker the ultrasonic signal becomes as it passes through the tank wall, which results in a smaller measuring range. Most fuel tanks are within the measurable range of the ultrasonic fuel sensors, and for those beyond the measurable range of the ultrasonic fuel sensors, actual measurement shall prevail.
Note 2: The blind zone and measuring range of the ultrasonic liquid level sensors vary depending on materials of vessels, vessel wall thickness and the medium whose level is to be measured, so please take into account these factors in actual applications.

2.3. Product Features

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 -30℃ to 80℃. This ensures the measurement accuracy even when the environment temperature is extremely 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

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pressure sensor and magnetic fuel sensor, so as to avoid corrosion and pollution by the fuel and maintain 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 normally.

2.3.4. Environmental Friendliness

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

2.3.5. Reliability

It can work perfectly in harsh environments.

2.4. Advantages 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 can easily 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 the original fuel pipe has to be truncated. It can measure the fuel consumption, but not the amount of refueling, 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 easily influenced by the measured 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 due 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.

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2.5. Applications

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

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3. Principle Analysis

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

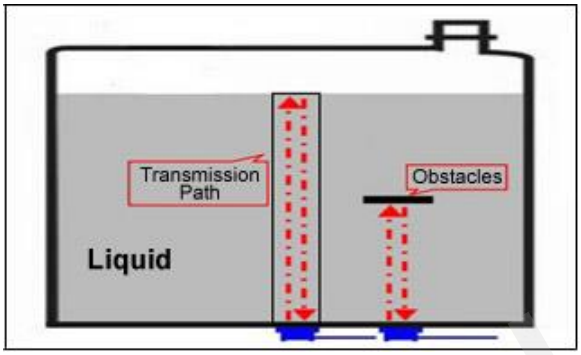


Figure 1: Principle Diagram

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 2: Obstacles in Fuel Tank

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4. Installation Guide

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

4.1. Description of Ultrasonic Sensor



Figure 3: Ultrasonic Sensor Probe and Signal Extension Wire

Table 4: Interface Description of Ultrasonic Sensor

Pin	Wire Color	Function	Description
1	Red	Positive Power	9 ~ 36VDC
2	Black	Negative Power	
3	Yellow	A	RS485 A
4	Blue	B	RS485 B
5	Green	Reserved	Reserved
6	Brown	GND	Reference Ground

4.2. Fuse

1 Fuse	Introduction
	➢ Please connect fuse to the red wire of the extension wire.

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4.3. Detailed Installation Guide

4.3.1. Installation Procedure

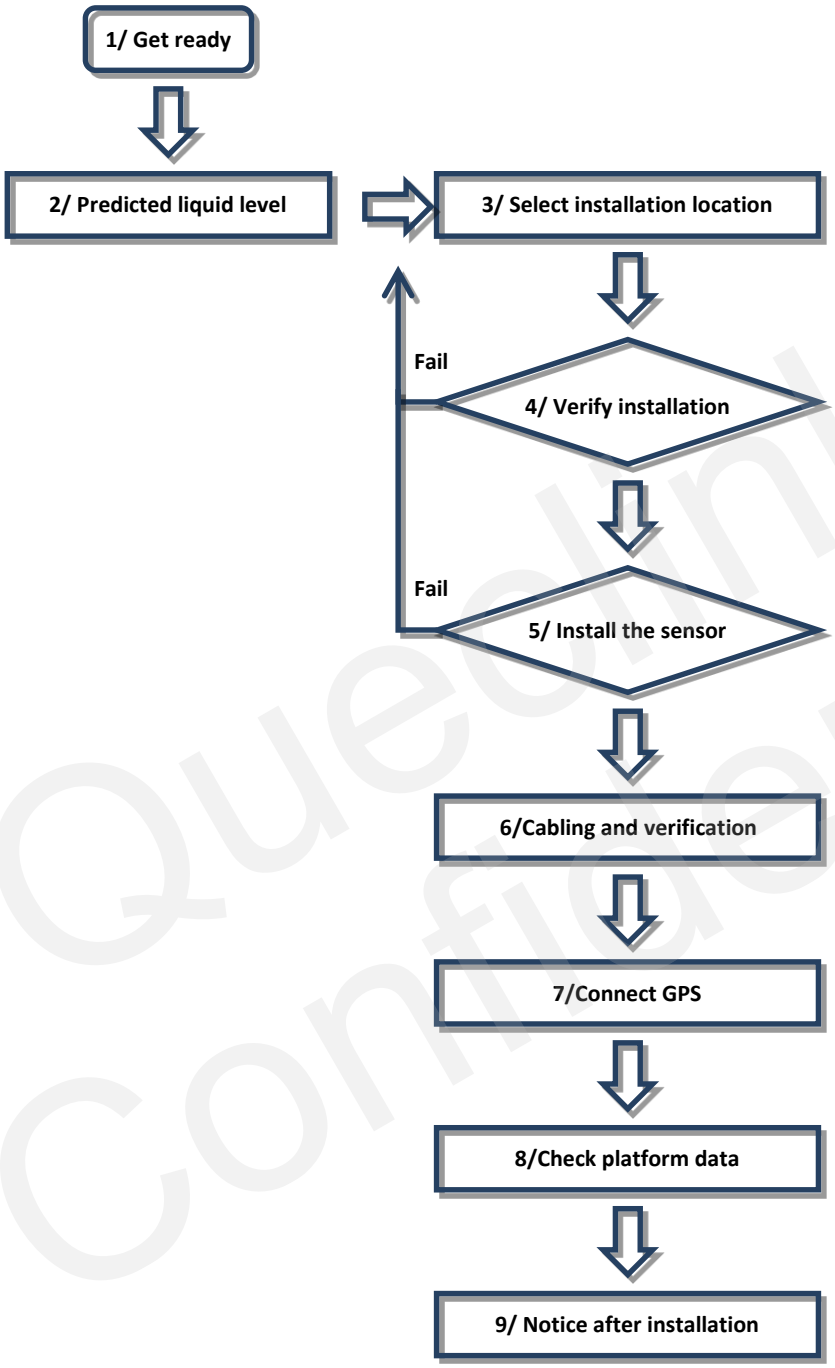


Figure 4: Installation Procedure

4.3.2. Prepare Tools and Check Fuel Level

- Requirements:

Please communicate with the customer before installation.
1) Ensure that there is 2 hours or more time available for the vehicle during installation.
2) Please half-fill the fuel tank, and park the car on level ground.
3) Probe cannot be installed when the temperature is below -10℃.

- Tool List:

1.Probe 	2.Extension Wire 	3. Sealing Ring and Protective Holder 	4.Cushion Gasket 
5.Hose Clamp 	6.Butter+Coupling Agent 	7.Fuse Wire 	8.WIFI TOOL (optional) 
9.Measuring Tape (prepared by yourself) 	10.Insulating Tape (Prepared by yourself) 	11.Anti rust paint (Prepared by yourself) 	12.Putty Knife (prepared by yourself) 
15.Rag (Prepared by yourself) 	16.Screw Driver (Prepared by yourself) 	17.Power Charger (Prepared by yourself) 	

- Check the fuel level in the tank
  Method 1: Check the vehicle oil meter to estimate the height of the oil tank.
  Method 2: Check the height through top orifice.

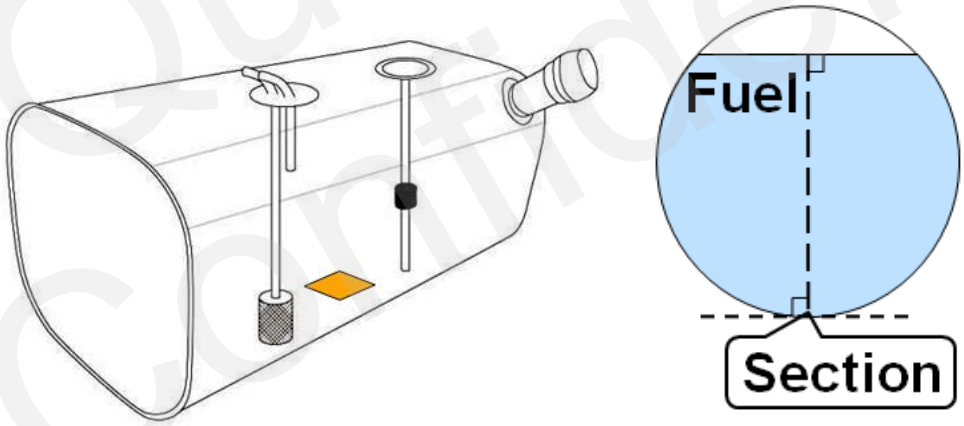
- Measure the length, width and height of the tank

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In low temperature environment, preheat the glue and probe before installation at relatively high temperature places (such as indoor air conditioning outlet, car air conditioning outlet and hand warmer).

4.3.3. Select a Probe Installation Area



- When pasting the probe, avoid the filling orifice of the fuel tank, float in the tank and other obstacles.
- The middle part at the bottom of the tank should be selected to ensure that the data is stable, as shown in the Figure on the left. Do not select the area beyond the yellow part for installation which will lead to data instability.
- Clean up the dirt and oil stain in the probe installation area, and keep the area dry.
- As the coupling agent will be frozen at 0℃, the probe cannot be installed when the temperature is below 0℃.

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4.3.4. Find a Precise Installation Location via UFS301 Diagnostic Tools

Use UFS301 Diagnostic Tools

- 1) Connect the sensor with UFS301 Diagnostic Tools first;
- 2) Connect the UFS301 Diagnostic Tools to power bank and power on. Once connected, the red indicator light is on.



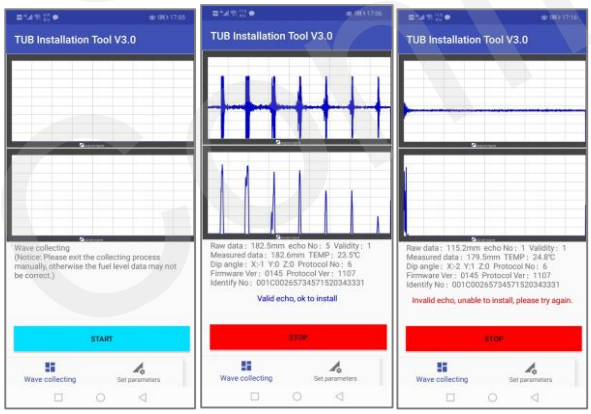
- 3) Turn on the list of available wireless networks on your mobile phone, select the network which start with USR-WIFI and click connect. Once connected, the green indicator light is on.
- 4) With Android phone, Please download and install the APP <TUB Installation Tool>; With iPhone, Please search for apps in APP Store input "TUB installation"

Note: UFS301 Diagnostic Tools is only for checking the installation position, not need to be installed, it can be reused.

Mark the installation position on the tank:

- 1) Put the couplant (pea size) on the surface of the senor (the side without the label).
- 2) Hold the sensor on the installation area, check the result on your phone.
  If the result is ok, make a circle mark with the screwdriver.
  If not, try another position.

UFS301 Diagnostic Tools - APP results



Installation requirements:

For iron tank: at least 1 echo and the installation status code should be 1 or 2.

For aluminum or stainless-steel tank:

• when the height of the fuel is < 60cm, it needs at least 2 echoes and the installation status code should be 2;

• when the height is > 60cm, it requires at least 1 echo and the installation status code should be 1 or 2.

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4.3.5. Mark the installation position on the tank

- Put the couplant (pea size) on the surface of the senor (the side without the label).
- Hold the sensor on the installation area, check the result on your phone.

If the result is ok, make a circle mark with the screwdriver. If not, try another position.

4.3.6. Install The Probe

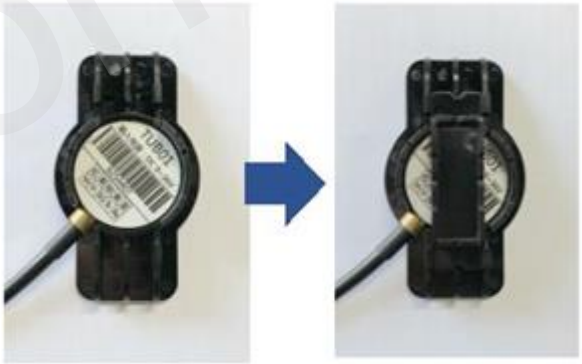
- Clean up the couplant on the fuel tank and probe surface.
- Install the protective holder , Please make sure the center of the holder matches the marked round installation position, also the holder should be parallel to the vehicle frame (chassis).



- Install the sensor
  1) Cushion gasket.

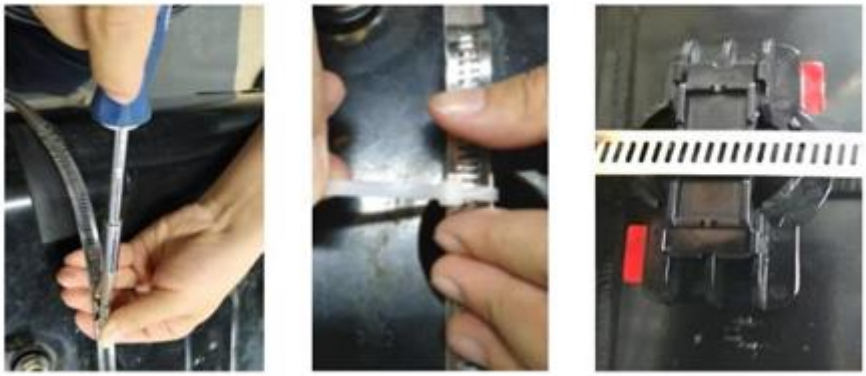


  2) Insert the sensor into the holder and install the cover plate.



- Install the steel clamp
  1) Stick the rubber pad on the four corners of tank;
  2) Fasten the steel clamp;
  3) Fasten the joint of the clamp with a cable tie;
  4) Check the installation status on the APP.

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4.3.7. Wiring

- Wire along the vehicle frame for future maintenance.
- Don't hinder the vehicle's functions of dump bucket and vehicle head maintenance.
- Connect the sensor to the extension cable, wrap the connection with insulating tape.
- Connect the fuse wire to the red wire of the extension cable.
- Fasten the extension cable to the chassis with cable ties and then connect to GPS device.

4.3.8. Connect to The Tracker

- Connect the extension cable to the tracker according to the following wiring.

Table 5: Connection with GV305CEU

Fuel Sensor	PIN Name	Color	Connect to GV305CEU	Color
Power Interface	Positive	Red	PIN 11 PWR	Red
	Negative	Black	PIN 6 GND	Black
Tracker Interface	A	Yellow	PIN 4 RS485-B	Pink
	B	Blue	PIN 5 RS485-A	Black and White
	Ground	Brown	PIN 6 GND	Black



Black cable: connect to the tracker's GND
Red cable: connect to the tracker's PWR
Yellow cable: connect to the tracker's RS485-B
Brown cable: connect to the tracker's GND
Blue cable: connect to the tracker's RS485-A

4.3.9. Check The Data on Server

- After finishing all above-mentioned steps, users can connect the tracker to the server and check the data from the fuel sensor.
- If the tank is an iron tank, it is necessary to paint the place which has been polished.

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4.3.10. Fuel Value Calibration

The fuel level value detected by UFS301 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), users should use the function of **AT+GTFSC**.

AT+GTFSC is used to configure fuel level calibration scale. For detailed information of the parameters for **AT+GTFSC**, please refer to @Track Air Interface Protocol.doc. Users need to enable Bit 3 and Bit 4 of <*ERI Mask*> in **AT+GTFRI** when using the function of **AT+GTFSC**.

First, users should configure the value of Max Tank Volume (unit: liter). For example, the Max Tank Volume of the tank is 77 liters. Then, set Num of Node to 11. Node N Value represents the fuel height detected by UFS301, and Node N Percentage stands for the fuel percentage corresponding to the fuel height detected by USF301. For example, if the fuel height detected by UFS301 is 0, then the corresponding fuel percentage is 0%. If the fuel height detected by UFS301 is 227.3mm, then the corresponding fuel percentage is 100%. The correspondence between fuel height detected by UFS301 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

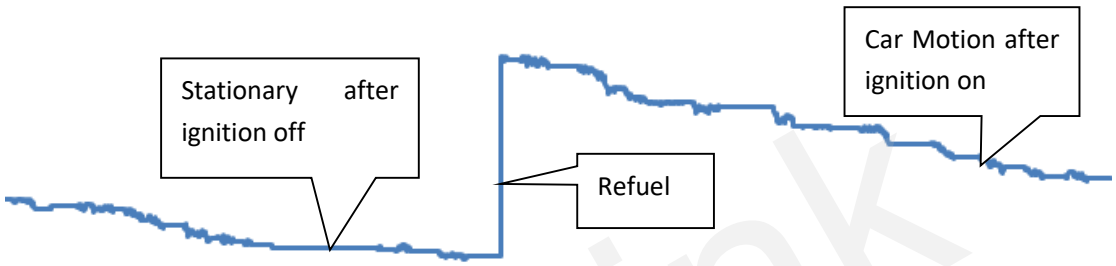
The command got finally is:
AT+GTFSC=gv305CEU,,0,4,1,77,,11,0,0,775,20,848,25,938,30,1019,35,1106,40,1274,50,1522,60,1666,70,2037,90,2273,100,,,,,,,,,1,20,0,100,,0,,,,,,,,,2,20,0,100,,0,,,,,,,,,3,20,0,100,,0,,,,,,,,,4,20,0,100,,0,,,,,,,,0001$

In the message of **+RESP:GTERI**, 04DF is the fuel height detected by UFS301, 48.4 is the remaining fuel percentage, and 37.3 is the remaining fuel in the tank.
+RESP:GTERI,060800,869158005181306,gv300-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,1,4,48.4,37.3,20141126111223,725F$

4.3.11. Test Application

Connect UFS301 to GV305CEU and install them in the car for test. Then set **GTFRI** report interval to 10S and enable Bit 0 of <*ERI Mask*>. In this case, GV305CEU will report one **+RESP:GTERI** message every 10S. Users can extract fuel level data from the message and convert them into diagram:



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5. Dos and Don'ts

- Pay attention to 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.

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.

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