

**Technical description of the fuel tank sensor  
"Escort TD-150"**

Kazan, 2017

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## 1. General info.

The sensor converts a level in digital code. Depending on the mode of operation sensor translates value through the interface RS-485, as a frequency or analog signal.

## 2. Technical characteristic.

1. Measurement error in the effective range is not more than	1%
2. Resolution of the output signal	0.1%
3. Measured media	petrol and diesel
4. Protocol of digital output	RS485,19200 bps
5. Frequency range of the output signal*	300 ...1323Hz
6. Range of output voltage	0.2 ... 9.5V
7. Power supply	+ (10...75)V
8. Consumption current is not more than	30mA
9. Sensor weight is not more than	0.5kg

\* «Range 4096» provides output signal 300...4395 Hz

## 3. Modes of operation.

The sensor can operate in one of two modes:

### a. *RS-485 mode.*

The sensor waits for a request from an external device in this mode. After 2... 3 milliseconds after receiving the request the sensor sends a response that has information about the level and temperature.

*Only those requests can be serviced whose network address agree to the address recorded in the sensor.*

### b. *Frequency mode.*

The sensor continuously generates a frequency conforming to the measured level. Zero level has a frequency of 300 Hz. Maximum level conforms to the frequency of 1323 Hz. Incorrect installation of maximum frequency can be higher or lower than 1323 Hz.

Frequency begins to form in 60... 90 seconds after the sensor powered on.

### c. *Analog mode.*

The sensor generates an analog voltage conforming to the measured fuel level. Zero level has a voltage of 0.2 V. The maximum level conforms to 9.5 V.

## 4. Software settings

Use the program "Escort sensor tuning 2.6.3" to configure the fuel level sensor. The program window is shown in Figure 1. (when the sensor is connected (refer to 5.1 paragraph))

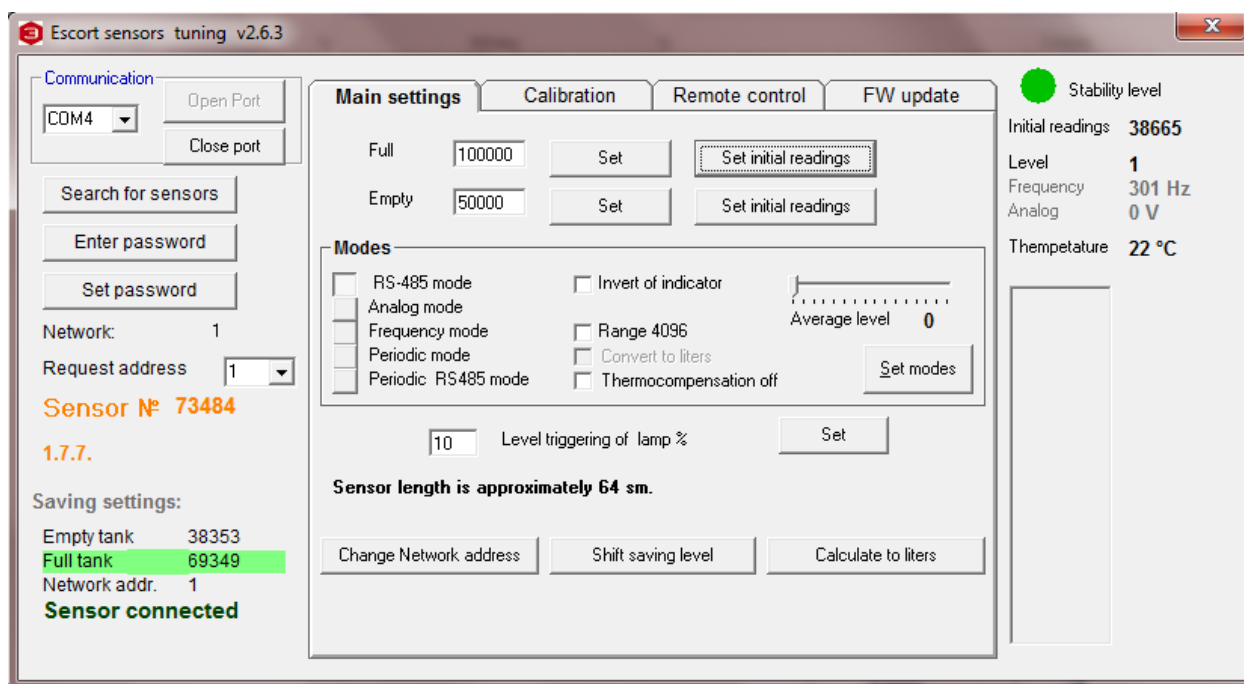


Figure 1. Settings window

### Communication section:

- **Open port** – activates communication sensor port (converter USB-RS485)
- **Close port** – closes communication sensor port
- **Search for sensors** – indicates connected sensors and the Network addresses
- **Set password** – sets the password for protection of unauthorized settings changes
- **Enter password** – enters password before every settings change if it was previously set
- **Network** – displays the list of network numbers of connected sensors
- **Request address** – selects the network number of the sensor to be configured
- **No** - displays the serial number of the active sensor.
- **Firmware** – displays the firmware version of sensor

### Saving settings section:

- **Empty** – displays the readings set for the minimum level
- **Full**- displays the readings set for the maximum level.
- **Network address** – displays the network address of sensor
- **Sensor connected** – indicates the connected sensor (if the sensor is not connected: «No answer from the sensor with addr.0»)

### Main settings tab:

- **Full/ Empty** – sets the entered Full/Empty readings (entering Full/Empty readings manually is not applicable)
- **Set** – setting entered Full/Empty readings
- **Set initial readings** – sets initial readings

### Modes section:

The new mode will be set after you click **Set modes**

- **Mode RS485** – switch the sensor output for RS-485 mode.
- **Frequency mode** – switch the sensor output for frequency mode.
- **Analog mode** – switch for the sensor output for analog mode
- **Average level** – switches smoothing of measurements. There are 15 levels of averaging. Every level increase time of smoothing for 10 seconds. (the recommended level - 4)
- **Range 4096** –selecting this mark switches a measuring range from 0 to 4096 units. Otherwise the measuring range is from 0 to 1023 units.
- **Thermocompensation off** – switches off the algorithm of thermal compensation. Thermocompensation is adjustment of the fuel level graph in reference to temperature change.

**We do not recommend to switch off the thermocompensation. It is recommended for large size fuel tanks where temperature of lower layer differs from upper one.**

- **Change Network address** – changes the network address of a sensor
- **Shift saving level** – adds specified shift to previously set levels.

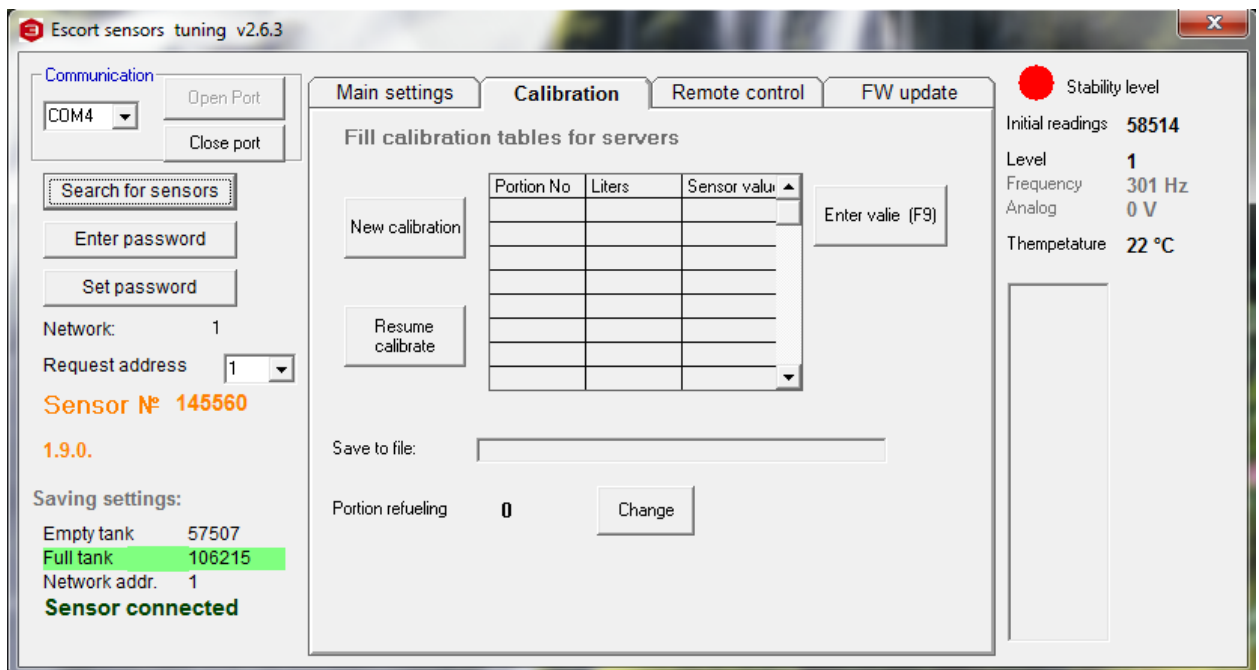


Figure 2.

### Calibration tab:

- **New calibration** – starts calibration process
- **Enter value (F9)** – enters the level readings into the calibration table
- **Resume calibrate** – resumes calibration process if the settings got busted, got stucked or crashed, etc.
- **Save to file** – displays the name of file for recording calibration table
- **Portion refueling** – displays refueling portion
- **Change** – opens the window for changing calibration portion

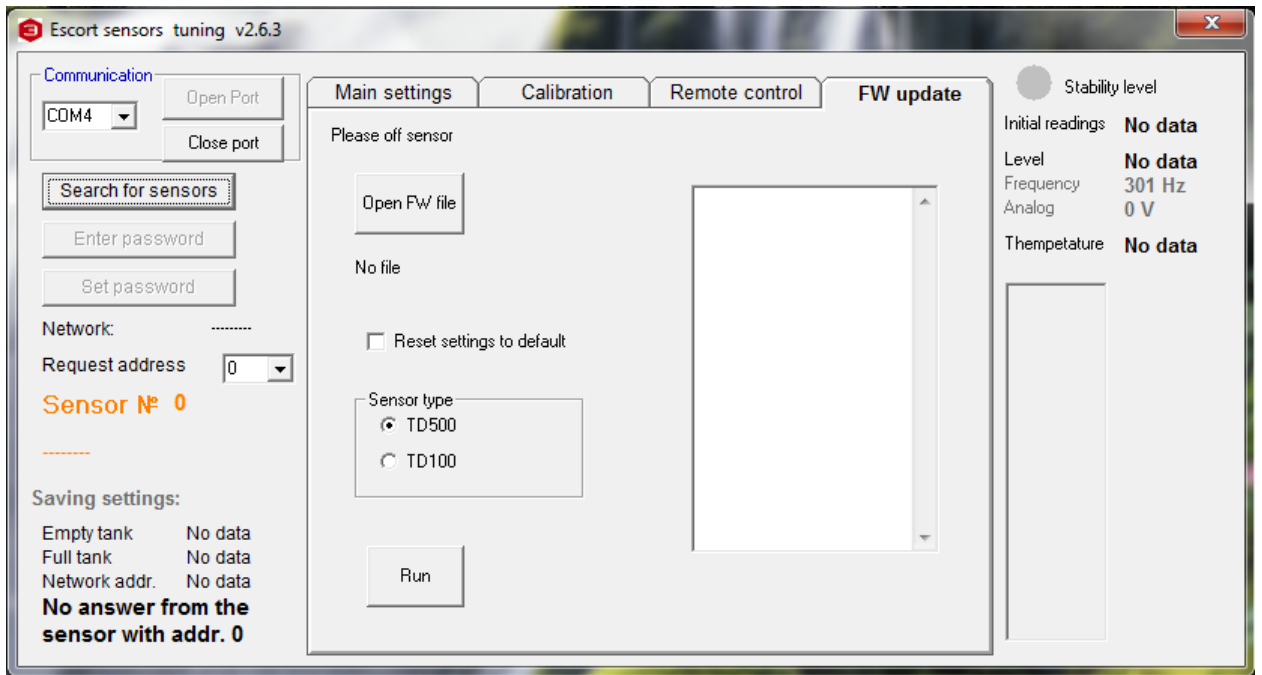


Figure 3.

**FW update tab:**

- **Open Firmware file** – opens firmware file.
- **Reset settings to default** – deletes previous settings from the sensor memory.
- **Sensor type** – selects the sensor type
- **Run** – runs firmware

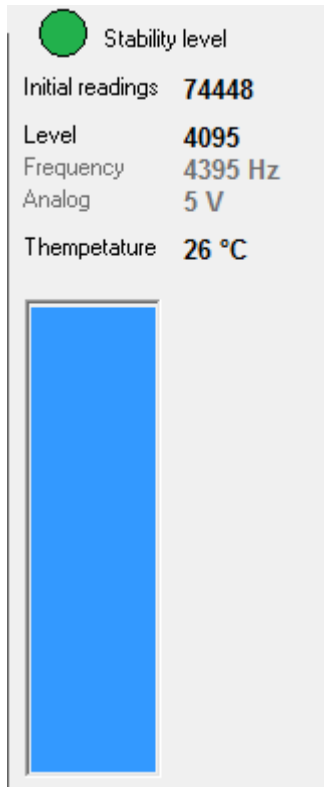
**Important !**

Use the following steps to set firmware of the sensor:

- Select in program window the port conforming to USB-RS485 converter
- Press «Open port»
- Open firmware file (has .cri extension)
- Mark «Reset settings to default» if necessary
- Select the sensor type
- Press the «Run» button
- Power on the sensor

The list of upgraded blocks should be displayed on the right side

### **Initial readings section:**



- **Initial readings** – raw value level
- **Level** – calculated value level (according to selected range 0...1023 (automatically) or 0...4096)
- **Frequency** – output frequency signal
- **Analog** – output voltage (not applicable for Escort TD-100 )
- **Temperature** – temperature measured by the sensor

Figure 4.

## **5. How to configure the sensor**

**ATTENTION!** After the sensor is powered on it has RS-485 output for the first 30 seconds. This allows you to connect for setting the sensor which operates in a mode other than RS-485.

### ***5.1. Connecting the sensor for setting***

Connect your computer, converter USB-RS485 and sensor according to figure 5.

Run the setup program. Select the port conforming to converter USB-RS485 in the window. You can see it in the Device manager of the computer (Figure 5).

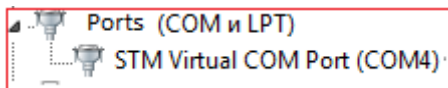


Figure 5.

**Note .** If the port number is greater than the 9, then open the «Device manager». Locate the «COM and LPT» ports and converter device. Open the properties of the port, and click «Advanced», change the number to the right one.

- Activate port (Open Port).
- Click "Search for sensors" - a list of detected sensors should be displayed. If nothing does appear, try turning off the sensor and start from the previous paragraph.
- Select the correct sensor in the drop-down list «Request address», then you can see the setting values, after 10 ...30 seconds values of temperature and «Initial readings».

### ***5.2. Setting the upper and lower levels.***

The upper and lower levels can be set if necessary, if the sensor has been cut off.

- Seal the drain hole with a tape.
- Turn the sensor and fill the measuring tubes with fuel. Make sure that the tubes are clean from the water and mud.
- Disable averaging.
- Wait for 1 minute. «Initial readings» should not be changed up to the 3<sup>rd</sup> symbol.
- Click «Set initial readings» in front of «Full» field. Initial reading should be displayed in the section «Saving settings».
- Drain the fuel and let it drain for 2 minutes.
- Click «Set initial readings» in front of «Empty» field. Initial reading should be displayed in the section «Saving settings».

**Note.** *The value «Full» should be about twice the value “Empty”, depending on the length. (Approximate value of Empty =1200 cm).*

When you set the sensor you can move fixed Empty/Full levels. This is applicable when there is no or poor access to previously installed sensor. To shift set the number to which you want to shift the fixed level, and press Shift.

For example: Full before shift was 209060, Full after shift by 100 units will be 2109060.

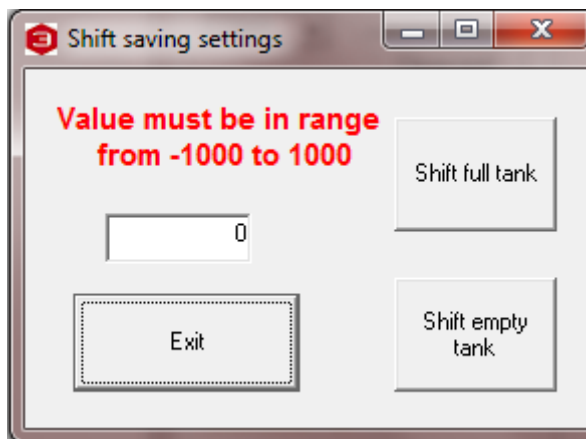


Figure 6.

### 5.3 The final setting.

- Set the correct Network address if it is necessary. The numbers are set in the range of 0 ...254. Press **Search for sensors** to get the sensor with a new number available.
- Set the required operation mode of the sensor.
- Set the measuring range 4096 if it is necessary (automatically 1 to1023).
- Set Averaging – in the most cases it is recommended during operation.
- Set a password - if there is a need to protect the sensor from unauthorized interference.

## 6. How to install the sensor.

### 6.1 Location of the sensor.

- 1) Install the sensor in the center of the tank as shown. It provides the sensor to give correct responses free from the inclination of the vehicle.
- 2) In cases where it is impossible to locate the sensor in the center of the fuel tank install as close as possible to shown in Figures. 7, 8, 9.



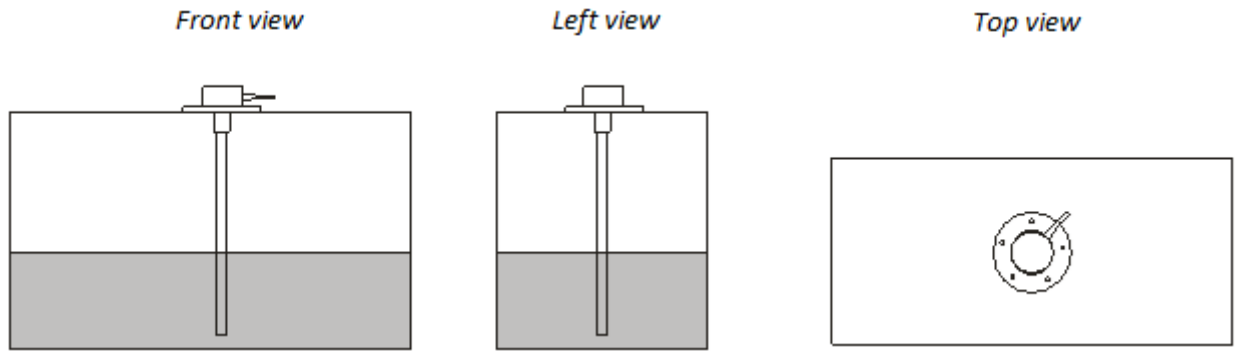


Figure 7.

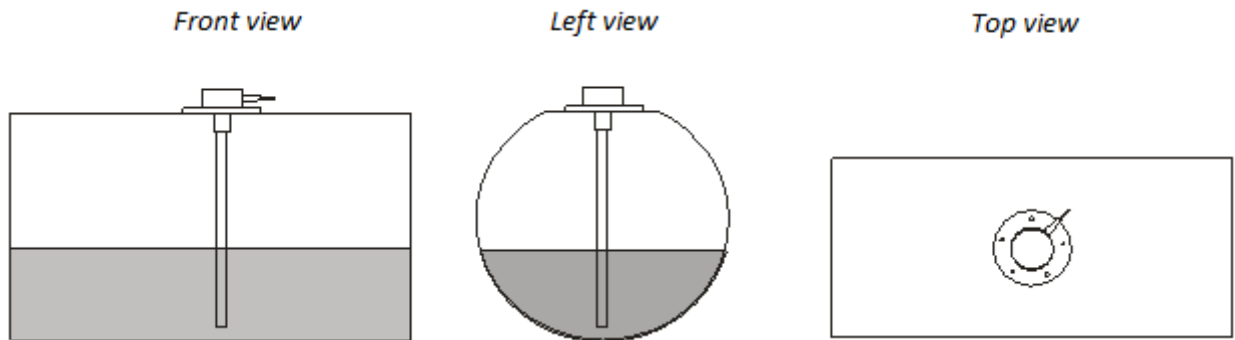


Figure 8.

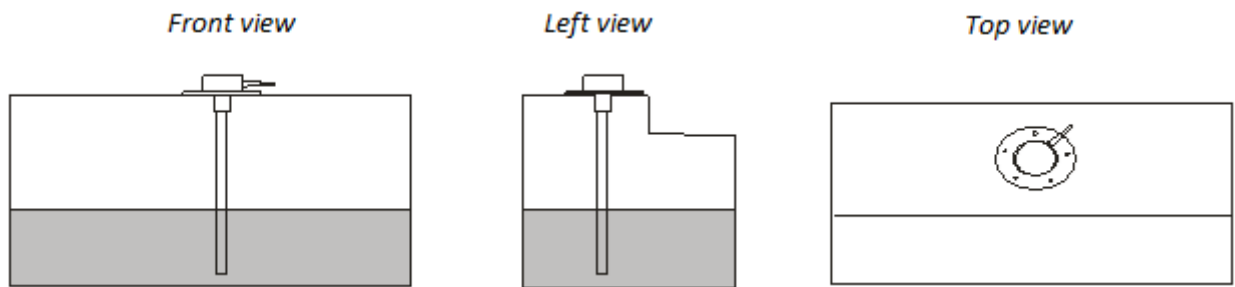


Figure 9.

3) To improve accuracy of the sensor and reduce the level variations it is allowed to install two sensors in one tank. It is commonly used in tanks with a capacity of more than 600 liters and length longer than 1500 mm. Sensors can be installed on the diagonal line at a distance of  $\frac{1}{3}$  of tank and  $\frac{2}{3}$  of tank as shown in Figure 10, 11.

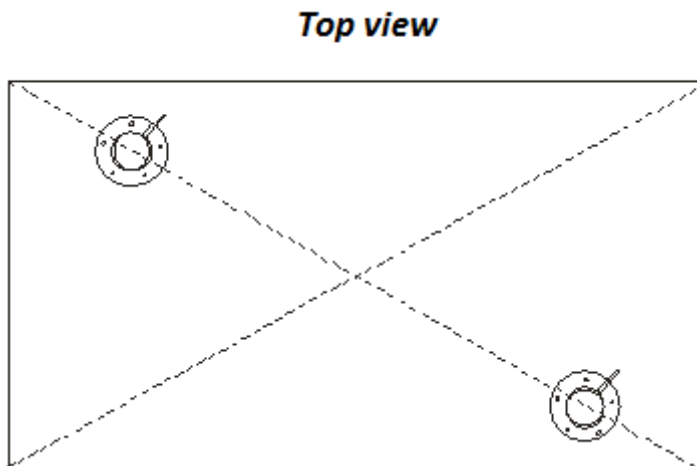


Figure 10.

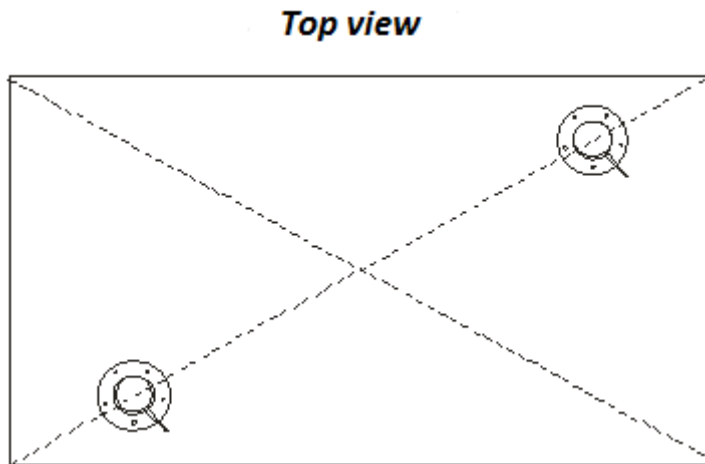


Figure 11.

### **6.2 Preparing the tank to install the sensor**

- 1) Prepare the fuel tank for the installation work in accordance with the requirements of the manufacturer and other standard documentation of safety precautions.
- 2) Make sure there are no baffle plates inside the fuel tank within a radius of 20 mm by drilling a 3 mm hole in the installation place.
- 3) Drill a hole with the 27... 32 mm diameter bimetal core bit.

### **6.3 Preparing the sensor for installation in a particular fuel tank**

- 1) Measure the depth of a fuel tank with the measuring ruler.
- 2) Measure off the length **L1** (depth of the fuel tank minus 10-15 mm) on the working length of the sensor (Fig.12).

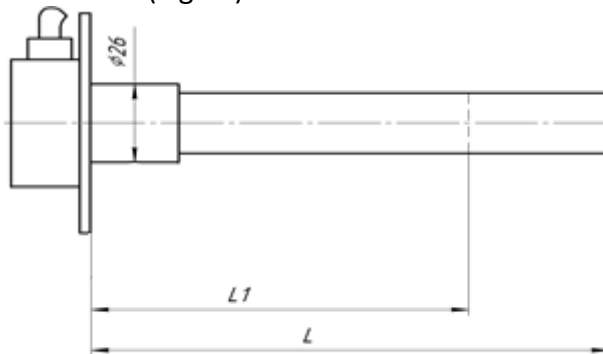


Figure 12.

- 3) Cut off the length **L1** of the sensor using a hacksaw at a slight angle in order to avoid metal chips getting inside the tubes. Immerse the sensor in and out of fuel till the middle of the tube and let it drain after each immerse. After that set the upper and lower levels. Without this setting you can get what is called «blind zones».

### **6.4 Details of the connection**

The sensors are supplied with a standard cable length of 70 cm. Cable can be extended with the PVS-wire 4x0,75, laid in the channel.

Wire connections outside the cabin must be insulated to avoid contact of copper with water. For example, apply sealant to the cable connections, put the heat-shrink tubing of proper size and heat pressing out excessive sealant.

### ***Power supply connection***

Connection must be powered inside the cabin. We recommend to connect in circuit the resistor in series (Supplied in tool kit). The resistor prevents sparking of the power line of the sensor in case of insulation damage. If one power wire connected to two sensors, connect two resistors in parallel.

### ***Data output connection***

#### ***- In RS-485 mode***

Connect correctly lines A and B

Check the voltage on the lines if it is necessary. Line A voltage is 3.3 V, line B voltage is 0.4 V.

***WARNING! Do not let the long standing of voltage on the lines A and B.***

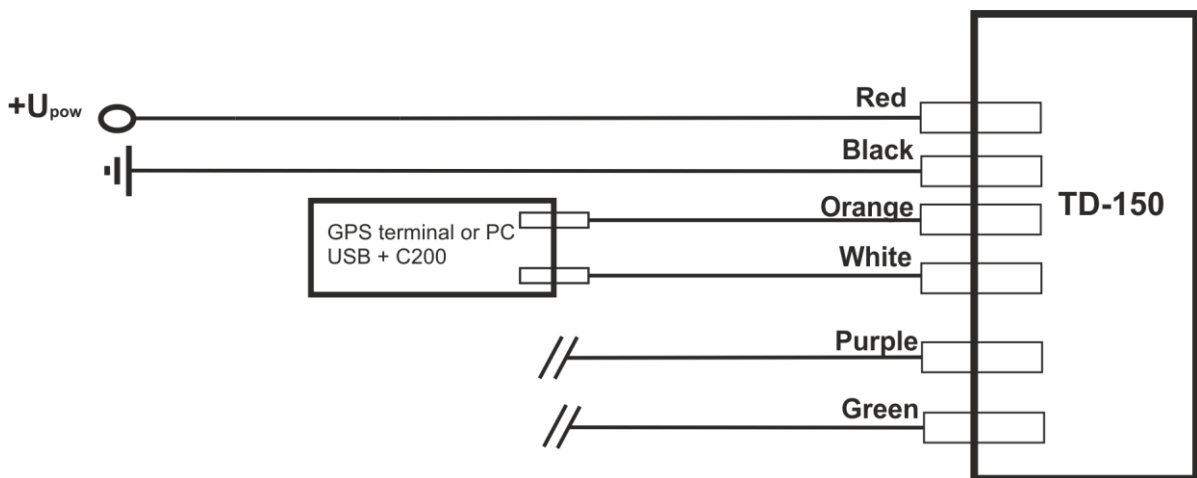


Figure 13. Connection in the RS-485 mode and by programming.

#### ***-In the frequency mode***

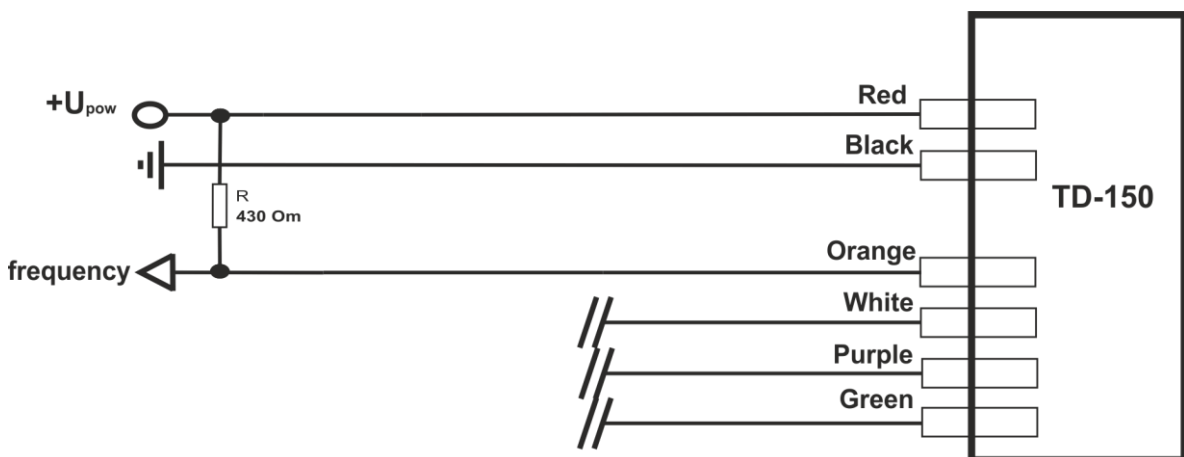


Figure 14. Connection in the frequency mode

**Important ! For using in hazardous areas it is necessary to fix extra protection circuits:**

There is a galvanic isolation, so there is no need the minus of the sensor and the minus of the GPS terminal to be connected. For example, «-» of the sensor is connected to the ground of the vehicle and «-» of the terminal is connected to «-» of the accumulator in a cars with switchable ground.

Check the voltage on the orange wire of the sensor if necessary. In this mode the DC voltage – 2.5 V and is independent of the fuel level.

**-In the analog mode**

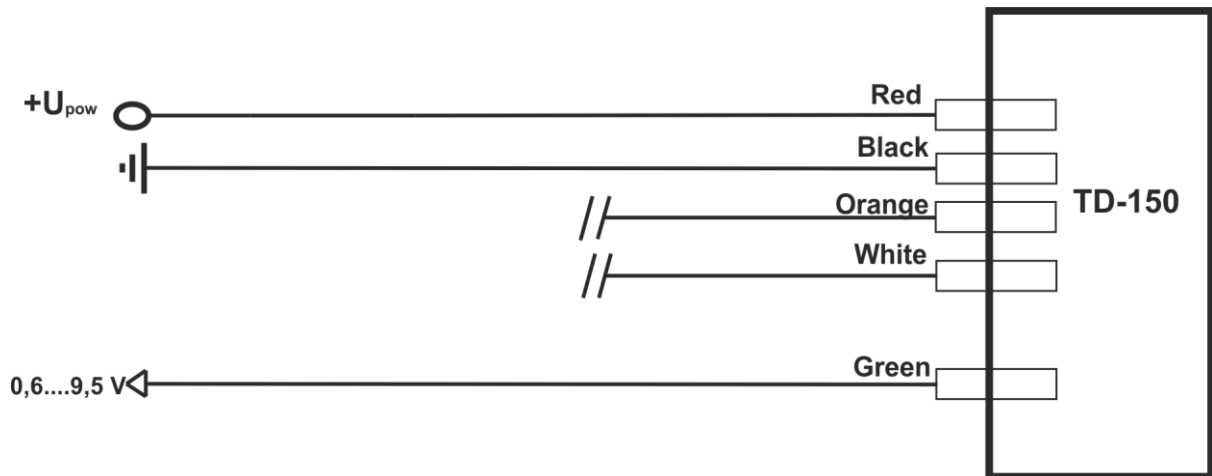


Figure 15. Connection in the analog mode

**6.5 Collaboration with digital Indicator**

Digital indicator allows you to connect up to 4 sensors simultaneously. It is an intermediate link between the terminal and the sensor. Indicator takes level readings from sensors in RS-485 mode and displays the volume in liters. For conversion level to liters calibration table of the indicator is used. The indicator has a frequency or analog output. For details see the description of the indicator.

**7. Details of the fuel tank calibration**

The sensor has a linear characteristic. If rectangular shape of a fuel tank the upper and lower level can be set in the calibration table in the software (at discretion of the installer).

The time of the calibration is dramatically increased when averaging is set. Remember that at a constant average time of 2 minutes you must wait for 15 minutes between each portion of fuel. If it is possible deactivate averaging during calibration using the setup program.

If you can not deactivate averaging, you can reduce the time of calibration as follows.

**Averaging is not in operation for the first 2 minutes after the sensor is powered on.**

Use this property and turn off momentarily the sensor after pouring each fuel portion. It is easy to do in vehicles with switchable ground by the short cutting off the ground. Then wait for 1 ..2 minutes and fix the displayed level.

**Fuel tank calibration steps**

1. Drain the fuel tank
2. Connect the fuel level sensor to the computer
3. Run the program «Escort sensor tuning 2.6.3». Click the «Calibration» tab in the program window.
4. Press «New calibration» button, enter the refueling portion value, save the file.

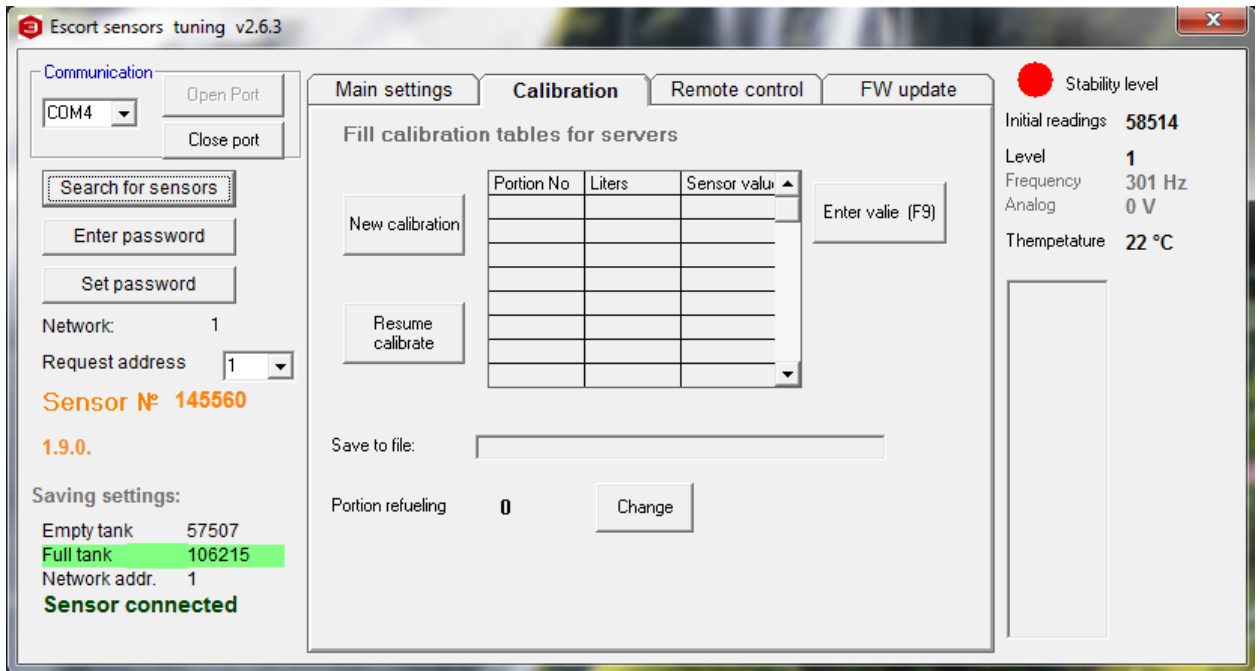


Figure 16.

5. Fill the fuel by small portion till the readings to change.
6. Wait for the level to stabilize after each portion (green light indicator) and press «Enter value (F9)».
7. Chose the refueling pitch **n** individually according to the shape of fuel tank – the more complex shape, the smaller refueling pitch **n**. Refueling pitch can vary during the calibration. The recommended refueling pitch shown in the table (according to fuel tank volume).

Tank volume V, liters	Refueling pitch n, liters	Flow Measurement, m=V/n
0-60	3-6	10-20
61-100	5	12-20
101-500	10	10-50
501-1000	20	20-50
More than 1000	Up to capacity	

**Important ! We recommend to perform at least 10 flow measurements for accurate readings.** During the fuel tank calibration the refueling portion can be changed. Press «Change» in the «Portion refueling» field and enter the value.

## 8. Error codes

The sensor has a built-in self-test system. If there is an error in level measurement caused by short circuit or broken measuring tubes, the coded error signal will be on the output of the sensor.

### **-In RS-485 mode**

the short circuit of the tubes – 7000 units.

the break of the measuring tubes – 6500 units.

### **-In frequency mode**

the short circuit of the tubes – 7300 Hz

the break of the measuring tubes - 6800 Hz

## 9. Sensor voltage table

Parameters	Unit	Standard
Resistance between ground and the negative cable of the sensor	Ohm	Not more than 10
Power supply red-black wires	Volt	10 ... 60
Supply current from an external source	mA	8 ... 15
AC voltage between the tube ends	Volt	0.35... 0.5
The voltage between the black wire and ground	Volt	Not more than 0,1
<b>In RS485 mode</b>		
Voltage on the line A (orange wire) -ground (black)	Volt	3,3
Voltage on the line B (white wire) – ground (black)	Volt	0,4
<b>In analog mode</b>		
Voltage on the line A (orange wire) -ground (black)	Volt	0,6...9,5
Voltage on the line B (white wire) – ground (black)	Volt	5-line A
Frequency	Hz	2000
<b>In frequency mode</b>		
Voltage on the line A (orange wire) -ground (black)	Volt	2,5
Voltage on the line B (white wire) – ground (black)	Volt	2,5
Frequency	Hz	300... 4395