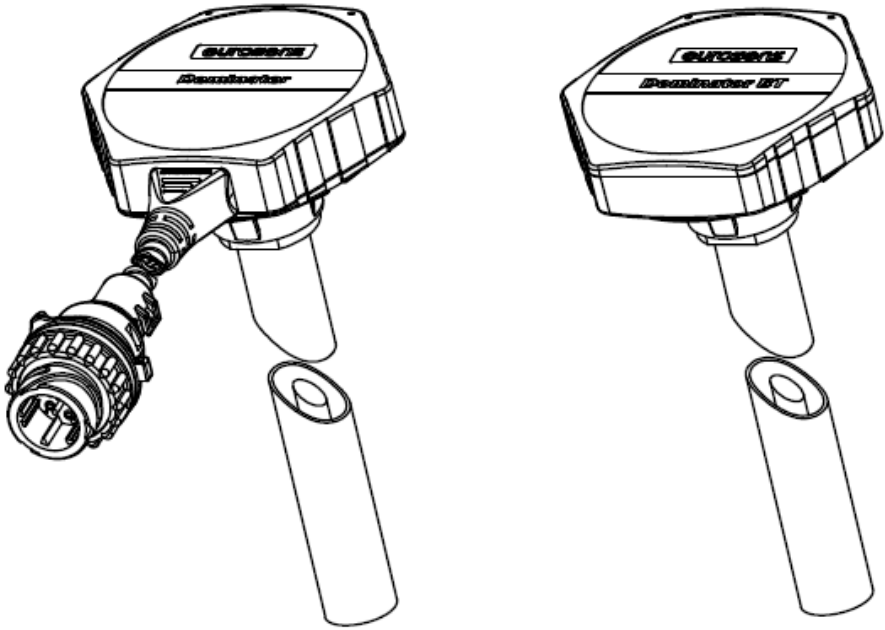


FUEL LEVEL SENSORS

# eurosens Dominator



User manual

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This User Manual applies to all modifications of fuel level sensors eurosens Dominator (hereafter: sensor(s)) developed by JSC Mechatronics, Vileyka, Republic of Belarus:

eurosens Dominator RS 485;

eurosens Dominator AF;

eurosens Dominator RS;

eurosens Dominator CAN;

eurosens Dominator AFRS;

eurosens Dominator RSCAN;

eurosens Dominator Bt.

This document provides the information on design, operation principles, functional characteristics and specifications of fuel level sensors eurosens, their operation and installation requirements.

The manufacturer guarantees that fuel level sensors eurosens comply with the requirements of technical regulations provided that the storage, operation and transportation conditions established in this manual are observed.



Manufacturer reserves the right to modify the technical specifications of fuel level sensors without any prior notice.

## 1 SAFETY REQUIREMENTS

---

Persons with the required qualification and expertise are allowed to perform the installation, verification and maintenance of sensors.

Installers and maintenance managers are recommended to undergo training at the manufacturer's site or in specialized centers to provide high-quality installation and operation of sensors.

Electric current (pumps, fuel flowmeters) and drilling tools can be hazardous during the installation of sensors in Ex areas.

## 2 DESCRIPTION OF SENSORS

---

### 2.1 USE

Sensors eurosens are designed to measure fuel level in tanks of vehicles and in stationary units. The sensors are used in fleet management systems to monitor real fuel consumption, discharges and refueling.

Sensors can measure POL (gasoline, kerosene, oil), which freely move inside measuring electrodes.

The sensors for water level measurement are produced on demand.

## 2.2 MODIFICATIONS

eurosens Dominator can be ordered in the modifications described in Table 2.1.

Table 2.1. eurosens Dominator XY

X		Y	
Output interface	Interface description	Special version index	Description
RS 485	RS485		
AF	analog output, power supply 0.5-15 V (customizable, limited by power supply)	Ex	explosion-proof
	frequency output, 200-2000 Hz (customizable)		
	K-line single-wire interface		
RS	RS-485, RS-232		special version (custom length)
	frequency output, 200-2000 Hz (customizable)		
	K-line single-wire interface		
CAN	CAN 2.0 interface	Ext	special version (custom length)
	frequency output, 200-2000 Hz (customizable)		
	K-line single-wire interface		
AFRS	RS232, RS485	Mini – version with lower height of sensor enclosure. We don't use the "Mini" index with RS 485 and Bt modifications because they exist only in Mini version.	
	analog output, power supply 0.5-15 V (customizable, limited by power supply)		
	frequency output, 200-2000 Hz (customizable)		
	K-line single-wire interface		
RSCAN	RS-485		
	CAN 2.0 interface		
	analog output, power supply 0.5-15 V (customizable, limited by power supply)		
	frequency output, 200-2000 Hz (customizable)		
	K-line single-wire interface		
Bt	built-in battery and wireless interface Bluetooth Low Energy		

### 2.3 OPERATION

Fuel level sensor eurosens Dominator (fig. 2.1) consists of (a) measuring electrode(s) (1), an electronic module (2) and an interface cable (3) with an electrical connection (except Dominator Bt).

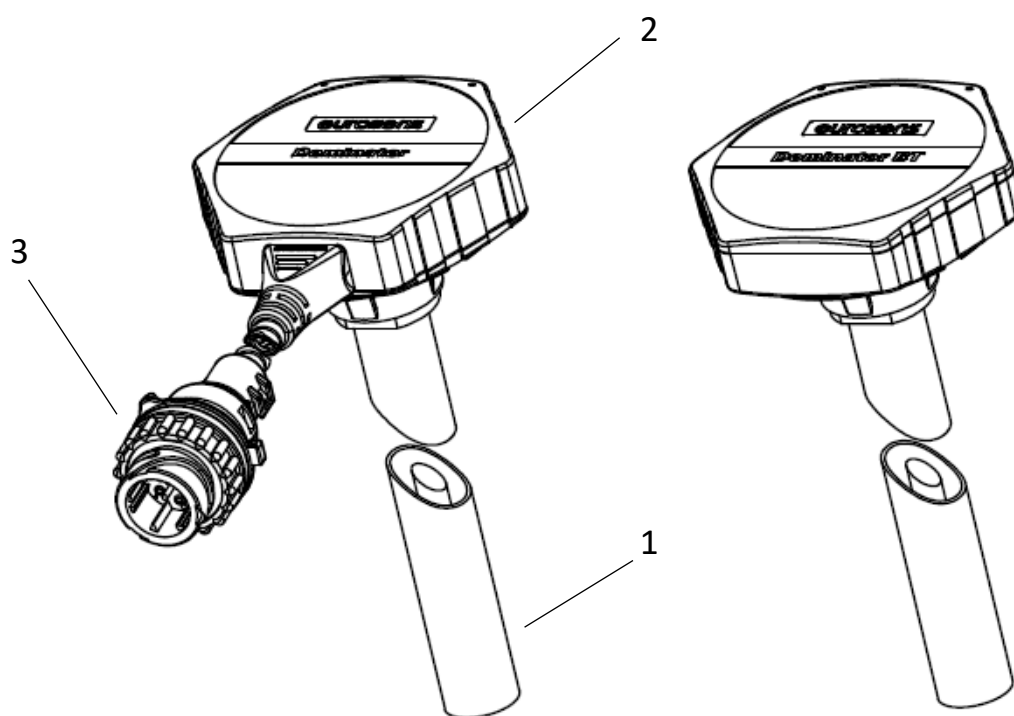


fig. 2.1. Fuel level sensors eurosens Dominator

Sensor operation is based on the measurement of electrical capacitance, which depends on how deep the measuring part of the electrode is immersed into fuel. The electronic circuit of the sensor analyzes the capacitance value at the moment, processes data and generates an output signal.

The fuel level data is converted into the fuel volume data according to the calibration table. The calibration process establishes the dependence of the fuel volume on its height in a particular fuel tank. All sensors eurosens can store a tank calibration table. After calibration the sensor output is proportional or equal to the fuel volume in the tank. Without a calibration table the output signal of the sensor is proportional to the height of the fuel level.

Built-in filtering algorithms filter readings by relevant values during fuel fluctuations. The filtering level (measurement time) of the output data can be set in the configuration software.

The sensor has built-in thermal correction algorithms that compensate changes in sensor design and properties of the fluid caused by temperature. Thermal correction works over the entire range of operating temperatures (from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ).

### 2.4 DESIGN

Sensors eurosens Dominator are of a modular design. The sensor is fastened to a bayonet mount attached to the tank with screws ([fig. 2.2](#) and [fig. 2.3](#)).

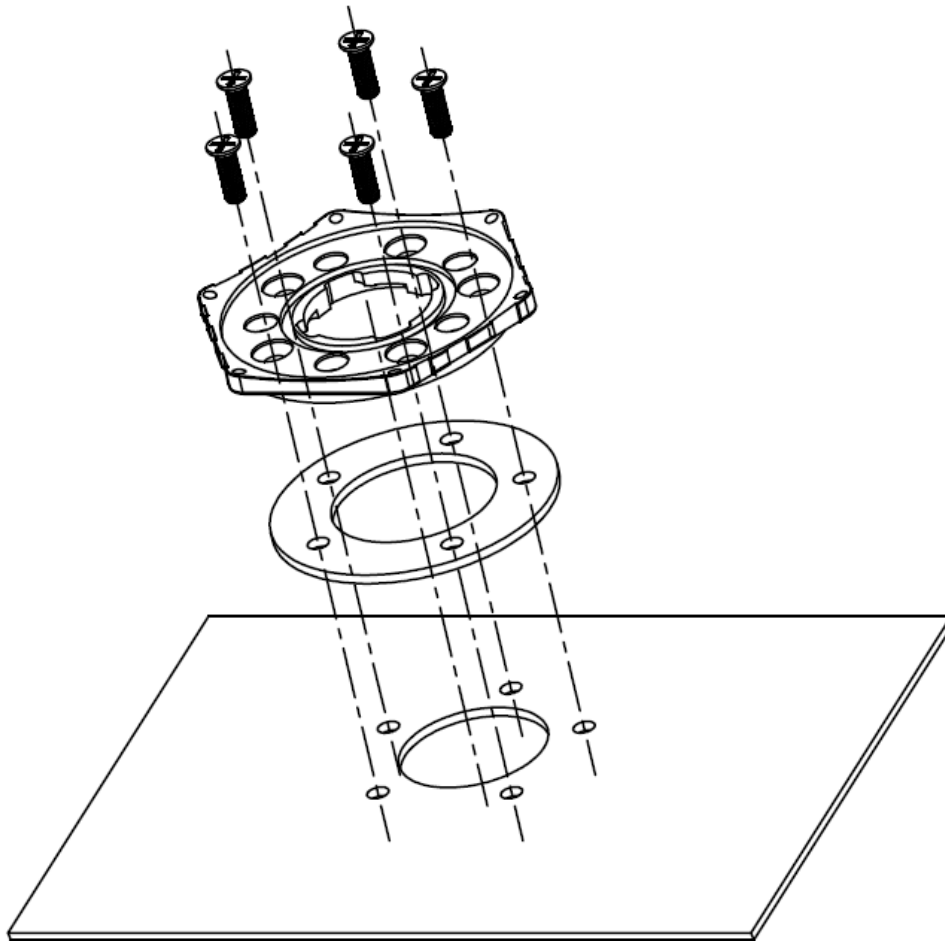


fig. 2.2. Bayonet mount installation

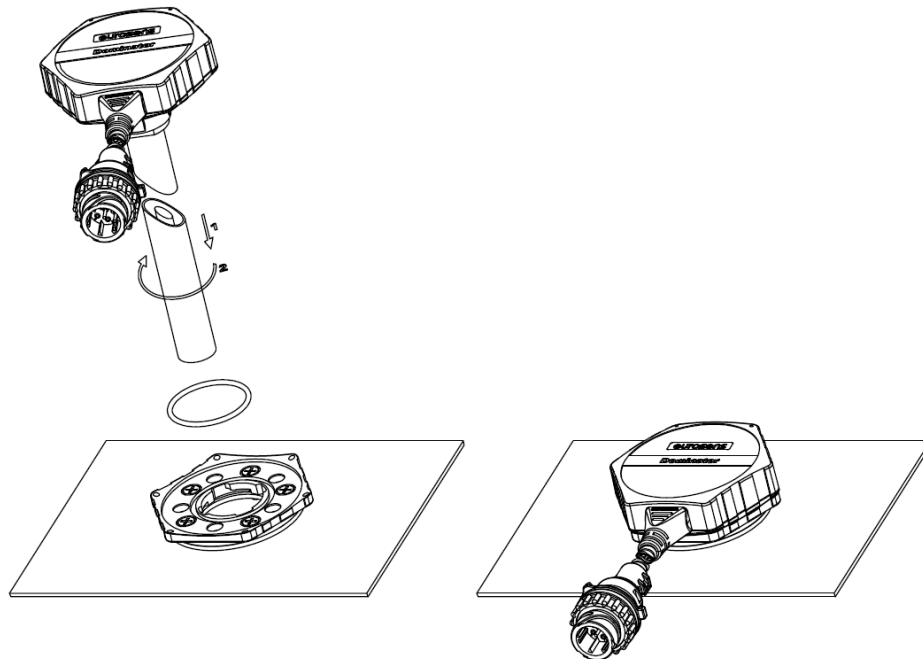


fig. 2.3. Sensor fastening to bayonet mount

You can disconnect measuring electrodes using thread connection ([fig. 2.4](#)).

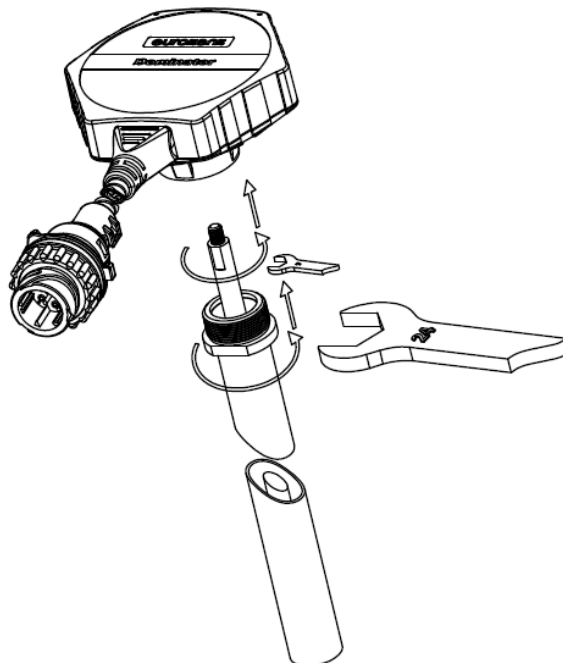


fig. 2.4. Disconnection of measuring electrodes

Use the bottom stop spring (supplied with the sensor) to reduce sensor swaying in large tanks (fuel tankers) while moving ([fig. 2.5](#)).



fig. 2.5. Bottom stop installation

The installed sensor is sealed (with the seals from the mounting kit) to protect it from cable disconnection and removal from the bayonet mount ([fig. 2.6](#)).

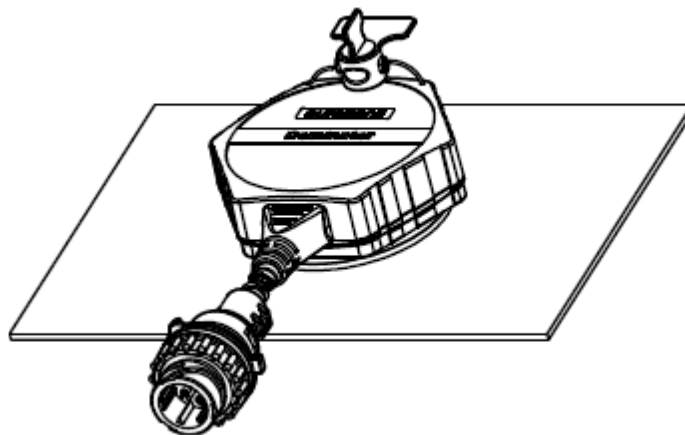


fig. 2.6. Sensor sealing

## 2.5 MEASURING ELECTRODES

Install the sensor in the tank so that the distance  $h2$  (fig. 2.7) between the bottom of the tank and the bottom edge of the measuring electrode is:

- $h2=25$  mm (if the bottom stop is installed), or
- $h2=10$ mm (if the bottom stop is NOT installed).

You can choose the length of a sensor electrode  $L$  from a standard range:

- $L$  is 700 mm,
- $L$  is 1000 mm,
- $L$  is 1500 mm,

and cut it or extend it to the length that you need.

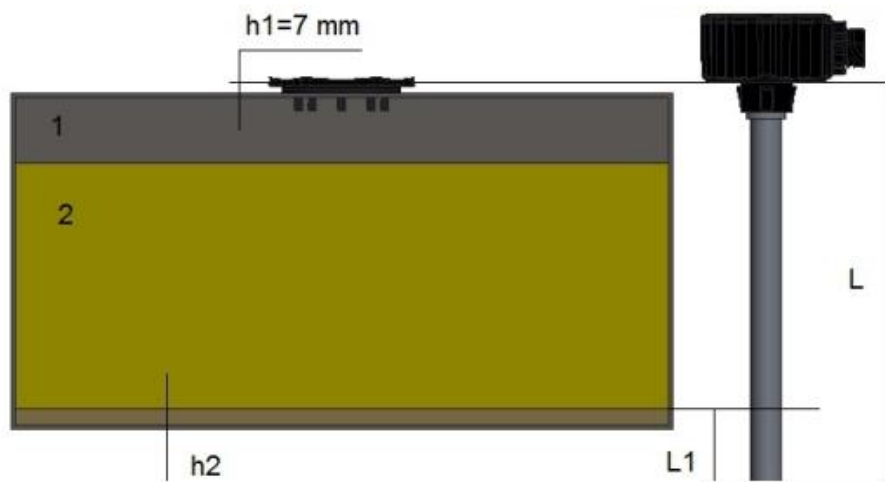


fig. 2.7. Sensor length

Sensors can be supplied assembled with measuring electrodes or without them. A measuring electrode can be ordered as a separate item.

There are 2 types of measuring electrodes (fig. 2.8):

1. Electrode 1:
  - has 1 threaded bushing;
  - is always the last (the lowest) electrode;
  - can be cut to the length you need;
2. Electrode 2:
  - has 2 threaded bushings;

- designed to extend the sensor: if there are several electrodes of the type Electrode 2, they can be connected consecutively and extend the sensor to the required length.

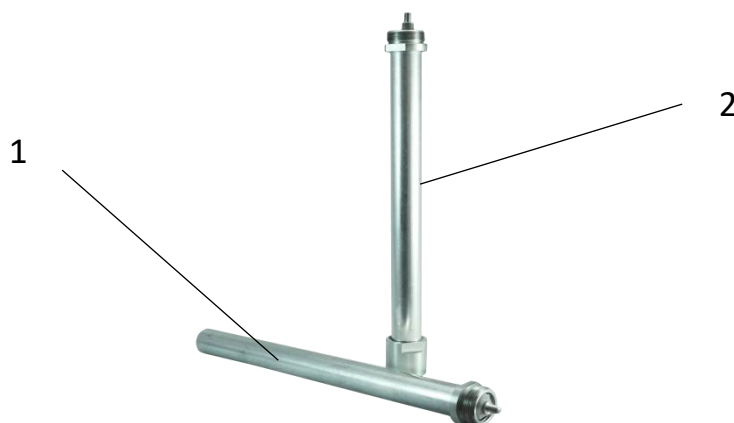


fig. 2.8. Electrode 1 (1) и Electrode 2 (2).

Measuring electrodes Electrode 1 and Electrode 2 have standard lengths of 700 mm, 1000 mm, and 1500 mm.



E.g.: it is necessary to install the sensor on a fuel tank with a height of 2,7 meters.

The following combinations of electrodes can be used:

- Electrode 1 (1000mm) x 1pc + Electrode 2 (1000mm) x 1pc + Electrode 2 (700mm) x 1pc, **or**
- Electrode 1 (1500mm) x 1pc + Electrode 2 (1500mm) x 1pc, **or**
- Electrode 1 (1500mm) x 1pc + Electrode 2 (700mm) x 2 pcs, etc.

Assembly procedure of measuring electrodes eurosens ([fig. 2.9](#)):

- pull the inner electrodes (rods) towards each other (1);
- fix the lower inner electrode into the upper inner electrode using thread connection (2);
- slide up the outer electrodes (3) and fix them using thread connection (4).

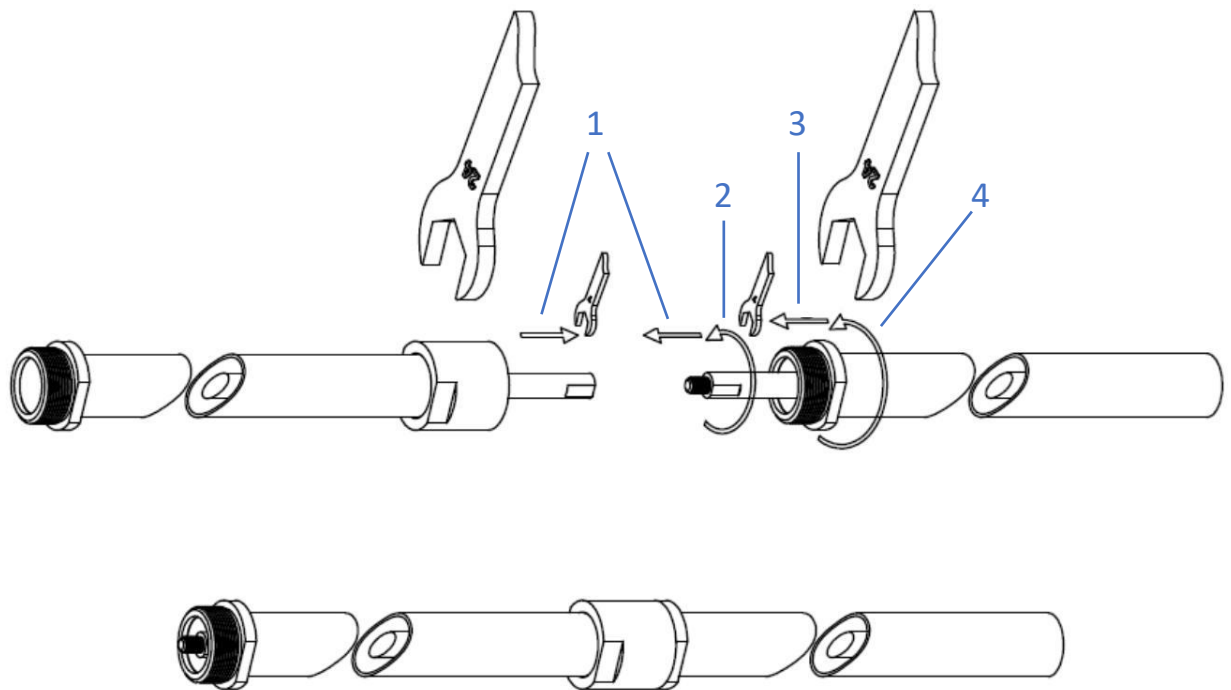
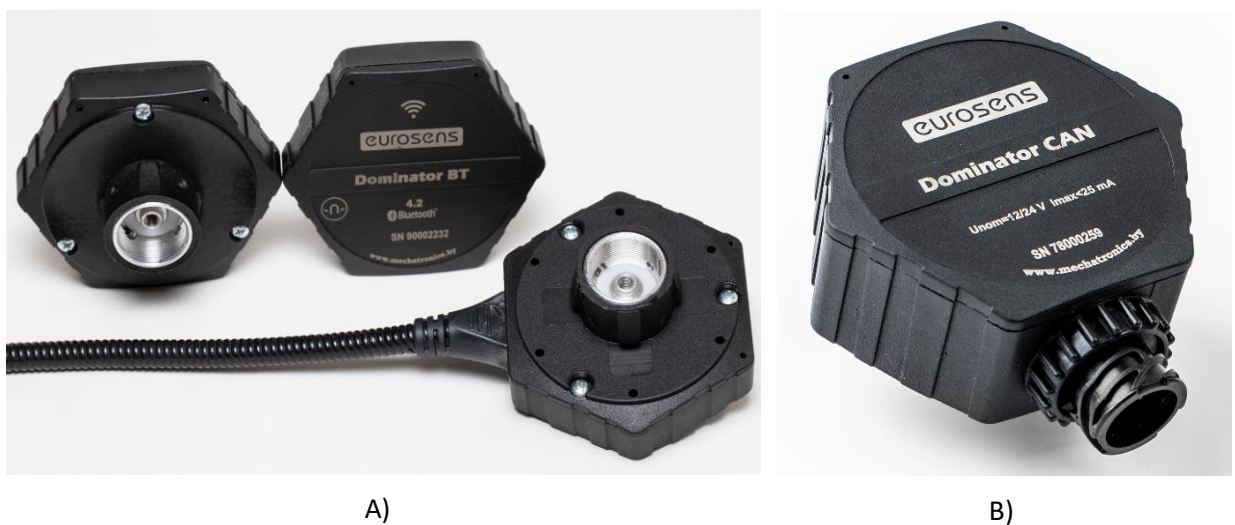


fig. 2.9. Extension of Electrode 1 (left) by Electrode 2 (right).

## 2.6 DIMENSIONS

Dimensions are given in [Appendix I](#).

eurosens Dominator sensors of AF, RS, CAN, AFRS versions are available in both standard and Mini versions with reduced overall height ([fig. 2.11](#)). Sensors of RS 485 and Bt versions are only available in Mini version.



A)

B)

Fig. 2.10. Appearance of Mini (A) and standard (B) versions

## 2.7 SPECIFICATION

Table 2.2. Specification of eurosens Dominator RS 485, AF, RS, CAN, AFRS

Parameter, measurement unit	Value
Measurement range, mm	20-1500 (with single electrode) 20-10000 (with composite electrodes)
Power supply, V	10-50
Reverse polarity protection	Yes
Measurement error	±1%
Data averaging period, sec	1-300
Signal output Range	see chapter 2.8
Max current consumption at 12 V, mA, no more	50
Max current consumption at 24 V, mA, no more	25
Ambient operating temperature, °C	- 40 ... + 85
Electromagnetic compatibility	UNECE Regulation № 10 (05), TR CU 020
Galvanic isolation of measuring electrodes from external circuits	Up to 1500 V
Ingress protection rating	IP67
Cable length	7m, other length on request
Tank calibration in sensor memory	supported
Explosion proof certificate	0ExiiaIBT6 X

Table 2.3. Specification of eurosens Dominator Bt

Parameter, measurement unit	Value
Built-in power battery	ER14505H, 3.6 V
Internal battery life, years	5
Measurement error	±1%
Data averaging period, sec	4, 8, 16, 32, 64, 128
Data sending interval, sec	2-1800
Output interface	Bluetooth BLE
Data transmission protocol	Advertising packages
Data transmission range	up to 200 meters
Transmission power	+8 dBm
Ingress protection rating	IP 67
Ambient operating temperature, °C	- 40 ... + 85
Electromagnetic compatibility	ECE Regulation № 10 (05)

## 2.8 WIRED INTERFACES SPECIFICATIONS

### 2.8.1 eurosens DOMINATOR RS 485

The sensor eurosens Dominator RS has a serial interface RS-485 and supports eurosens Dominator protocols (LLS) and MODBUS RTU ([Appendix II](#)). Data transfer rate is from 1200 to 115200 bps (can be set in the configuration software).

Fuel volume output range is:

- for LLS protocol: from 0 to 65535 (adjustable);
- for the MODBUS protocol: according to [Table II. 1](#) in Appendix II.

The eurosens DOMINATOR RS 485 sensors are configured using eurosens Destination 02/CAN adapters or other USB/RS485 converters.

### 2.8.2 eurosens DOMINATOR AF

The sensor eurosens Dominator AF has an analog-frequency interface AF and a service single-wire interface K-line. The configurator offers to choose one of the following options for fuel level (or fuel volume) data transmission:

- Voltage within the specified range (min=0.5 V, max=20 V). The maximum voltage with a full tank should be 5 V less than supply voltage. Therefore, for a 12V on-board network it is recommended to set the maximum output voltage to 7 V.
- Frequency within the specified range (min=200 Hz, max=2000 Hz). The frequency signal can be either pulled up to the power supply, or without pull-up (short circuit to minus). The settings of the range and the pull-up are selected in the programming device.
- Signal output via single-wire K-line interface. Is used to exchange information between sensors eurosens, e.g., when summing up the fuel volume of several sensors eurosens.

The eurosens DOMINATOR RS 485 sensors are configured using eurosens Destination adapters via single-wire K-line interface.

### 2.8.3 eurosens DOMINATOR RS

The sensor eurosens Dominator RS serial interfaces RS-485 and RS-232 and supports eurosens Dominator protocols (LLS) and MODBUS RTU ([Appendix II](#)). Data transfer rate is from 1200 to 115200 bps (can be set in the configuration software).

Fuel volume output range is:

- for LLS protocol: from 0 to 65535 (adjustable);
- for the MODBUS protocol: according to [Table II. 1](#) in Appendix II.

The eurosens Dominator RS sensors also have a frequency interface whose properties are similar to those described in section 2.8.2.

The eurosens DOMINATOR RS sensors are configured using eurosens Destination adapters via single-wire K-line interface.

#### 2.8.4 eurosens DOMINATOR CAN

The sensor eurosens Dominator CAN transmits data via CAN 2.0 interface, SAE J1939 protocol with additions ([Appendix III](#)). Data transfer rate is from 62500 to 1000 Kbps (is adjusted in the configuration software).

The eurosens Dominator CAN sensors also have a frequency interface whose properties are similar to those described in section 2.8.2.

The eurosens DOMINATOR CAN sensors are configured using eurosens Destination adapters via single-wire K-line interface.

#### 2.8.5 eurosens DOMINATOR AFRS

The sensor eurosens Dominator AFRS has serial interfaces RS-232 and RS-485, (select one of them in the configuration software). In addition, the sensor has the interfaces of eurosens Dominator AF.

The eurosens DOMINATOR AFRS sensors are configured using eurosens Destination adapters via single-wire K-line interface.

### 2.9 WIRELESS INTERFACES SPECIFICATIONS

The sensor eurosens Dominator Bt is configured and transmits measurement results via Bluetooth Low Energy radio channel. The sensor is configured via Android app eurosens Dominator configurator. The structure of Advertising packets, which transmit data, is given in [Appendix IV](#).

#### 2.10 DELIVERY SET

The delivery set of wired sensors (Dominator RS 485, AF, RS, CAN, AFRS) is given in [fig. 2.11](#). It consists of a sensor electronic module, (a) measuring electrode(s) and a mounting kit. The abovementioned items can be ordered separately.



fig. 2.11. Delivery set of wired sensors



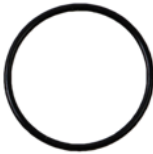








The delivery set of a wireless sensor eurosens Dominator Bt has no cable, but there is a magnetic key ([fig. 2.12](#)) to activate the service mode of the sensor.



fig. 2.12. Magnetic key

The mounting kit is the same for all models of sensor eurosens (table 2.4):

Table 2.4. Mounting kit components.

<p><b>Oil-and-gasoline resistant rubber gasket – 1 pc</b></p> 	<p><b>Bayonet – 1 pc</b></p> 
<p><b>Seal ring – 1 pc</b></p> 	<p><b>Fuse (1 A) – 1 pc</b></p> 
<p><b>Sealing – 2 pcs</b></p> 	<p><b>Sealing cable – 1 pc</b></p> 
<p><b>Screws – 5 pcs</b></p> 	<p><b>Bottom stop – 1 pc</b></p> 
<p><b>Protection cover bracket – 1 pc (optional)</b></p> 	<p><b>Cover plate – 1 pc (optional)</b></p> 
<p><b>Fuse – 1 pc (for models Ex)</b></p>	
	

## 2.11 PACKAGING

Sensors are supplied in the individual ([fig. 2.13](#)) or multiple ([fig. 2.14](#)) packages.



fig. 2.13. Individual package



fig. 2.14. Multiple package

Due to modular design the sensors can be supplied disassembled to reduce shipping costs.

### 3 WARRANTY

---

1. The manufacturer guarantees that fuel level sensors eurosens comply with the requirements of technical regulations provided that the storage, operation and transportation conditions established in this manual are observed.
2. Warranty period of operation is 24 months from the date of production. Extended warranty is available.
3. This warranty does not cover:
  - mechanical, chemical, thermal, electrical and other damages to the sensor;
  - absence of warranty seals and labels;
  - malfunctioning of the sensor due to storage, installation and use not in conformance with instructions in this manual;
  - malfunctioning of the sensor due to its installation on a defective vehicle;
  - unpacking, repairing or enhancement of sensors by unauthorized persons;
  - operation of sensors in conditions that do not conform to their technical specifications.

## 4 INSTALLATION OF SENSORS eurosens

### 4.1 BAYONET PLATE INSTALLATION

It is recommended to install the sensor in the center of the tank where it has the deepest bottom point ([fig. 4.1](#)).

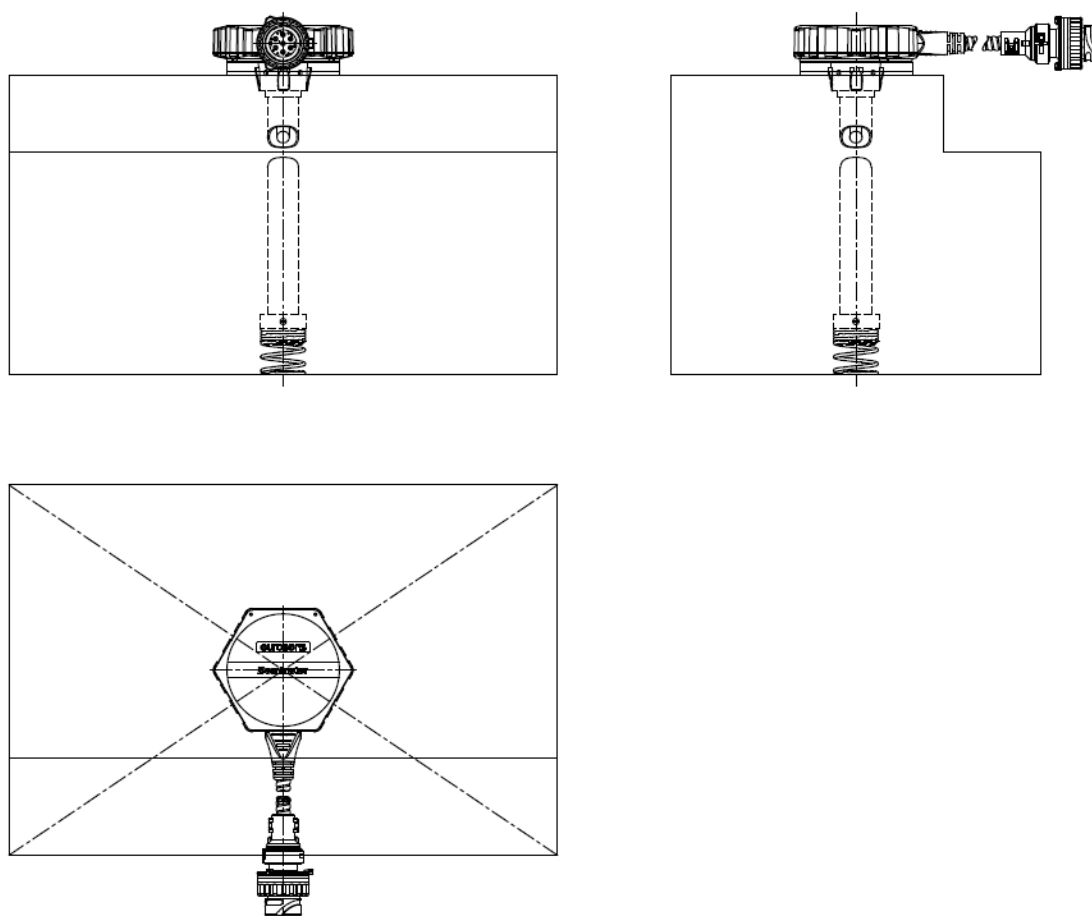


fig. 4.1. Installation recommendations



You can displace the sensor from the geometric center of a tank if it is impossible or difficult to install the sensor there, or if you are going to install the sensor in the standard hole of a tank. In this case unfavorable fuel level fluctuations will increase at the sensor location and worsen the data quality.

1. Mark the center point and drill holes for the measuring electrodes with a 38 mm bimetal drill bit ([fig. 4.2](#)).



Follow the safety rules! Gasoline tanks and large diesel fuel storage tanks must be either evaporated or filled with water before drilling.

2. Make 5 holes for screws or self-tapping screws to match the holes in the bayonet plate.



It is recommended to use screws when installing the sensor on tanks with metal wall thickness of 3 mm or more (with threading in the holes), or when installing in standard holes.

3. Place the flat rubber gasket from the mounting kit between the container and the bayonet plate.
4. Fix the bayonet plate with screws/self-tapping screws ([fig. 4.3](#)).

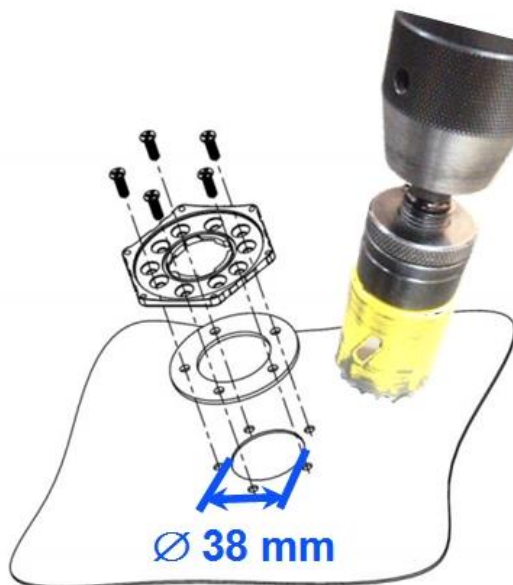


fig. 4.2. Drilled hole for sensor

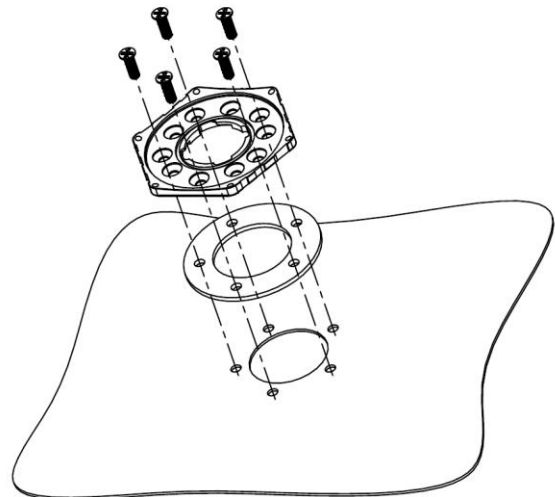


fig. 4.3. Bayonet mount

## 4.2 SENSOR CUTTING

1. Measure the distance  $S$  (through the drilled hole) between the top surface of the bayonet and the bottom of the tank.
2. Determine the sensor cutting length  $L1$  as the sensor length  $L$  (fig. 4.4 and fig. 4.5) and subtract the distance from the sensor edge to the tank bottom (30 mm if the bottom stop is installed). It is not recommended to install the bottom stop on stationary containers or if the sensor length is up to 700 mm.
3. Cut the sensor with a hacksaw.

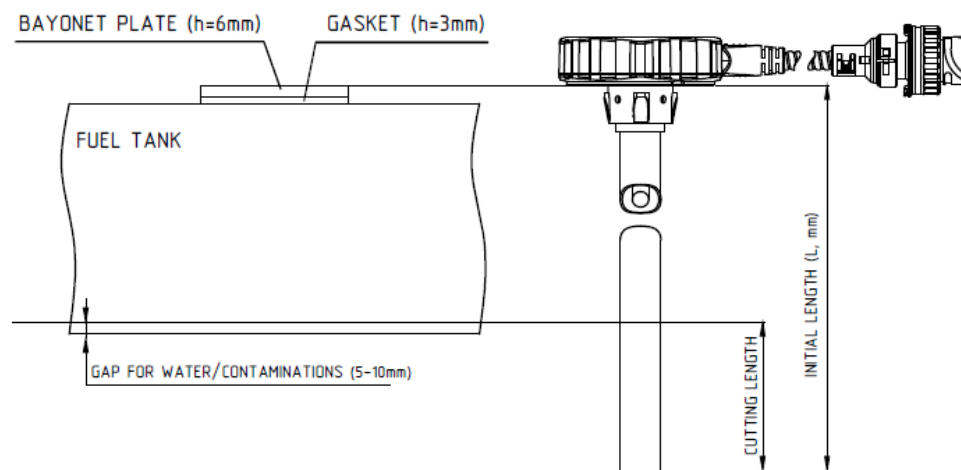


fig. 4.4. Determining sensor length

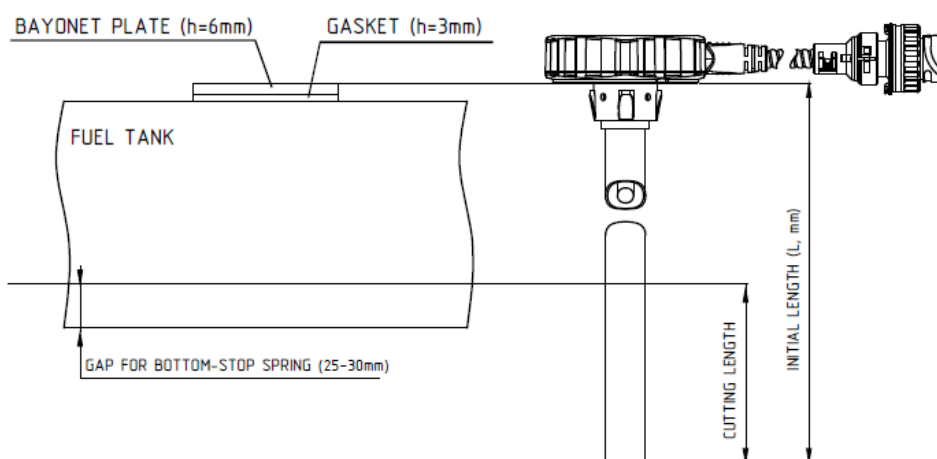


fig. 4.5. Determining sensor length



After cutting, it is necessary to carefully remove all foreign contaminants from the internal space between the electrodes. You can remove the electrodes and clean them, if necessary. ([fig. 4.6](#)).

### 4.3 SENSOR INSTALLATION

1. If necessary, connect the measuring electrodes to the electronic module of the sensor. Note that firstly you need to screw in the inner electrode (it can be pulled out of the outer electrode as shown in [fig. 4.6](#)), then screw in the outer electrode.
2. Install the bottom stop spring ([fig. 4.7](#)).
3. Place the rubber seal ring (O-ring) into the slot of the bayonet.
4. Insert the assembled sensor into the bayonet mount, press till it stops and turn the sensor clockwise until fixed (the edges of the housing should align with the edges of the bayonet plate) ([fig. 4.8](#)).

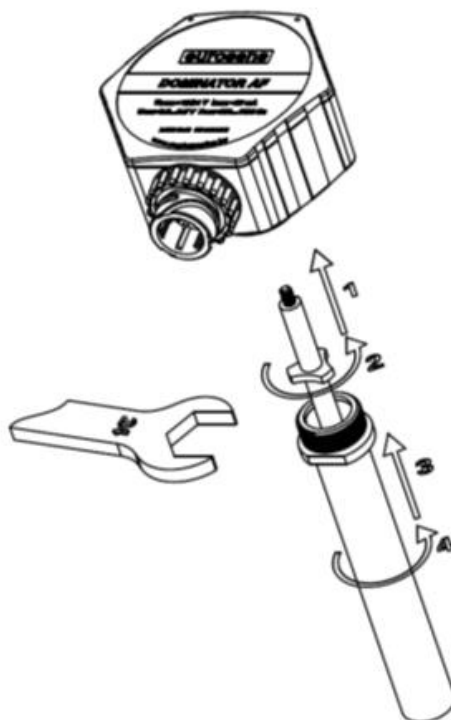


fig. 4.6. Connecting electrodes to electronic module of sensor

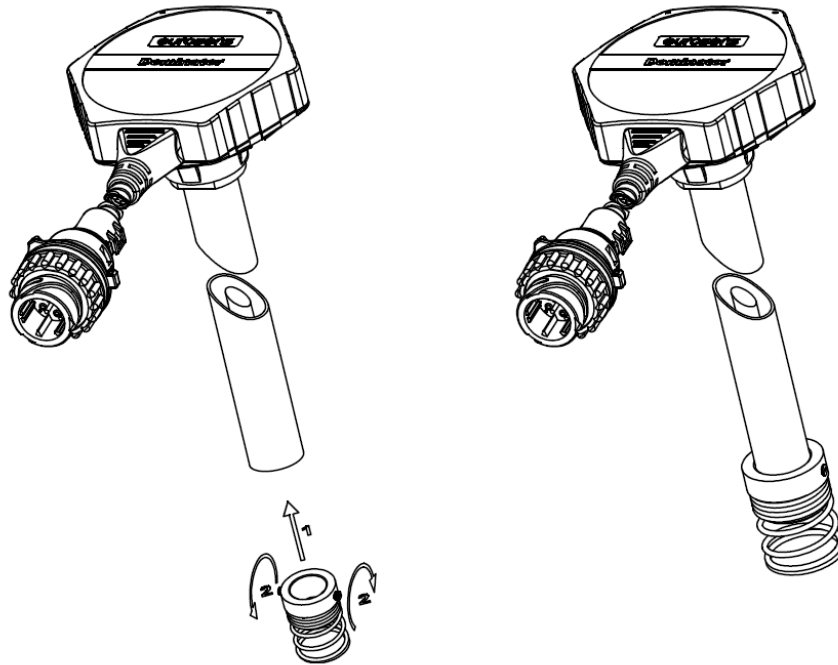


fig. 4.7. Bottom stop installation

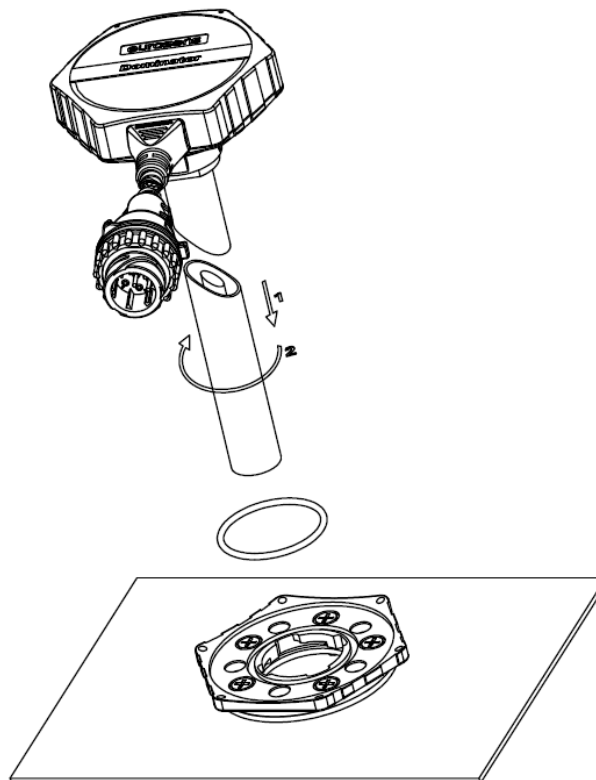


fig. 4.8. Installing sensor into bayonet



The installed sensor is shown in [fig. 4.9](#). With the bottom stop in place and the electrode properly trimmed, the sensor is about 15 mm above the bayonet mount. Compress the bottom stop spring for clamping in bayonet.



fig. 4.9. Installed sensor



If the sealant is used, its excess should not overlap the sensor case and the tank opening during operation, otherwise air from the drain holes in the top part of the sensor will not be able to return into the tank ([fig. 4.10](#)).

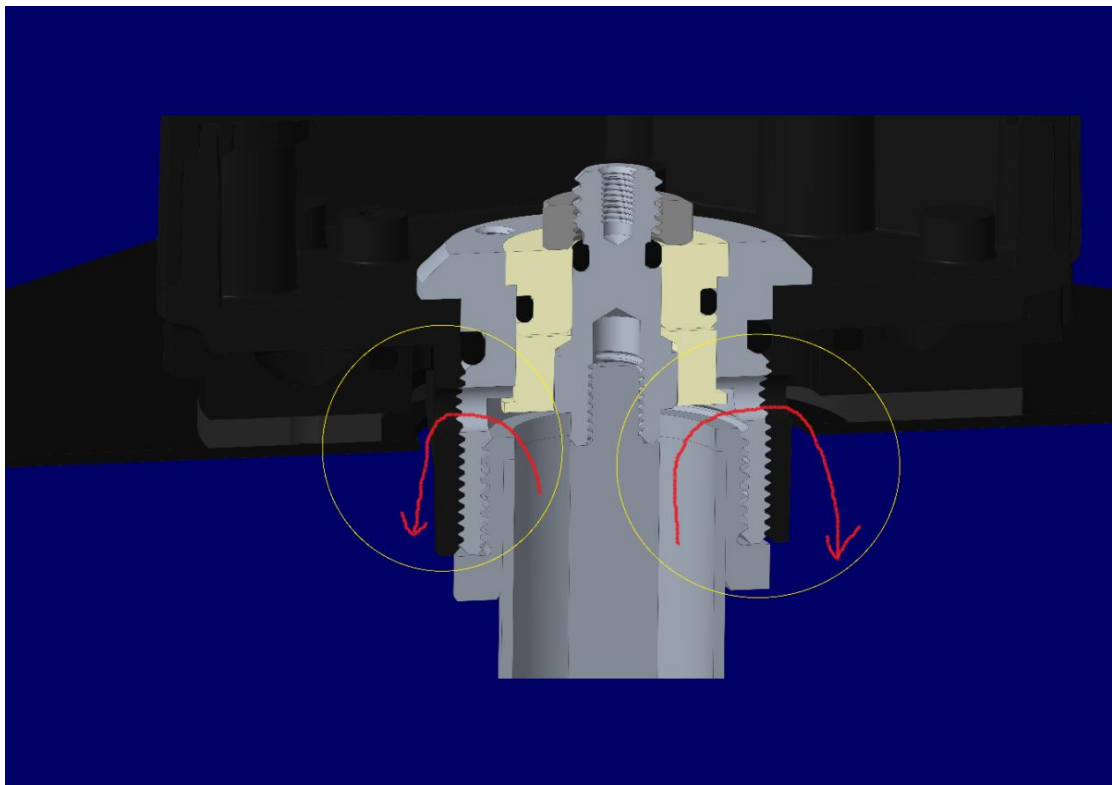


fig. 4.10. Sealant application

#### 4.3.1 INSTALLATION ON CYLINDER TANK

Sensor installation on a cylinder tank requires a shaped gasket Dominator SHIM ([fig. 4.11](#)).

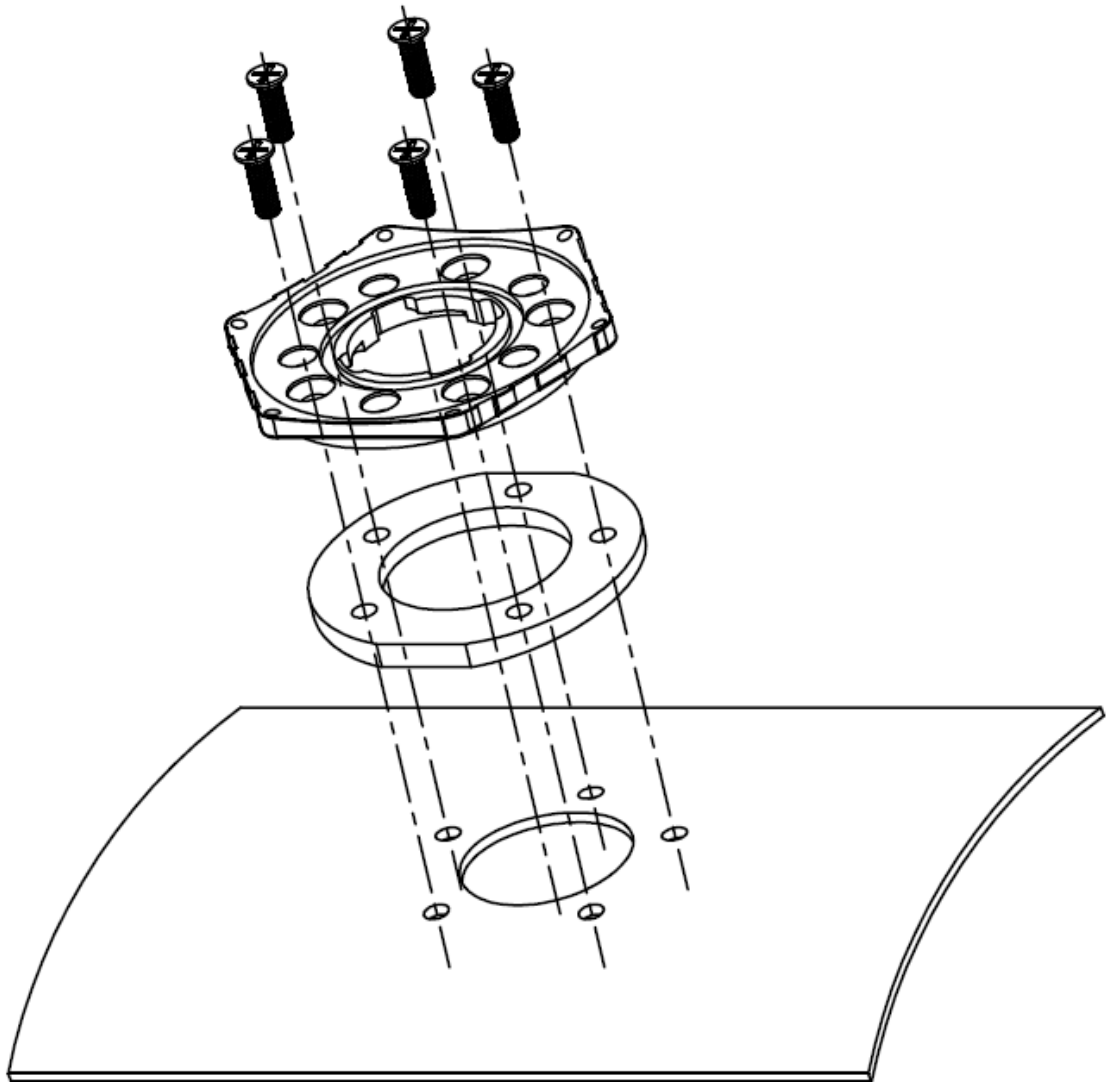


fig. 4.11. Installation on cylinder tank using Dominator SHIM

### 4.3.2 INSTALLATION OF eurosens DOMINATOR BT

The location of the data receiver is important when installing a wireless fuel level sensor eurosens Dominator Bt. Bluetooth signal is stronger if the antenna icon on the sensor ([fig. 4.12](#)) is directed to the receiver: monitoring terminal or data receiver eurosens Bt-COM.



fig. 4.12. Antenna icon

## 5 SENSOR AND TANK CALIBRATION

---

Sensor calibration means comparing the minimum and maximum values of the internal detector (at minimum and maximum fuel level) of a particular sensor with the minimum and maximum values of the output signal, which are specified in the sensor settings.

As the internal detector range shifts when sensor length is trimmed or extended, the output signal exceeds the set maximum and minimum values and cannot be displayed. Thus, a dead zone appears. The sensor is calibrated to eliminate the dead zone caused by changes of sensor length.

The fuel tank calibration converts the fuel level values into the fuel volume values and includes a conversion table that is programmed either in the sensor or on the software side.

### 5.1 SENSOR CALIBRATION

There are several ways of calibration:

- **Calibration by dipping/immersing in fuel**  
Calibrate the digital sensor in "empty" and "full" states:
  1. connect the sensor to a PC and run eurosens Dominator Configurator software;
  2. completely immerse the sensor into fuel and click the button "Full" on the tab "Sensor calibration";
  3. take the sensor out of fuel, wait until fuel drains from electrodes, and click the button "Empty" on the tab "Sensor calibration".
- **Calculated calibration**  
Calculated calibration does not require the immersion of the sensor into fuel.
- **Calibration not necessary**
  1. You don't need to carry out sensor calibration by yourself if the tank is going to be calibrated via eurosens Dominator Configurator software. In this case, the first and the last tank calibration points are automatically used to calibrate the sensor.

2. Calibration is not necessary if no dead zone is formed after changing the length of the sensor. Dead zones do not appear if the minimum output value of the sensor in the settings is set with a reserve for cutting. For example, from 1000 to 4000 conventional units (Dominator RS), from 3 to 9 volts (Dominator AF). In this case, if the sensor is cut, the range of output values is shifted down. And if the output value of the empty sensor exceeds the minimum set value, the dead zone does not appear.

## 5.2 FUEL TANK CALIBRATION

The output data of the calibrated sensor is directly proportional to **the level** of fuel being measured. A tank calibration is necessary for the data in the fuel level monitoring system to be directly proportional to (or consistent with) **the volume of fuel**.

The calibration table considers properties of a container, as well as properties of electrodes of a particular sensor.

The calibration table can be stored in the sensor or on the server side of a GPS tracking platform or another software.

Tank calibration can be performed using the methods below.

### 5.2.1 TANK FILLING OR DRAINING

Tank calibration by filling the tank (or draining it) with measured portions when the fuel level sensor is installed:

- the output signal from the sensor and the corresponding value of the fuel volume in the tank are recorded;
- calibration is performed via the software eurosens Dominator Configurator;
- the tank calibration table can be saved directly to the sensor; thus, the output values of the sensor will be proportional to the volume of fuel in the tank;
- or: the sensor can be calibrated as "full-empty", and the tank calibration results can be saved on the software side;

Tank calibration can be performed without the configurator, by looking through the sensor outputs in a data collection device or remote monitoring system.

### 5.2.2 ANALYTICAL CALCULATION

Analytical calculation of the calibration table that is based on the geometric shape of the tank is usually used for large containers, where the filling from an "empty" state to a "full" one is rather time-consuming.

For tanks of a "cistern/horizontal cylinder" type you can use the web calculator on the manufacturer's website or the calculator built into the Configurator ([fig. 5.1](#)).

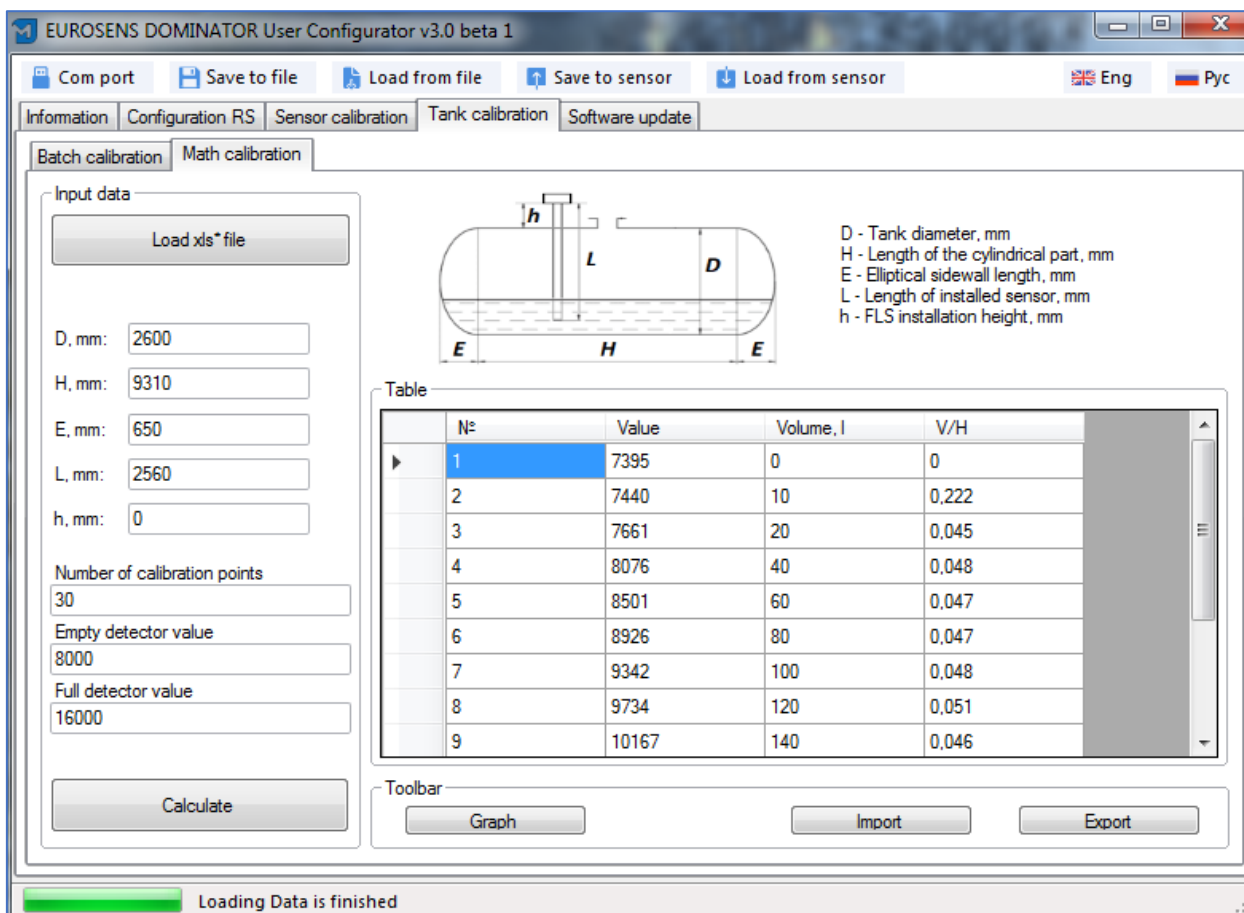


fig. 5.1. Calculator in configurator

### 5.2.3 USE OF EXISTING TANK CALIBRATION TABLE

Large containers of gasoline tankers and fuel storage tanks usually have a data sheet with a table of dependence of the fuel volume on its height. The table can be used with the web calculator on manufacturer's website or in the sensor Configurator.

## 6 CONFIGURATION SOFTWARE

Install and set up the sensor using service adapter (programming device) [eurosens Destination](#) and configuration software eurosens Dominator Configurator ([fig. 6.1](#)).

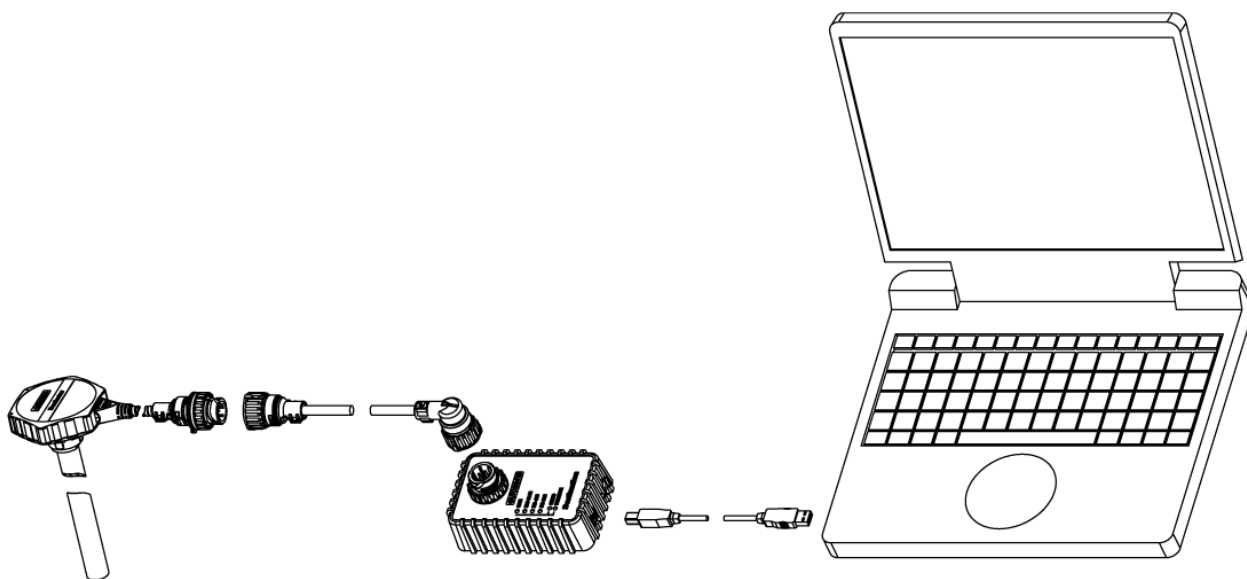


fig. 6.1. Sensor setup

### 6.1 DRIVERS AND CONFIGURATOR INSTALLATION

Microsoft.NET Framework 4.0 client is necessary for Configurator operation.

- [Download this file](#) from the Microsoft website and install the software.
- When adapter is connected to the PC for the first time, Windows OS will install the adapter driver.



The latest versions of drivers, software, etc. are in [Mechatronics folder](#).

## 6.2 SETTING COM PORT NUMBER

To select a COM port number:

- 1) select the item **“Select COM port”** from the menu **“Settings”**;
- 2) in the window that appears, select the COM port number from the list of available ports ([fig. 6.2](#)) and enter the required COM port number at the bottom of the window (input line).

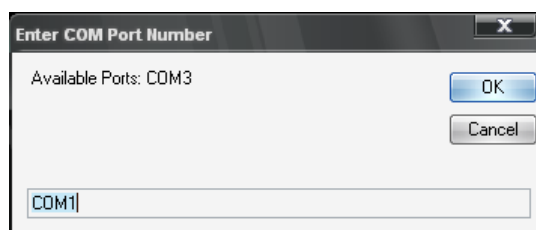


fig. 6.2. Available ports



If there are several available ports in the list, select the item **“Ports (COM & LPT)”** in the program **“Device Manager”**, find an entry similar to that shown in [fig. 6.3](#) and [fig. 6.4](#), depending on adapter type. The COM port number is in brackets after the word **“COM”**.

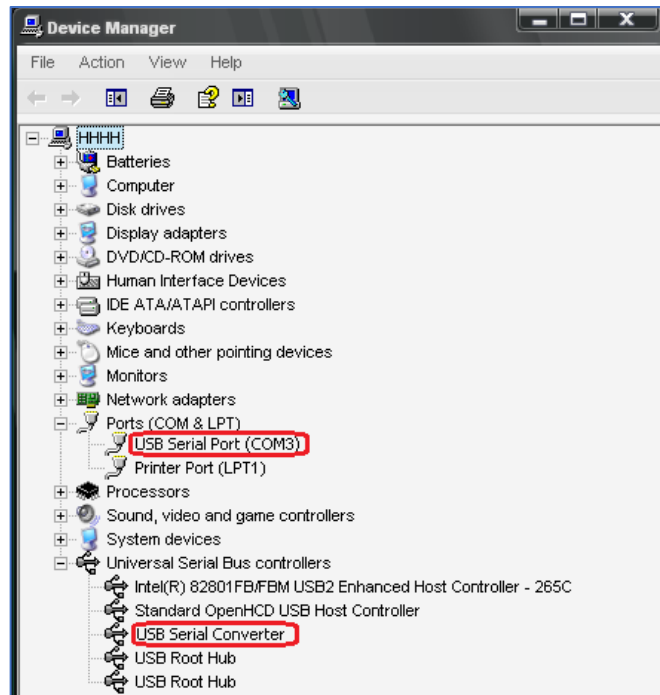


fig. 6.3. Device manager

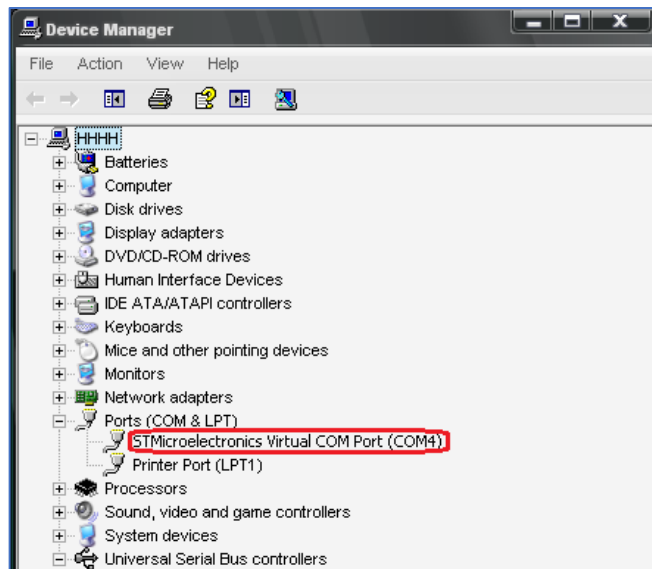


fig. 6.4. Device manager

### 6.3 SENSOR CONNECTION

Program setup procedure:

- 1) connect the service adapter to the PC via a USB 2.0 Am-Bm cable (supplied with the adapter);
- 2) run the Configurator and select the COM port if necessary. If the COM port is set correctly, the LED **“Receive”** on the service adapter starts blinking;
- 3) connect the sensor to the service adapter via a 2-way cable (supplied with the adapter). If you use the service adapter **“Destination 02”**, set the connection interface type to RS-485.

The sensor connects to the PC within a few seconds. The program operates properly if:

- information on the connected sensor is displayed at the top of the program window;
- communication indicator (**“Send”**) blinks fast before the program starts, and both communication indicators (**“Send”** and **“Receive”**) blink slowly after the sensor is connected;
- if the service adapter is not connected, the error message will be displayed on the screen ([fig. 6.5](#));
- it is necessary to connect the service adapter and select the required COM port (or restart the program).

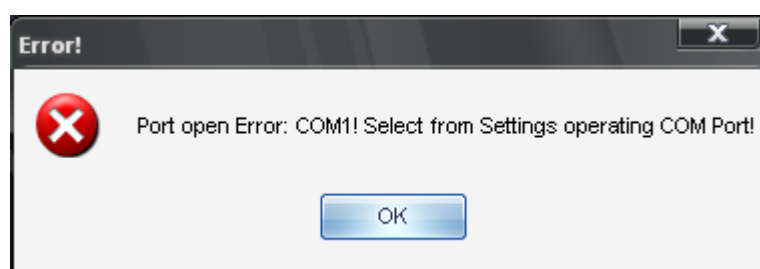


fig. 6.5. Error message



The service connection to the sensor occurs within a few seconds after power is on. Therefore, if you connect the sensor to the service adapter before you start the software, it might fail to detect the sensor. In this case you need to disconnect the sensor from the service adapter and connect it anew.

#### 6.4 CONFIGURATOR MENU DESCRIPTION

The program window contains ([fig. 6.6](#)):

- main menu;
- operation buttons;
- tab bar;
- active tab screen.

The tab **“Information”** contains the information about the sensor: its model, serial number, calibration date, hardware version, firmware version, and current values measured by the sensor. The values inapplicable to a particular sensor model are displayed in gray.

The operation buttons **“Save to file”** and **“Load from file”** save the current configuration to a file and upload it from the file to the configurator. The operation buttons **“Save to sensor”** and **“Load from sensor”** save the configuration to the sensor and load it from the sensor.

Change the language of program interface by clicking the icon in the top-right corner.

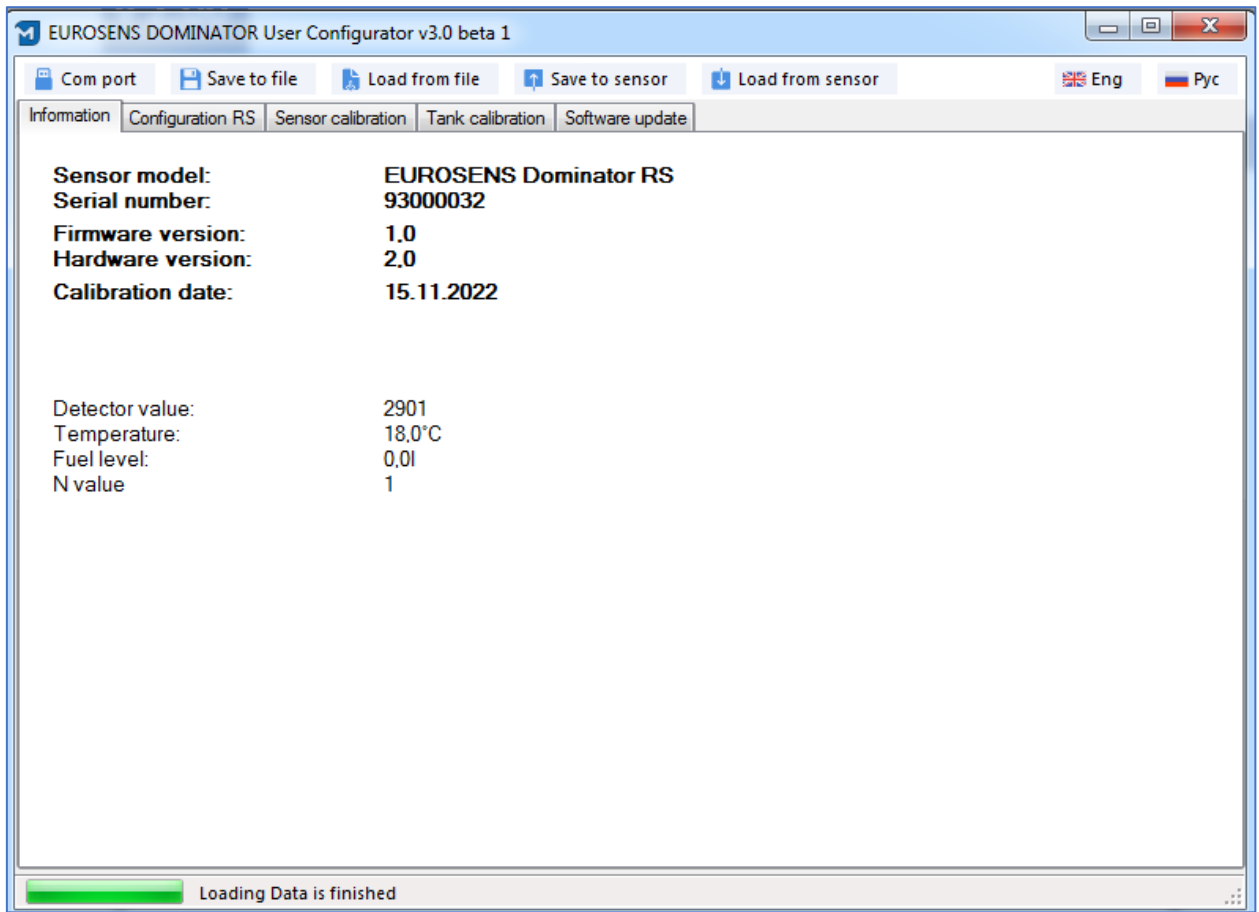


fig. 6.6. Configurator window

## 6.5 TAB “CONFIGURATION” FOR DOMINATOR RS

The configurator generates a list of possible settings based on the sensor model.

The tab “**Configuration RS**” contains the possible settings for the sensor eurosens Dominator RS ([fig. 6.7](#)).

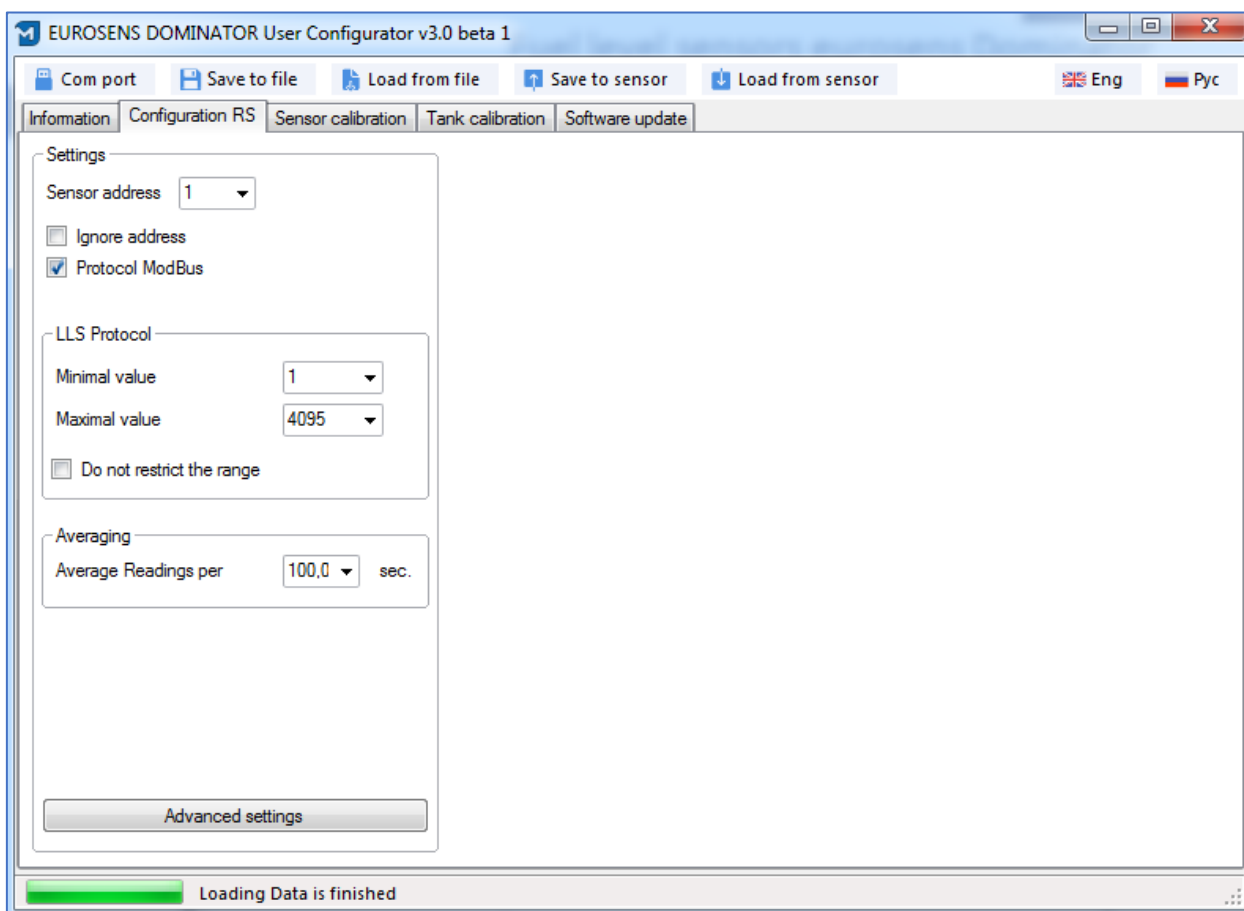


fig. 6.7. Tab “Configuration” for eurosens Dominator RS

Click the button “**Advanced Settings**” to see the extended list of settings for Dominator RS ([fig. 6.8](#)).

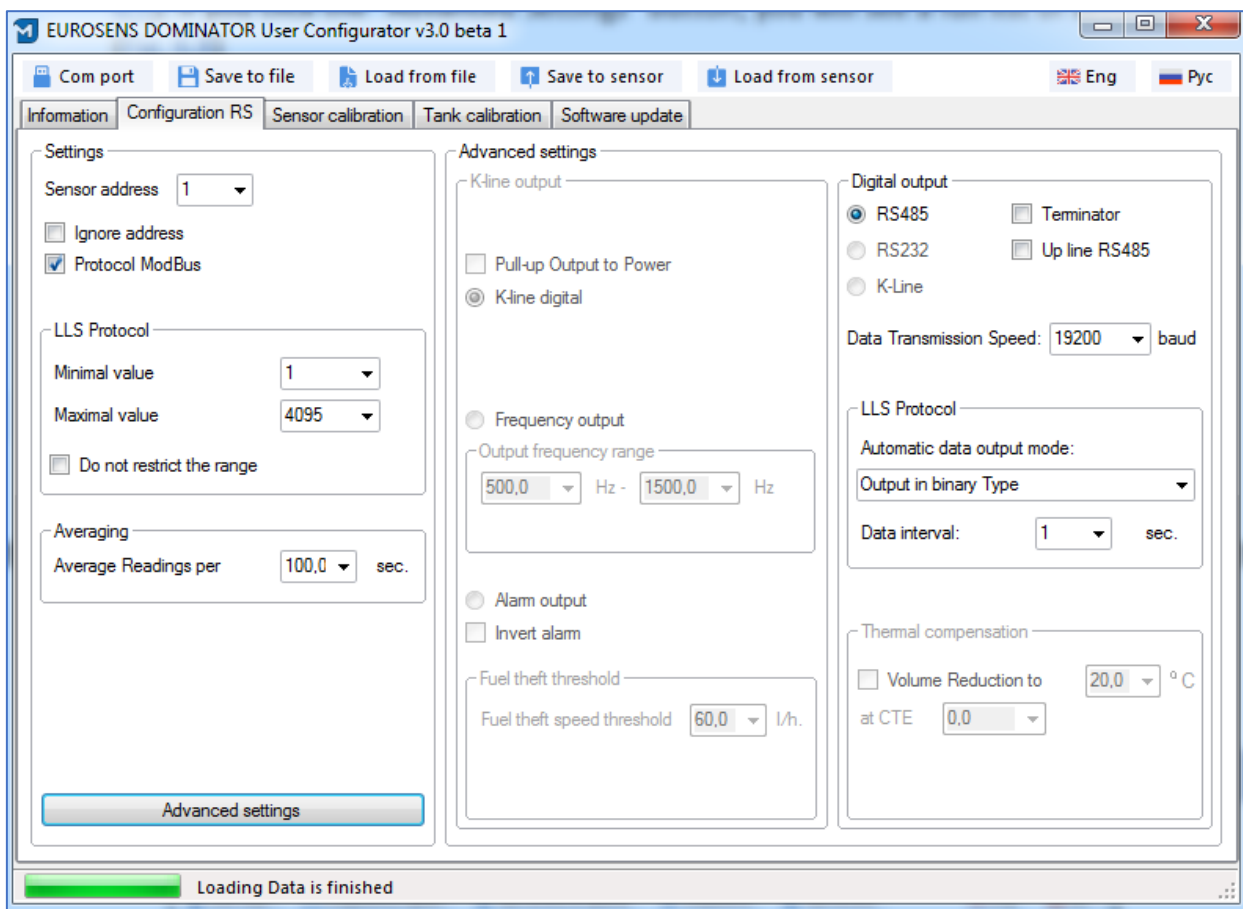


fig. 6.8. Advanced settings for eurosens Dominator RS

- **“Sensor address”** is a unique address of a sensor in RS-485 network.
- **“Ignore address”** option is enabled if, e.g., a connected sensor with unknown settings must respond to the data collection terminal at any address.



All sensors in RS-485 network must have their unique addresses.

If several sensors are connected to the data collection terminal via RS-485, it is necessary to assign them different addresses (1, 2, 3...). The option **“Ignore address”** must be disabled.

- **“Protocol ModBus”** option enables data exchange mode via Modbus RTU protocol.
- **“Minimal value”** and **“Maximal value”**.

The sensor operates via LLS protocol by default. It is possible to set the **minimum** and **maximum values** for this mode in the respective entries. The sensor will send the values via LLS protocol for an empty and full tank.



To obtain the data in liters, save the calibration table to the sensor and set the values as follows:

**“Minimal value” = 0,**

**“Maximal value” = tank volume.**

- **“Averaging”** is set in seconds and defines averaging interval for output data.



To speed up the tank calibration by filling it is recommended to disable **“Averaging”** by setting the parameter to 1sec.

After tank calibration it is recommended to set this parameter to 30-60 seconds. A higher value is recommended for asymmetric tanks and vehicles that operate on rough terrain.

- **“Temperature Compensation”** option recalculates fuel volume depending on the temperature, measured by a temperature sensor built in the electronic module. Set the conversion temperature value, and the algorithm will recalculate the current fuel volume to the volume at the conversion temperature (20 °C by default). Coefficient of Temperature Expansion is based on density  $\rho$  of fuel  $\beta$  (Table 6.1).

Table 6.1. Temperature coefficient of volume expansion for fuel  $\beta$

$\rho$ , kg/m <sup>3</sup>	$\beta$ , 1/°C	$\rho$ , kg/m <sup>3</sup>	$\beta$ , 1/°C	$\rho$ , kg/m <sup>3</sup>	$\beta$ , 1/°C
690,0 - 699,9	0,00130	800,0 - 809,9	0,00094	910,0 - 919,9	0,00067
700,0 - 709,9	0,00126	810,0 - 819,9	0,00092	920,0 - 929,9	0,00065
710,0 - 719,9	0,00123	820,0 - 829,9	0,00089	930,0 - 939,9	0,00063
720,0 - 729,9	0,00119	830,0 - 839,9	0,00086	940,0 - 949,9	0,00061
730,0 - 739,9	0,00116	840,0 - 849,9	0,00084	950,0 - 959,9	0,00059
740,0 - 749,9	0,00113	850,0 - 859,9	0,00081	960,0 - 969,9	0,00057
750,0 - 759,9	0,00109	860,0 - 869,9	0,00079	970,0 - 979,9	0,00055
760,0 - 769,9	0,00106	870,0 - 879,9	0,00076	980,0 - 989,9	0,00053
770,0 - 779,9	0,00103	880,0 - 889,9	0,00074	990,0 - 999,9	0,00052
780,0 - 789,9	0,00100	890,0 - 899,9	0,00072	-	-
790,0 - 799,9	0,00097	900,0 - 909,9	0,00070	-	-

## 6.6 TAB “CONFIGURATION” FOR DOMINATOR AF

The tab “**Configuration AF**” contains the basic settings for the sensor eurosens Dominator AF (fig. 6.9):

- **Interface types:**

1. Analog, with adjustable range (the default setting is 2.5-9 volts).
2. Frequency, with adjustable range (the default setting is 500-1500 Hertz).
3. Single-wire K-line interface (K-line digital) to exchange information with other eurosens sensors via K-line digital interface.

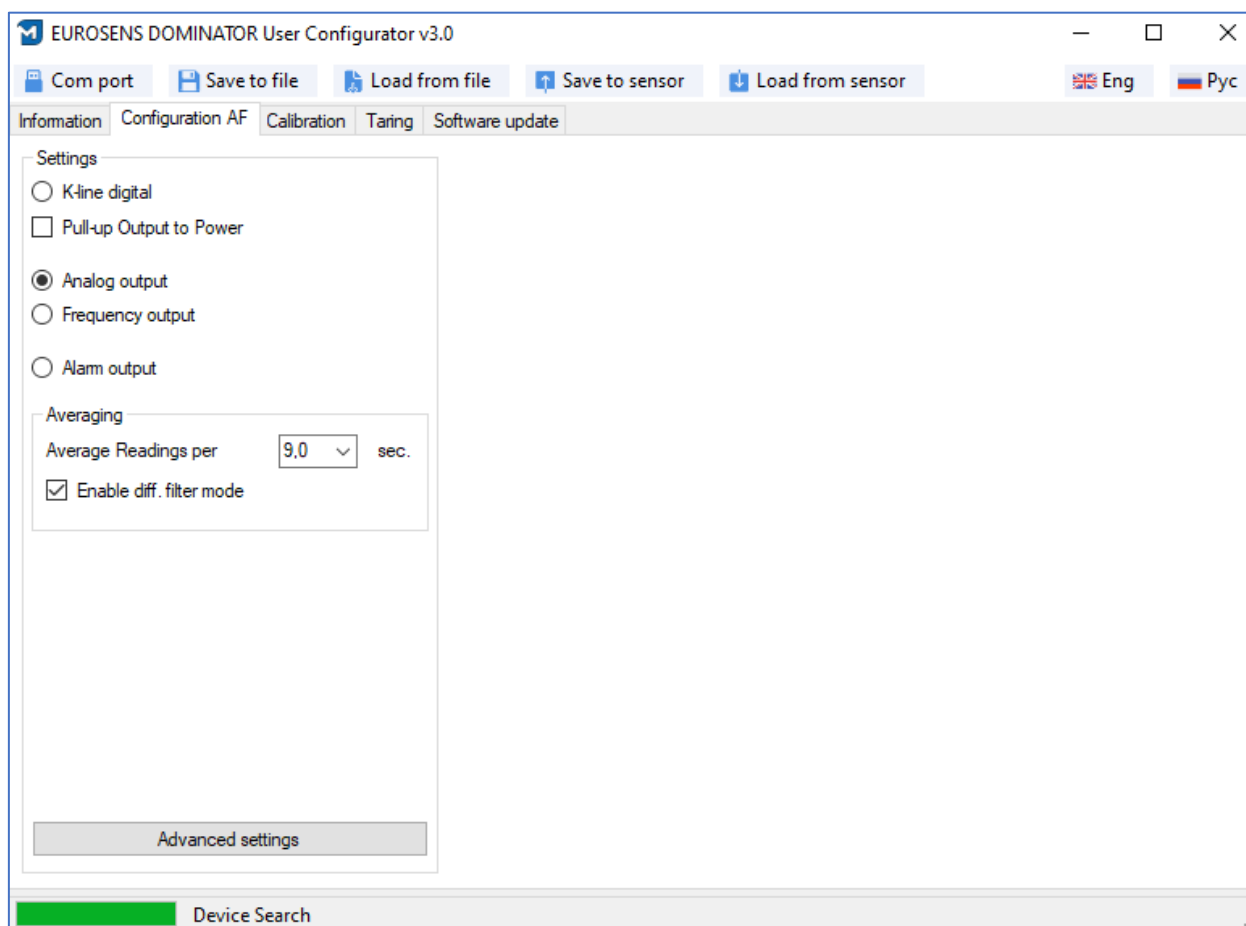


fig. 6.9. Tab “Configuration” for eurosens Dominator AF

- **“Averaging”** is set in seconds and defines averaging interval for output data.



To speed up the tank calibration by filling it is recommended to disable **“Averaging”** by setting the parameter to 1 sec.

After tank calibration it is recommended to set this parameter to 30-60 seconds. A higher value is recommended for asymmetric tanks and vehicles that operate on rough terrain.

- **“Enable diff. filter mode”** setting allows the sensor to change the averaging mode in case of abrupt changes in fuel level.

The advanced settings for eurosens Dominator AF are given in [fig. 6.10](#).

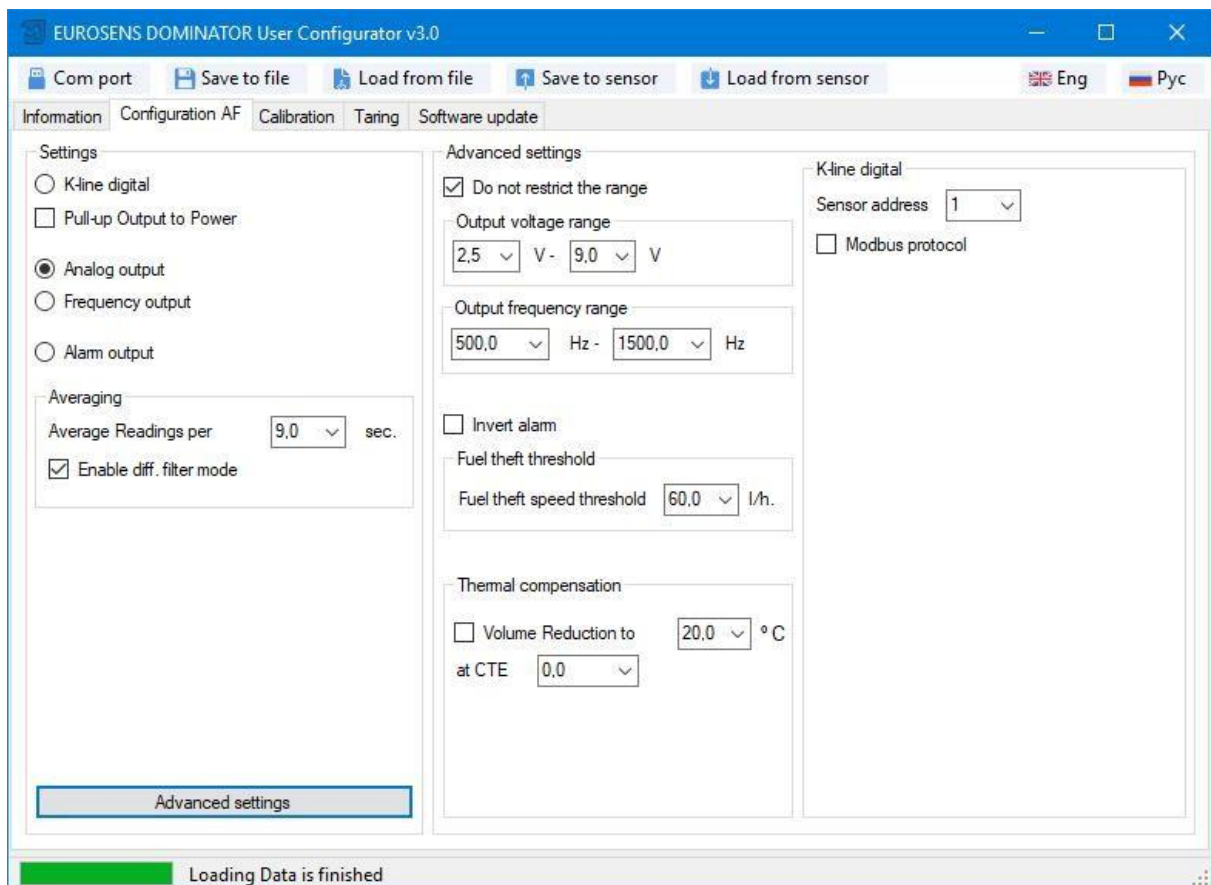


fig. 6.10. Advanced settings for eurosens Dominator AF

- **“Do not restrict the range”** option allows the sensor to exceed the set limits of minimal and maximal values if the level measurement result goes beyond

the empty and full limits of a tank respectively (according to current sensor calibration).

- “**Output voltage range**” setting changes the output power range of the sensor. The minimum output power is 0.5V, the maximum output power is 20V.



There can be power drops, e.g., when starting the engine, the power supply in the vehicle's on-board network temporarily drops by several volts. Therefore, it is recommended to **set the maximum output voltage 5 volts lower than the on-board voltage** to avoid incorrect data on the analog interface of the sensor.

- “**K-line digital**” sets sensor address in the internal network of eurosens sensors and allows using the network of Modbus RTU protocol.

## 6.7 TAB “CONFIGURATION” FOR DOMINATOR CAN

In the tab “**Configuration CAN**” (fig. 6.11) it is necessary to set the basic options for the sensor eurosens Dominator CAN:

- sensor address in CAN network;
- controllable pull-up mode of CAN interface (built-in CAN terminator ON or OFF).

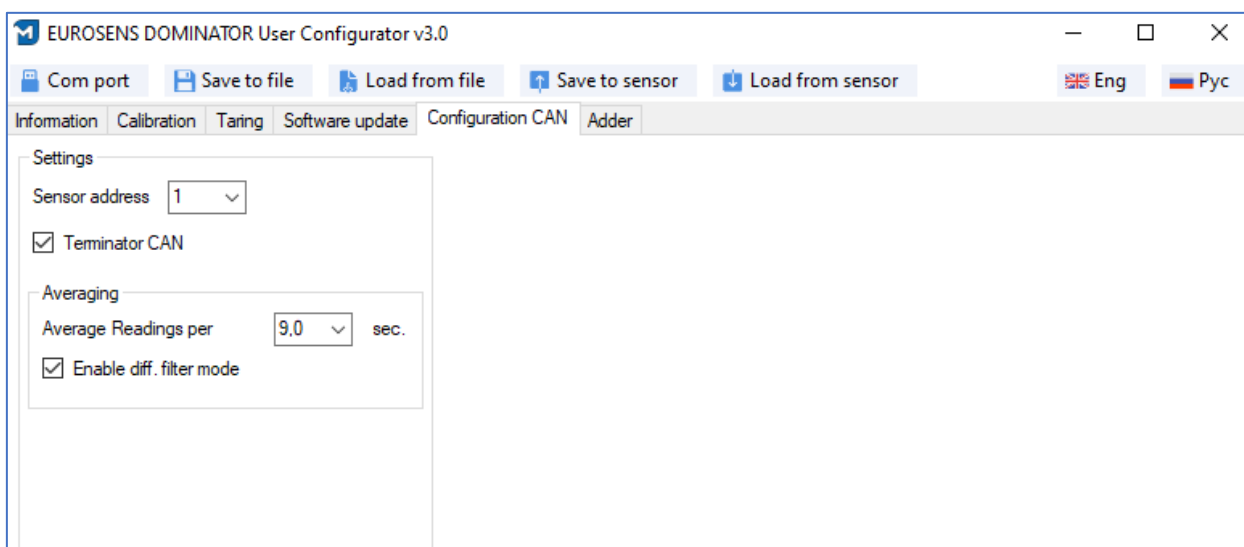


fig. 6.11. Tab “Configuration” for eurosens Dominator CAN

- “**Averaging**” is set in seconds and defines averaging interval for output data.



To speed up the tank calibration by filling it is recommended to disable “**Averaging**” by setting the parameter to 1sec.

After tank calibration it is recommended to set this parameter to 30-60 seconds. A higher value is recommended for asymmetric tanks and vehicles that operate on rough terrain.

- “**Enable diff. filter mode**” setting allows the sensor to change the averaging mode in case of abrupt changes in fuel level.

In the advanced settings you can change the speed of data exchange via CAN interface.

## 6.8 TAB “SENSOR CALIBRATION”

The tab “Sensor calibration” ([fig. 6.12](#)) allows you to calibrate the sensor in several ways:

1. Buttons “**Empty**” and “**Full**” allow you to calibrate the sensor by immersing it into fuel (see chapter 5.1).
  2. Calibration can be performed without immersing the sensor into fuel. Click the button “**Calculated calibration**”. If the option “**Length calculation**” is enabled, it is necessary to set the sensor length after cutting, then the calibration will be carried out by the calculation method.
- If the option “**Length calculation**” is disabled, the calculation of sensor length is based on the following facts:
    - the connected sensor is not immersed into fuel,
    - the connected sensor is in the state “Empty”.
  - During the calculated calibration the Configurator automatically sets the calibration limits so as to avoid a dead zone. Therefore, when you measure the fuel level with a calculated calibration, the empty tank value will be slightly higher than the minimum value, and the full tank value will be slightly lower than the maximum value given in the settings.

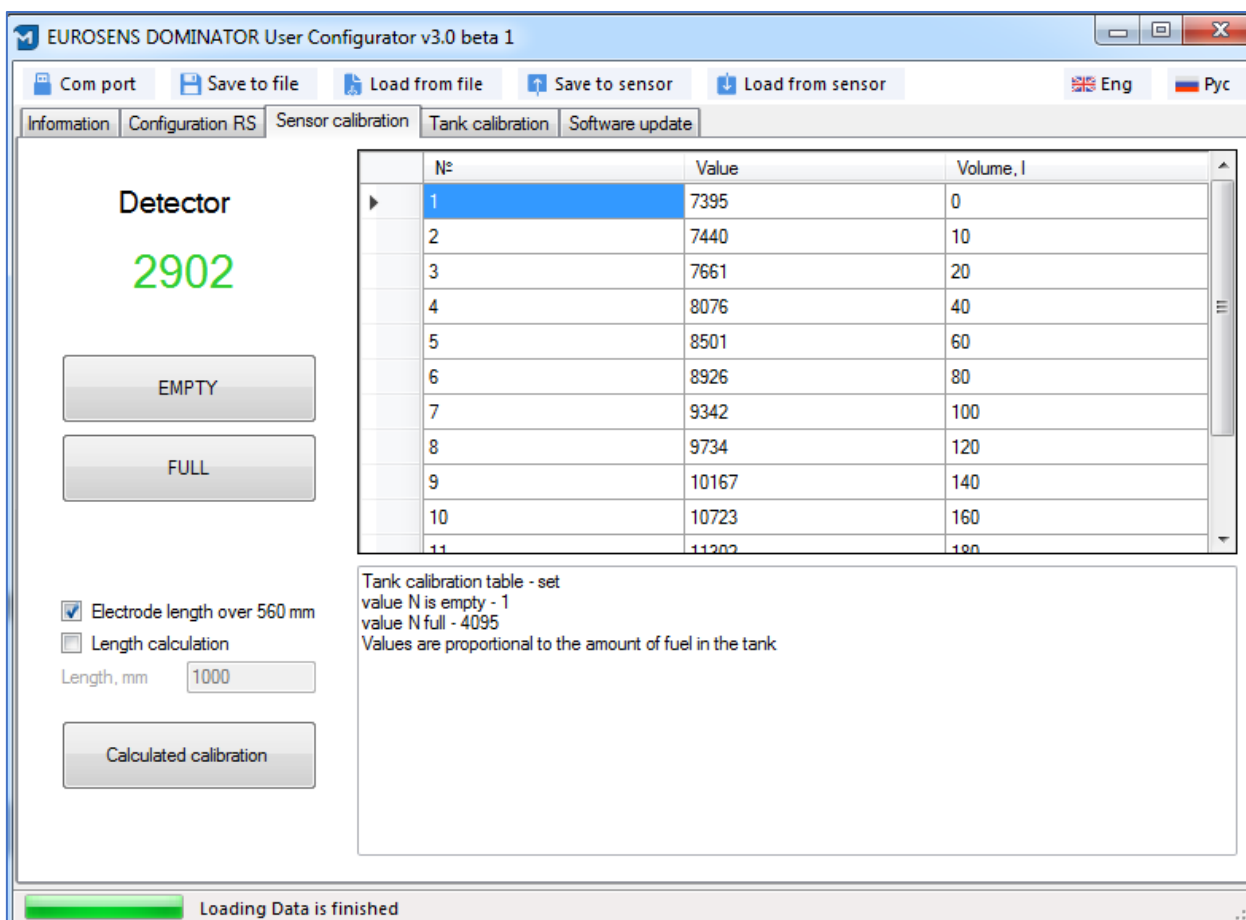


fig. 6.12. Tab "Sensor calibration"

## 6.9 TAB “TANK CALIBRATION”

The tab “Tank calibration” contains tools for tank calibration. The tank calibration can be carried out either by filling, or by calculation.

### 6.9.1 BATCH CALIBRATION

The tab “**Batch calibration**” (fig. 6.13) allows you to calibrate the tank by either pouring or draining. Select the necessary option.

When calibrating the sensor:

1. Briefly immerse the entire measuring part (probe) of the sensor into fuel and then take it out. Let the fuel drain for a few minutes.

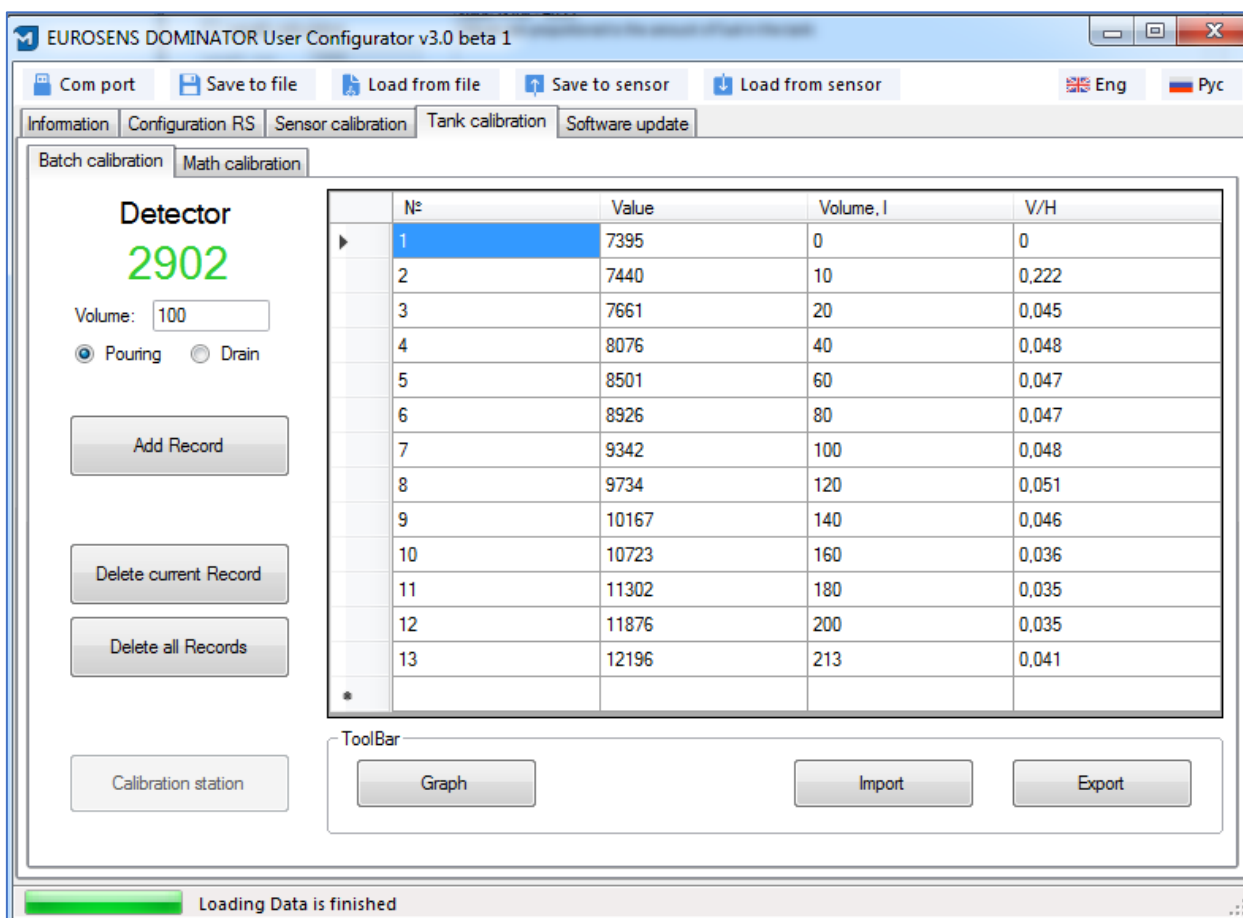


fig. 6.13. Tab “Batch calibration”



Instead of immersing the entire probe into fuel, you can turn the electronic module down, cover the drain holes near the electronic module and pour fuel between the electrodes.

2. Install the sensor in an empty tank (or completely filled if calibrated by draining).
3. Run eurosens Dominator User Configurator software.
4. Connect the sensor to a PC using the service adapter.
5. Go to **“Tank calibration”** – **“Batch calibration”** and select the option of calibration: **“Pouring”** or **“Drain”**.
6. Click the button **“Delete all Records”** to clear the calibration table.
7. Wait until the parameter **“Detector”** is stable: its value will become green.



To accelerate the stabilization of the value, it is recommended to set the averaging value to **“1”**.

8. Set the value of **“Volume”** parameter to zero.
9. Click the button **“Add Record”**. Make sure that you enter the parameter values **“Detector”** and **“Volume”** in the first row of the table.
10. Add fuel to the tank until the detector value changes. Measure the refilled volume after the detector value stabilizes. Click the button **“Add Record”** and specify the refilled volume in the column **“Volume”** of the table.
11. Pour fuel in portions of a certain volume (which you know). As each portion is added the detector value increases (or drops in case of calibration by draining). After the value stabilization click the button **“Add Record”**. If you want the value of current fuel volume to be set automatically in the table when adding a record, you can set the required value **“Volume”** in the left part of the screen. Repeat step 11 until the tank is full (or completely drained). When adding the last portion before the tank is full, measure its volume (as it will not be equal to the volume of previously added portions) and enter it in the table manually.
12. Save the tank calibration table to the sensor by clicking the button **“Save to sensor”**.
13. Save the tank calibration table to a file by clicking the button **“Export”**.

After saving the tank calibration table to the sensor you can see the updates from the sensor in the tab **“Information”**.



The V/H column in the table allows you to control the tank calibration process. V/H is the ratio of volume increment to height increment and depends on the shape of the tank at a given point. E.g., for a perfectly rectangular tank, the ratio V/H is constant throughout the height of the tank. For a horizontal cylinder tank, the ratio V/H increases smoothly toward the center and decreases from the center to the edges.

## 6.9.2 MATH CALIBRATION

In some cases, it is possible to avoid tank calibration by filling/pouring, since it can be rather time-consuming, especially for tanks of large volume.

For standard containers such as cisterns you can calculate the tank calibration based on the geometric dimensions of the cistern. Enter its dimensions in the appropriate fields in the left part of the window ([fig. 6.14](#)).

EUROSENS DOMINATOR User Configurator v3.0 beta 1

Com port Save to file Load from file Save to sensor Load from sensor Eng Pyc

Information Configuration RS Sensor calibration Tank calibration Software update

Batch calibration Math calibration

Input data

Load xls\* file

D, mm: 2600

H, mm: 9310

E, mm: 650

L, mm: 2560

h, mm: 0

Number of calibration points: 30

Empty detector value: 8000

Full detector value: 16000

Calculate

Diagram labels: D - Tank diameter, mm; H - Length of the cylindrical part, mm; E - Elliptical sidewall length, mm; L - Length of installed sensor, mm; h - FLS installation height, mm

Table

№	Value	Volume, l	V/H
1	7395	0	0
2	7440	10	0,222
3	7661	20	0,045
4	8076	40	0,048
5	8501	60	0,047
6	8926	80	0,047
7	9342	100	0,048
8	9734	120	0,051
9	10167	140	0,046

Toolbar: Graph Import Export

Loading Data is finished

fig. 6.14. Tab "Math calibration"

To bind the shape of the tank to a given sensor:

1. calibrate the sensor by immersing it into fuel and obtain the detector values for the empty and full states;
2. enter the detector values of full and empty states, the required number of tank calibration points (up to 255 points are allowed) and click the button **“Calculate”**. The calculated tank calibration values will appear in the table, and you can save them to the sensor and to the file, as it is shown above.



Note that the part of the sensor can be higher than a tank, for example, when installing the sensor in the filler neck or on protruding parts of the tank. In this case, when calibrating the sensor in the pipe, do not immerse the sensor completely, but to the level corresponding to the maximum filling when installing it in the tank.

Sometimes you have a ready-made tank calibration table, usually in “height of level – volume” format. Load it to the sensor from a file in \*.xls format by clicking the button **“Load xls\* file”**. The file should contain only the tank calibration table, as it is shown in [fig. 6.15](#), where column A stores the fuel level height value, and column B stores the volume value.

	A	B	C	D	E	F
1	0	100				
2	1	200				
3	2	300				
4	3	400				
5	4	500				
6	5	600				
7						
8						

fig. 6.15. Tank calibration table for import

To use a tank calibration table from Excel:

1. determine the detector values for empty and full states in case of installing the sensor in the tank;

- 2. enter the detector values in the corresponding fields ([fig. 6.16](#));
- 3. load Excel file with a table.

Number of calibration points
30
Empty detector value
8000
Full detector value
16000

fig. 6.16. Input fields for detector value

### 6.9.3 GRAPH TOOLBAR

If you click the button "**Graph**" on the tab "**Tank calibration**", you can see the panel with the tools for calibration curves analysis ([fig. 6.17](#)).

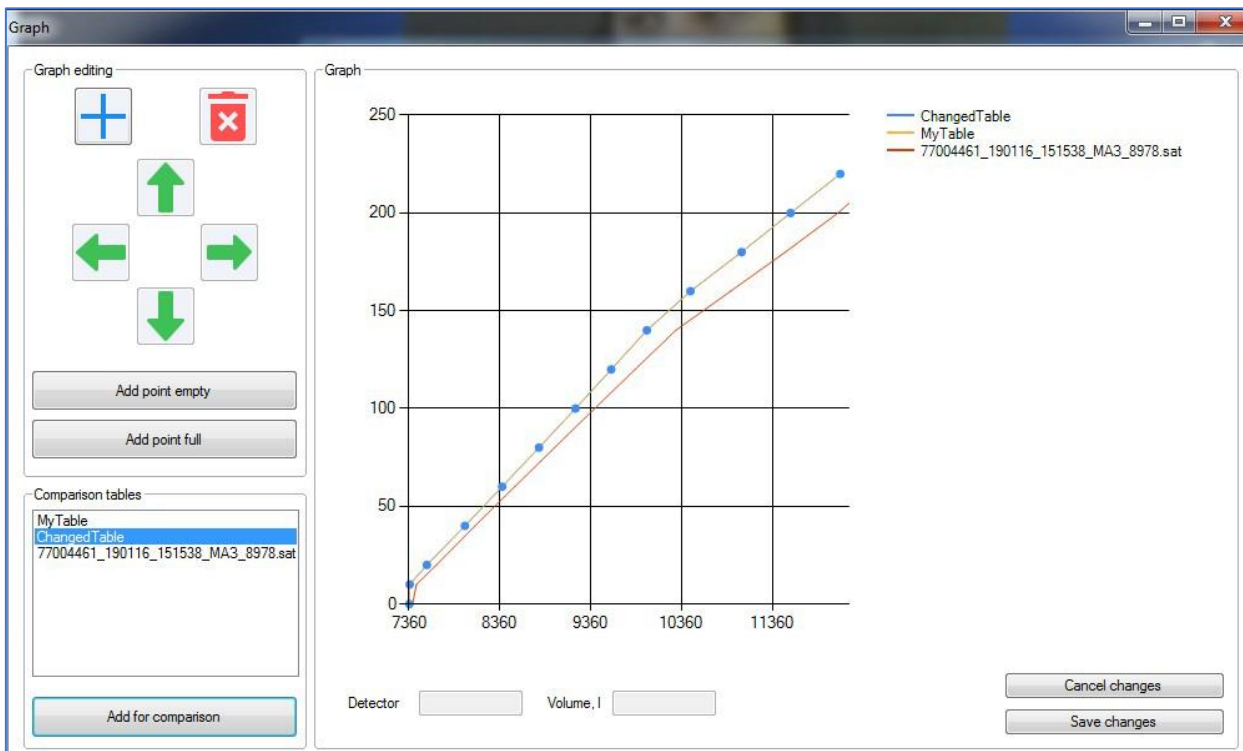


fig. 6.17. Analysis panel of calibration curves

The analysis panel allows you to perform the following operations:

### 1. Visual verification of tank calibration table:

- the graph allows you to see the tank calibration defects;
- as a rule, the tank calibration curve does not have abrupt changes in its trajectory.

### 2. Comparison of sensor tank calibration table with other tables:

- can help find errors in calibration of containers of the same type;
- you can load the table for comparison by clicking the button "Add for comparison";
- the tank calibration tables of eurosens sensors in \*.sat, \*.sat2 formats are supported;
- it is possible to load several tables from the file for comparison ([fig. 6.18](#)).

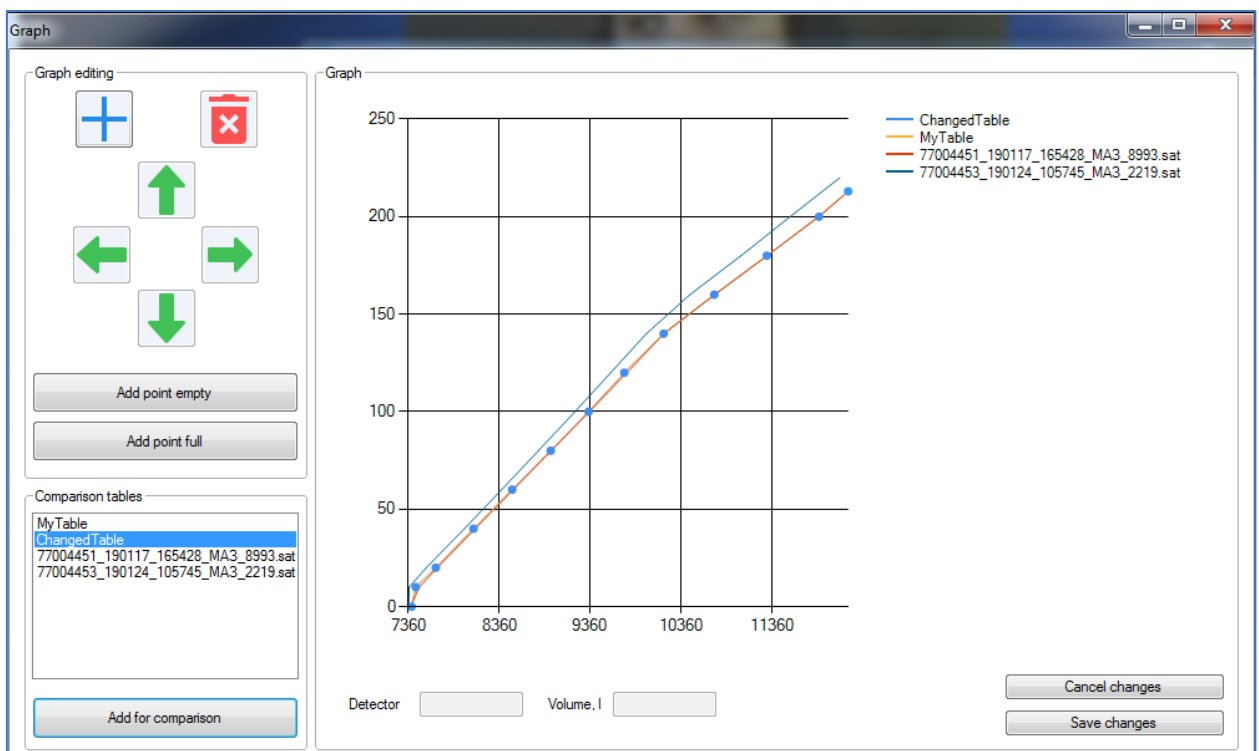


fig. 6.18. Calibration tables for comparison

### 3. Editing of tank calibration table:

- the current table is marked with blue markers;
- if you select one of the markers, the graph values of the marker point appear at the bottom of the window. You can edit them;

- when you change the values, the marker moves together with the graph;
- the button "**Save changes**" allows you to get a new tank calibration table.

#### 4. Adding and removing points:

- the button "+" adds a point to the table after you enter the fuel volume value for this point;
- the configurator automatically places the point on the graph by interpolation if the point is inside the existing curve, or by extrapolation if the point is outside the existing curve. Then you can move the point (see par. 3);
- the icon "✖ Bin" deletes the selected point on the graph.

The buttons "**Add point empty**" and "**Add point full**" are used to add those points of empty and full tank which were not obtained during tank calibration by filling/pouring. The configurator adds them automatically by extrapolation of existing data.

#### 5. Stretching graph horizontally and vertically

Let us consider the case: there are 2 identical fuel tanks. The first tank has got a tank calibration table ([fig. 6.19](#)). In this table the detector value of an empty tank is 7418, and the one of a full tank is 12211. After calibration of the second sensor its detector value of an empty tank is 7365, and the one of a full tank is 12150.

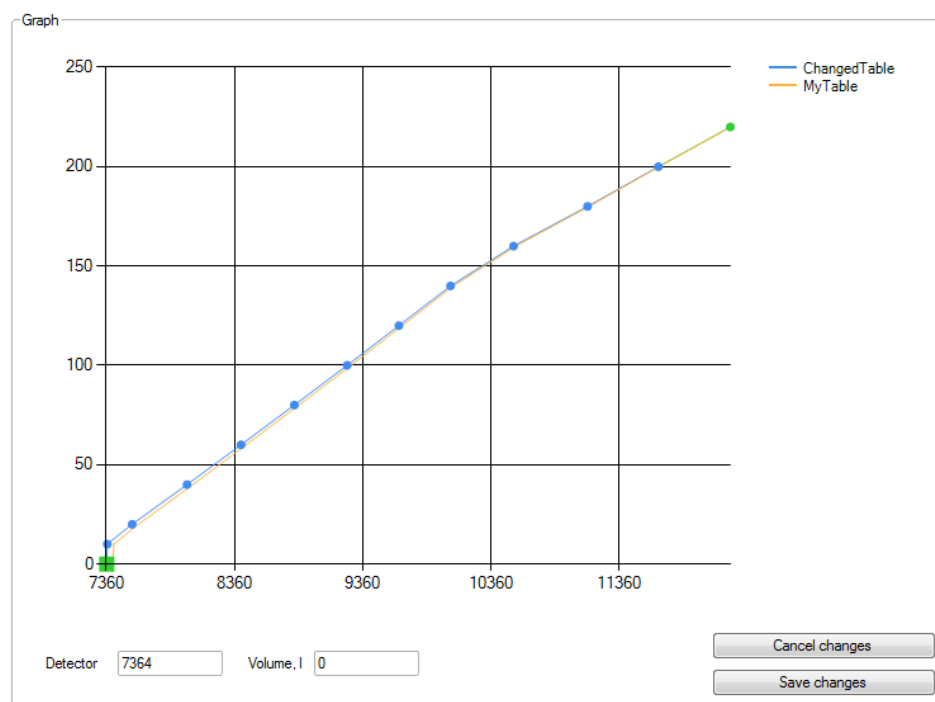


fig. 6.19. Tank calibration table

To use the existing tank calibration table:

- select the lower detector point (it will become green) and by clicking the left arrow, move the lower detector point to the value closest to 7365 ([fig. 6.19](#));
- select the upper point of the graph and shift it to the value 12155 ([fig. 6.20](#)). You can see that shifting the extreme points reshapes the whole graph (the original table is displayed in orange, the modified one – in blue);
- save the received table (by clicking the button “Save changes”) and store it in the sensor.

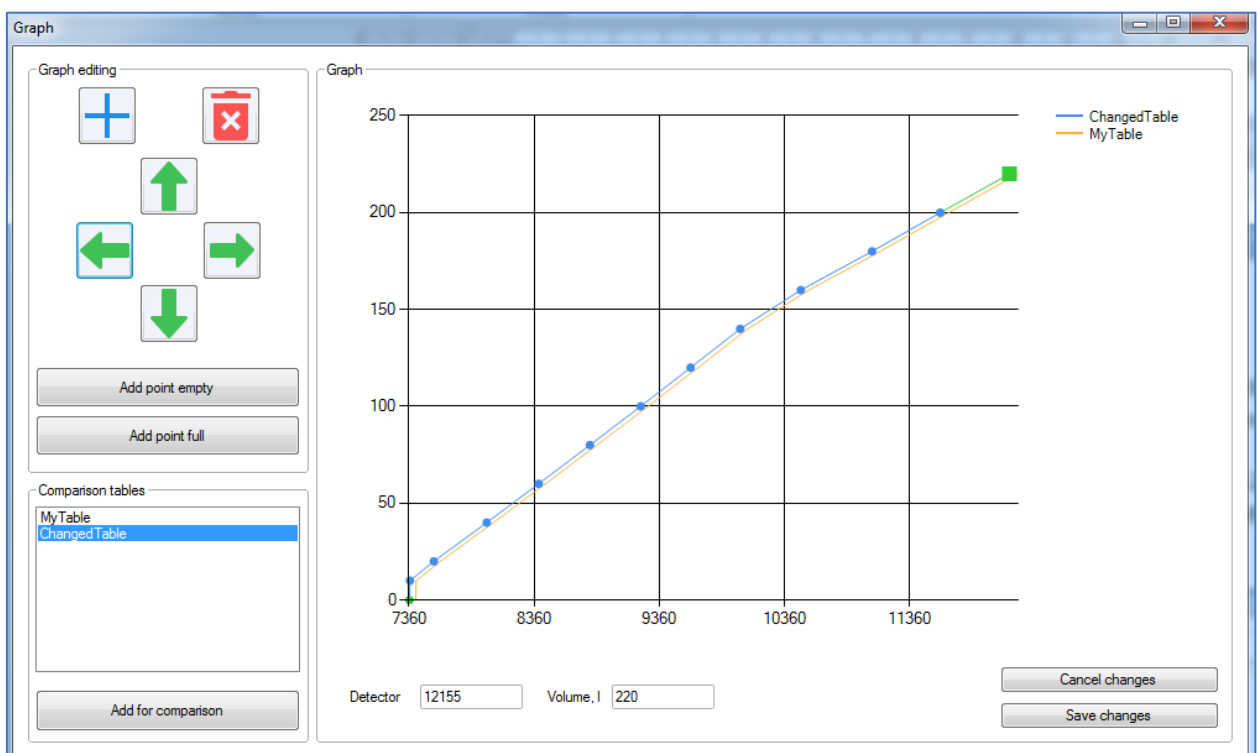


fig. 6.20. Stretching graph horizontally

Likewise, the graph can be stretched vertically to align calibration table to a new tank volume. This can be useful when there are several very similar tanks with a bit different width (length) resulting in different volumes. You can calibrate by portions only one tank and reshape calibration table for other tanks.

## 6.10 TAB “SOFTWARE UPDATE”

The tab “**Software update**” is used to update the firmware of the sensor and contains the following settings ([fig. 6.21](#)):

- “**Erase configuration**” option resets the settings to defaults during firmware update. It is required if the sensor is not connected to the software after a hardware failure of configuration load.
- “**Firmware update**” button selects the firmware file, and the update of the sensor software starts automatically. The status bar in the bottom-left corner shows the update progress.
- “**Default settings**” button resets the settings to defaults without firmware update.

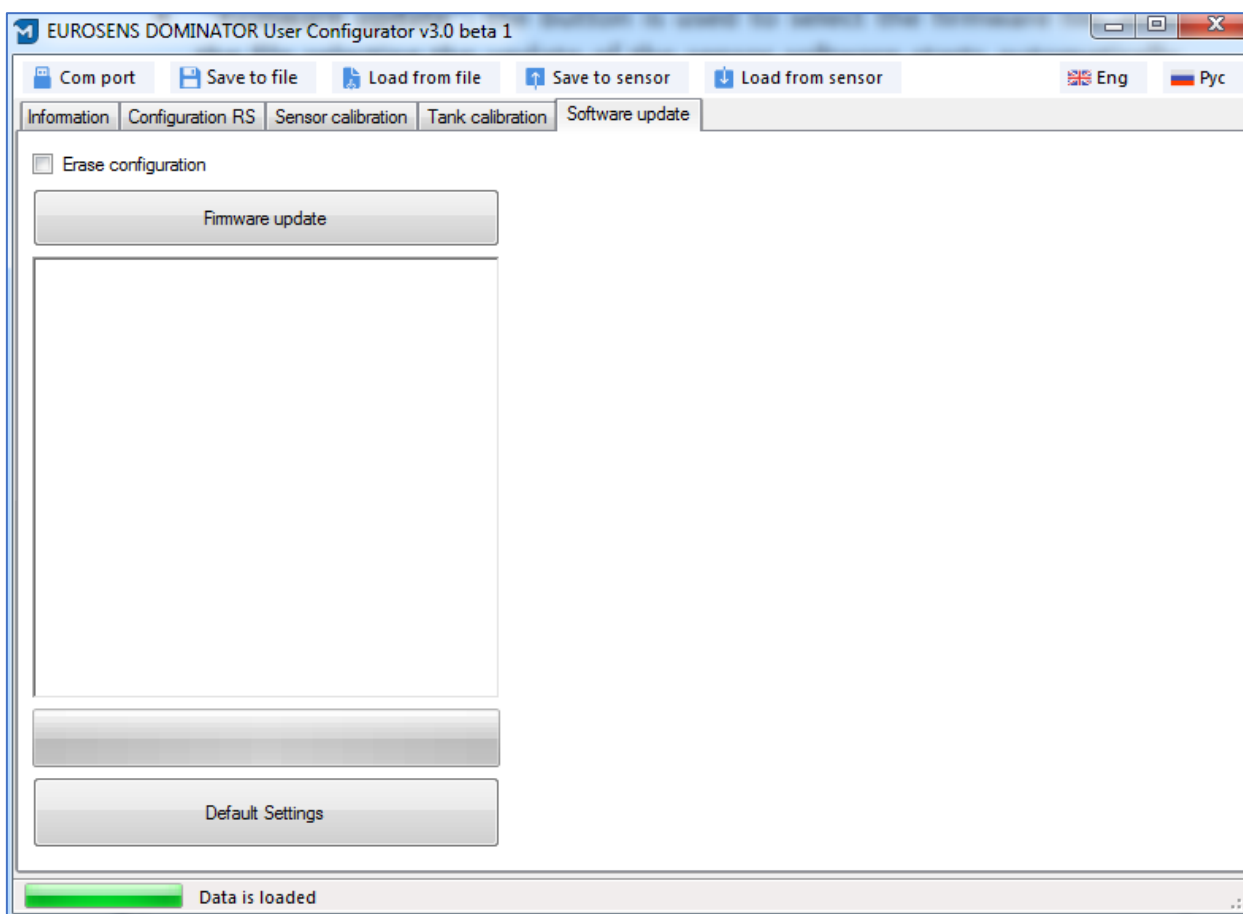


fig. 6.21. Tab “Software update”



If the sensor does not respond to the connection to the service adapter (failure), it is necessary to update the firmware in the Recovery mode.

Firmware update in the Recovery mode:

1. Disconnect the sensor.
2. Select the tab **“Software update”**.
3. Click the button **“Firmware update”** and select the file.
4. Connect the sensor to the service adapter and wait for the update process to finish.

### 6.11 TANK CALIBRATION FAQs

#### 1. Is it possible not to calibrate a tank?

If it suits you that the fuel height measurement is given in millimeters or % of the tank height rather than volume, then you can skip tank calibration.

#### 2. How does the shape of the tank affect the tank calibration?

The two points of "full" and "empty" are enough to calibrate a tank, whose cross-section width is constant in height. Examples of such shapes are: a perfectly rectangular tank (a parallelepiped without roundings) or a vertical cylinder (not a horizontal one) ([fig. 6.22](#)).

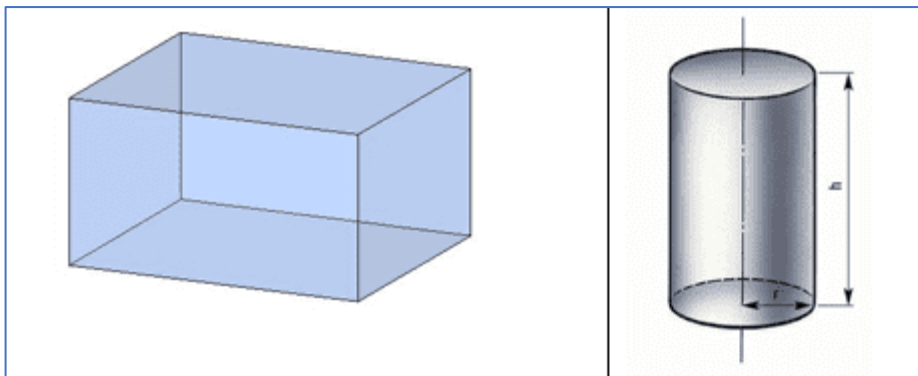


fig. 6.22. Perfect shapes of tanks that don't need calibration

Tank calibration results can be plotted in the graph (sensor output signal - fuel volume in the tank). For the tanks shown in [fig. 6.22](#), the graph represents a perfect straight line ([fig. 6.23](#)).

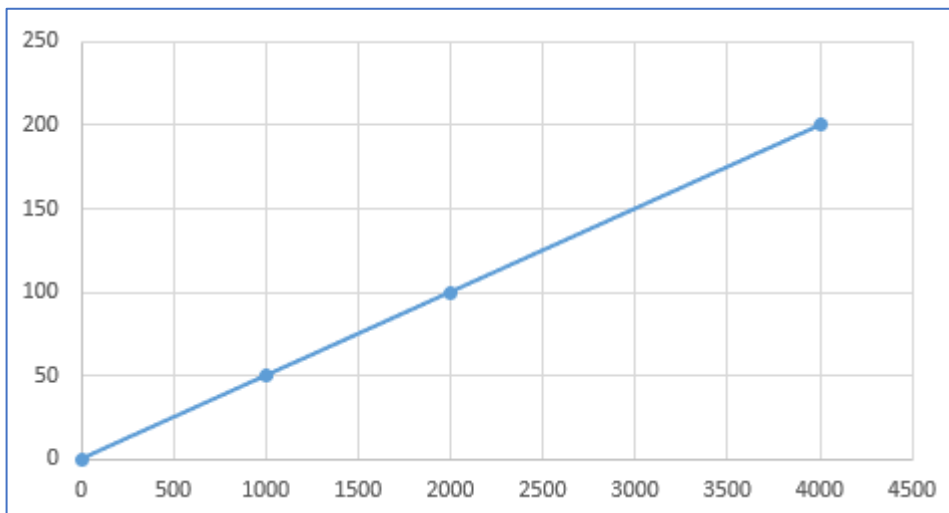


fig. 6.23. Calibration graph of perfect shape tank

There is no need to calibrate the entire tank, since all the points fall on the same straight line.

However, it is impossible to find such tanks in reality. The real ones have roundings, dents, and can be inclined ([fig. 6.24](#)).



fig. 6.24. Most “rectangular” tanks have roundings

Therefore, the real tank calibration graph is not a straight line, it rather looks as shown in [fig. 6.25](#).

The graph shows that where the walls of the tank are vertical and not curved, the points of the calibration curve fall on the same straight line.

In the places of tank roundings the graph is curved. Therefore, to calibrate rectangular tanks with roundings, you can use a different pouring step: pour smaller portions in the area of roundings and larger portions in the middle of the tank, where the walls are vertical. This will save your time while maintaining tank calibration accuracy.

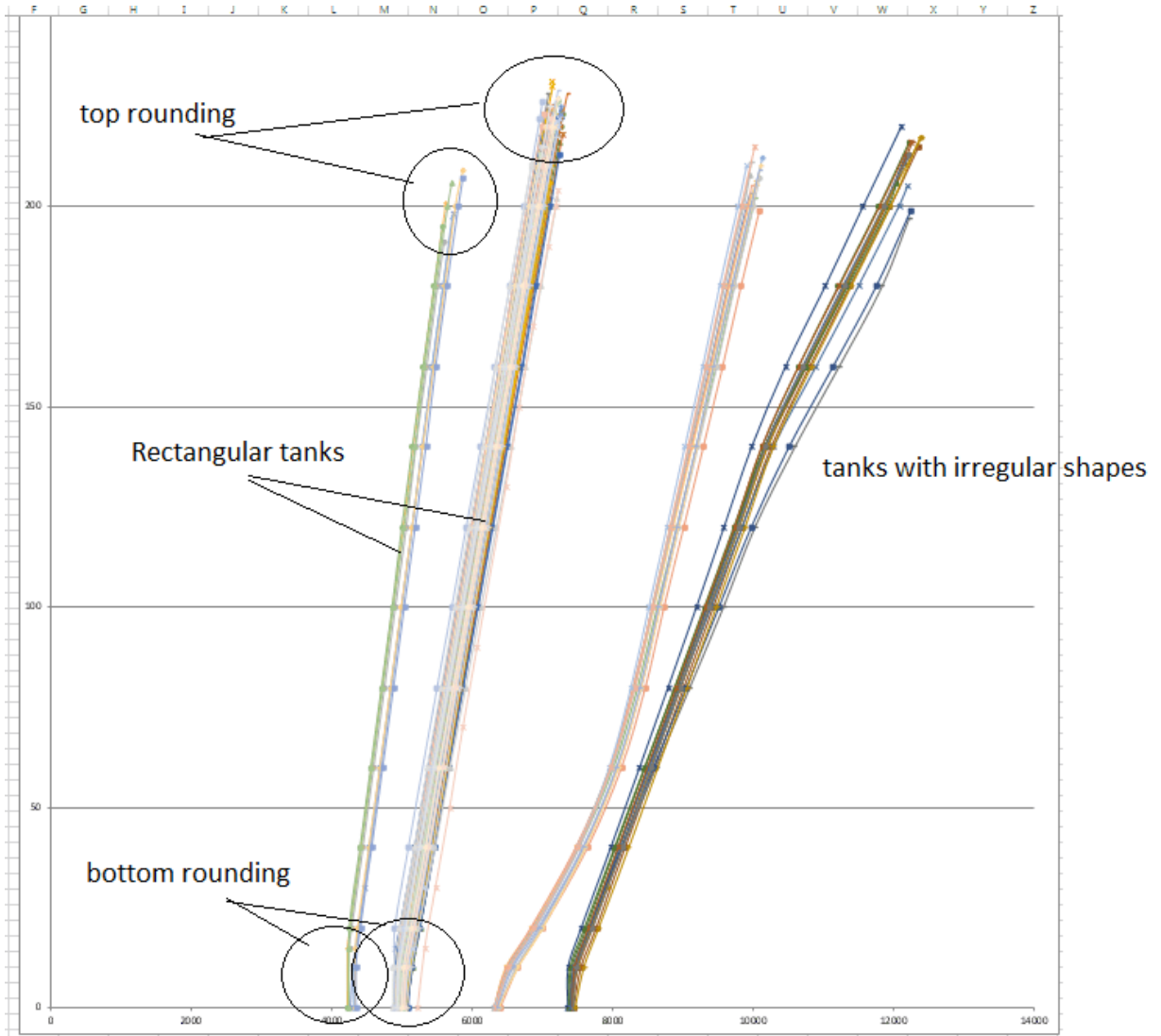


fig. 6.25. Graphs of calibration tables for rectangular tanks with roundings and irregularly shaped tanks

### 3. What if to enter only 2 points ("full" and "empty") to the tank calibration table?

The measurement error will increase depending on the size of roundings. The error will be higher when the fuel is inside the area with roundings.

Tanks of complex shapes, however, require tank calibration with a constant step, since there are no straight sections in the graph, as it can be seen in [fig. 6.25](#). This also relates to the tanks of a "horizontal cylinder" type.

Please note that Analysis panel of calibration curves allows you to control the accuracy of tank calibration. The graph clearly shows the defects of tank calibration

even before the customer complains about inaccurate operation of the fuel monitoring system. There must be no vertical or horizontal sections on the tank calibration graph, if there are some – that is an error ([fig. 6.26](#)). Sharp bends of the calibration curve are also a probable error.

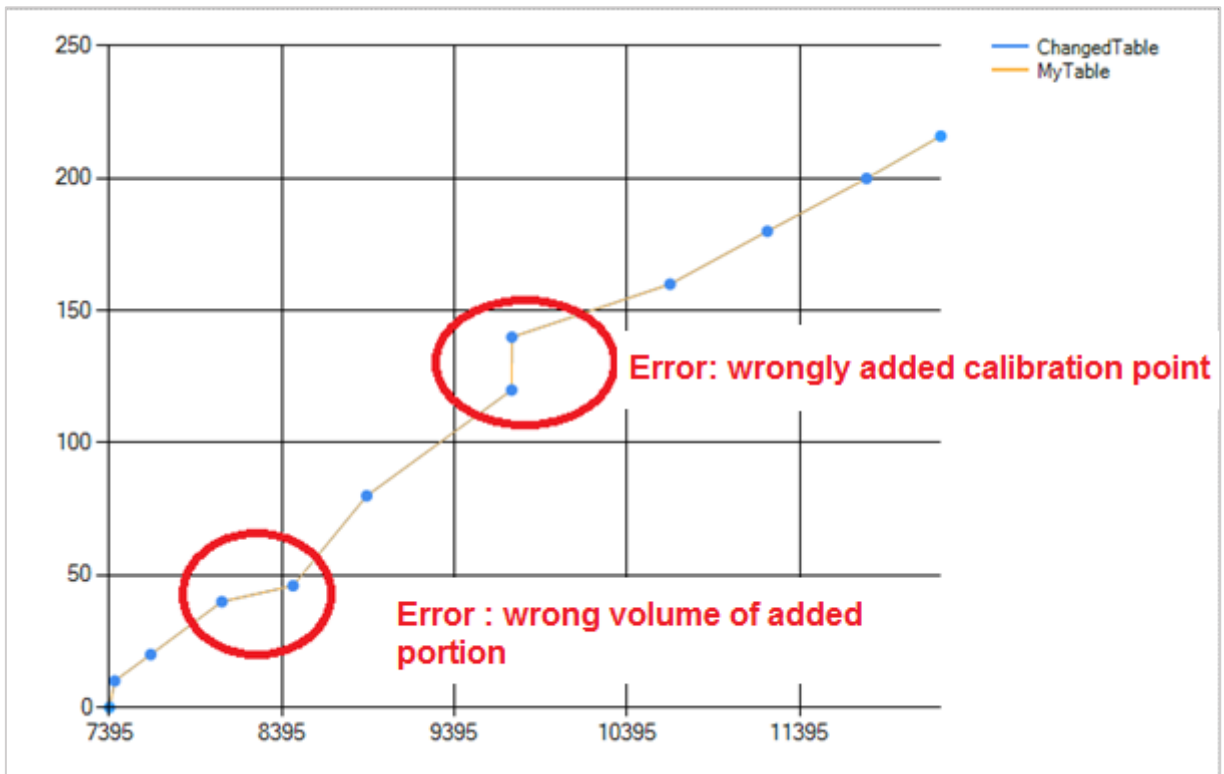


fig. 6.26. Tank calibration defects

## 7 ELECTRICAL CONNECTION

Fuel level sensors are powered from on-board power system of a vehicle.



When connecting the sensor to on-board power system, it is necessary to connect the wires **Power “+”** and **Ground “-”** to the corresponding inputs of a monitoring device.



Before performing electrical connection of the sensor to the vehicle, check the **“Ground”** of the vehicle. The resistance between the wire **“GND”** connection point and the clamp **“-”** of a battery terminal should not exceed 1 Ohm.



It is recommended to lay eurosens signal cable together with the standard electrical wiring of a vehicle, and fix its position with ties every 30 cm.

Electrical connection of flowmeters eurosens is performed in accordance with pin assignment of interface cable wires ([fig. 7.1](#), [fig. 7.2](#), [fig. 7.3](#) and [fig. 7.4](#)), as given in the product specification.

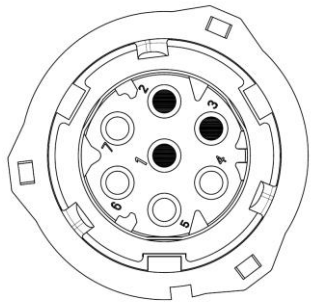
	Pin	Circuit	Wire color in cable
	1	VBAT	green
	2	GND	black
	3	K-LINE/OUT	blue
	4	NC	-
	5	NC	-
	6	NC	-
	7	NC	-

fig. 7.1. Pin assignment in eurosens Dominator AF

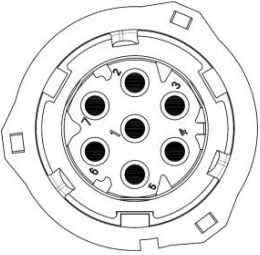
	Pin	Circuit	Wire color in cable
	1	VBAT	red
	2	GND	brown
	3	K-LINE/OUT	blue
	6	RS-485A	yellow
7	RS-485B	green	

fig. 7.2. Pin assignment in eurosens Dominator RS

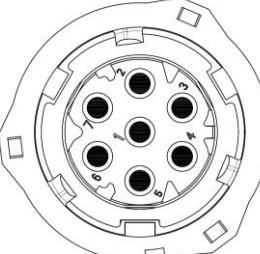
	Pin	Circuit	Wire color in cable
	1	VBAT	red
	2	GND	brown
	3	K-LINE/OUT	blue
	6	CAN_H	yellow
7	CAN_L	green	

fig. 7.3. Pin assignment in eurosens Dominator CAN

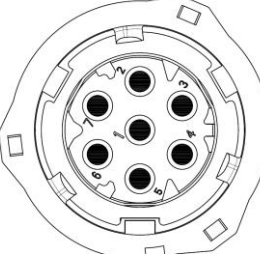
	Pin	Circuit	Wire color in cable
	1	VBAT	red
	2	GND	brown
	3	K-LINE/OUT	blue
	6	CAN_H	yellow
7	CAN_L	green	

fig. 7.4. Pin assignment in eurosens Dominator 2

## 7.1 CONNECTION VIA SERIAL RS-485 INTERFACE

Digital interface RS-485 complies with the requirements of the international standard ANSI EIA/TIA-485-A. Data is transmitted via eurosens Dominator (LLS) protocol or MODBUS RTU.

RS-485 allows connecting several sensors to one port of the data logger (data collection device). When connecting several sensors at the **maximum distance of 20 meters** from the data logger, use the topology of “Star” connection diagram (fig. 7.5).

The topology of “Bus” connection diagram (fig. 7.6) is used to connect several sensors at the **maximum distance of 100 meters**. It is necessary to enable the “Terminator” option in the settings of the sensor which is the farthest from the data logger. This option will turn on the 120 Ohm termination resistor in the sensor, which is vital for this topology.

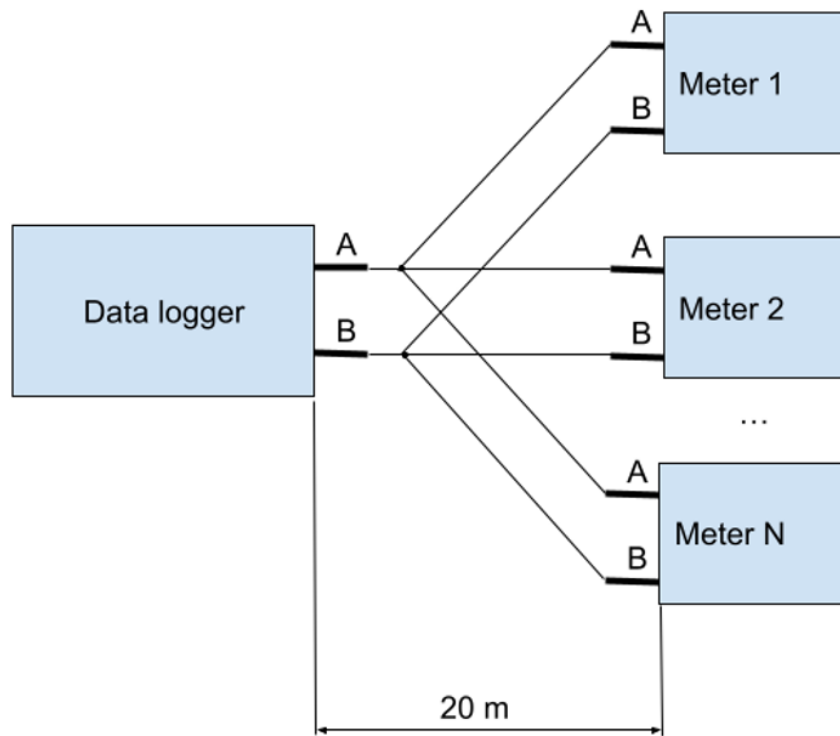


fig. 7.5. Topology of “Star” connection diagram

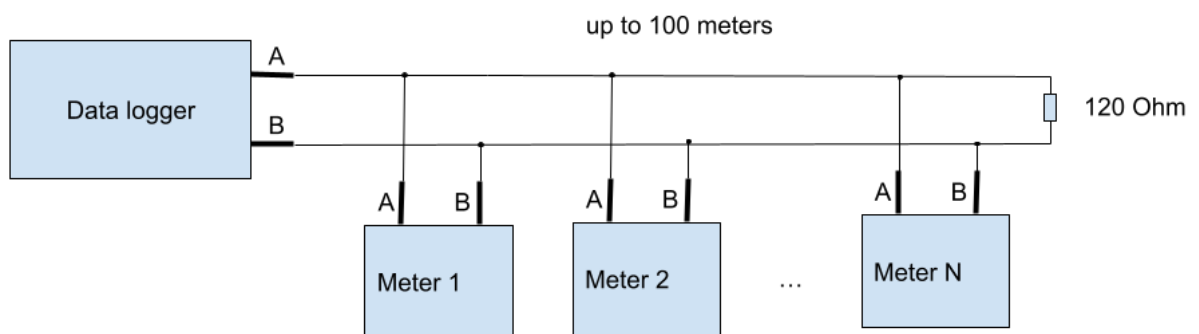


fig. 7.6. Topology of “Bus” connection diagram

For the bus length **over 20 meters**, it is recommended to use a shielded twisted pair cable. The shield of the cable is connected to the minus pole of power supply. Before connecting several sensors in a network, each of them must be configured. Each device in the bus is assigned a unique address.

## 7.2 CONNECTION VIA CAN INTERFACE

Digital interface CAN of sensors complies with the CAN 2.0b specification. Data is transmitted via SAE J1939-31 protocol (with some modifications). CAN interface allows connecting several sensors to one port of the data logger.

When connecting several sensors at the **maximum distance of 10 meters** from the data logger, use the topology of “Star” connection diagram ([fig. 7.7](#)). Make sure that at least one of the network nodes has an enabled termination resistor (enabled by software in sensor settings).

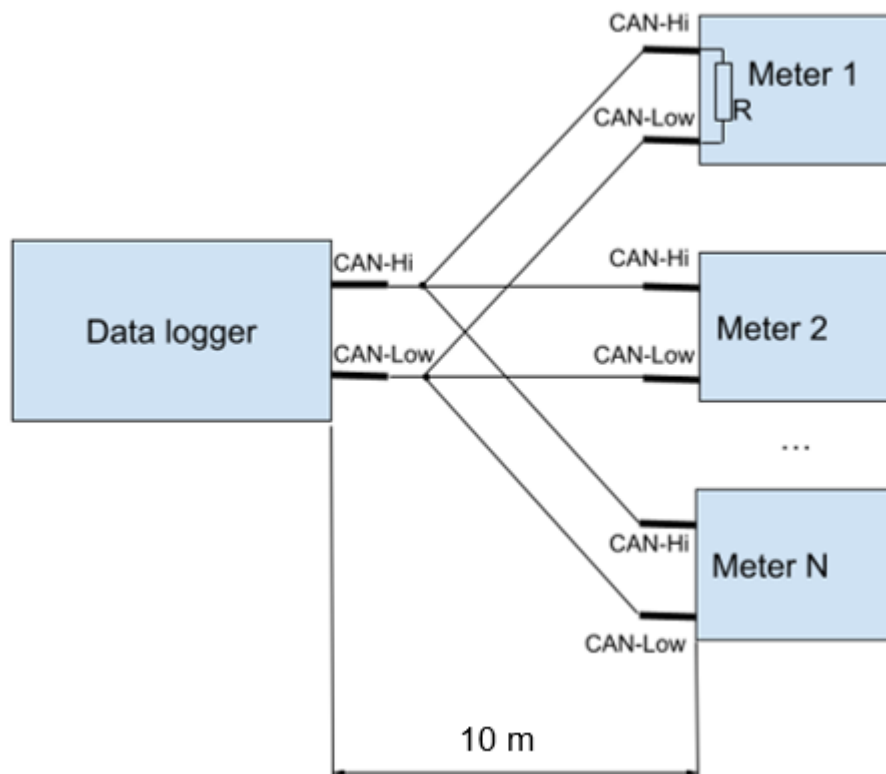


fig. 7.7. Topology of “Star” connection diagram

The topology of “Bus” connection diagram ([fig. 7.8](#)) is used to connect several sensors at the **maximum distance of 100 meters**. It is necessary to enable the “Terminator” option in the settings of sensors located at each end of the bus. This option will turn on the 120 Ohm termination resistor in the sensors, which is vital for this topology.

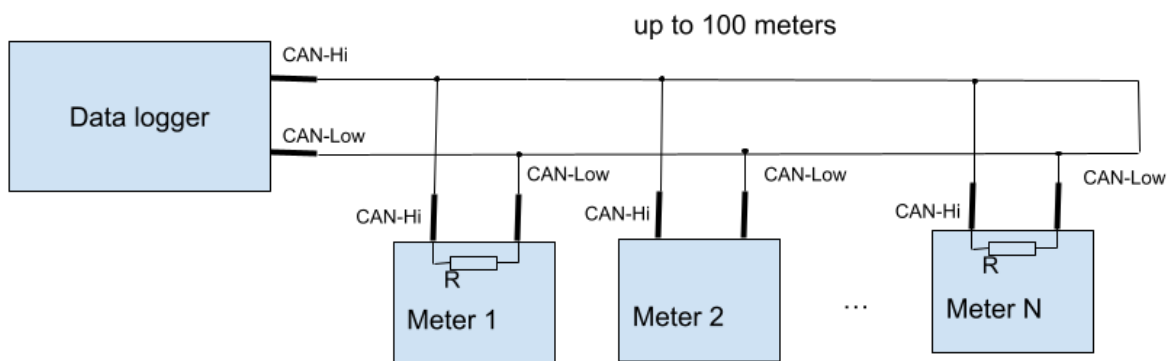


fig. 7.8. Topology of “Bus” connection diagram

For the bus length **over 50 meters**, it is recommended to use a shielded twisted pair cable. The shield of the cable is connected to the minus pole of power supply. Before connecting several sensors in a network, each of them must be configured. Each device in the bus is assigned a unique address.

### 7.3 CONNECTION WITH T-CABLE

Use cables eurosens and T-cables to connect the sensors in a network ([fig. 7.9](#)):

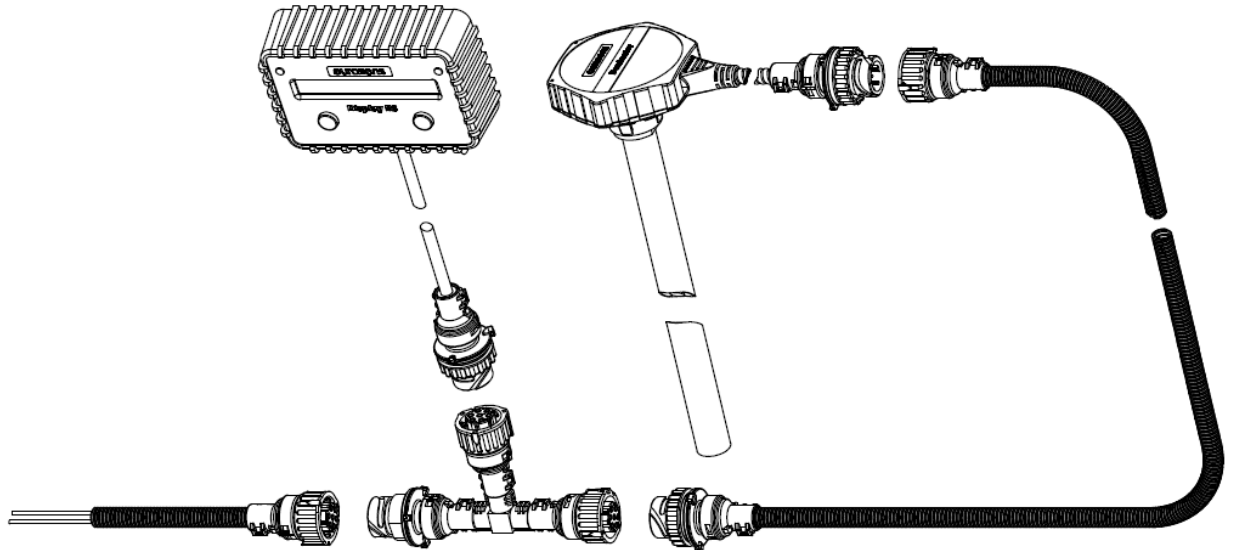


fig. 7.9. Cables eurosens and T-cables



Cables eurosens must have connectors on both sides when used between the sensors and T-cables. Therefore, they cannot be cut on site and must be ordered of the required length.

The standard lengths of eurosens cable: 1m, 3m, 7m.

## 7.4 SEALING

### 7.4.1 SEALING OF SENSOR POSITION

The sensor can be sealed in 2 ways:

1. The sealing cable is threaded through the holes in the sensor case and in the bayonet, and prevents the sensor from removal ([fig. 7.10](#)).

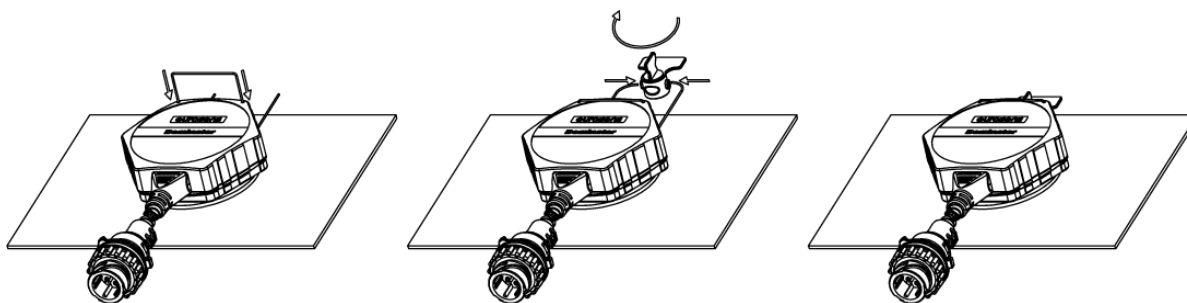


fig. 7.10. Sealing method 1

2. The sealing cable is threaded through the bayonet from below and through the sensor case upwards ([fig. 7.11](#)).

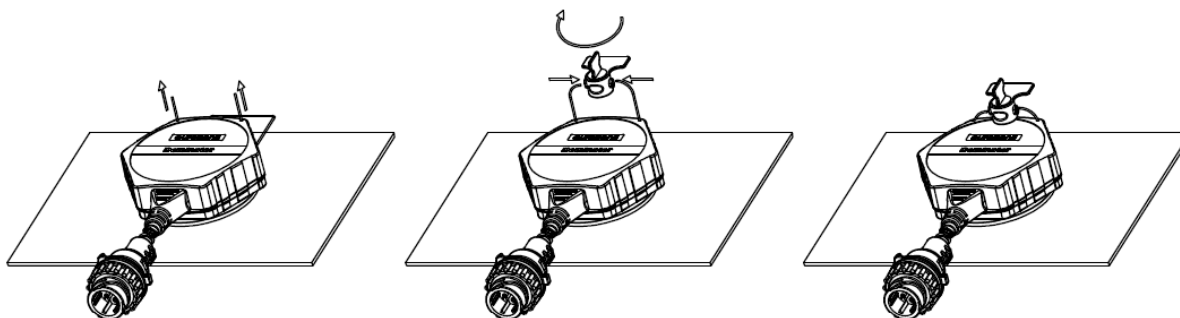


fig. 7.11. Sealing method 2

Method 1 is applied when the sensor is replaced or during the first installation. Method 2 is usually applied during the first installation.

#### 7.4.2 SEALING OF CABLE CONNECTION

Eurosens cable connectors (Fig. 7.12) have special holes for sealing.



fig. 7.122. eurosens cable connectors.

Insert the sealing wire through the holes on the sensor side, then pass it through the holes of the cable connector and pull it out to the side for installing the screw seal (Fig. 7.13).



fig. 7.133. Sealing wire installation

Pass the sealing wire through the holes of the cable socket (Fig. 7.14).

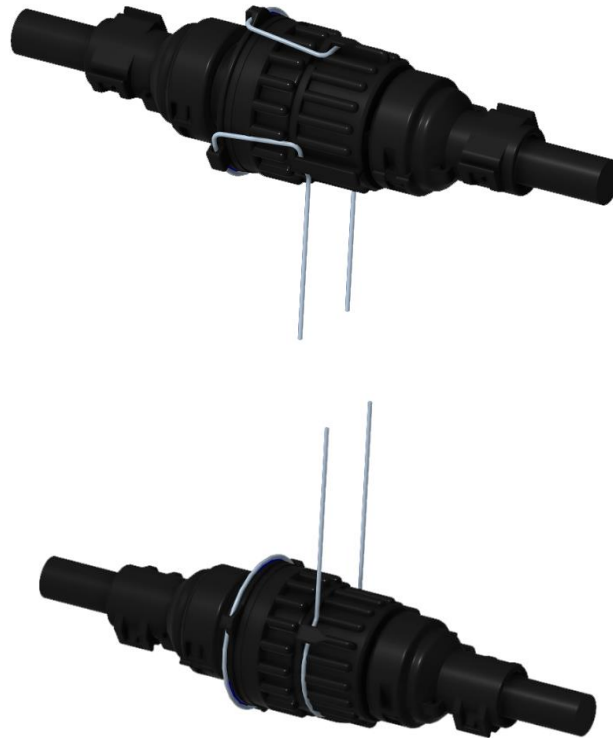


fig. 7.14.

Insert both ends of the wire through the holes of the rotary seal (Fig. 7.15), then tighten the seal against the connector by rotating the rotor (Fig. 7.16). Finally, cut off the excess ends of the sealing wire (Fig. 7.17).

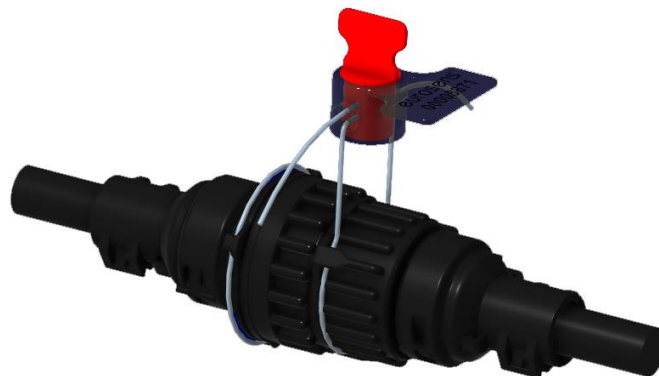


Fig. 7.155. Seal installation



Fig. 7.166.



Fig. 7.177. Sealing completed

## 7.5 ELECTRICAL CONNECTION IN HAZARDOUS AREA

Fuel level sensors eurosens Dominator are certified in accordance with the requirements of TR CU 012 (Technical Regulations of the Customs Union) and have the ExialIBT6 X explosion-proof certification. Therefore, it is necessary to limit the electrical power entering the hazardous area in accordance with the requirements of GOST 31610.11-2014 "Equipment of explosion protection type "i" – intrinsically safe electrical circuit".

Table 7.1. Electrical intrinsically safe parameters of sensors eurosens.

Parameter, measurement unit	Value
Maximum input voltage $U_i$ , B	30
Maximum input current $I_i$ , mA	25
Maximum internal capacity $C_i$ , $\mu\text{F}$	0.5
Maximum internal inductance $L_i$ , $\mu\text{H}$	0.33

Intrinsic safety barrier eurosens Defender 24 limits electrical power and must be installed in a safe area. Up to 4 sensors can be connected to one barrier ([fig. 7.18](#)). The I.S. barrier limits the voltage value to the intrinsically safe one.

Table 7.2. Electrical intrinsically safe parameters of sensors eurosens.

Parameter, measurement unit	Value
Maximum input voltage $U_m$ , V	30
Maximum output voltage $U_o$ , V	24
Maximum output current $I_o$ , mA	4x0.025
Maximum external capacitance $C_o$ , $\mu\text{F}$	4x4.0
Maximum external inductance $L_o$ , $\mu\text{H}$	4x1.0

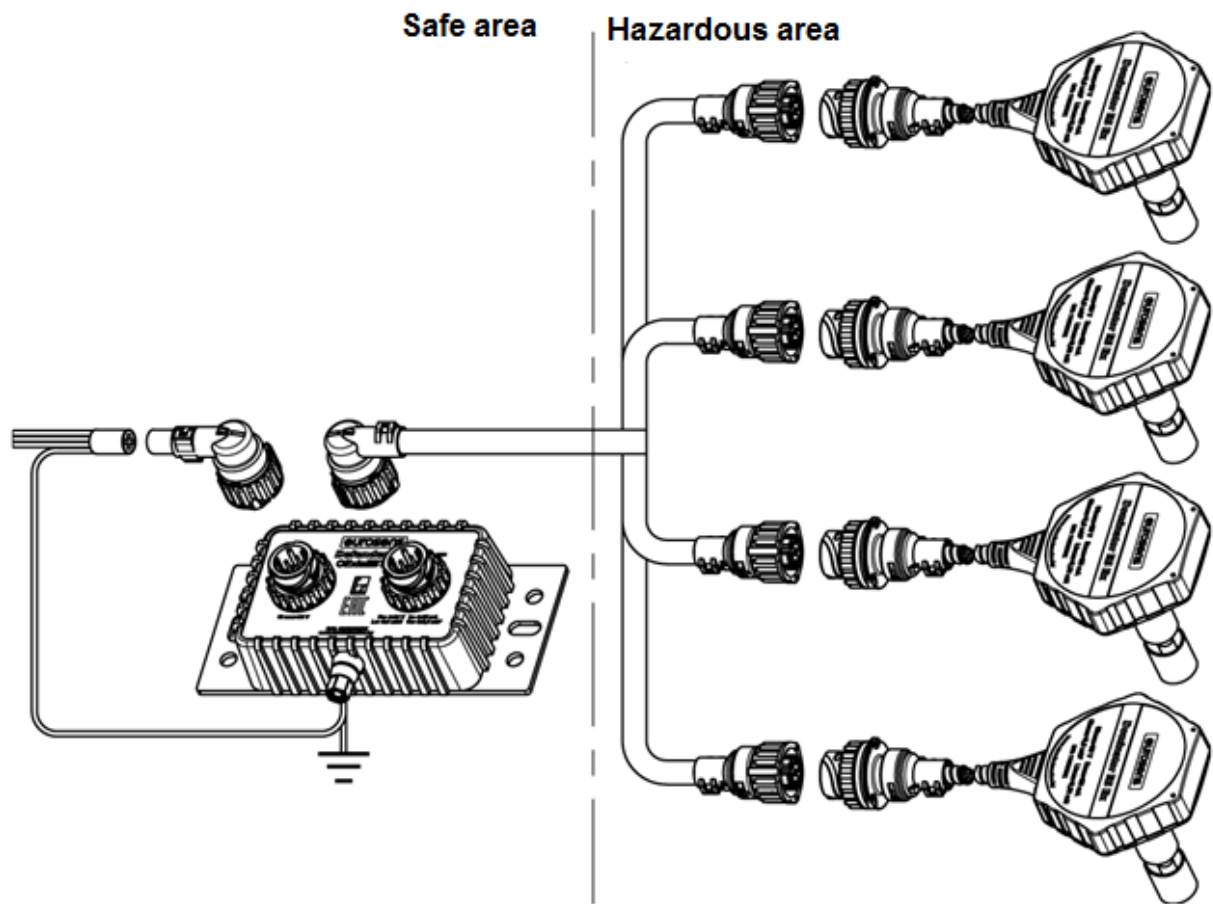


fig. 7.188. Connection of sensors eurosens Dominator via I.S. barrier eurosens Defender 24

If the I.S. barrier eurosens Defender 24 is not available, use an equivalent protective electrical circuit to limit the power entering the hazardous area.

## 8 TROUBLESHOOTING

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### 1. Sensor output value is equal to minimum possible value:

- For Dominator AF the voltage or frequency values are equal to the minimum value in the settings.
- For Dominator RS (RS 485) the output value N is equal to the minimum value in the settings.
- For Dominator CAN the fuel volume value is equal to zero.

Check the calibration table of the sensor and the current detector value. If the detector value is **below 3000**, then check whether the electrodes have contact with the measurement module.



The current detector value can be determined remotely for the sensor eurosens Dominator RS (RS 485) if the GPS tracker transmits the internal frequency value of the sensor (LLS protocol or Modbus RTU).

### 2. Sensor output value is equal to maximum possible value:

- Most likely the electrodes are short-circuited by water or dirt. Remove the sensor from the bayonet mount and lift it above the tank.
- If the sensor continues to transmit the maximum value, disconnect the electrodes and check for the dirt inside.

### 3. Fuel volume value in GPS tracking software is “frozen” (does not change):

- The monitoring software may filter out incorrect values.
- Frequent reasons for incorrect values:
  - power or data wires are disconnected from the sensor;
  - short circuit by water or dirt (see situation 2);
  - GPS tracker is powered from the built-in battery, while the general power supply of the system (and sensor) is disconnected.

## 9 ADDITIONAL INFORMATION

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### 9.1 STORAGE

It is recommended to store fuel level sensors eurosens in dry enclosed areas.

Do not store fuel level sensors eurosens with substances that cause metal corrosion and/or contain aggressive impurities.

### 9.2 TRANSPORTATION

Fuel level sensors eurosens must be transported in manufacturer's packaging and in compartments that protect packages from mechanical damage and precipitation.

Air environment in transportation compartments must not contain acidic, alkaline and other corrosive impurities.




### 9.3 DISPOSAL


Fuel level sensors eurosens do not contain any substances or components that could be hazardous to health and the environment during and after the service life and disposal.

The disposal of spent ER14505 batteries used in sensors eurosens Dominator Bt must be carried out in accordance with applicable legislation.

Fuel level sensors eurosens do not contain precious metals in amount mandatory for accounting.

## 9.4 TECHNICAL SUPPORT

   +37525-691-87-76

 +37525-691-87-76

 [support@mechatronics.by](mailto:support@mechatronics.by)

## 9.5 CONTACTS

JSC Mechatronics

80/3 1<sup>st</sup> May Street

Vileyka, 222416

Belarus

t: +375 (1771) 33011

f: +375 (1771) 24190

E-mail: [office@mechatronics.by](mailto:office@mechatronics.by)

<https://eurosenstelematics.com/en/>



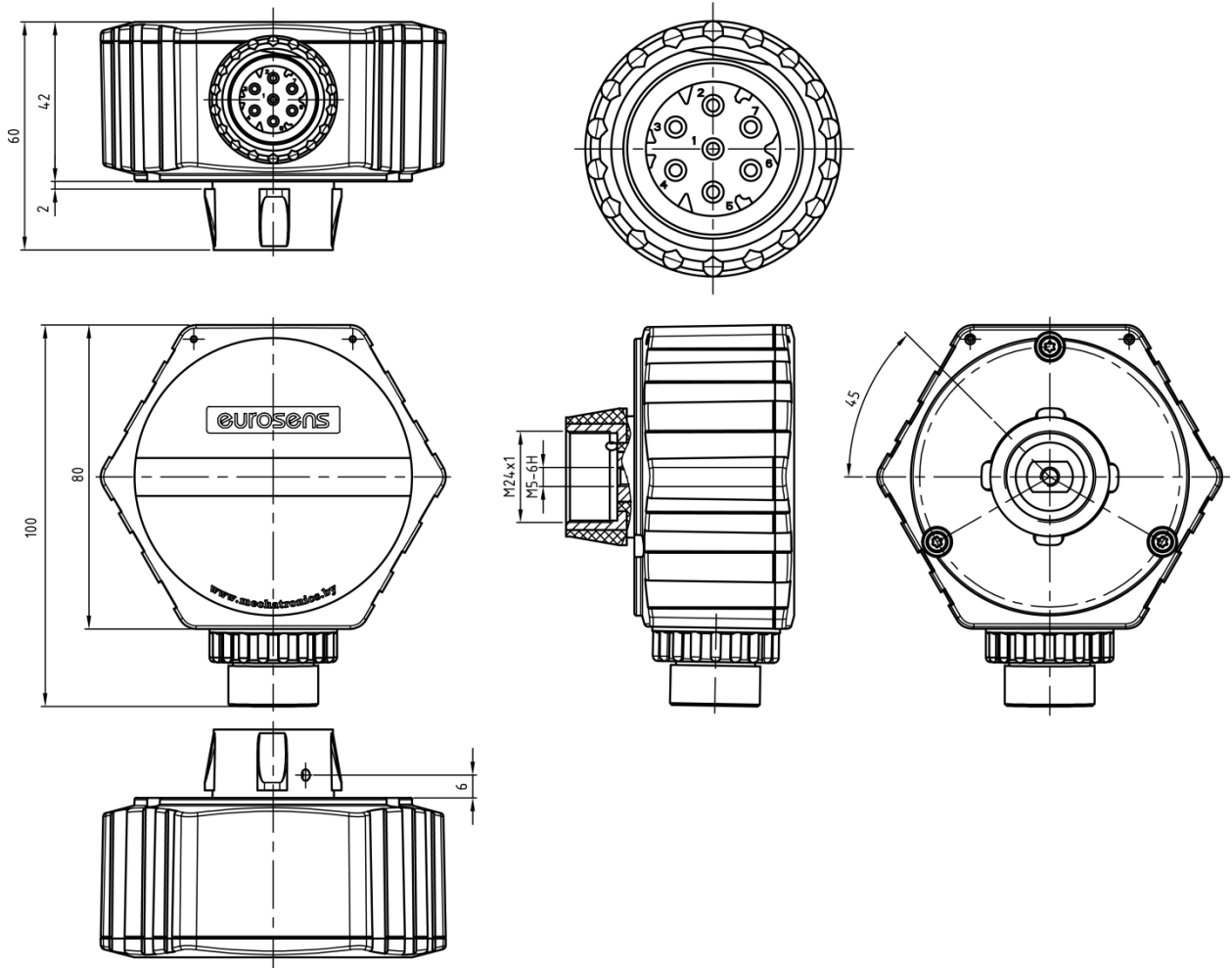


fig. I. 2. Dimensions of eurosens Dominator RS 485, AF, RS, CAN, AFRS

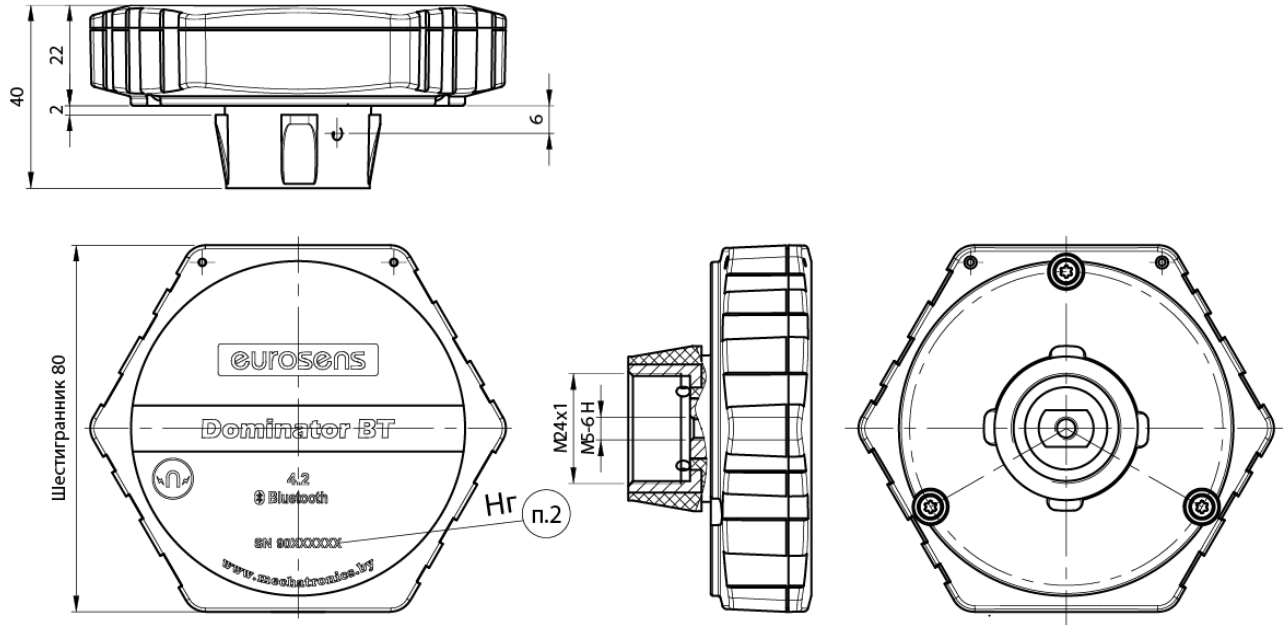


fig. I. 3. Dimensions of eurosens Dominator Bt

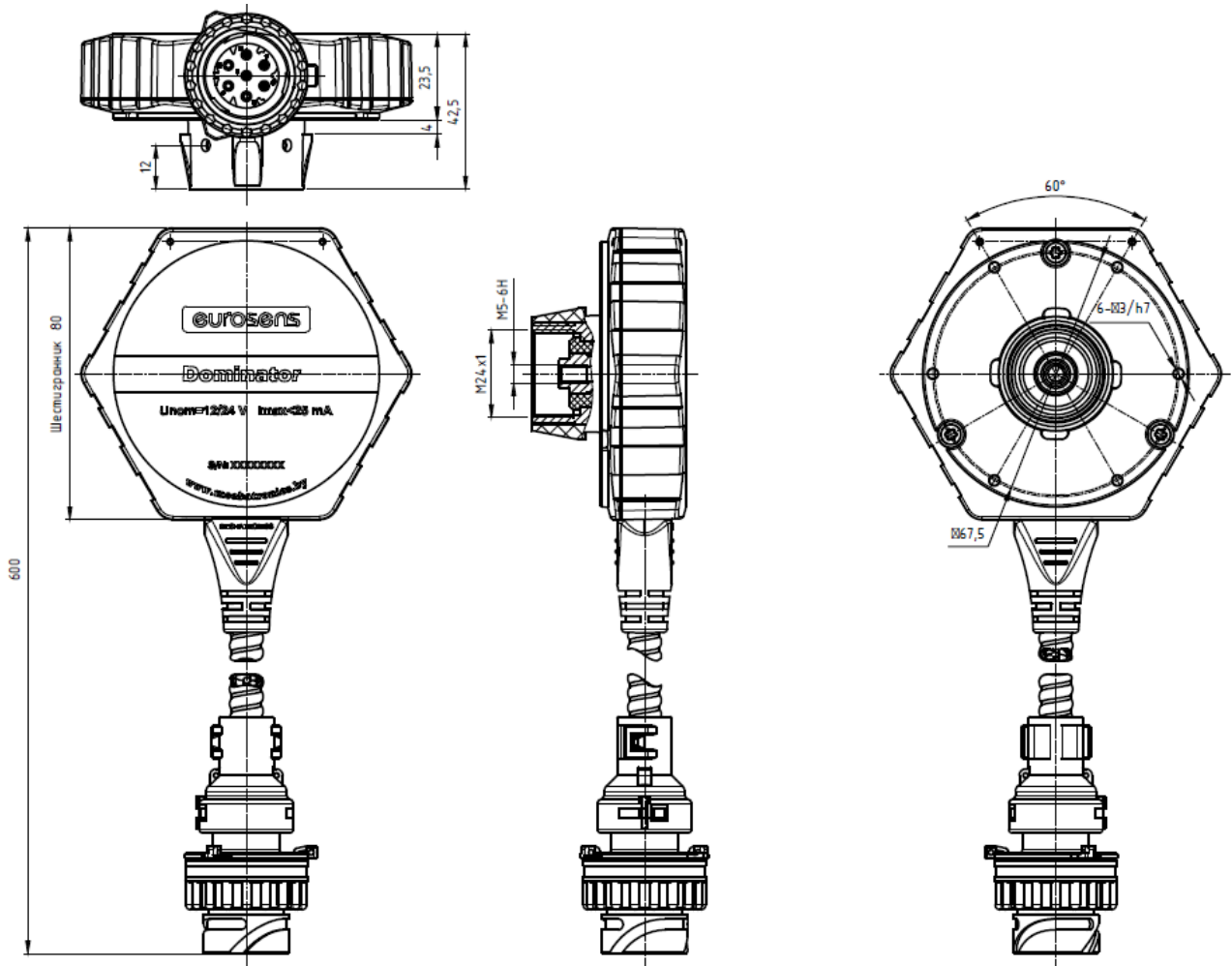


fig. I. 4. Dimensions of eurosens Dominator RS 485 and Mini versions

## APPENDIX II. ADDRESS SPACE FOR MODBUS PROTOCOL

Table II. 1. Modbus protocol

No	Modbus address	Storage location	Data type	Comments
1	30000	Input Register	signed 16-bit	Temperature (in 0.1 °C)
2	30001	Input Register	unsigned 16-bit	N (according to LLS protocol)
3	30002	Input Register	unsigned 16-bit	F* (according to LLS protocol)
4	30003	Input Register (high 16-bit)	signed 32-bit	Fuel volume (in 0.01 l)
5	30004	Input Register (low 16-bit)		
6	30005	Input Register (high 16-bit)	signed 32-bit	Tank volume (in 0.01 liters)
7	30006	Input Register (low 16-bit)		
8	30007	Input Register	unsigned 16-bit	Error codes (bit by bit): 0-bit - empty tank calibration threshold error; 1-bit - full tank calibration threshold error; 3-bit - drain detection; 2, 4...15-bit - not used
9	30008	Input Register (high 16-bit)	unsigned 32-bit	Device serial number
10	30009	Input Register (low 16-bit)		
11	30011	Input Register	unsigned 16-bit	Type of device

## APPENDIX III. CAN-MESSAGES OF eurosens DOMINATOR CAN

Table III.1.

PGN	Parameter	Position of meaningful bytes in PGN	Length of SPN, byte	Range of parameter	Resolution/bit	Offset	Units
65276 (FEFC)	Fuel level	2	1	from 0 to 100	0.4%	0	%
65321 (FF29)	Fuel volume in high resolution	1-4	4	from 0 to 421108 1.215	0.001 л	0	л
65321 (FF29)	Fuel volume in high resolution, in %	5-6	2	from 0 to 160.637 5%	0.0025 %	0	%
65321 (FF29)	Fuel temperature	7	1	from -40 to 210	1°C	-40	°C
65321 (FF29)	Status bits	8	1	Error codes (bit by bit): 0-bit - empty tank calibration threshold error; 1-bit - full tank calibration threshold error; 3-bit - drain detection; 2, 4...7-bit - not used			
62982 (F606)	Fuel level	1-2	2	from 0 to 6425.5	0.1 mm	0	mm
62982 (F606)	Fuel volume	3-4	2	from 0 to 6425.5	0.1 l	0	l
62982 (F606)	Fuel temperature	7	1	from -40 to 210	1°C	-40	°C
65279 (FEFF)	Operator indicators	1	1	Error codes (bit by bit): 0-bit - Full tank calibration threshold error; 1...7-bit - not used			
65380 (FF64)	Fuel level	1-2	2	from 0 to 64255	1 N (mm)	0	N (mm)
65380 (FF64)	Fuel level	3-4	2	from 0 to 64255	1 Hz	0	Hz
65380 (FF64)	Fuel level	5-8	4	from 0 to 429496 7295	1	0	–

## APPENDIX IV. DOMINATOR BT MESSAGE FORMAT

Table IV.1. Protocol ver. 1

Field name	Specification	Example	Offset, bytes	Length, bytes
48-bit Unique Identifier (UID)	constant	0x795FB8622EB6	7	6
Type	constant	0x5A (dec 90)	13	1
Serial number	constant	0x00001B (dec 27)	14	3
Message number	Message Overwrite Count	0x0003CA36 (dec 248374)	17	4
Detector value	Current average detector value	0x3602 (dec 13826)	21	2
Fuel volume, l (0.01l / bit)	The current amount of fuel. Resolution 0.01 L per bit.	0x00001DE3 (dec 7651, vol 76,51)	23	4
% of fuel from a full tank (0.01% / bit)	Current % of the volume. Resolution 0.01% per bit.	0x0EF1 (dec 3825, % 38,25)	27	2
Temperature, ° C. (1 ° C / bit) (-40)	The current temperature. Resolution 1 ° C per bit. Offset - 40.	0x45 (dec 69, t +29 °C)	29	1
Battery charge (1% / bit)	The current battery charge. Resolution 1% per bit.	0x64 (dec 100)	30	1

Raw data

0x0201061BFFFFFF795FB8622EB65A00001B0003CA36360200001DE30EF14564

Table IV.2. Protocol ver. 2

Field name	Specification	Example	Offset, bytes	Length, bytes
40-bit Unique Identifier (UID)	constant	0x3F36B4FDBE	7	5
Type	constant	0x5A (dec 90)	12	1
Serial number	constant	0x00001B (dec 27)	13	3
Message number	Message Overwrite Count	0x0003CA36 (dec 248374)	16	4
Status*	status flags	0x00 (dec 0)	20	1
Detector value	Current average detector value	0x3602 (dec 13826)	21	2
Fuel volume, l (0.01l / bit)	The current amount of fuel. Resolution 0.01 L per bit.	0x00001DE3 (dec 7651, vol 76,51)	23	4
% of fuel from a full tank (0.01% / bit)	Current % of the volume of the fuel tank. Resolution 0.01% per bit.	0x0EF1 (dec 3825, % 38,25)	27	2
Temperature, ° C. (1 ° C / bit) (-40)	The current temperature. Resolution 1 ° C per bit. Offset -40.	0x45 (dec 69, t +29 °C)	29	1
Battery charge (1% / bit)	The current battery charge. Resolution 1% per bit.	0x64 (dec 100)	30	1

Raw data

0x0201061BFFFFFF3F36B4FDBE5A00001B0003CA3600360200001DE30EF14564

Table IV.3. Status parameter.

Description	Bit number
Sensor locked	0
Calibration error "empty"	1
Calibration error "full"	2
Broken electrode	3
Reserve	4-7

## APPENDIX V. EQUIPMENT FOR SENSOR INSTALLATION

Table V.1

No	Item
1	Fuel level sensor with cable, mounting kit and measuring electrode(s)
2	Ø38 mm bimetal drill bit
3	Metal hacksaw
4	Wrench (for electrodes)
5	PC/laptop (for installation of Dominator BT - smartphone with Android OS, version 9 or higher)
6	Service adapter eurosens Destination 02 (except Dominator BT)
7	Equipment for tank calibration: tank calibration station, or a pump and a meter, or a measuring container; a container for fuel storage
8	Cable ties (except Dominator BT)

## APPENDIX VI. READING SENSOR DATA BY NAVTELECOM GPS TRACKER USING MODBUS RTU

For communication using RS485 interface and MODBUS RTU protocol we set up the fuel level sensor according to fig. VI. 1.

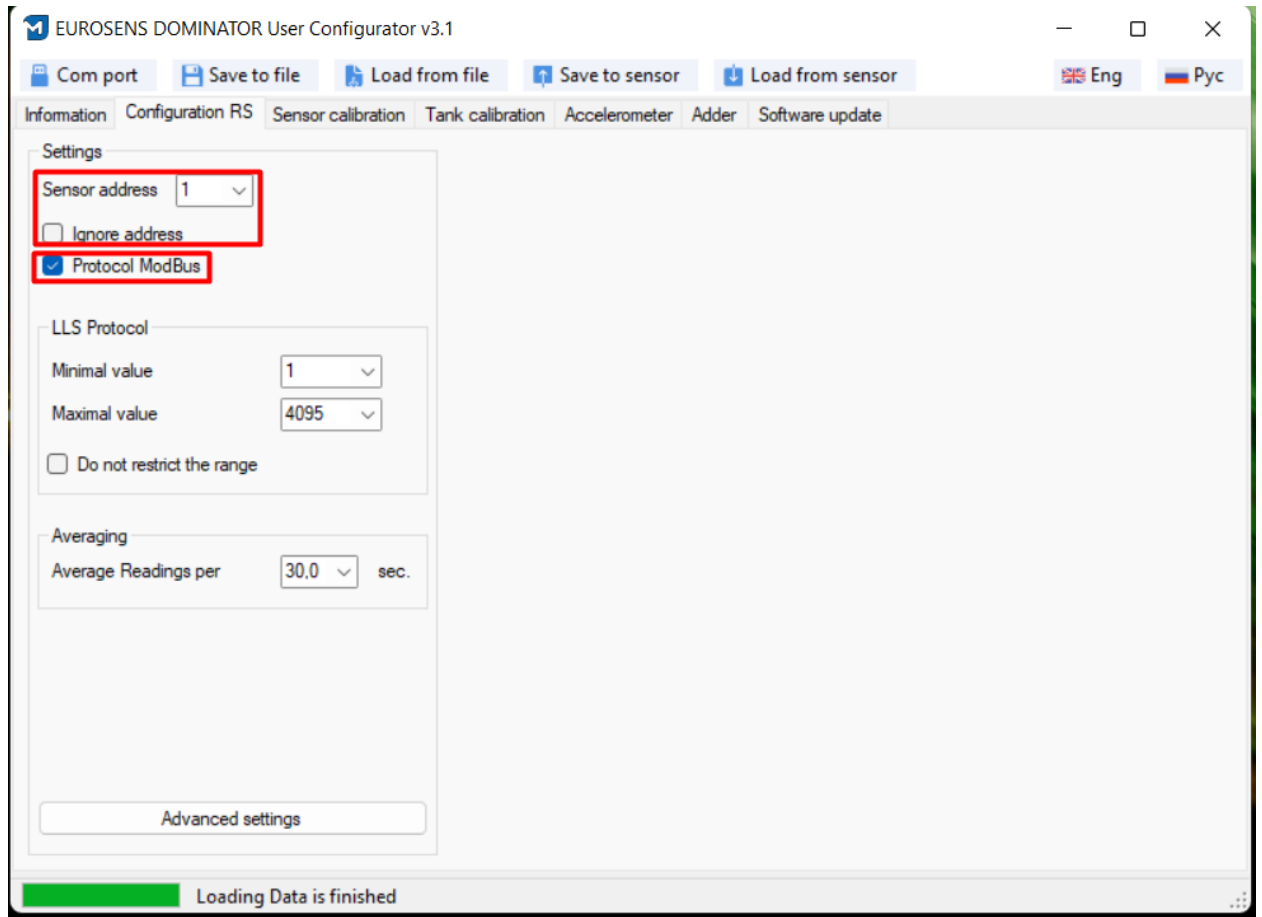


fig. VI. 1

In the Navtelecom configurator on the RS-232/RS485 tab we choose the Device1 – Modbus interface, speed 19200 bps (fig. VI. 2). Sensor address should be same with connected sensor address. Then we have to choose the Modbus registers to read (according to Appendix II).

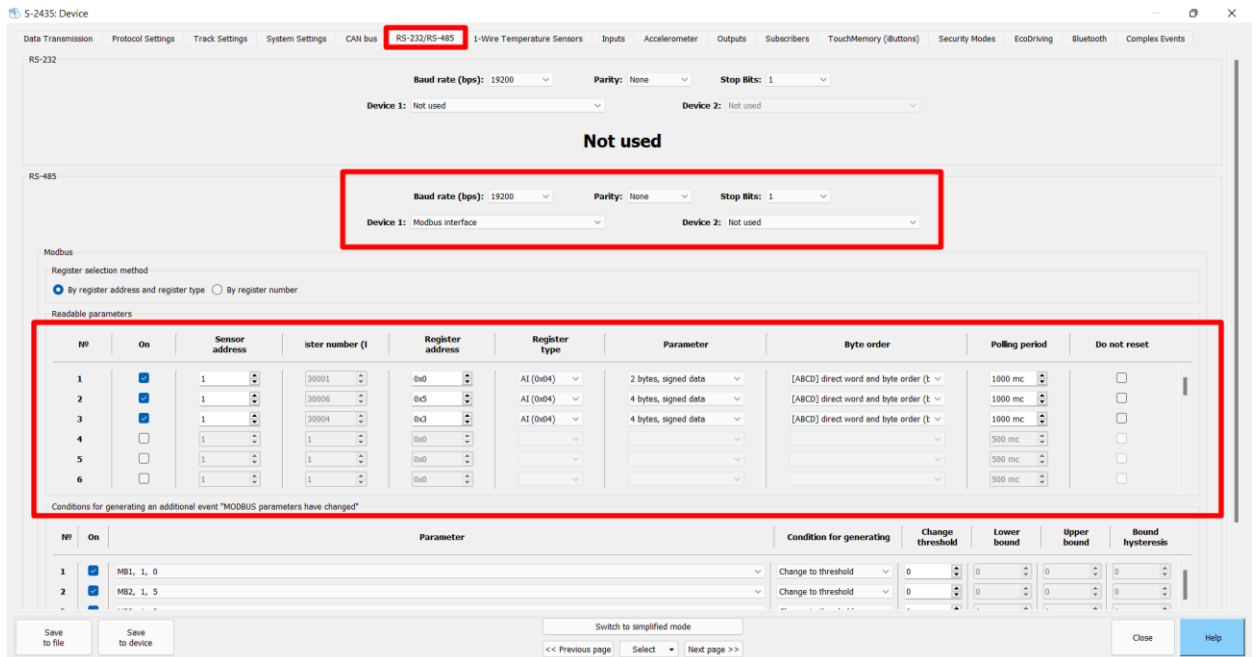


fig. VI. 2

Note that register addresses in the Navtelecom GPS tracker must be set in hexadecimal system, for this purpose they must be converted from decimal, for example, with a Windows calculator (the address in the decimal system 0010, in hexadecimal 0xA). Fill the registers of interest as shown on fig. VI. 3. The Parameter field (length, signed or unsigned) is filled in according to appendix II.

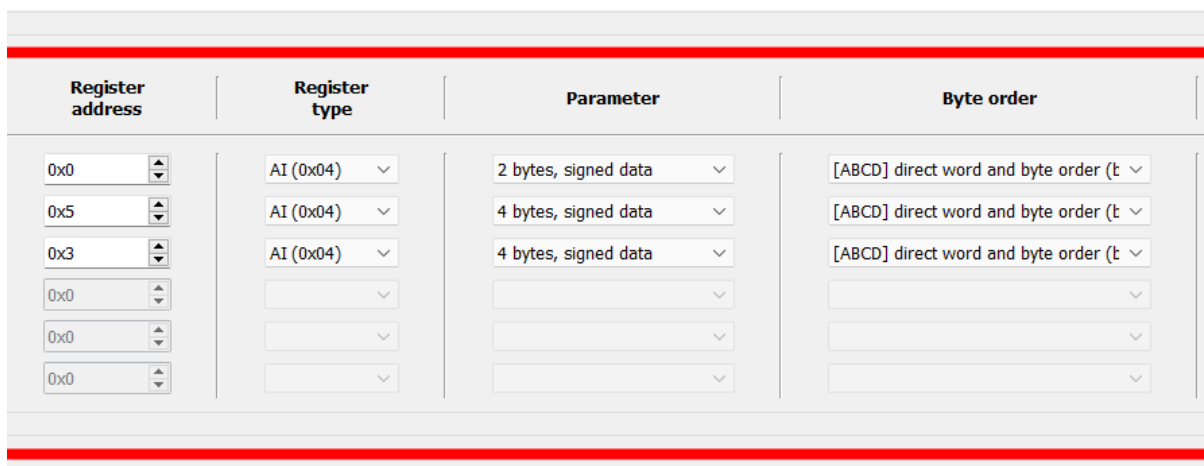


fig. VI. 3

Next, go to the **Protocol section**. Select **FLEX 3.0** version of the data transmission protocol. On the **User Parameters** tab, select the parameters to be transmitted by the tracker (fig. VI. 4).

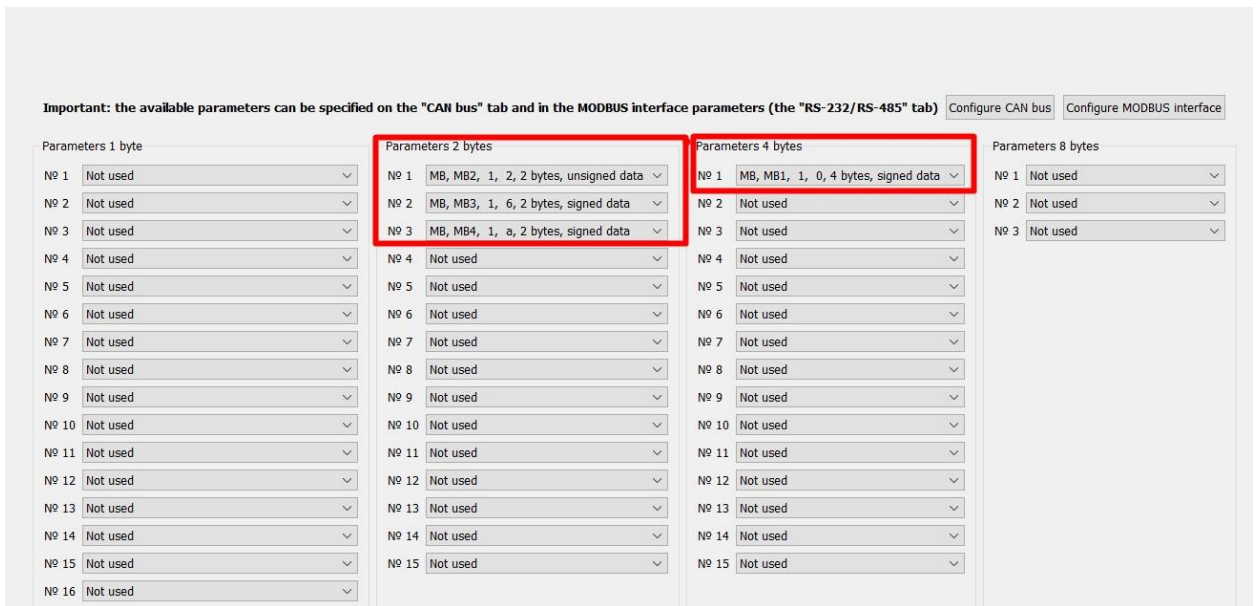


fig. VI. 4

Save the configuration into the GPS tracker. It will reboot and after 40 seconds it will start reading data from the sensor. Connection of sensors via RS485 to the GPS tracker is carried out according to the scheme shown on fig. VI. 5. It is possible to connect several sensors to 1 RS485 port, also it is possible to simultaneously use other sensors supporting MODBUS RTU protocol. To read several sensors it is necessary to set the corresponding sensor addresses in the Device Address column (see fig. VI. 1).

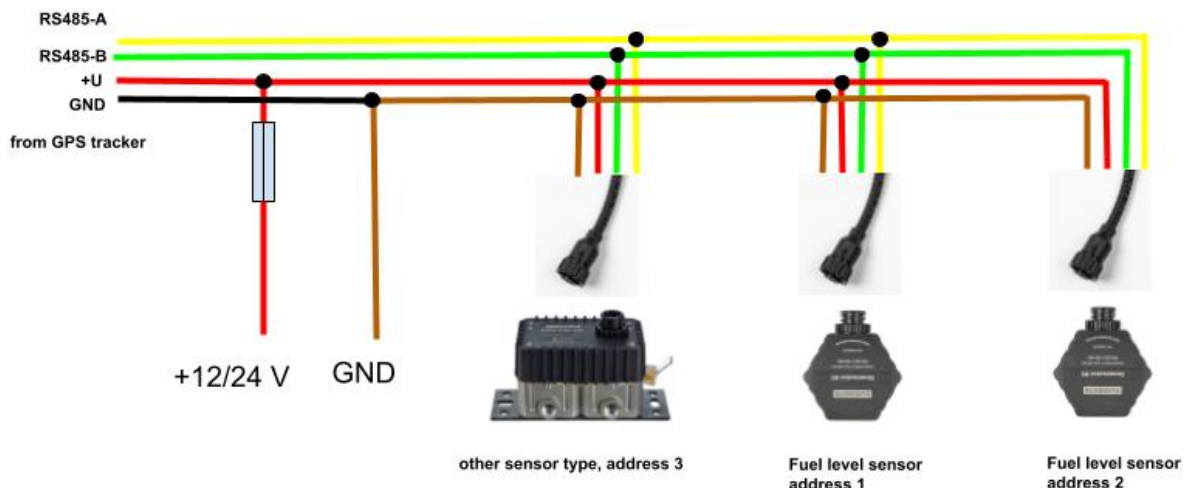


fig. VI. 5

It is possible to check the values in Telemetry section, User parameters tab. Note that you must apply coefficients to the fuel level sensor data according to Appendix II. Fuel volume is transmitted in 0.1L, temperature in 0.1 celsius.

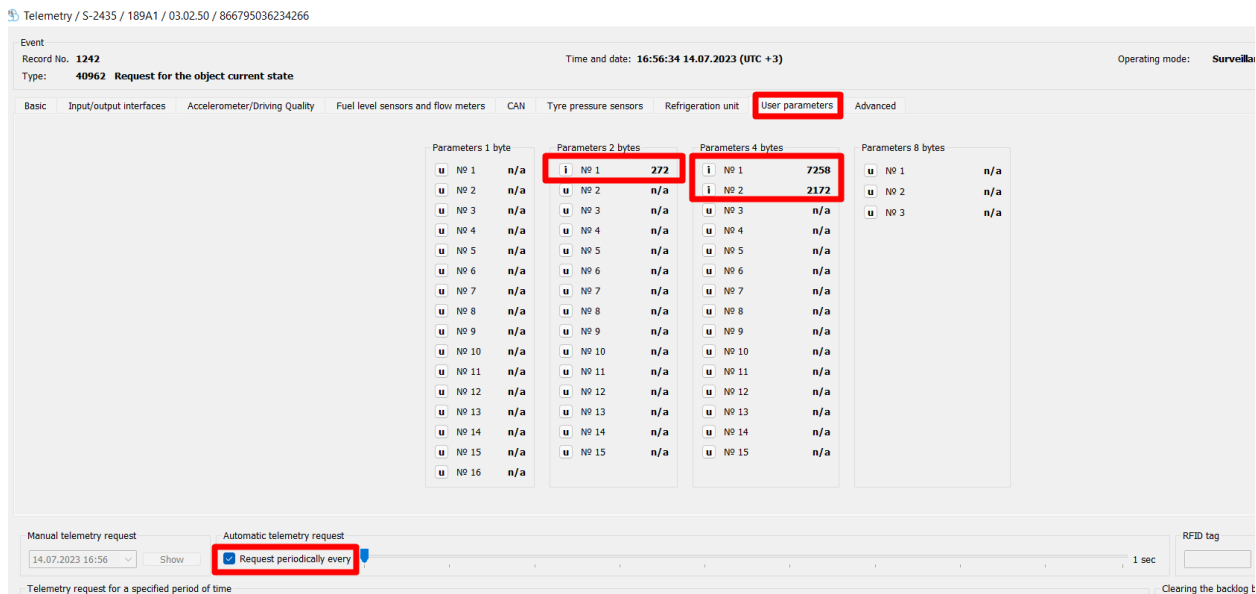


fig. VI. 6

## APPENDIX VII. READING SENSOR DATA BY TELTONIKA GPS TRACKER USING RS485 INTERFACE

For operation via RS485 interface and LLS protocol the fuel level sensor must be configured as shown on fig. VII. 1. It is necessary to set the **Sensor Address** and disable the "Ignore" option if you connect several fuel level sensors per RS485 interface. Each of sensor should has its unique address (1, 2, 3 and so on).

For long RS-485 networks you may need also turn ON the option "Up line RS485".

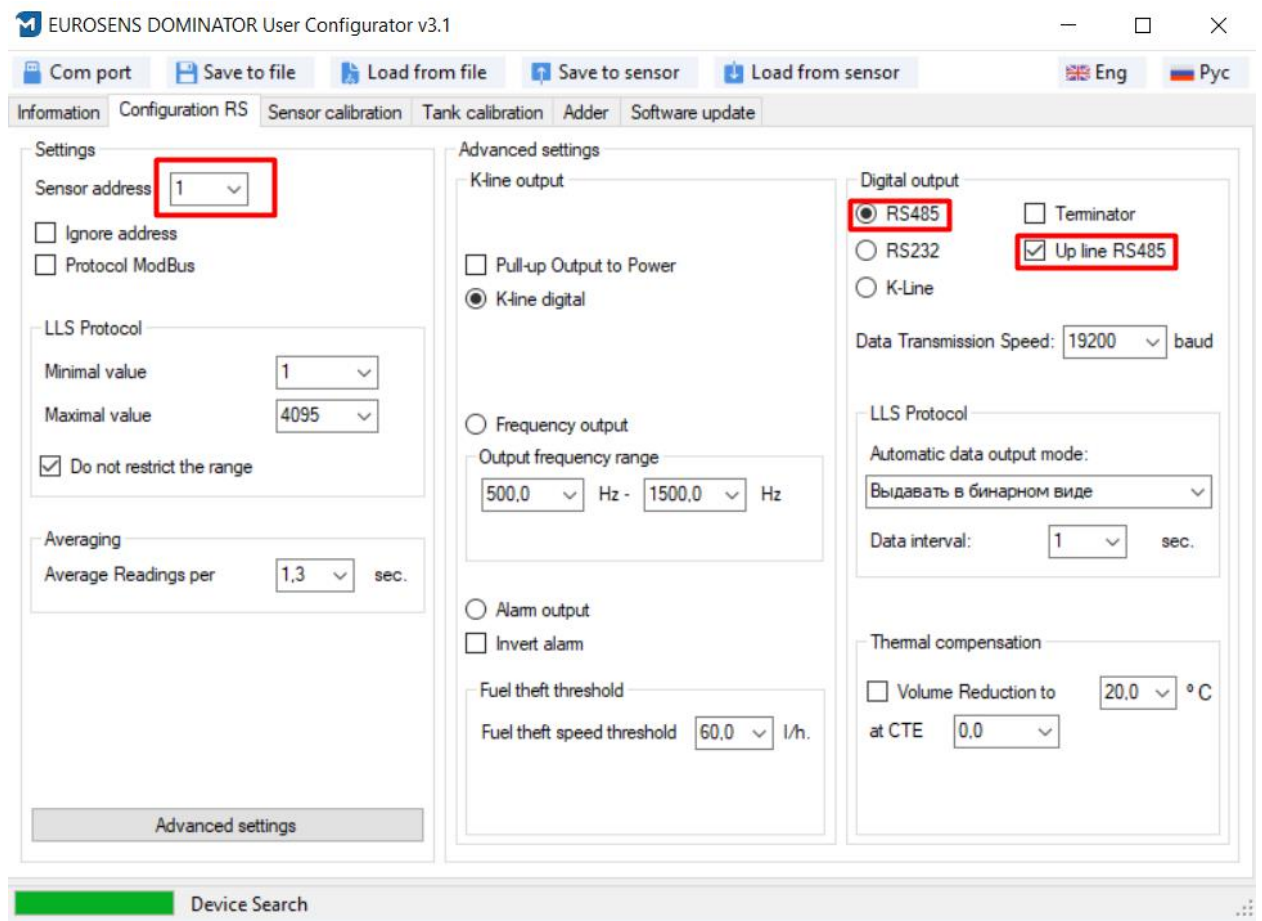


fig. VII. 1

In the Teltonika settings go to RS232/RS485 section, for RS485 interface choose LLS mode and baudrate 19200 (fig. VII. 2). In RS485 LLS sensors set addresses for connected sensors, for example LLS 1 Address – fuel level sensor with address=1. You can connect up to 5 sensors per RS485 interface of Teltonika, each having its unique address.

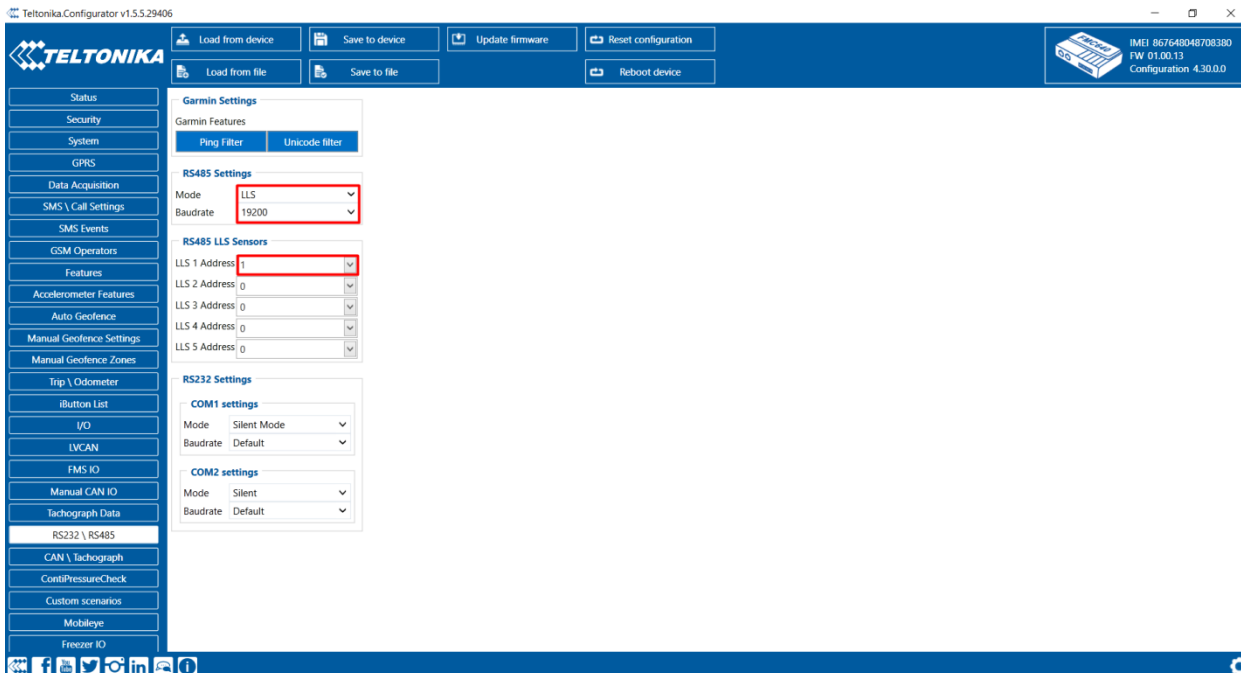


fig. VII. 2

In the I/O section find the LLS parameters and set option “Low” for fuel level and LLS temperature for connected sensors (**Ошибка! Источник ссылки не найден.**). Save settings to GPS tracker and connect sensor. Data from sensor appears.

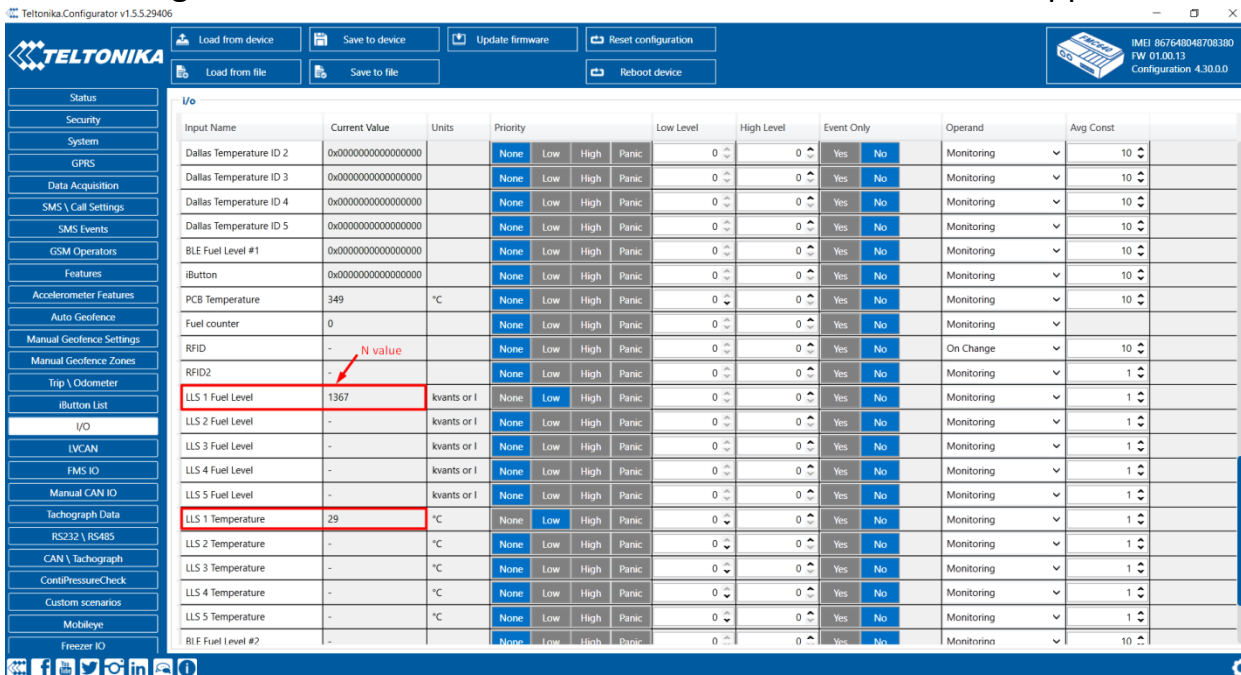


fig. VII. 3

According to Teltonika Wiki, on server side LLS 1 Fuel level – io\_201, LLS 1 Temperature – io\_202. You can see other io numbers there : [https://wiki.teltonika-gps.com/view/FMB640\\_Teltonika\\_Data\\_Sending\\_Parameters\\_ID](https://wiki.teltonika-gps.com/view/FMB640_Teltonika_Data_Sending_Parameters_ID)



Sensor output is mapped between from **Minimal** and **Maximal** values (fig. VII. 1). If you have tank calibration table stored in sensor on server side you need to enter tank calibration table consisting only from 2 points. For example, for Wialon it looks like:

X1 : Minimal value (1) ; Y1=0 (liters)

X2 : Maximal value (4095); Y2=tank volume

Saving the calibration table both in sensor and on server side is incorrect.

## APPENDIX VIII. CONNECTION TO TELTONIKA GPS TRACKER USING CAN BUS INTERFACE

For operation via CAN bus interface the sensor must be configured as shown on fig. VIII. 1. Choose CAN J1939 mode, set 250000 Data transmission speed. It is necessary to set the **Sensor Address** and turn on "**Terminator CAN**" option in one sensor in the CAN bus network.

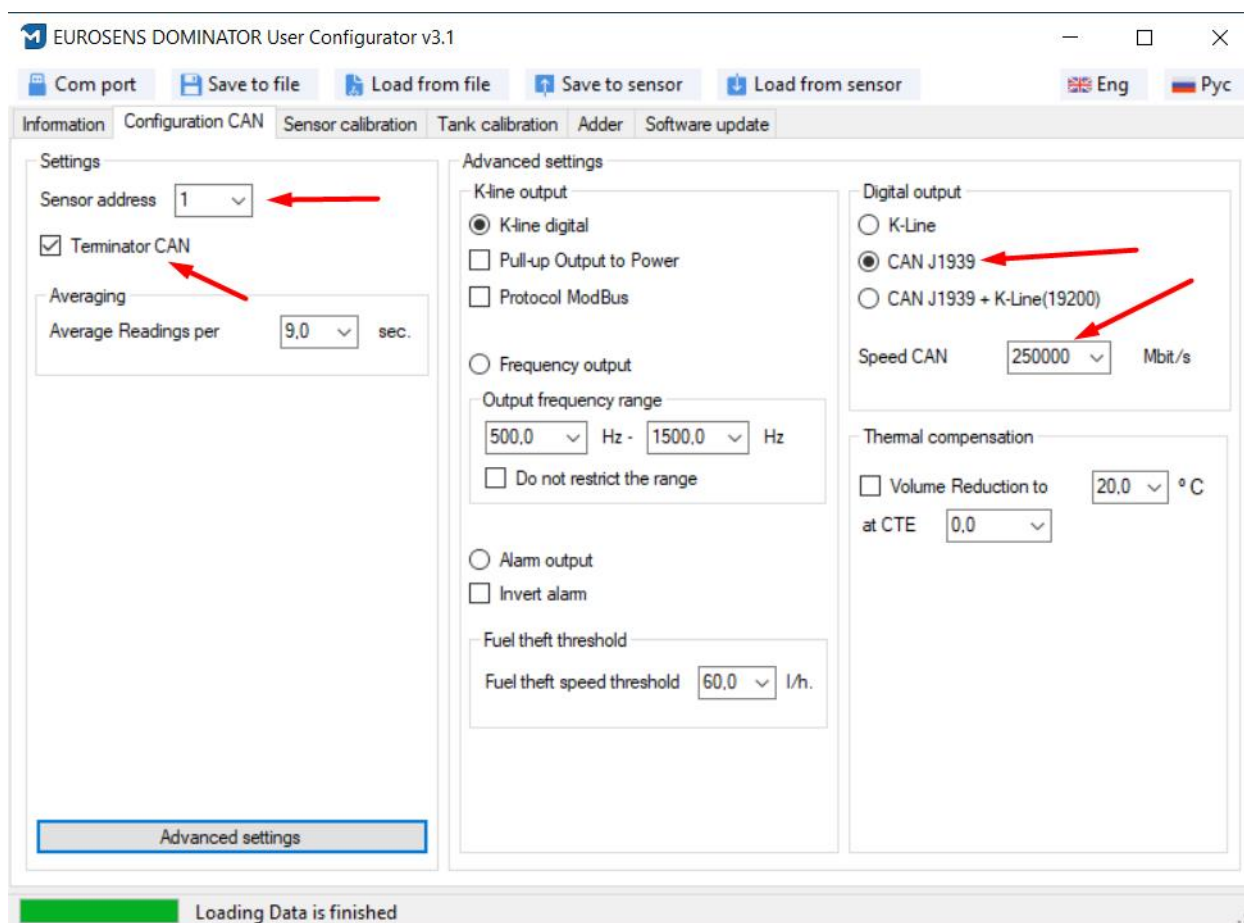


fig. VIII. 1

In Teltonika configurator go to CAN interface settings and choose **Normal** mode of operation and **250 kbps speed** (Ошибка! Источник ссылки не найден.). Choose the CAN data source – CAN1 or CAN2.

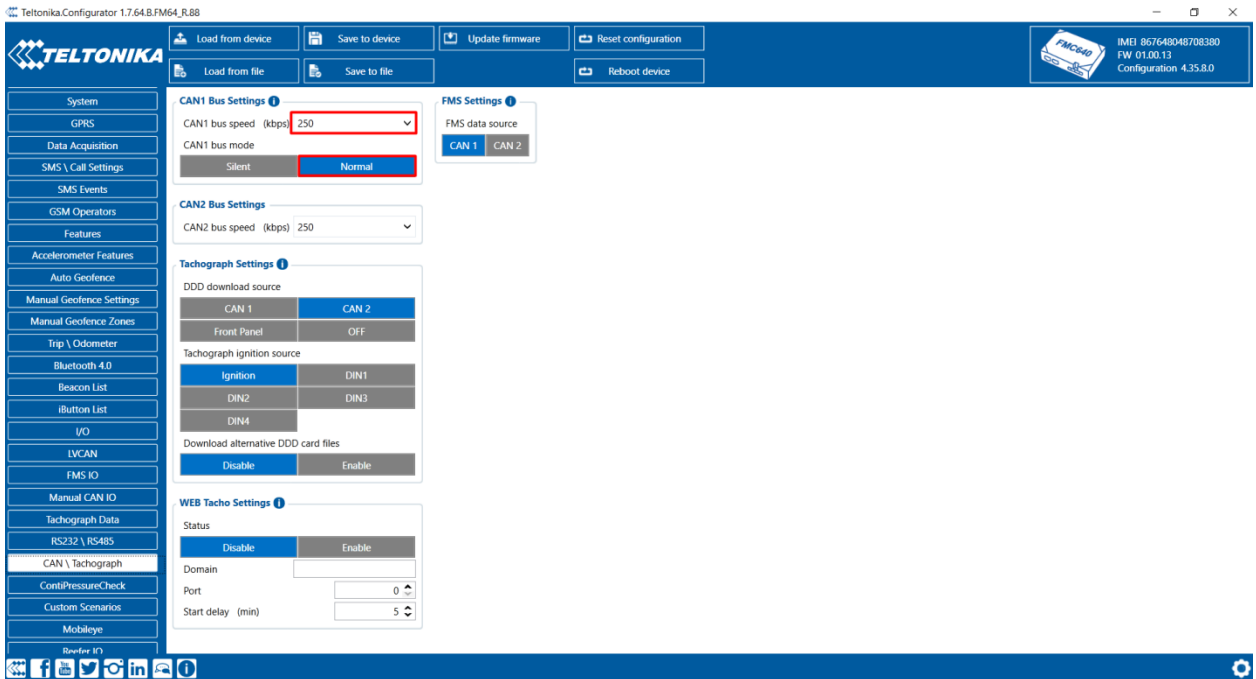


fig. VIII. 2

Then we need to set up the CAN bus identifiers. Choose the necessary parameters to read from sensor according to **Appendix III**. Then fill in CAN bus data slots as shown on **Ошибка! Источник ссылки не найден..** You can read as many parameters as you need using free CAN0...CAN69 slots.

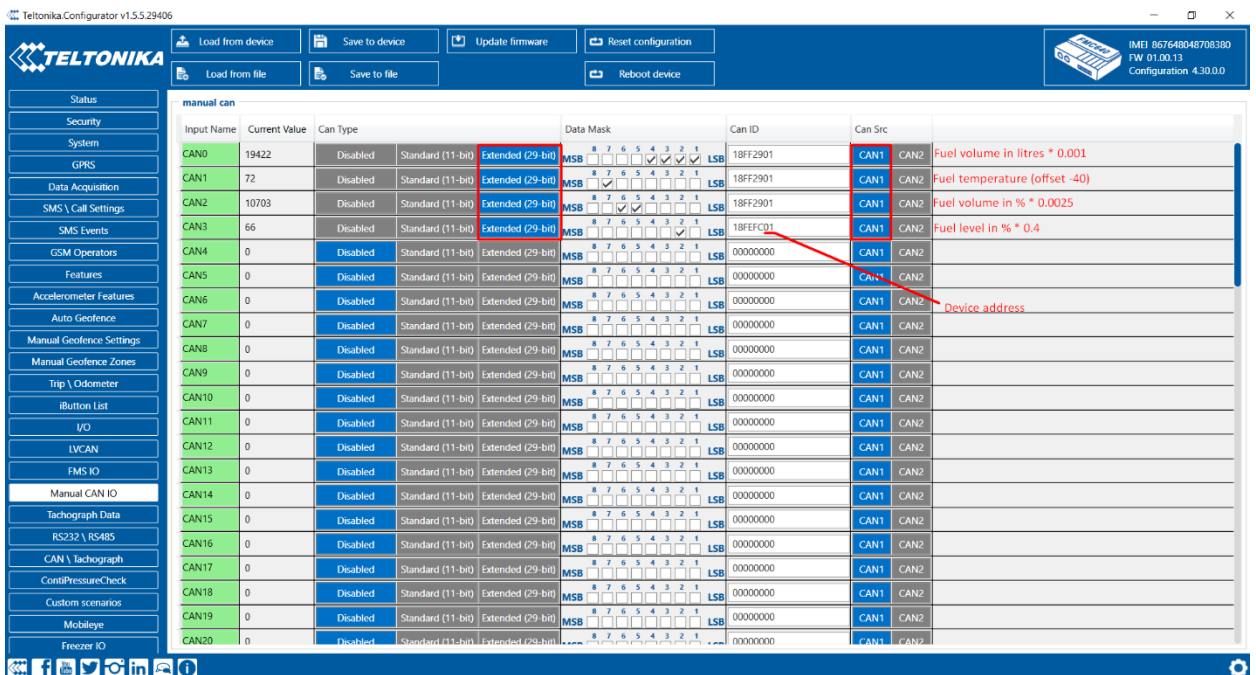


fig. VIII. 3

In the **CAN ID** field enter prefix **18 + PGN to read + sensor address** in the network. Mark bytes to read according to Appendix C parameter specification. Save configuration to Teltonika device.

Connection of sensors via CAN to the GPS tracker is carried out according to the scheme shown on fig. VIII. 4. It is possible to connect several sensors to one CAN interface port, also it is possible to simultaneously use other types of sensors supporting CAN protocol.

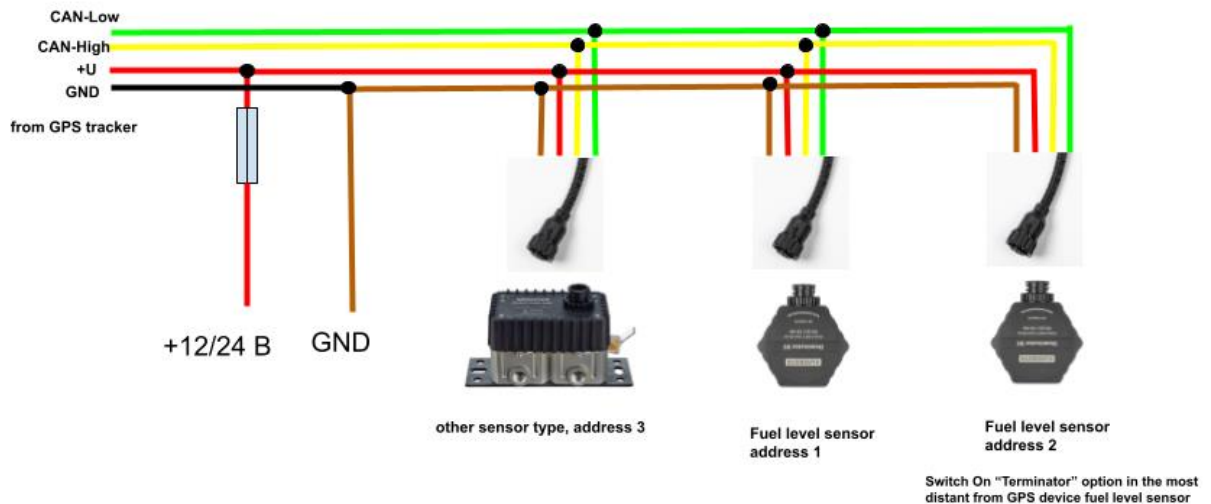


fig. VIII. 4

After sensor connection data appears on Manual CAN IO tab (fig. VIII. 3). The sensor values should be calculated taking into account the Resolution and Offset values specified in the description of CAN messages (Appendix III). For example, the "Fuel volume in high resolution" parameter has a resolution of 0.001L, so its value must be multiplied by 0.001 to be converted into liters. The fuel temperature parameter has a resolution of 1 degree and offset -40, so the resulting value for conversion to celsius is calculated by the formula : parameter \* 1 - 40.

Each CAN parameter has its own IO\_id in Teltonika protocol. You can refer to the Teltonika Wiki:

[https://wiki.teltonika-gps.com/view/FMB640\\_Teltonika\\_Data\\_Sending\\_Parameters\\_ID](https://wiki.teltonika-gps.com/view/FMB640_Teltonika_Data_Sending_Parameters_ID)

For example, CAN0 element is transmitted as io\_145, CAN1 – io\_146 etc.



JSC Mechatronics

80/3 1<sup>st</sup> May Street, Vileyka, Belarus, t: +375 (1771) 33011, f: +375 (1771) 24190

E-mail: [office@mechatronics.by](mailto:office@mechatronics.by)

<https://eurosenstelematics.com/en/>