FUEL LEVEL SENSOR

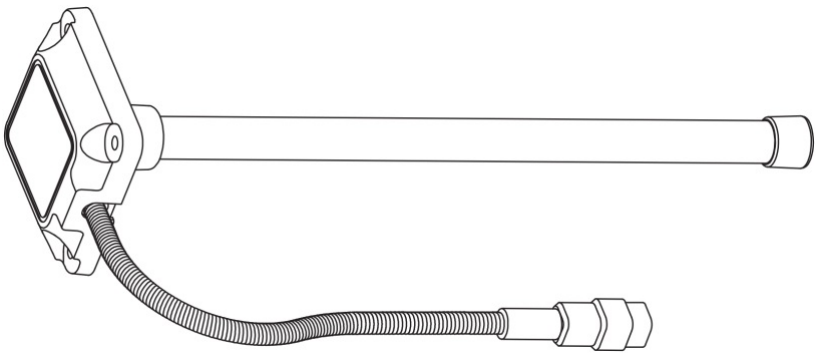
"ONE.MAX"

Passport, Operation Manual and Mounting Instructions

LK588.00.00-08PS
Revision of 02.06.2022

For models

ONE.MAX L=1000 mm
ONE.MAX L=1500 mm
ONE.MAX L=2000 mm



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List of Abbreviations and Symbols

PS	-	Power Supply;
FLS	-	Fuel Level Sensor;
PC	-	Personal Computer;
CLS	-	Capacitance Level Sensor;
CPU	-	Central Processing Unit;
L	-	nominal length of the measuring part of the FLS (mm);
L1	-	actual length of the measuring part of the FLS (mm);
L2	-	working length of the measuring part of the FLS (mm);
L3	-	length of the measuring part of the FLS, after cutting it to fit the specific fuel tank (mm);
CNT	-	internal oscillator period.

1. General Information

This data sheet is a document combined with the operation manual and mounting instructions. It is intended to explain the construction, mounting and operation of the **ONE.MAX** fuel level sensor (hereinafter – the "device").

The device model designation depends on the intended use and the length of the measuring part.

The device model designed to work with any external device is designated **ONE.MAX**.

Types of fuel in which the device operates: petrol with different octane numbers, summer and winter diesel and other liquid petroleum devices that retain their aggregate state in the operating temperature range.

The device is available with a high-stiffness powder-coated aluminium alloy body.

The enclosure compartment with the electronic components is filled with dielectric polyurethane compound. This protects the components against aggressive fuels and ensures mechanical strength when the device is used on the vehicle at temperatures ranging from minus 40 °C to plus 85 °C.

The measuring part is made of aluminium alloy.

The connecting cables are protected by a metal hose.

Communication with the device is via either RS-232 or RS-485. **The device can only be configured via the RS-232 interface!**

2. Description and Operation

2.1 Purpose

The device is designed to measure fuel levels in vehicle fuel tanks and stationary fuel tanks, as well to measure the fuel temperature.

2.2 Technical data

Name	Value		
Nominal length of the measuring part, L mm	1000	1500	2000
Actual length of measuring part, L1 mm	993	1493	1993
Working length of measuring part, L2 mm	977	1477	1977
Limits of tolerable basic reduced error of level measurement, % - temperature range from -40° to +60° - temperature range from -40° to +85°	 < ±0.8 < ±1.0		
Temperature measuring range, °C	-40 to +85		
Temperature measurement error, °C	±2		
Electrical strength of galvanic insulation, V	>2500		
Supply voltage, V	7…80		
Current consumption, mA, max.	20		
Power consumption, W, max.	0.3		
Overall dimensions, mm, max.	87x83x (38+L2)		
Sensor enclosure height above tank surface (excluding gasket), mm	22		
Sensor weight, kg, max.	0.63	0.77	0.92
Average MTBF, hours, min.	40000		
Average lifetime, years	6		
Enclosure degree of protection against dust and moisture	IP 69		
Operating conditions: - ambient temperature, °C - relative humidity at 25 °C, % - atmospheric pressure, kPa	 -40 to +85 30 – 80 84 – 107		
Operating mode according to GOST R52230-2004	continuous		

Specifications:	
- interface for connection to an external device	RS-232, RS-485
- baud rate, baud	9600, 19200, 38400, 57600, 115200
- level measurement code range	0…4095
- volume code range	0…32767
- measurement period, sec	1
- level measurement range shift	0…1023
- automatic data output interval, sec	1 – 255
- size of the internal measurement result filter	0 – 21

2.3 Package contents

Name	Designation	Q-ty
Fuel level sensor ONE.MAX	LC588.00.00 (-08*,-09*,-10*)	1 pc.
Assembly parts kit		1 set
Document "Passport, Operation Manual and Mounting Instructions"	LC588.00.00-08PS**	1 pc.
Fuel level sensor connection diagram		1 pc.

Note:

* – designation depending on intended use and selected L (see table Technical data)

** - the document is available on the manufacturer's website in a publicly accessible .pdf format

Assembly parts kit		
Gasket	LC588.00.03	1 pc.
Mounting cable	LC588.31.00	1 pc.
Plug	LC060.00.04	1 pc.
Bolt M5x25 DIN933		4 pcs.
Threaded rivet nut M5		4 pcs.
Lock washer 5 DIN127		4 pcs.
Thread cutting screw 4.8x35 DIN 7504K with reduced drill		4 pcs.*
Rotary type numbered seal		1 pc.*
Sealing wire, diameter 0.8 mm, length 0.3 m**		1 pc.***

Note:

* one of the 4 similar self-tapping screws with a hole for sealing is permitted, but 1 control seal must be added to the set.

** The use of similar monofilament, cables and ropes for sealing with a specified diameter is permitted.

*** The number of pieces of wire depends on the quantity of numbered seals in the set.

2.4 Design and operation

The structural diagram is shown in figure 1.

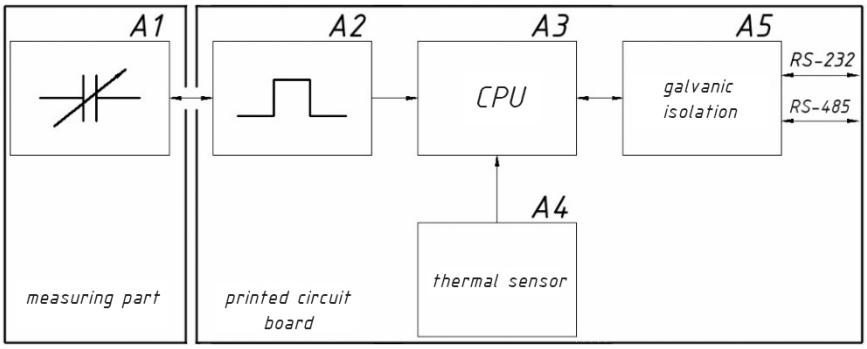


Fig. 1 - Structural diagram of the device (A1 – CLS, A2 – frequency generator, A3 – CPU, A4 – thermal sensor, A5 – galvanic isolation).

The device is a linear converter of the fuel level to the electrical capacity. A change in the fuel level causes a change in the capacity of the CLS (A1). The altered capacitance corresponds to the altered signal period produced by the oscillator (A2).

In the CPU (A3), the period length of the signal issued by the oscillator is converted into a code:

- the temperature code is corrected according to the temperature sensor (A4);
- the measurement results are filtered according to a preset number of previously taken results.

Temperature correction is a code change to compensate for the linear expansion of the fuel.

The N code corresponding to the fuel level is generated in the CPU (A3) taking into account the following parameters: numerical codes corresponding to the maximum and minimum values of the measured level. Accordingly, the CPU (A3) performs a linear conversion of the measurement results into the digital code N. The N code can then be converted to fuel volume according to the calibration table. The numeric N codes corresponding to the maximum and minimum values of the measured level, as well as the calibration table, are set in the "IE Configurator" software.

The device has galvanic isolation (A5) between the power supply circuits, RS-232, RS-485 serial interface lines and the measuring part including the enclosure circuits and the CLS. The electrical strength of the galvanic insulation is at least 2.5 kV.

The device has a network operation mode – several devices (via RS-485) can be connected to one external device.

2.5 Marking

The marking affixed to the enclosure contains:

- trademark;
- device name;
- designation of device modification and device version;
- serial number of the device according to the manufacturer's numbering system;
- a unique QR code in which the information is encoded:
  device type#website link#model_sensor length#serial number;

The labelling on the individual packaging contains:

- trademark of the manufacturer;
- name and address of the manufacturer;
- device name;
- a unique QR code in which the information is encoded:
  device type#website link#model_sensor length#serial number;
- date of packaging.

The labelling on the transport packaging contains:

- trademark of the manufacturer;

- name and address of the manufacturer;
- device name;
- number of devices;
- total weight;
- barcode in ITF-14 format;
- date of packaging;
- manipulative signs.

2.6 Packaging

The individual packaging for the ONE.MAX device L=1000 mm is made of corrugated cardboard and is intended for two sets.

The individual packaging for devices: ONE.MAX L=1500 mm, ONE.MAX L=2000 mm is a polyethylene bag and is intended for one set.

The transport packaging is in the form of a corrugated box made of five-layer corrugated cardboard. The number of packaged devices varies depending on the model.

3. Intended use

3.1 Operational limitations

1) The ambient air temperature must not exceed the values stated in the technical data.
2) The device must not have any mechanical damage in the form of potholes, cracks or bends.
3) Do not damage the insulation of the mounting cable.
4) **Minimum cut-off length of the measuring part is 150 mm.**
5) The device must be used only with liquid petroleum devices that maintain their aggregate state within the operating temperature range.
6) The use of substandard petroleum devices may lead to incorrect operation of the device.
7) The dielectric permittivity of the medium to be measured must be constant. Failure to comply with this requirement leads to an increase in the measurement error.

3.2 Use of the device

The device can output data to an external device on request from an external device or periodically.

1) The data output can be carried out both when a single device is connected to an external device and when several devices are connected. If several devices are connected to the same external device, network addresses must be assigned to the devices and network mode must be activated. Specify the network address of the device in the request. If more than one device is connected to the same RS-485 bus, an external device sends a request to one of the devices and is waiting for a response, the request to the next device can only be sent by the external device after the previous request has been answered or the waiting time has elapsed.
2) Intermittent data output can only be carried out when one device is connected to an external device. Enable periodic data output and select a data output interval are carried out using the "IE Configurator" software or by commands from an external device.
3) The message format and a detailed description of the commands for operating the device can be found in Appendix B.

Once the sensor has been switched on and until a stable measurement result is set (the time for different sensor models may be in units of seconds), the level measurement results are not reliable. The sensor will return an LVL level value of FFFFh (or 65535d). After receiving a packet with such a level value, it is recommended to stop further processing, wait for 1-2 seconds and repeat the request to the sensor.

4. Device mounting and adjustment

A list of all the work required to mount the device:

1. Checking the completeness of the device.

2. Selecting the mounting place.
3. Preparing the fuel tank for mounting.
4. Cutting the device to suit the specific fuel tank.
5. Configuring the device using the "IE Configurator" software.
6. Device mounting.
7. Calibration of the fuel tank.
8. Preparation and laying of the cable for connecting the device to an external device.
9. Connecting the power supply via a standard fuse box.
10. Sealing.

A list of the necessary equipment and tools is given in Appendix B.

All assembly, disassembly and adjustment work must be carried out within a temperature range of minus 30 °C to plus 40 °C.

4.1 Security Measures

Only personnel with a valid certificate and proof of training are allowed to carry out mounting and commissioning work.

When carrying out mounting and commissioning work, the safety requirements stipulated in the operating instructions of the manufacturer of the vehicle in which the device will be mounted, as well as the requirements of the regulations for this type of equipment, must be observed.

4.2 Preparation for mounting

4.2.1 Checking the completeness of the device

1) Open the packaging container. Check the completeness of the device in accordance with the table in clause 2.3 "Package contents".
   If the device does not match the package contents specified in the document, contact the supplier of the device to eliminate the discrepancy.
2) Perform an external inspection of the device. The device must not have visible damages.
   If damage is found, the device must be replaced by the supplier.

4.2.2 Selecting the mounting place

Mount the device depending on the geometry of the tank in the locations shown in the figures (*Fig. 2*, *Fig. 3).* Mounting the device in these locations ensures that the fuel level is independent of the vehicle's inclination.

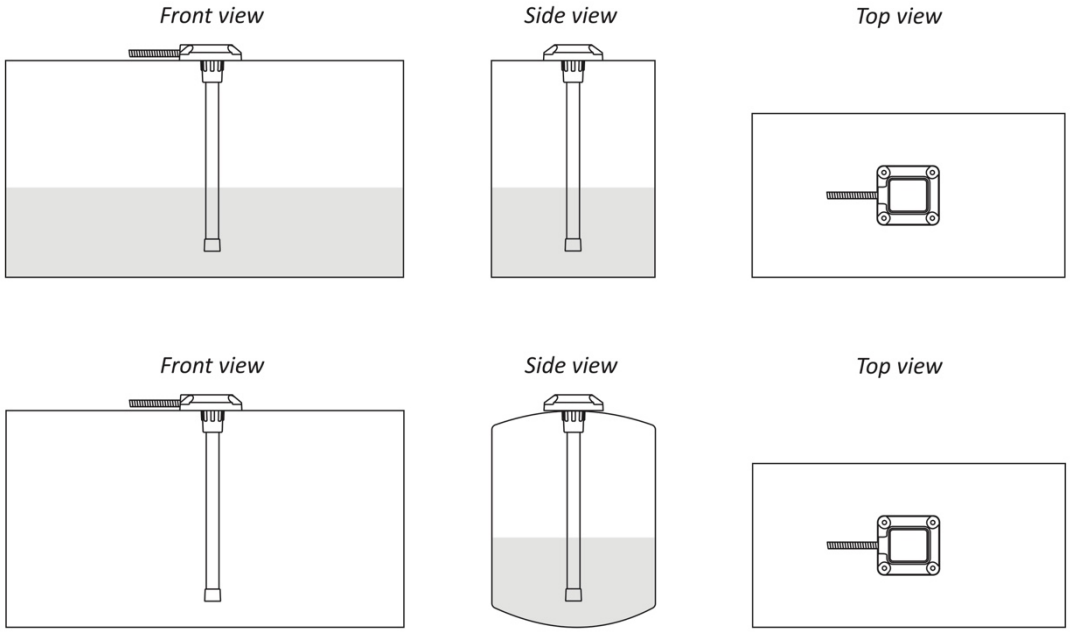


Fig. 2 – Fuel tank of a simple geometric shape

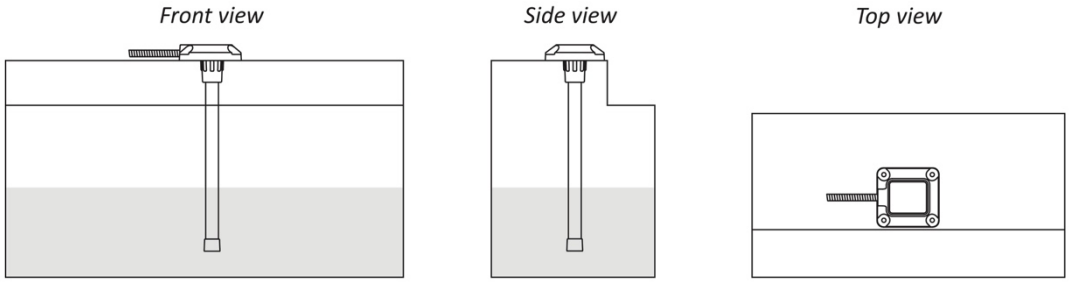


Fig. 3 – Fuel tank of complex geometric shape

If it is not possible to mount the device in the locations shown in the figures (*Fig. 2, Fig. 3*), the device must be mounted as close as possible to the indicated location.

Significant misalignment of the mounting location of the device from the centre of the tank to the sides results in incorrect fuel level measurement due to fuel level fluctuations when the vehicle is tilted. Also, such an mounting reinforces the impact of the negative effects of fuel fluctuations on measurement accuracy, even with software filtering.

ATTENTION! The device must be mounted by a qualified technician who is qualified as an "auto electrician" or "auto mechanic". The technician must be familiar with the technical documentation for setting up and mounting the device, as well as know and follow the safety procedures for working with fuels and lubricants.

4.2.3 Preparing the fuel tank for mounting

1) Prepare the tank for welding and fitting work in accordance with the safety regulations associated with this type of work.
2) De-energise the vehicle.
3) Drain the fuel completely.
4) Evaporate the tank. The steam supply temperature must not exceed 80% of the auto-ignition temperature of the fuel.
5) Select the position of the sensor on the tank as required in clause 4.2.2.
6) Drill a central hole in the tank with a bimetallic crown Ø35 mm.
7) Drill the mounting holes depending on the type of tank and the mounting method.
   Bolted fastening using threaded rivets is recommended for metal tanks with a wall thickness of 0.5-2.5 mm, as it offers the best reliability. The mounting holes are Ø7 mm (see *Fig. 4c).* Use a specialized tool to mount the threaded rivets.
   M5 threads may be cut and bolts may be used for a metal tank with a wall thickness of more than 3 mm. Thread-cutting holes – Ø 4.2 mm (see *Fig. 4b*)
   Use a self-tapping screw attachment from the delivery package for metal tanks with a wall thickness of 1.5 mm or more. Fastening holes – Ø 4 mm (see *Fig. 4a*)
   Only self-tapping screws may be used for a plastic tank with a wall thickness of more than 3 mm.

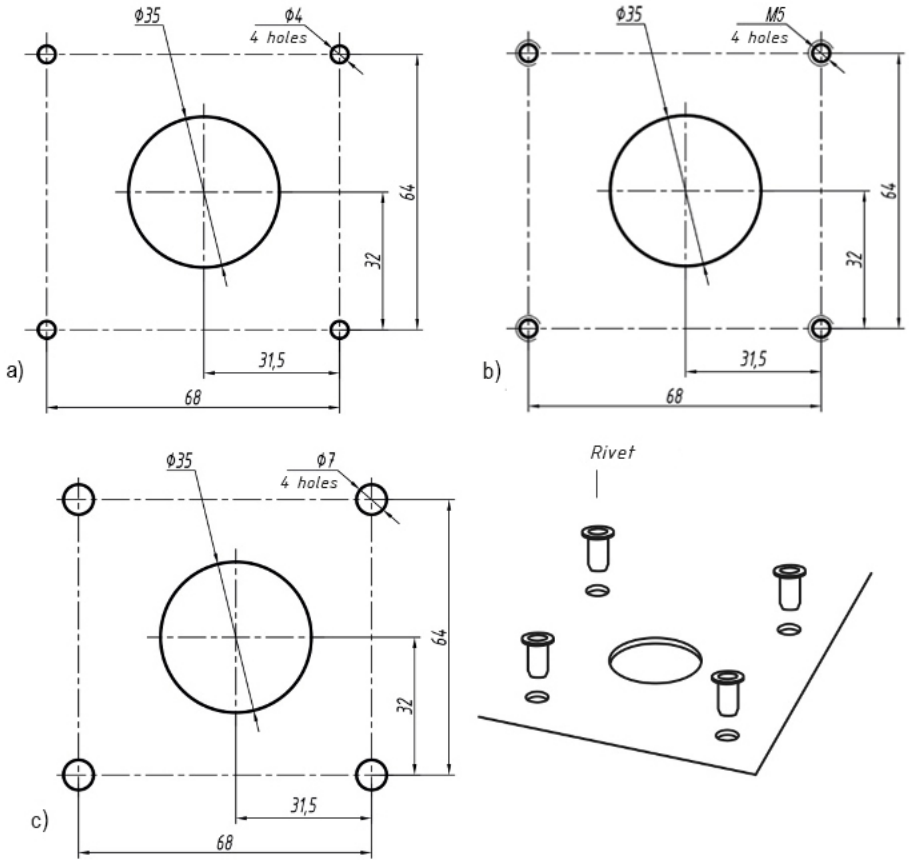


Fig. 4 – Dimensions: a) for mounting on self-tapping screws;
b) for mounting on threaded bolts;
c) for bolt-on mounting using rivets.

4.2.4 Cutting the device to suit the specific fuel tank.

1) Measure the depth of the tank with a ruler by dropping it into the centre mounting hole.
2) At length **L1** of the device, measure with a ruler the length **L3** equal to the depth of the tank minus 20 mm.
3) Cut off length **L3** of the device with a hacksaw so that the cut line is perpendicular to the longitudinal axis of the device (*Fig. 5*).

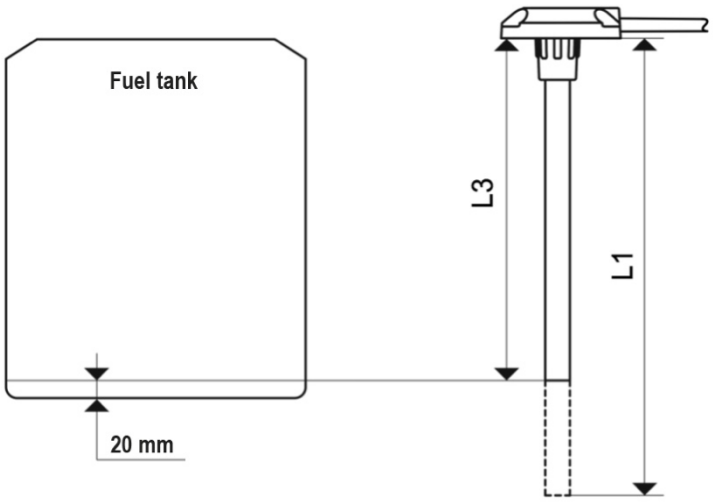


Fig. 5 – Cutting the measuring part of the device

4) Fit the plastic plug supplied with the mounting parts to the centre pivot of the device.

ATTENTION! AVOID DEFORMING THE SENSOR'S MEASURING PART. A SENSOR WITH A DEFORMED MEASURING PART IS NOT SUBJECT TO WARRANTY REPAIR.

4.3 Configuring the device using the "IE Configurator" software.

4.3.1 Purpose and conditions of use of the "IE Configurator" software

4.3.1.1 Purpose of the program

The program is intended for the adjustment of fuel level sensors.
The software performs the following tasks:

- calibration of sensors,
- calibration of fuel tanks and compilation of a table,
- setting up filtering of sensor readings,
- updating the sensors' firmware,
- restoring the sensors' firmware.
- diagnostics.

4.3.1.2 System requirements

To work with "IE Configurator" you need:

- personal computer with USB or COM port and Windows 7 (or later) with .NET Framework version 4 (or later) installed;
- fuel level sensor ONE.MAX;
- "Adjustment cable".

The user must be proficient with the Windows 7 operating system.

4.3.2 Preparing to use "IE Configurator"

4.3.2.1 Installing "IE Configurator"

Run the file "**IE Configurator 1.0.9 beta Setup.exe**". Follow the installer prompts.

4.3.2.2 Preparing to use "IE Configurator"

Each sensor must be individually configured using the "IE Configurator" software.
Connect the device to a PC via "IE Configurator" installed using the "Universal Setup Device – USD":

1. Connect the device to the universal setup device (USD) using the adjustment cable. Connect the USD to the PC using the connection cable USB A to USB B. The wiring diagram is shown in *Figure 6*.

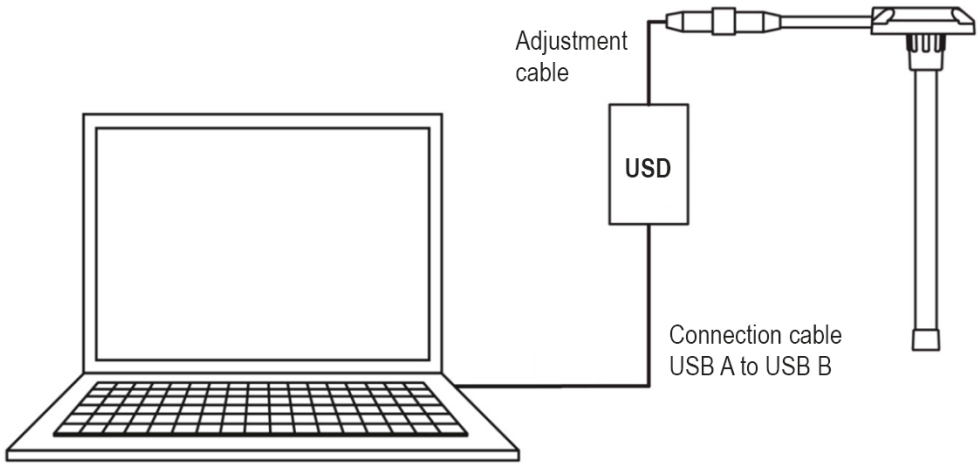
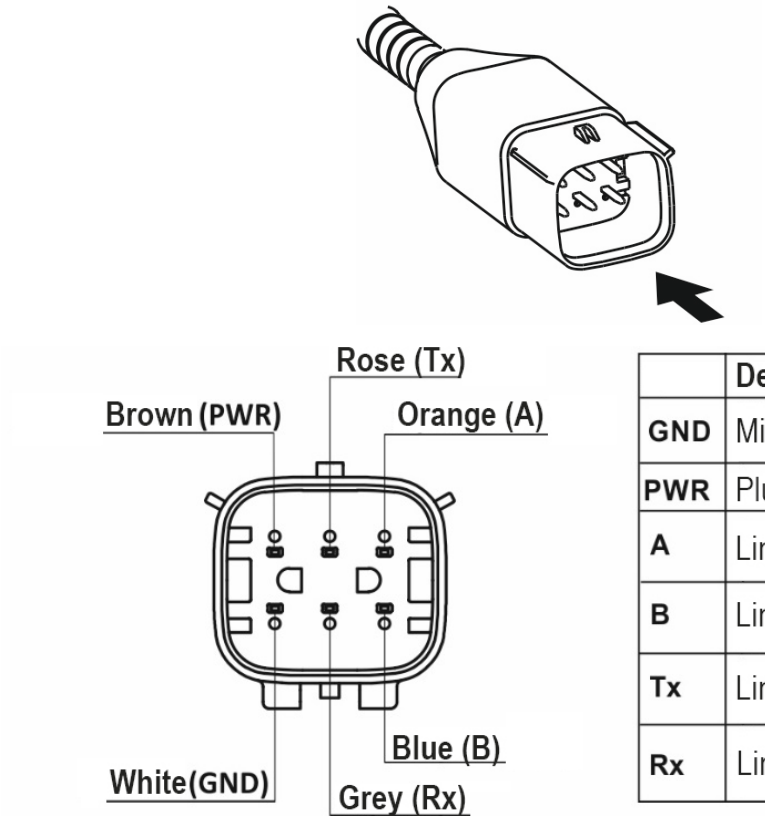


Fig. 6 – Device connection scheme to PC

You can use Omnicomm's USD or analogs with RS-232 interface. When using other interface

converters, correctly connect fuel level sensor ONE.MAX wires and interface pins (RX sensor to TX interface, TX sensor to RX interface).

Connector pin assignment and cable wire colours for connection to an external device as per *Fig. 7*.



	Description	Wire
GND	Minus pole	White
PWR	Plus pole	Brown
A	Line A (RS-485)	Orange
B	Line B (RS-485)	Blue
Tx	Line Tx (RS-232)	Rose
Rx	Line Rx (RS-232)	Grey

Fig. 7 – Connector pin assignment

4.3.2.3 Launching "IE Configurator" and establishing a connection with the sensor

Launch "IE Configurator" via "Start/Programs/Ivanov-Engineering Configurator".

The main program window opens (see *Fig. 8 a*, b).

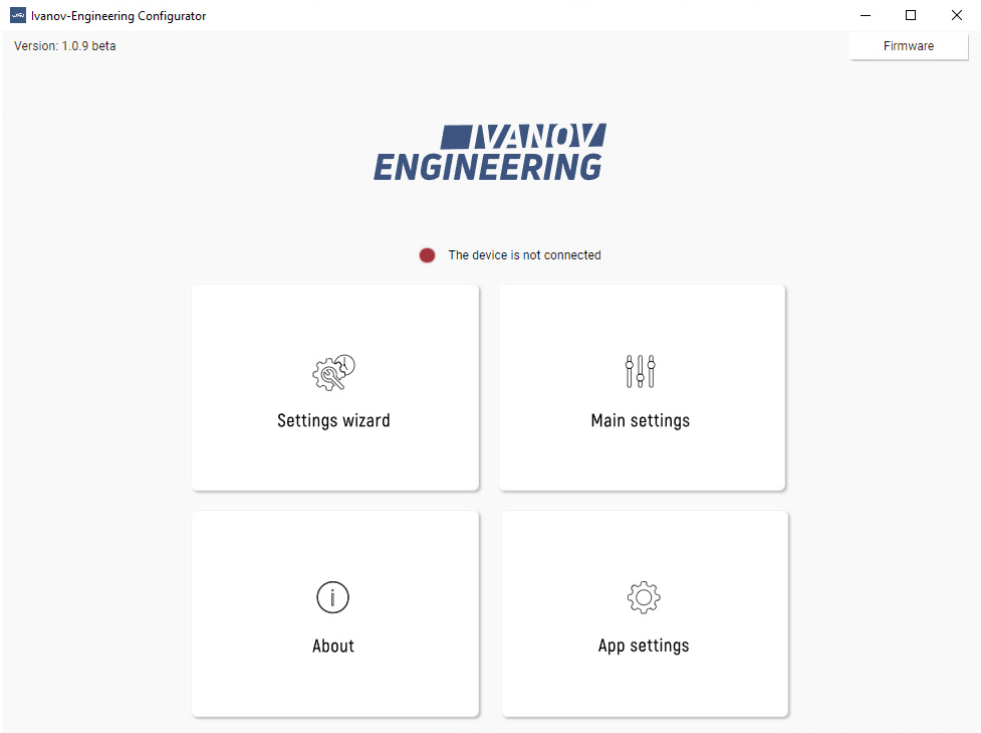


Fig. 8a – Main program window when the device is not connected

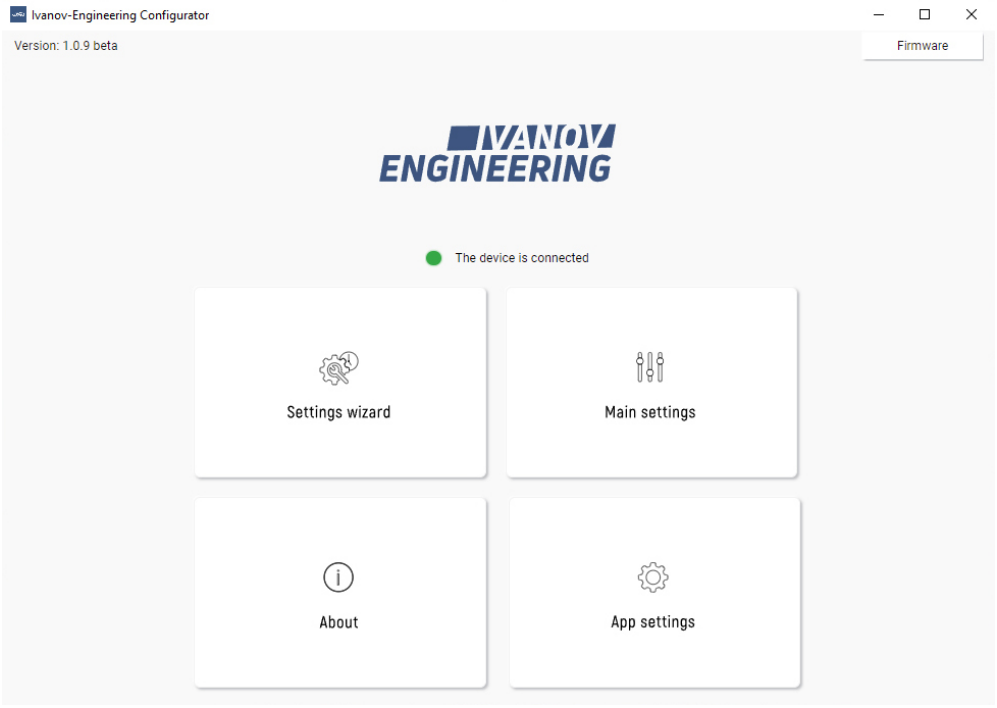


Fig. 8b - Main program window when the device is connected

The connection indicator changes colour depending on whether there is a connection:

- **red** – the device is not connected (see *Fig. 8a*),
- **green** – the device is connected (see *Fig. 8b*),

Once the connection has been successfully established, the fuel level sensor must be set up. To do this, enter the Setting wizard[1] or the Main settings menu by pressing the relevant button.

After clicking on **Main settings**, the window shown in *Fig. 9* opens.

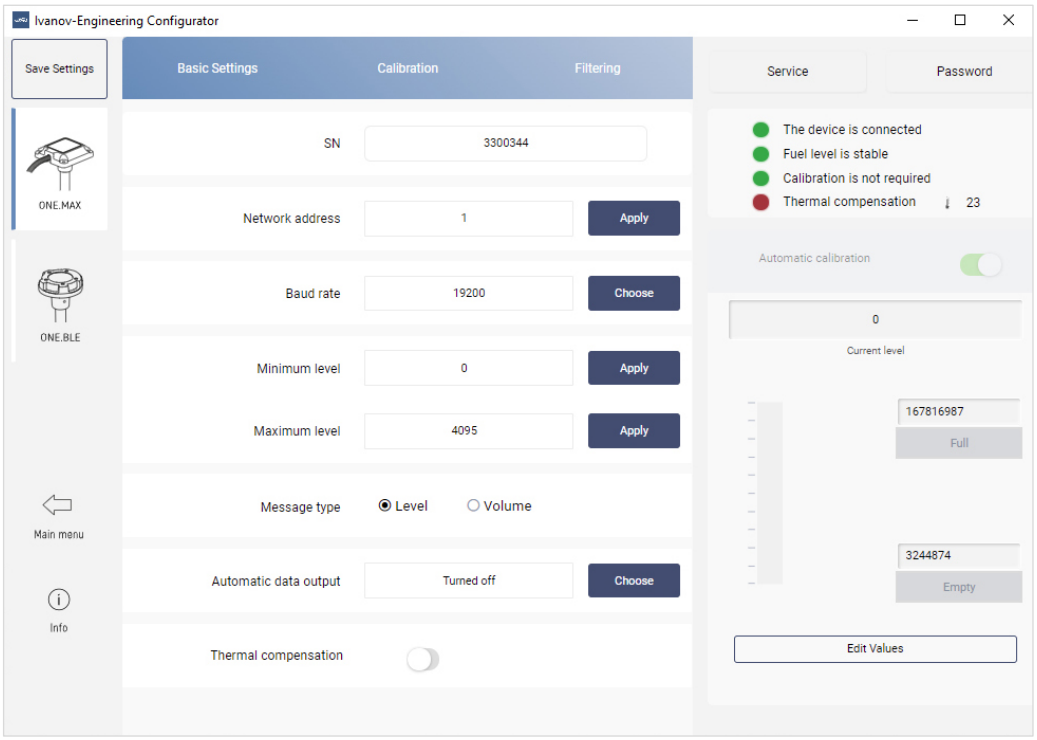


Fig. 9 – Program window

If the sensor has already been configured and a password has been set on the sensor, the password input screen will appear (see *Fig. 10*).

[1] Access to this section is expected in future versions of the program.

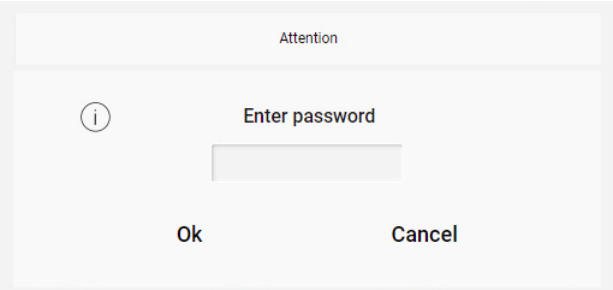


Fig. 10 – Password entry window

If the password is correct, the program window shown in *Figure 9* will open. If the password is incorrect, the password input window will look like the one shown in *Fig. 11*.

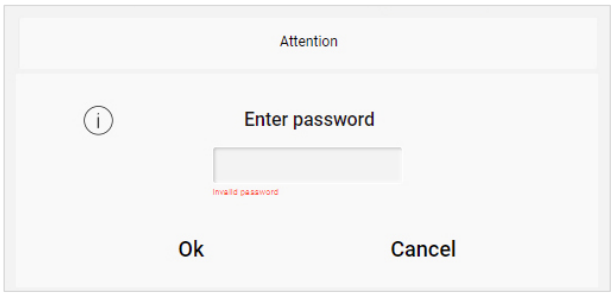


Fig. 11 – Window for incorrect password entry

From the window shown in *Fig. 8b*, you can go to the sections **About** and **App settings**.

After clicking on **About**, the window shown in *Fig. 12* will open, providing information about the program.

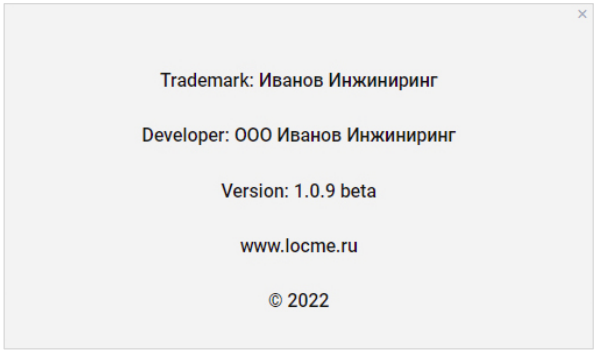


Fig. 12 – Window with information about the program

After pressing the **App settings** button, the window shown in *Fig. 13* will open.

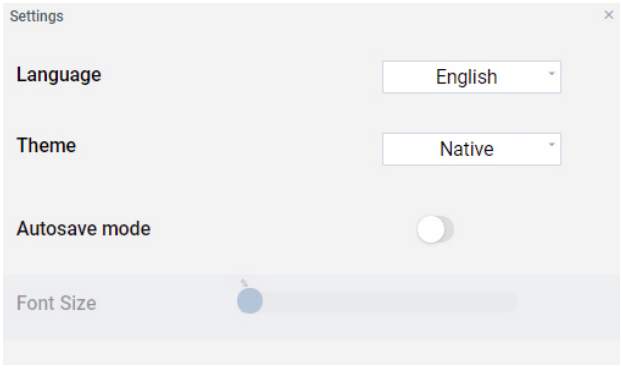


Fig. 13 – Settings window of the configurator.

The following configurator settings can be made: select program language (*Fig. 14a*), select program colour (*Fig. 14b*), enable automatic saving of sensor settings (*Fig. 14c*), change program font size.[2]

[2] This function is expected in future versions of the program.

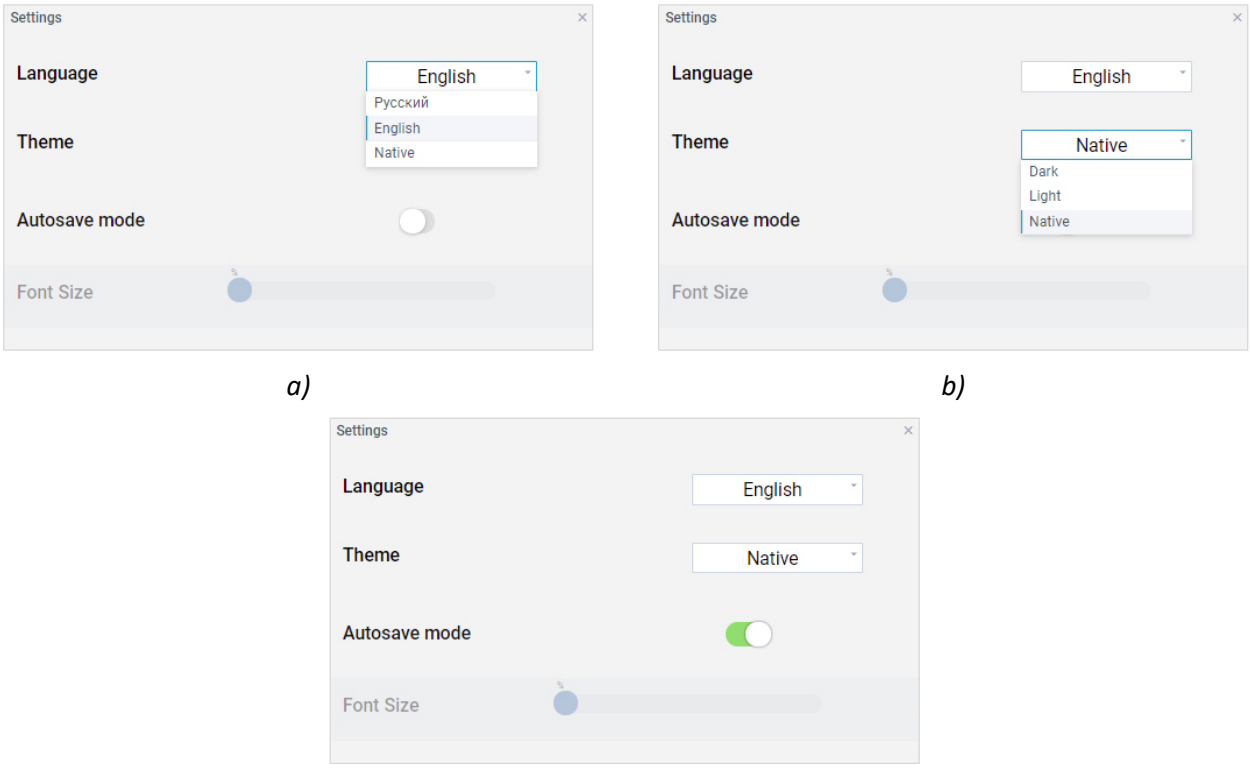


Fig. 14 – Configurator settings

4.3.3. Working in the "Main settings" menu of "IE Configurator"

The "Main settings" menu is shown in *Fig. 15*.

Fig. 15 – Main settings window

When changes are made to the settings, a change indicator appears next to the relevant parameter – a yellow bar next to the button (see *Fig. 16*).

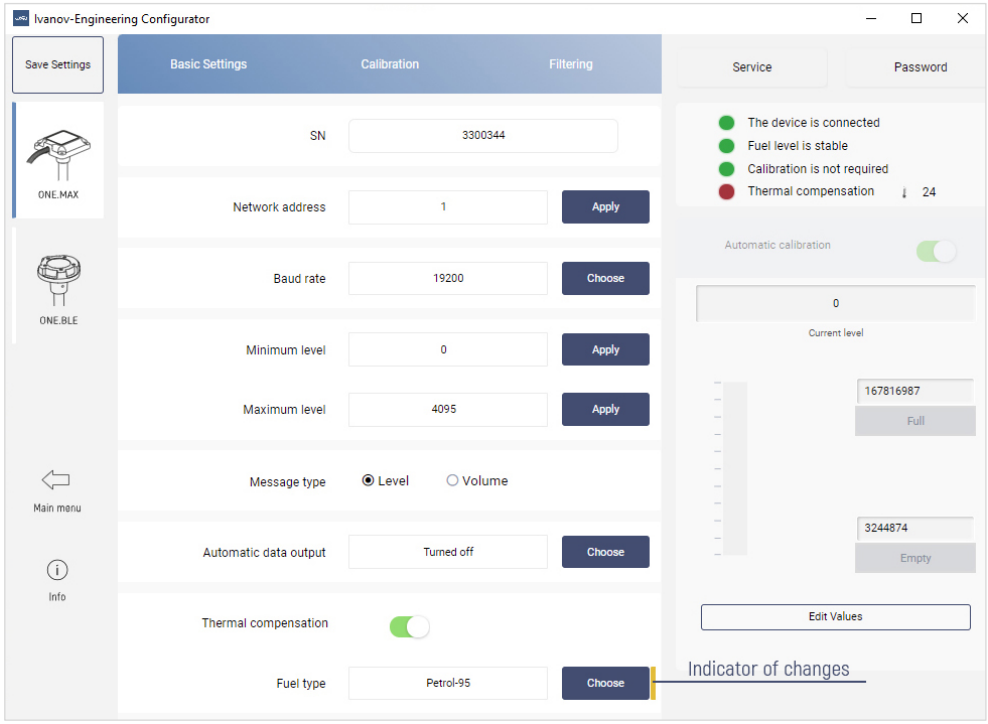


Fig. 16 – Main settings window with the changed parameter "Automatic data output".

The changes made must be recorded in the device. If **Autosave mode** is enabled in **App settings** (see *Fig. 14c*), recording is automatic. Otherwise, click on **Save Settings**. When the settings are saved, a pop-up window appears indicating that they have been successfully saved (see *Fig. 17*).

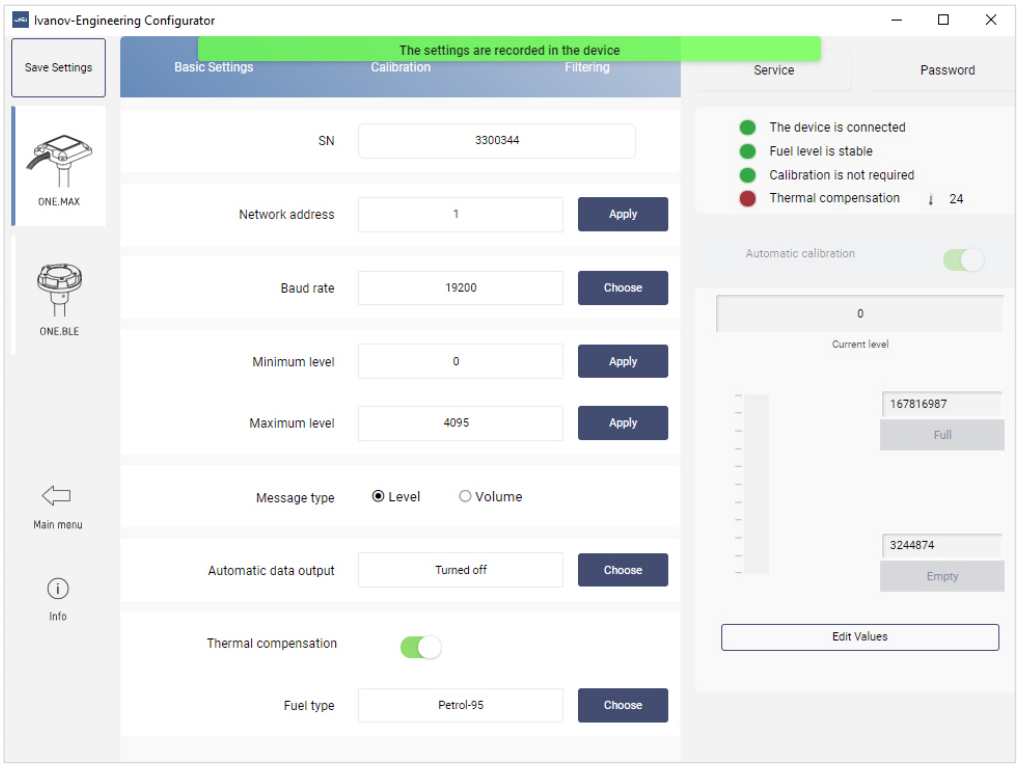


Fig. 17 – Main settings window with a pop-up window

If communication with the sensor is lost, a warning window will appear (see *Fig. 18*) and the **Device is not connected** indicator will turn red.

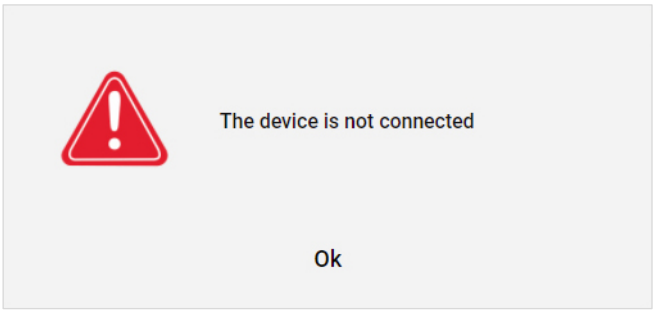


Fig. 18 – Warning window

Once you have pressed the **Ok** button, you will be taken to the main program menu.

Check that the cable connectors are securely connected to continue with the setting. After successful connection to the sensor, re-enter the engineering menu to continue setting.

4.3.3.1 Device calibration

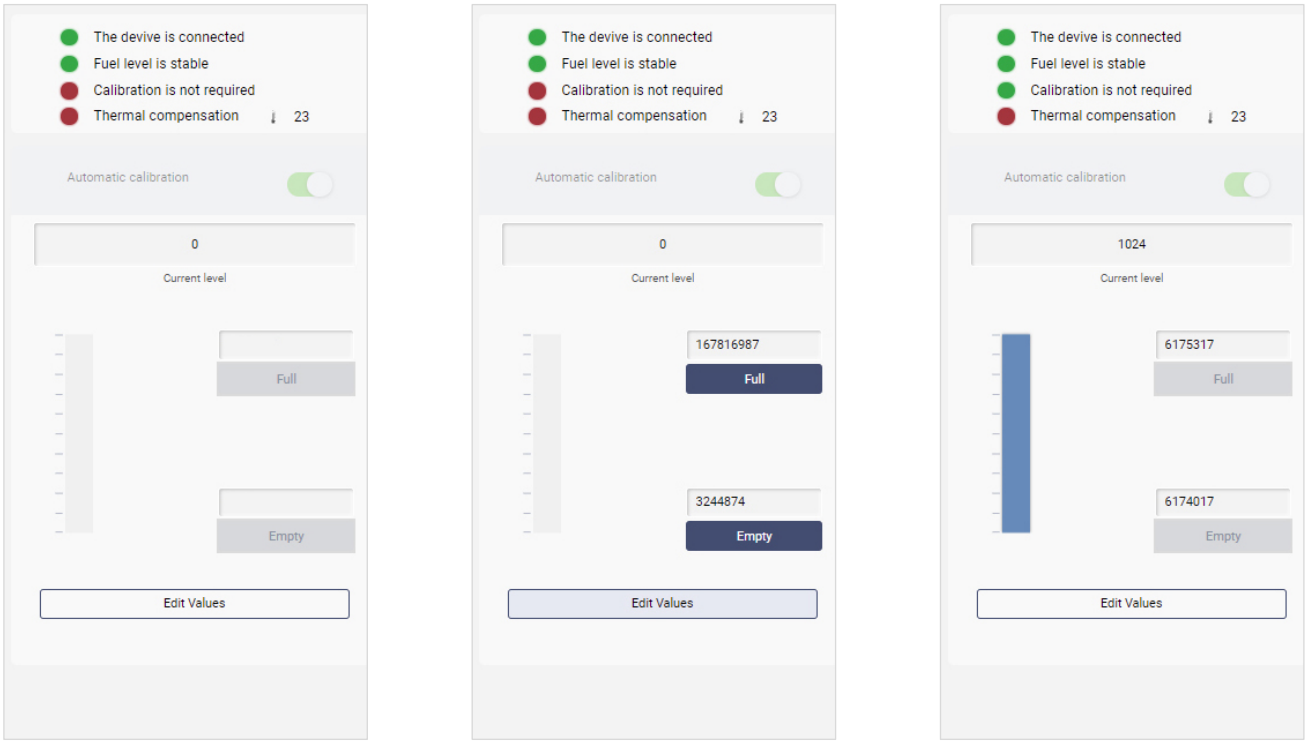
Device calibration consists of setting the upper and lower measuring limits. This must be done after cutting the measuring part of the device. For calibration, use the same type of fuel whose level this device will measure during operation.

There are two ways to calibrate the device. Use the one that works best for you.

1. Calibrate in a measuring container.
2. Calibration without measuring container by filling the measuring part of the device.

The calibration section can be found in the tab **Basic Settings**. The calibration indicator changes colour depending on the stage of calibration:

- **red** – the FLS is calibrated (see *Fig. 19a*)
- **green** – the FLS is not calibrated (see *Fig. 19c*).



a) *b)* *c)*

Fig. 19 – Empty/full FLS calibration section.

Click on "Edit" to start the calibration. The calibration section will then appear as shown in Fig.19b.

4.3.3.1.1 Calibrating the fuel level sensor in the measuring container

1. Use a measuring container for the **empty/full** calibration.
2. Dip the device into the measuring container. Pour fuel into the measuring container so that the device is submerged over the entire length of the measuring section (up to the drain hole). Wait at least 1 minute.
3. Click on **Full**. This will write the measured value of the internal oscillator period (CNT) to the non-volatile memory of the device as the full sensor value.
4. Remove the device from the measuring container and allow the fuel to drain completely.
5. Click on **Empty**. The measured value of the internal oscillator period (CNT) to the non-volatile memory of the device as the empty sensor value.
6. When the **empty/full** calibration is complete, the calibration indicator will turn green and the "Empty/Full" fields will be filled with the values received (see *Fig. 19c*).

Click on **Edit** again to exit calibration mode.

You can further edit the recorded internal oscillator period (CNT) values corresponding to the upper and lower limit of the measurement by pressing **Edit**.

4.3.3.1.2 Calibrating the fuel level sensor without the measuring container

1. Close the drain holes on the sensor enclosure.
2. Fill the sensor tube completely with fuel.
3. Click on **Full**.
4. Drain the fuel.
5. OPEN THE DRAIN HOLES.
6. Hold the sensor vertically with the measuring section facing downwards for 1 minute.
7. Click on **Empty**.
8. When the **empty/full** calibration is complete, the calibration indicator light turns green (see *Fig. 19c*).

4.3.3.2 Setting parameters

Information about the sensor and its configurable parameters displays in the window shown in *Fig. 15*, the **Basic Settings** tab.

Status indicators are located in the upper right corner of the window.

SN (serial number) is a unique sensor number, determined automatically when the sensor is connected;

Network address – enter the sensor address (default setting is 1). When connecting via RS-232, the sensor address does not need to be entered – it is detected automatically.

Baud rate – the speed at which data will be exchanged with an external device. The value is selected from a drop-down list (9600, 19200, 38400, 57600, 11520 baud). The default communication speed is 19200 baud (most external devices operate at this speed).

4.3.3.3 Level code range setting

To set the minimum level code value, select the minimum level code in the **Minimum level** field (0 to 1023). The minimum level value allows the graduation scale to be shifted. The default value is 0. After changing the setting, click on **Apply** to write the setting to the sensor.

To set the maximum level code value, select the maximum level code in the **Maximum level** field (1 to 4095). The maximum level value allows you to change the scale divisional value. The default value is 4095. After changing the setting, click on **Apply** to write the setting to the sensor.

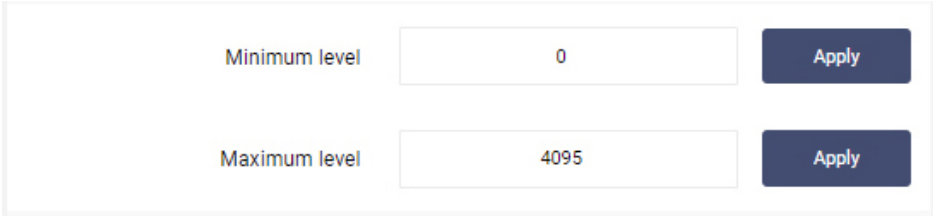


Fig. 20 – Level code range setting

4.3.3.4 Setting the sensor output message

The ONE.MAX fuel level sensor can transmit one of two possible parameters in the output message:

- "**Level**" – sensor transmits the level in relative units as an output parameter;
- "**Volume**" (according to calibration table) – the sensor transmits as output the fuel volume calculated on the basis of the relative level and the calibration table by interpolation.

This parameter is set in the "**Sensor output message**" field (see *Fig. 21*).

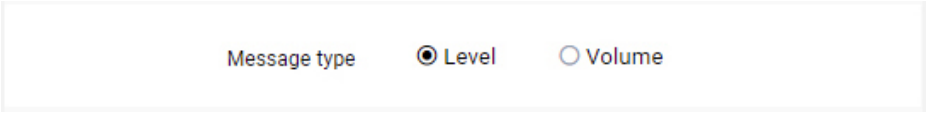


Fig. 21– Setting the sensor output message

The default value is "**Level**".

To switch the sensor to the fuel volume output mode, you must first compile a calibration table and write it to the sensor (see clause 4.3.3.7), then select **Volume** in the **Output message** field.

After changing the settings, you must record them in the sensor by pressing the **Save Settings** button at the top of the screen.

4.3.3.5 Setting up measured parameter output

The ONE.MAX fuel level sensor can transmit measured values via RS-232 and RS-485 interfaces either on request or independently with a defined period of time.

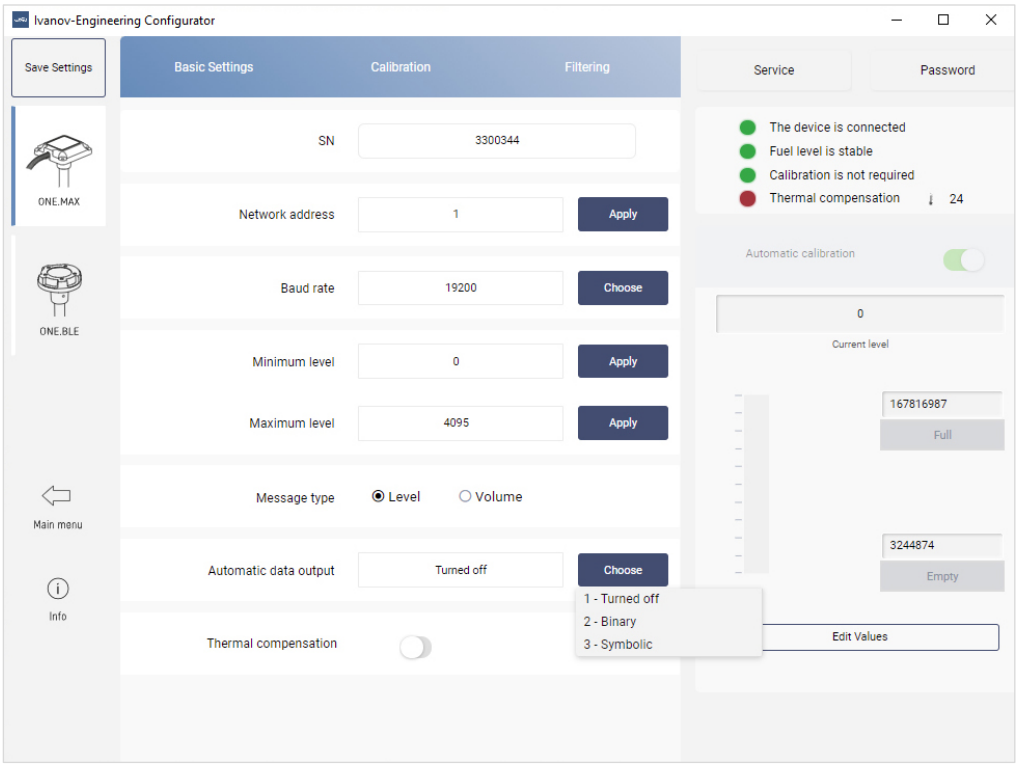


Fig. 22 – Setting up measured parameter output

To activate/deactivate the automatic data output function, in the **Automatic data output** field, press "Select" and select from the list displayed:

- **Turned off** – the sensor does not output data on its own;
- **Binary** – the sensor performs its own output in binary format;
- **Symbolic** – the sensor performs its own data output in symbolic form.

Automatic data output is only possible when one fuel level sensor is connected to an external device. The default value is **Turned off**.

Once the automatic data output function has been activated, the "Data output period" field will appear (see Fig.23). Set the interval (0 to 255 seconds) for the fuel level sensor to output data independently to an external device. The default value is 1 second.

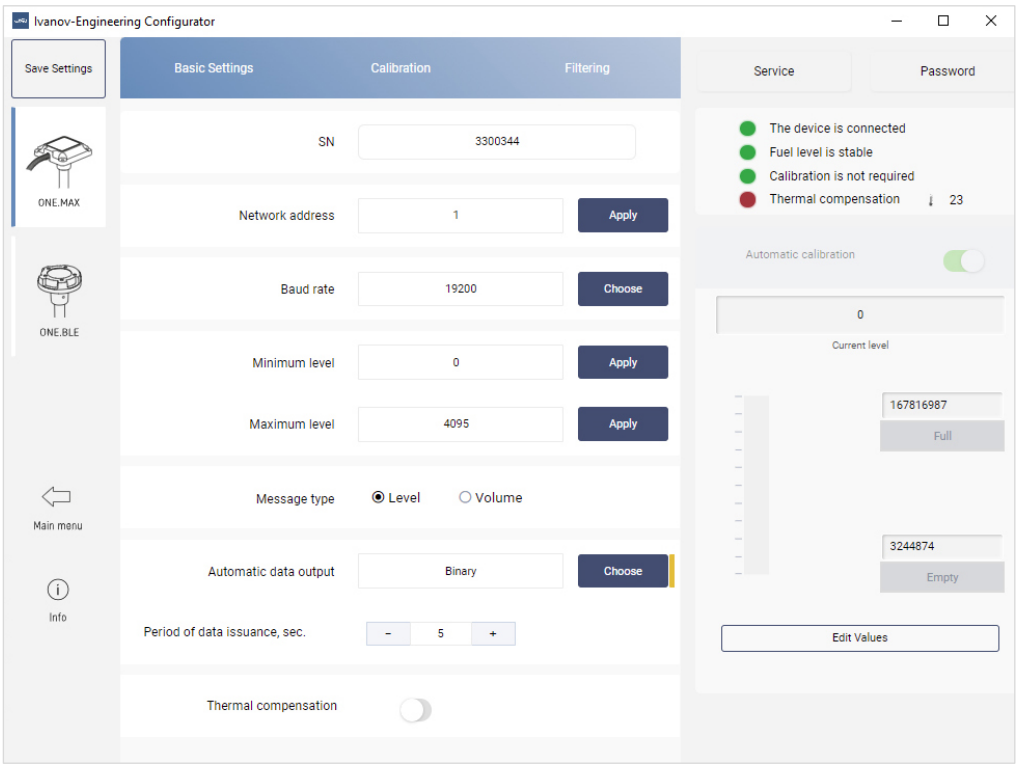


Fig. 23 – Setting up measured parameter output

4.3.3.6 Setting the temperature compensation

The expansion and contraction of the fuel, caused by a change in its temperature, leads to a change in the volume of fuel in the tank. The ONE.MAX has an automatic compensation for this effect by recalculating the fuel level to an operating temperature of 20 °C.

By default, this function is switched off.

To activate the automatic temperature compensation function, the **Thermal compensation** switch must be turned on. In the **Fuel type** field that appears, select one of the preset options from the drop-down list (see *Fig. 24*).

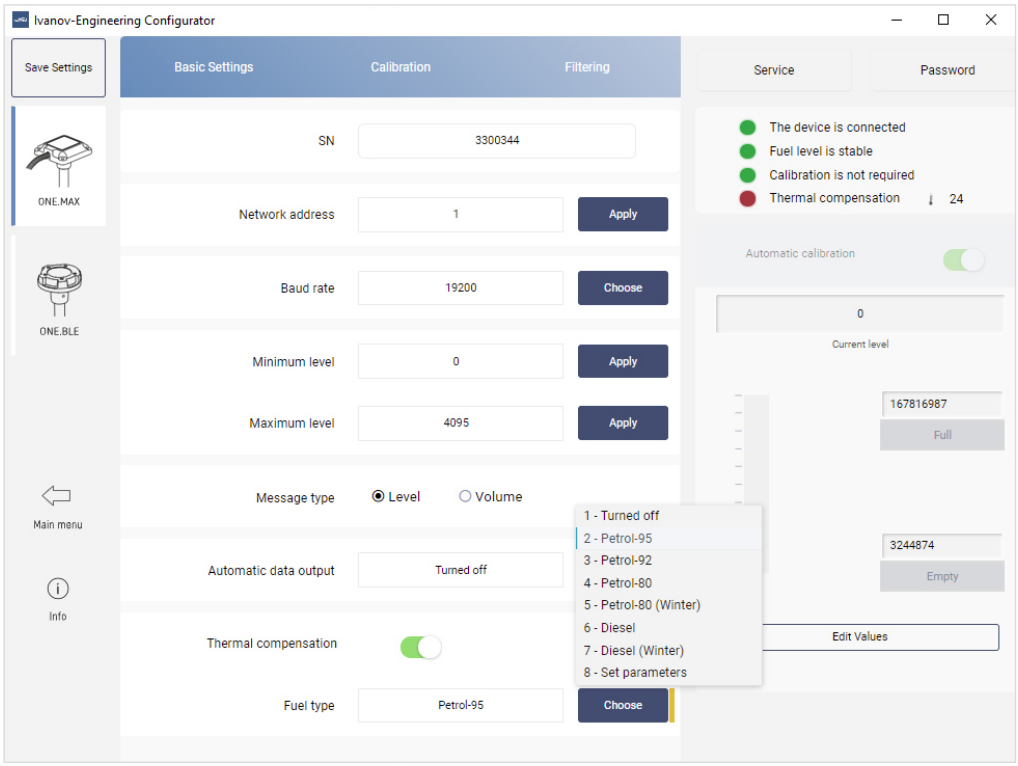


Fig. 24 – Fuel type selection

It is also possible to enter your own coefficients of linear expansion of the fuel by selecting the appropriate option from the list. Additional fields will then appear for entering the K1 and K2 coefficients (see *Fig. 25*), where:

K1 – change in fuel density when the temperature changes by 1 °C, g/cm3/°C;

K2 – fuel density at 0°C, g/cm3.

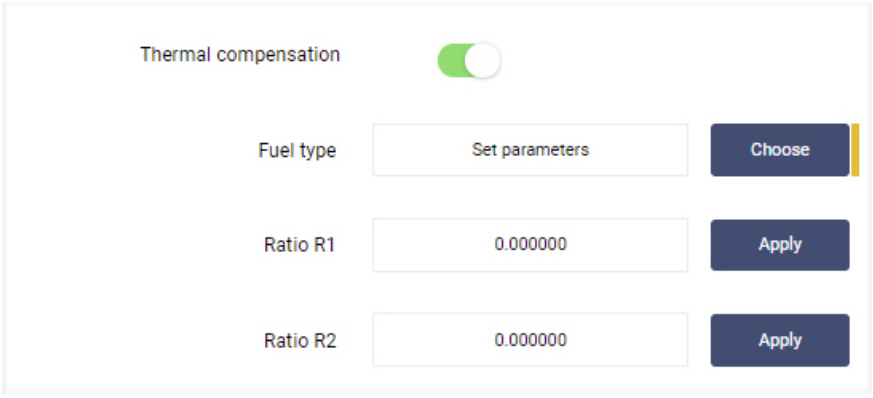


Fig. 25 – Fields for entering the K1 and K2 coefficients

After entering the coefficient values, you must press **Apply** to record the setting values to the device.

Table 1 – Table of linear expansion coefficients for preset options.

Mode	**K1, g/cm³/°C**	**K2, g/cm³**
Turned off	To automatic temperature compensation	
Petrol-95	−0.00088	0.78004
Petrol-92	−0.00088	0.77999
Petrol-80 (Summer)	−0.00089	0.75438
Petrol-80 (Winter)	−0.00090	0.73734
Diesel (Summer)	−0.00071	0.83258
Diesel (Winter)	−0.00072	0.84144
Own parameters	Set in fields K1 and K2	

4.3.3.7 Calibration of the fuel tank.

Tank calibration is necessary to determine whether the digital values of the sensor code match the fuel level in a particular tank.

The calibration process consists of filling the tank from empty to full in specific increments and recording the sensor reading in the calibration table.

It is possible to calibrate the tank by draining.

To compile the calibration table, go to the **Calibration** tab (see *Fig. 26*) and select the method to be used for calibration (by filling or draining fuel). If the connected sensor has previously been calibrated, the tab will show the existing calibration table.

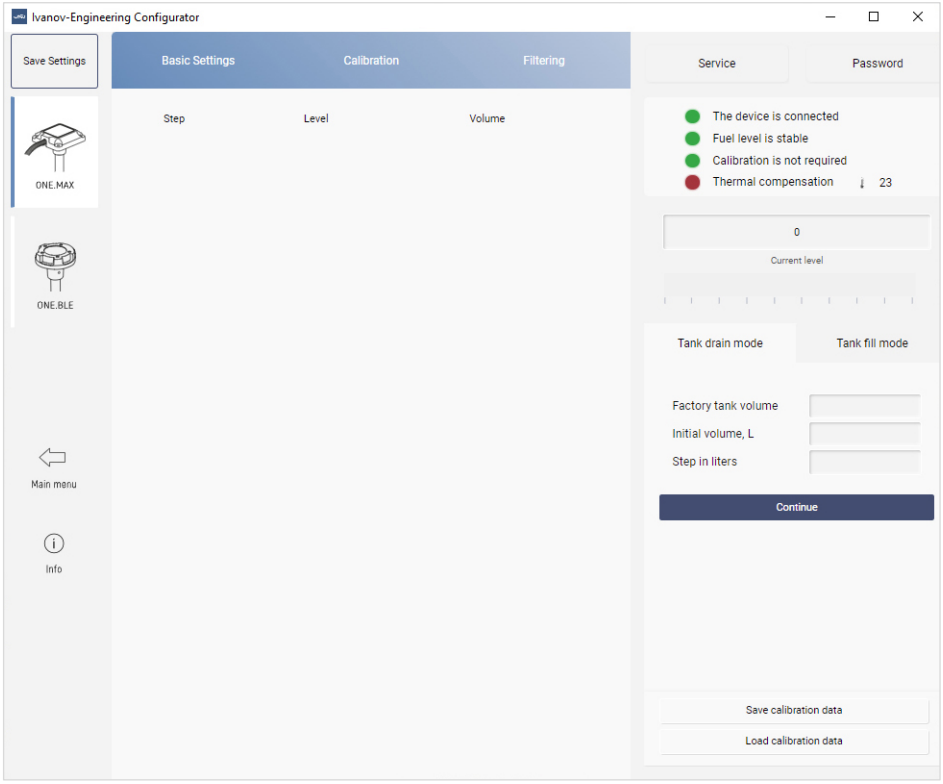


Fig. 26 – the "Main settings" menu with the "Calibration" tab open

Let's consider the process of tank calibration by the method of filling fuel.

1) Drain the fuel from the fuel tank.
2) Go to the **Tank fill mode** tab. The calibration section will appear as shown in *Fig. 27*.

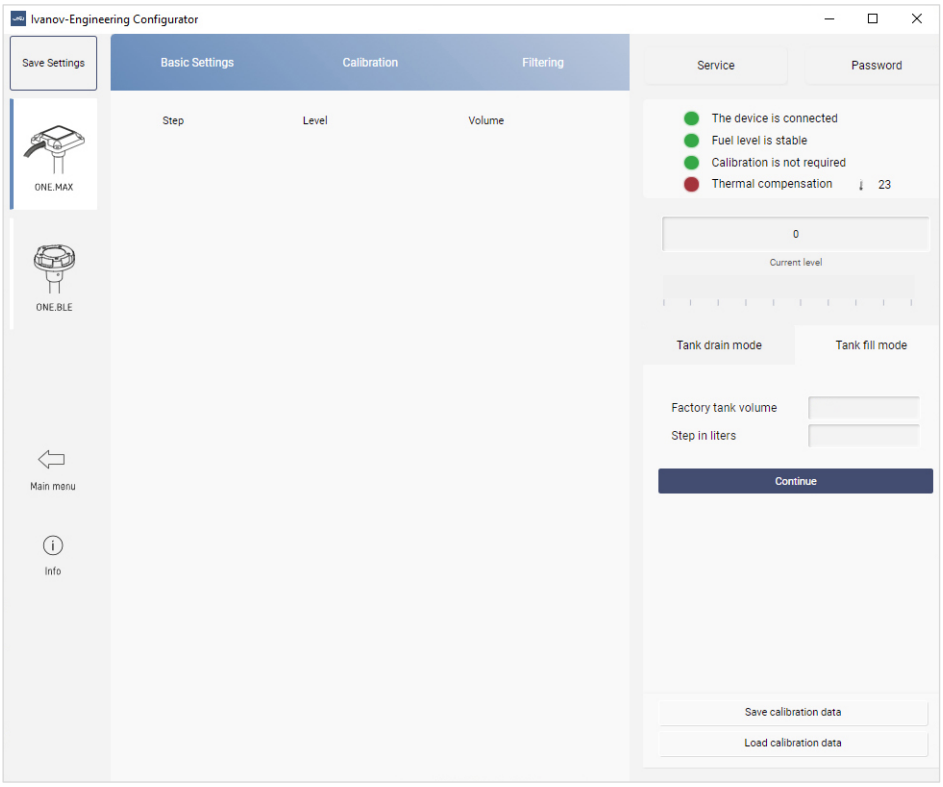


Fig. 27 – The program window with the "Calibration" tab open

In the **Calibration** section you must enter **Factory tank volume** and **Step in liters**. Step is the volume of fuel to be poured (and, in the drain method – drained). The amount and volume of fuel per step is calculated based on the tank volume. The bigger the tank, the higher the number of steps. The recommended number of points in the calibration table is 15. A maximum of 30 points in total can be added to the internal sensor table.

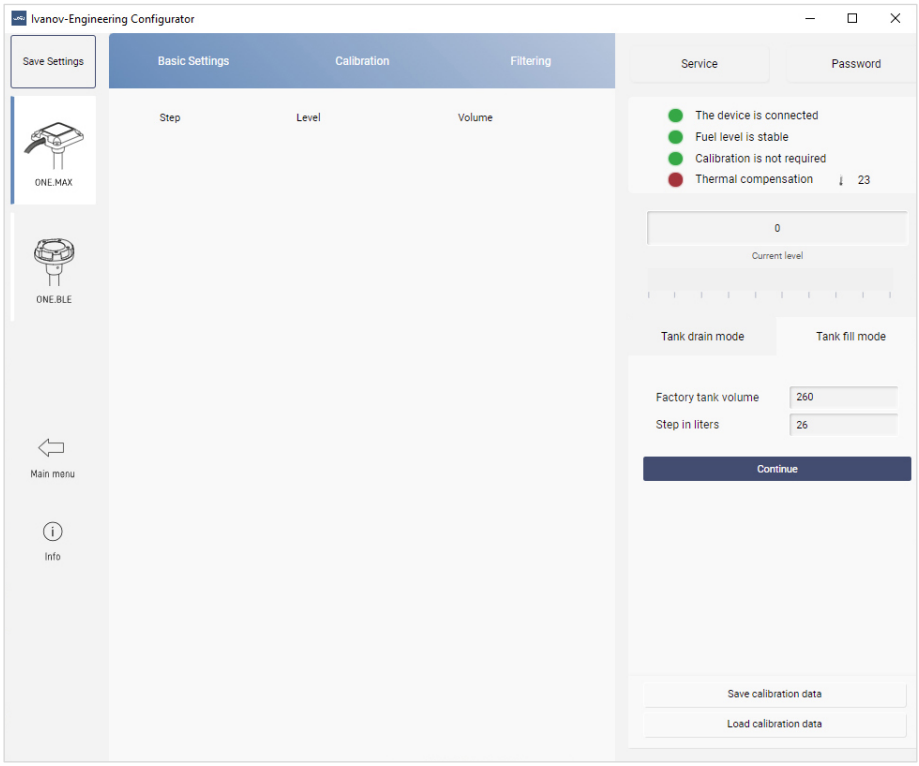


Fig. 28 – The program window with the "Calibration" tab open after entering values

Click on **Continue**. The program window will appear as shown in *Fig. 29*.

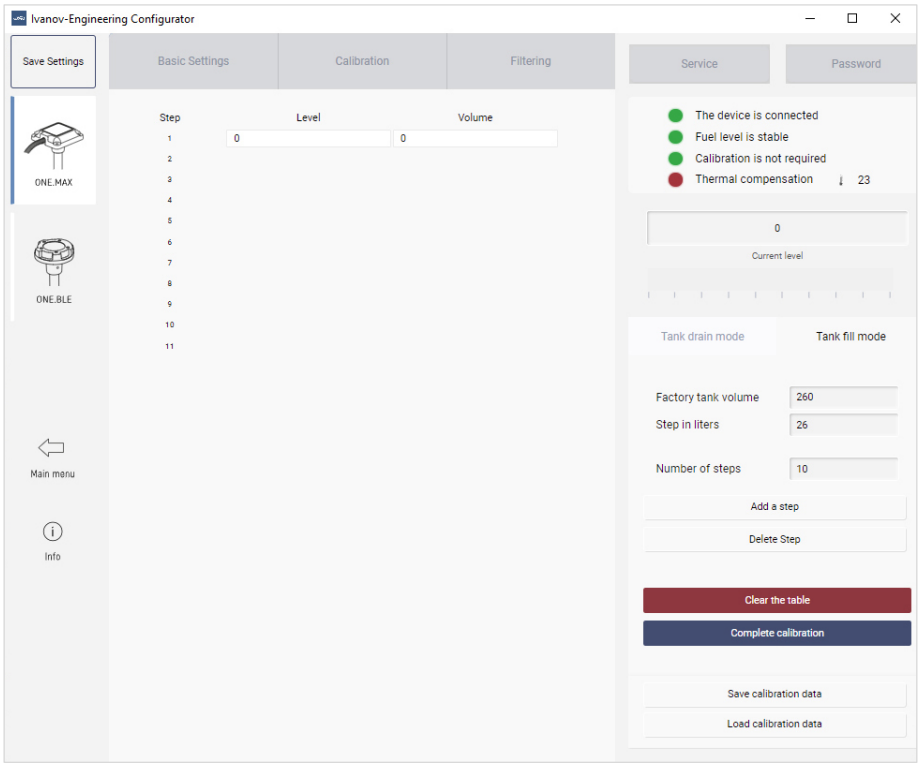


Fig. 29 – The program window during the calibration process

The program will automatically calculate the number of steps and create a table with the required number of lines. The first line will be filled with the initial value.

Attention! Navigation to other tabs in the program will be blocked until the calibration process is completed

3) Refuel with a measuring container.
When the fuel tank of the vehicle is filled, the fuel is "pumped".

To reduce the "pumping" effect of the fuel, fill the tank slowly to the required step level.

The "Fuel level is stable" indicator changes colour depending on the state of fuel in the tank:

- **red** – there is a fuel pumping (fluctuation)
- **green** – the fuel is stable.

Wait until the fuel level has stabilized.

The amount of fuel filled per step can be corrected manually by entering the appropriate value in the cell.

4) You can add a point to the table with the current fuel level value by pressing **Add step**

5) Repeat points 3-4 until the tank is full. When the calibration process is complete, the program window will look as shown in *Fig. 30*.

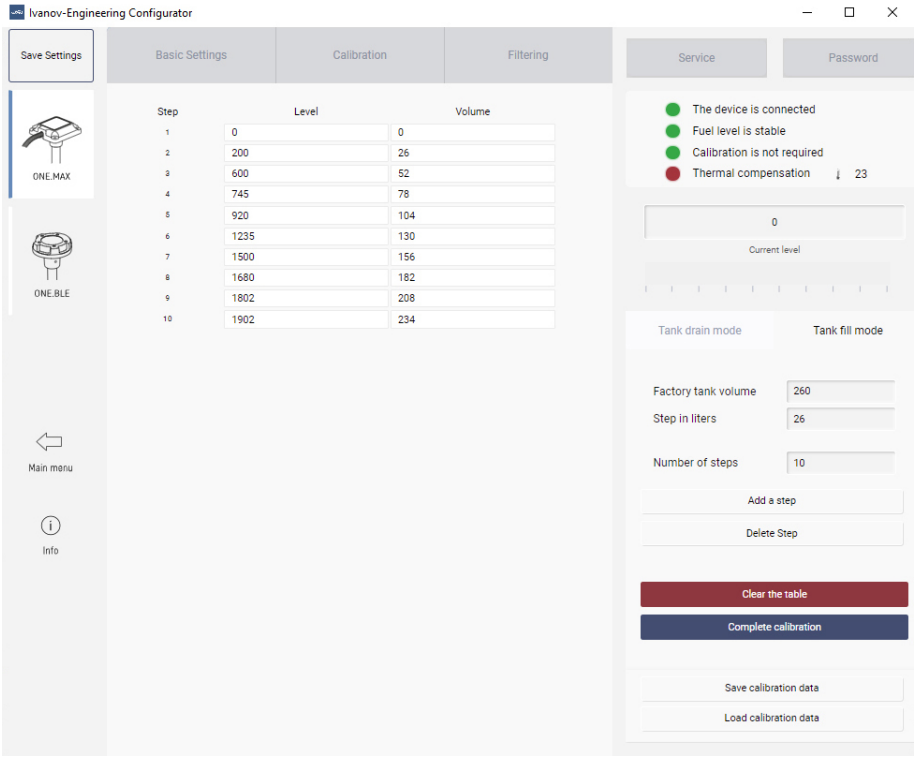


Fig. 30 – Program window at the end of the calibration process

6) Press **Complete calibration**. After that, the calibration table will be recorded in the non-volatile memory of the sensor.

To delete the previous step, press **Delete step**.

To delete all values in the calibration table, press **Clear the table**.

If the vehicle tank is not full at the end of the calibration process, you can additionally add lines to the calibration table by pressing **Add a step** until the tank is full.

4.3.3.8 Importing the calibration table from a file

To import a calibration table, select **Load calibration data** from the **Calibration** tab. In the window that opens, select the calibration table file to be imported. The table import confirmation screen will then appear (see *Fig. 31*).

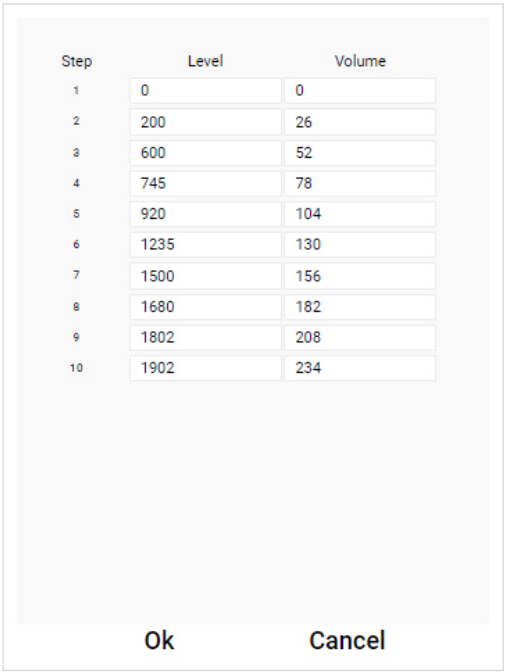


Fig. 31 – Confirmation window for importing the calibration table

4.3.3.9 Exporting the calibration table to a file

To export a calibration table, select **Save calibration data** from the "Calibration" tab. In the window that opens, enter the path and name of the file where the calibration table will be saved.

4.3.3.10 Filtering settings

To configure filtering, go to the **Filtering** tab (see *Fig. 32*). By default, this function is switched off.

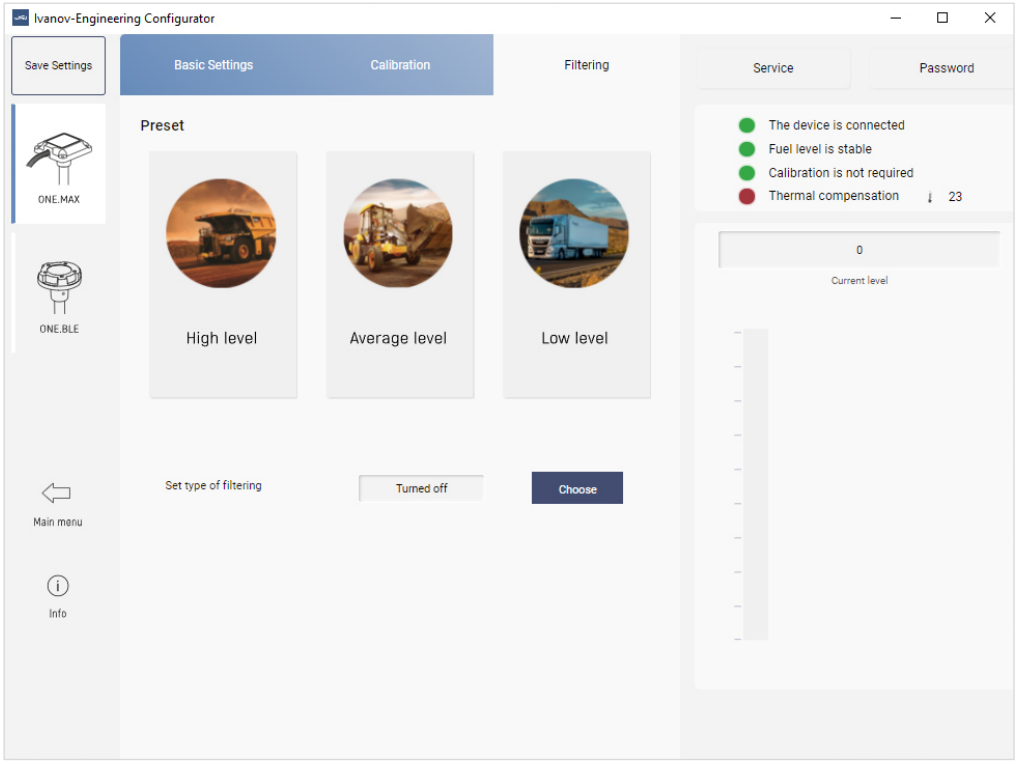


Fig. 32 – The program window with the "Filtering" tab open

Select the degree of filtering in this window. The program window will appear as shown in *Fig. 33*. The filtration degree is specified on the basis of the operating conditions of the vehicle.

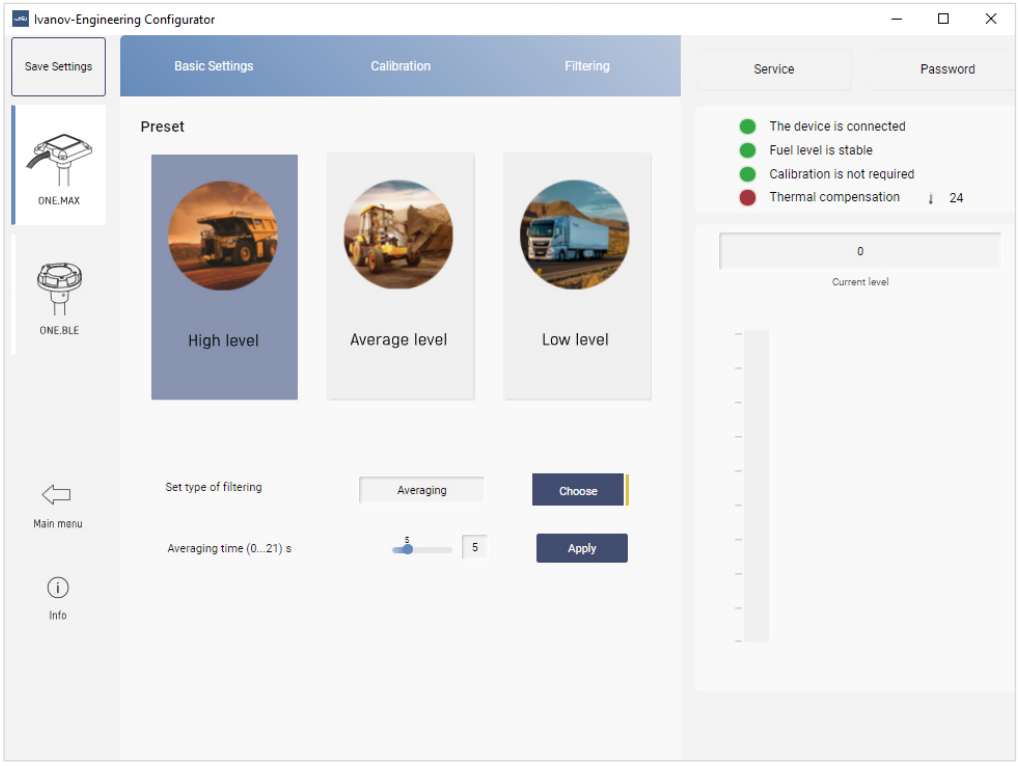


Fig. 33 – Program window with selected degree of filtering

If necessary, you can make additional filtering settings.

The ONE.MAX fuel level sensor supports 4 operating modes to filter the measured fuel level:

- **Turned off** – filtering of values is disabled, "raw" data is transmitted;
- **Averaging** – the measurement result is averaged over a set time interval;
- **Median** – the measurement results for a given time are sorted in ascending order, the minimum and maximum values for a given period are discarded, and the intermediate values are averaged;
- **Adaptive** – filtering is performed based on the current measured value and the predicted value.

The filtering mode is set in the **Type of filtering** field (see *Fig. 32*). When you select the type of filtering, the window displays the parameters specific to that type. *Fig. 34* shows all the filtering parameters.

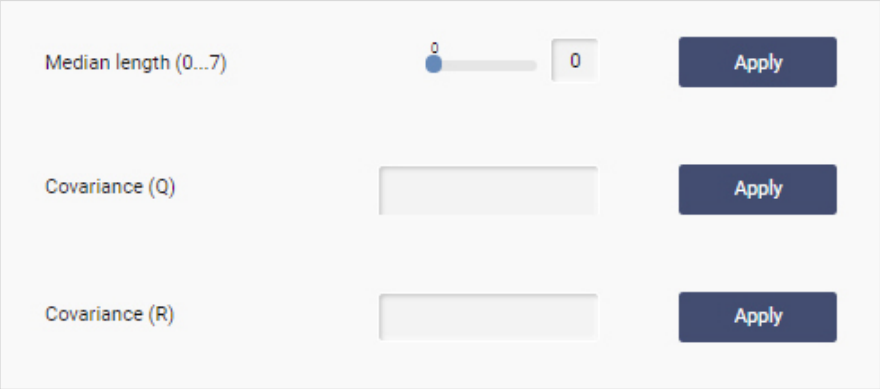


Fig. 34 – Filtering parameters

The averaging time (0-21s) is set in the **Averaging time** field (see *Fig. 33*). The longer the averaging time, the slower the sensor reacts to level changes. By default – 21 sec.

The number of additional samples for the median filter is set in the **Median length** field (0-7) (see *Fig. 36*). The longer the median length, the weaker the effect of single outliers on the median filter result. By default – 7.

The **process noise covariance Q** and the measurement **noise covariance R** are specified in their respective fields (see *Fig. 34*). The greater the ratio of the process noise covariance to the measurement noise covariance, the weaker the result of the single measurement affects the result of the adaptive filter.

Under normal operating conditions, it is recommended to use the **Averaging** mode with an averaging time of 21 s. In harsh environments (rough terrain) it is recommended to use **Median** mode with an averaging time of 21 and a median length of 7 or **Adaptive** mode with a covariance of process noise of 15 and measurement noise of 0.5.

Note that data filtering is also used in the controller and in the *Monitoring point* portal.

We recommend deactivating filtering in the device when filtering is enabled in the controller or server.

4.3.3.11 Resetting all settings

To reset the sensor to default settings, press **Service** and select **Reset all settings** from the drop-down list (see *Fig. 35*). The warning window shown in *Fig. 36* will then appear.

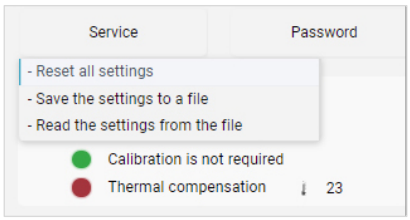


Fig. 35

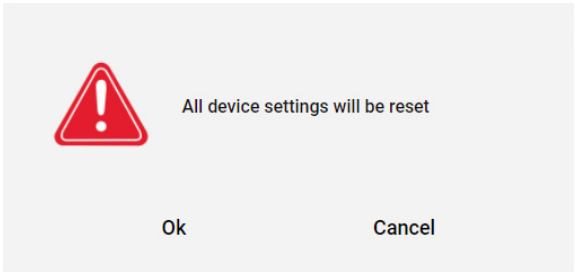


Fig. 36

4.3.3.12 Importing settings from a file

To import sensor settings, click on **Service** and select **Read settings from file** from the drop-down list (see *Fig. 35*). In the window that opens, select the settings file to be imported.

4.3.3.13 Exporting settings to a file

To export the sensor settings, click on Service and select **Save settings to file** from the drop-down list. In the window that opens, enter the path and name of the file where the sensor settings will be saved.

4.3.3.14 Changing the setup password

The password allows you to block access to change settings and the sensor calibration table without preventing the data from being read.

To set a password in the program's main menu, press **Password**. A window will open (see *Fig. 37*).

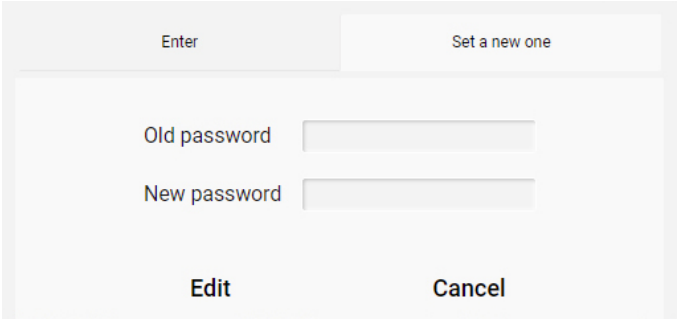


Fig. 37– Changing the setup password

In the window that opens, in the **Old password** field, enter the current password, and in the **New password** field, enter the new password (maximum 8 characters). If this is the first time you have entered a password on the sensor, leave the **Old Password** field blank.

Attention!
We recommend writing down the password you enter, as if you lose it you will not be able to connect to the sensor.

To save the new setting password, press **Change**. If the current password is entered incorrectly, the input window will look like the one shown in *Fig. 38*.

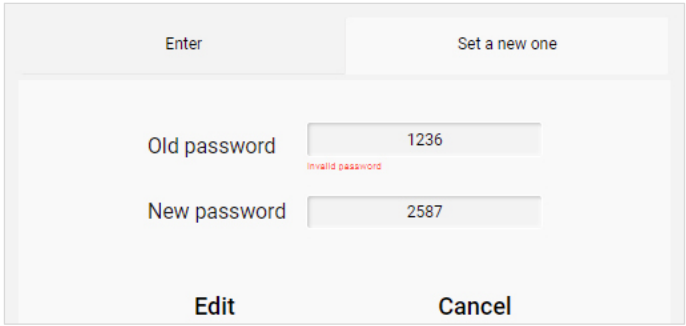


Fig. 38 – Window for changing the setting password when an incorrect password is entered.

4.3.3.15 Updating the sensor firmware

The sensor firmware can only be updated via the RS-232 interface.

To update the firmware, select **Firmware** in the main software window (see *Fig. 8b*). A window will open (see *Fig. 39*).

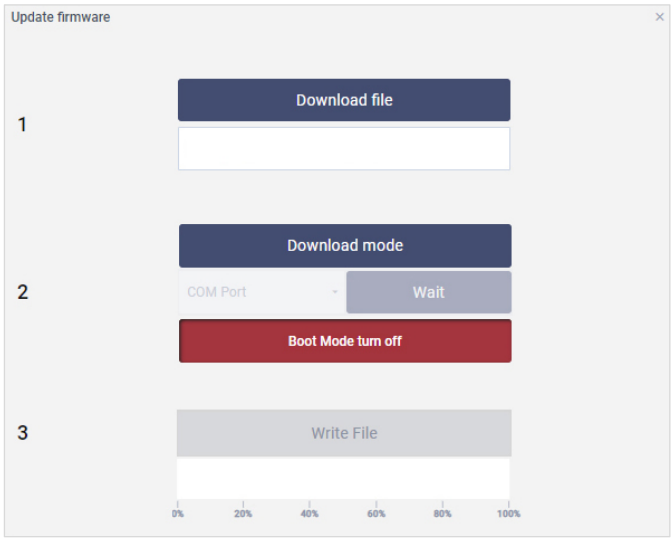


Fig. 39 – Firmware update window

In the window that opens, press **Download file** and specify the path to the firmware file. Click **Download mode** (see *Fig. 40a*).

If the program window is as shown in *Fig. 40b*, proceed as follows:

1) disconnect the sensor from the USD;
2) select the COM port to which the USD is connected and press **Wait**;
3) connect the sensor to the USD by connecting the cable connectors.

Fig. 40a

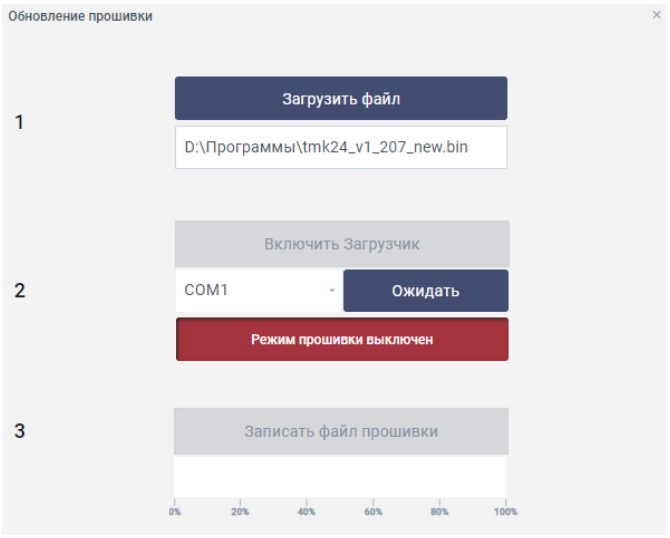


Fig. 40b

If you have successfully entered firmware mode, the update window will appear as shown in *Fig. 41*.

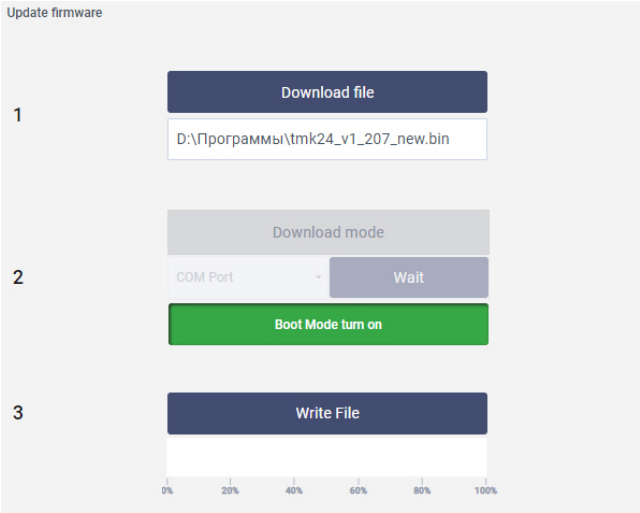


Fig. 41 – Firmware update window

Click **Write file**. The fuel level sensor firmware update process will start.

Do not switch off the sensor's power supply during the update.

When the firmware update is complete, a window will appear informing you that the firmware has been written. Close the window. Disconnect the sensor from the USD.

If an error occurs, check that the cable connectors are securely connected and retry the firmware update.

4.3.4. Emergency situations

If the software fails or malfunctions, contact Technical Support.

4.4 Device assembly and disassembly

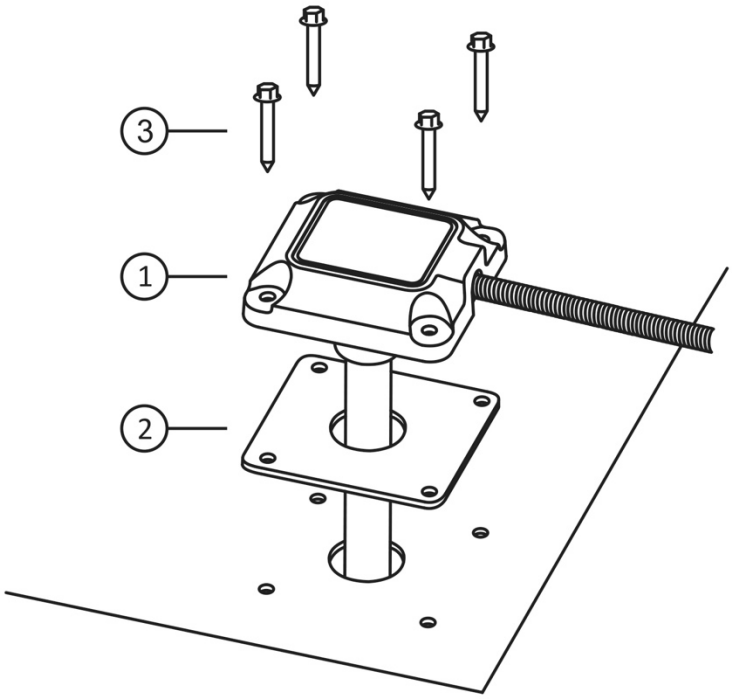
4.4.1 Device mounting

1) Clean and degrease the surface of the tank around the device mounting hole.
2) Apply petroleum sealant to both sides of the gasket along the contour, around the inlet hole of the measuring part of the device and the holes for attachment to the tank.

ATTENTION! APPLYING SEALANT TO ONLY ONE SIDE OF THE GASKET WILL NOT ENSURE A TIGHT INSTALLATION OF THE DEVICE.

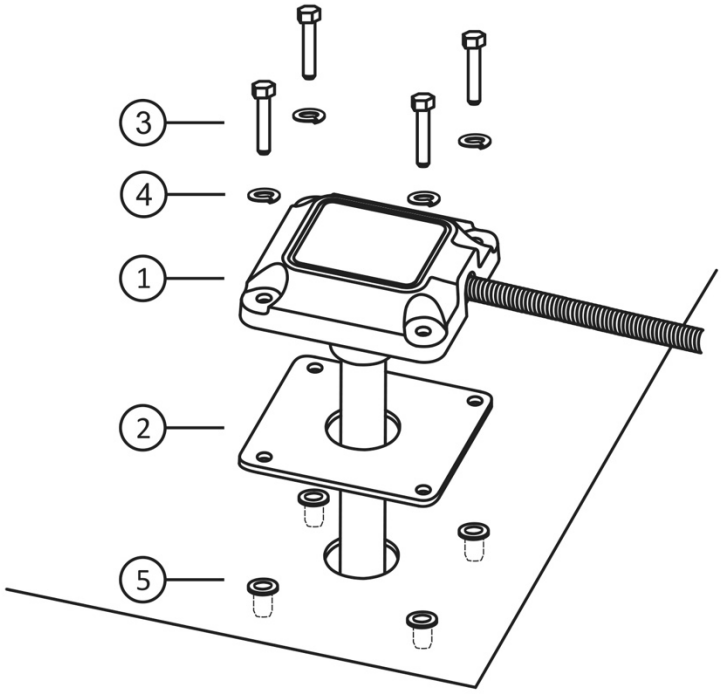
When mounting the device on a vehicle fuel tank with non-flat surfaces, it is recommended to use an additional compensating gasket (not included) in combination with an oil and petrol sealant to ensure a tight connection.

3) Place the gasket on the measuring part and insert item 1 into the tank opening (*Fig. 42, 43*).



Item number	Name	Q-ty
1	Fuel Level Sensor	1
2	Gasket	1
3	Self-tapping screws 5,5x32 DIN 7504K	4

Fig. 42 – Mounting the device to the vehicle's fuel tank with self-tapping screws



Item number	Name	Q-ty
1	Fuel Level Sensor	1
2	Gasket	1
3	Bolt M5x25 DIN933	4
4	Lock washers 5 DIN127	4
5	Rivet M5	4

Fig. 43 – Mounting the device to the vehicle's fuel tank with bolts

4) Insert the fasteners provided with the mounting parts kit (item 3) into the holes in the device enclosure (item 1). The use of fasteners with a smaller diameter is not permitted. Tighten the fasteners using a wrench in the sequence 1-2-3-4 according to *Fig. 44*, checking the tightening torque to avoid twisting the fasteners. The tightening torque for mounting the level gauge with self-tapping screws is 0.2 N·m. The tightening torque for mounting the level gauge with bolts is 0.6 N·m.
When mounting the device on a metal tank with bolts, be sure to mount the lock washers (item 4) (see *Fig. 43*). After tightening the bolts, loosen two of them and tighten them again. This is necessary to damage the body paint, which ensures electrical contact between the device enclosure and the tank.

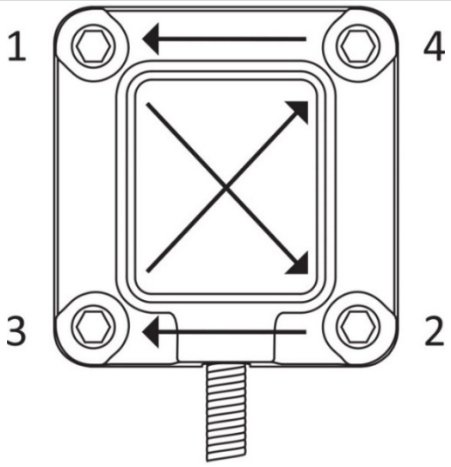
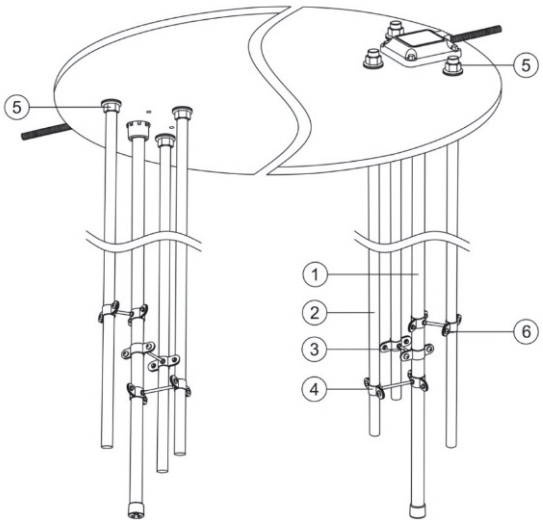


Fig. 44 – Tightening sequence for the fasteners

5) To mount the device on vehicles with large fuel tanks, when the length of the measuring part exceeds 1.5 m, it is recommended to reinforce the measuring part of the device by using steel studs and clamps (*Fig. 45*) or steel fittings (*Fig. 46*). This will reduce the influence of the fuel masses on the measuring part of the device when the vehicle changes direction abruptly.

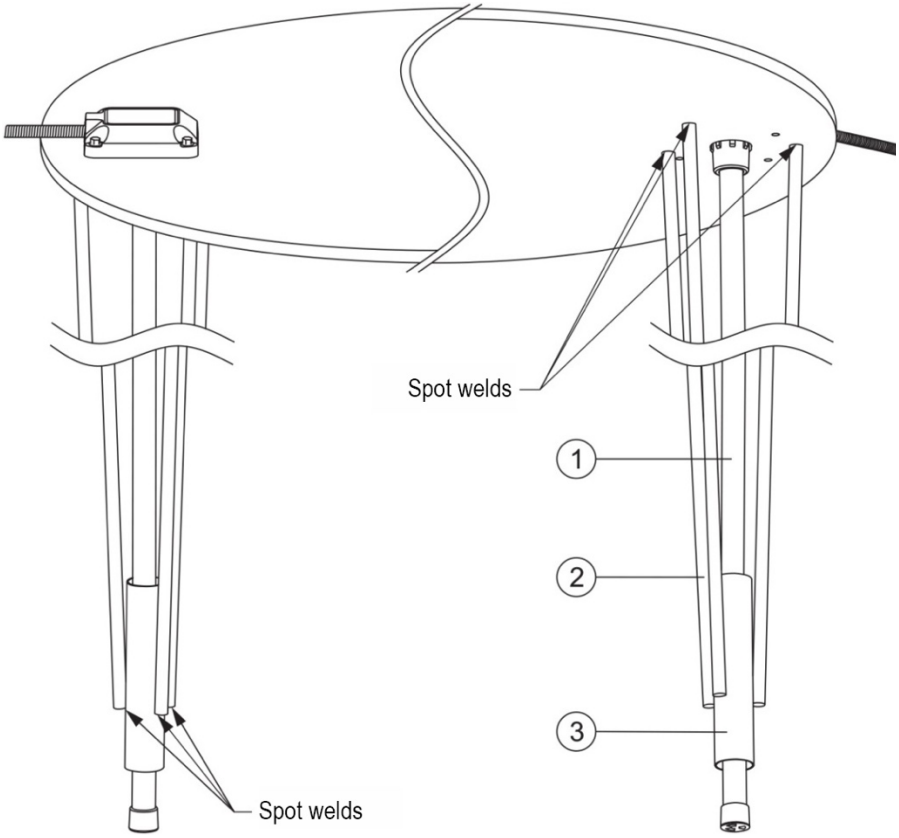
ATTENTION! Carry out welding and fitting work in accordance with the safety requirements associated with this type of work.

Note: the reinforcement schemes shown are based on the example of tanks with removable manhole covers. The decision to reinforce the measuring part of the device and a suitable reinforcing method shall be taken by the company installing the device on the vehicle.



Item number	Name
1	Measuring part of the fuel level sensor
2	Threaded stud M16 DIN 975
3	Threaded stud M6 DIN 975
4	Steel clamp
5	Fastening of the threaded stud M16: Flat washer ∅17 DIN 125 – 2 pcs. Spring washer ∅16.2 DIN 127 – 2 pcs. Nut M16 DIN 934 – 2 pcs.
6	Fastening of the steel clamp

Fig. 45 – Reinforce the measuring part of the device with steel studs and clamps



Item number	Name
1	Measuring part of the fuel level sensor
2	Steel reinforcement
3	Steel reinforcement ∅30 mm

Fig. 46 – Reinforcing the measuring part of the device with steel reinforcement

4.4.2 Connecting the device

ONE.MAX is connected according to the scheme in *Fig. 47*.

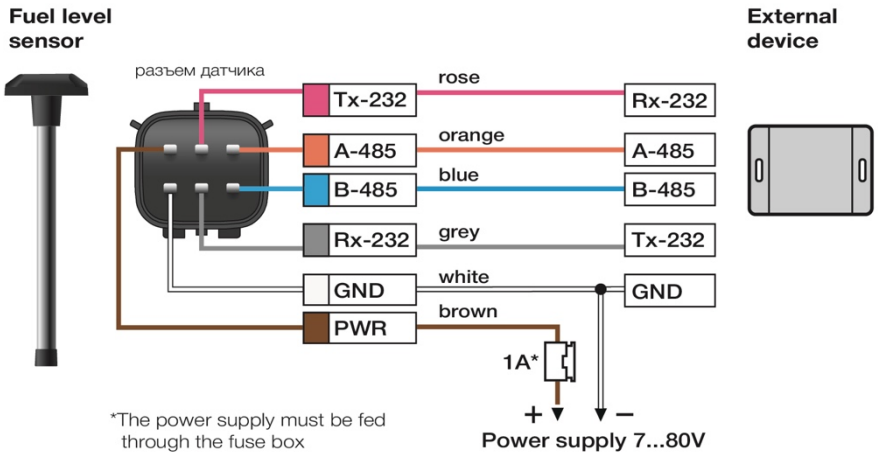


Fig. 47 – Device connection scheme

Lay the mounting cable from the place of the device mounting to the place of connection of the sensor to an external device. It is recommended to lay the mounting cable next to the original vehicle wiring harness and secured with plastic cable ties. The power supply must be fed through the standard fuse box. Use a fuse with a rating not exceeding 2A to protect the device. We recommend using a separate fuse to connect the ONE.MAX fuel level sensor.

ATTENTION! The fuse should be mounted as close as possible to the sensor power connection!

4.4.3 Sealing the connector

The connection point of the sensor and the mounting cable must be sealed with a rotary type seal from the supplied package (see *Fig. 48*).

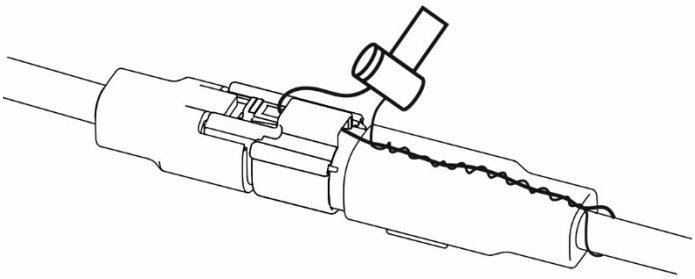


Fig. 48 – Sealing the sensor and mounting cable connection point with a rotary seal

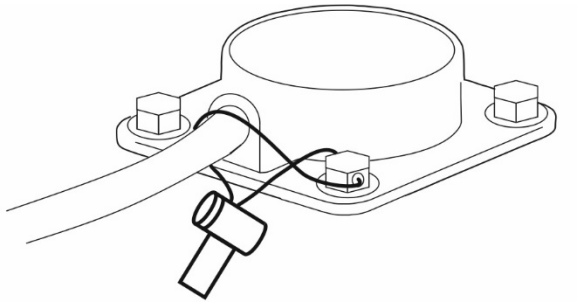


Fig. 49 – Fitting a seal to the sensor.

ATTENTION! The connector between the sensor and the mounting cable must not be located directly beside the filler neck. Continuous exposure to fuel reduces the reliability of the connector and can lead to the device failure.

ATTENTION! Before turning on the device for the first time, check that the colours of the wires are correct. Refer to the fuel level sensor wiring scheme. An error will cause the sensor to fail.

4.4.4 Disassembly of the device

1) De-energise the vehicle.
2) Carefully cut off the seals.
3) Disconnect the connector.
4) Unscrew the fastening elements.
5) Remove the device from the fuel tank.

5. Maintenance

Inspect the device at least once a month. Check that the sensor is securely fastened, that there are no fuel leaks and that the control seal is intact.

6. Current repairs

The device is indecomposable. It is forbidden to make repairs. In case of malfunction of the device, contact Technical Support.

7. Common malfunctions and remedies

Possible malfunctions	Methods of elimination
The device works, but does not connect to "IE Configurator":	1) Check the device connector for soiling (use a universal cleaner or Carb Cleaner if necessary). 2) Make sure that the device connector is fully engaged in the USD mating connector. 3) Check the device ID (ensure that the ID entered matches the ID specified when setting up the device). 4) Check the baud rate (the baud rate when connected to "IE Configurator" must match the baud rate in the sensor settings). 5) Check that the device password is correct (if a password has been set). 6) Reset the factory settings (if it is impossible to connect the device to "IE Configurator", contact the technical support department). "Attention, all settings will be lost!"
The device does not work and does not connect to "IE Configurator":	1) Check that the connector is intact (disconnect the device from the mounting cable, check the pins for oxidation or moisture). 2) Use a multimeter to test the connector of the mounting cable (check the plus line and earth of the device).
Incorrect values when calibrating the device:	1) "IE Configurator" shows "full tank" but the actual tank is not full. Check the drainage holes on the device (clean off any dirt or tape residues if necessary). 2) Recalibrate the empty/full calibration (if the device is calibrated by pouring fuel into the measuring part of the device from above, there is a greater chance of an air lock).

8. Transport and storage regulations

The device can be transported in any enclosed vehicle over any distance. Transportation must be carried out in the manufacturer's packaging at an ambient temperature of minus 60 °C to +85 °C, taking care to protect against mechanical influences.

The devices must be stored in the manufacturer's packaging in conditions 1 to GOST 15150-69. The air in vehicles and warehouses must be free of aggressive impurities and corrosive substances.

9. Manufacturer's guarantees

The warranty service period is 24 months. The warranty period is calculated from the day the device is handed over to the customer, the transport company or the courier. The document confirming the transfer of the device is a universal transfer document or consignment note, duly dated and stamped.

Conditions for refusal of warranty repairs:

- improper transport, storage, mounting and operation;
- traces of chemical, mechanical or thermal stress (melting, cracks, deformation, etc.);
- mounting of the sensor by unqualified personnel*;
- the presence of defects caused by an accident, natural disaster;
- damage to the device as a result of wilful or negligent action by the user, or improper or negligent handling;
- using the sensor for other purposes.

** A qualified person is one who is certified as an "auto electrician" and "auto mechanic". The technician must be familiar with the technical documentation for setting up and installing the device, as well as know and follow the safety procedures for working with fuels and lubricants.*

To obtain warranty service for your device, you will need to:

1) Fill in the reclamation certificate for the defective sensor, affix the seal of the user organisation and state the date of sale on it. All points about the condition and operation of the device must be completed in the Complaint form. Complaint forms which are not fully completed will not be considered and warranty replacements will not be issued. You can request the Complaint form by emailing technical support.
2) Take pictures:
   - of the device with a "readable" serial number mounted on the tank,
   - of a general view of the location of the device on the vehicle's tank,
   - of the location of the connection socket, mounted sensor.
3) Send an application to the email address support@locme.ru.
4) After confirming the status of the application, make the device available for inspection.
5) Delivery of the device is at the customer's expense.

10. Disposal

1) Before disposal, dismantle the device and drain off any residual fuel.
2) Cut the device's connecting cable.
3) The devices do not contain precious metals or hazardous substances with hazardous properties (toxicity, explosiveness, fire hazard, high reactivity) or which may present an immediate or potential hazard to the environment and human health.
4) The measuring part (tube and central electrode) and the wires of the device's interface cable are recycled as non-ferrous metal scrap.
5) The device enclosure with integrated components is to be disposed of as municipal solid waste. Disposal must be carried out in accordance with the procedure established by the company and compiled in accordance with the laws of the Russian Federation No. 96-F3 "On Atmospheric Air Protection", No. 89-F3 "On Production and Consumption Waste", No. 52-F3 "On Sanitary and Epidemiological Well-Being of the Population".

APPENDIX A. General appearance and mounting dimensions of the device

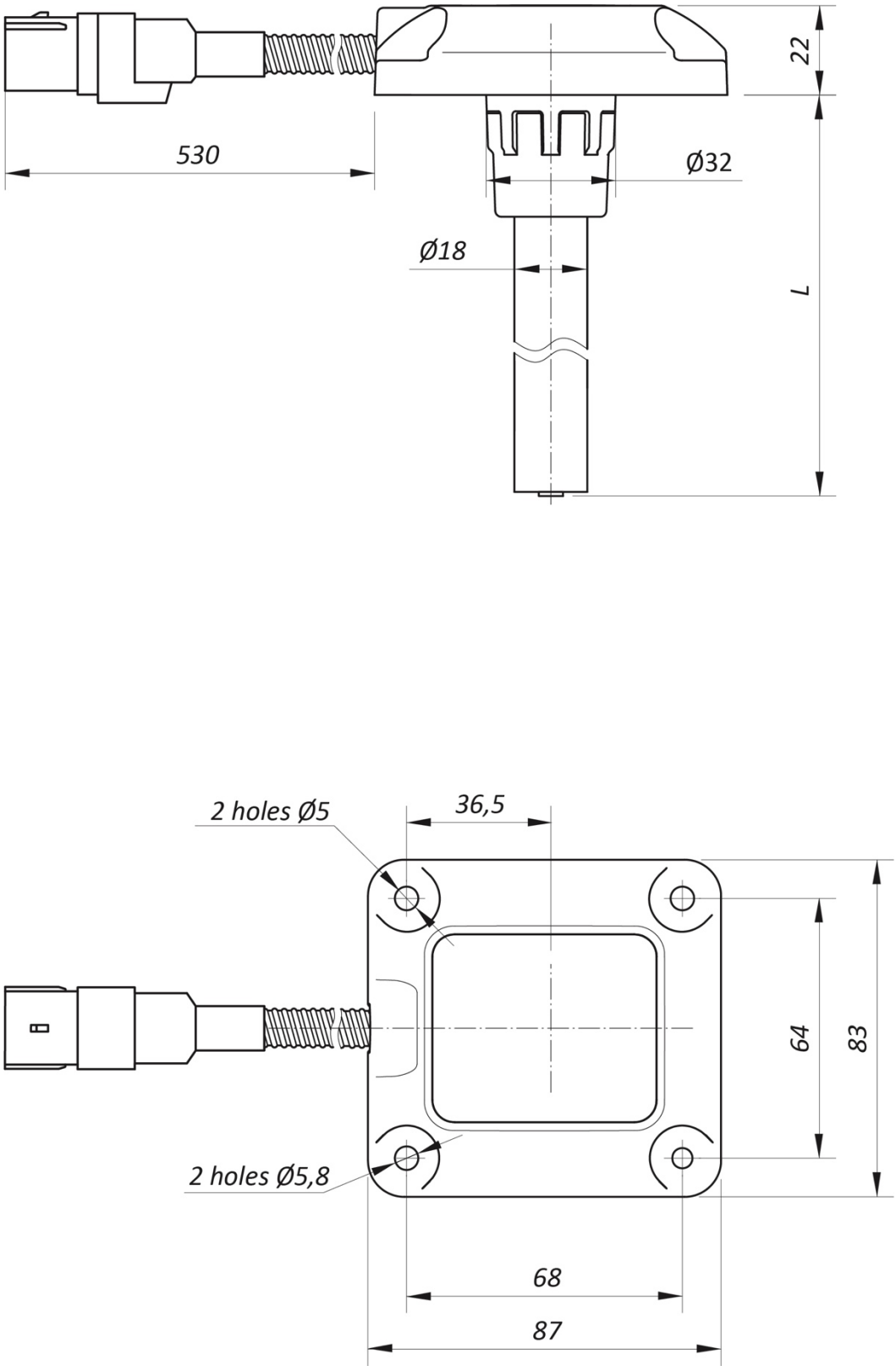


Fig. 50 – General appearance of the device, L1 – the actual length of the measuring part of the device

L2 – working length of the measuring part of the device

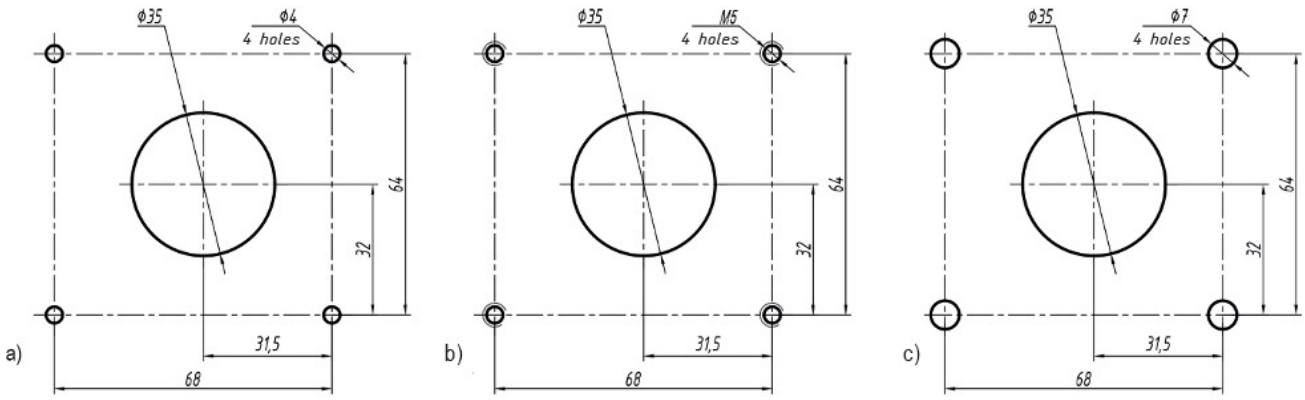


Fig. 51 – Mounting dimensions: a) for mounting on self-tapping screws;

b) for mounting on threaded bolts;

c) for bolt-on mounting using rivets.

APPENDIX B. List of necessary equipment and tools

No.	Name	Q-ty	Note
Tools:			
1	Bimetallic crown ø35 mm	1 pc.	
2	Shank to crown	1 pc.	
3	- Metal drill ø4 mm - Metal drill ø7 mm - Metal drill ø4.2 mm and tap M5	1 pc.	ø4 mm for mounting on self-tapping screws ø7 mm for rivets ø4.2 mm and tap M5 for thread
4	Measuring ruler	1 pc.	Length at least the length of the tank
5	Hacksaw for metal	1 pc.	
6	Wrench for 8 mm	1 pc.	
7	Tool for installing threaded rivets	1 pc.	To mount rivets
Accessories:			
1	Universal Setup Device (USD)	1 pc.	
2	Adjustment cable LK588.50.00	1 pc.	
3	Connection cable USB A -USB B	1 pc.	
4	PC with pre-installed Windows (Windows XP, Windows 7, Windows 10)	1 pc.	
5	“IE Configurator” program	1 pc.	For the current version, see website *https://locme.ru*
6	Measuring container	1 pc.	Height ≥ L3
7	Fuel		
8	Calibration container	1 pc.	For recommended volume see cl. 4.3.3.1
9	Silicone sealant, oil and petrol resistant	100 g	Recommended brands: • IMG MG-404 • Reinzosil

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