MIELTA
МОНИТОРИНГ ТРАНСПОРТА

USER MANUAL

Fuel level sensor

«KATANA»

FLS software version: 1.1.13

Configurator version: 1.0.27

Revision dated 09/16/2024

Tambov 2024

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1. Device description

Fuel level sensor (FLS) KATANA MIELTA is designed to measure the level of light petroleum products (diesel, gasoline, kerosene, etc.) in tanks of different purposes. The sensor might be installed on stationary objects, as well as on road and rail vehicles.

The sensor is capacitive, the capacitance depends in the depth of submersion of the measuring rod in the fuel.
The sensor is made out of sturdy stainless steel and the housing has IP68 protection, the cable is protected by a synthetic braid and has a hermetic port. The sensor is mounted in the hole in the tank and is held with 4 screws.

The sensor can be configured with a PC configurator using a wired interface converter RS485 USB.

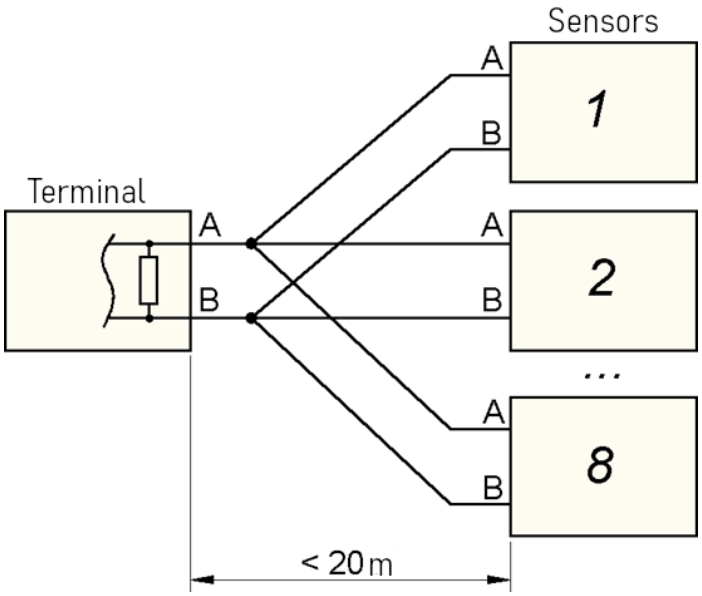
2. Technical specifications

Table 1.

Power supply voltage	8 – 55 V
Average power consumption	0.5 W
Measurement period	1 - 255 sec
Smoothing window length	1 – 60 measurements
Relative error of level measurement over the entire range	1%
Maximum frequency output range	30 - 2048 Hz
Frequency output resolution	1 Hz
Frequency output pull-up	2 kΩ
Frequency output current limit	0.1 A
RS485 bus speed	9600, 19200, 38400, 57600, 115200
Galvanic isolation: Power, frequency output – RS485 Power, frequency output - measuring rod Measuring rod – RS485	 1000 V 1000 V 1000 V
Measuring rod length	1000 - 3000 mm
Minimum recommended measuring rod length	150 mm
Cable length	0.7 m
Installation kit cable length	7 m
Operating temperature range	-40..+80 °C
Degree of protection of the case	IP68

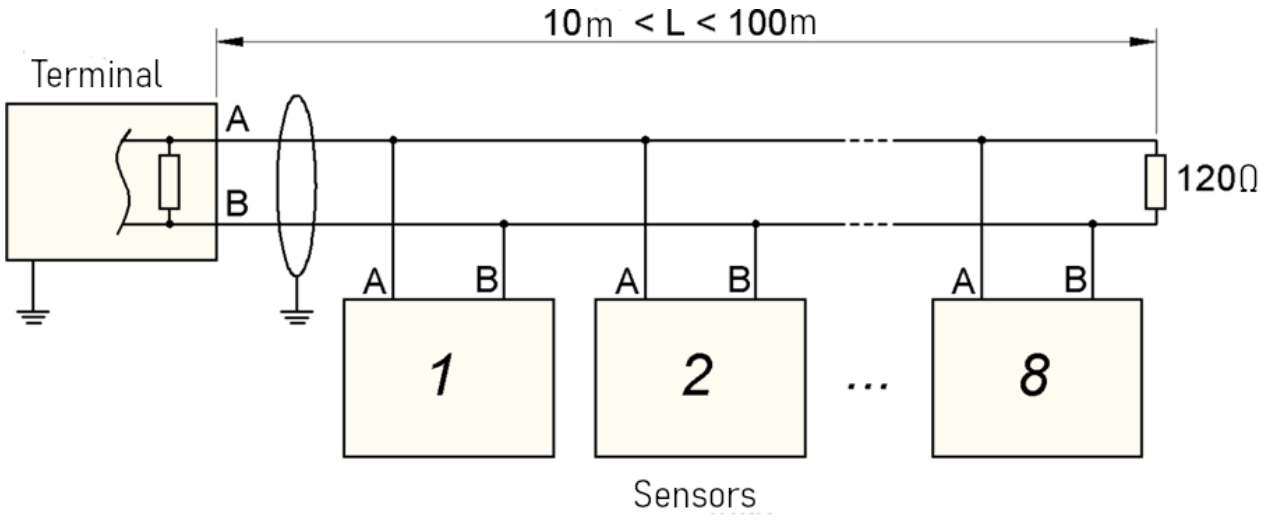
3. RS485 interface

Digital interface RS485 is made according to the international standard ANSI EIA/TIA-485-A. The data is transmitted according to a proprietary protocol, developed by MIELTA, which is compatible with LLS protocol for the fuel level.
Digital interface RS485 is used to get data measured by the sensor, configuring the sensor and updating firmware.
RS485 interface allows for connection of multiple sensors to a single terminal (pictures 1 and 2). All of the MIELTA terminals support connecting up to 8 sensors or other peripheral devices on the RS485.



Picture 1. Network topology "star".

When connecting multiple sensors on the distance no more than 20 m from the terminal it is recommended to use the «star» topology. This topology does not need any terminal resistors.



Picture 2. Network topology "bus".

Network topology «bus» is used for connecting multiple sensors to a single terminal on the distance up to 100 m. In this case it is necessary to connect a terminal resistor of 120 Ω 0,25 W near the furthest sensor in the network. If the network length in greater than 20 m it is recommended to use shielded twisted pair. The cable shield should be connected only to the ground of the terminal. It is not necessary to connect the shield to the ground of the FLS. Because of galvanic isolation, sensors in the same network might be powered from different power sources.

Before connecting multiple sensors to the same network it is necessary to configure each of them individually. Each device in the network should have a unique bus address. The terminal should be configured to receive data from devices with these addresses with the same bus speed, and the data types should also be configured (fuel level, frequency output, temperature).

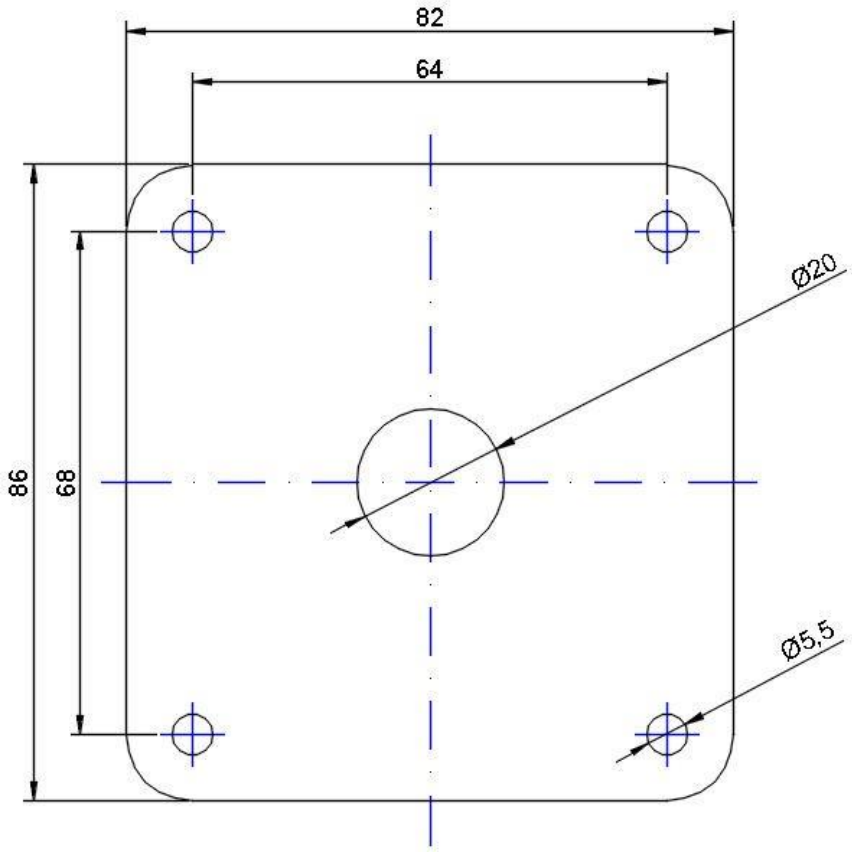
The parameter «level» is in the range 30-4095 by default. Values of 2XXXX, 3XXXX and 40000 are used as FLS error codes. The parameter «level» is the same as the frequency output, the output range might be configured.

Table 2.

Parameter	Values	Description
Level	From 0 to 10000	The fuel level. The range might be configured, by default it is 30-4095.
	2XXXX	Error code, level below calibrated minimum, where XXXX – the level below minimum as percentage. Example: 20015 – level below minimum by 15%.
	3XXXX	Error code, level above calibrated maximum, where XXXX – the level above maximum as percentage. Example: 30015 – level above maximum by 15%.
	40000	Error code, sensor is not calibrated.
Temperature	From -50 to +100	Sensor's temperature, °C
	-127	Error code, temperature below -50 °C
	+127	Error code, temperature above +100 °C

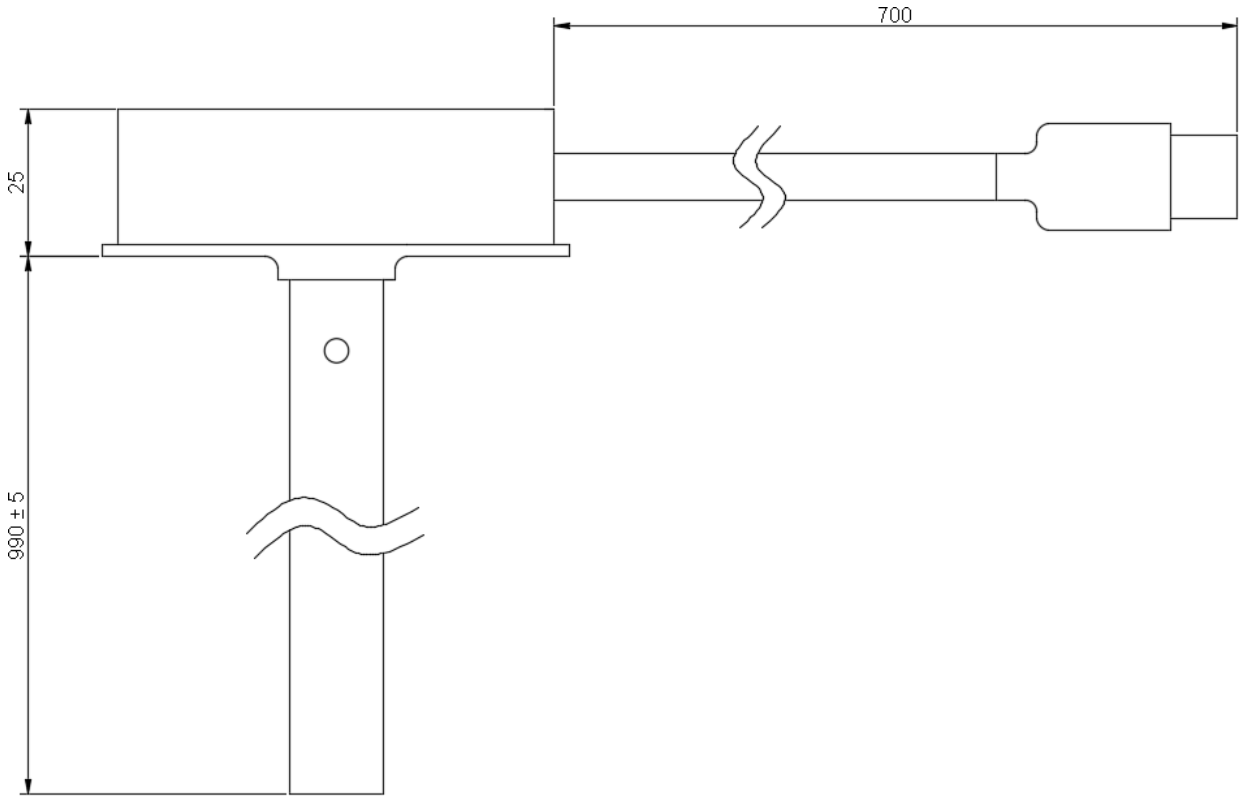
4. Installation

The sensor is mounted in the highest point of the tank and above the lowest point of the tank. The mounting surface should be horizontal.



Picture 3. Sizes of FLS mounting plate.

The center hole should have a diameter at least Ø25 mm. The screw holes' diameters are chosen according to the material of the tank. FLS is mounted using self-tapping screws. When mounting to a metal tank, drill 4 holes with the diameter of 4-4.5 mm. When mounting to a plastic tank, drill 4 holes with the diameter of 3 mm.



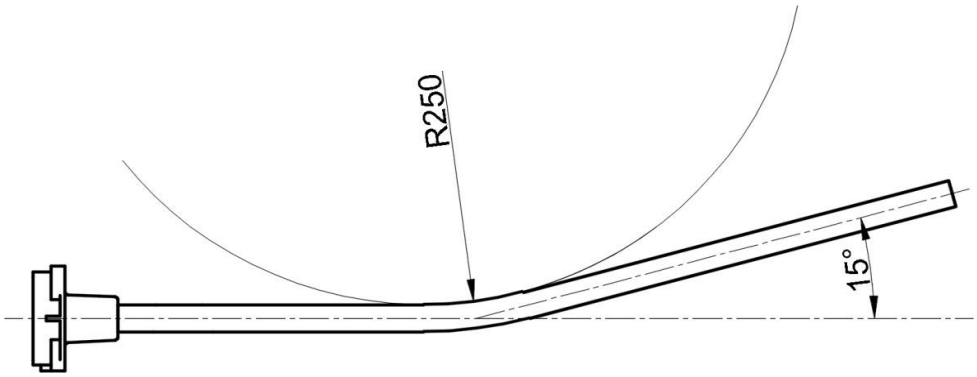
Picture 4. Sizes of FLS.

Installation steps:

1. Select the installation place and clean it.
2. Mark the holes according to the installation plate sizes, drill and clean them.
3. Measure the depth of the tank from the bottom to the installation place.
4. Measure the length of the FLS measuring rod 20 mm shorter than the measured tank depth.
5. Cut the FLS measuring rod and the internal electrode to the measured length, clean the cut surfaces and install the isolator cap.
6. Calibrate the sensor.
7. Clean and degrease the installation surface. Put the sealant of the surface and place the gasket. Put the sealant on the gasket and install the FLS.
8. Screw the FLS to the tank.
9. Connect the cable port.
10. Seal the screws and the port connector.

When necessary to avoid obstacles in the complex shaped tanks, the measuring

rod might be bent. Bending is done using a pipe bender with the bend radius not shorter than 250 mm. Bend angle should be no more than 15° (picture 5).



Picture 5. Bending the measuring rod.

Steps for bending the measuring rod:

1. Disconnect the FLS power supply;
2. Calculate and mark the bend place;
3. Put the measuring rod in the pipe bender according to marked bend location;
4. Connect a circuit tester to the measuring rod and the central electrode;
5. Bend the measuring rod to the necessary angle, making sure to not short circuit the measuring rod and the central electrode;
6. If the measuring rod touched the central electrode, creating a short circuit, decrease the bend angle by bending the measuring rod in the opposite direction.
7. Cut the measuring rod to the appropriate length.
8. Calibrate and install the FLS and proceed with the taring process.

Note: the measuring rod, when bent, loses its symmetry and linearity, which affects the sensor's readings. Bent sensor without an appropriate taring table will give nonlinear errors in different fuel levels. While taring a bent sensor, it is recommended to do more data points (30-50 points per meter) to compensate for non-linearity.

Table 3.

Contact No.	Color	Purpose
1	Red	Positive power supply, Vcc
2	Black	Negative power supply, ground

3	White	Frequency output
4	-	-
5	Yellow	RS485-A
6	Blue	RS485-B

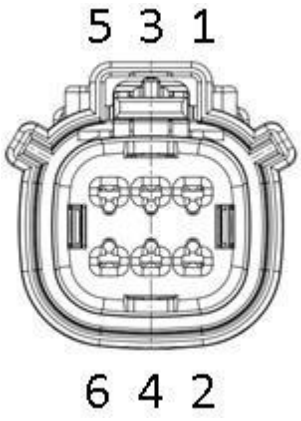


Figure 6. Pin numbers in the connecting cable port.

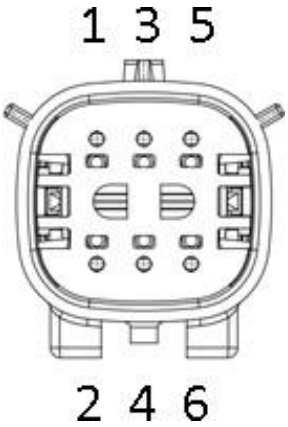


Figure 7. Pin numbers in the FLS port.

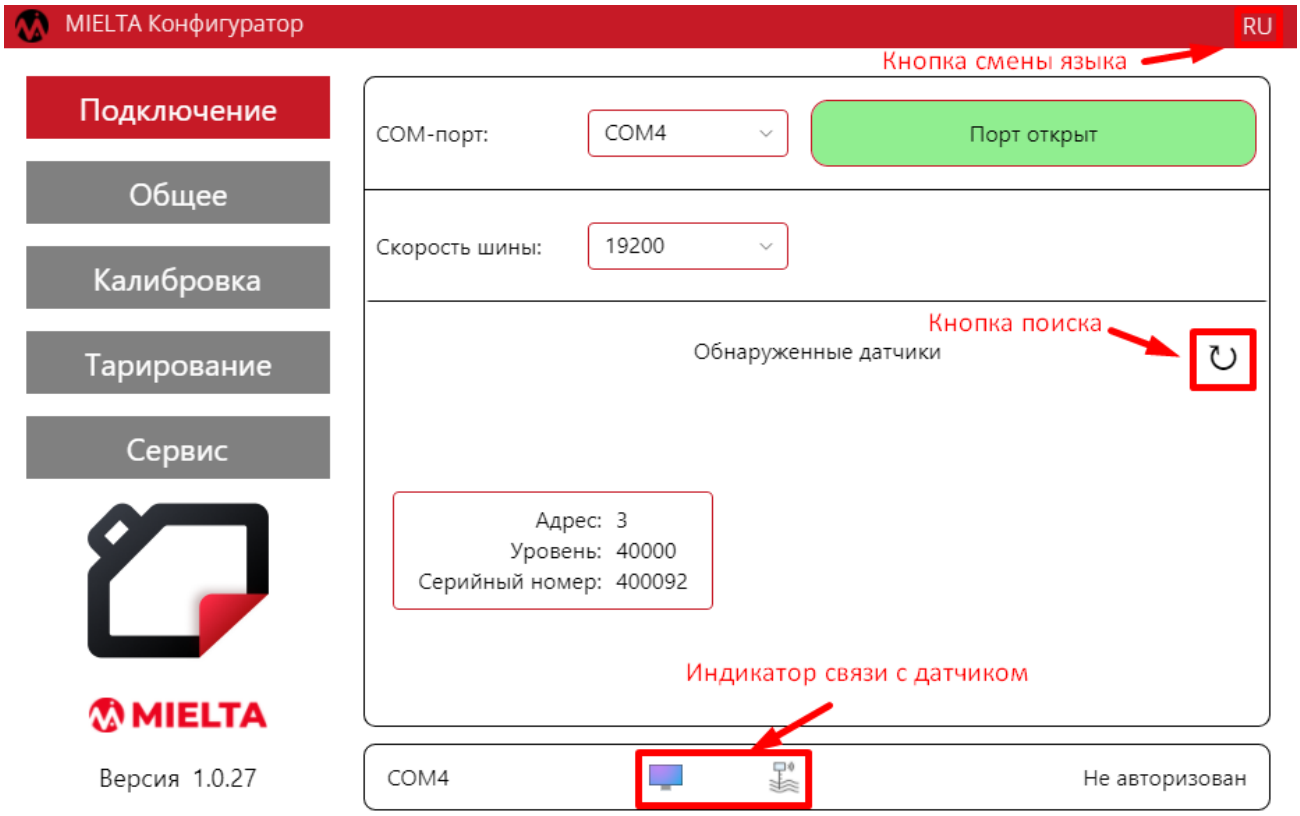
All electric connections should be made with soldering or crimping. The connections should be sealed with a heat shrink.

5. Configuration

5.1. Connection

To configure the sensor, use the MIELTA Configurator program.

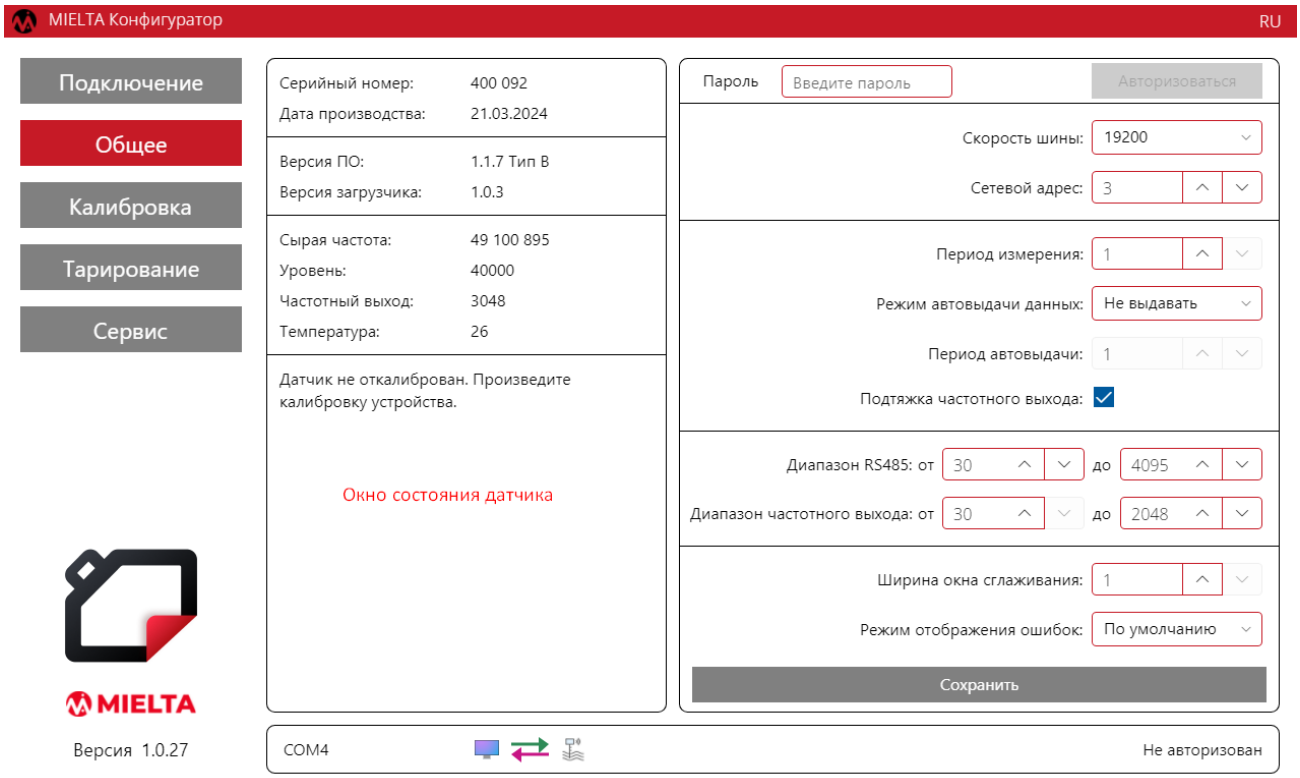
Connect the sensor to the computer using a USB-RS485 converter and supply power to it. When connecting the converter to the computer, a new COM port will appear in the program. After selecting the COM port, a search for sensors on the bus will be performed automatically. The search can also be started manually. After the search is completed, brief information about the found sensors will appear in the list of devices, namely their network addresses, level readings and serial numbers.



When you select one sensor from the list, the program will automatically connect to it and open the general settings window.

5.2. Setting

The General tab shows a list of settings.



To change the settings, you must first log in. To do this, you must enter the authorization password. The default password is 0000. If the password has been changed and forgotten, you must send master password request to the address teh@mielta.ru. The request must include the name of your organization and the serial number of the sensor. The request must have the stamp of your organization and/or the signature of the responsible person.

The configurator program allows you to change the following sensor settings:

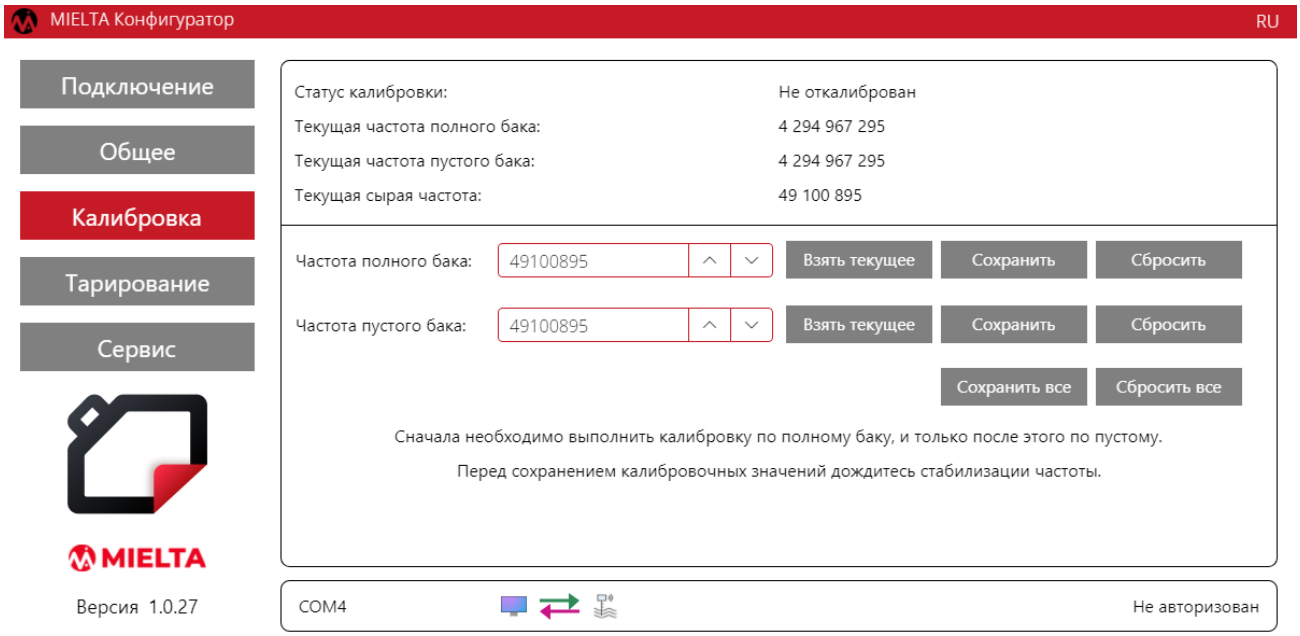
- RS-485 bus speed (9600, 19200, 38400, 57600, 115200);
- Bus address (0..254);
- Fuel level and temperature measurement period;
- Sensor operating mode:

  - Without automatic data output;
  - Automatic output in binary format;
  - Automatic output in character format;
- Automatic output interval (not used in "No autooutput" mode);
- Pull-up (enable/disable pull-up of frequency output);
- RS485 level output range;
- Frequency output range;
- Smoothing window length;
- Error output format.

After setting the required parameters, click the "Save" button.

5.3. Calibration

Before using the sensor, it is necessary to calibrate it using the values "empty tank" and "full tank". These values will correspond to the sensor readings of 0% and 100%, respectively.



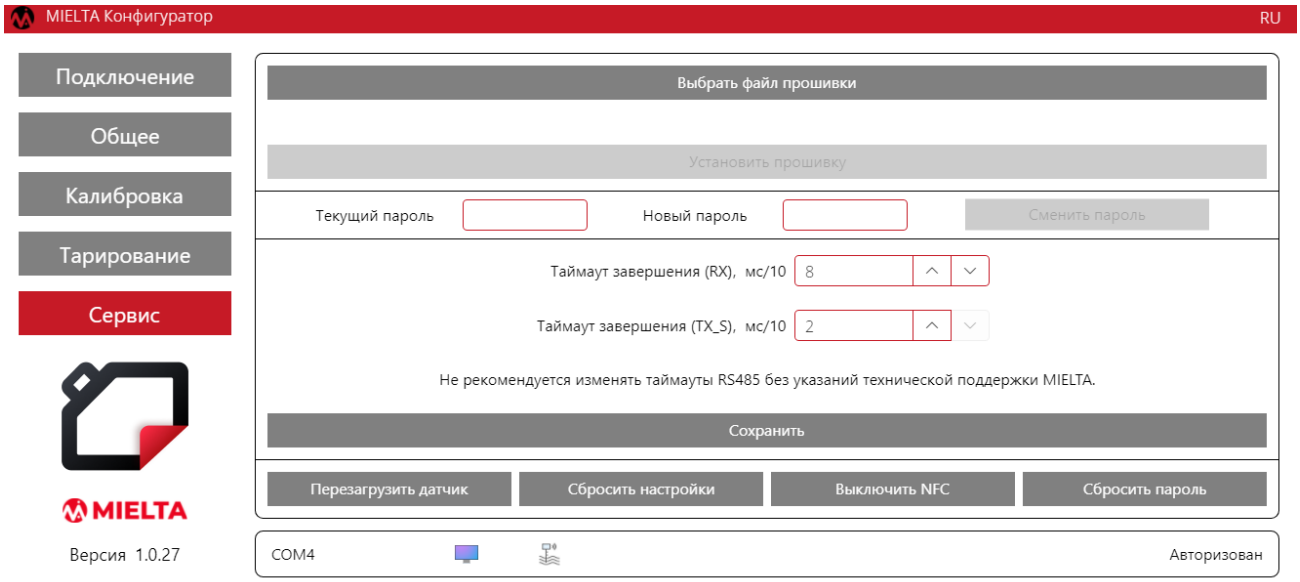
Calibration should be performed as follows:

1. Cut off the measuring rod of the sensor such that there is a gap of 20 mm between the measuring rod's end and the bottom of the tank;
2. Clean the sensor tube from metal shavings and install a plastic end insulator;
3. Connect the fuel level sensor to the configurator program;
4. Lower the fuel level sensor into the fuel container to the maximum depth (up to the mounting flange);
5. After the readings in the program have stabilized, calibrate for "full tank". For that you need to click the "Take current" and "Save" buttons near the calibration field for a full tank;
6. Remove the fuel level sensor from the fuel container and allow the remaining fuel to drain for 5 minutes;

7. After the readings in the program have stabilized, calibrate for "empty tank". For that you need to click the "Take current" and "Save" buttons near the empty tank calibration field.

Calibration should be performed in this sequence. Calibration using the "empty tank" value of a dry sensor (without filling the tube with fuel first) might cause incorrect level readings. Fuel vapors in the tube significantly affect the sensor readings.

5.4. Service settings



The service settings menu contains the following functions:

- Updating the fuel level sensor firmware;
- Change password;
- Setting up configurator timeouts;
- Other commands:
  - Restart sensor;
  - Reset settings;
  - Enabling the NFC module (only relevant for ZOND NFC model sensors);
  - Reset password.

6. Tarring

Tarring of the sensor is the creation of a table for mapping the sensor level readings to the actual volume of fuel in the tank. Tarring is performed for each tank individually and is necessary to obtain readings in liters with a given accuracy and linearity. The more complex the shape of the tank, the more tarring points need to be made. Most often, 20-40 tarring points are sufficient in practice.

Fill the tank with the required amount of fuel and wait for the level to stabilize. The level is considered stable if only the lower 4 digits change. When the level stabilizes, specify the tarring step volume and click the "Add line" button. This algorithm is repeated until the entire tank is calibrated. Then click the "Export table" button. This calibration table must be loaded into the monitoring system to convert sensor readings into fuel volume in liters.

7. Transportation and storage

The fuel level sensor must be stored in a warehouse in a horizontal position at a temperature of -20° C to +50° C and a relative humidity of no more than 85° C. Damage due to water and technical fluids is excluded.

Transported in original packaging, by any type of transport.

8. Warranty obligations

The manufacturer guarantees the operability of the fuel level sensor for 3 years from the date of sale, provided that the consumer complies with the terms and conditions of transportation, storage, installation and operation.

Average service life is 5 years.

The warranty does not cover:

- fuel level sensors with mechanical damage (cracks, chips, dents, traces of impacts, thermal, electrical and chemical influences) that arose due to the fault of the user or third parties as a result of violation of usage, storage or transportation conditions;
- fuel level sensors with traces of repair outside the manufacturer's service center;
- fuel level sensor with traces of electrical and/or other damage that arose as a result of unacceptable changes in the parameters of the external electrical network or signals;
- fuel level sensor that failed due to an incorrect software update.

9. Delivery package contents

Name	Quantity
FLS Mielta KATANA (FLS-3404-12)	1
Mounting cable	1
Installation kit: - Gasket - Self-tapping screw - Self-tapping screw with hole for sealing - Screw seal - Connector seal	 1 2 2 1 1
Technical passport	1
Package wrapper	1