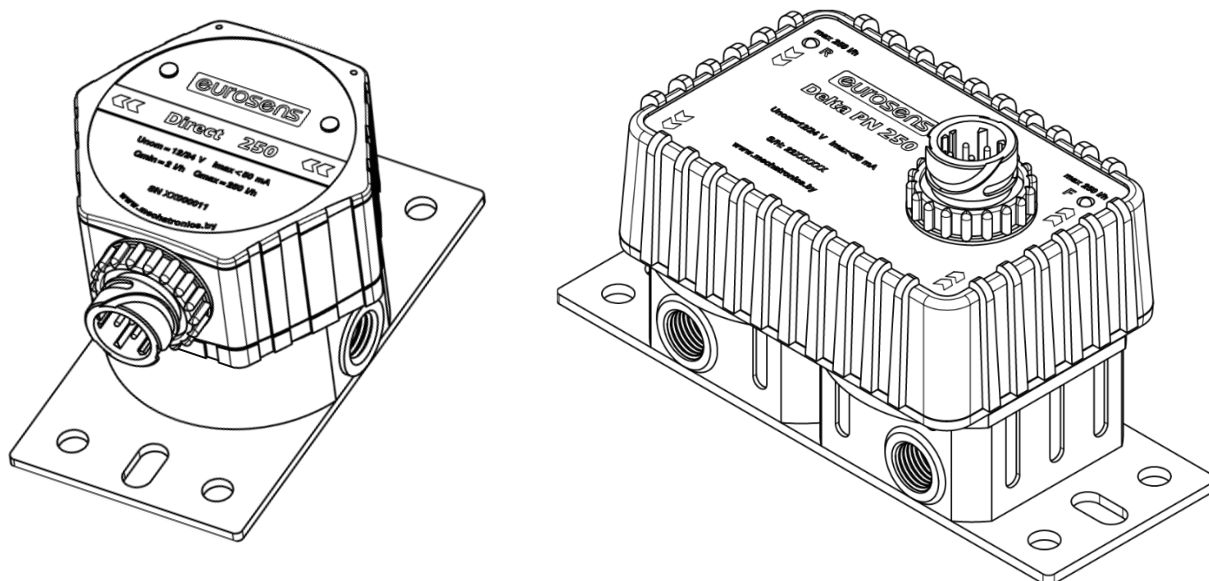


FUEL FLOWMETERS

eurosens Direct

eurosens Delta



User manual

CONTENTS

1	Safety requirements	6
2	Description and operation of flowmeters	7
2.1	Use	7
2.2	Designation	7
2.3	Application	8
2.4	Operating parameters and model selection recommendations	8
2.5	Dimensions	10
2.6	Specification	10
2.7	Packaging	17
2.8	Design and operation of fuel flowmeter	17
2.8.1	Principle of operation	17
2.8.2	Operation modes	18
2.8.3	Displayed parameters for models with LCD	19
2.8.4	Protection against tampering	20
2.8.5	Characteristics of eurosens pulse signal	21
3	Warranty	23
4	Installation recommendations	24
4.1	Visual inspection of fuel flowmeter	24
4.2	Preparation for installation	25
4.3	General installation instructions	27
4.4	Connection diagrams for fuel flowmeters eurosens	29
4.4.1	Diagram of a typical diesel engine fuel system	29
4.4.2	Installation of fuel flowmeter eurosens Direct according to "Pressure side" diagram	30
4.4.3	Installation of fuel flowmeter eurosens Direct according to "Suction side" diagram	31
4.4.4	Installation of flowmeter eurosens Direct on diesel engine according to "Pressure side" diagram	34
4.4.5	Installation of flowmeter eurosens Delta according to "Differential" diagram	37
4.4.6	Installation of flowmeter eurosens Delta on diesel engine according to "Differential" diagram	39
4.5	Deaerator installation	43
4.6	Electrical connection	45
4.7	Connection via serial RS-485 interface	47
4.8	Connection via CAN interface	49
4.9	Electric connection to NMEA 2000	51
5	Flowmeter setup and operation check	53
5.1	Drivers and configurator installation	54
5.2	Setting COM-port number	54
5.3	Connecting to flowmeter	56
5.4	Configurator menu description	57
5.4.1	"Settings" category	58
5.4.2	"Configuration" tab	59
5.4.3	"Settings" tab	64
5.4.4	"Variables" tab	66
5.4.5	"Values" tab	69
5.4.6	"Update/Recovery" tab	71
5.5	Standard flowmeter settings	73

5.5.1	Standard flowmeter settings when connected via pulse output	73
5.5.2	Standard flowmeter settings when connected via RS-485	74
5.5.3	Standard flowmeter settings when connected via CAN J1939	75
5.5.4	Standard flowmeter settings when connected via CAN NMEA 2000	76
5.5.5	Other settings	77
6	Diagnostics	78
6.1	Elementary diagnostics without special equipment	78
6.2	Diagnostics with Configurator	79
7	Firmware update	81
8	Additional information	83
8.1	Storage	83
8.2	Transportation	83
8.3	Disposal	83
8.4	Technical support	84
8.5	Contacts	84
	APPENDIX A. DIMENSIONS	85
	APPENDIX B. ADDRESS SPACE FOR MODBUS PROTOCOL	89
	APPENDIX C. DESCRIPTION OF CAN-MESSAGES (SAE J1939)	94
	APPENDIX D. DESCRIPTION OF LLS-MESSAGES (RS-485 INTERFACE)	98
	APPENDIX E. MOUNTING KIT CONTENTS	99
	APPENDIX F. READING METER DATA BY NAVTELECOM GPS TRACKER USING MODBUS RTU	100
	APPENDIX G. READING METER DATA BY TELTONIKA GPS TRACKER RS485 INTERFACE	104
	APPENDIX F. CONNECTION TO TELTONIKA GPS TRACKER USING CAN BUS INTERFACE	107

This User Manual applies to all modifications of fuel flowmeters eurosens Direct and eurosens Delta developed by JSC Mechatronics (Vileyka, Republic of Belarus).

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

The manufacturer guarantees that fuel flowmeters 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 the flowmeters without any prior notice.

1 SAFETY REQUIREMENTS

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

Installers and maintenance managers must know the structure and operation features of fuel systems. They are recommended to undergo training at the manufacturer's site or in specialized centers to provide high-quality installation and operation of fuel flowmeters.

Electric current and working fluid (fuel) can be hazardous during the installation and operation of fuel flowmeters. Working fluid can be pressurized to 2.5 MPa and have temperature up to 85 °C.

Installation and dismantling of fuel flowmeters must be carried out with no pressure in the pipeline.

2 DESCRIPTION AND OPERATION OF FLOWMETERS

2.1 USE

Fuel flowmeters eurosens are designed to measure the volume of liquid fuel flowing through them. The flowmeters operate in a temperate and cold climate, can be installed on stationary or mobile units for fuel consumption measurement, automatic monitoring and regulation of technological processes in various branches of industry, agriculture and transport.

2.2 DESIGNATION

Table 2.1. Designation of fuel flowmeters eurosens

Type	Interface	Autonomous features	Flow rate	Extra features
Delta	PN	A	250	I / Ext
Delta – 2 measuring chambers	Output interface	Autonomous operation	Max fuel flow rate in each measuring chamber, liters/hour	I – LCD display
Direct – 1 measuring chamber	PN – pulse output	A – autonomous operation is possible	100	No symbol – LCD is not installed
	RS - normalized pulse + RS-485 interface*	No symbol – autonomous operation is not possible	250	
			500	
			1500	
	CAN - normalized pulse + CAN interface		3000	
	No symbol – no interface		5000	

*Flowmeters with RS232 interface can be manufactured by request.

2.3 APPLICATION

Usage of fuel flowmeters eurosens provides:

- current fuel consumption records;
- real-time monitoring and fuel consumption optimization;
- normalizing of fuel consumption quotas;
- fuel theft detection and prevention;
- fuel consumption tests for engines.

2.4 OPERATING PARAMETERS AND MODEL SELECTION RECOMMENDATIONS

Fuel flowmeters eurosens can measure the following types of liquids:

- diesel fuel;
- heating oil;
- motor fuel;
- other types of liquid fuels with kinematic viscosity from 1.5 to 6 mm²/s.



Fuel flowmeters eurosens are factory calibrated with diesel fuel or equivalent. When measuring other liquids, recalibration of the flowmeter on site might be necessary.



It is recommended to make the final decision on the choice of model after inspecting the vehicle/engine/boiler.



Before choosing a model of flowmeter, it is important to decide on the installation diagram of the flowmeter in the fuel line.

If the Eurosens Direct installation scheme involves measuring engine fuel consumption directly, the maximum hourly fuel consumption should not exceed the meter index. For example, for a maximum instantaneous flow rate of 80 l/hour, Eurosens Direct 100 meters would be suitable.



If the maximum hourly fuel consumption is unknown, it can be determined by the approximate formula : $F_{\text{consmax}} = \text{Engine power (hp)} / 4$ for diesel engines without electronic control systems, turbocharger and intercooler, otherwise the motor is more effective and the formula is closer to $F_{\text{consmax}} = \text{Engine power (hp)} / 5$.

Recommendations for model selection of eurosens Delta.

To select the model of eurosens Delta, it is necessary to know the maximum fuel flow in the supply and return lines of the engine. Otherwise use:

- information about recommended models from our telegram [@MXTmeter bot](#);
- information about the maximum consumption of the engine per hour, multiplied by coefficient 4. For example, if the maximum consumption of the engine is 50 liters per hour, the capacity of the fuel supply pump is (50x4=) 200 liters per hour;
- information about the engine power in kW. For example, a 150-kW engine needs installation of eurosens Delta 250, and a 300-500-kW engine needs eurosens Delta 500.



Fuel flowmeter eurosens Delta can work in the Differential mode (factory setting) and in the Adder mode. In the Adder mode, the flow rates through both measuring chambers are added up, and the differential flowmeter works like a single-chamber one, but with doubled flow capacity. For example, the maximum flow rate through Delta 500 in the Adder mode is 1000 liters per hour.



If there are air bubbles in the return fuel line, it is recommended to install eurosens Deaerator.

2.5 DIMENSIONS

The dimensions are specified in [Appendix A](#).

2.6 SPECIFICATION

Table 2.2. General technical specifications

Parameter, measurement unit	Value
Max pressure, MPa	2,5
Nominal pressure, MPa	0,2
Filtering degree of measured liquid, micron, no more than	15
Connection thread	M14x1,5 M16 x 1,5 – for Delta 500 G ¾" – for Direct 1500 G 1" – for Direct 3000, 5000
Flange connection	On demand
Pressure drop at maximum flow rate, nominal pressure on diesel fuel at 20 °C, MPa, no more than	0,015
Power supply, V	10-50
Current consumption, mA (at 12V), no more than	50
Current consumption, mA (at 24V), no more than	25
Ambient operating temperature, °C	-40 ...+85
Relative ambient humidity, % (at 20 °C), no more than	95
Electromagnetic compatibility	UNECE Regulation № 10

Advantages of fuel flowmeters eurosens:

- immunity to external magnetic field due to the use of Hall sensors and algorithms for processing their data in the measuring system;
- flowmeter operation monitoring;
- flowmeter can calculate the derived parameters such as: engine (boiler) operating time, fuel consumption and operating time in different modes,

intervention time, etc. These parameters can be read via the following interfaces: K-line (PN), RS-232, RS-485, CAN;

- flowmeter can be installed without a check valve, as the electronic module determines the direction of the fuel flow and significantly increases the reliability of the fuel supply system;
- a 2-year warranty period due to high quality of chamber materials and mechanical processing.



Index I – a flowmeter has an integrated LCD display.

Index PN – a flowmeter has a pulse output ([fig. 2.1](#)).

eurosens **Direct** is a single-chamber fuel flowmeter for direct measurement of fuel consumption.

Table 2.3. Specifications of fuel flowmeters eurosens Direct PN/PN I.

Model of flowmeter eurosens	Q min, l/h	Q nom, l/h	Q max, l/h	Amount of pulses/l	Measurement error
Direct PN 100	1	50	100	200	±1%
Direct PN 250	2	125	250	100	±1%
Direct PN 500	5	250	500	50	±1%
Direct PN 100 I	1	50	100	200	±1%
Direct PN 250 I	2	125	250	100	±1%
Direct PN 500 I	5	250	500	50	±1%

- Flowmeter eurosens Direct **I** displays local information, does not have a pulse output and requires an external power supply.
- Flowmeter eurosens Direct **A** is powered with a built-in battery which provides its autonomous operation for 3 years.
- Flowmeter eurosens Direct **A I** is equipped with reed switches instead of Hall sensors, which is due to considerations of minimal power consumption.
- Flowmeter eurosens Direct **PN A I** can be powered both from an external power supply and with a built-in battery. It has a pulse output and a display.



eurosens Direct PN 250



eurosens Direct PN 250 I

fig. 2.1 .Fuel flowmeters eurosens Direct PN

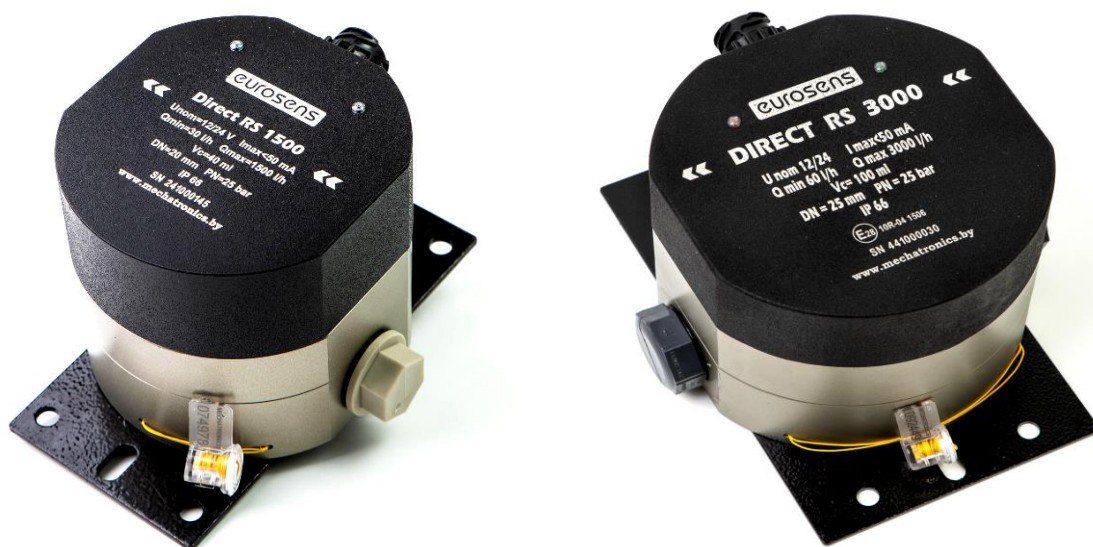
Table 2.4. Specifications of fuel flowmeters eurosens Direct I/PN A I.

Model of flowmeter eurosens	Q min, l/h	Q nom, l/h	Q max, l/h	Amount of pulses/l	Measurement error
Direct 100 I	1	50	100	-	±1%
Direct 250 I	2	125	250	-	±1%
Direct 500 I	5	250	500	-	±1%
Direct PN A 100 I	1	50	100	200	±1%
Direct PN A 250 I	2	125	250	100	±1%
Direct PN A 500 I	5	250	500	50	±1%

Fuel flowmeters with digital indices 1500 and 3000 are high-performance meters with flow rates up to 1500 and 3000 liters per hour respectively ([fig. 2.2](#)).

Table 2.5. Specifications of fuel flowmeters eurosens Direct 1500/3000.

Model of flowmeter eurosens	Q min, l/h	Q nom, l/h	Q max, l/h	Amount of pulses/l	Measurement error
Direct PN 1500	30	750	1500	25	±1%
Direct PN 1500 I	30	750	1500	25	±1%
Direct PN 3000	60	1500	3000	10	±1%
Direct PN 3000 I	60	1500	3000	10	±1%
Direct PN 5000	250	2500	5000	10	±1%
Direct PN 5000 I	250	2500	5000	10	±1%



eurosens Direct RS 1500

eurosens Direct RS 3000

fig. 2.2. Fuel flowmeters eurosens Direct RS

eurosens Delta is a **dual-chamber fuel flowmeter for differential measurement of fuel consumption**.

Differential flowmeter eurosens Delta is used to measure the fuel consumption of engines with supply and return fuel lines without changing the fuel supply diagram. It calculates the fuel consumption of the engine as the difference between the fuel consumption in the supply and return lines.

eurosens Delta has the following unique features:

- a temperature sensor is installed in both measuring chambers to automatically compensate for fuel extension under temperature in both chambers and temperature difference in the supply and return lines;
- possibility of summing fuel flows in both chambers.

Table 2.6. Specifications of fuel flowmeters Delta PN/ PN I/ PN A I.

Model of flowmeter eurosens	Q min, l/h	Q nom, l/h	Q max, l/h	Amount of pulses/l	Measurement error
Delta PN 100	10	50	100	200	±1%
Delta PN 250	50	125	250	100	±1%
Delta PN 500	90	250	500	50	±1%
Delta PN 100 I	10	50	100	200	±1%
Delta PN 250 I	50	125	250	100	±1%
Delta PN 500 I	90	250	500	50	±1%
Delta PN A 100 I	10	50	100	200	±1%
Delta PN A 250 I	50	125	250	100	±1%
Delta PN A 500 I	90	250	500	50	±1%

Fuel flowmeters eurosens Delta can have RS-232/RS-485 series interfaces, as well as CAN interface. Data operation is carried out via eurosens Delta or MODBUS RTU protocols.

The MODBUS protocol table is given in [Appendix B](#).

CAN interface is based on SAE J1939 or NMEA 2000 specification. The list of CAN messages is given in [Appendix C](#).

Flowmeters with serial RS-232/RS-485 interfaces have the “RS” index. The “CAN” index denotes CAN interface. Other specifications of flowmeters are identical to those of the “PN” model ([Table 2.6](#)). Besides, the flowmeters of “RS” and “CAN” models have a pulse output, i.e. they include the functionality of the “PN” model ([Table 2.7](#) and [Table 2.8](#)).

Table 2.7. Specifications of fuel flowmeters eurosens Direct RS/CAN.

Model of flowmeter eurosens	Q min, l/h	Q nom, l/h	Q max, l/h	Amount of pulses/l	Measurement error
Direct RS 100	1	50	100	200	±1%
Direct RS 250	2	125	250	100	±1%
Direct RS 500	5	250	500	50	±1%
Direct CAN 100	1	50	100	200	±1%
Direct CAN 250	2	125	250	100	±1%
Direct CAN 500	5	250	500	50	±1%
Direct RS 100 I	1	50	100	200	±1%
Direct RS 250 I	2	125	250	100	±1%
Direct RS 500 I	5	250	500	50	±1%
Direct CAN 100 I	1	50	100	200	±1%
Direct CAN 250 I	2	125	250	100	±1%
Direct CAN 500 I	5	250	500	50	±1%
Direct RS 1500	30	750	1500	25	±1%
Direct RS 1500 I	30	750	1500	25	±1%
Direct CAN 1500	30	750	1500	25	±1%
Direct CAN 1500 I	30	750	1500	25	±1%
Direct RS 3000	60	1500	3000	10	±1%
Direct RS 3000 I	60	1500	3000	10	±1%
Direct CAN 3000	60	1500	3000	10	±1%
Direct CAN 3000 I	60	1500	3000	10	±1%
Direct RS 5000	250	2500	5000	10	±1%
Direct RS 5000 I	250	2500	5000	10	±1%
Direct CAN 5000	250	2500	5000	10	±1%
Direct CAN 5000 I	250	2500	5000	10	±1%

Table 2.8. Specifications of fuel flowmeters eurosens Delta RS/CAN.

Model of flowmeter eurosens	Q min, l/h	Q nom, l/h	Q max, l/h	Amount of pulses/l	Measurement error
Delta RS 100	10	50	100	200	±1%
Delta RS 250	50	125	250	100	±1%
Delta RS 500	90	250	500	50	±1%
Delta RS 100 I	10	50	100	200	±1%
Delta RS 250 I	50	125	250	100	±1%
Delta RS 500 I	90	250	500	50	±1%
Delta CAN 100	10	50	100	200	±1%
Delta CAN 250	50	125	250	100	±1%
Delta CAN 500	90	250	500	50	±1%
Delta CAN 100 I	10	50	100	200	±1%
Delta CAN 250 I	50	125	250	100	±1%
Delta CAN 500 I	90	250	500	50	±1%

2.7 PACKAGING

Table 2.9. Packaging of fuel flowmeter eurosens

No	Item	Q-ty
1.	Fuel flowmeter eurosens	1
2.	Specification	1
3.	Cable*	1
4.	Magnetic key to switch display screens (for models with LCD display)	1

* Can be supplied separately.

2.8 DESIGN AND OPERATION OF FUEL FLOWMETER

2.8.1 PRINCIPLE OF OPERATION

The fuel volume is measured with the help of the ring-shaped piston that moves in the measuring chamber. Under the pressure of the liquid entering the measuring chamber through the inlet fitting, the ring moves along the inner surface of the chamber and simultaneously slides along the jumper link. The ring forces the liquid out of the chamber through the chamber outlet into the outlet fitting ([fig. 2.3](#)).

One rotation of the ring displaces the volume of liquid equal to the volume of the chamber. As the ring turns over, electronic position sensors generate signals, which are processed by the microprocessor unit of the flowmeter. The result of measurements with a running total is available via the corresponding external interface. It is also stored in the flowmeter memory and can be displayed on the built-in screen.

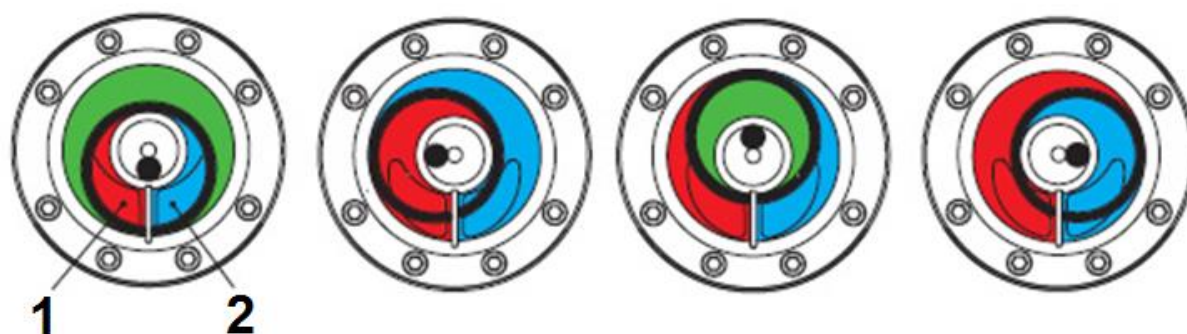


fig. 2.3. Operation diagram of eurosens measuring chamber,

where 1 – chamber inlet, 2 – chamber outlet, ■ - liquid entering the measuring chamber,
■ - liquid in the process of measurement, ■ - liquid leaving the measuring chamber

2.8.2 OPERATION MODES

The current mode of operation is determined by the flowmeter according to the criteria specified in [Table 2.10](#). Operation mode boundaries can be adjusted for each engine via configuration software. For differential flowmeters eurosens Delta the operation mode is determined by the difference in fuel consumption between the supply and return lines (“Differential consumption”).

Table 2.10. Operation modes criteria.

Flowmeter modification, max flow rate, l/h	Flow rate, l/h				Interference
	Normal flow rate $Q_0 < Q \leq Q_{max}$			Tampering	Impact of constant magnetic field for more than 10 seconds
	Idle	Normal operation	Overload		
100	< 2	2-70	70-100	> 100	Attempts are fixed
250	< 5	5-200	200-250	> 250	
500	< 10	10-400	400-500	> 500	

2.8.3 DISPLAYED PARAMETERS FOR MODELS WITH LCD

Table 2.12. Displayed parameters.

Direct I*		Delta I*	
Nº	Displayed parameter	Nº	Displayed parameter
1	Total volume of fuel consumed, l	1	Total volume of fuel consumed, l
2	Idling volume, l	2	Idling volume, l
3	Volume of nominal mode, l	3	Volume of nominal mode, l
4	Overload volume, l	4	Overload volume, l
5	Cheat volume, l	5	Cheat volume, l
6	Negative volume, l	6	Negative volume, l
7	Total engine operating time, hour**	7	Total engine operating time, hour**
8	Intervention time, hour***	8	Intervention time, hour***
9	Flow rate, l/h	9	Consumption flow rate, l/h
10	Chamber temperature, °C	10	Total volume in supply chamber, l
11	Battery charge, %	11	Cheat volume in supply chamber, l
12	Firmware Version	12	Flow rate in supply chamber, l/h
		13	Temperature in supply chamber, °C
		14	Total volume in return chamber, l
		15	Cheat volume in return chamber, l
		16	Flow rate in return chamber, l / h
		17	Temperature in return chamber, °C
		18	Battery charge, %
		19	Firmware Version

* The given parameters (and a number of additional ones) are displayed by all flowmeter models. Service adapter (programming device) eurosens Destination and a PC are necessary.

** For all models except autonomous ones.

*** For autonomous models only.

A magnetic key switches the screens ([fig. 2.4](#)).



fig. 2.4. Magnetic key

2.8.4 PROTECTION AGAINST TAMPERING

In order to avoid flowmeter blocking, damage or false reading, the following means of protection are used:

- 1) **The mode "Cheat"** protects against a sudden excessive increase in fuel consumption caused by air purging. When the electronic circuit board of the flowmeter detects excessive fuel consumption, the flowmeter starts recording the volume of the fuel which is flowing through it at an increased speed.

Exit from the mode "Cheat" occurs automatically after normalization of flowmeter operating conditions.

- 2) **The mode "Intervention"** detects the intentional impact of an external magnetic field on the flowmeter aimed to suspend the metering or falsify the readings of consumed fuel. During magnetic exposure the flowmeter operates in a standard mode, detects an intervention attempt, and records the exposure time in the counter "Intervention time".

Exit from the mode "Intervention" occurs automatically after the intervention attempt is over.

- 3) **Sealing of connections:** the mounting accessories for flowmeters (fuel connectors, couplings, etc.) supplied by JSC Mechatronics have **holes for sealing**, which make it possible to determine the facts of unauthorized intervention into the operation of fuel system after the flowmeter is installed.

2.8.5 CHARACTERISTICS OF eurosens PULSE SIGNAL

Fuel flowmeters with **normalized pulse** (models **PN, RS, CAN**) have an output pulse signal shown in [fig. 2.5](#).

For each flowmeter, the number of pulses (generated by 1 liter of fuel flowed through the measuring chamber) is indicated in Tables 2.4 - 2.9.

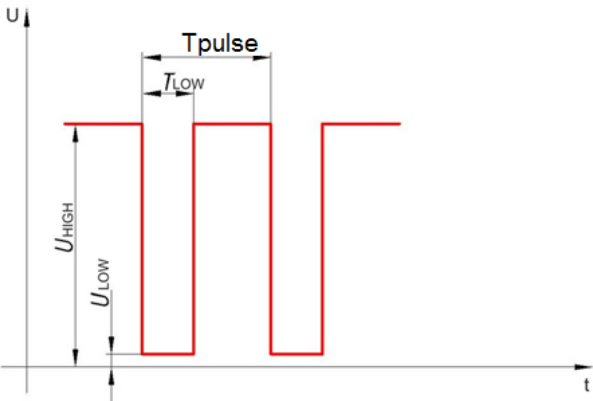


fig. 2.5. Output normalized signal of flowmeter

Table 2.13. Averaged characteristics of output normalized signal of flowmeters.

Model of flowmeter eurosens	U _{high} , V	U _{low} , V
Direct PN (A) 100, 250, 500, 1500, 3000	0.7(U _{bat} – 0.4)*	1.4 V
Delta PN (A) 100, 250, 500	0.8(U _{bat} – 0.8)*	0.7 V

* When the output pull-up to the power circuit (U_{bat})) is enabled for Direct PN/Delta PN.

Table 2.14. Characteristics of output normalized signal of flowmeters.

Model of flowmeter eurosens	$T_{\text{pulse max,}}$	$T_{\text{pulse min,}}$	$T_{\text{low max}}$ (0,5 T_{pulse}),	$T_{\text{low min}}$ (0,5 T_{pulse})
Direct PN (A) 100	18000	180	500	90
Direct PN (A) 250	7200	144	500	72
Direct PN (A) 500	7200	144	500	72
Direct PN (A) 1500	4800	96	500	48
Direct PN (A) 3000	6000	120	500	60
Delta PN (A) 100	18000	180	500	90
Delta PN (A) 250	36000	144	500	72
Delta PN (A) 500	72000	144	500	72

The information on the compatibility of particular models of GPS-trackers and eurosens fuel flowmeters, as well as recommendations for their installation and configuration, can be found on the website https://mechatronics.by/en/portfolio-items/eurosens_compatibility/

3 WARRANTY

- 1) The manufacturer guarantees that fuel flowmeters 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.
- 3) In case other enterprises supply flowmeters as components to other businesses, the warranty periods of storage and operation must be specified in the supply agreement between these enterprises/businesses.
- 4) This warranty does not cover:
 - mechanical, chemical, thermal, electrical and other damages to the flowmeter;
 - absence of warranty seals and labels;
 - malfunctioning of the flowmeter due to storage, installation and use not in conformance with instructions in this manual;
 - malfunctioning of the flowmeter due to its installation on a defective vehicle (or other fuel consumer), or its operation on a defective vehicle, which led to the flowmeter malfunctioning;
 - unpacking, repairing or enhancement of flowmeters by unauthorized persons;
 - operation of flowmeters in conditions that do not conform to their technical specifications.

4 INSTALLATION RECOMMENDATIONS

This section gives general recommendations on the installation of fuel flowmeters eurosens.

4.1 VISUAL INSPECTION OF FUEL FLOWMETER

Before installing the flowmeter, it is necessary to perform its visual inspection to detect the possible defects that might occur during transportation, storage or careless handling:

- visible damage to the case, fittings, mounting plate, display, interface cable and/or connectors;
- backlash of constituent parts or gaps between them.

Prior to installation it is recommended to check the connection of fuel flowmeter to power supply:

- supply a minimum flow of fuel or air (10-40 l/h, $\leq 0,3$ atm) to the flowmeter;
- check if the signal LEDs on the flowmeter case blink during fuel/air supply.

Contact the supplier if any defects are detected.

4.2 PREPARATION FOR INSTALLATION

Before installing the flowmeter, thoroughly inspect the vehicle and to make sure that the installation is possible.

Table 4.1. Preparation for installation.

No	Action	Normal state	Recommendations in case of mismatch condition
1.	Inspect all fuel lines for damage or fuel leakage.	No leakage.	Customer eliminates leakage.
2.	Check engine operation for 5-10 minutes at idle.	The engine runs evenly and does not stall. No air in the fuel system.	Customer eliminates malfunctions.
3.	Check engine operation for 5-10 minutes under load or when vehicle is moving.	The engine runs evenly and does not stall.	Customer eliminates malfunctions.
4.	Check the onboard voltage with voltmeter.	A 12-V onboard power system has operating voltage of 10-18 V. A 24-V onboard power system must have operating voltage of 18-32 V.	Customer eliminates malfunctions.
5.	During the installation of flowmeter eurosens Delta check the presence of gases in the return line.	No foam or air bubbles in fuel.	Deaerator installation or elimination of malfunctions required.
6.	Check the amount of excess fuel removed through the return line from injectors.	The measurement error increases with a significant amount of excess fuel, since excess fuel flows back into the tank and is re-counted by flowmeter.	Change the connection of the return line from injectors so that the measurement is correct.
7.	Check the pressure in fuel system with manometer.	Hydraulic resistance of the chosen flowmeter in the Nominal mode does not reduce the pressure by more than 5%.	Compare the values of pressure in fuel system before and after flowmeter installation.

No	Action	Normal state	Recommendations in case of mismatch condition
8.	Check the “ground” of the vehicle.	The resistance between connection point and clamp “-” of a battery terminal does not exceed 1 Ohm.	Customer eliminates malfunctions

The Protocol of vehicle inspection should be filled in and signed based on the results of the inspection.

The customer should eliminate any malfunctions indicated in the Protocol before flowmeter installation.



The values of maximum and minimum fuel consumption in the supply and return lines can be indicated in technical specification of the pump installed in the vehicle, or gotten by measuring the volume of fuel flowing from the return line into a measuring container.



It is not recommended to install a differential flowmeter if there are air bubbles in the supply or return fuel lines. In this case the installation of deaerator is required.

4.3 GENERAL INSTALLATION INSTRUCTIONS



This chapter presents special cases of the engine operation diagram. It is recommended to carefully study the technical documentation of a vehicle before installing a fuel flowmeter on it.

To install a fuel flowmeter you will need:

- a fuel flowmeter;
- service adapter eurosens Destination (02 Lite, 02 or CAN);
- PC;
- mounting kit (to be purchased separately);
- hand tools (sets of box wrenches, socket heads, and screwdrivers);
- two fuel filters with attached washed hoses and clamping clamps to protect the chambers from contamination during the initial installation of flowmeters (can be purchased from JSC Mechatronics);
- flowmeter chamber with transparent cover (optional) to determine the presence of gases in the measured fuel.

The flowmeter can be mounted vertically, horizontally or at an angle.

It is recommended to mount the flowmeter horizontally for the best operation. If the fuel flow direction (shown by an arrow icon on the flowmeter case) is not horizontal, the output of the flowmeter must be located higher than its inlet. Avoid damaging the cable and fuel lines.

The flowmeter must be attached to the surface at three points at least.



It is prohibited to drill the base frame of a vehicle when installing a flowmeter. Use spot welding if it is not possible to secure a mounting plate with screws.



The installed flowmeter must not be exposed to direct water jets from a high-pressure cleaner.

Follow the rules below:

- 1) When installing a flowmeter on any equipment, attach additional plastic fuel filters (or metal ones if there is high pressure in the system) directly in front of each chamber, and perform the initial start. Additional fuel filters will help avoid the ingress of dirt, particles of rubber, cord, and metal resulting from cutting the fuel lines and tightening the threads. Additional filters can be dismantled after half an hour of system operation.
- 2) If the fuel system is highly contaminated:
 - perform maintenance of the vehicle and replace regular filters;
 - install additional filters, if there are no regular ones.
- 3) When connecting the fuel lines, make sure that flanges and threaded connections are clean.
- 4) Use only new sealing washers from the mounting kit.
- 5) Fuel lines of a vehicle must be protected from external destructive influence.
- 6) Do not reduce the internal cross-sections of fuel lines at bends.
- 7) Fuel lines must be fastened to a vehicle with ties every 0.3 m.
- 8) Fuel lines should have a small margin in length to compensate for temperature changes.
- 9) Do not install the flowmeter on vehicle elements that are subject to strong vibration and heat.
- 10) Connect rubber fuel lines to the elements of the fuel system using pivot brackets or flow-through fittings and secure them with hose clamps or hose crimps (recommended).
- 11) Exclude the air from the fuel system after the flowmeter is installed.
- 12) Seal all the detachable and threaded connections of the fuel line situated in the sections “engine – flowmeter”, “flowmeter – engine” including a standard relief valve.



Do not use fuel flowmeter with a maximum flow rate lower than that actually available on the equipped vehicle or diesel generator.



It is not recommended to use internal or external filters with petrol gauze (cell area is less than 0.6 microns) in the connection diagram. There could be failures in work of fuel system at subzero temperatures.

4.4 CONNECTION DIAGRAMS FOR FUEL FLOWMETERS eurosens

4.4.1 DIAGRAM OF A TYPICAL DIESEL ENGINE FUEL SYSTEM

The most common diagram of a diesel engine fuel system is shown in [fig. 4.1](#).

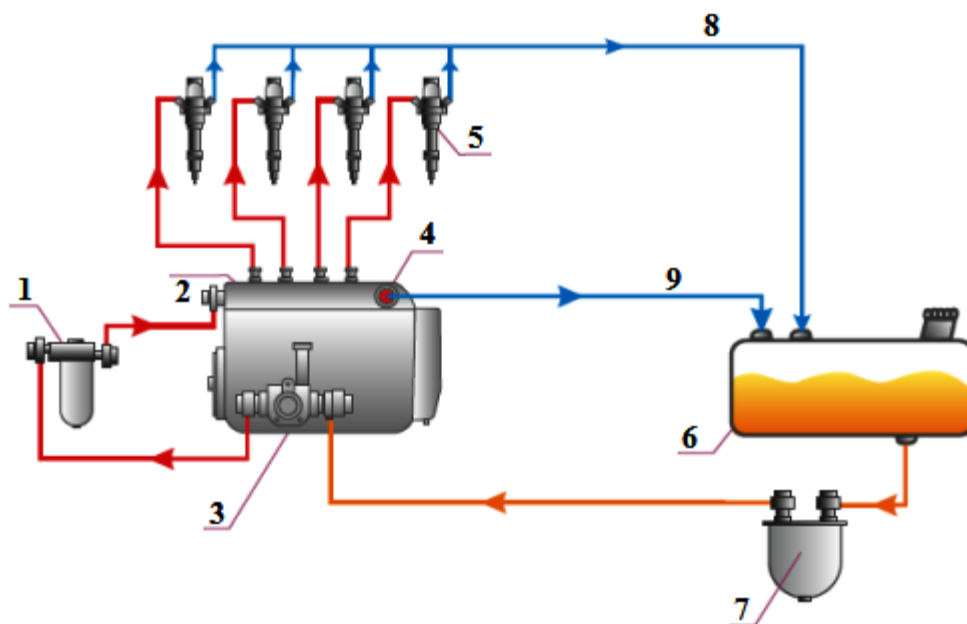


fig. 4.1. Standard fuel system,

where 1 – fine filter, 2 – high-pressure fuel pump (HPFP), 3 – low-pressure fuel pump (LPFP), 4 – relief valve, 5 – injectors, 6 – fuel tank, 7 – preliminary filter, 8 – return line from injectors, 9 – return line from HPFP

The LPFP delivers a significantly larger amount of fuel to the HPFP inlet than can be consumed in any mode of engine operation. Excess fuel from the HPFP and injectors of the engine is discharged back into the tank through a relief valve.

4.4.2 INSTALLATION OF FUEL FLOWMETER eurosens DIRECT ACCORDING TO “PRESSURE SIDE” DIAGRAM

Installation of flowmeter eurosens Direct according to "Pressure side" diagram shows its installation between the fine fuel filter and the HPFP inlet, where fuel flows under pressure ([fig. 4.2](#)).

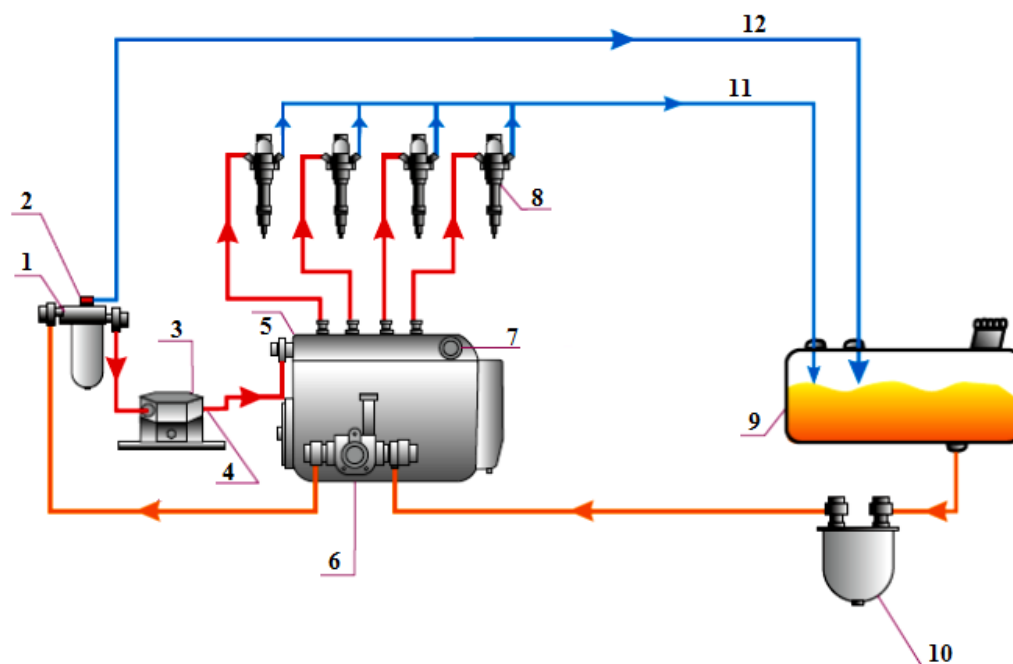


fig. 4.2. "Pressure side" installation diagram of flowmeter eurosens Direct,

where 1 – fine filter, 2 – relief valve, 3 – flowmeter Direct, 4 – check valve (optional), 5 – HPFP, 6 – LPFP, 7 – plug, 8 – injectors, 9 – fuel tank, 10 – preliminary filter, 11 – return line from injectors, 12 – return line from fine filter

It is necessary to modify the return line from injectors so that fuel circulates in a reduced circle, i.e. to shift the return line from the HPFP outlet to the fine filter inlet, and plug the HPFP outlet with a stopper.

It is necessary to install a relief valve at the fine filter inlet for correct operation of the modified fuel system. That will maintain the required constant pressure of 1-1.5 atm on the section "fine filter – HPFP inlet". As a rule, a standard valve installed on the engine is used. If it doesn't create enough pressure for the engine to operate, you can use a calibrated relief valve for the pressure of 1-1.5 atm from JSC Mechatronics.

The excess fuel from low pressure fuel pump (LPFP) will return to the tank from the inlet of fine filter. And only the amount of fuel that is consumed by the engine flows through eurosens Direct.

Advantages of "Pressure side" diagram:

- eurosens Direct is installed after standard fine filter;
- fuel flows through the flowmeter under pressure, which ensures the filling of the HPFP;
- return flow heats fuel in the tank.

Disadvantages of "Pressure side" diagram:

- cooling of the HPFP slightly decreases and the fuel temperature increases;
- return line temperature is slightly lower than in the standard fuel system diagram.

4.4.3 INSTALLATION OF FUEL FLOWMETER eurosens DIRECT ACCORDING TO "SUCTION SIDE" DIAGRAM

"Suction side" diagram describes installation of the flowmeter in the area of the fuel system, where fuel flow is forced by the suction created by LPFP.



Installation of flowmeters eurosens according to "Suction side" diagram requires an additional fine filter in the fuel line section from the tank to the flowmeter (see ind. 8 at [fig. 4.3](#)).

Install fuel flowmeter eurosens according to "Suction side" diagram in the engine fuel system with LPFP ([fig. 4.3](#)) in the fuel line section between preliminary filter and LPFP inlet.

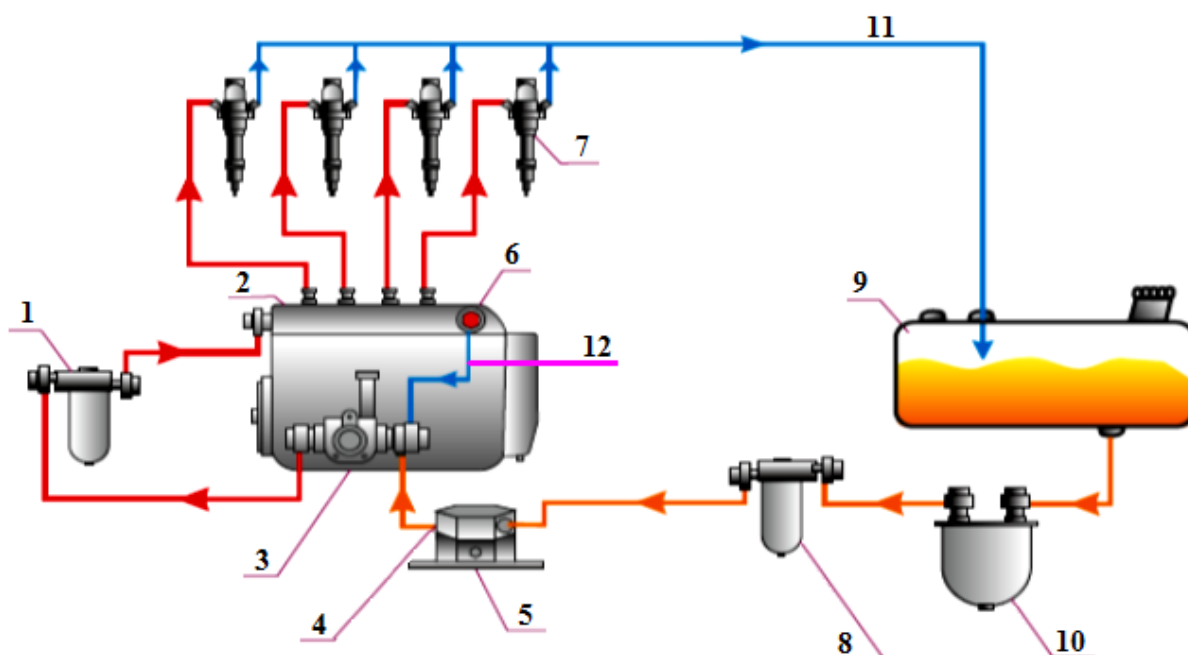


fig. 4.3. "Suction side" installation diagram of flowmeter eurosens Direct,
 where 1 – fine filter, 2 – HPFP, 3 – LPFP, 4 – check valve (optional), 5 – flowmeter Direct, 6 –
 relief valve, 7 – injectors, 8 – additional fine filter, 9 – fuel tank, 10 – preliminary filter, 11 –
 return line from injectors, 12 – return line from HPFP

- On condition that injectors work properly, their return flow is no more than 0.1% of the engine's fuel consumption, therefore this value can be ignored.
- Reconfigure the fuel return line if you don't need to measure the amount of fuel returned to the tank.
- For this very case, change the return line from HPFP so that the fuel circulates in small circles without returning to the fuel tank – connect the return line to LPFP inlet.

Thus, the two fuel lines are connected to LPFP inlet:

1. supply line from the tank, passing through the flow sensor;
2. return line from HPFP.

After the fuel system is modified according to "Suction side" diagram, all excess fuel injected by the LPFP is discharged from the HPFP outlet to the LPFP inlet. Thus, only the amount of fuel that is consumed by the engine flows through eurosens Direct.



The discharge of excess fuel to the tank through the return fuel line heats the fuel in the tank. Therefore, don't use "Suction side" installation diagram when operating vehicles at low temperatures. Install a fuel heater or a differential fuel flowmeter eurosens Delta instead.

Advantages of "Suction side" diagram:

- simple installation;
- applicable to the majority of engines.

Disadvantages of "Suction side" diagram:

- as a rule, an additional fuel filter is necessary;
- clogging of the flowmeter can lead to a loss of engine power, since fuel intake due to the created suction is difficult;
- installation of a fuel heater might be necessary since the fuel in the tank is not heated up by the fuel from return line.

4.4.4 INSTALLATION OF FLOWMETER eurosens DIRECT ON DIESEL ENGINE ACCORDING TO “PRESSURE SIDE” DIAGRAM

The original fuel system is shown in [fig. 4.4](#) and [fig. 4.5](#).

The fuel from the tank **1** is sucked in by LPFP **5** through the supply line **2** and goes under pressure to the fine filter **6**. The purified fuel is delivered to the HPFP inlet **7**. The excess fuel from HPFP returns to the tank **1** through the return line **3** with the help of a relief valve **8**, which maintains the required pressure in the fuel supply system.

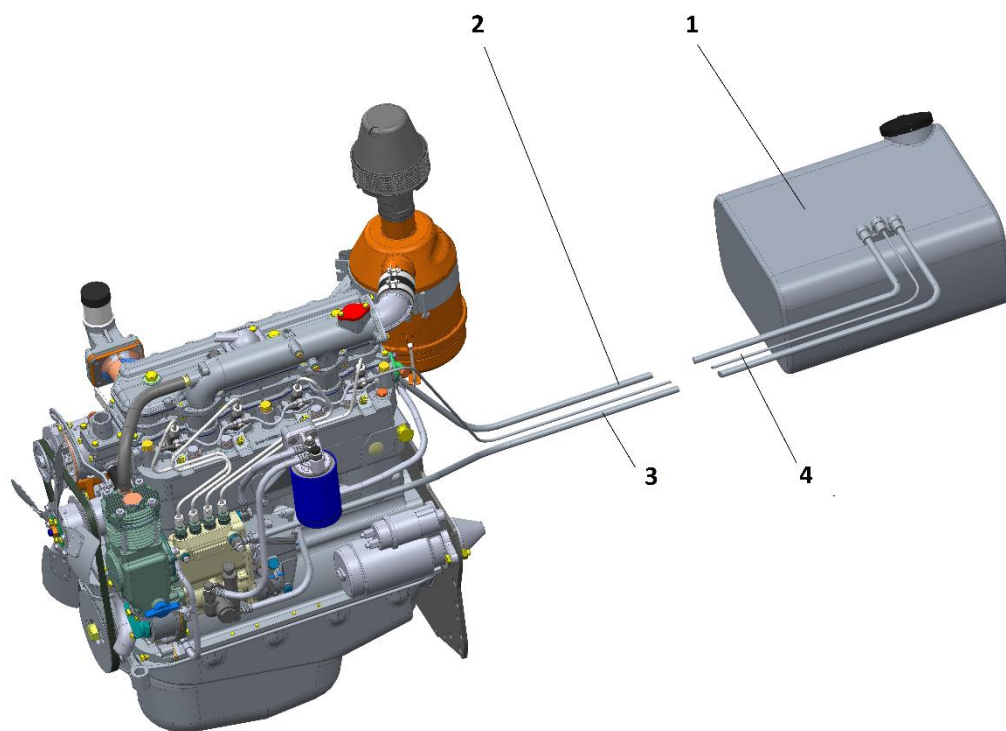


fig. 4.4. Original fuel system,
where 1 – fuel tank, 2 – supply line, 3 – return line, 4 – return line from injectors

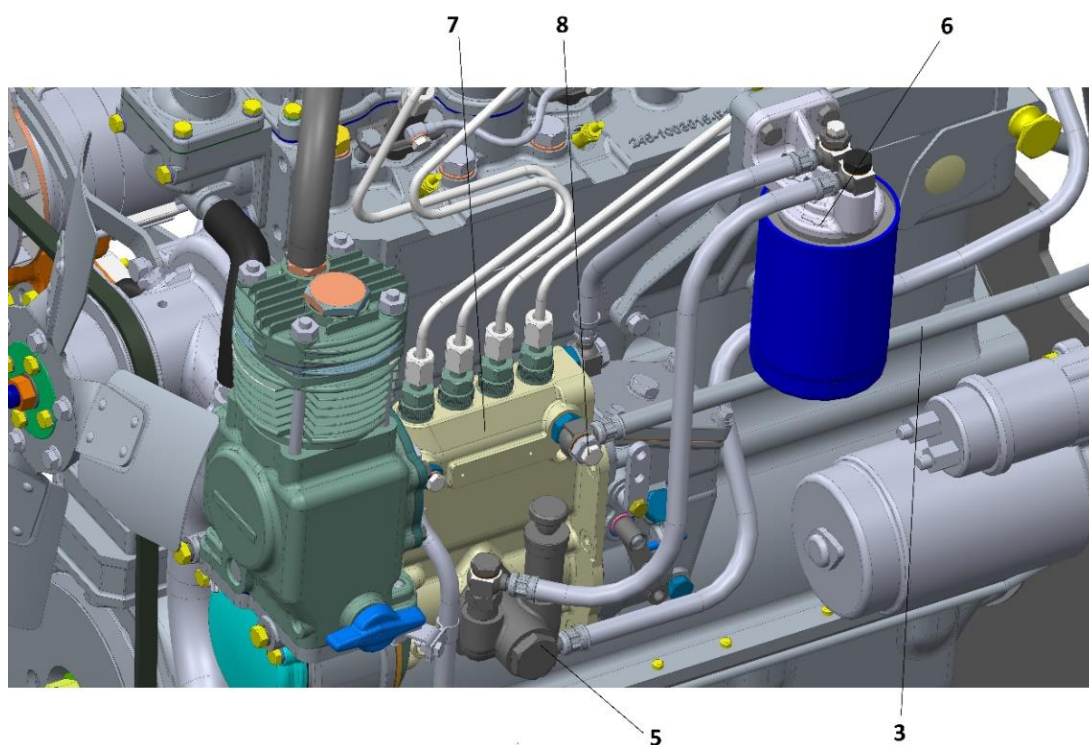


fig. 4.5. Original fuel supply system,
where 3 – return line, 5 – LPFP, 6 – fine filter, 7 – HPFP, 8 – relief valve

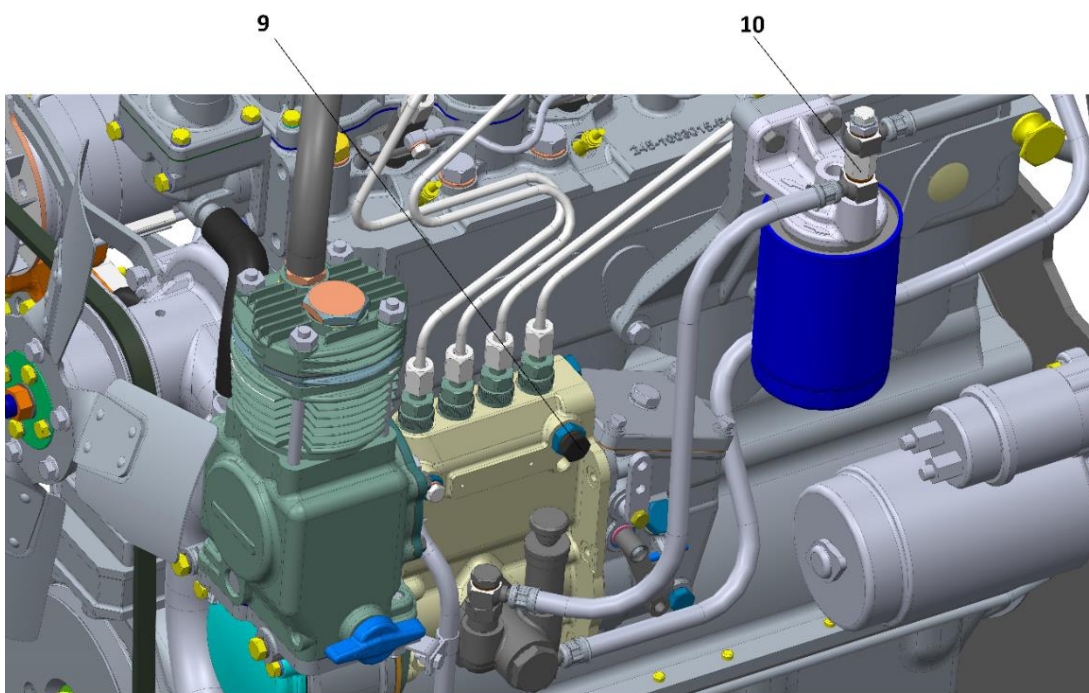


fig. 4.6. Moving the return line,
where 9 – threaded stopper, 10 – adapter fitting M14x M14.

- 1) Disconnect the fuel line between the fine fuel filter and the HPFP.
- 2) Remove the relief valve **8** from the HPFP. Install a threaded stopper **9** instead of the relief valve.
- 3) Using the adapter fitting **10** connect the previously removed relief valve to the fuel line inlet into the fine filter ([fig. 4.6](#)).
- 4) Connect the outlet of fine filter to the flowmeter inlet **11**.
- 5) Connect the flowmeter outlet to the HPFP inlet ([fig. 4.7](#)). Arrow marks on flowmeter case indicate the direction of fuel flow.



If the fuel system operates properly, the return line from injectors **4** does not contain a significant amount of fuel and can be ignored. However, it is recommended to check the flow rate in it.

If fuel consumption affects the measurement result (more than 2% of the engine fuel consumption), it is recommended to connect the return line from the injectors to the HPFP inlet.

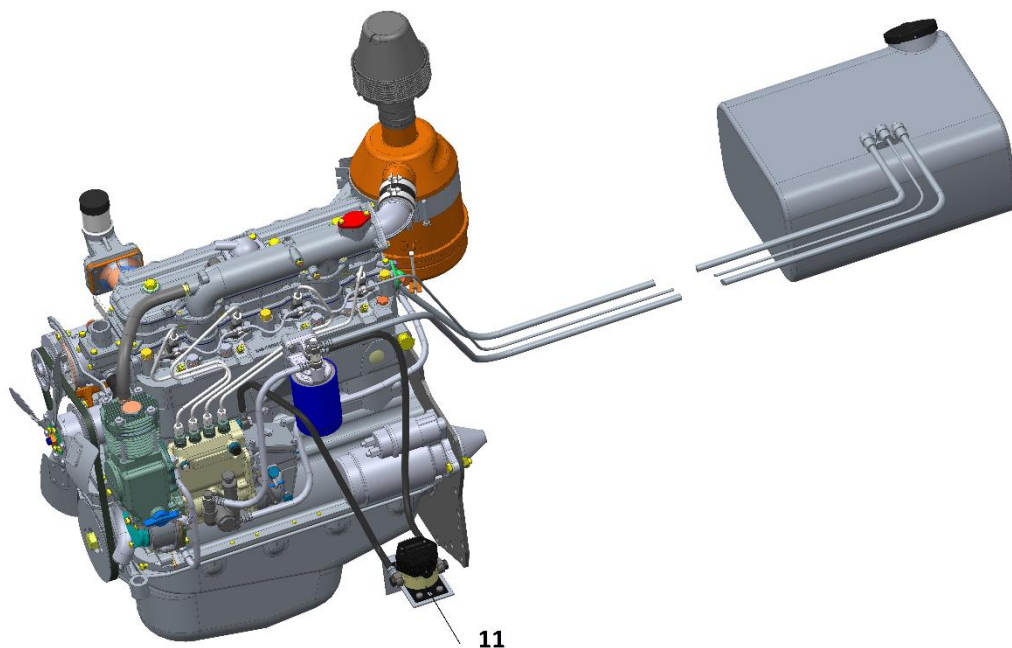


fig. 4.7. Connection of eurosens Direct (ind. 11).

4.4.5 INSTALLATION OF FLOWMETER eurosens DELTA ACCORDING TO “DIFFERENTIAL” DIAGRAM

Fuel circulation pattern in the fuel system does not change during differential measurement. The supply chamber of differential flowmeter eurosens Delta is installed in the fuel supply line of the engine. The return chamber is installed in the return fuel line. Fuel consumption is determined as the difference between the measured flow values in the supply and return chambers.

Special cases of installation of flowmeter eurosens Delta according to “Differential” diagram:

- supply chamber is installed in the fuel line after LPFP (pressure side) ([fig. 4.8](#));
- supply chamber is installed in the fuel line before LPFP (suction side). In this case, it is necessary to install an additional fine filter ([fig. 4.9](#)).

In both cases the return chamber of flowmeter eurosens Delta is installed in the return section “HPFP outlet – fuel tank”.

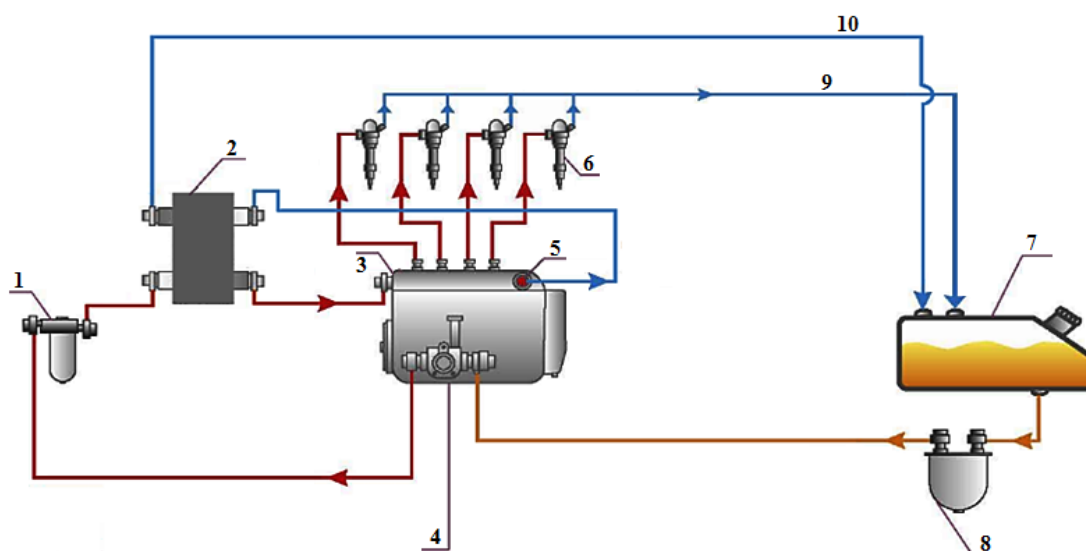


fig. 4.8. eurosens Delta installation with supply chamber on pressure side,

where 1 – fine filter, 2 – flowmeter eurosens Delta, 3 – HPFP, 4 – LPFP, 5 – relief valve, 6 – injectors, 7 – fuel tank, 8 – preliminary filter, 9 – return line from injectors, 10 – return line from HPFP

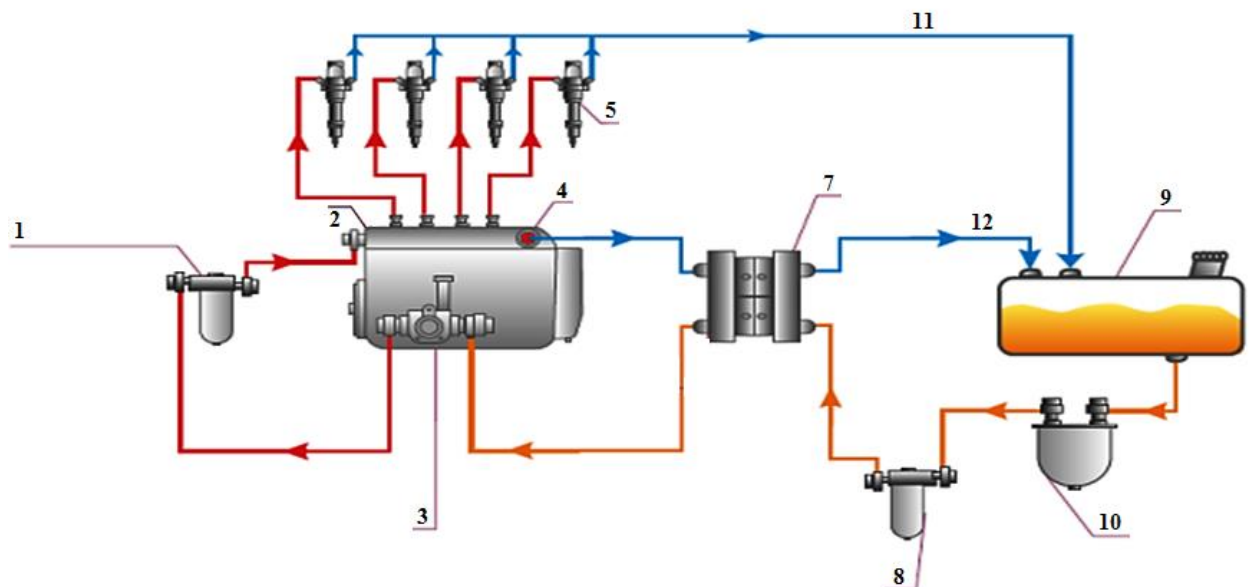


fig. 4.9. eurosens Delta installation with supply chamber on suction side,

where 1 – fine filter, 2 – HPFP, 3 – LPFP, 4 – relief valve, 5 – injectors, 7 – flowmeter Delta, 8 – additional fine filter, 9 – fuel tank, 10 – preliminary filter, 11 – return line from injectors, 12 – return line from HPFP

Advantages of “Differential” diagram:

- no changes in fuel system.

Disadvantages of “Differential” diagram:

- higher cost;
- higher measurement error of fuel consumption.

4.4.6 INSTALLATION OF FLOWMETER eurosens DELTA ON DIESEL ENGINE ACCORDING TO “DIFFERENTIAL” DIAGRAM

The original fuel system is shown in [fig. 4.10](#) and [fig. 4.11](#).

The fuel from the tank **1** is sucked in by LPFP **5** through the supply line **2** and goes under pressure to the fine filter **6**. The purified fuel is delivered to the HPFP inlet **7**. The excess fuel from HPFP returns to the tank **1** through the return line **3** with the help of a relief valve **8**, which maintains the required pressure in the fuel supply system.

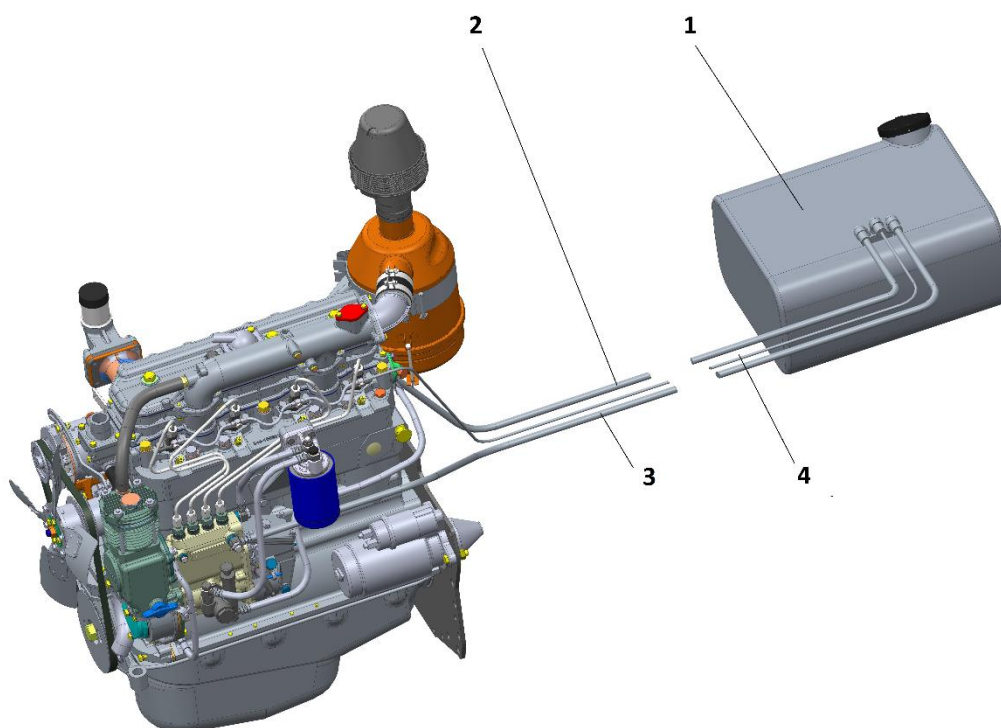


fig. 4.10. Original fuel system,

where 1 – fuel tank, 2 – supply line, 3 – return line, 4 – return line from injectors

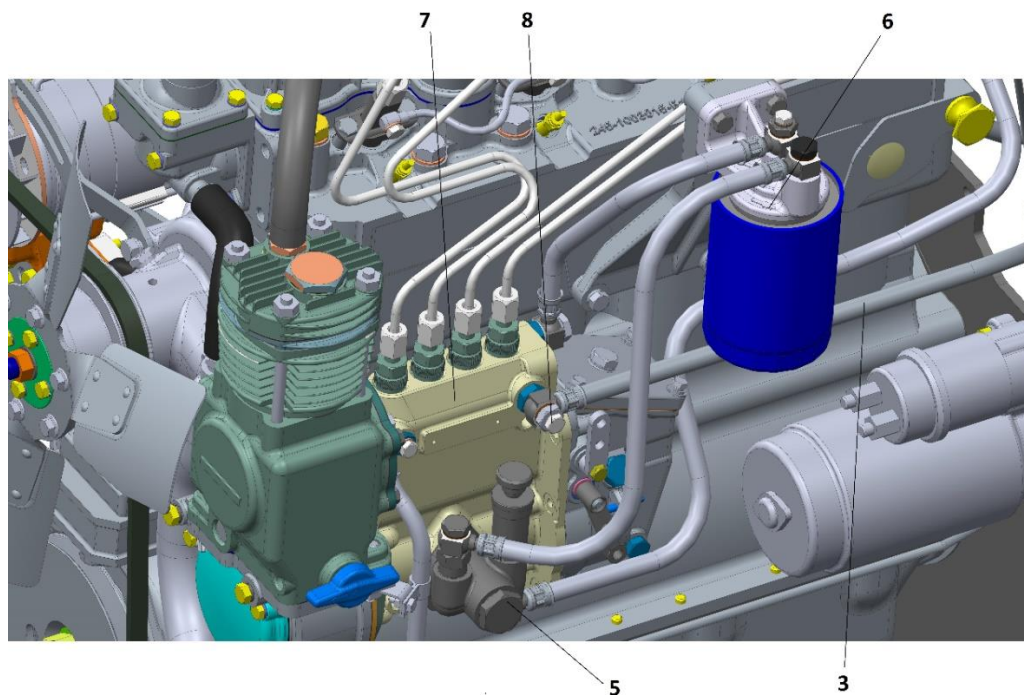


fig. 4.11. Original fuel supply system,
where 3 – return line, 5 – LPFP, 6 – fine filter, 7 – HPFP, 8 – relief valve

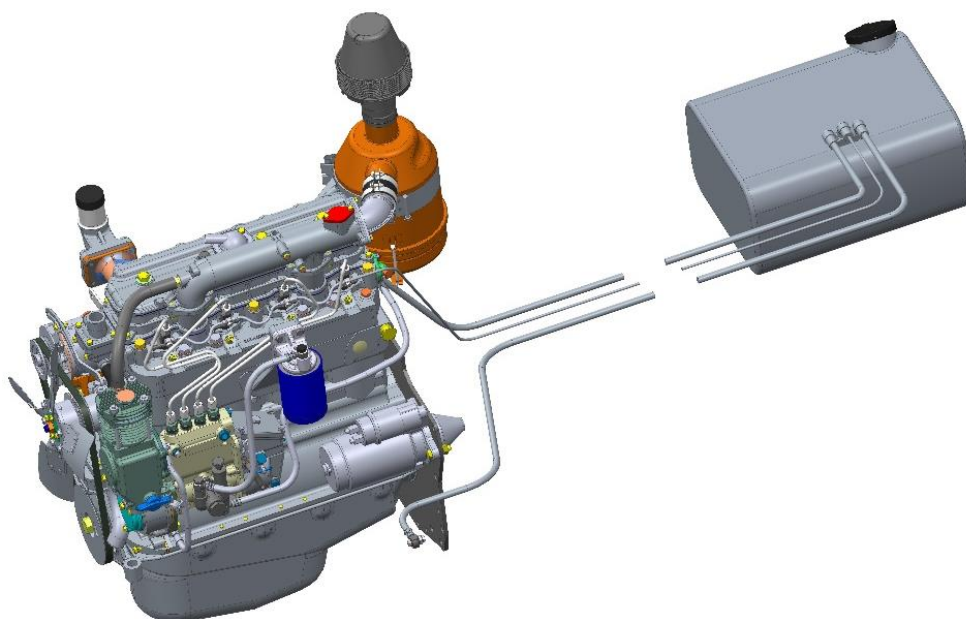


fig. 4.12. Engine with HPFP

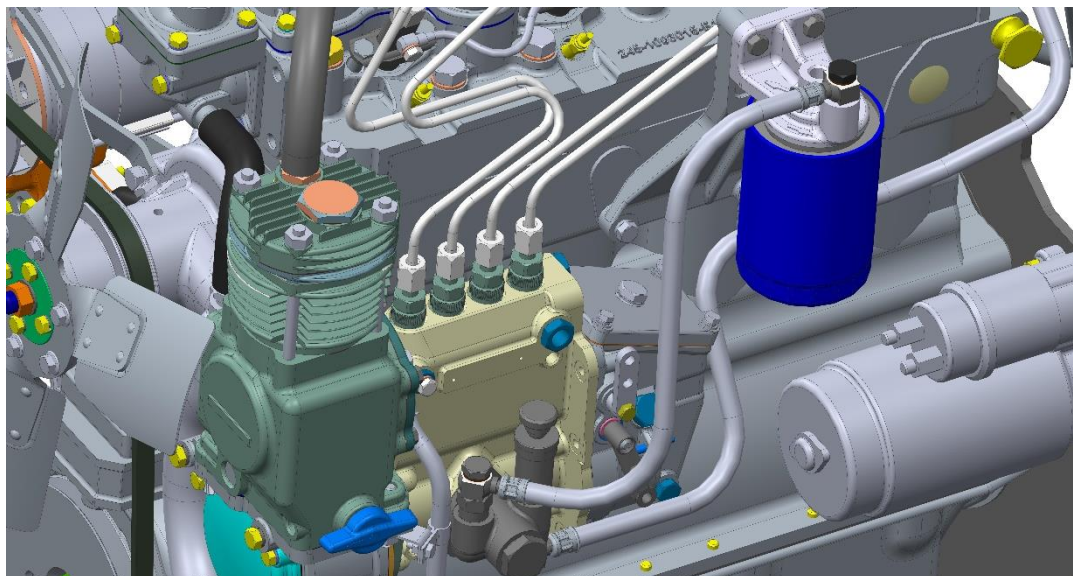


fig. 4.13. Engine with HPFP

- 1) Disconnect the fuel lines connected to HPFP: fuel supply from the fine fuel filter and the return line with the relief valve 8 ([fig. 4.12](#) and [fig. 4.13](#)).
- 2) Install and connect fuel flowmeter eurosens Delta ([fig. 4.14](#), [fig. 4.15](#), [fig. 4.16](#)):
- 3) Connect the supply chamber inlet (marked as "F" on flowmeter case) to the fine filter outlet.
- 4) Connect the supply chamber outlet to the HPFP inlet.

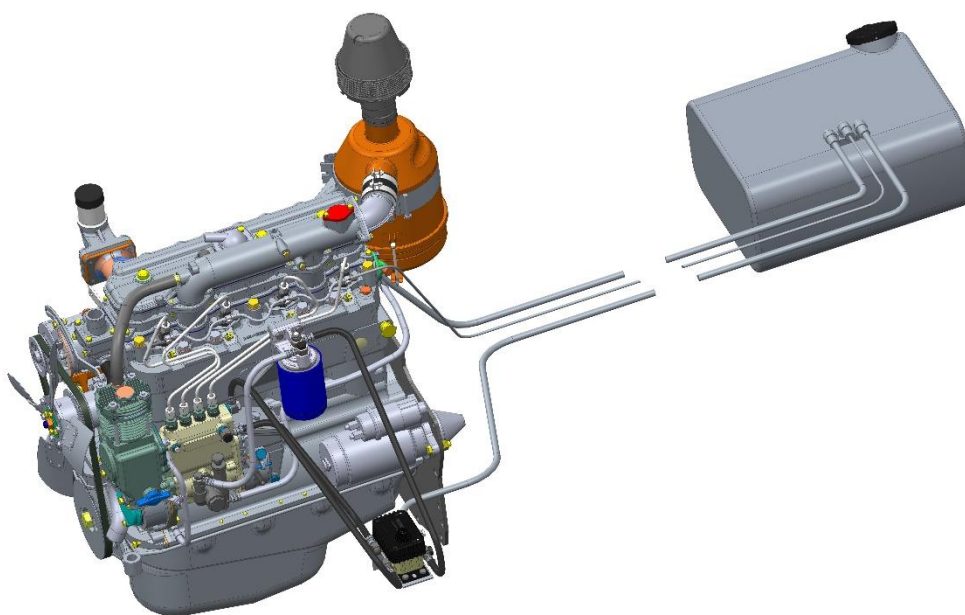


fig. 4.14. Engine with HPFP and fuel lines

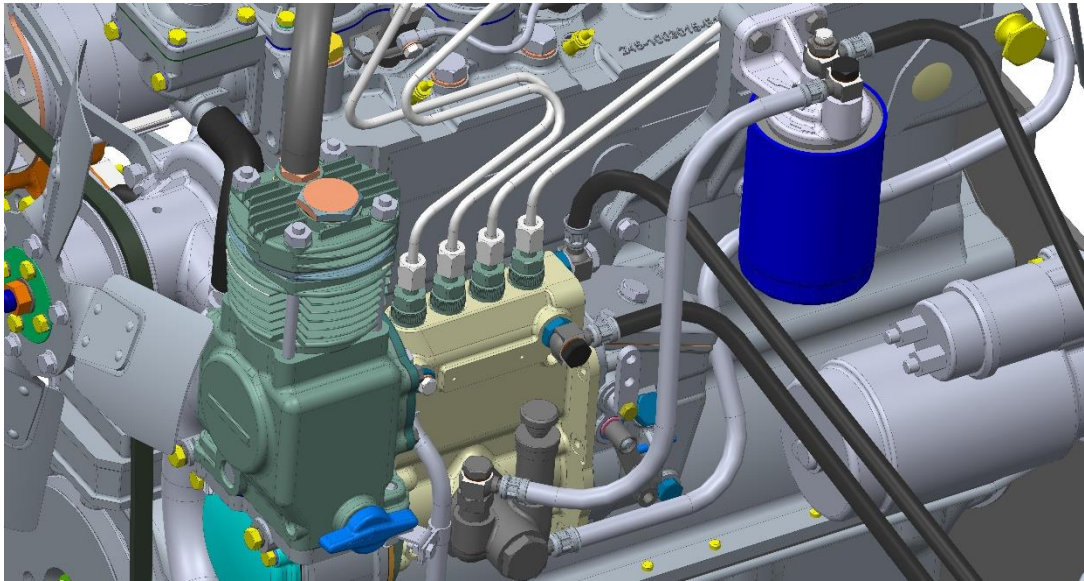


fig. 4.15. Connection of flowmeter to HPFP

- 5) Connect the HPFP outlet to the return chamber inlet (marked as “R” on flowmeter case).
- 6) Connect the return chamber outlet to the return fuel line with the help of previously removed relief valve 8.

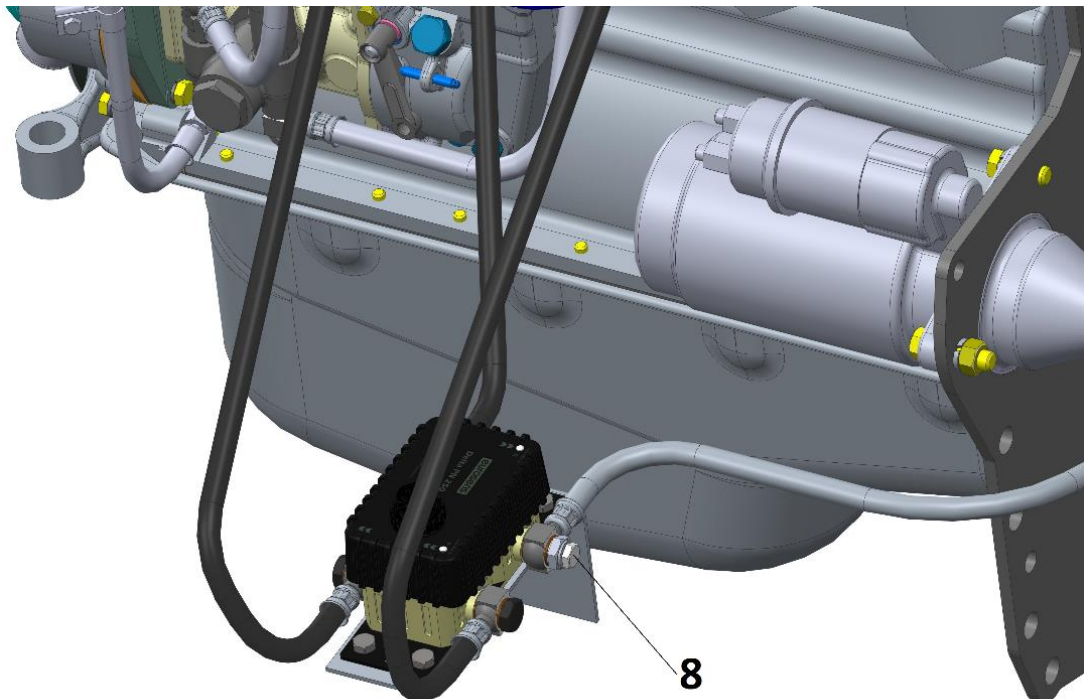


fig. 4.16. Relief valve installed at return chamber outlet



If the fuel system operates properly, the return line from injectors **4** does not contain a significant amount of fuel and can be ignored. However, it is recommended to check the flow rate in it.

If fuel consumption affects the measurement result (more than 2% of the engine fuel consumption), it is recommended to connect the return line from the injectors to the HPFP inlet.

4.5 DEAERATOR INSTALLATION

There can be air bubbles in the return line of the engine. To determine their presence, lower the return pipeline into a transparent container ([fig. 4.17](#)). The presence of air increases the fuel consumption in the return line, which results in a higher measurement error of fuel consumption of the engine, as determined by eurosens Delta flowmeter.



fig. 4.17. Air in return line

If there are air bubbles in the return line, it is necessary to remove them by installing eurosens Deaerator.

- 1) Install the deaerator in front of the return measuring chamber of eurosens Delta.
- 2) Connect the outlet of the engine return line to the deaerator inlet, and the purified fuel will be delivered to the flowmeter inlet ([fig. 4.18](#)).
- 3) The separated air contains a small amount of fuel, droplets of which could leave stains under the engine. Therefore, in order to leave no diesel stains and observe the environmental requirements for operation, it is recommended to connect the gas outlet to the return line behind the flowmeter.

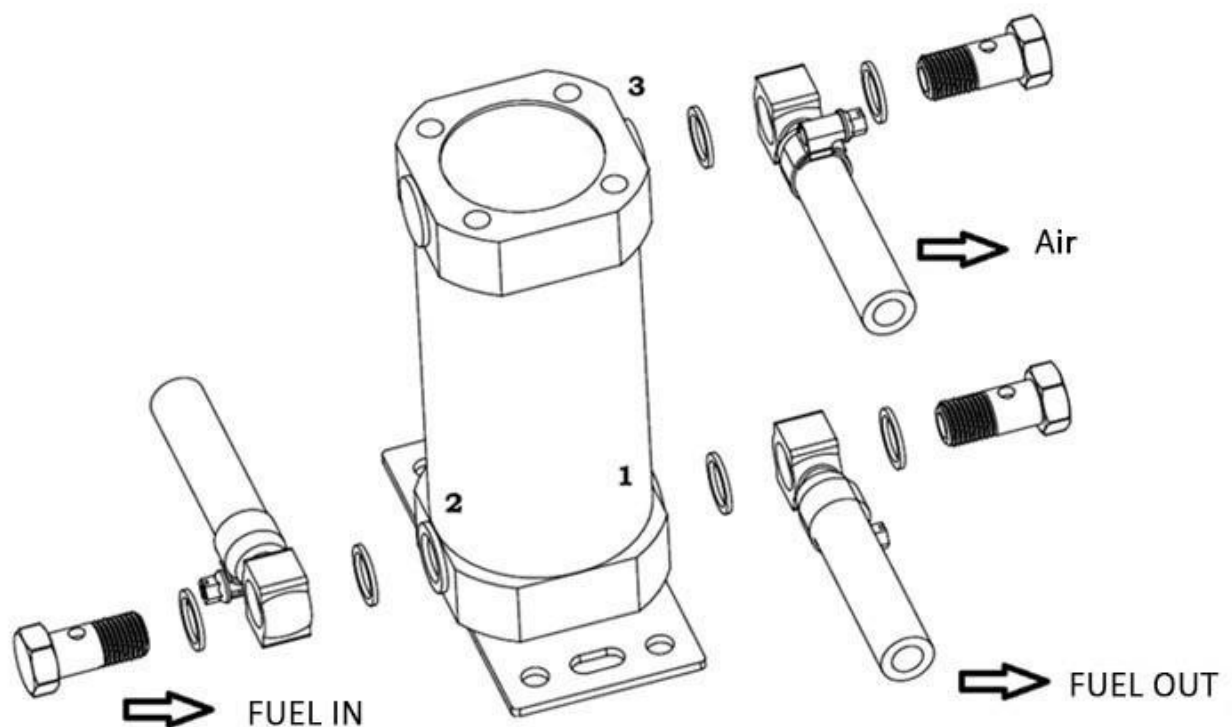


fig. 4.18. Deaerator installation

4.6 ELECTRICAL CONNECTION

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



When connecting eurosens flowmeter 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 flowmeter 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. 4.19](#), [fig. 4.20](#), [fig. 4.21](#)) as given in the product specification. All flowmeter models with external PN/RS/CAN interfaces have K-line/OUT pulse output.

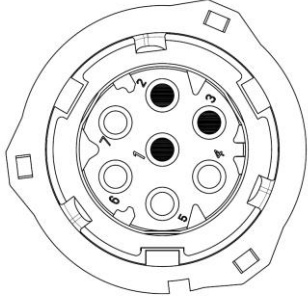
	Pin	Circuit	Wire color in cable
	1	VBAT	green
	2	GND	black
	3	K-LINE/OUT	blue
	4	NC	-
	5	NC	-
	6	NC	-
	7	NC	-

fig. 4.19. Pin assignment in flowmeters eurosens PN

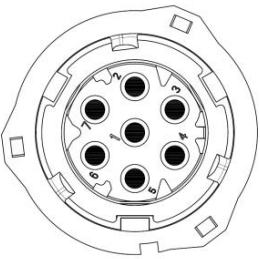
	Pin	Circuit	Wire color in cable
	1	VBAT	red
	2	GND	brown
	3	K-LINE/OUT	blue
	6	RS-485A	yellow
	7	RS-485B	green

fig. 4.20. Pin assignment in flowmeters eurosens RS (a 5-wire cable)

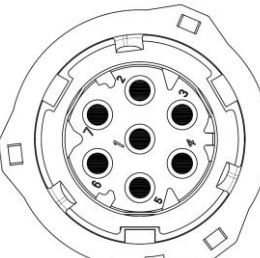
	Pin	Circuit	Wire color in cable
	1	VBAT	red
	2	GND	brown
	3	K-LINE/OUT	blue
	6	CAN_H	yellow
	7	CAN_L	green

fig. 4.21. Pin assignment in flowmeters eurosens CAN (a 5-wire cable)

4.7 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 Delta protocol or MODBUS RTU. RS-485 allows connecting several flowmeters to one port of the data logger (data collection device). When connecting several flowmeters at the **maximum distance of 20 meters** from the data logger, use the topology of “Star” connection diagram ([fig. 4.22](#)).

The topology of “Bus” connection diagram ([fig. 4.23](#)) is used to connect several flowmeters at the **maximum distance of 100 meters**. It is necessary to enable the “Terminator” option in the settings of the flowmeter which is the farthest from the data logger. This option will turn on the 120 Ohm termination resistor in the flowmeter, which is vital for this topology.

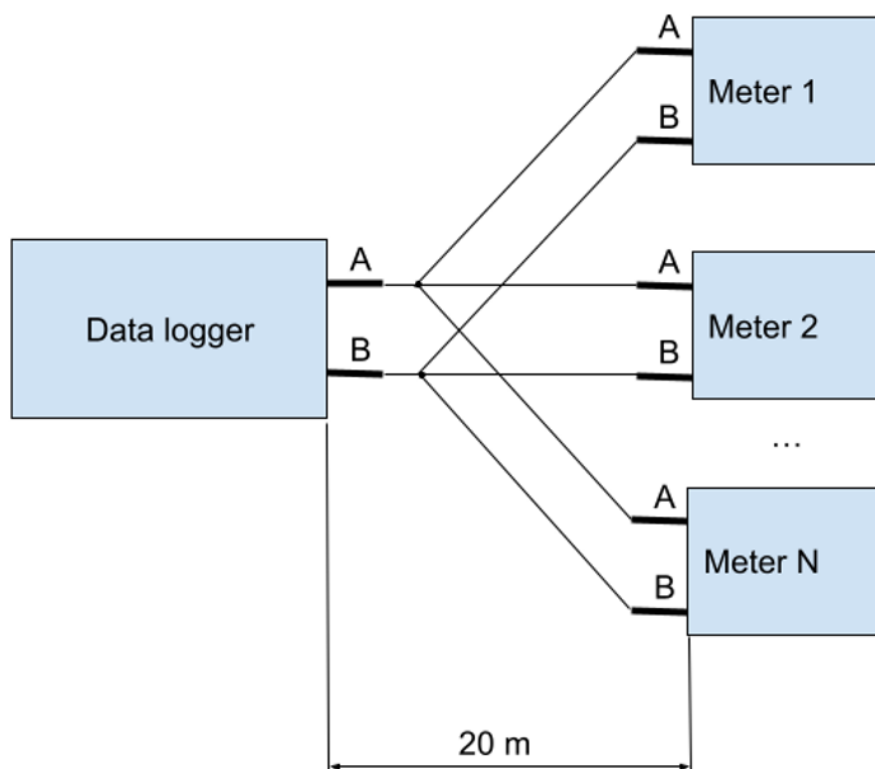


fig. 4.22. Topology of “Star” connection diagram

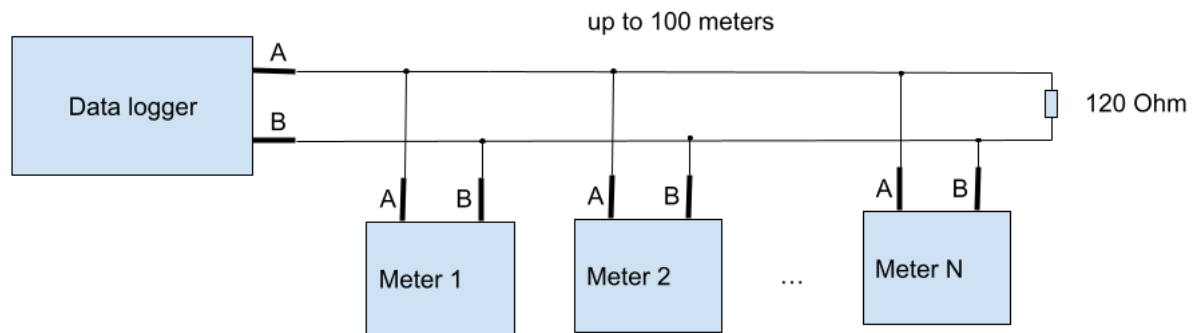


fig. 4.23. Topology of "Bus" connection diagram

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 flowmeters to a common bus, each of them must be calibrated. Each device in the bus is assigned a unique address.

4.8 CONNECTION VIA CAN INTERFACE

Digital interface CAN of flowmeters complies with the CAN 2.0b specification. Data is transmitted via SAE J1939-31 protocol (with some modifications) or NMEA 2000. CAN interface allows connecting several flowmeters to one port of the data logger.

When connecting several flowmeters at the **maximum distance of 10 meters** from the data logger, use the topology of “Star” connection diagram ([fig. 4.24](#)). Make sure that at least one of the network nodes has an enabled termination resistor (enabled by software in flowmeter settings).

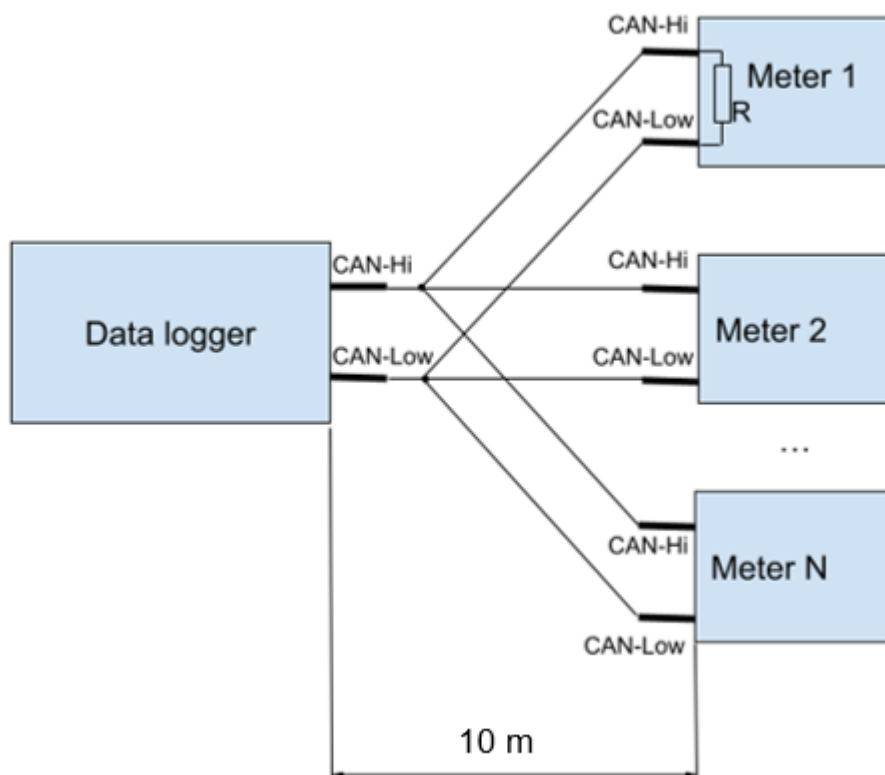


fig. 4.24. Topology of “Star” connection diagram

The topology of “Bus” connection diagram ([fig. 4.25](#)) is used to connect several flowmeters at the **maximum distance of 100 meters**. It is necessary to enable the “Terminator” option in the settings of flowmeters located at each end of the bus. This option will turn on the 120 Ohm termination resistor in the flowmeters, which is vital for this topology.

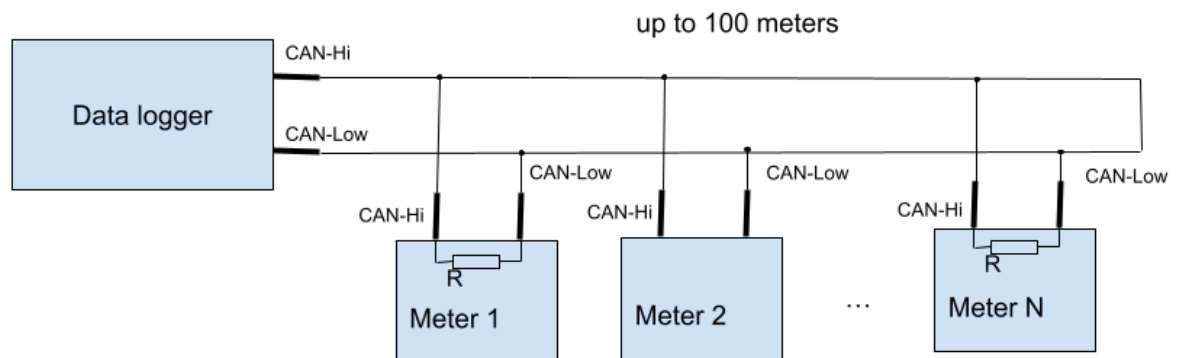


fig. 4.25. Topology of “Bus” connection diagram

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 flowmeters to a common bus, each of them must be calibrated. Each device in the bus is assigned a unique address.

4.9 ELECTRIC CONNECTION TO NMEA 2000

NMEA (National Marine Electronics Association) 2000 is a communications standard for navigation, sensors, and other devices based on CAN interface. The format of NMEA 2000 protocol is based on SAE J1939 with some modifications. NMEA 2000 network consists mainly of a central cable known as a backbone, which connects and powers other electronic devices and sensors.

The maximum backbone cable length is 200 meters, which allows it to cover all the units on board the vessel. 5-pin screw connectors are used to connect cables to devices or other NMEA 2000 network components, turning the network into a plug-and-play system.

The devices that are connected to the backbone cable have unified connectors, protected from water and sealed with hose crimps.

Up to 50 devices can be connected to NMEA 2000 network ([fig. 4.26](#)).



Remember that the total length of branch cabling **must not exceed 78 meters**.

The maximum distance for any device from the bus is **6 meters**.

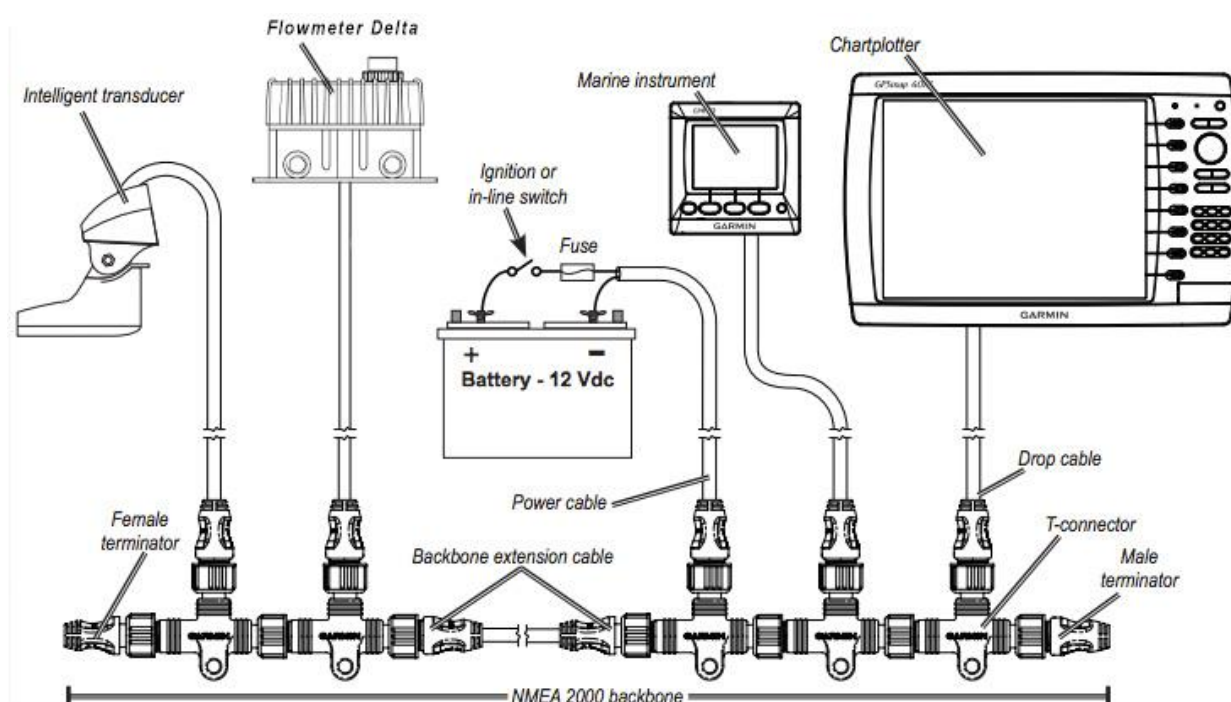


fig. 4.26. NMEA 2000 network

Mini-C and Micro-C standard connectors are usually used to connect devices ([fig. 4.27](#)):

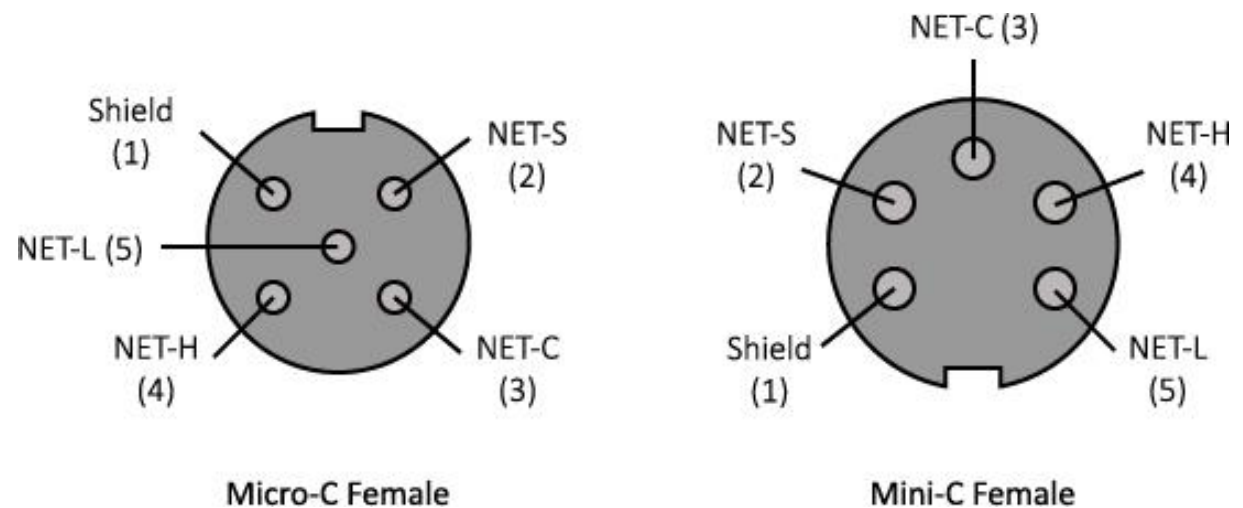


fig. 4.27. Micro-C and Mini-C standard connectors

Flowmeters eurosens Direct/Delta are connected to NMEA network by means of Cable 77FR-NMEA2K-7-0 Micro-C.



Find out the type of connectors used in your existing NMEA 2000 network before ordering a flowmeter to work with NMEA 2000 chartplotters.

It is possible to use a T-Splitter NMEA to embed in NMEA 2000 bus.

5 FLOWMETER SETUP AND OPERATION CHECK

Install and set up the flowmeter using service adapter (programming device) [eurosens Destination](#) and configuration software eurosens Delta Configurator (hereinafter: Configurator) ([fig. 5.1](#)).

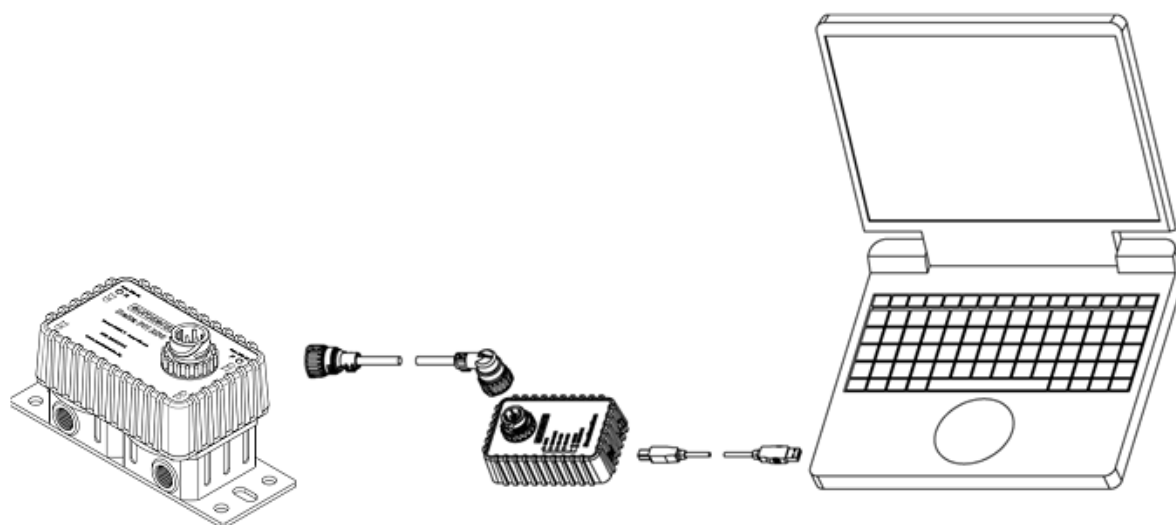


fig. 5.1. Flowmeter setup

5.1 DRIVERS AND CONFIGURATOR INSTALLATION

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

- 1) [Download the file](#) and install the software.
- 2) When adapter is connected to the PC for the first time, Windows OS will search and install the adapter driver.



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

5.2 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. 5.2](#)) and enter the required COM port number at the bottom of the window (input line).

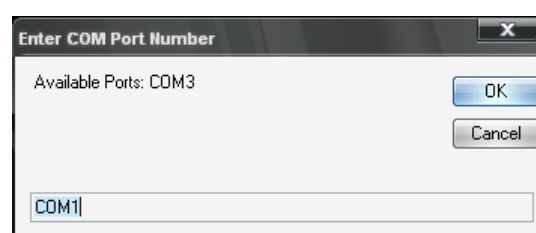


fig. 5.2. Available ports



If there are several options in the list of available ports, select the item **“Ports (COM & LPT)”** in the program **“Device Manager”**, find an entry similar to that shown in [fig. 5.3](#) and [fig. 5.4](#), depending on adapter type. The COM port number is in brackets after the word **“COM”**.

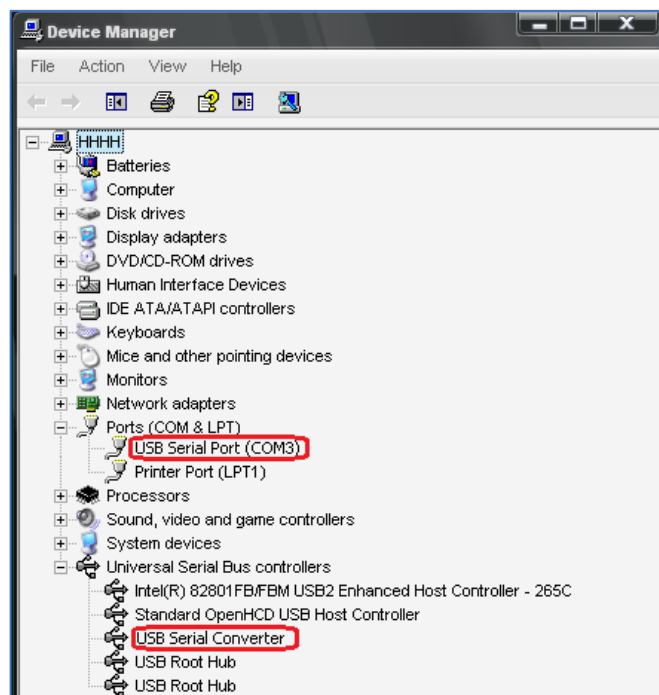


fig. 5.3. Device manager

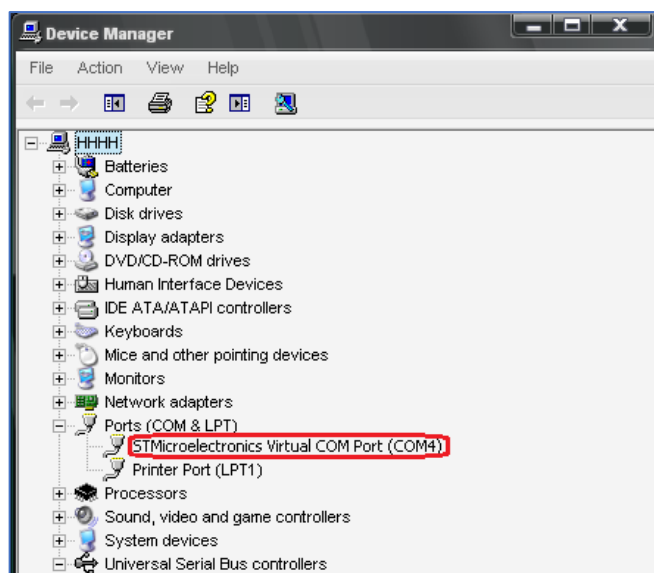


fig. 5.4. Device manager

5.3 CONNECTING TO FLOWMETER

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 flowmeter to the service adapter via a 2-way cable (supplied with the adapter). In case of using the service adapter “Destination 02”, set the connection interface type to ISO 9141 (K-Line).

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

- information on the connected flowmeter is displayed in the upper part of the program window;
- service adapter communication indicators (**“Send”** and **“Receive”**) blink fast (when program starts) and slowly (when flowmeter is connected);
- if the service adapter is not connected, the error message will be displayed on the screen ([fig. 5.5](#));
- it is necessary to connect the service adapter and select the required COM port (or restart the program).

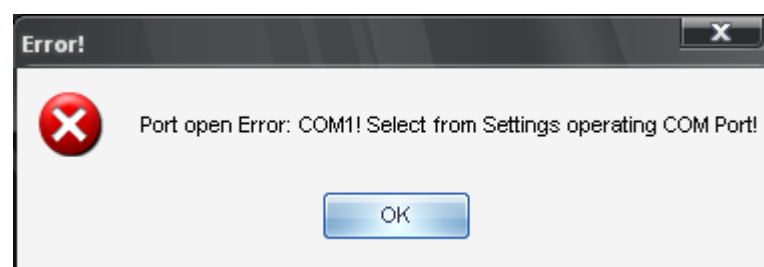


fig. 5.5. Error message

5.4 CONFIGURATOR MENU DESCRIPTION

The software has a single-window interface ([fig. 5.6](#)). The window contains:

- 1) main menu;
- 2) information field (contains the information about the model, serial number, production date, hardware version, firmware version, protocol version, and loader version);
- 3) tab bar;
- 4) status bar (contains the indicator of data downloading from/uploading to the flowmeter).

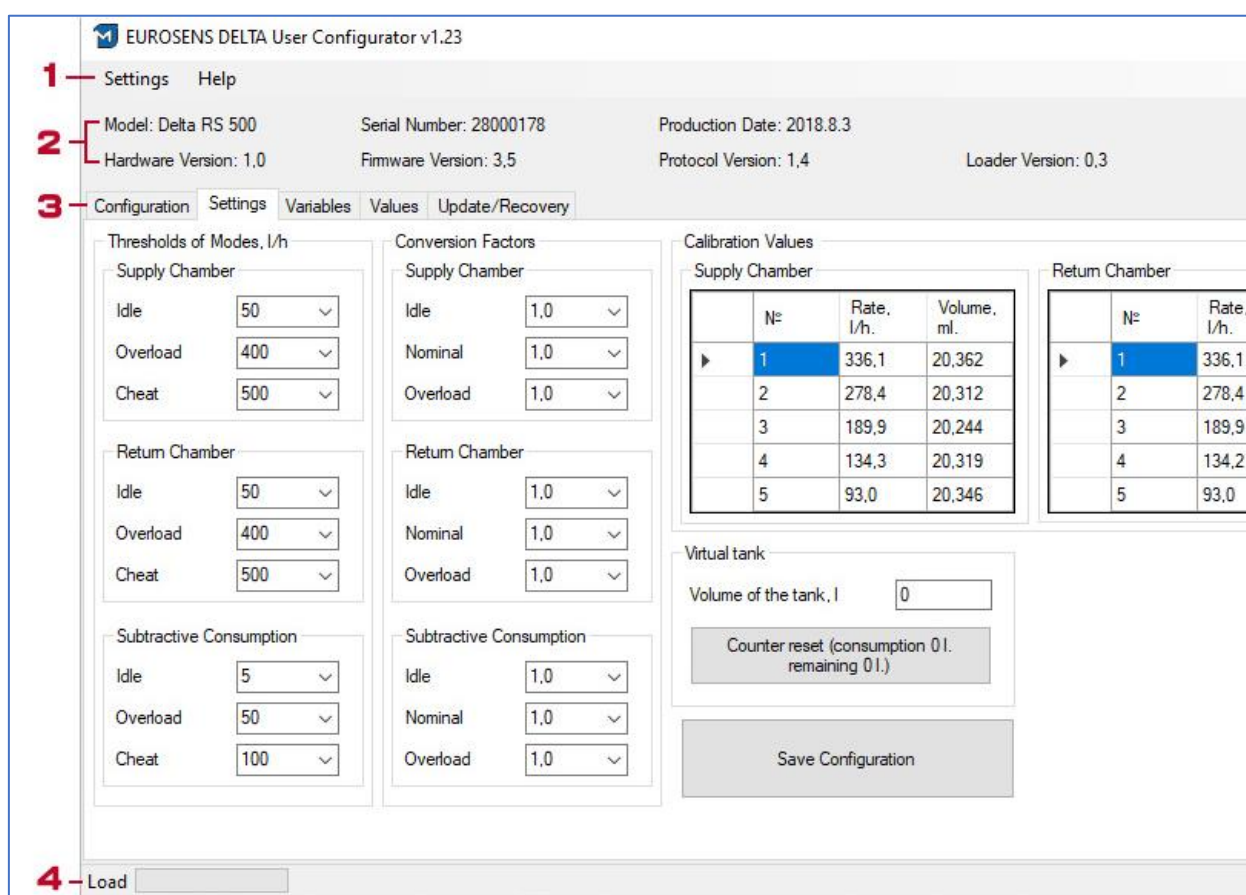


fig. 5.6. Configurator window

The main menu contains the categories “**Settings**” and “**Help**”.

5.4.1 “SETTINGS” CATEGORY

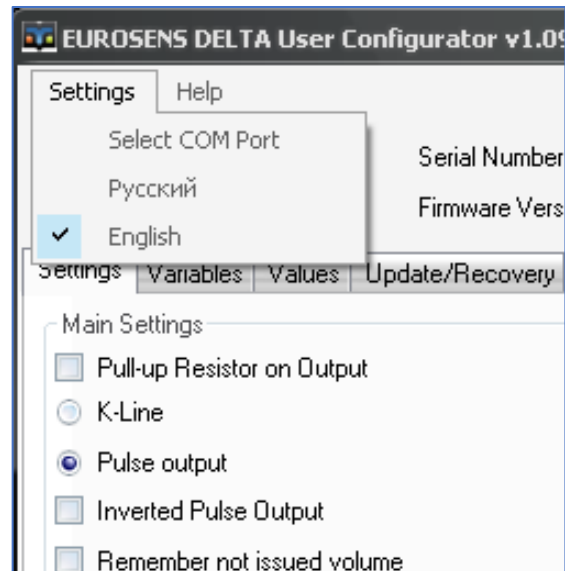


fig. 5.7. “Settings” category

- **“Select COM port”** item allows setting the COM port number and shows the list of available COM ports.
- **“Русский” and “English”** items switch the language of program interface. The language is selected by ticking the menu item.

The tab bar includes the following tabs: **“Configuration”**, **“Settings”**, **“Variables”**, **“Values”**, and **“Update/Recovery”**.

5.4.2 “CONFIGURATION” TAB

The tab **“Configuration”** (fig. 5.8) contains configuration parameters of a flowmeter. It consists of:

- two buttons: **“Save configuration”** and **“Reread data”**;
- three information fields: **“Main Settings”**, **“Digital Output”** and **“Measurement”**.

Buttons:

- 1) **“Save configuration”** button saves the set configuration parameters to flowmeter.
- 2) **“Reread data”** button is used when working with several flowmeters. Allows reading data from a new flowmeter without restarting the program.

Information fields:

- 1) **“Main settings”** field contains the basic parameters that determine the mode and operating conditions of flowmeter. Contains the following settings:

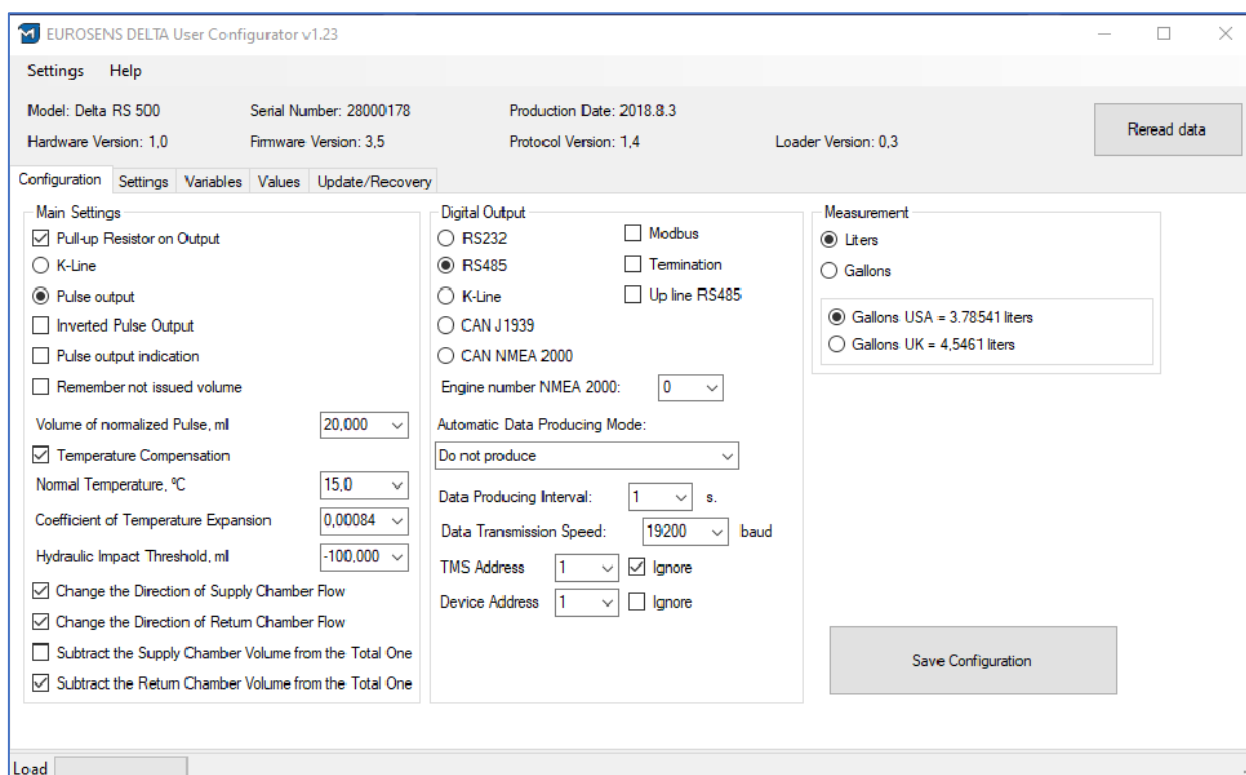


fig. 5.8. Configuration tab

- **“Pull-up Resistor on Output”** option pulls up the pulse output to the power supply circuit. When the setting is enabled, the pulse signal corresponds to that described in chapter 2.8.5. The option is enabled if the pulse input of a data logger counts positive square-wave voltage pulses. If the pulse input counts short circuits negative voltage pulses, then this option must be disabled.
- **K-Line** switches K-Line output to the data transmission mode via eurosens Delta or Modbus protocols. Pulse output is disabled. It is used if a data logger can operate via K-Line interface.
- **Pulse output** switches K-Line output to the pulse signal output mode. Data transmission via a single-wire K-Line interface is disabled. The option allows using the pulse signal of a flowmeter.
- **“Inverted Pulse Output”** option, if enabled, allows changing the process of generating a pulse signal. Initially, the pulse formation begins with a transition from a high-level signal to a low one and back. When this option is enabled, the low-level signal switches to high one and back.
- **“Pulse output indication”** option transmits data to the LED indication (red LED) during the pulse signal output.
- **“Remember not issued volume”** option provides storage and output of information on fuel consumption to the monitoring system while the flowmeter is not powered (for autonomous flowmeters connected via a pulse output).
- **“Volume of normalized Pulse (ml)”** sets the amount of selected fuel, at which the output signal (counting pulse) of the flowmeter is generated.
- **“Temperature Compensation”** option recalculates fuel volume depending on its temperature. The higher the temperature, the greater the fuel volume.
- **“Normal Temperature (°C)”** sets the standard temperature value, which determines the change in fuel volume. The usual value is +15°C or +20°C.
- **“Coefficient of Temperature Expansion”** is the value of the temperature coefficient of volume expansion for fuel β when the temperature changes by 1°C. It can be taken from [Table 5.1](#), based on the density ρ of the oil product at +20°C.

Table 5.1. Temperature coefficient of volume expansion for fuel β

ρ , kg/m ³	β , 1/°C	ρ , kg/m ³	β , 1/°C	ρ , kg/m ³	β , 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	-	-

- **“Hydraulic Impact Threshold (ml)”** is the volume of negative fuel consumption at which the Variables of negative volume do not increase (hydraulic impact). If the negative fuel consumption gradually increases, then the threshold value must be increased as well.
- **“Change the Direction of Supply Chamber Flow”** and **“Change the Direction of Return Chamber Flow”** are the settings that depend on flowmeter model (enabled by default). **DO NOT CHANGE THE SETTINGS.**
- **“Subtract the Supply Chamber Volume from the Total One”** and **“Subtract the Return Chamber Volume from the Total One”** are the settings that set flowmeter operation modes. – If both "ticks" are removed, the flowmeter operates in the mode of adding chamber streams (the Adder mode). The return chamber subtraction mode (the Differential mode) is set by default.

2) **“Digital Output”** field contains configuration parameters for data transmission modes via digital protocols of flowmeters eurosens Delta. Contains the following settings:

- **RS-232.** Enables data exchange mode via RS-232 interface.
- **RS-485.** Enables data exchange mode via RS-485 interface.
- **K-Line.** Enables data exchange mode via K-Line interface.
- **CAN J1939.** Enables data exchange mode via CAN J1939 interface.
- **CAN NMEA 2000.** Enables data exchange mode via CAN NMEA 2000 interface.



The Configurator does not detect the physical presence of the selected interface in the flowmeter. Make sure that the flowmeter model supports the selected digital interface.

- **Modbus.** Enables data exchange mode via Modbus protocol. For this protocol “**Data Transmission Speed**” and “**Device Address**” settings are used. If the mode is disabled, data exchange is performed via «eurosens Delta» protocol.



Modbus protocol description is given in Appendix B and “[Modbus Data Communications protocol](#)” manual for eurosens Delta.

- “**Termination**” option enables the mode of matching the wave impedances of RS-485 data bus. When this option is ON, a 120 Ohm termination resistor is included in the data bus from the device side. The option can be enabled only for the two end devices of the entire RS-485 bus with long transmission lines.
- “**Up line RS-485**” option is used to set a stable logical state “1” when there is no data exchange. Bus “A” is pulled up to the power supply of the interface, bus “B” is pulled up to the common wire. The option is used for long communication lines (over 100 meters).
- “**Automatic Data Producing Mode**” sets the status of data transmission mode such as: “Do not produce”, “Produce in binary type”, or “Produce in symbolic type”. The mode is used only for “eurosens Delta” protocol.
- “**Data Producing Interval**” setting shows the time interval between messages transmitted via the protocol. Ranges from 1 to 255 seconds. If the interval is set to “0”, messages are not transmitted. The option is used only for “eurosens Delta” protocol.
- “**Data Transmission Speed**” shows message transmission speed via RS-232, RS-485 and K-Line interfaces (in digital output mode). It can vary from 1200 to 115200. By default, the speed value is set to 19200.
- “**TMS Address**” is the address of the fuel monitoring system module (data logger) to which the flowmeter transmits data. If “**Ignore**” option is selected, the flowmeter will send response to the module that makes the request. The option is used only for “eurosens Delta” protocol.

- **“Device Address”** shows flowmeter network address. If **“Ignore”** option is selected, any meter in the network will respond to the module(s) request. **“Ignore”** option is inactive in the mode of data exchange via Modbus protocol. When using Modbus protocol, the address value must be ranged from 1 to 247.



When using flowmeters in a network, remember to set the addresses in accordance with the recommendations for the particular data collection device.

- 3) **“Measurement”** field allows choosing the units of volume measurement: **Liters** or **Gallons**.

5.4.3 “SETTINGS” TAB

The tab **“Settings”** (fig. 5.9) contains setting parameters of a flowmeter and consists of four fields: **“Threshold of Modes, l/h”**, **“Conversion Factors”**, **“Calibration Values”** and **“Virtual Tank, l”**.

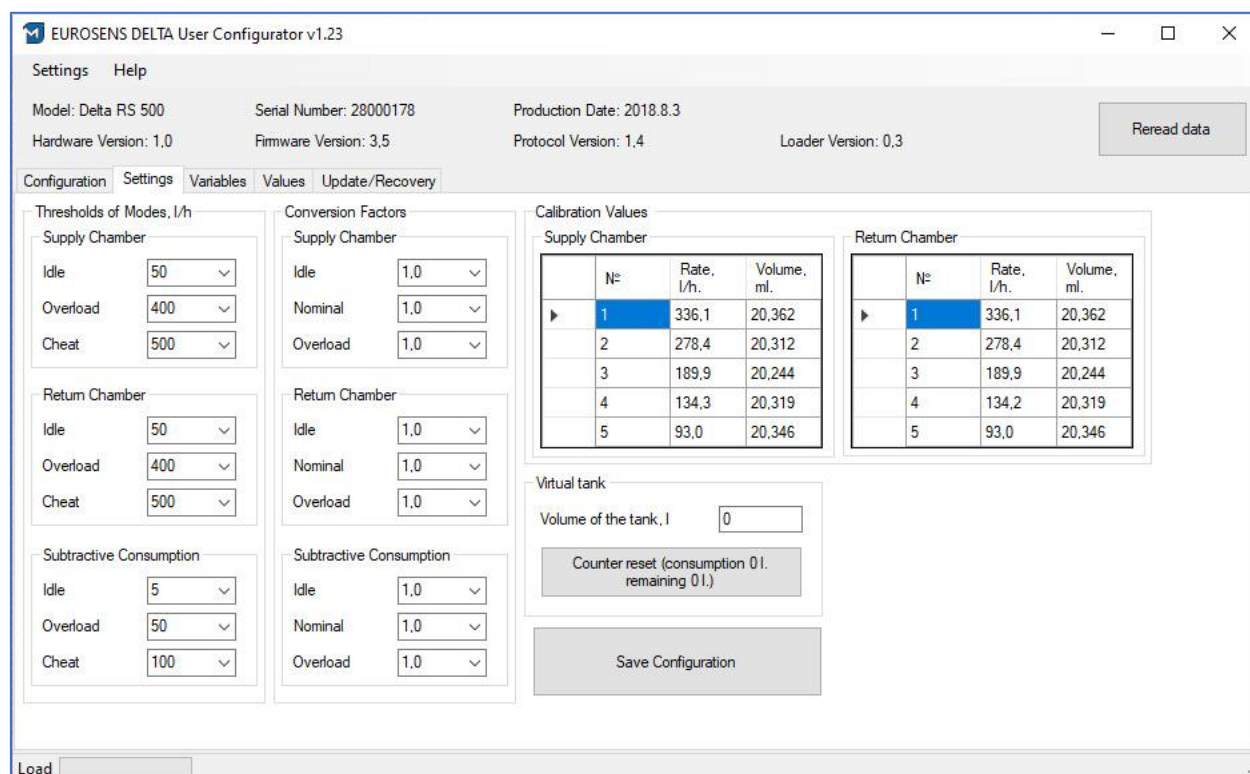


fig. 5.9. Settings tab

1) **“Threshold of Modes, l/h”** field contains three smaller fields: **“Supply Chamber”**, **“Return Chamber”** and **“Subtractive Consumption”**.

- The fields **“Supply Chamber”** and **“Return Chamber”** allow setting the flow rate measurement in respective flowmeter chambers.
- **“Subtractive Consumption”** field provides additional options to monitor the measurement process and contains parameters for the total (or differential, depending on flowmeter operation mode) flow of both flowmeter chambers.

All smaller fields contain the following parameters:

- **Idle** – the parameter determines the threshold value of fuel consumption when switching from the **“Idle”** mode to the **“Nominal”** mode.

- **Overload** – the parameter determines the threshold value of fuel consumption when switching from the “**Nominal**” mode to the “**Overload**” mode.
 - **Cheat** – the parameter determines the threshold value of fuel consumption when switching from the “**Overload**” mode to the “**Cheat**” mode.
- 2) “**Conversion Factors**” field contains three smaller fields: “**Supply Chamber**”, “**Return Chamber**” and “**Subtractive Consumption**”.
- All smaller fields contain the correction coefficients “**Idle**”, “**Nominal**” and “**Overload**”, which makes it possible to additionally correct the measurement process in respective engine operation modes.
- 3) “**Calibration Values**” field contains the factory calibration table of flowmeter chambers. **DO NOT CHANGE THE SETTINGS.**
- 4) “**Virtual Tank, I**” field is used for meter verification by fuel tank comparison method.

5.4.4 “VARIABLES” TAB

The tab “**Variables**” (fig. 5.10) contains the data of program variables. Consists of the following fields:

- 1) “**Supply Chamber**”,
- 2) “**Return Chamber**”,
- 3) “**The Difference on Chambers**”,
- 4) “**Additional Counters**”.

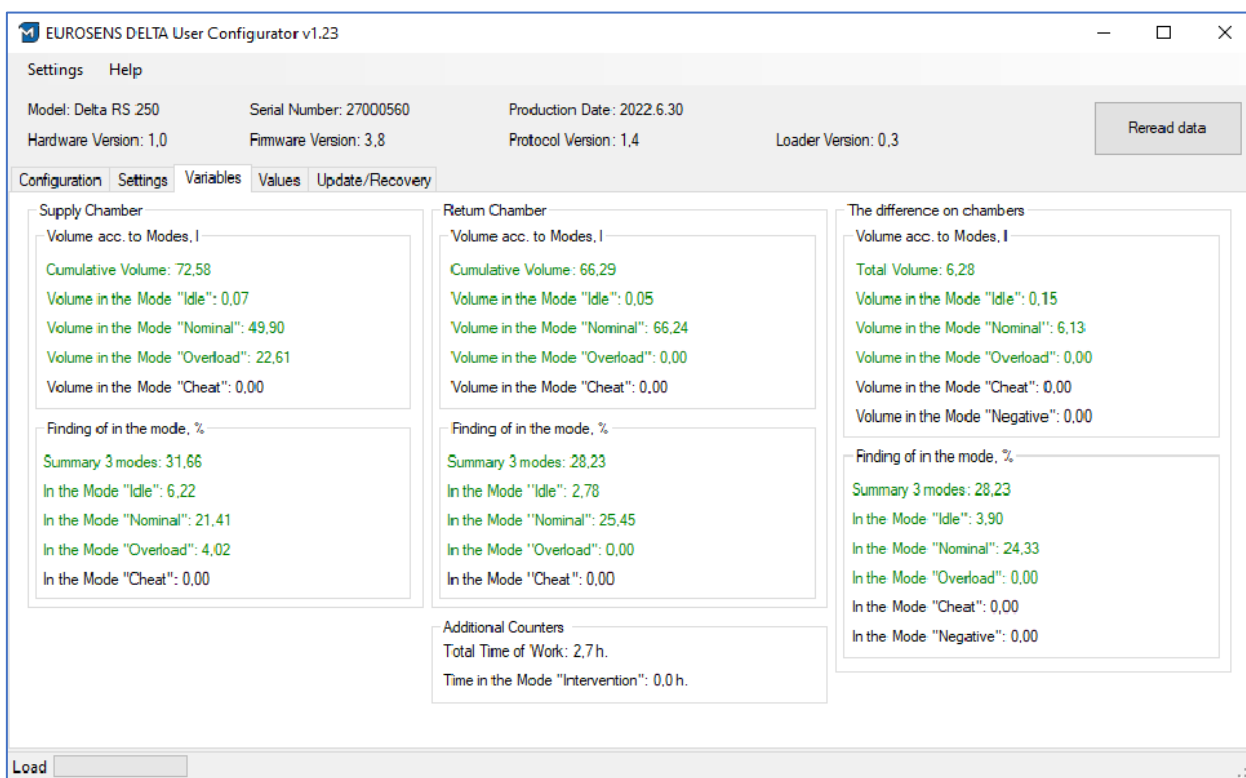


fig. 5.10. Variables tab

Each field (except “**Additional Counters**”) consists of two smaller fields:

- a) “**Volume acc. to Modes, l**”;
- b) “**Finding of in the mode, %**”

The smaller field “**Volume acc. to Modes, l**” (in larger fields “**Supply Chamber**” and “**Return Chamber**”) contains the following variables:

- **Cumulative Volume** shows the total volume of fuel that flowed through the chamber in the three modes (highlighted in green).
- **Volume in the Mode “Idle”** shows the volume of fuel that flowed through the chamber in the “Idle” mode.
- **Volume in the Mode “Nominal”** shows the volume of fuel that flowed through the chamber in the “Nominal” mode.
- **Volume in the Mode “Overload”** shows the volume of fuel that flowed through the chamber in the “Overload” mode.
- **Volume in the Mode “Cheat”** shows the volume of fuel that flowed through the chamber in the “Cheat” mode.

The smaller field **“Finding of in the mode, %”** (in larger fields **“Supply Chamber”** and **“Return Chamber”**) contains the following variables:

- **Summary 3 modes** – shows the total percentage of operating in the three modes (highlighted in green).
- **In the Mode “Idle”** – shows the percentage of operating in the “Idle” mode.
- **In the Mode “Nominal”** – shows the percentage of operating in the “Nominal” mode.
- **In the Mode “Overload”** – shows the percentage of operating in the “Overload” mode.
- **In the Mode “Cheat”** – shows the percentage of operating in the “Cheat” mode.

The smaller field **“Volume acc. to Modes, l”** (in a larger field **“The difference on chambers”**) contains the following variables:

- **Total Volume** shows the total volume of fuel that flowed through the chambers in all modes (highlighted in green) except the modes **“Cheat”** and **“Negative”**. The total volume value depends on the operation mode – the Adder mode or the Differential one – and is shown as sum or difference respectively.
- **Volume in the Mode “Idle”** shows the volume of fuel that flowed through the chambers in the “Idle” mode. Depends on the operation mode.

- **Volume in the Mode “Nominal”** shows the volume of fuel that flowed through the chambers in the **“Nominal”** mode. Depends on the operation mode.
- **Volume in the Mode “Overload”** shows the volume of fuel that flowed through the chambers in the **“Overload”** mode. Depends on the operation mode.
- **Volume in the Mode “Cheat”** shows the volume of fuel that flowed through the chambers in the **“Cheat”** mode. Depends on the operation mode.
- **Volume in the Mode “Negative”** shows the volume of fuel that flowed through the chamber in case of exceeding hydraulic impact threshold.

The smaller field **“Finding of in the mode, %”** (in a larger field **“The difference on chambers”**) contains the following variables:

- **Summary 3 modes** – shows the total percentage of operating in the three modes (highlighted in green).
- **In the Mode “Idle”** – shows the percentage of operating in the **“Idle”** mode.
- **In the Mode “Nominal”** – shows the percentage of operating in the **“Nominal”** mode.
- **In the Mode “Overload”** – shows the percentage of operating in the **“Overload”** mode.
- **In the Mode “Cheat”** – shows the percentage of operating in the **“Cheat”** mode.
- **In the Mode “Negative”** – shows the percentage of operating in the **“Negative”** mode (in case of exceeding hydraulic impact threshold).

The field **“Additional Counters”** contains:

- **Total Time of Work** – shows the total time of flowmeter operation in turned on state.
- **Time in the Mode “Intervention”** – shows the total time of flowmeter operation in the **“Intervention”** mode.

5.4.5 “VALUES” TAB

The tab “**Values**” (fig. 5.11) contains a field for the flowmeter operation line graph and the following parameters:

- **Temperature of the Supply Chamber** shows the current temperature value in the supply chamber. The measurement error is 1°C.

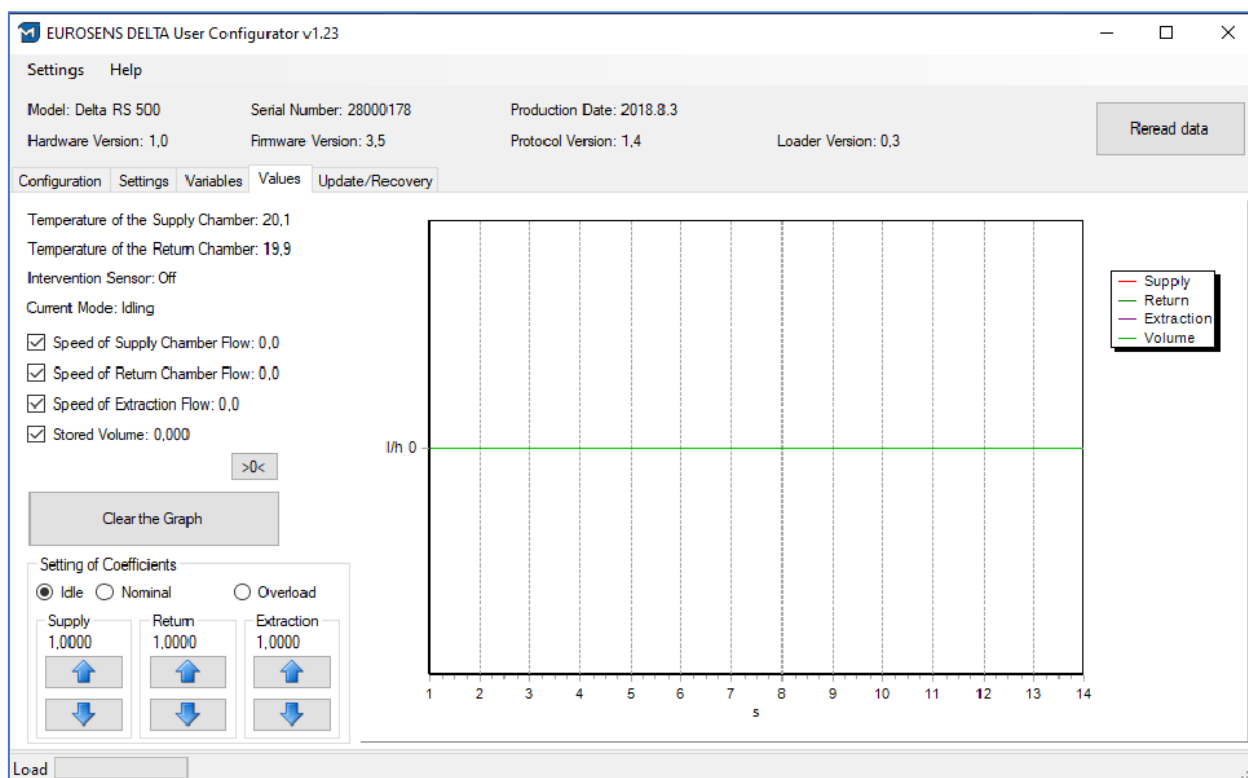


fig. 5.11. Values tab

- **Temperature of the Return Chamber** shows the current temperature value in the return chamber. The measurement error is 1°C.
- **Intervention Sensor** parameter shows the status of the intervention sensor: “On” or “Off”.
- **Current Mode** shows the current operation mode of both chambers (“Idling”, “Nominal”, “Overload”, “Cheat” and “Negative”).

Parameters displayed by the graph:

- **Speed of Supply Chamber Flow.** If selected (with a “tick” mark), the parameter shows the speed of the supply chamber flow on the graph.

- **Speed of Return Chamber Flow.** If selected (with a “tick”), the parameter shows the speed of the return chamber flow on the graph.
- **Speed of Extraction Flow.** If selected (with a “tick”), the parameter shows the speed of extraction flow on the graph (subtractive consumption).
- **Stored Volume.** If selected (with a “tick”), the parameter shows the total fuel volume that flowed through the flowmeter.

The line graph shows the flowmeter operation process: the x-axis is the time in seconds, the y-axis is the speed in l/h. At the top right there are graph colour notes.

- **“Clear the Graph”** button clears the graphical field and resets the coordinate system.

The field **“Setting of Coefficients”** contains coefficients from the tab **“Settings”** (the field **“Conversion Factors”**) and is used to quickly change the coefficients during engine operation. This allows simultaneous monitoring of the measurement process and, if necessary, adjusting the flowmeter parameters to a particular engine.

- Buttons  and  are used to respectively increase/decrease the values of coefficients for each of the flows (**“Supply Chamber”**, **“Return Chamber”** and **“Subtractive Consumption”**).
- Checkboxes **“Idle”**, **“Nominal”** or **“Overload”** allow selecting the correction coefficient depending on the operation mode.



If the coefficients are corrected during flowmeter operation, there can be abrupt changes in graphs readings provoked by quick switches between operation modes.



The coefficient values selected in the field **“Setting of Coefficients”** can be saved to the flowmeter memory in the tab **“Settings”** – **“Subtractive Consumption”**.

5.4.6 “UPDATE/RECOVERY” TAB

The tab **“Update/Recovery”** ([fig. 5.12](#)) is used to update the flowmeter firmware.

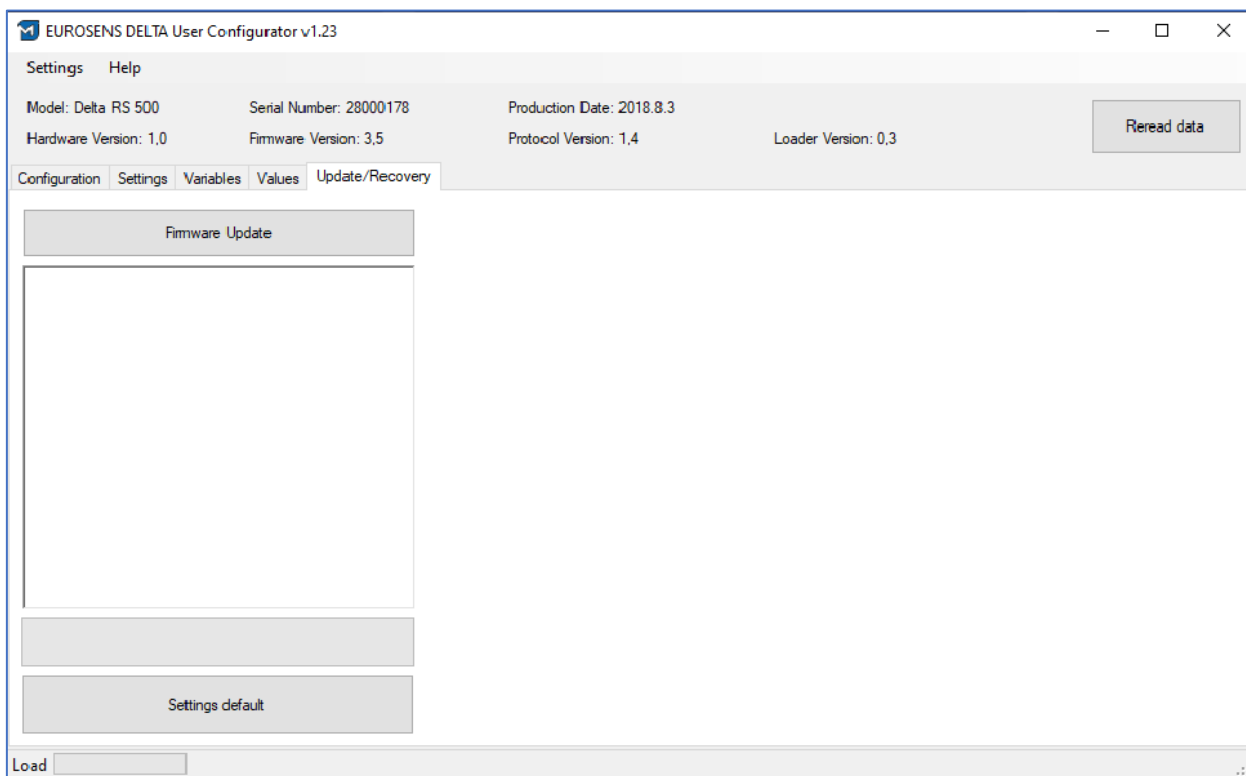


fig. 5.12. Update/Recovery tab

The tab **“Update/Recovery”** contains the following settings:

- **“Firmware Update”** button is used to select the firmware file. After the file is selected, the software updates automatically. The update progress is shown by a status bar at the bottom left.



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

Firmware update in the Recovery mode:

- 1) disconnect the flowmeter;
- 2) run the Configurator and select the tab **“Update/Recovery”**;

- 3) press the button **“Firmware Update”** and select the firmware file ([fig. 5.13](#)) (Delta_... or Direct_... depending on the type of the flowmeter);
- 4) connect the flowmeter to the service adapter and wait for the update process to finish.

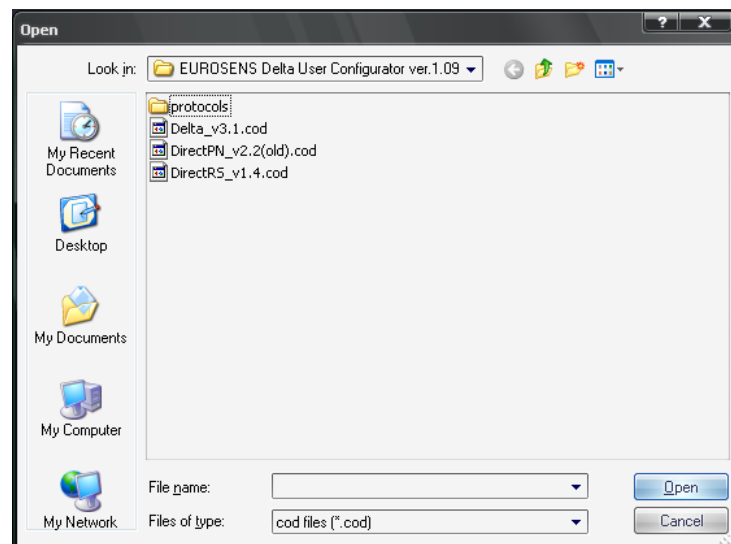


fig. 5.13. Selecting firmware file

- **“Settings Default”** button resets the current flowmeter configuration and sets factory defaults.

5.5 STANDARD FLOWMETER SETTINGS

Fuel flowmeters eurosens are factory calibrated to be used in the most popular configurations. Therefore, in most cases there is no need for additional calibration.

Flowmeters eurosens Delta are configured in the Differential mode, i.e. fuel consumption is calculated as the difference between the supply and return flow rates.

5.5.1 STANDARD FLOWMETER SETTINGS WHEN CONNECTED VIA PULSE OUTPUT

Fuel flowmeters eurosens have a pulse output, it is activated by default with enabled pull-up (positive square waves). No additional setting is necessary ([fig. 5.14](#)).

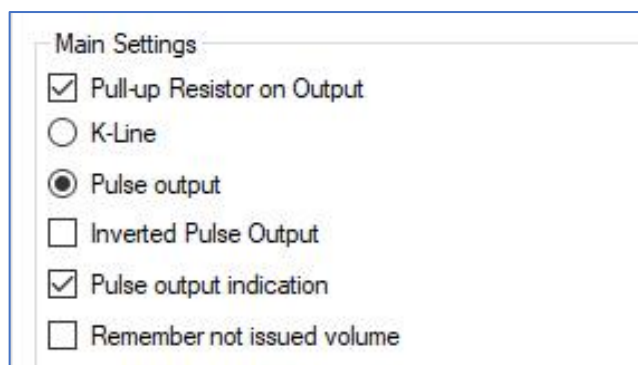


fig. 5.14. Pulse output settings

5.5.2 STANDARD FLOWMETER SETTINGS WHEN CONNECTED VIA RS-485

RS-485 is enabled by default, eurosens Delta protocol is used. To switch it to the output mode via MODBUS RTU protocol, it is necessary to set this mode.

By default, the flowmeter has address №1 in the RS-485 network, but responds to information requests at any address (the option to ignore device address is enabled). It is necessary to set the flowmeter address and turn off the option **“Ignore Device Address”** ([fig. 5.15](#)).

Digital Output

☐ RS232 ☐ Modbus

☒ RS485 ☐ Termination

☐ K-Line ☐ Up line RS485

☐ CAN J1939

☐ CAN NMEA 2000

Engine number NMEA 2000:

Automatic Data Producing Mode:

Data Producing Interval: s.

Data Transmission Speed: baud

TMS Address ☒ Ignore

Device Address ☐ Ignore

fig. 5.15. Digital output configuration for eurosens Delta protocol

It is necessary to enable MODBUS in order to use MODBUS RTU protocol.

5.5.3 STANDARD FLOWMETER SETTINGS WHEN CONNECTED VIA CAN J1939

To work via CAN interface, it is necessary to set the flowmeter address in the network and turn off the option **“Ignore Device Address”**.

CAN J1939 interface should be enabled by default. If the flowmeter connects to a monitoring terminal only, and ignores the working CAN network, it is necessary to enable a termination resistor in the flowmeter ([fig. 5.16](#)).

The screenshot shows a configuration window titled "Digital Output". It contains several settings for the CAN J1939 interface. The "CAN J1939" radio button is selected. The "Termination" checkbox is checked and highlighted with a red rectangle. The "Device Address" is set to 1, and the "Ignore" checkbox next to it is unchecked, also highlighted with a red rectangle. Other settings include "Modbus" (unchecked), "Up line RS485" (unchecked), "Engine number NMEA 2000" (0), "Automatic Data Producing Mode" (Do not produce), "Data Producing Interval" (1 s), "Data Transmission Speed" (19200 baud), and "TMS Address" (1) with its "Ignore" checkbox checked.

Digital Output	
☐ RS232	☐ Modbus
☐ RS485	☒ Termination
☐ K-Line	☐ Up line RS485
☒ CAN J1939	
☐ CAN NMEA 2000	
Engine number NMEA 2000:	0
Automatic Data Producing Mode:	Do not produce
Data Producing Interval:	1 s
Data Transmission Speed:	19200 baud
TMS Address	1
	☒ Ignore
Device Address	1
	☐ Ignore

fig. 5.16. Digital output configuration for CAN interface

5.5.4 STANDARD FLOWMETER SETTINGS WHEN CONNECTED VIA CAN NMEA 2000

To work via CAN NMEA 2000 interface, it is necessary to enable the mode NMEA 2000, set the flowmeter (device) address in CAN network and turn off the option **“Ignore Device Address”** (fig. 5.17). It is also necessary to set the engine number in order to display data about the engine from the counter.

Digital Output

☐ RS232 ☐ Modbus

☐ RS485 ☒ Termination

☐ K-Line ☐ Up line RS485

☐ CAN J1939

☒ CAN NMEA 2000

Engine number NMEA 2000:

Automatic Data Producing Mode:

Data Producing Interval: s.

Data Transmission Speed: baud

TMS Address ☒ Ignore

Device Address ☐ Ignore

fig. 5.17. Digital output configuration for NMEA 2000 network

Eurosens fuel meter sends two identifiers: PGN 127489 (a package containing instant fuel consumption) and PGN 127497 (a package with a cumulative fuel volume consumed by engine).

5.5.5 OTHER SETTINGS

“Subtract the supply/return chamber volume from the total one” is the calculation setting of differential flowmeters eurosens Delta. If both options are disabled, eurosens Delta sums up fuel volumes in the supply and return chambers ([fig. 5.18](#)). In the Adder mode, the differential flowmeter works in a single-chamber mode, but with doubled flow capacity. For example, eurosens Delta PN (RS, CAN) 500 can measure the fuel flow of up to 1000 liters per hour, if the fuel is divided into 2 flows and each flow is sent to the corresponding measuring chamber of eurosens Delta.

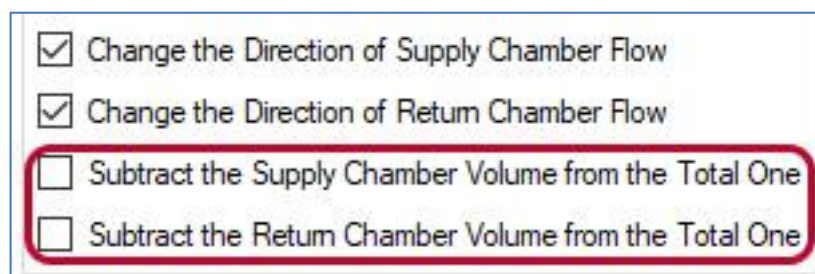


fig. 5.18. Adder mode of eurosens Delta

The flowmeter is factory calibrated to subtract the return chamber volume from the total fuel volume ([fig. 5.19](#)). In this case, the return chamber volume is subtracted from the supply chamber volume, i.e. the flowmeter operates in the mode of differential calculation of fuel consumption (the main operation mode of eurosens Delta).

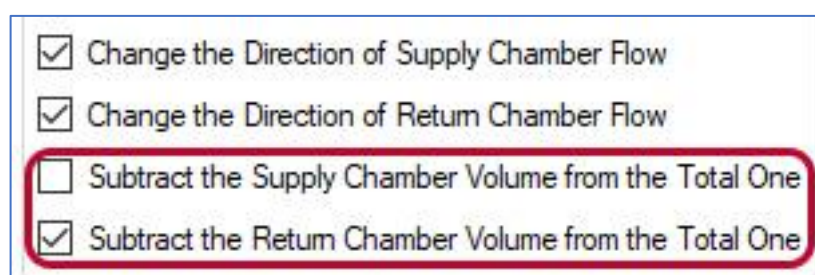


fig. 5.19. Differential mode of eurosens Delta

If, for some reason, the fuel supply line is connected to the return chamber and the return line – to the supply chamber, then instead of switching the fuel lines, it is possible to change the summation logic in this setting by enabling the option **“Subtract the Supply Chamber Volume from the Total One”**.

6 DIAGNOSTICS

6.1 ELEMENTARY DIAGNOSTICS WITHOUT SPECIAL EQUIPMENT

- 1) When power is supplied to flowmeter eurosens Delta, the LEDs on the flowmeter light up once and fade a second later. When eurosens Direct is powered ON, the green LED lights up. If this does not happen, check whether power is supplied to the flowmeter.
- 2) If fuel flows through the measuring chamber(s) of a powered flowmeter, the red LED in eurosens Direct and both LEDs in eurosens Delta (for each measuring chamber) will blink with a frequency proportional to the flow rate. If this does not happen, check whether the measuring chamber is clogged by blowing some air into it. The properly working chamber should make a swishing sound. Otherwise, disassemble and wash the chamber. The procedure is described in eurosens Direct/Delta Cleaning Procedure manual.
- 3) The flow LED blinks, but the monitoring system shows zero instant fuel consumption.
 - For eurosens Direct – check the direction of fuel lines connection to the flowmeter. If the flow direction is opposite to that indicated on the flowmeter case, the LED will blink, but the value of the instant fuel consumption will be:
 - zero (Direct CAN);
 - negative (Direct RS);
 - no pulses at the pulse output (Direct PN).
 - For eurosens Delta – check the blinking frequency of the supply and return LEDs. If the blinking frequency in the return line is higher than in the supply line, then the negative instant consumption is displayed as either “zero” (Delta CAN) or “no pulses” (Delta PN).
- 4) Check the presence of pulses at the pulse output with a voltmeter by measuring the voltage relatively to GND (minus) wire. With the pull-up on and low fuel consumption, there will be a voltage drop at the measuring output when the pulse is produced.

6.2 DIAGNOSTICS WITH CONFIGURATOR

Perform diagnostics by means of the Configurator and service adapter eurosens Destination.

- 1) Run the Configurator;
- 2) connect the flowmeter to PC. Flowmeter information will be displayed on the screen (serial number, firmware version and settings).

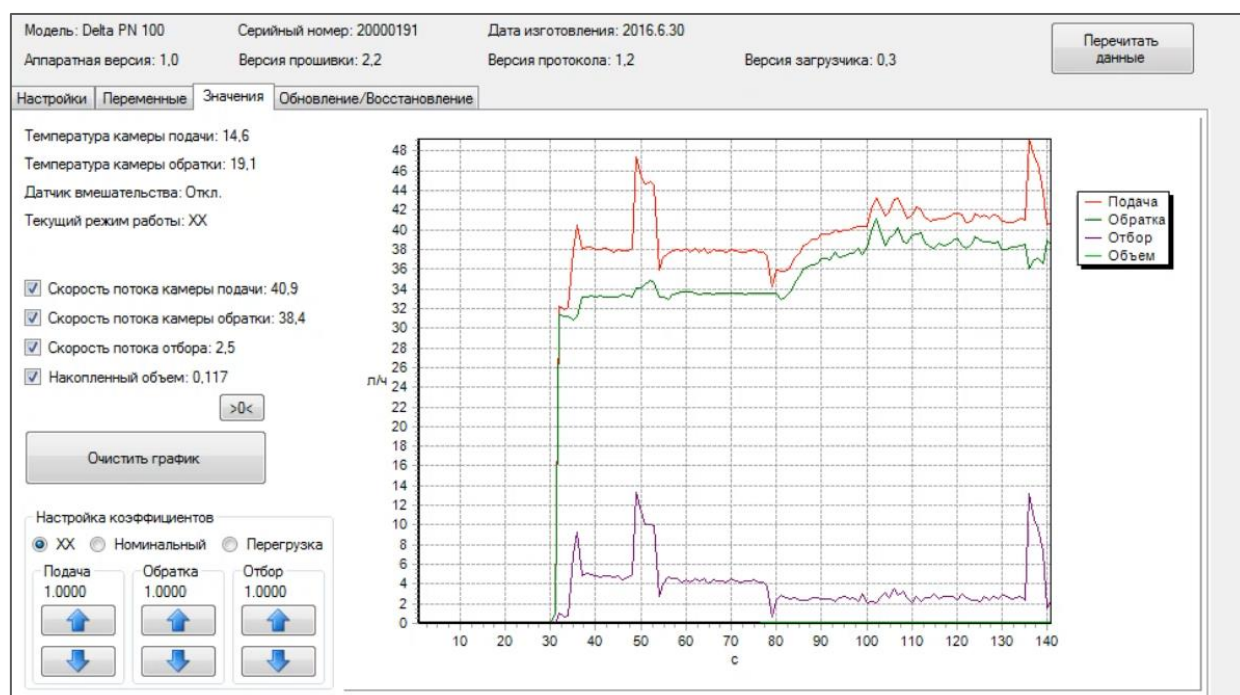


fig. 6.1. Values tab

- The tab **“Values”** is used for diagnostics of flowmeter operation. The tab displays current values of the instant fuel consumption in the measuring chambers as digital values and line graphs ([fig. 6.1](#)).

If the measuring chambers are connected correctly, the instant consumption in each of them is above zero. If the instant consumption is negative, check whether the fuel lines are connected correctly.

- The graph **“Extraction”** shows the consumption values calculated by the flowmeter. For eurosens Direct, the graphs “Extraction” and “Supply” have the same values. For eurosens Delta, the graph values are calculated as the difference between the supply and return flows (the most common case), or as the sum of supply and return flows in Adder mode. When calculating the

difference, the instant consumption can normally drop below zero for a short time ([fig. 6.2](#)).

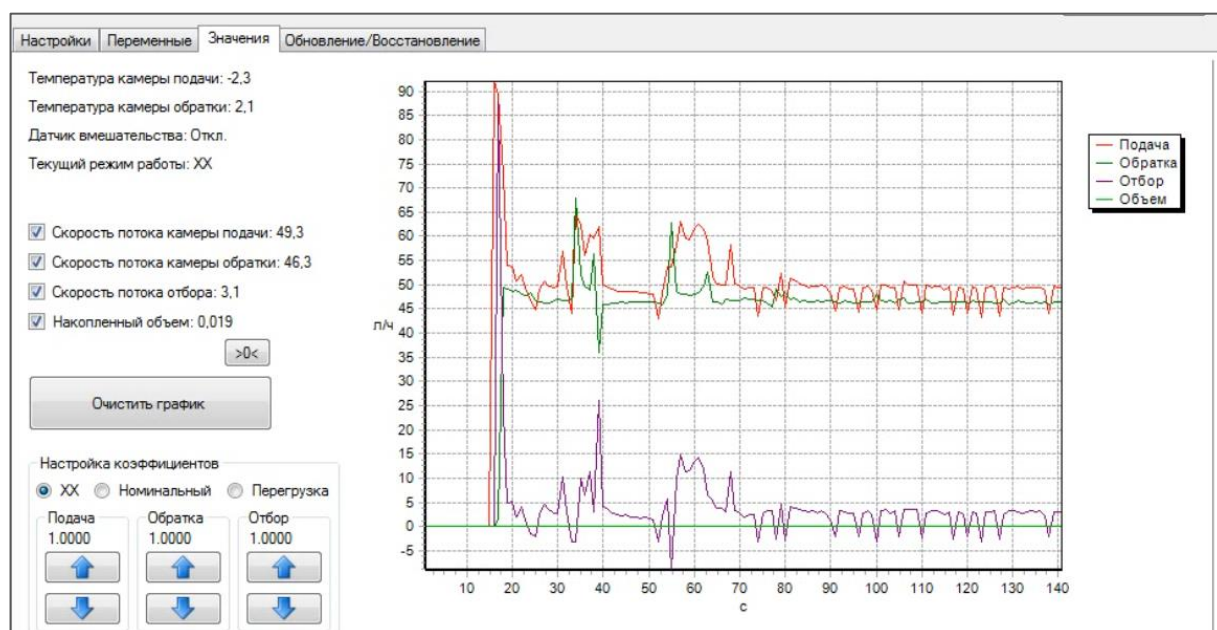


fig. 6.2. Instant consumption drops below zero



If the return flow exceeds the supply flow (constantly or in certain engine operation modes), it is necessary to identify the cause, since the flowmeter values will be incorrect. There can be air in the return line.

7 FIRMWARE UPDATE

The tab **“Update/Recovery”** ([fig. 7.1](#)) is used to update the flowmeter firmware.

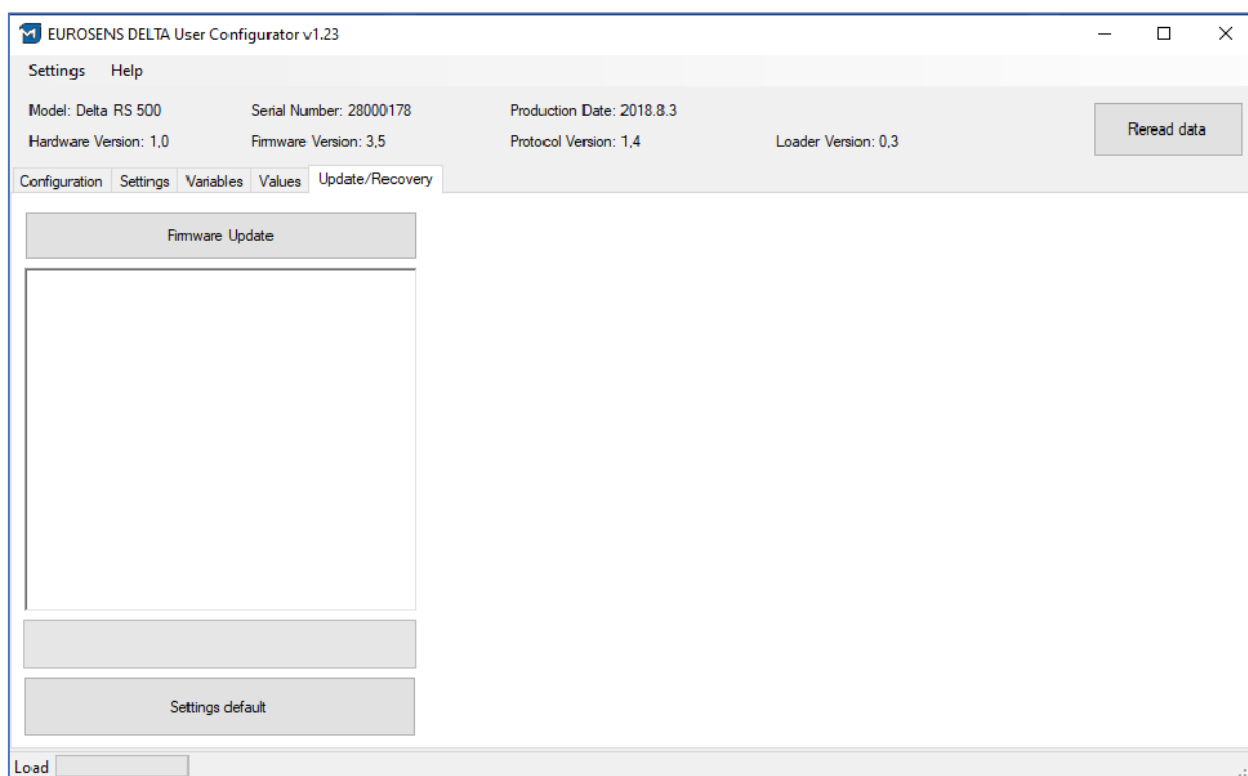


fig. 7.1. Update/Recovery tab

The tab **“Update/Recovery”** contains the following settings:

- **“Firmware Update”** button is used to select the firmware file. After the file is selected, the software updates automatically. The update progress is shown by a status bar at the bottom left.



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

Firmware update in the Recovery mode:

- 1) disconnect the flowmeter;

- 2) run the Configurator and select the tab **“Update/Recovery”**;
 - 3) press the button **“Firmware Update”** and select the firmware file (Delta_... or Direct_... depending on the type of the flowmeter);
 - 4) connect the flowmeter to the service adapter and wait for the update process to finish.
- **“Settings Default”** button resets the current flowmeter configuration and sets factory defaults.

8 ADDITIONAL INFORMATION

8.1 STORAGE

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

Fuel flowmeters eurosens may only be stored in its original packaging at temperature range from -50 to + 40 °C and relative humidity up to 100% at +25 °C.

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

The storage period of fuel flowmeters eurosens should not exceed 12 months.

8.2 TRANSPORTATION

Fuel flowmeters 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.

Shipping containers with fuel flowmeters eurosens must be sealed.

8.3 DISPOSAL

Fuel flowmeters 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.

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

8.4 TECHNICAL SUPPORT



+37525-691-87-76



+37525-691-87-76



support@mechatronics.by

8.5 CONTACTS

JSC Mechatronics

80/3 1st May Street

Vileyka, 222416

Belarus

t: +375 (1771) 33011

f: +375 (1771) 24190

E-mail: office@mechatronics.by

www.mechatronics.by/en

APPENDIX A. DIMENSIONS

Dimensions of fuel flowmeter models are given below in [fig.A. 1](#), [fig.A. 2](#), [fig.A. 3](#) and [fig.A. 4](#).

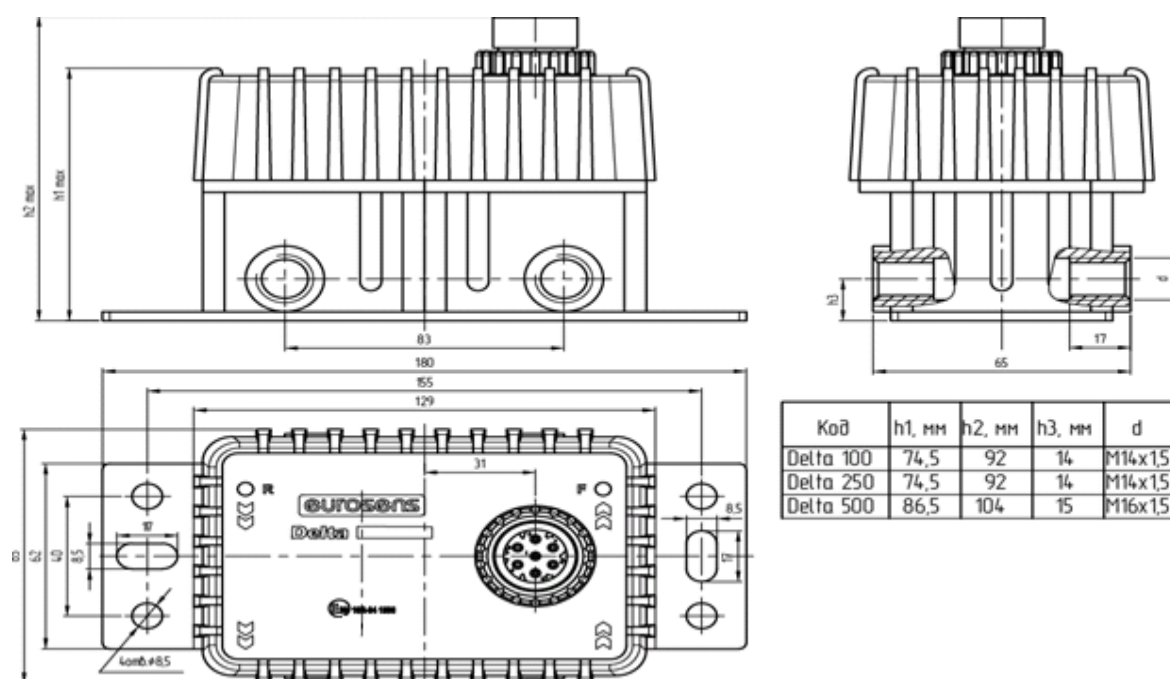


fig.A. 1. Dimensions of eurosens Direct (100/250/500)

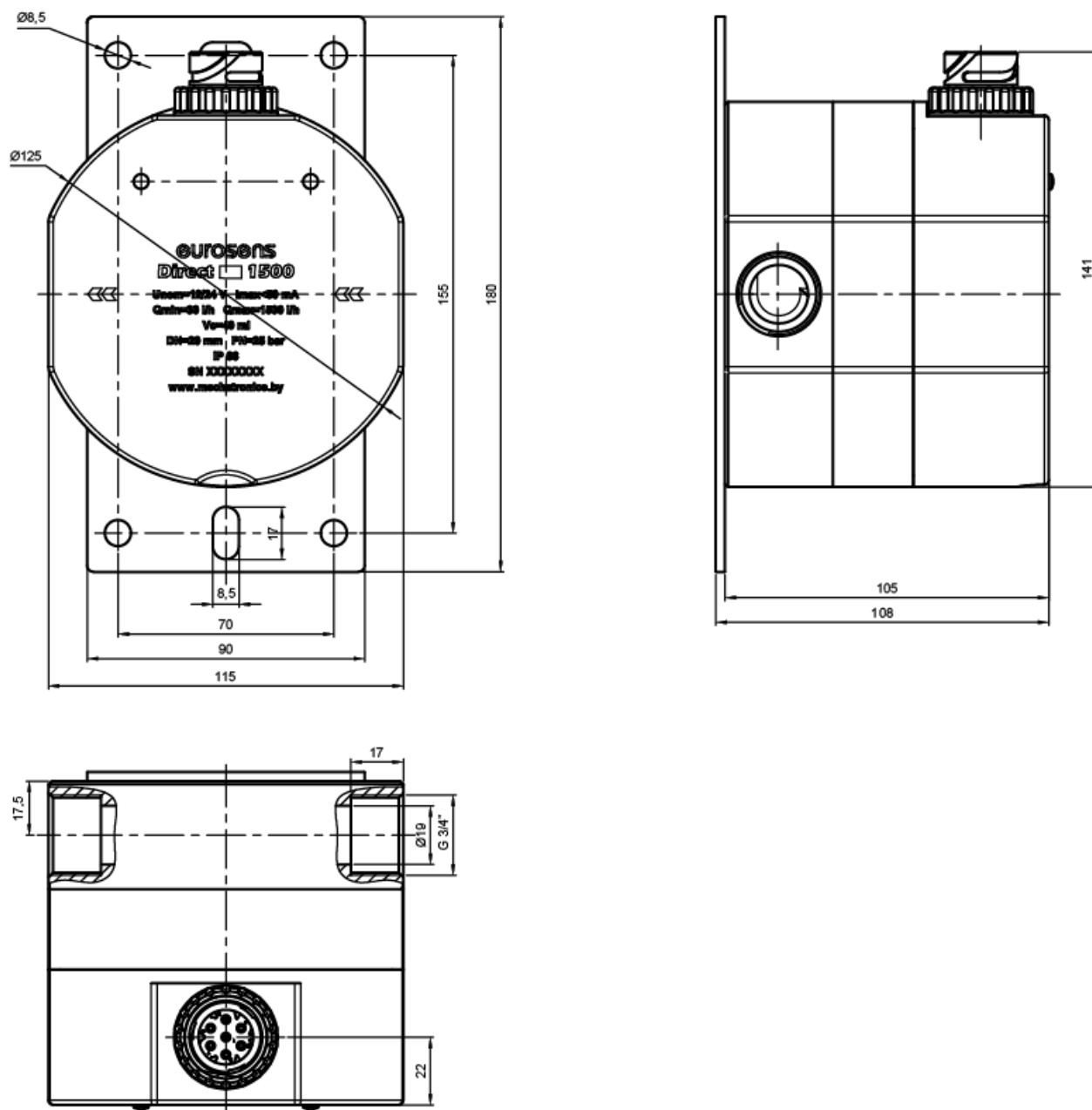


fig.A. 3. Dimensions of eurosens Direct 1500

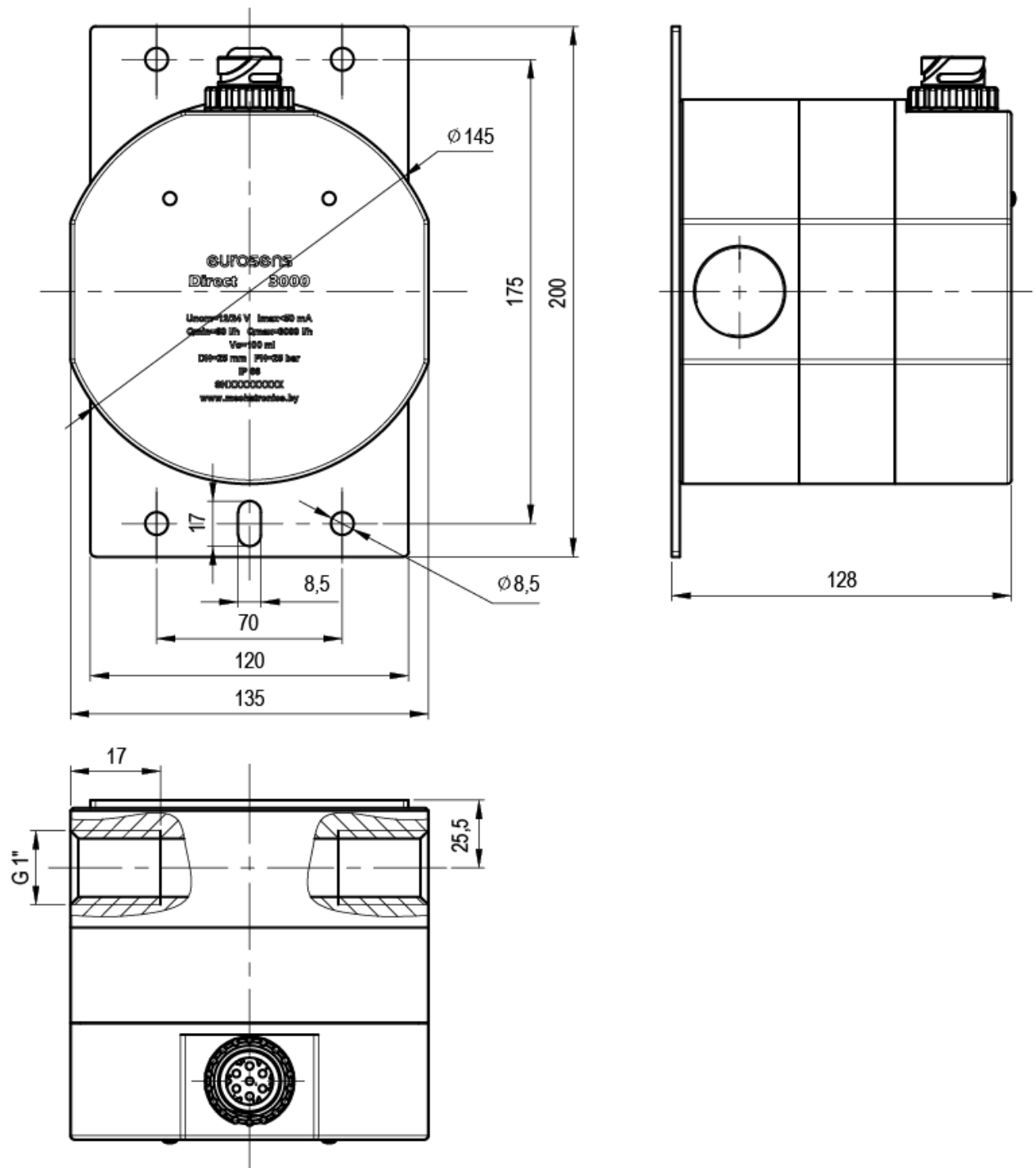


fig.A. 4. Dimensions of eurosens Direct 3000

APPENDIX B. ADDRESS SPACE FOR MODBUS PROTOCOL

Table B1. Modbus protocol

No	Modbus address	Storage location	Data type	Comments
1	0000	Input register (High 16-bit)	32-bit signed	Fuel volume (in 0.01 liter)
2	0001	Input register (Low 16-bit)		
3	0002	Input register	16-bit signed	Current fuel flow rate (in 0.1 liter/hour)
4	0003	Input register	16-bit unsigned	Status*
5	0004	Input register (High 16-bit)	32-bit signed	Fuel volume in supply chamber (in 0,01 liter)
6	0005	Input register (Low 16-bit)		
7	0006	Input register	16-bit signed	Current fuel flow rate in supply chamber (in 0.1 liter/hour)
8	0007	Input register	16-bit signed	Fuel temperature in supply chamber (in 0.1 °C)
9	0008	Input register (High 16-bit)	32-bit signed	Fuel volume in return chamber (in 0,01 liter)
10	0009	Input register (Low 16-bit)		
11	0010	Input register	16-bit signed	Current fuel flow rate in return chamber (in 0.1 liter/hour)
12	0011	Input register	16-bit signed	Fuel temperature in return chamber (in 0.1 °C)
13	0012	Input register (High 16-bit)	32-bit signed	Fuel volume in mode "Idle" (in 0.01 liter)
14	0013	Input register (Low 16-bit)		
15	0014	Input register (High 16-bit)	32-bit signed	Fuel volume in mode "Nominal" (in 0.01 liter)
16	0015	Input register (Low 16-bit)		

No	Modbus address	Storage location	Data type	Comments
17	0016	Input register (High 16-bit)	32-bit signed	Fuel volume in mode "Overload" (in 0.01 liter)
18	0017	Input register (Low 16-bit)		
19	0018	Input register (High 16-bit)	32-bit signed	Fuel volume in mode "Cheat" (in 0.01 liter)
20	0019	Input register (Low 16-bit)		
21	0020	Input register (High 16-bit)	32-bit signed	Fuel volume in mode "Negative" (in 0.01 liter)
22	0021	Input register (Low 16-bit)		
23	0022	Input register (High 16-bit)	32-bit signed	Fuel volume of supply chamber in mode "Idle" (in 0.01 liter)
24	0023	Input register (Low 16-bit)		
25	0024	Input register (High 16-bit)	32-bit signed	Fuel volume of supply chamber in mode "Nominal" (in 0.01 liter)
26	0025	Input register (Low 16-bit)		
27	0026	Input register (High 16-bit)	32-bit signed	Fuel volume of supply chamber in mode "Overload" (in 0.01 liter)
28	0027	Input register (Low 16-bit)		
29	0028	Input register (High 16-bit)	32-bit signed	Fuel volume of supply chamber in mode "Cheat" (in 0.01 liter)
30	0029	Input register (Low 16-bit)		
31	0030	Input register (High 16-bit)	32-bit signed	Fuel volume of return chamber in mode "Idle" (in 0.01 liter)
32	0031	Input register (Low 16-bit)		
33	0032	Input register (High 16-bit)	32-bit signed	Fuel volume of return chamber in mode "Nominal" (in 0.01 liter)
34	0033	Input register (Low 16-bit)		

No	Modbus address	Storage location	Data type	Comments
35	0034	Input register (High 16-bit)	32-bit signed	Fuel volume of return chamber in mode "Overload" (in 0.01 liter)
36	0035	Input register (Low 16-bit)		
37	0036	Input register (High 16-bit)	32-bit signed	Fuel volume of return chamber in mode "Cheat" (in 0.01 liter)
38	0037	Input register (Low 16-bit)		
39	0038	Input register (High 16-bit)	32-bit signed	Time in mode "Idle" (in sec)
40	0039	Input register (Low 16-bit)		
41	0040	Input register (High 16-bit)	32-bit signed	Time in mode "Nominal" (in sec)
42	0041	Input register (Low 16-bit)		
43	0042	Input register (High 16-bit)	32-bit signed	Time in mode "Overload" (in sec)
44	0043	Input register (Low 16-bit)		
45	0044	Input register (High 16-bit)	32-bit signed	Time in mode "Cheat" (in sec)
46	0045	Input register (Low 16-bit)		
47	0046	Input register (High 16-bit)	32-bit signed	Time in mode "Negative" (in sec)
48	0047	Input register (Low 16-bit)		
49	0048	Input register (High 16-bit)	32-bit signed	Time of supply chamber in mode "Idle" (in sec)
50	0049	Input register (Low 16-bit)		
51	0050	Input register (High 16-bit)	32-bit signed	Time of supply chamber in mode "Nominal" (in sec)
52	0051	Input register (Low 16-bit)		

No	Modbus address	Storage location	Data type	Comments
53	0052	Input register (High 16-bit)	32-bit signed	Time of supply chamber in mode "Overload" (in sec)
54	0053	Input register (Low 16-bit)		
55	0054	Input register (High 16-bit)	32-bit signed	Time of supply chamber in mode "Cheat" (in sec)
56	0055	Input register (Low 16-bit)		
57	0056	Input register (High 16-bit)	32-bit signed	Time of return chamber in mode "Idle" (in sec)
58	0057	Input register (Low 16-bit)		
59	0058	Input register (High 16-bit)	32-bit signed	Time of return chamber in mode "Nominal" (in sec)
60	0059	Input register (Low 16-bit)		
61	0060	Input register (High 16-bit)	32-bit signed	Time of return chamber in mode "Overload" (in sec)
62	0061	Input register (Low 16-bit)		
63	0062	Input register (High 16-bit)	32-bit signed	Time of return chamber in mode "Cheat" (in sec)
64	0063	Input register (Low 16-bit)		
65	0064	Input register (High 16-bit)	32-bit signed	Time in mode "Intervention" (in sec)
66	0065	Input register (Low 16-bit)		
67	0066	Input register (High 16-bit)	32-bit signed	Total time of operation
68	0067	Input register (Low 16-bit)		

* – status field bits are given in Table B2.

Table B2. Status field bits

Bit number	Description
0	Current mode: idle
1	Current mode: nominal
2	Current mode: overload
3	Current mode: cheat
4	Current mode: negative
5	Intervention
6-15	Not in use

The address space is duplicated for storage registers in read mode and for 70h user instruction.

Thus, the data is available for the commands 03h, 04h и 70h.

APPENDIX C. DESCRIPTION OF CAN-MESSAGES (SAE J1939)

Table C1. Standard PGNs and SPNs (SAE J1939)

No	PGN	SPN	Parameter	Position of meaningful bytes in PGN	Length of SPN, byte	Range of parameter	Resolution/bit	Offset	Units
1.	65257 (FEE9)	182	Fuel consumption from start	1-4	4	from 0 to 210554 0607.5	0.5 liters	0	liter
2.	65257 (FEE9)	250	Fuel consumption	5-8	4	from 0 to 210554 0607.5	0.5 liters	0	liter
3.	64777 (FD09)	5053	Fuel consumption from start in high resolution	1-4	4	from 0 to 421108 1.215	0.001 liter	0	liter
4.	64777 (FD09)	5054	Fuel consumption in high resolution	5-8	4	from 0 to 421108 1.215	0.001 liter	0	liter
5.	65266 (FEF2)	183	Instant fuel consumption	1-2	2	from 0 to 3212.7 5	0.05 liters/hour	0	liter/hour
6.	65253 (FEE5)	247	Operation time	1-4	4	from 0 to 210554 060.75	0.05 hours	0	hour
7.	65262 (FEEE)	174	Fuel temperature (in supply chamber)	2	1	from -40 to 210	1°C	-40	°C

Table C2. PGNs not described by SAE J1939

№	PGN	Parameter	Position of meaningful bytes in PGN	Length of SPN, byte	Range of parameter	Resolution/bit	Offset	Units
1.	65360 (FF50)	Fuel volume in Idle mode	1-4	4	from 0 to 4,211,081.215	0.001 liter	0	liter
2.	65360 (FF50)	Fuel volume in Nominal mode	5-8	4	from 0 to 4,211,081.215	0.001 liter	0	liter
3.	65361 (FF51)	Fuel volume in Overload mode	1-4	4	from 0 to 4,211,081.215	0.001 liter	0	liter
4.	65361 (FF51)	Fuel volume in Cheat mode	5-8	4	from 0 to 4,211,081.215	0.001 liter	0	liter
5.	65362 (FF52)	Fuel volume in Negative mode	1-4	4	from 0 to 4,211,081.215	0.001 liter	0	liter
6.	65362 (FF52)	Intervention time	5-8	4	from 0 to 210,554,060.75	0.05 hours	0	hour
7.	65363 (FF53)	Fuel volume in supply chamber	1-4	4	from 0 to 4,211,081.215	0.001 liter	0	liter
8.	65363 (FF53)	Fuel volume in supply chamber in Cheat mode	5-8	4	from 0 to 4,211,081.215	0.001 liter	0	liter
9.	65364 (FF54)	Fuel volume in return chamber	1-4	4	from 0 to 4,211,081.215	0.001 liter	0	liter
10.	65364 (FF54)	Fuel volume in supply chamber in Cheat mode	5-8	4	from 0 to 4,211,081.215	0.001 liter	0	liter
11.	65365 (FF55)	Fuel flow rate in supply chamber	1-2	2	from 0 to 3,212.75	0.05 liters/hour	0	liter/hour
12.		Fuel temperature in supply chamber	3	1	from -40 to 210	1 °C	-40	°C

№	PGN	Parameter	Position of meaningful bytes in PGN	Length of SPN, byte	Range of parameter	Resolution/bit	Offset	Units
13.		Status	4	1	See below for description of bit fields			
14.		Fuel flow rate in return chamber	5-6	2	from 0 to 3,212.75	0.05 liters/hour	0	liter/hour
15.		Fuel temperature in return chamber	7	1	from -40 to 210	1 °C	-40	°C
16.		Firmware Version	8	1	Firmware Version Number			
17.	65366 (FF56)	Total operating time of engine	1-4	4	from 0 to 4,211,081.215	1 sec	0	sec
18.	65366 (FF56)	Negative mode time	5-8	4	from 0 to 210,554,060.75	1 sec	0	sec
19.	65367 (FF57)	Idle mode time	1-4	4	from 0 to 4,211,081.215	1 sec	0	sec
20.	65367 (FF57)	Nominal mode time	5-8	4	from 0 to 4,211,081.215	1 sec	0	sec
21.	65368 (FF58)	Overload mode time	1-4	4	from 0 to 4,211,081.215	1 sec	0	sec
22.	65368 (FF58)	Cheat mode time	5-8	4	from 0 to 4,211,081.215	1 sec	0	sec

Table C3. Status fields (0 – inactive, 1 – active)

Bit number	Description
0	Current mode: idle
1	Current mode: nominal
2	Current mode: overload
3	Current mode: cheat
4	Current mode: negative
5	Intervention
6-7	Not in use

In NMEA2000 mode Eurosens fuel meter sends two identifiers: PGN 127489 (a package containing instant fuel consumption) and PGN 127497 (a package with a cumulative fuel volume consumed by engine).

APPENDIX D. DESCRIPTION OF LLS-MESSAGES (RS-485 INTERFACE)

Flowmeters with RS485 interface could be polled by LLS protocol widely used in GPS tracking industry for fuel level sensor connection.

Table D1. Description of LLS messages.

LLS field	Description
Fuel level 2-byte field	Accumulated fuel consumption in liters*0.5. The range is from 0 to 32767 liters, overflow monitoring must be done on the server side.
Temperature, 1-byte, signed	Instantaneous fuel consumption in % of maximum fuel consumption. <i>Example:</i> for a Delta 250 meter, the value 12 in this field means $250 * 12 / 100 = 30$ liters per hour.
Frequency, 2-byte field (not always present)	First byte (low) - instantaneous flow rate in supply line in % of maximum, second byte (high) - instantaneous flow rate in return line in % of maximum <i>Example:</i> For a Delta 250 flowmeter 10796 means the first byte is 44, i.e. $44 * 250 / 100 = 110$ l/h Second byte - 42, that is $42 * 250 / 100 = 105$ l/h Both bytes are signed values, i.e. values greater than 127 must be calculated using the formula as <i>flow = value - 256</i> .

LLS protocol is quite simple but we recommend to use a MODBUS RTU connection to obtain a complete list of flowmeter parameters

APPENDIX E. MOUNTING KIT CONTENTS

MK Delta 01 for crimping 1. BANGO BOLT M14x1.5 fitting with a hole under the seals 6 pcs. 2. Fitting DN 10 BANGO 14x10 7 pcs. 3. Copper washer 14x19x1.5 14 pcs. 4. Coupling DN 10 1SN / 2SN / 2SC ... 7 pcs. 5. Bolt M8x16 4 pcs. 6. Nut M8..... 4 pcs. 7. Washer M8 4 pcs. 8. Washer Grover M8..... 4 pcs.	MK Direct 01 for crimping 1. Fitting BANGO BOLT M14x1.5 with hole for seal 3 pcs. 2. Fitting DN 10 BANGO 14x10 6 pcs. 3. Double fitting BANGO BOLT M14x1.5 with hole for seal 1 pcs. 4. Fitting M14x14..... 1 pcs. 5. Copper washer 14x19x1,5..... 12 pcs. 6. Coupling DN 10 1SN/2SN/2SC ... 6 pcs. 7. Bolt M8x16 4 pcs. 8. Nut M8 4 pcs. 9. Washer M8 4 pcs. 10. Washer Grover M8 4 pcs. 11. Screw plug 1 pcs.
MK Delta 01 1. Fitting BANGO BOLT M14x1.5 with hole for seal.....6 pcs. 2. Fitting DN 10 BANGO 14x10..... 7 pcs. 3. Copper washer 14x19x1,5..... 14 pcs. 4. Hose clamp 12-22..... 7 pcs. 5. Bolt M8x16..... 4 pcs. 6. Nut M8..... 4 pcs. 7. Washer M8..... 4 pcs. 8. Washer split M8..... 4 pcs.	MK Delta 01-500 for crimping 1. BANGO BOLT M16x1.5 fitting with a hole under the seals 6 pcs. 2. Fitting PN13.B10 7 pcs. 3. Copper washer 16x22x1.5 14 pcs. 4. Coupling SIH310 7 pcs. 5. Bolt M8x16 4 pcs. 6. Nut M8..... 4 pcs. 7. Washer M8 4 pcs. 8. Washer Grover M8..... 4 pcs.

APPENDIX F. READING METER DATA BY NAVTELECOM GPS TRACKER USING MODBUS RTU

For communication using RS485 interface and MODBUS RTU protocol we set up the meter according to fig. F. 1.

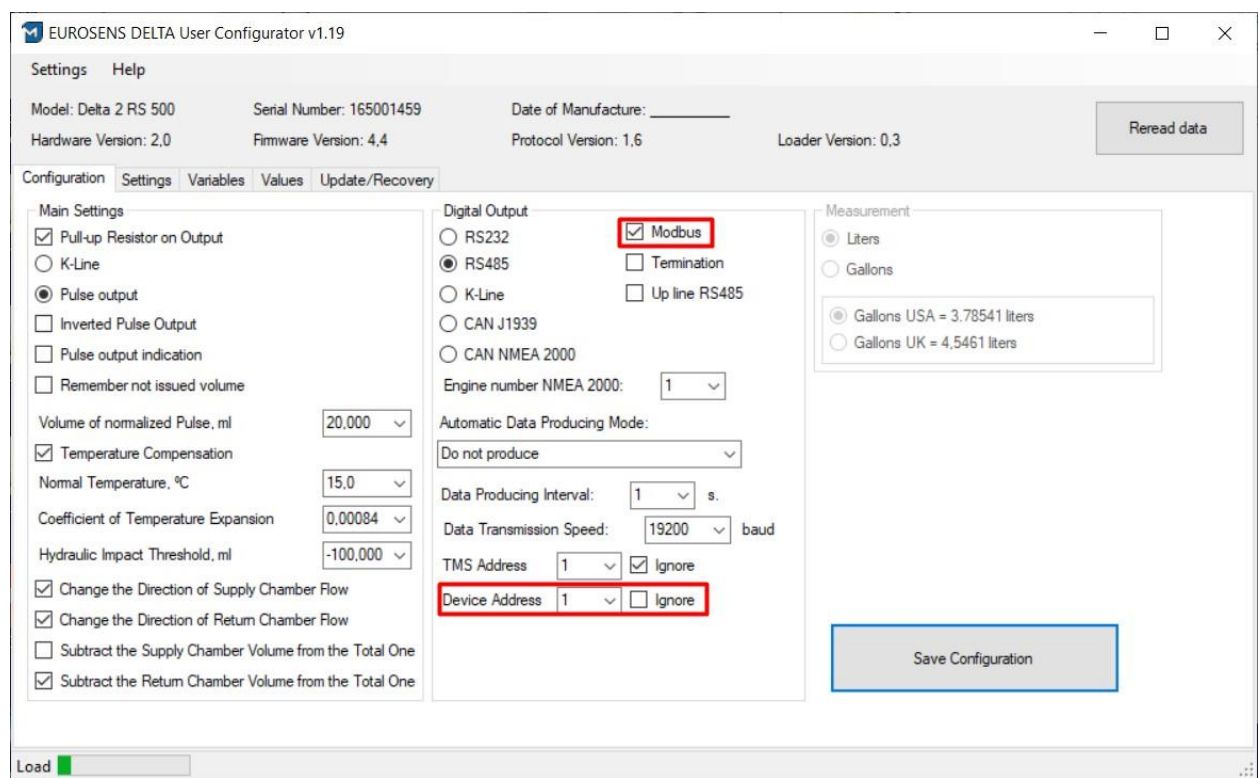


fig. F. 1

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

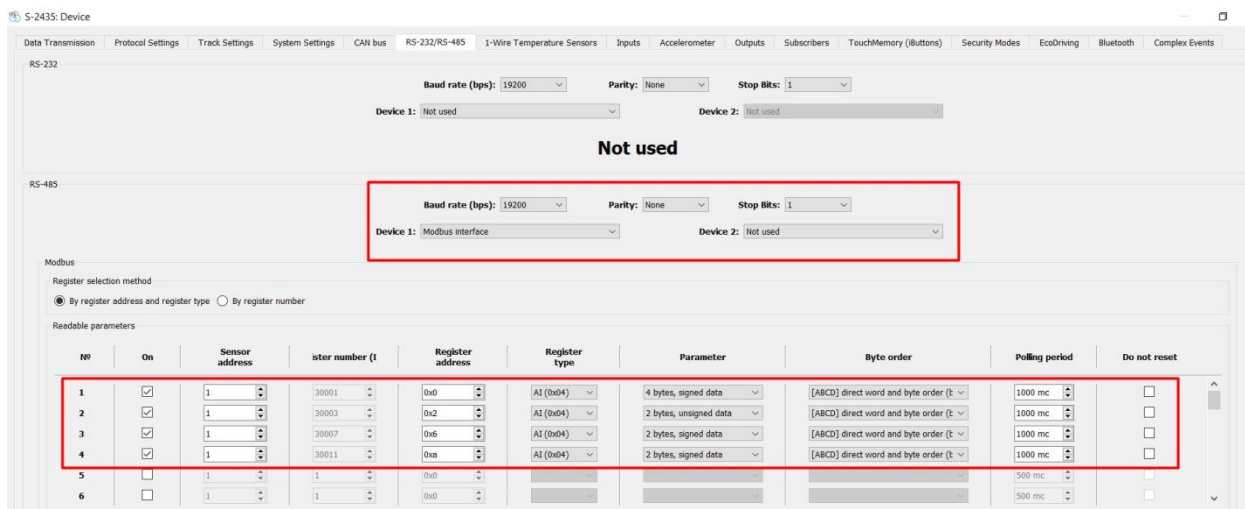


fig. F. 2

Example of the most interesting parameters:

- 0000 – total fuel consumption;
- 0002 – instant fuel consumption;
- 0003 - status (current engine mode);
- 0006 - instant fuel consumption in supply line;
- 0010 - instant fuel consumption in return line;
- 0012 – fuel consumption in the mode "idling";
- 0014 - fuel consumption in the mode "nominal";
- 0016 - fuel consumption in the mode "overload";
- 0018 - fuel consumption in the mode "cheat";
- 0038 - time of engine operation in the mode "idling";
- 0040 - time of engine operation in the mode "nominal";
- 0042 - time of engine operation in the mode "overload";
- 0044 - time of engine operation in the mode "cheat";
- 0064 – total time of cheating.

Note that register addresses in the Navtelecom GPS tracker must be set in hexademical 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. F. 2. The Parameter field (length, signed or unsigned) is filled in according to appendix B (fig. F. 3.).

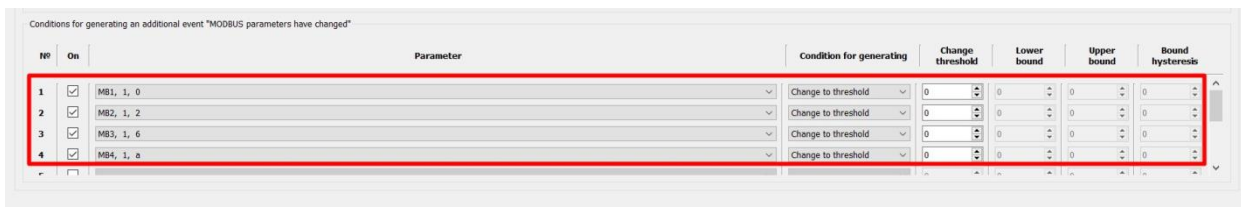


fig. F. 3.

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. F. 4).

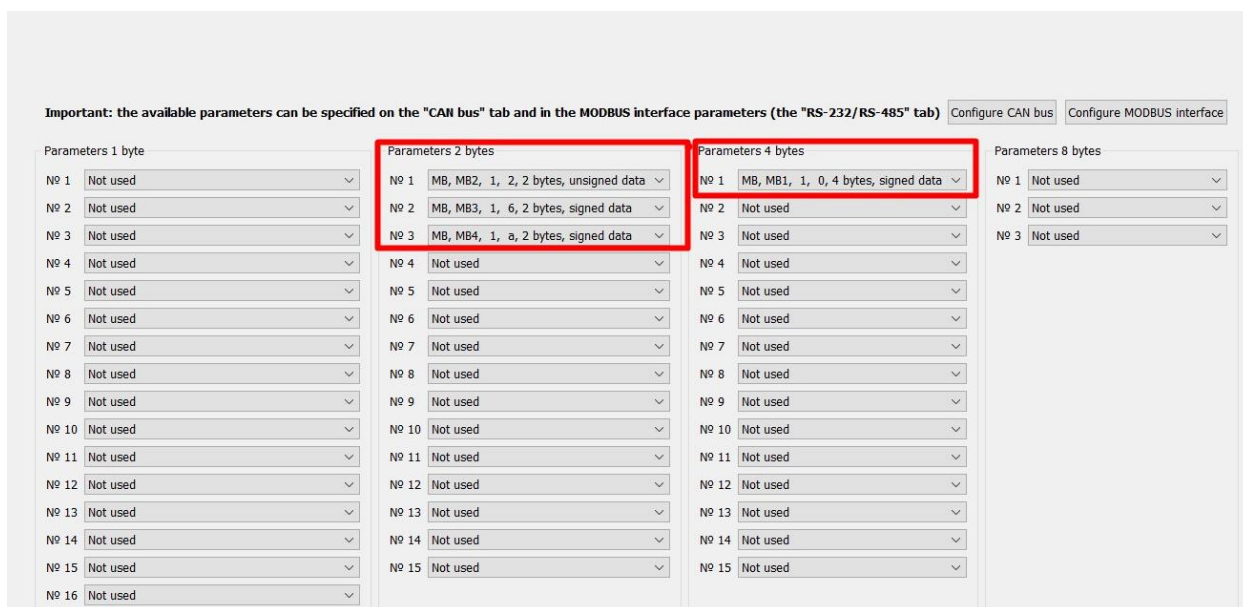


fig. F. 4

Save the configuration into the GPS tracker. It will reboot and after 40 seconds it will start reading data from the meter. Connection of meters via RS485 to the GPS tracker is carried out according to the scheme shown on fig. F. 5. It is possible to connect several meters 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. F. 1).

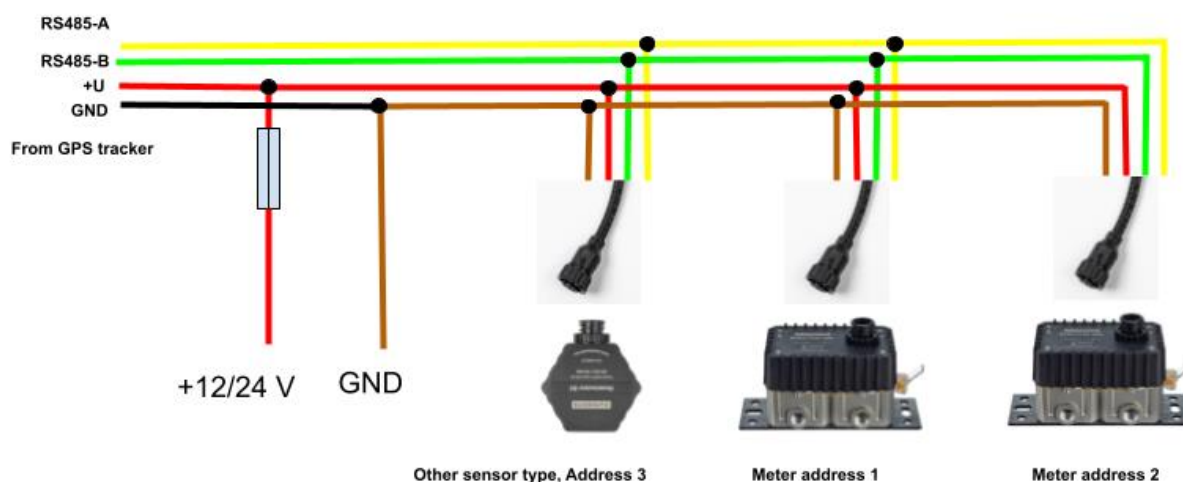


fig. F. 5

It is possible to check the values in Telemetry section, User parameters tab (fig. F. 6). Note that you must apply coefficients to the meter's data according to Appendix B. Fuel volume is transmitted in 0.01L, instant fuel consumption in 0.1 Liters/hour, time in seconds.

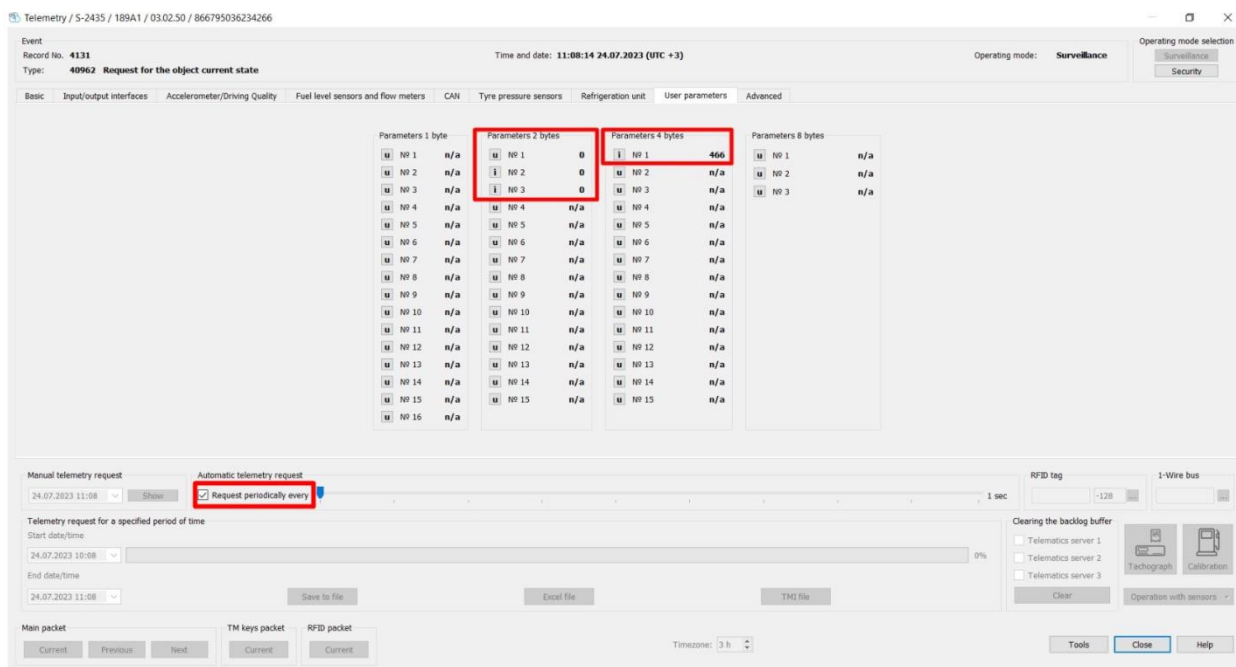


fig. F. 6

APPENDIX G. READING METER DATA BY TELTONIKA GPS TRACKER RS485 INTERFACE

For operation via RS485 interface and LLS protocol the meter must be configured as shown on fig. G. 1. It is not necessary to set LLS protocol operation - the meter detects the LLS protocol request from the GPS tracker and responds to it. It is necessary to set the **Device Address** and disable the "Ignore" option if you connect several meters per RS485 interface.

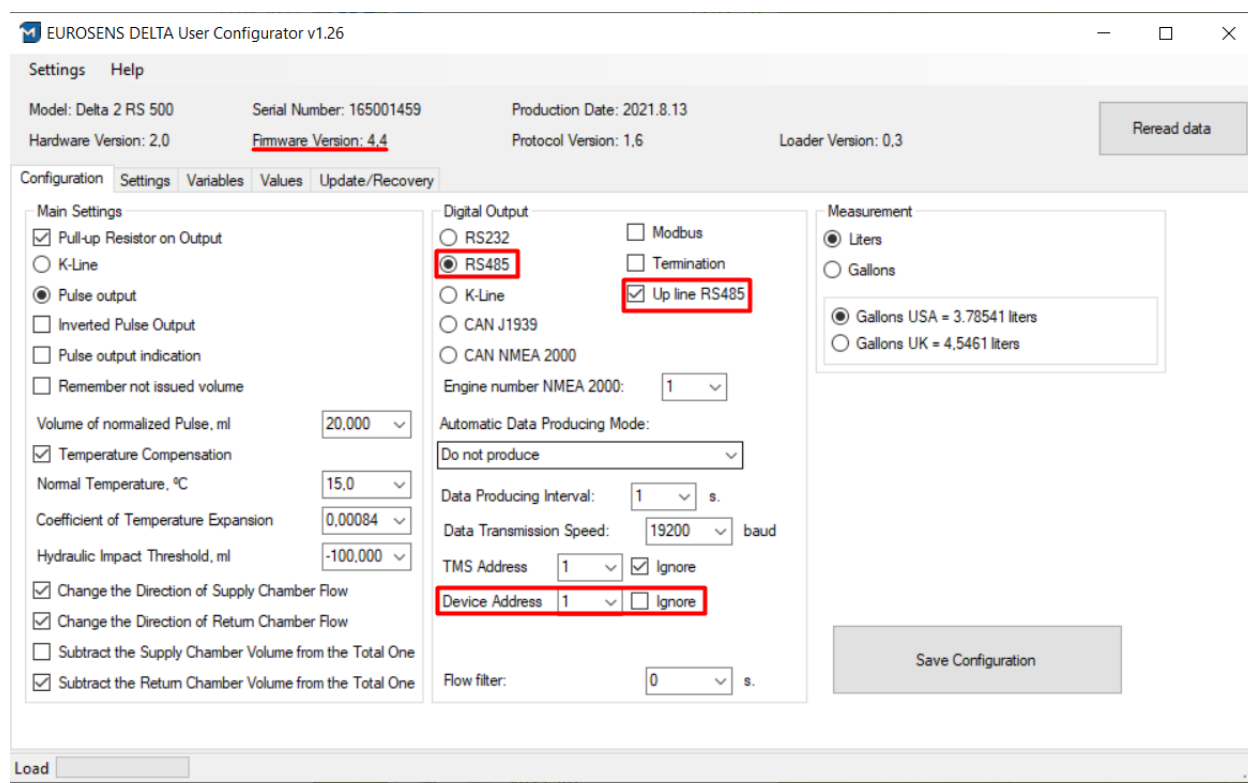


fig. G. 1

LLS-protocol is supported in firmware versions 4.4 and above.

In the Teltonika settings go to RS232/RS485 section, for RS485 interface choose LLS mode and baudrate 19200 (fig. G. 2). In RS485 LLS sensors set meter addresses for connected sensors, for example LLS 1 Address – meter with Device address=1. You can connect up to 5 meters per RS485 interface of Teltonika, also you can combine meters with other LLS sensors, like fuel level sensors.

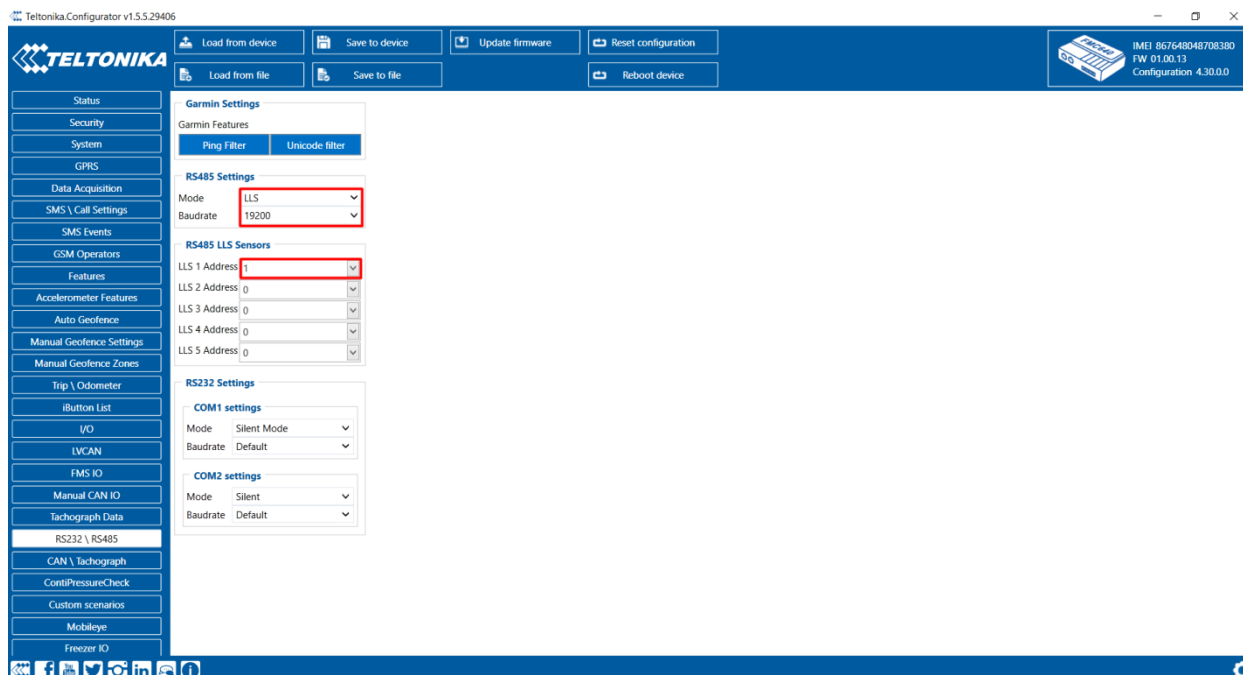


fig. G. 2

In the I/O section find the LLS parameters and set option “Low” for fuel level and LLS temperature for connected sensors (fig. G. 3). Save settings to GPS tracker and connect meter. Data from sensor should appear.

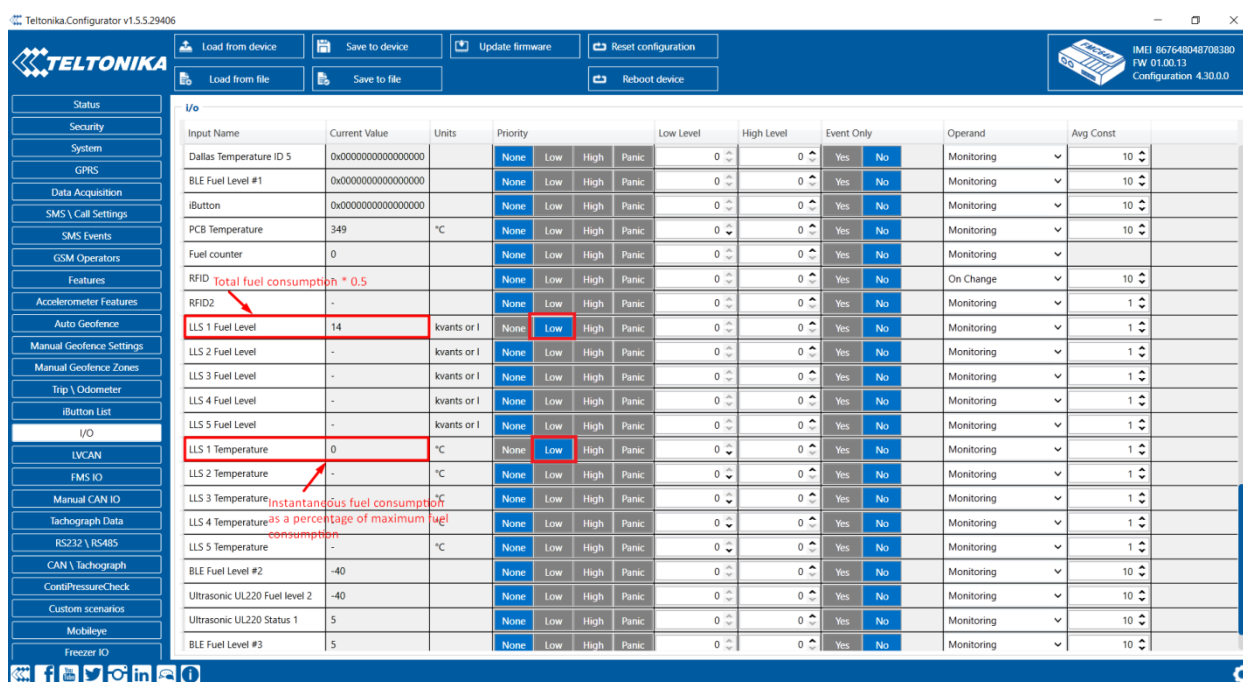


fig. G. 3

Fuel level : total fuel consumption counter with resolution 0.5 L. Value 14 means $14 * 0.5 = 7$ Liters. Maximum possible value – 32767 liters.

Temperature : instant fuel consumption in % from maximum. For example, for Delta 250 value 23 means instant fuel consumption of $0.23 * 250 = 57,5$ liters/hour.

APPENDIX F. CONNECTION TO TELTONIKA GPS TRACKER USING CAN BUS INTERFACE

For operation via CAN bus interface the meter must be configured as shown on fig. H. 1. Choose CAN J1939 mode, set 250000 Data transmission speed. It is necessary to set the **Device Address** and disable the "Ignore" option if you connect several meters per CAN interface.

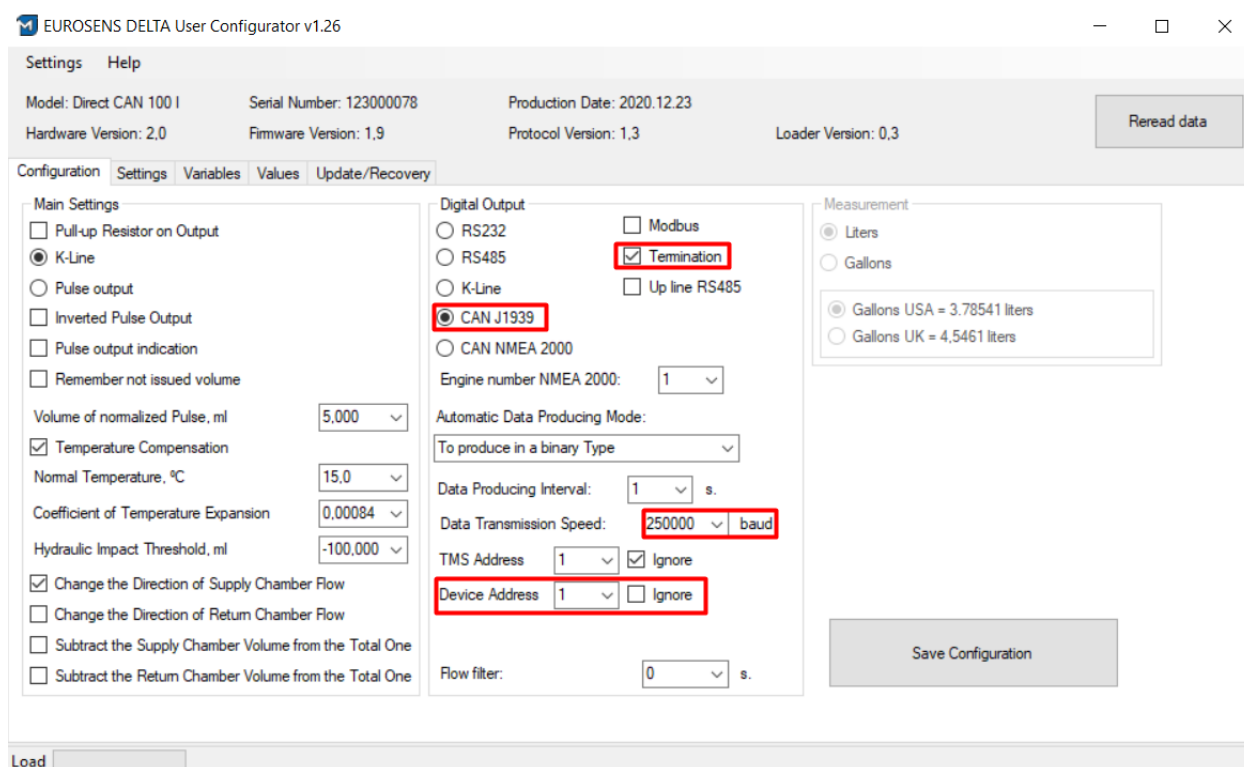


fig. H. 1

In Teltonika configurator go to CAN interface settings and choose **Normal** mode of operation and **250 kbps speed** (fig. H. 2). Choose the CAN data source – CAN1 or CAN2.

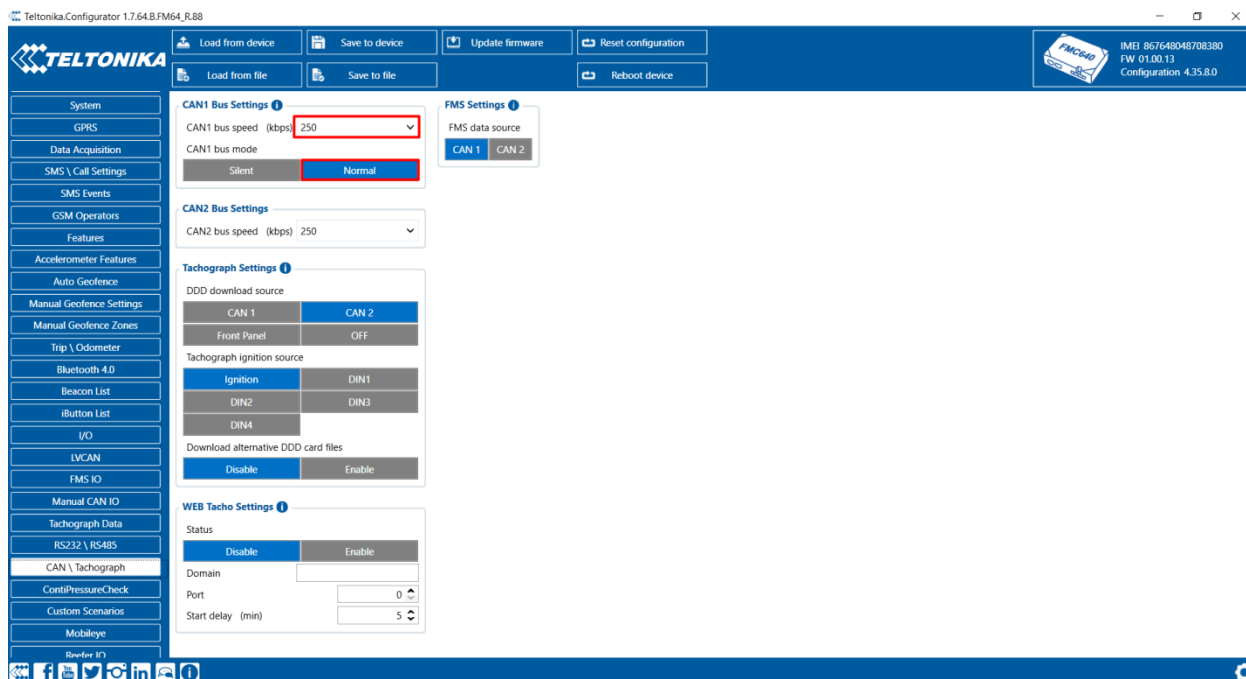


fig. H. 2

Then we need to set up the CAN bus identifiers. Choose the necessary parameters to read from meter according to **Appendix C**. Then fill in CAN bus data slots as shown on fig. H. 3. You can read as many parameters as you need using free CAN0...CAN69 slots.

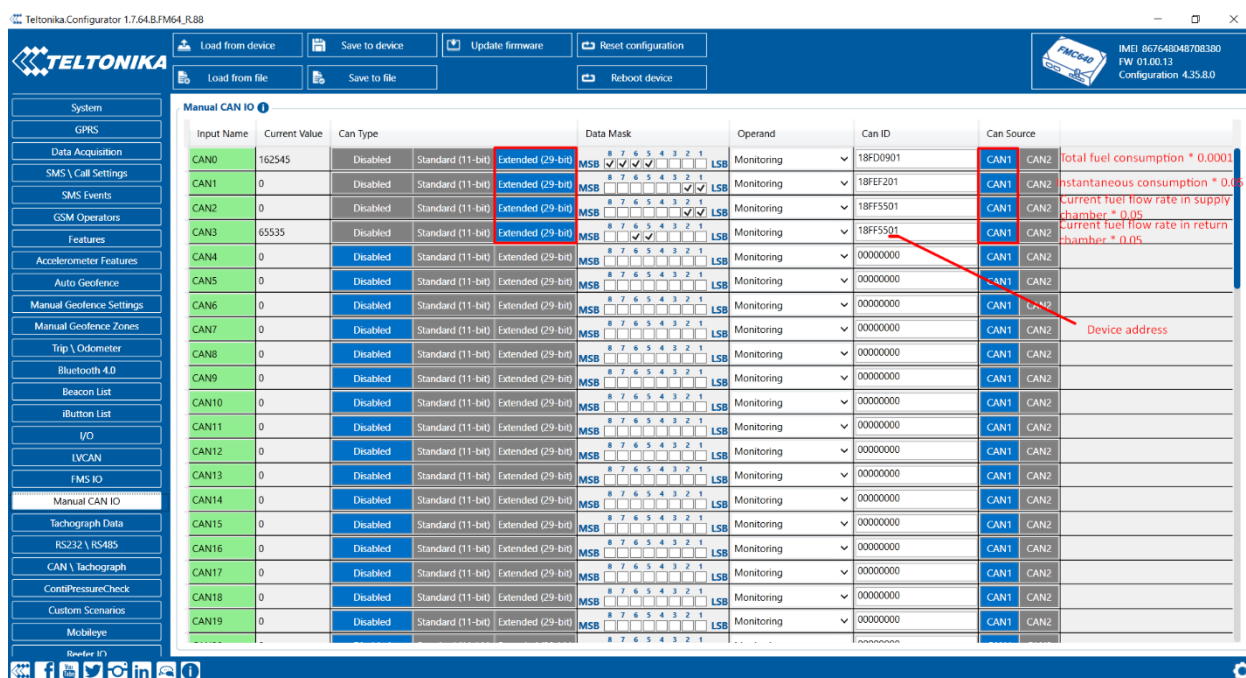


fig. H. 3

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

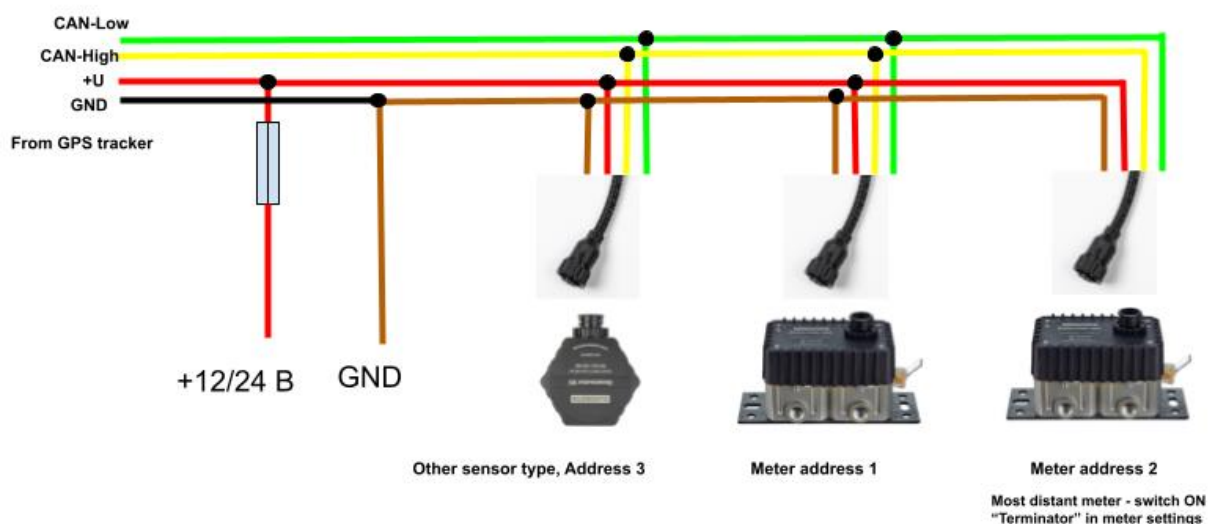


fig. H. 4

After sensor connection data appears on Manual CAN IO tab (fig. H. 3). The meter values should be calculated taking into account the Resolution and Offset values specified in the description of CAN messages (Appendix C). For example, the fuel consumption meter parameter SPN250 has a resolution of 0.5L, so its value must be multiplied by 0.5 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.



JSC Mechatronics

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

E-mail: office@mechatronics.by

Eurosenstelematics.com