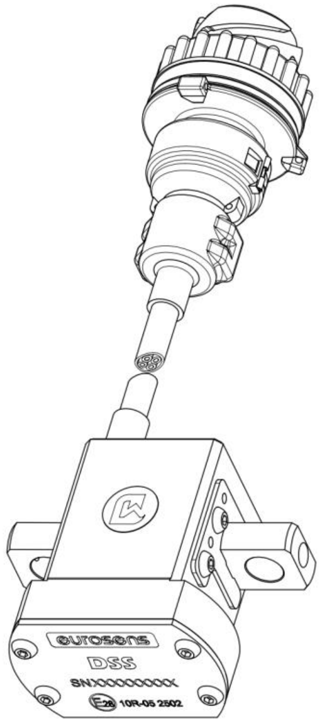
v 2.01

LOAD CONTROLLER

eurosens DSS



User manual

MECHATRONICS

v 2.01

Load controller eurosens DSS

USER MANUAL

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1 General information

Load controller (axle load sensor) eurosens DSS (fig. 1.1) is used to determine the axle load of a vehicle by measuring the microdeformations of the load-bearing elements, such as vehicle frame.

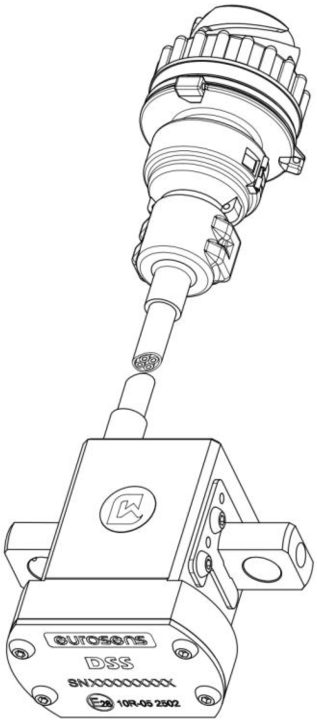

fig. 1.1. eurosens DSS

The load controller consists of a sensor and 4 support elements (brackets) welded to the vehicle frame.

2 SPECIFICATION OF eurosens DSS

Table 1

Parameter	Value
Power supply, V	10 - 50
Max current consumption, mA	50 (at 12 V)
Reverse polarity protection	Yes
Ambient operating temperature, °C	-40 - +85
Output interface	CAN (DSS CAN) RS485 (DSS 485)
Data protocol	CAN 2.0, J1939 (DSS CAN) LLS (DSS 485)
Ingress protection rating	IP 67
Dimensions, mm	65x45x26

Measurement error of eurosens DSS depends on the microstrain of the element the sensor is fixed on. The more the load-bearing element is deformed under load, the more sensitive the sensor is to axle load changes.

3 Installation of eurosens DSS

3.1 Choosing installation place

The truck frame is the main load-bearing structure (usually two longitudinal side members connected by cross members) that supports the weight of the body and the cargo. When the vehicle is loaded, the frame bends under the weight of the cargo: this causes the side members to deflect in the vertical plane. The upper zones of the side members experience compressive stresses, while the lower zones are subjected to tensile stresses—this is the typical stress distribution under vertical bending. Maximum normal stresses from bending are usually concentrated in the span and support sections of the frame—i.e., at the midpoint between supports (axles) and directly above the supports (locations where the suspension is attached to the frame). Under uniformly distributed load on the truck body, the greatest deflection and bending moment are observed approximately at the midpoint between the front and rear axles. If the cargo is shifted toward the rear (typical for dump trucks, where most of the load is concentrated over the rear axle), the peak stresses shift closer to the rear support of the frame.

The most heavily loaded sections of the frame and selection of sensor mounting points:

1. Section above the rear axle (rear suspension mounting point).

The area of the frame above the rear axle experiences the highest stresses from the cargo in the body, especially when the load is shifted toward the rear of the truck. Here, the side members act as cantilever beams supported by the rear axle, taking most of the vertical load. When installing sensors in this section, it is advisable to orient them along the longitudinal axis of the frame to record longitudinal (axial) strains of the side member due to bending. The maximum signal is obtained if the sensor is mounted near the lower surface of the side member (tension zone) or at the top (compression zone)—as shown in Fig. 3.1.

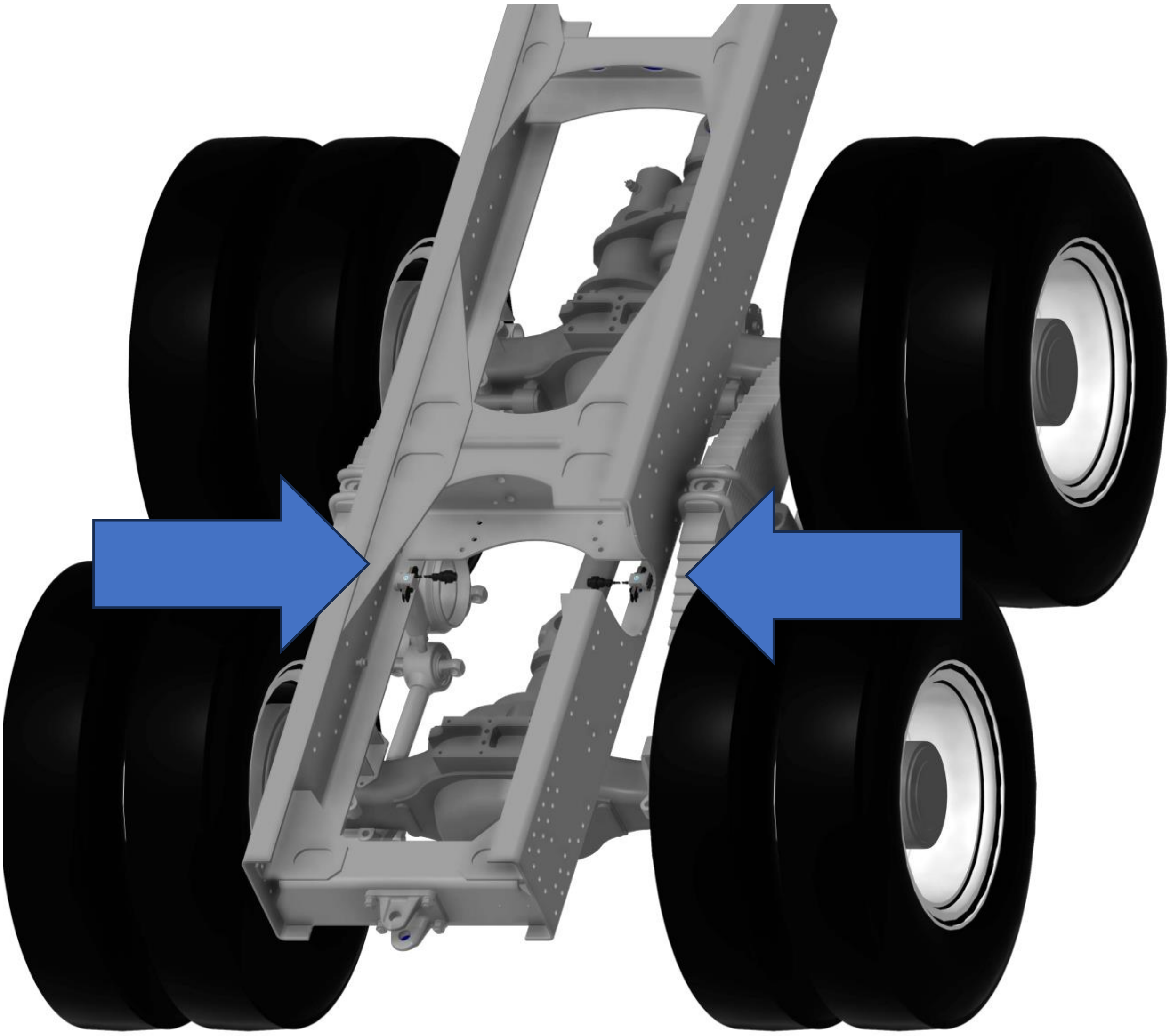

Fig. 3.1 Sensor installation on the frame near leaf spring bracket

2. Span between axles (middle of the frame).

The middle part of the frame between the front and rear supports also experiences significant bending deformations, especially under uniformly distributed cargo. In symmetric loading conditions, the maximum bending moment occurs at the center of the span. Therefore, installing strain gauges around the midpoint of the wheelbase (roughly equidistant from the front and rear axles) makes it possible to register the overall deflection of the frame from the total cargo weight. Sensitivity at this point to the load weight is high under uniform loading but may decrease if the load is shifted closer to one of the supports (in such cases, the main deformation occurs nearer that support). Nevertheless, including sensors in the mid-frame area is useful for accounting for front axle load and ensuring balanced measurements.

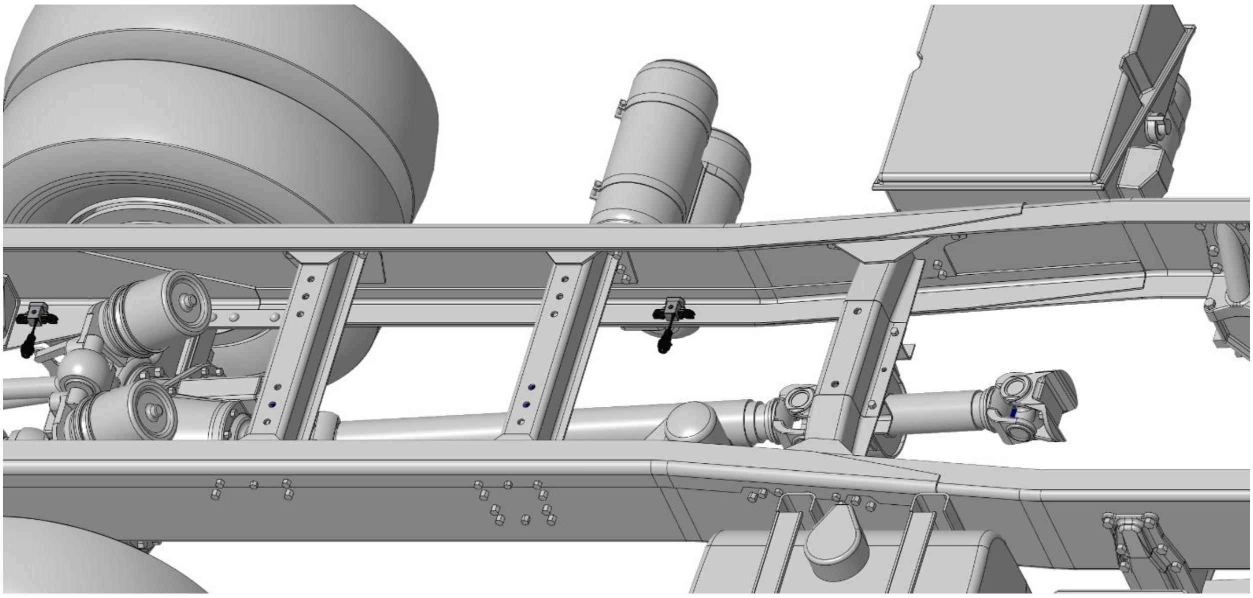

Fig. 3.2. Sensor installation on the frame between front and rear axles

3. Section above the front axle (front suspension mounting).

Although most of the truck's cargo weight is carried by the rear bogie, the front part of the frame is also loaded (by the cab, engine, and a portion of the cargo in the case of long bodies). The area around the front spring/axle mount is subjected to bending stresses from the share of load borne by the front axle. Installing strain gauges on the side member above the front suspension provides additional data on the load carried by the front axle (e.g., in cases of uneven cargo distribution). While absolute deformations here are usually smaller than above the rear axle, they are still proportional to the share of cargo weight on the front axle and thus relevant to the total weight.

4. Other sections of the frame.

As for the rear overhang of the frame (the section behind the rear axle), it experiences relatively low bending stresses from the cargo—the majority of the load is already transferred to the suspension, and the remaining cantilever overhang is less stressed. Therefore, mounting sensors at the very end of the frame is less sensitive to cargo mass (it responds more to dynamic impact loads during unloading of a dump truck than to static mass). Similarly, installing sensors on cross members of the frame or in areas near attachment points of other units (e.g., cab or body mounts) may produce distorted readings due to local effects and torsional deformations. It is preferable to select long, continuous sections of the side members without local joints or connections, where vertical load-induced bending is the dominant effect.

3.2 Installation recommendations

1) Clean the sensor installation site: degrease, remove excess moisture and all kinds of non-metallic objects, remove rust and other contaminants.
2) Cleaning can be done manually by using metal brushes, files, emery paper, or by using a grinder.

> Surface cleaning is a very important step, since any contaminations can lead to the pores and cracks, metal stress and decrease in mount quality.

3) Assemble the jig with supports for welding the brackets at the installation site (Fig. 3.3). The function of the jig is to ensure the correct orientation of the brackets during welding. First, it is necessary to install the pins (Fig. 3.4), which secure the brackets in a fixed position while the bolts are tightened.

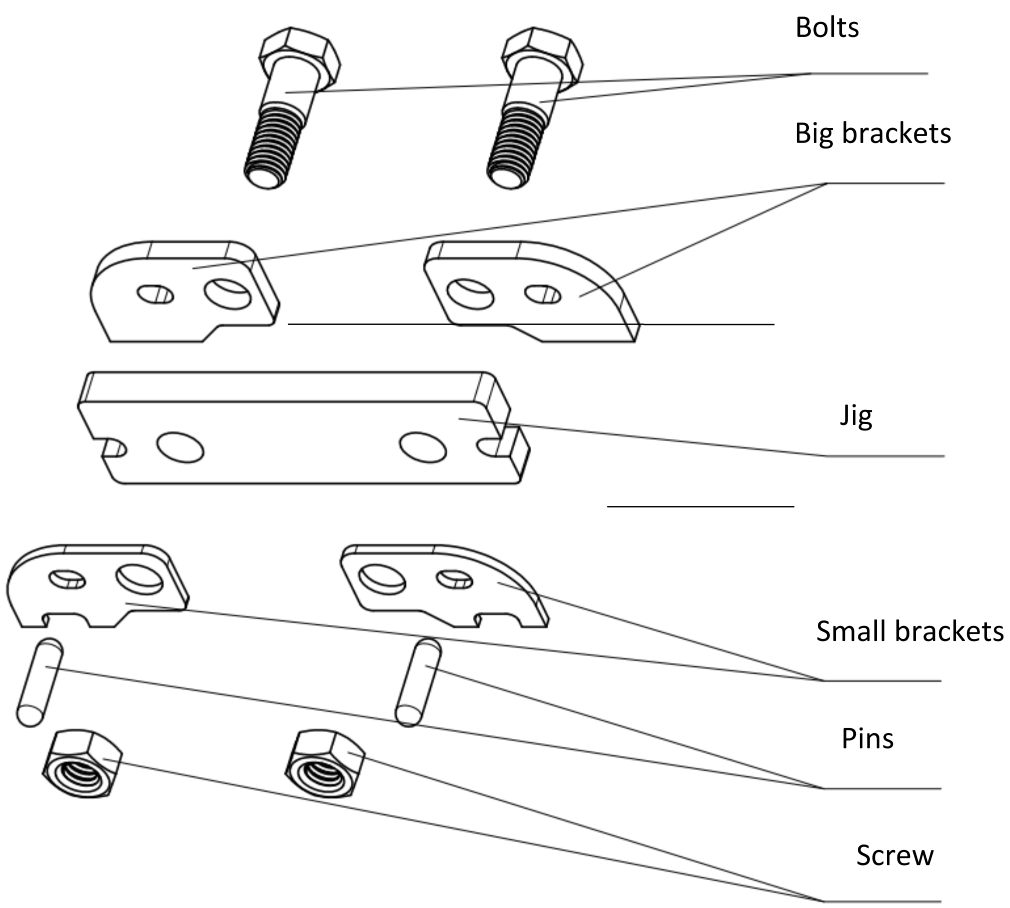

fig. 3.3. Sensor assembly with brackets

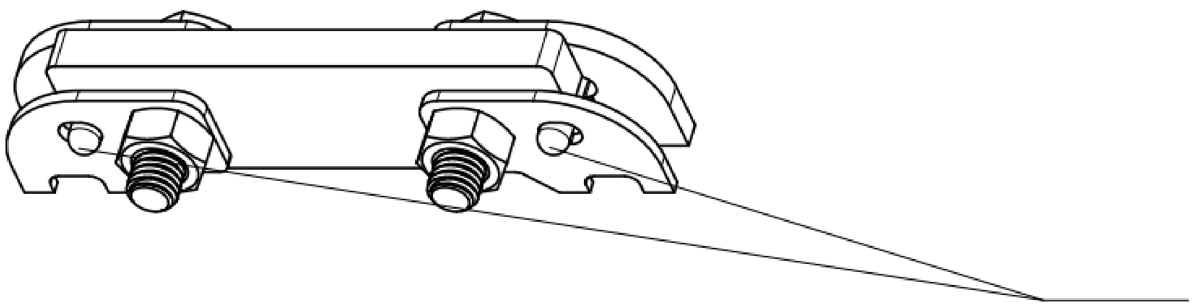

Fig. 3.4. The pins secure the supports when tightening the nuts.

4) Weld the controller mounting brackers (big and small) in the selected location (Fig. 3.5).

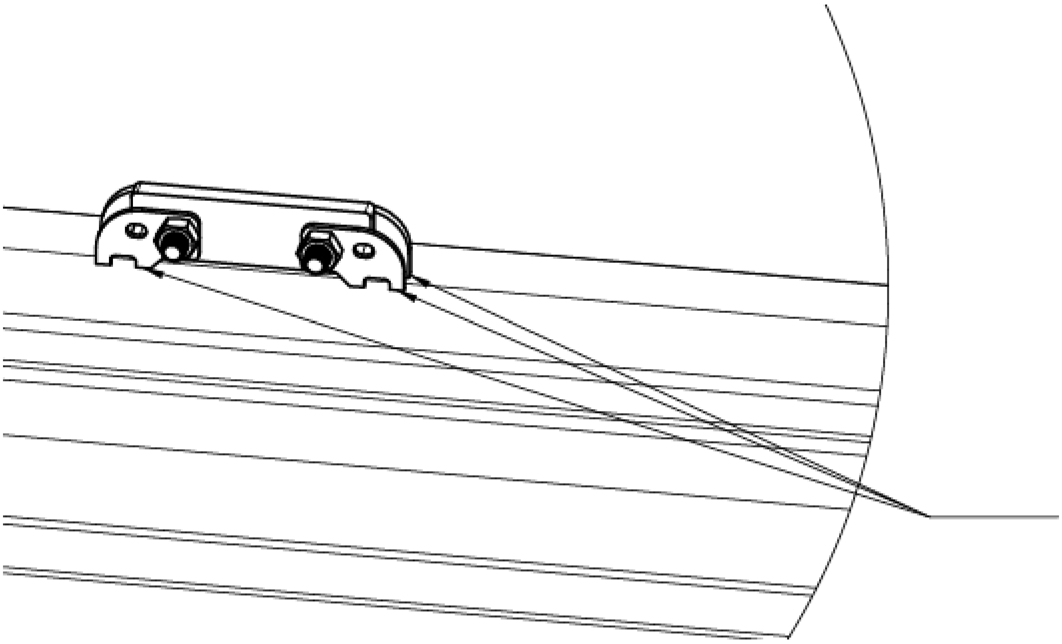

Fig. 3.5. Welding the brackets oriented by jig.

5) Remove the jig and install the controller housing onto the support pins so that the housing fits snugly against the supports, then fasten it using the bolts from the mounting kit. (**Ошибка! Источник ссылки не найден.**, fig. 3.7). **The tightening force of the screws should be 20-25 N*m.**

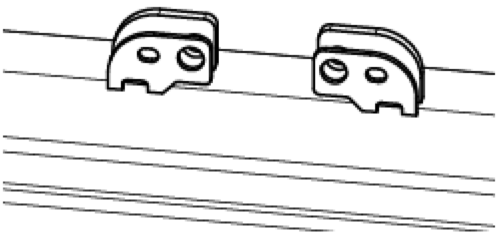

Fig. 3.6. Welded brackets

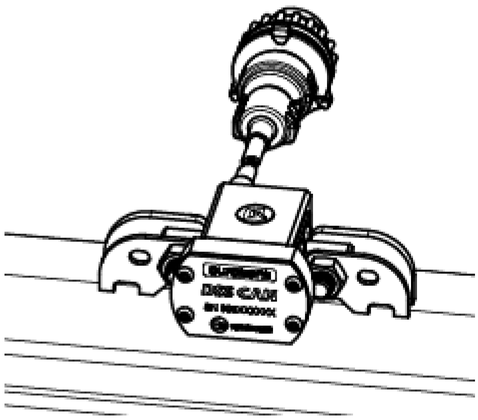

Fig. 3.8. Installed sensor

4 CONNECTION OF eurosens DSS

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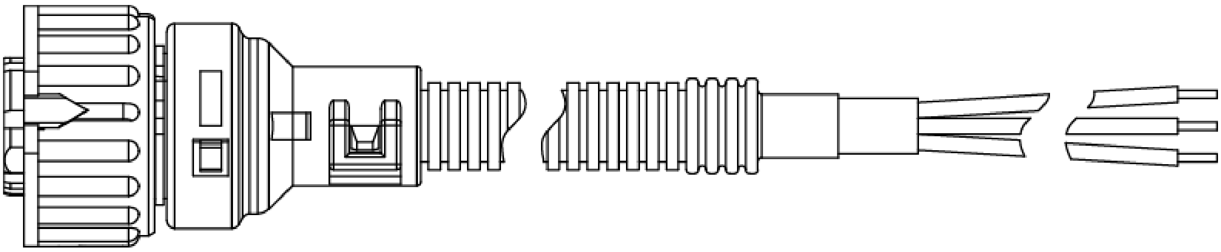
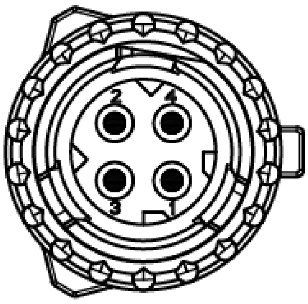
eurosens DSS sensor can be connected using CAN bus interface. Sensor pinout is given in fig. 4.1.





1 – VBAT red
2 – GND brown
3 – CANH (RS-485A) yellow
4 – CANL (RS-485B) green

fig. 4.1. eurosens DSS pinout

- Use special T-Cables to create sensor network (fig. 4.2).

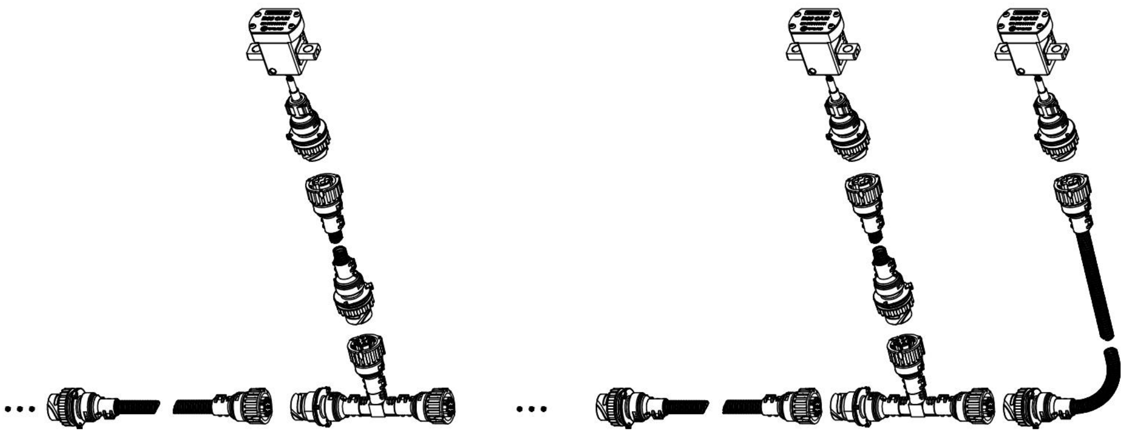


fig. 4.2. Connecting sensors via T-Cables

- Use eurosens Display CAN to display axle loads and cargo weight to a driver (fig. 4.3).

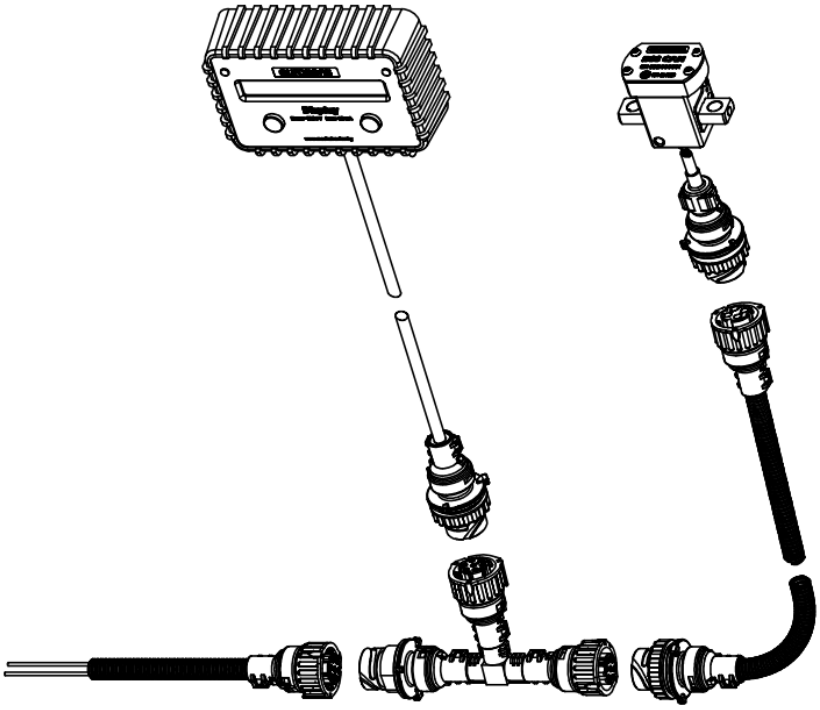


fig. 4.3. eurosens Display with eurosens DSS sensor

5 SETTINGS AND CALIBRATION OF eurosens DSS

Configuration of eurosens DSS is performed with the service software eurosens DSS CAN Configurator and the service adapter (programming device) eurosens Destination CAN.

5.1 CONNECTION PROCEDURE

1) Download the service software eurosens DSS CAN Configurator from the eurosens DSS CAN product page and install it on your PC.

2) Connect the service adapter eurosens Destination to your PC via a USB port.

3) Run the service software and select the COM-port if necessary. The LED "Send" on the service adapter will start blinking.

4) Connect the sensor to the service adapter (fig. 5.1).

The configurator automatically searches for the connected devices. The **"Information"** tab shows the information about the connected sensor eurosens DSS (fig. 5.2).

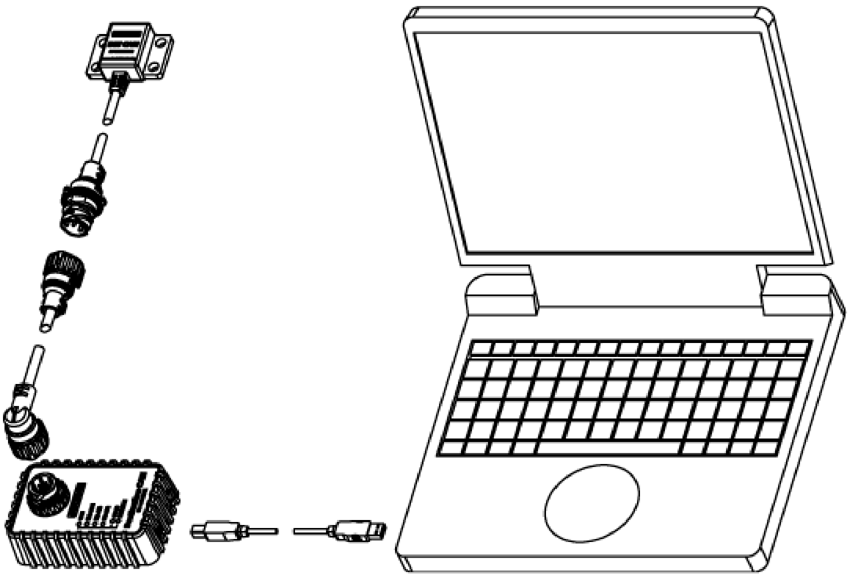


fig. 5.1. Connecting sensor to service adapter and PC

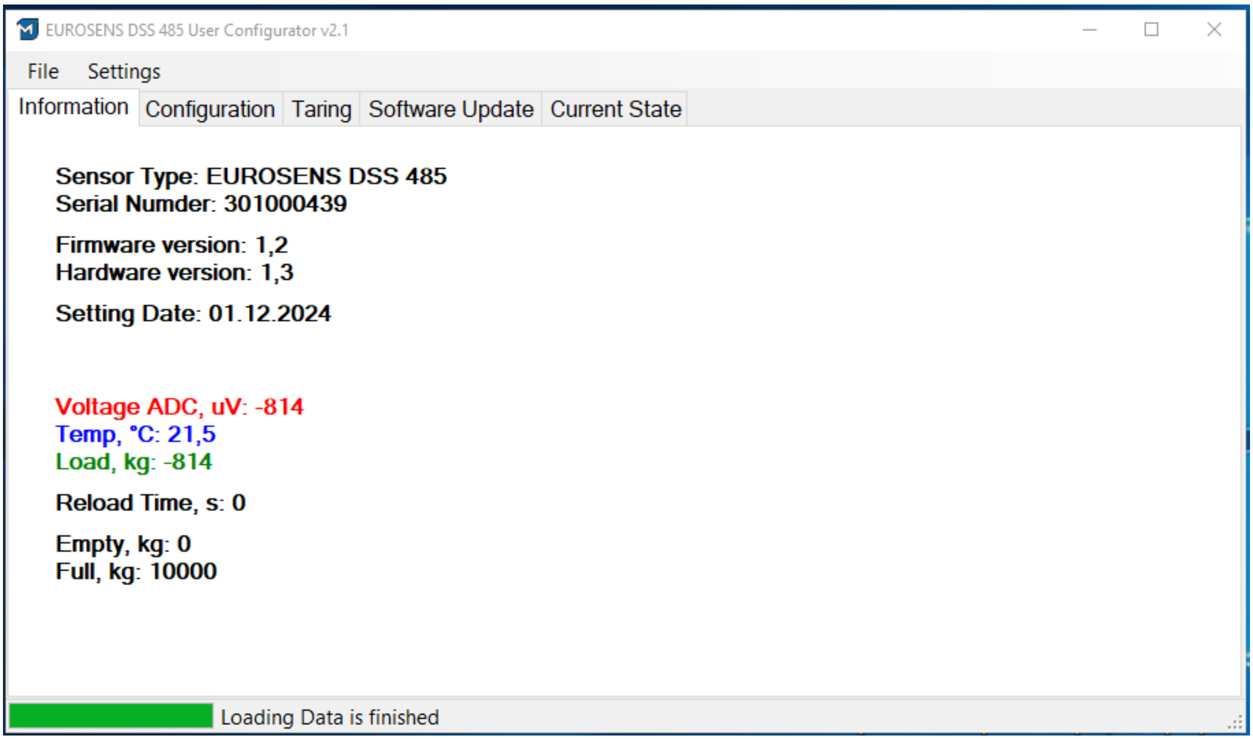


fig. 5.2. Information about connected sensor

5.2 Sensor setup

5.2.1 Information tab

This tab (Fig. 5.2) contains information about the device type, serial number, and the hardware and software versions of the sensor. It also allows monitoring of the current values of the primary element voltage and the sensor temperature.
The displayed load value is calculated and shown based on the calibration table stored in the sensor.
Information about overload time (the duration for which the load exceeded the “Full” threshold) is also provided.
Additionally, it includes information about the set “Full” value (used to calculate the time when the sensor was overloaded) and the “Empty” value (used for zero reset).

5.2.2 Configuration tab

This tab contains settings related to the digital interface, temperature compensation, signal averaging, and overload counter configuration.

Digital Output (Interface). In this settings section, you can set the data transmission rate, enable pull-up resistors on the RS485 A and B lines, and activate the terminal resistor.

> By default, the sensor address field contains an address equal to the last two digits of the sensor’s serial number.

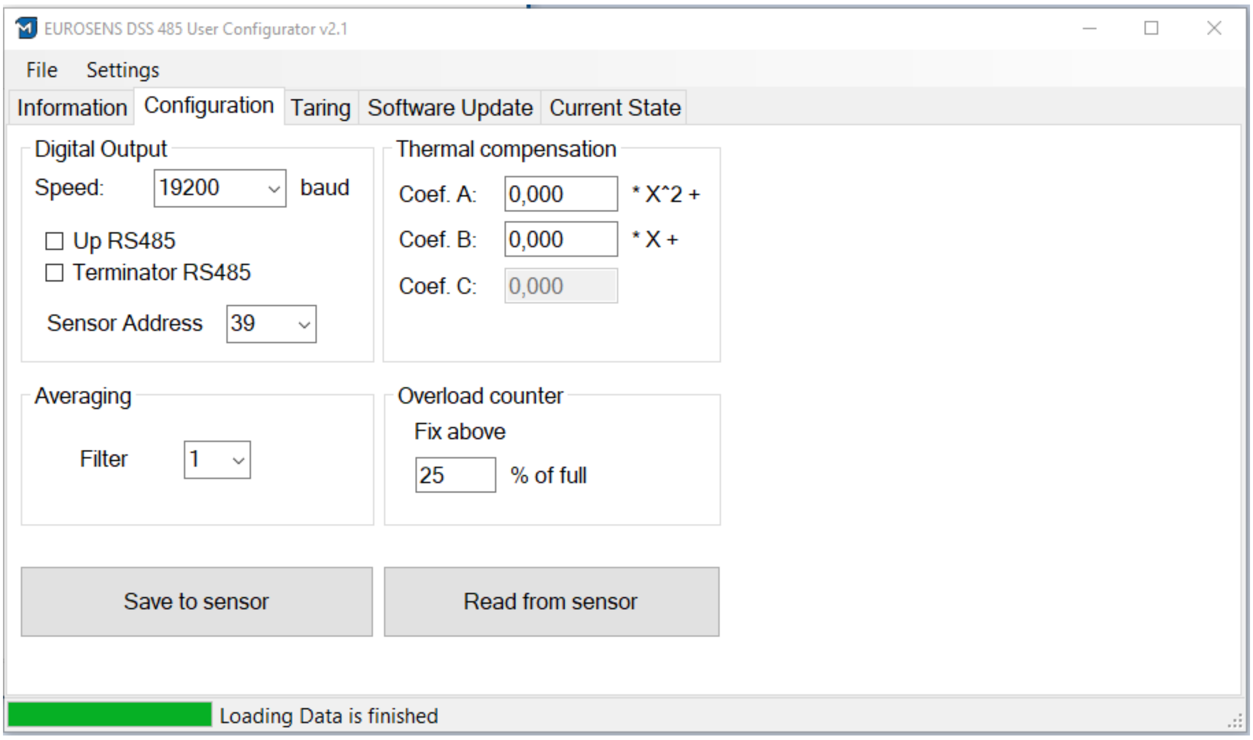


fig. 5.3. Configuration tab

Pull-up resistors on the RS485 A and B lines are required only if the terminal interface to which the sensor is connected does not include its own pull-up circuits. In most cases, the pull-up is implemented on the terminal side, and it should be enabled on the sensor side only if data transmission issues occur.

The terminal resistor should be enabled only for long communication lines (over 20 meters) and only on the last sensor in the chain.

The connection between the configuration software and the sensor via the service kit is established over RS485 at a fixed speed of **19,200 bit/s**. To avoid baud rate mismatch, if the user has set a different speed, the sensor initially operates at 19,200 bit/s for the first 2 seconds after power-up while attempting to establish communication with the PC. If the connection is successfully established, the sensor continues operating at 19,200 bit/s. If the connection is not established, the sensor switches to the user-defined speed specified in the corresponding field.

Sensors with an RS485 interface use an **LLS-like protocol**, which is supported by telematics equipment. In this protocol, the **N (level)** field transmits the load value in kg/10, and the **F (frequency)** field transmits the primary element voltage in µV.

Averaging. The *Filter* field defines the level of signal averaging. The higher the value, the stronger the averaging effect. Values of 1–2 are recommended for stationary installations, while 4–5 are suitable for vehicle applications operating under harsh conditions.

Overload Counter. The *% of Full Scale* field allows setting a load threshold, above which the sensor begins counting the duration of overload. This overload time is periodically saved to the sensor's non-volatile memory and can be restored even after the device is powered off.

Thermal Compensation. Since the thermal expansion coefficients (TEC) of the measuring plate material and the bridge material (beam, etc.) are not always matched, this configuration software includes settings for compensating temperature-related expansion effects.
To use this function, a number of data points of voltage measurements at different temperatures must be collected. The vehicle must remain stationary and unloaded during this process. A function describing the dependence of voltage on temperature is then constructed in external software (e.g., Excel), and the resulting coefficients are entered into the configuration software.

By default, and in most cases, the temperature compensation settings are not used and are set to **0.000**.

After making changes to the sensor settings, they must be saved to the device's memory. To do this, click the **"Save to Sensor"** button.
You can also read the current settings from the sensor by clicking the **"Read from Sensor"** button.

5.2.3 Calibration tab

This tab contains the sensor's calibration table, the threshold load values for Empty and Full, and the coefficients of the function (polynomial equation) describing the relationship between load and voltage (Fig. 5.4).

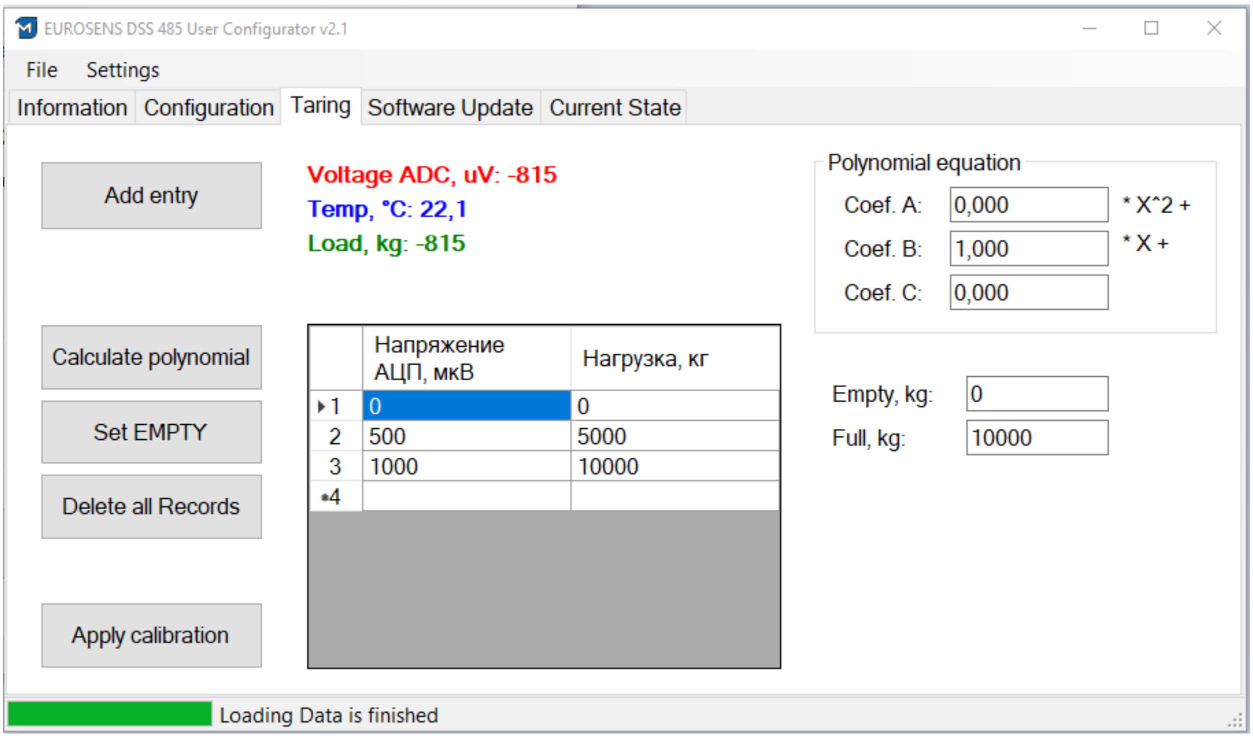


fig. 5.4. Calibration tab

Calibration procedure using the example of a sensor installed on one of the vehicle's axles:

- **Unload the vehicle.** It must remain stationary for some time to allow the sensor voltage readings to stabilize.
- **Clear the table** by clicking the corresponding button. The table should become empty.
- **Add a record** by clicking the *Add Record* button. A new row will appear in the table, and the *Voltage* column will automatically be filled with the current sensor voltage value at the moment of clicking.

- In the **right-hand column** of the row, enter the current axle load in kilograms (kg).
- **Load the vehicle** and repeat steps 3–4 the required number of times. The recommended minimum number of table entries is **five (5)**.
- After filling in the table, click the **“Calculate Polynomial”** button. The program will display a window with the calculated coefficients of the load–voltage relationship function. After pressing **OK**, these coefficients will be automatically transferred to the corresponding settings fields.
- In the **Empty (kg)** field, enter the load value (in kg) corresponding to the unloaded vehicle. This parameter is used when resetting the sensor to the *Empty* state (this can be done by pressing the **“Set Empty”** button or remotely by sending the appropriate command to the sensor).
- In the **Full (kg)** field, enter the maximum allowable load value for the given axle. This parameter is used to determine the duration of the sensor’s overload condition.
- Once the *Empty* and *Full* fields, the table, and the coefficients are filled and calculated, click the **“Apply Calibration”** button.

At least two measurements allow you to create the table "Sensor value - axle load" in kg and program it using the server software.

5.2.4 Current state tab

This tab (Fig. 5.5) displays the changes in the current values of voltage, load, and temperature in graphical form over a period of one minute. The display or hiding of each corresponding graph can be controlled by checking or unchecking the box next to the graph’s name on the left side of the window.

On this set of graphs, you can observe how the sensor voltage changes — directly from the ADC, after temperature compensation, or after both temperature compensation and signal averaging.

It is also possible to record the current values directly into an Excel table. To do this, click the corresponding **“Log Excel”** button.

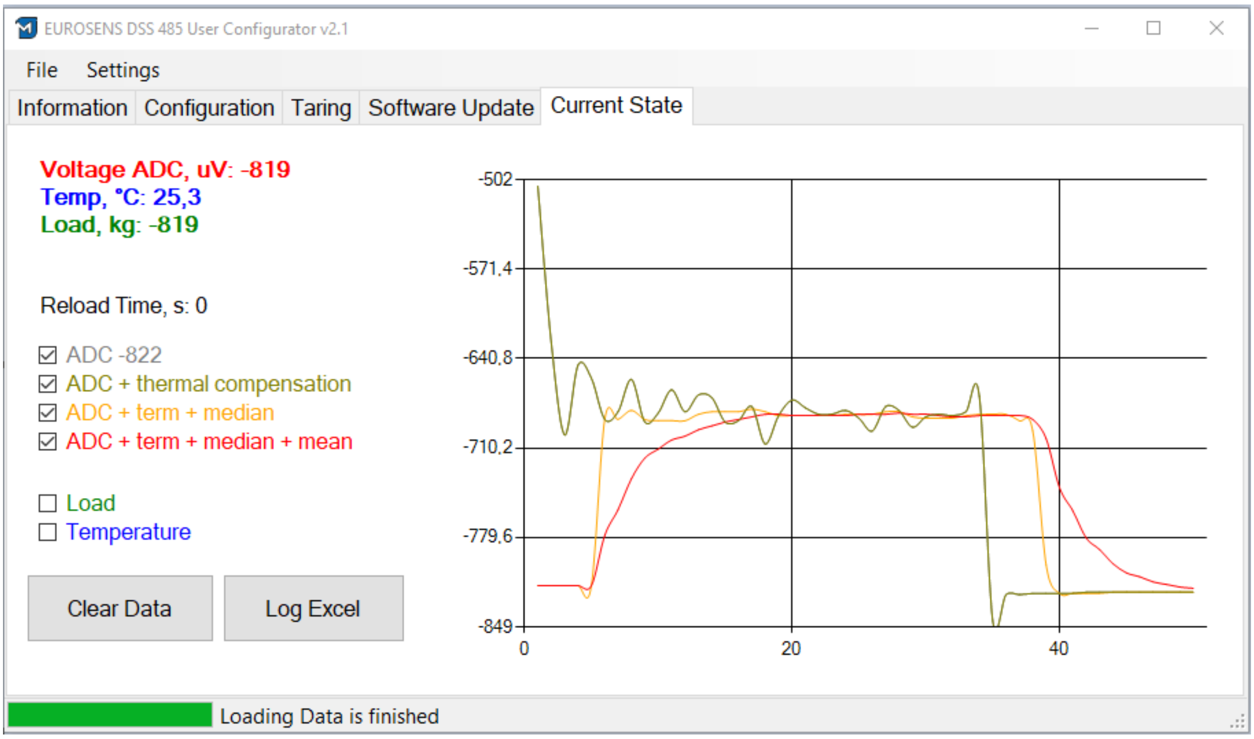


fig. 5.4. Current state tab

5.2.5 Software update tab

This tab allows you to update the sensor's firmware. To do this, connect the sensor, click the **"Firmware Update"** button, and then select the appropriate firmware file for this sensor type. After selecting the file, the update process will start automatically, as indicated by the progress bar filling up.

If the user needs to reset the settings and calibration table to factory defaults, click the **"Restore Factory Settings"** button.

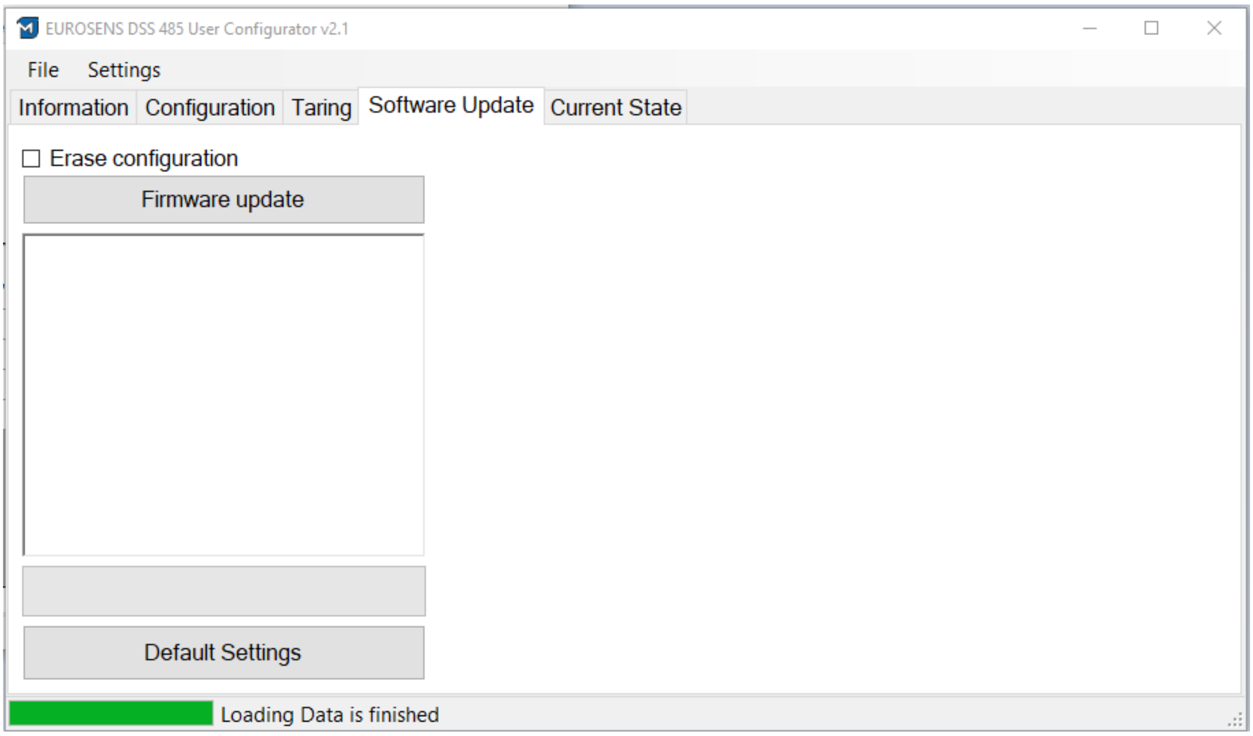


fig. 5.6. Software update tab

If the **"Reset settings during update"** checkbox is selected before starting the firmware update process, the sensor will revert to its factory default settings after the update. The calibration table and all other settings will be erased. The sensor address will be set according to the last two digits of its serial number.

If a failure occurs during the firmware update process for any reason (e.g., the USB cable is disconnected, an operating system error closes the software, or another issue arises), the sensor may stop responding and enter a “dead mode.”

To attempt a firmware update recovery from this dead mode, follow these steps:

1. Disconnect the sensor from the programmer.
2. Close the configuration software, then reopen it.
3. Make sure the programmer is set to the correct **RS485 interface** and that the **SEND** indicator is blinking.
4. Open the **Firmware Update** tab, select the appropriate firmware file, and **only then** connect the sensor to the programmer. The update process should start automatically.

5 ADDITIONAL INFORMATION

6.1 STORAGE

It is recommended to store eurosens DSS in dry enclosed areas.

eurosens DSS 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 eurosens DSS with substances that cause metal corrosion and/or contain aggressive impurities.

The storage period of eurosens DSS should not exceed 24 months.

6.2 TRANSPORTATION

eurosens DSS must be transported 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 eurosens DSS must be sealed.

6.3 DISPOSAL

eurosens DSS does not contain any substances or components that could be hazardous to health and the environment during and after the service life and disposal.

eurosens DSS does not contain precious metals in amount mandatory for accounting.

6.4 Technical support

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support@mechatronics.by

6.5 Contacts

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f: +375 (1771) 24190
E-mail: office@mechatronics.by
www.eurosenstelematics.com/en

APPENDIX I. DATA TRANSFER PROTOCOL OF eurosens DSS CAN

Table I - 1. **ID 29-bit** (in hex mode) **1CE755**** (** - sensor address)

Bytes							
1	2	3	4	5	6	7	8
Internal detector value, 4 bytes, unsigned				Axle load, kg (10 kg step) 2 bytes, signed		Temperature, ^{0}C 2 bytes, signed	
1	2	3	4	1	2	1	2

APPENDIX II. DATA TRANSFER PROTOCOL OF eurosens DDS 485

The command is designed to read the current data of the axle load sensor. Data is transmitted in the lower byte forward order.

Command format:

Table II - 1. Command structure of data exchange protocol

Displacement, byte	Field size, byte	Value	Description
0	1	31h	Prefix
+1	1	01h...FFh	Network address
+2	1	06h	Operation code
+3	1	00h...FFh	Checksum (CRC)

Response format:

Table II - 2. Response structure of data exchange protocol

Offset, byte	Field size, byte	Value	Description
0	1	3Eh	Prefix
+1	1	01h...FFh	Network address
+2	1	06h	Operation code
+3	1	0	Sensor temperature, degrees (signed)
+4	2	0000h...FFFFh	Axle load, kg (1 kg resolution)
+6	2	0000h...FFFFh	Internal sensor value
+8	1	00h...FFh	Checksum (CRC)

APPENDIX III. READING DSS 485 DATA BY TELTONIKA/GALILEOSKY GPS TRACKERS USING RS485 INTERFACE

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

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

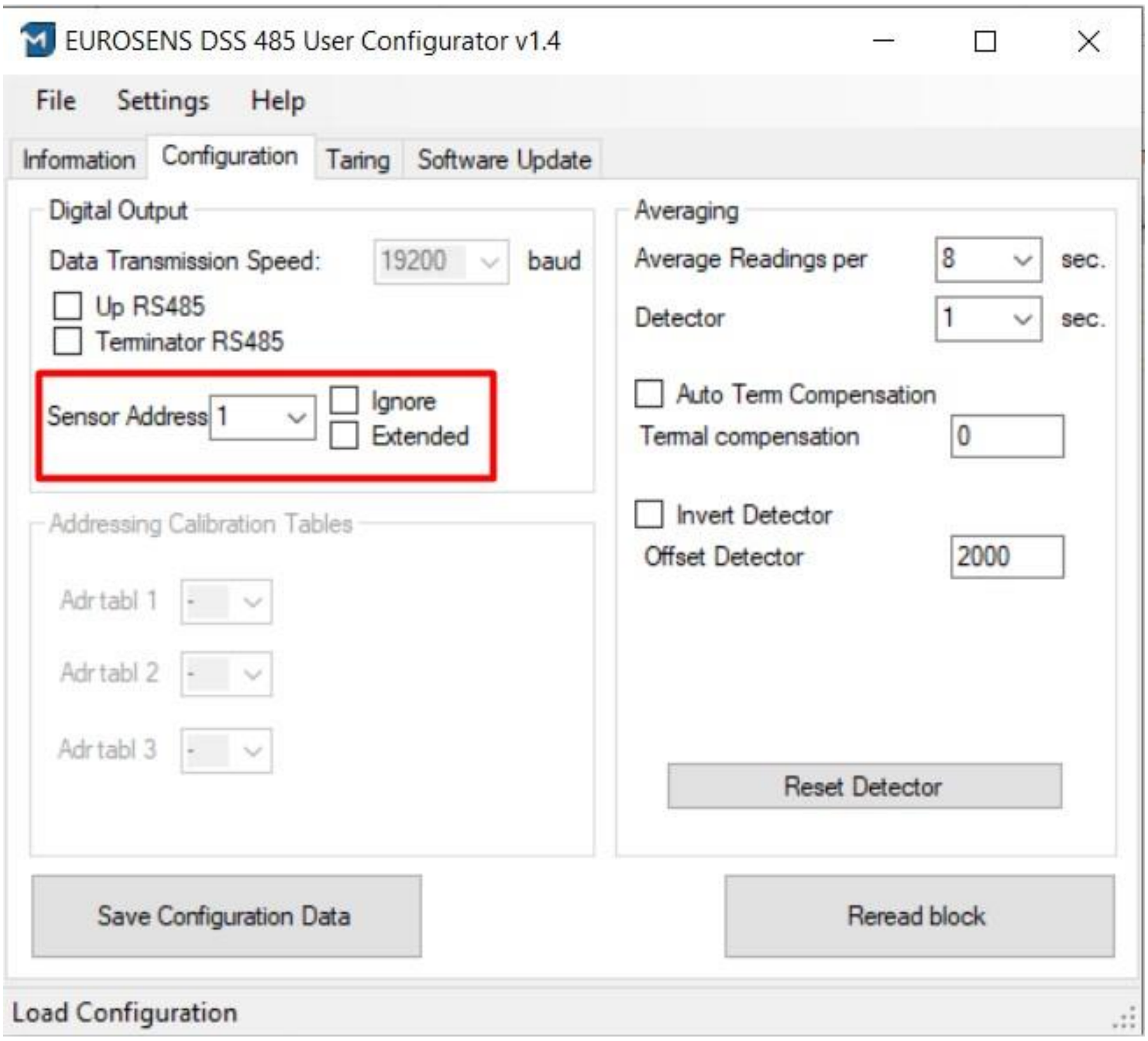

fig. III. 1

Sensor address in RS485 network by default is equal to the last 2 digits of the serial number.

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

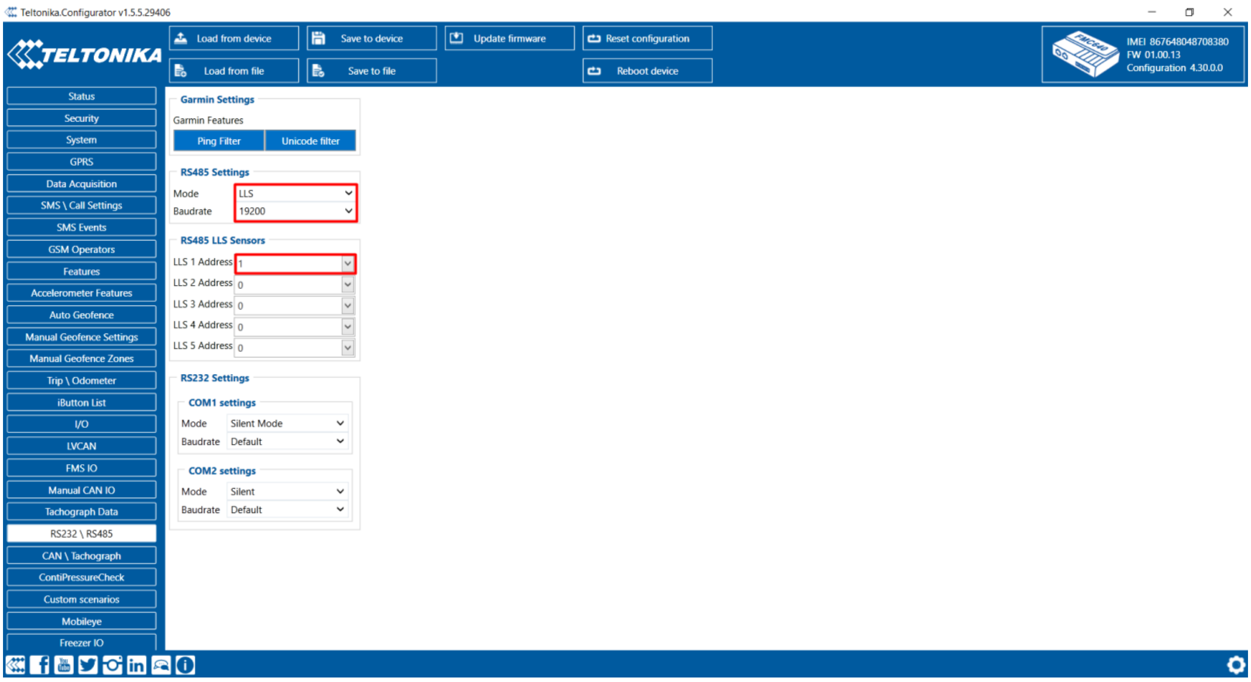

fig. III. 2

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

According to Teltonika Wiki, on server side LLS 1 Fuel level – io_201, LLS 1 Temperature – io_202. You can see other io numbers there : https://wiki.teltonika-gps.com/view/FMB640_Teltonika_Data_Sending_Parameters_ID

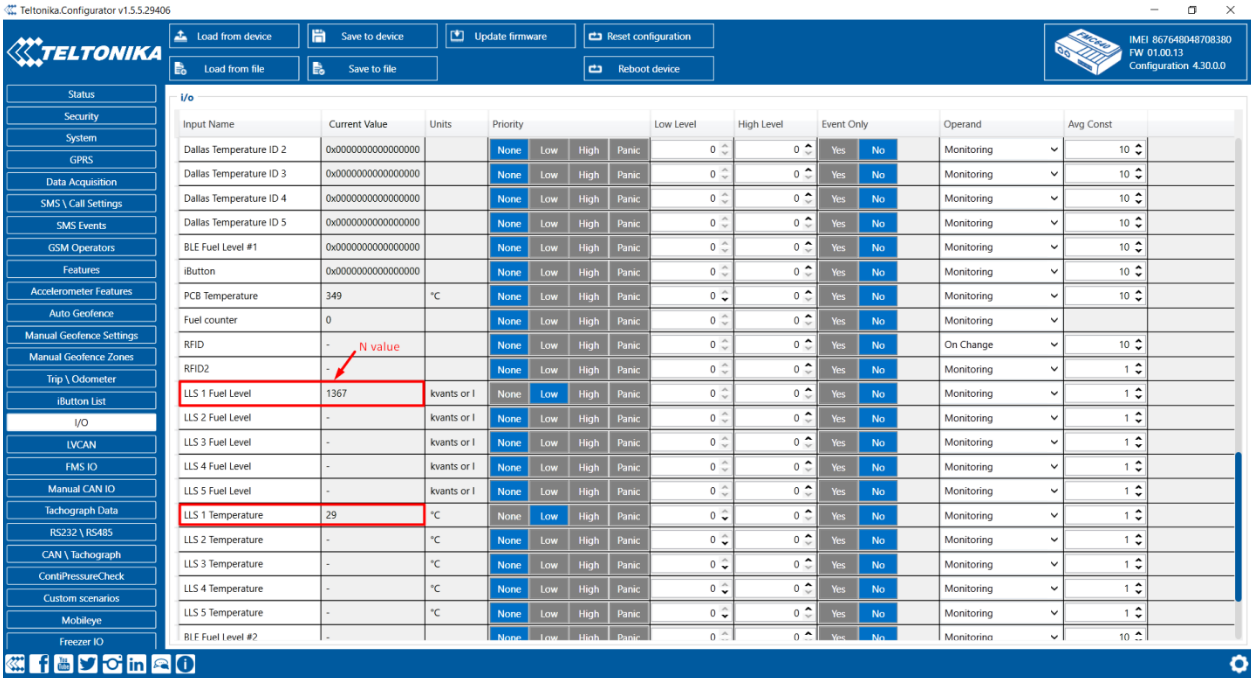

fig. III. 3

The maximum number of sensors is limited by the capabilities of the tracker - for Teltonika terminals - 5 x RS485 sensors. If you need to connect more sensors, you can use Galileosky devices. Sensors are connected according to the scheme as shown on fig. III. 4.

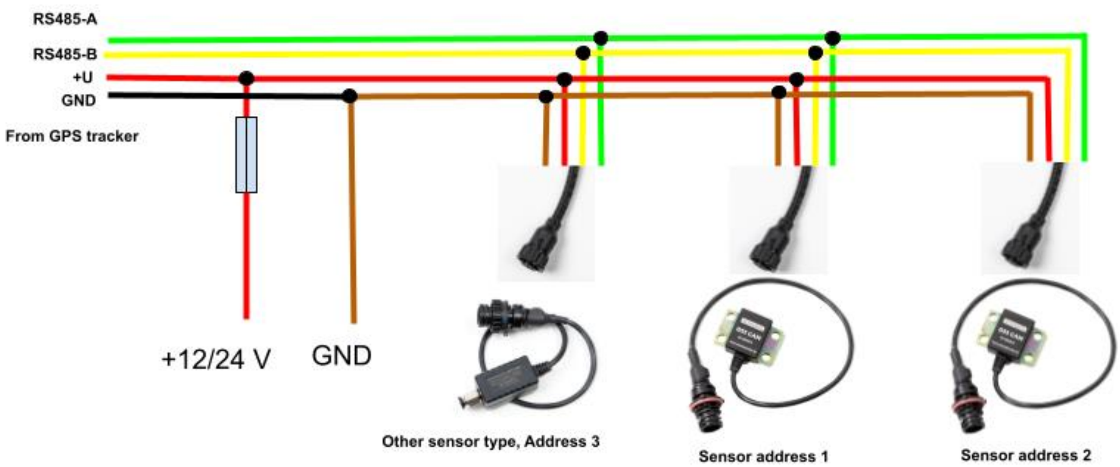

fig. III. 4

Proceed to the GalileoSky tracker configuration. On the **Serial Ports** tab in the RS485 section select the "Galileosky camera and FLS" peripheral type (fig. III. 5).

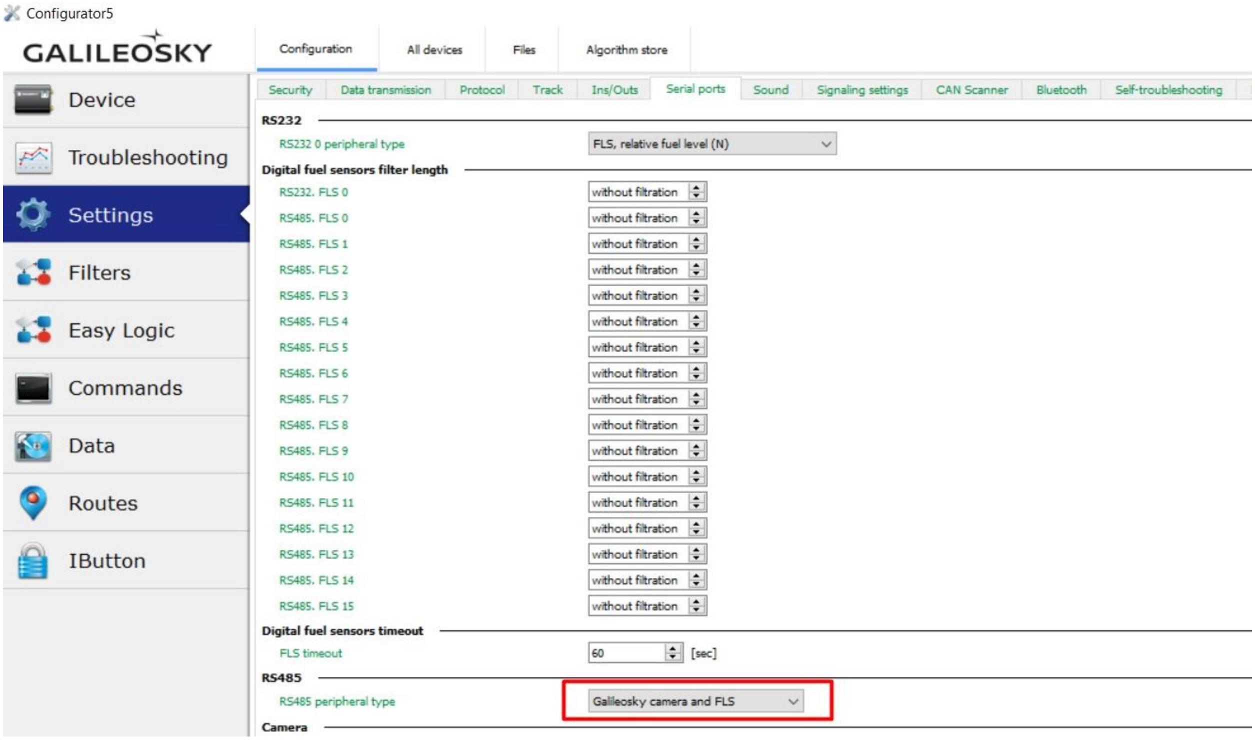

fig. III. 5

On the Protocol tab mark the data transfer to the server in the first and main packet as shown on fig. III. 6.

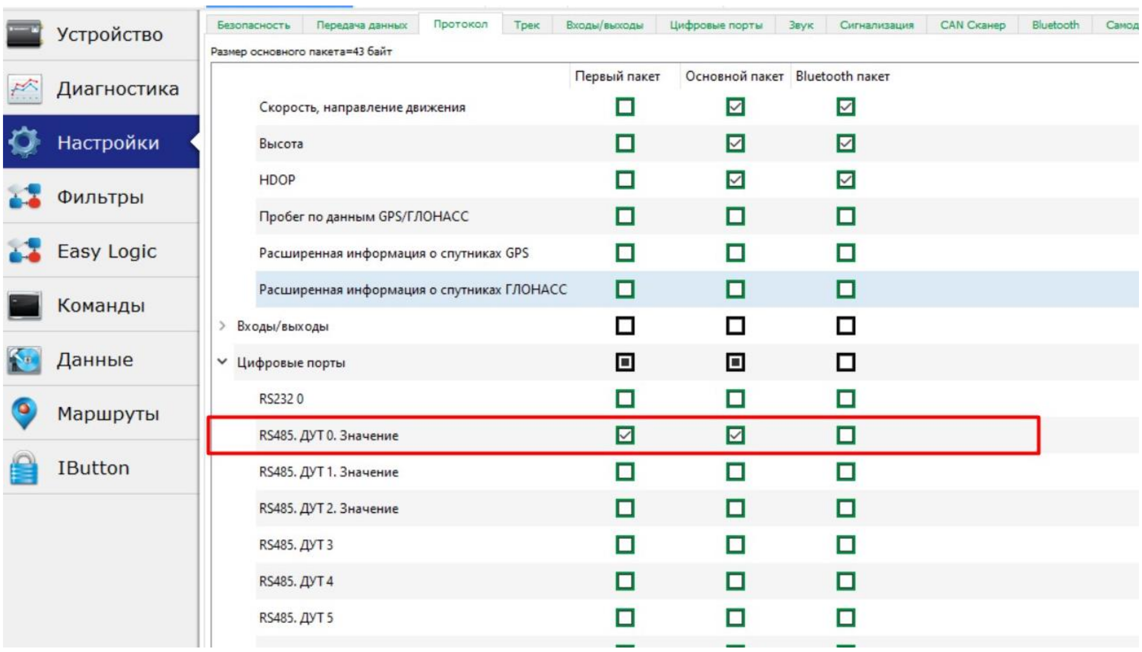

fig. III. 6

In the **Device** section you can immediately check the data (fig. III. 7).

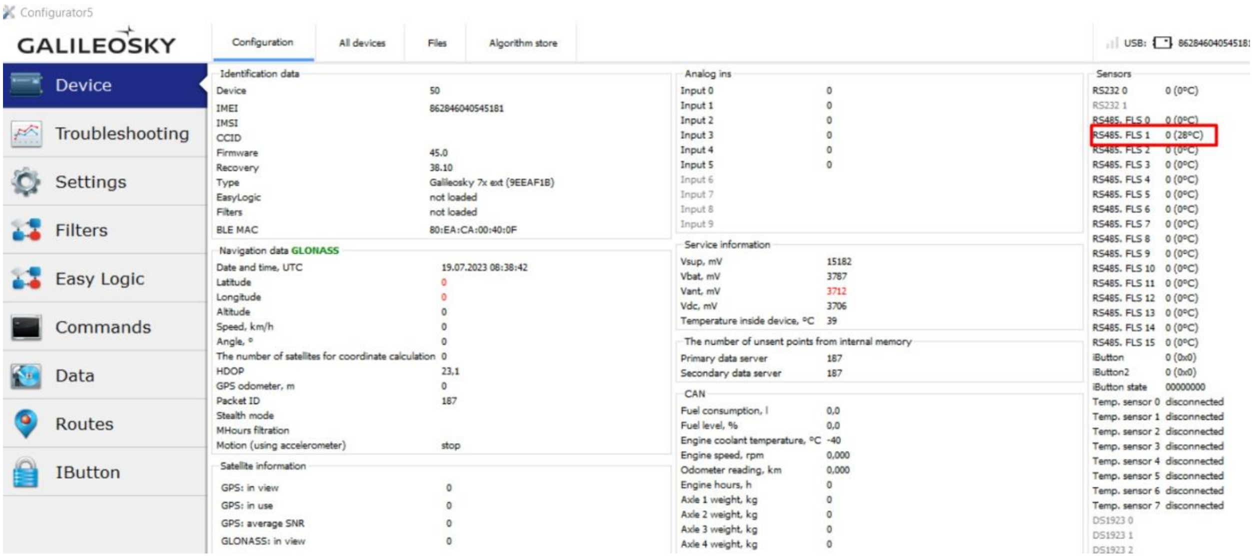

fig. III. 7

According to Appendix II, the fuel level parameter contains the axle load in kg (according to the current calibration table stored in the sensor), temperature is the sensor temperature in ^{0}C.

APPENDIX IV. AXLE LOAD SENSOR eurosens DSS CAN CONNECTION USING CAN BUS

For operation via CAN bus interface the sensor must be configured as shown on fig. IV. 1. In the sensor settings it is necessary to enable the **Terminator CAN** (not required if we connect the sensor to an already working CAN network). Set the sensor address in the CAN network - in the our example the first address (**SA=1**). By default the period of data transmission by the sensor is 1 second, it can be changed in the **Period** field. If several sensors are connected, each sensor must have its own unique **SA** address.

Default sensor address in CAN network is equal to the last 2 digits of the serial number.

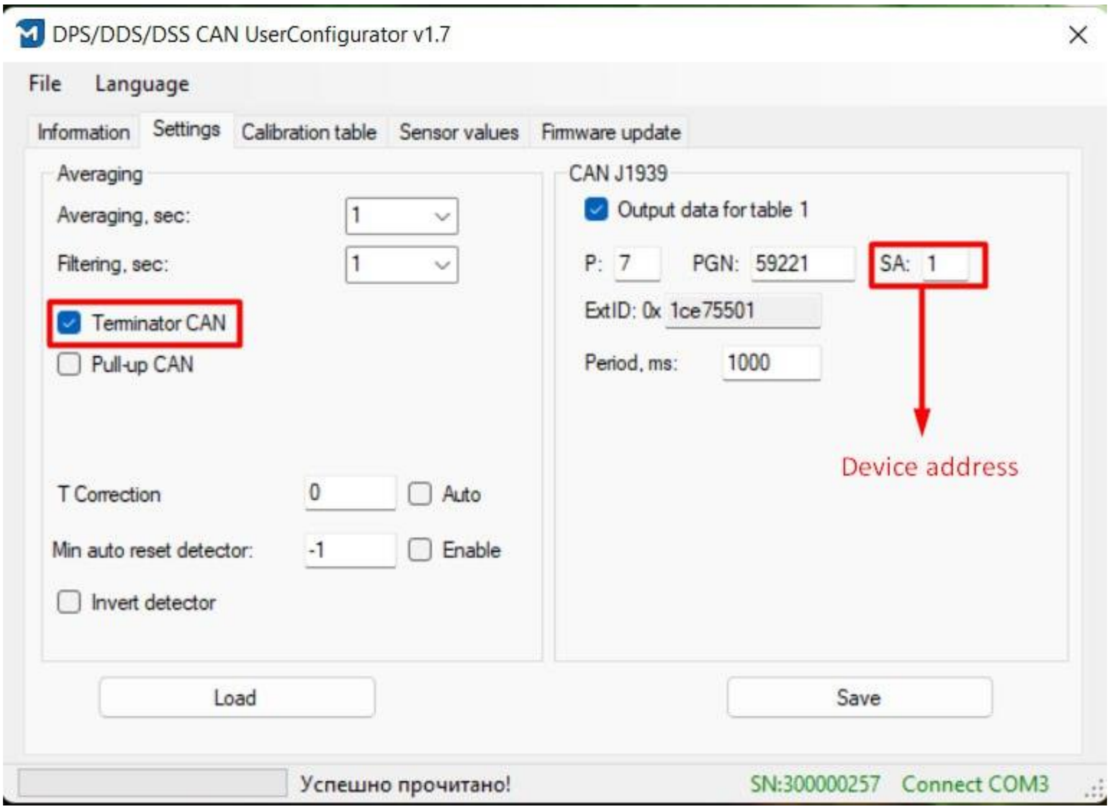

fig. IV. 1

You can start configuring the system after installing the required number of sensors (the maximum number of sensors is limited by the tracker capabilities), connecting power supply to them and connecting CAN lines of sensors and tracker (fig. IV. 2).

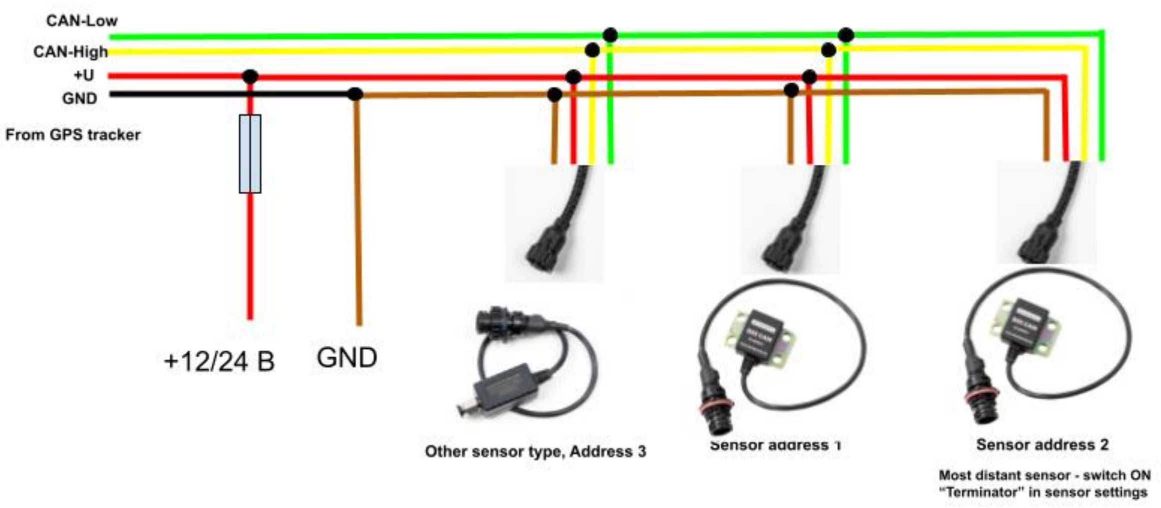

fig. IV. 2

In Teltonika configurator go to CAN interface settings and choose **Normal** mode of operatoin and **250 kbps speed** (fig. IV. 3). Choose the CAN data source – CAN1 or CAN2.

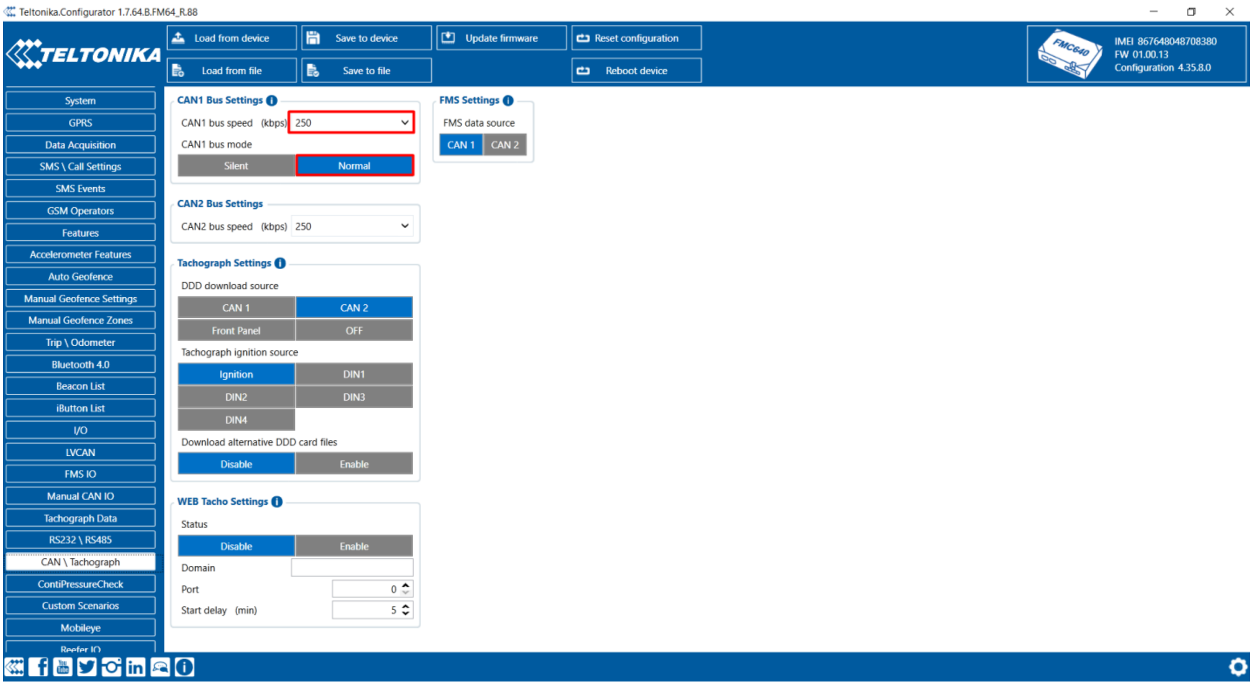

fig. IV. 3

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

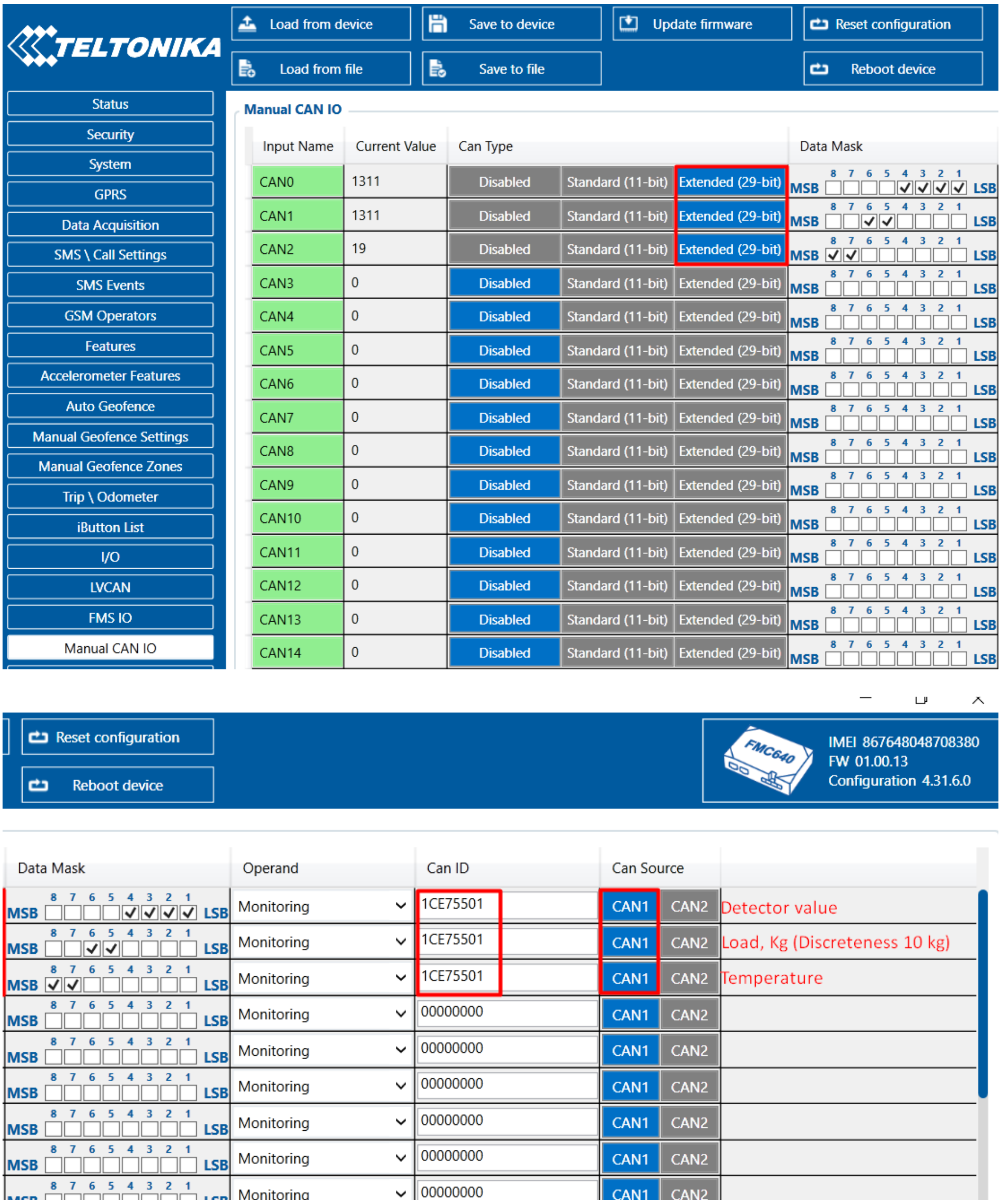

fig. IV. 4

In the **CAN ID** field enter prefix **1C + PGN to read + sensor address** in the network. Mark bytes to read according to Appendix I parameter specification. Save configuration to Teltonika device.

After sensor connection data appears on Manual CAN IO tab (fig. IV. 4). The sensor values should be calculated taking into account the Resolution and Offset values specified in the description of CAN messages (Appendix I). For example, the “Axle load” parameter has a resolution of 10kg, so its value must be multiplied by 10 to be converted into kilograms.

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

https://wiki.teltonika-gps.com/view/FMB640_Teltonika_Data_Sending_Parameters_ID

For example, CAN0 element is transmitted as io_145, CAN1 – io_146 etc.

Galileosky settings can be done in the same way (fig. IV. 5).

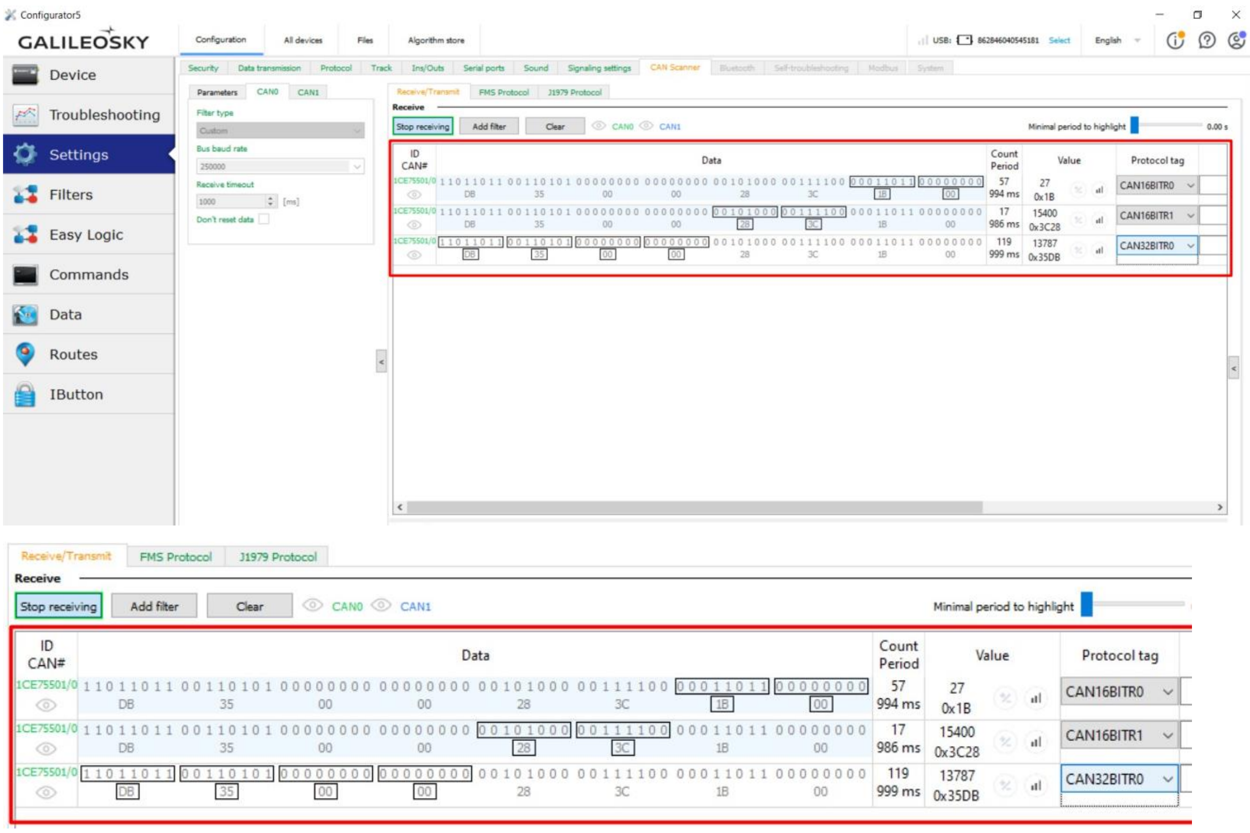

fig. IV. 5

APPENDIX III. DIMENSIONS

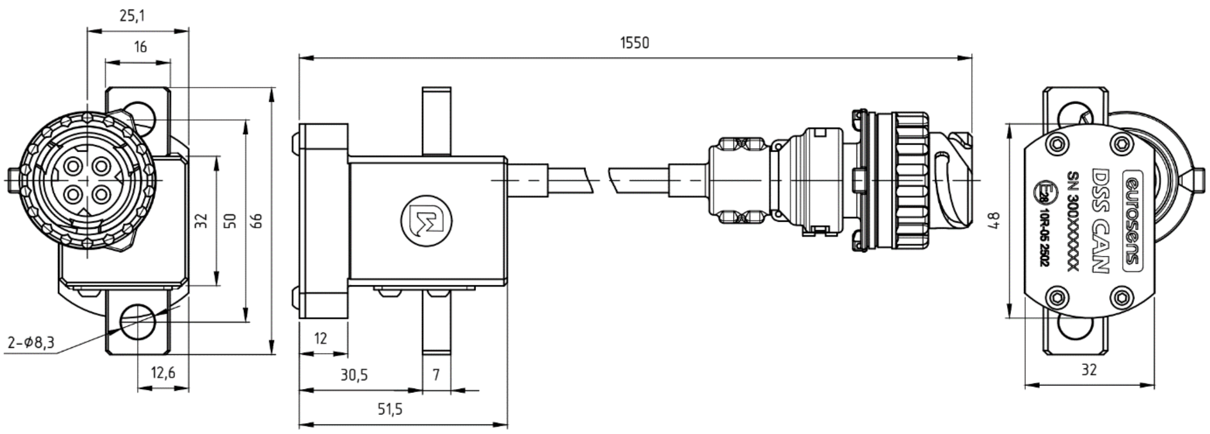

fig. V-1. eurosens DSS dimensions

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