v 1.02

TILT ANGLE SENSORS

eurosens Degree RS/CAN

Operation manual

MECHATRONICS

TABLE OF CONTEXT

1 eurosens DEGREE APPLICATION

The eurosens Degree tilt andle sensor (hereinafter - the Sensor) is designed to determine the position of the object in space relative to the vector of gravity. Together with the GPS tracking device, it allows us to monitor remotely the angle position of of the controlled mechanism as well as informs about triggering events (body lift, excavator operation, etc.)

2 SENSORS DESIGN

Overall and connection dimensions of the sensor are given in Appendix 1.

2.1 MODIFICATIONS

eurosens Degree RS – tilt angle sensor with RS-485 interface and discrete output.

eurosens Degree CAN - tilt angle sensor with CAN bus interface and discrete output.

Index “Ex” means that sensor is certified according to Ex-regulations of Custom Union (TR TS 012).

2.2 SPECIFICATIONS

Table 1.

Parameter	eurosens **Degree RS**	eurosens **Degree CAN**
Supply voltage, V	10-50	
Temperature range, °C	-40 — +85	
Resolution, degrees	1	
Measurement error, degrees	±1	
Configuration interface	RS-485	K-line
Data interface	RS-485, discrete output	CAN, discrete output
Measurement range	0…180 (1 angle)	0…180 (2 angles)
IP protection class	IP67	IP67
Max current consumption, mA (for 12V)	50	50
Service adapter for configuration	eurosens Destination 02, or any RS-485/USB	eurosens Destination 02, 02 Lite, CAN (K-line interface)

2.3 DELIVERY SET

Sensor delivery set consists of sensor, fuse and self-tapping screws (fig. 2.1).

fig. 2.1 Sensor delivery set

Optionally available with a protective cover (fig. 2.2)

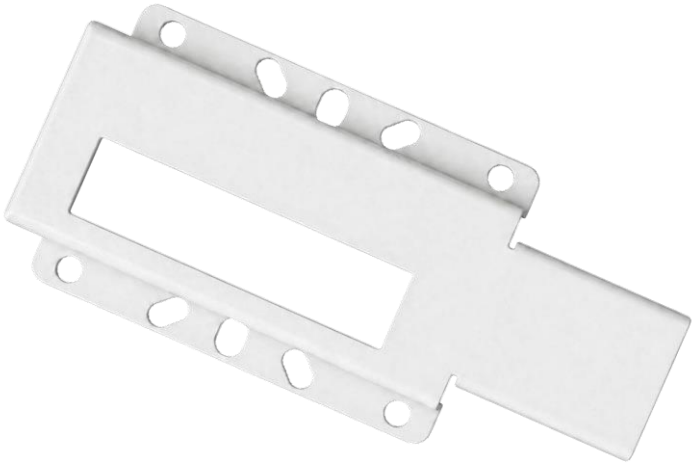


fig. 2.2. Protective cover

3 SENSOR INSTALLATION

The sensor is fixed with a mounting kit to the moving part whose movement is to be monitored. For example, on fig. 3.1 example of using eurosens Degree on a fuel tanker to control the opening of hatches.

fig. 3.1. Using eurosens Degree on fuel tanker

Note that with the sensor you can monitor only movements when angle between the sensor and the vector of gravity changes (fig. 3.2).

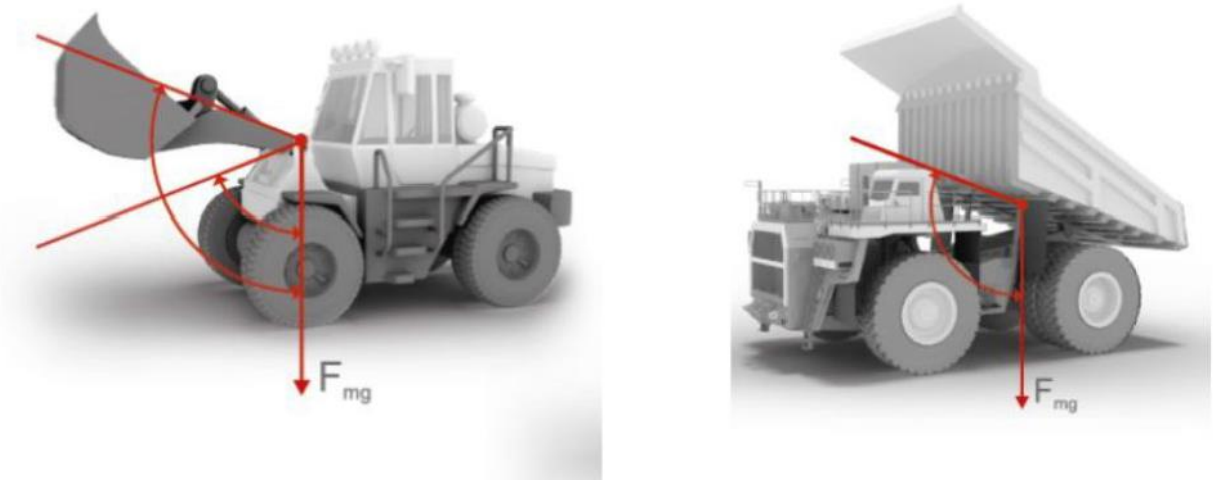
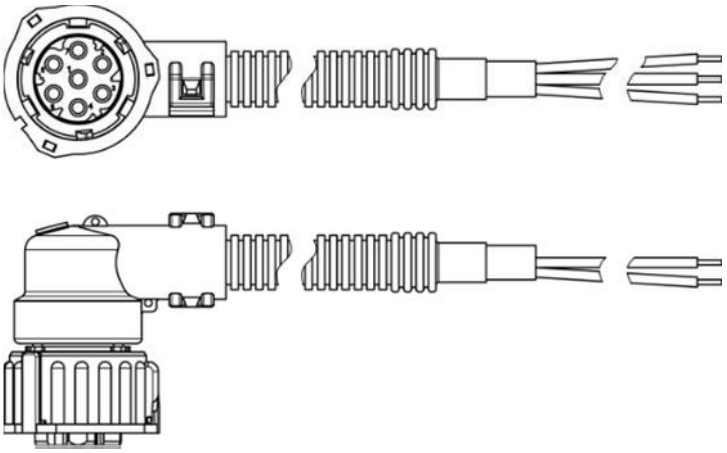


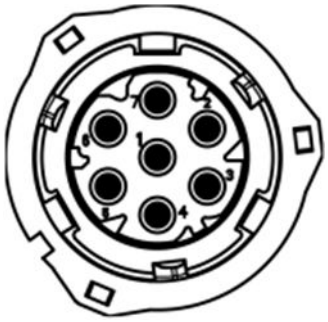
fig. 3.2. These movements can be controlled

On the contrary, the movement of the door (Fig. 3.3) cannot be controlled by means of eurosens Degree - the angle to the vector of gravity does not change.

fig. 3.3. Door status (opened, closed) cannot be monitored

The color coding of the wires is shown on the fig. 3.4





1 – VBAT	red/красный
2 – GND	brown/коричневый
3 – Kline	blue/синий
4 –	–
5 –	–
6 – RS-485 (A), CAN_Hi	yellow/желтый
7 – RS-485 (B),CAN_Low	green/зеленый

fig. 3.4. Eurosens Degree cable pinout

4 SENSOR CONFIGURATION

After installation, the sensor is configured using the eurosens Destination service adapter and the eurosens Degree Configurator software (hereinafter referred to as configurator) (fig. 4.1).

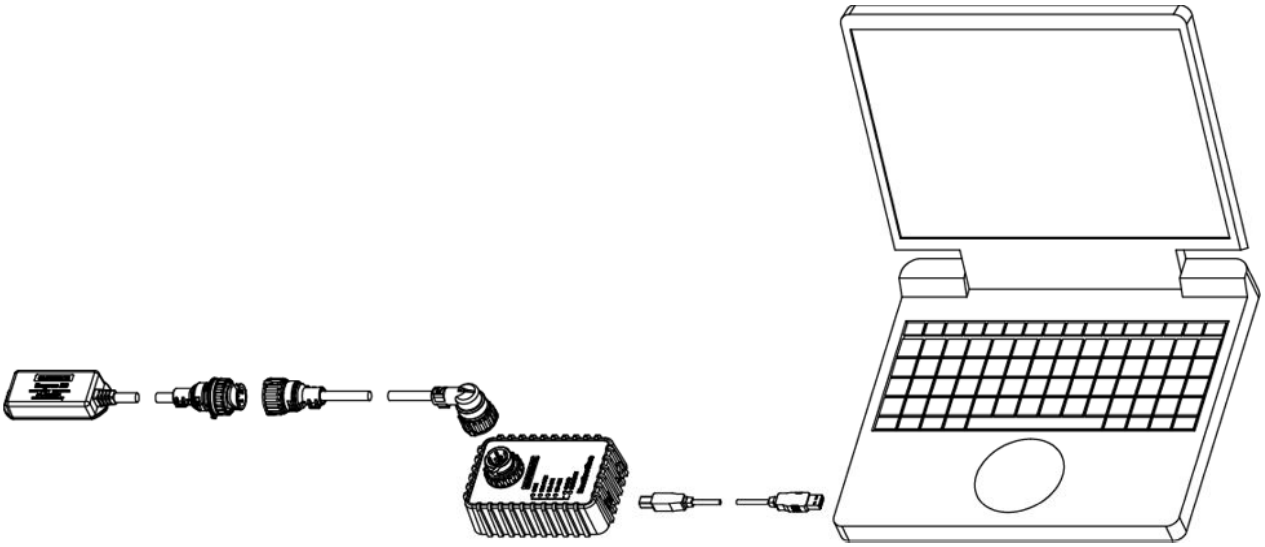


fig. 4.1. Sensor connection to laptop for configuration

4.1 DRIVERS AND CONFIGURATOR INSTALLATION

The configurator requires the Microsoft .NET Framework 4.0 installed.

- Install this software by downloading this file from the Microsoft website.
- The first time you connect the adapter to your computer, Windows will search for and automatically install the adapter driver.

Latest configurator version you can download from the product page on the official website.

4.2 CHOOSING THE COM-PORT

To select the COM port number you need:

1. select in the menu "**Settings**", item "COM port selection";

2. select in the appeared window the number of COM port from the list of available ports (Fig. 4.2) and manually enter the required number of COM port in the lower part of the window (input textbox).

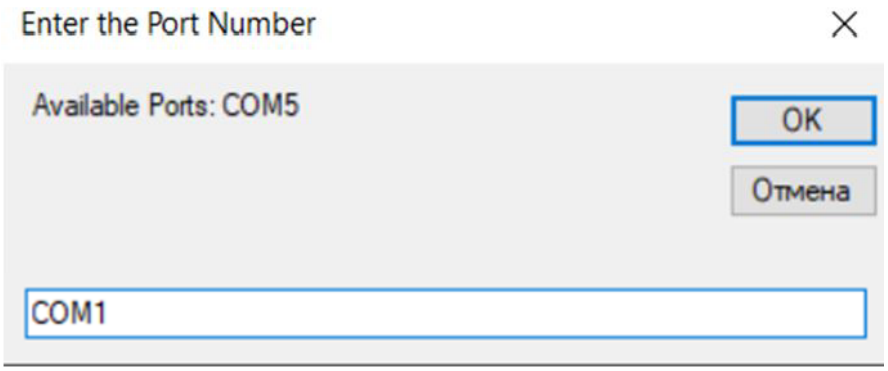


fig. 4.2. setting up the COM port

If there are several options in the list of available ports, you must open the item "Ports (COM and LPT)" in the "**Device Manager**", find an entry similar to the one shown in fig. 4.3 and рис. 4.4 depending on the type of adapter. The number of COM-port is in brackets after the word "COM".

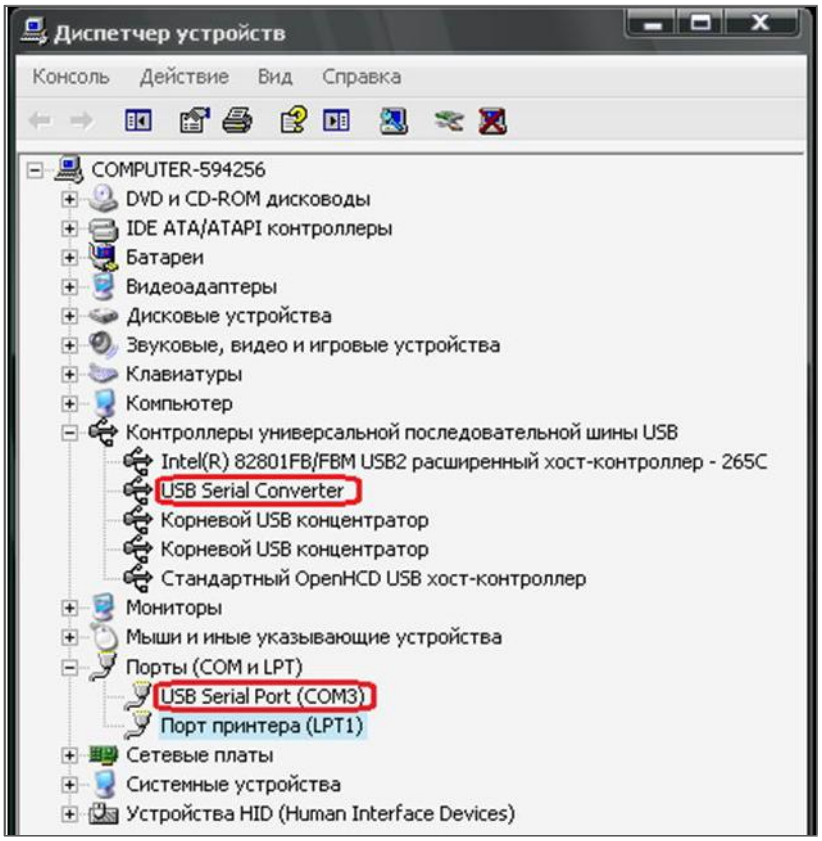


fig. 4.3. Device manager window

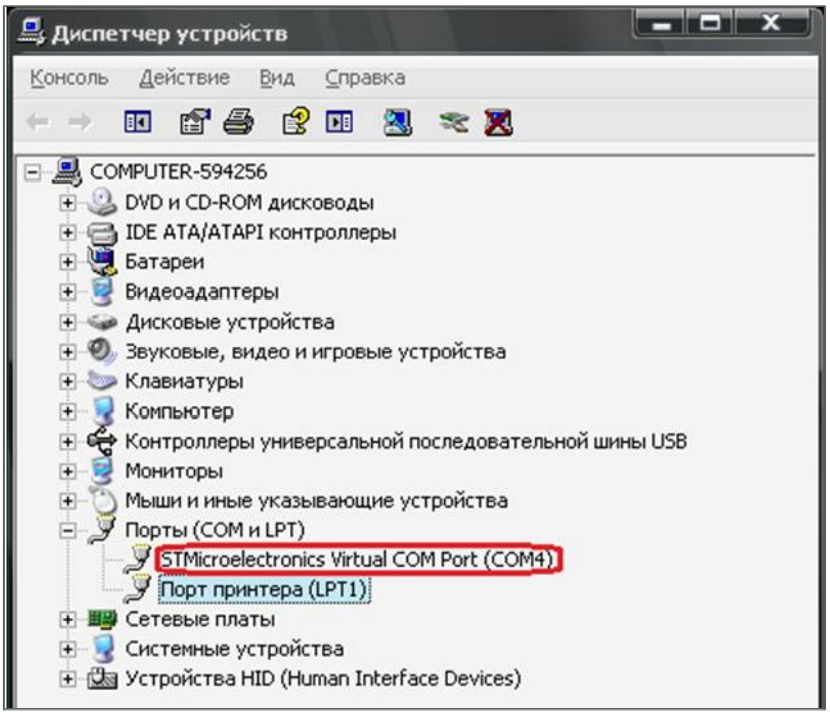


рис. 4.4. Device manager window

4.3 CONNECTION TO SENSOR

Preparing to work with the configurator:

1. Connect the service adapter to the computer with 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 "Receive" LED on the service adapter will start blinking;

3. Connect the meter to the service adapter with a two-way cable (comes with the adapter). Press the button to set the connection interface type RS-485 for Degree RS sensor and ISO9141 for Degree CAN sensor.

In a few seconds the connection between the sensor and the computer will be established. Visual indications of normal operation will be as follows:

- information on the connected sensor will be displayed in the upper part of the program window;

- the service adapter communication indicator ("Send") will blink quickly before connecting the sensor and both indicators ("Send", "Receive") will blink slowly after connecting the sensor;

- If there is no connected service adapter, the message will appear on the screen (fig. 4.5);

- it is required to connect the service adapter and select the required COM-port.

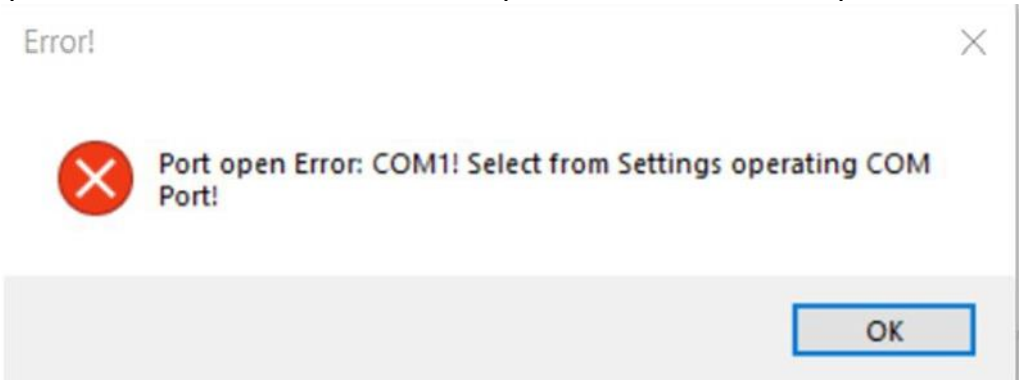


fig. 4.5. Error message

4.4 CONFIGURATION

When you start the program, a window appears with the following options:

- The "**File**" button allows you to save the sensor configuration to a file or load a previously saved configuration from a file.

- The "**Settings**" button allows you to select the number of COM port and language of the configurator.

- The "**Help**" button, when pressed, opens the help window.

- Tab "**Information**" (*fig. 4.6*), where the device type, serial number, configuration versions, firmware, protocol, hardware and date of calibration of the sensor are indicated.

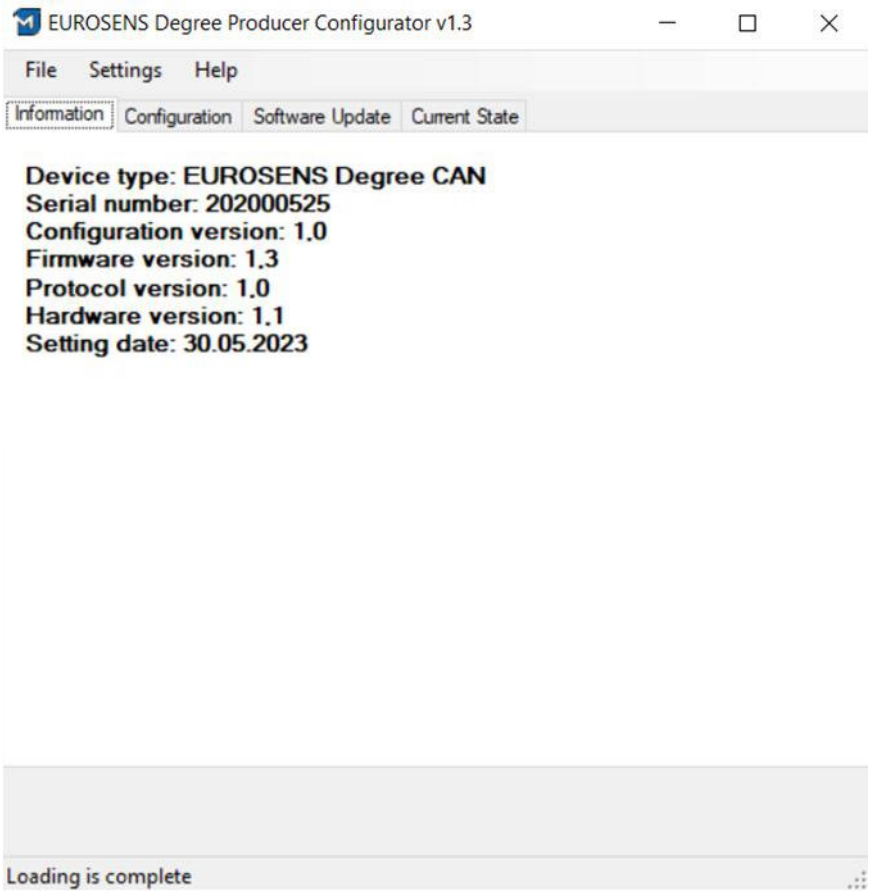


fig. 4.6. «Information» tab

- Tab **«Configuration»** (fig. 4.7) contains sensor settings. Depending on the sensor model, either the RS-485 (for Degree RS) or CAN (for Degree CAN) interface settings will be active.

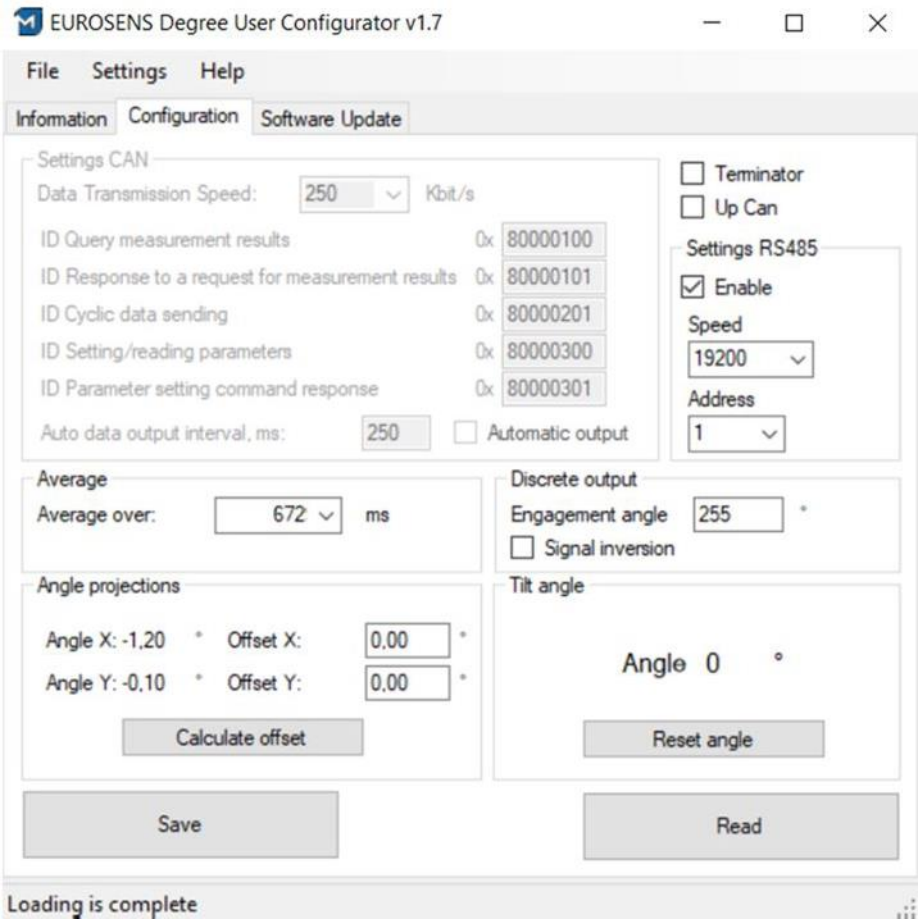


fig. 4.7. Tab «Configuration» (for eurosens Degree RS sensor)

- The "**Angle projections**" section. It shows the measured angles in the X, Y axes. These values are the output value of the sensor. By pressing the "**Calculate offset**" button, you can set the current values of the sensor angles as zero (if you want the sensor to read the angle from zero at the current position).
- The "**Tilt Angle**" section. It displays the current angle, which is the output value of the sensor. If you press the "**Reset Angle**" button, you can set the current position of the sensor as a zero reference point.
- The "**Averaging**" setting allows you to generate averaged values at the sensor output over a specified period of time.
- The "**Discrete output**" setting allows you to get the discrete sensor output state changed when the measured angle value exceeds the preset value. The "**Signal inversion**" flag allows you to set the state of the digital output to

"On" when there is no triggering of the digital output. When triggering with the inversion on, the discrete output will be set to the state "Off".

- "**Read**" button polls the sensor for current settings saved in sensor.

The tab "Software update" (fig. 4.8) allows you to update the software version of the sensor or reset it to the factory settings.

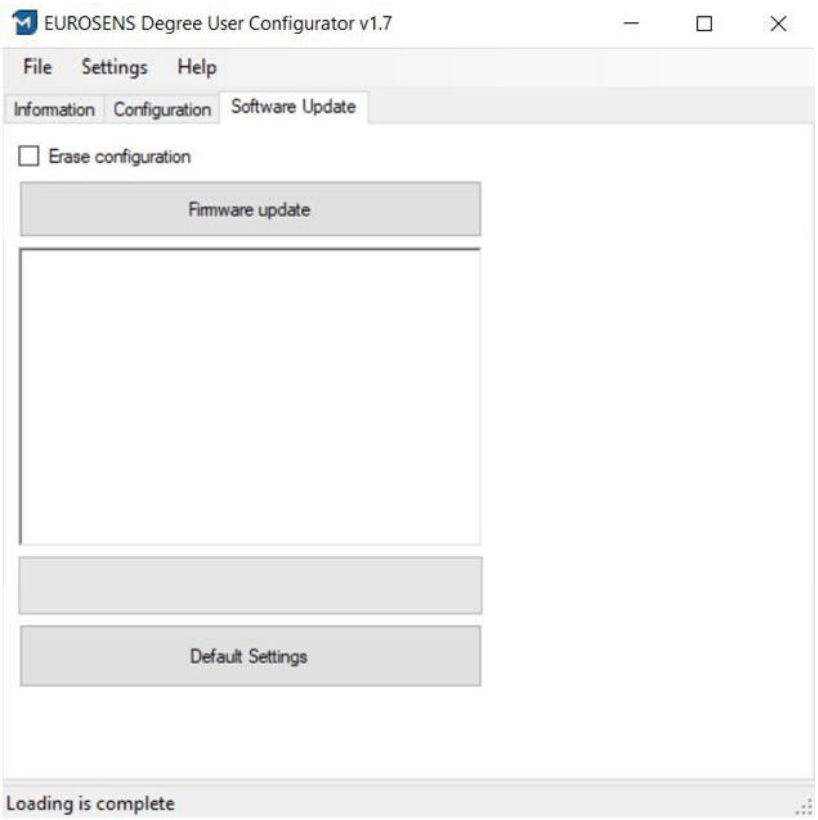


fig. 4.8. Tab «Software update»

4.5 SETTING UP THE RS-485 INTERFACE

By default, the eurosens Degree RS sensor uses a communication rate of 19200 kb/s and uses address №1 on the RS-485 network. These values can be changed in the settings.

You can also enable terminator and pull-up the RS-485 line to the supply voltage (see chapter 6).

4.6 SETTING UP THE CAN INTERFACE

In the CAN interface settings you can select the baud rate for the CAN interface and enable Pull-up (pull-up output to power supply) and Terminator (terminating resistor) by selecting the checkboxes.

Also you can change CAN IDs used by sensor in CAN bus communication protocol.

You can also select the interval of automatic data output and enable or disable auto output - the function when the sensor sends data without request (fig. 4.9).

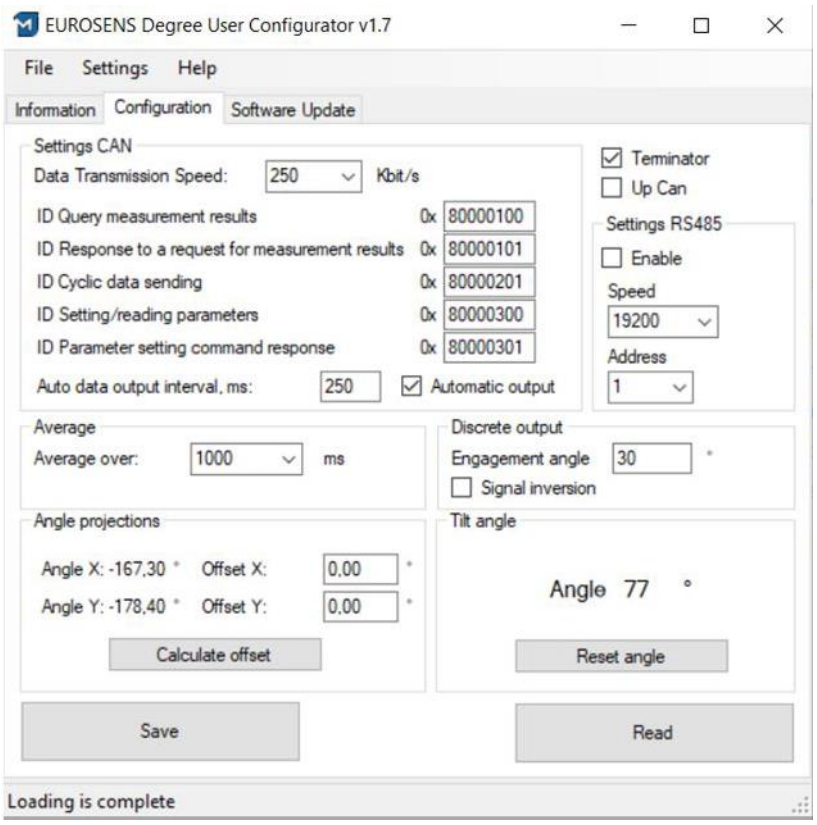


fig. 4.9. CAN interface settings

5 DATA PROTOCOL

Degree RS sensors with RS-485 interface support LLS protocol, widely used for reading data from fuel level, temperature, tilt sensors, etc.

Table 2. Description of the LLS protocol fields

Name of the field	Description
Output sensor value, 2-bytes, unsigned	The angle between the sensor vector and the vector of gravity in degrees (from 0 to 180 degrees)
Temperature, 1-byte, signed	0 (reserved)
Frequency, 2-bytes	0 (reserved)

The eurosens Degree CAN sensor supports three operating modes:

- Single data output on request;
- cyclic data transmission;
- reading/setting of device operation parameters.

Each mode has its own CAN-ID. The values of all identifiers can be reassigned by the user. Standard format with an 11-bit identifier and extended format with a 29-bit identifier are supported.

6 TERMINATOR AND PULL-UP OPTIONS

6.1 TERMINATOR

The distance from the CAN bus to the RS-485/CAN devices should be as short as possible, because long branches create signal mismatch and cause reflections. In order to avoid signal mismatch, terminating resistors or "terminators" are needed.

- If the line is below 30 meters long, or there are few devices on the line, it is enough to turn on the terminator only at the most distant device in the line.
- If the line is long or there are many devices, you need to turn on two terminators, one near the GPS-terminal, and the second on the most distant device in the line.

6.2 PULL-UP

- In case the Degree CAN sensor is connected to an already working CAN bus, no pull-up is required.
- On the CAN bus the pull-up on the line is always obligatory, but only on one device.
- In order to know whether a terminator or a pull-up is needed, you have to measure the line voltage.
- If there is about 2.5 volts between CAN H and ground, and about 2.5 volts between CAN L and ground, then a pull-up or terminator is not needed.
- If the pull-up is off everywhere, there will be 0 on the CAN H and CAN L wires.
- If the pull-up is on but the terminator is not, then CAN H will be about 5 volts and CAN L will be 0 volts.

7 EXTRAS

7.1 SETTING UP THE DEGREE CAN WITH NAVTELECOM SMART S-2435

1) In the sensor settings switch ON the «**Terminator**» and «**Automatic output**» options (fig. 7.1).

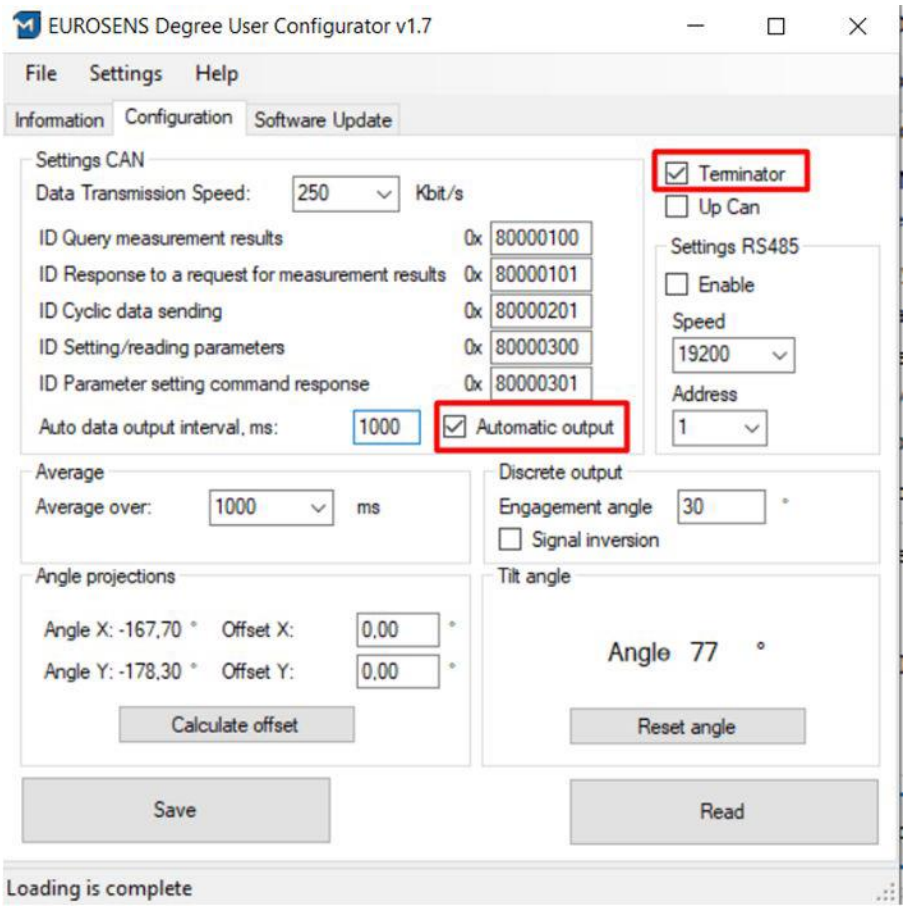


fig. 7.1. Eurosens Degree CAN settings

2) In the Navtelecom configurator make following settings:
- go to the tab "**CAN-bus**",
- select the mode "**By user parameters**",
- select the interface operation mode "**Active**",
- set the speed the same as in the settings of the sensor, in our case 250 kBit/sec,
- in the options "CAN messages" select the 29-bit parameter with the ID, which is selected in the settings of the sensor for automatic data transmission (in our case it is the standard ID 0x80000201) (fig. 7.2).

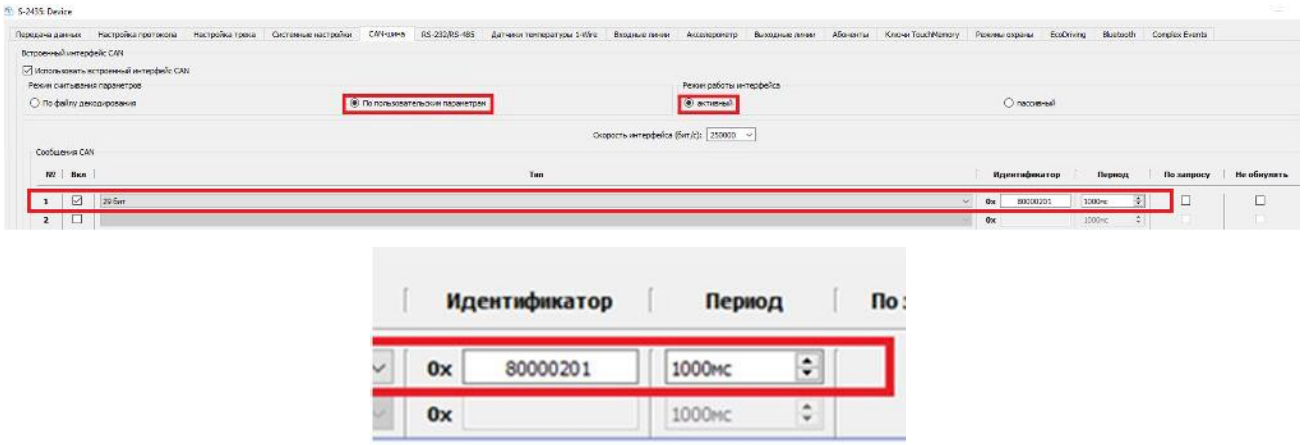


fig. 7.2. Setting up the sensor CAN bus ID to read

2) In the CAN message data you must select:

- 2-byte signed parameter with offset 2 (X-axis angle);
- 2-byte signed parameter with offset 4 (Y-axis angle);
- 1-byte bit field with offset 1 (sensor status), (fig. 7.3).

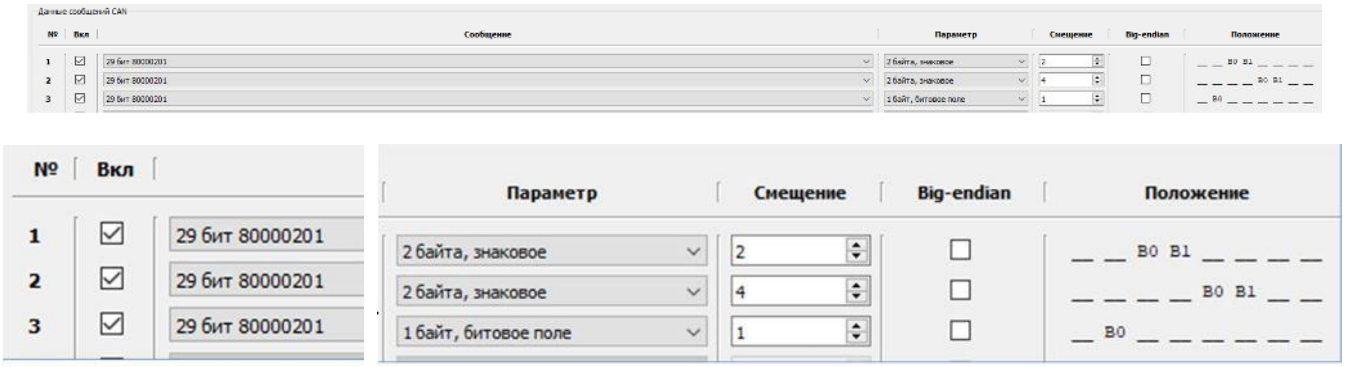


fig. 7.3. Setting up the parameters reading from CAN ID

3) In the Protocol settings choose the parameters to be transmitted to server (fig. 7.4).

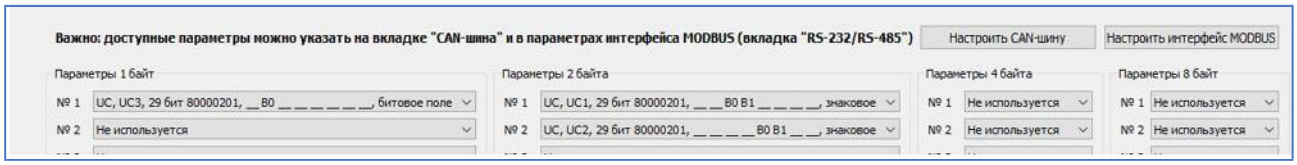


fig. 7.4. Choosing the user-parameters for transmission

4) In the **«Telemetry»** tab of the Navtelecom configurator you can test the data readings (fig. 7.5).

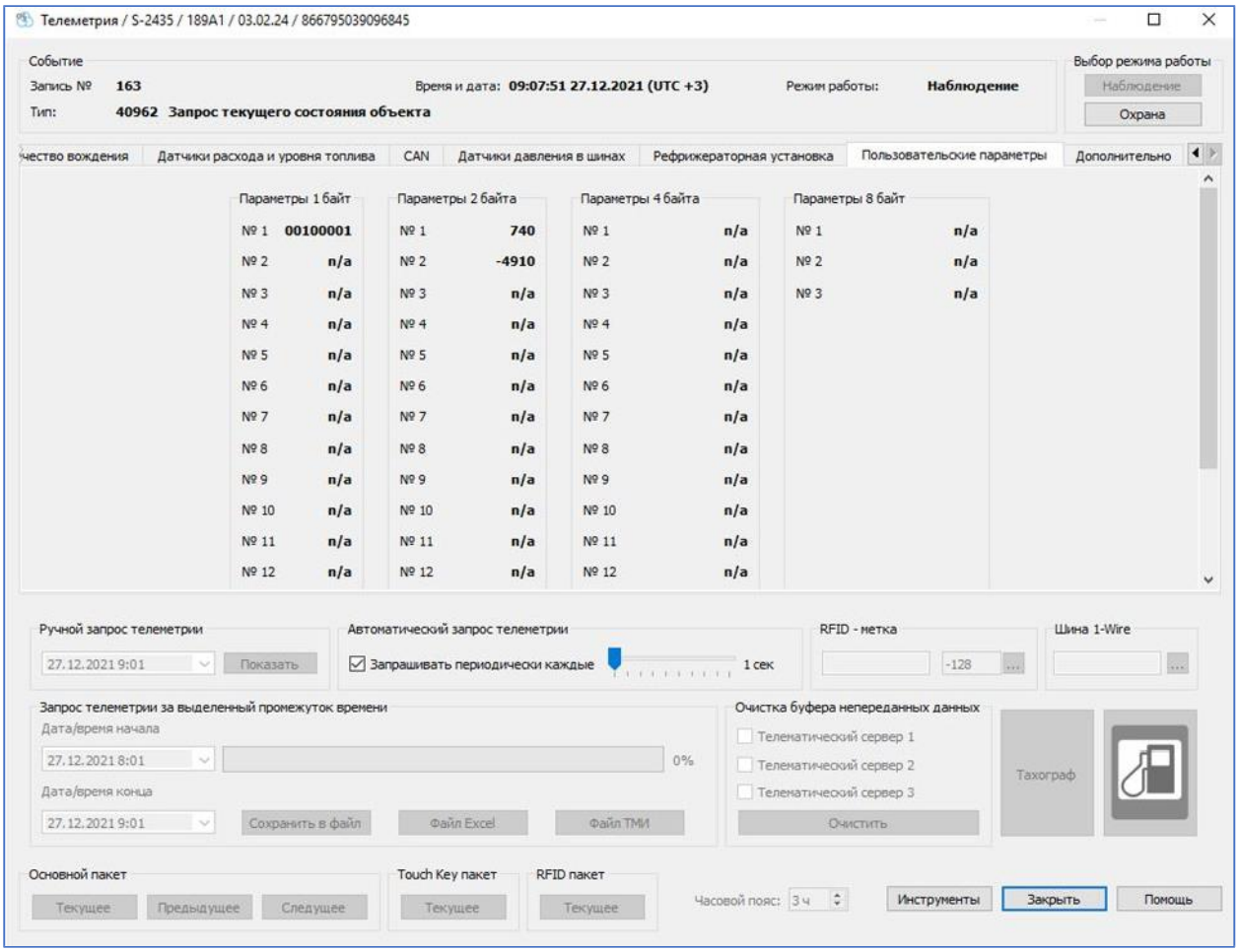


fig. 7.5. «Telemetry» tab of Navtelecom configurator

1 byte parameter – sensor status.

2 byte parameter №1 – 100 * angle X (on fig. 7.5 value 7.4 degrees).

2 byte parameter№2 – 100 * angle Y (on fig 7.5 value -49.1 degrees).

On fig. 7.5 you can see that there is a Y-axis error in the sensor status in the bit №5. It occurs when the tilt angle of the sensor deviates from zero by more than 15 degrees. This option is convenient to use when you want to control an object standing on horizontal surface ground.

7.2 Setting up Degree RS with Teltonika FMB (C,M) 125 GPS tracker

For sensor operation with GPS trackers via RS485 interface the default settings are suitable (fig. 7.6).

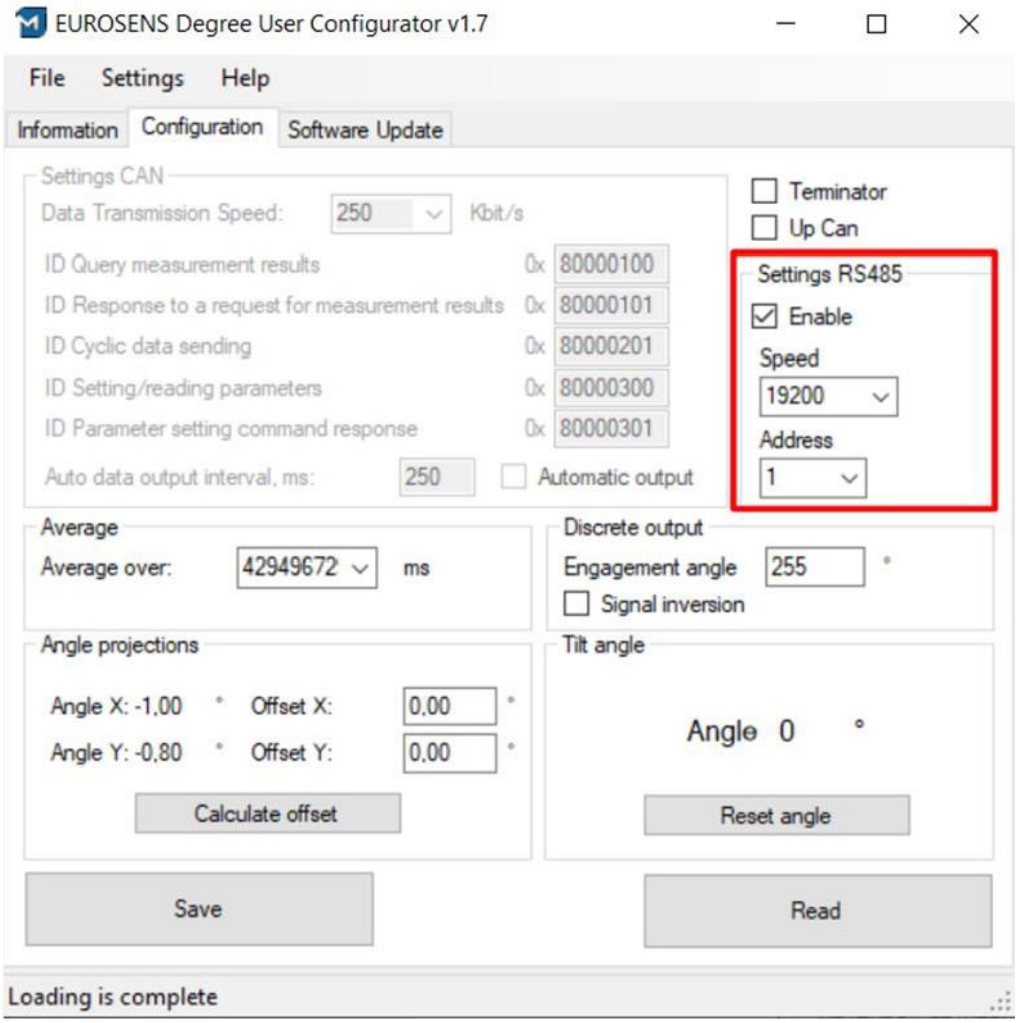


fig. 7.6. Eurosens Degree RS default settings for RS-485 interface operation

1) Specify in the RS-485 interface settings the addresses of tilt sensors in the RS-485 network (up to 5 sensors are supported) (fig. 7.7).

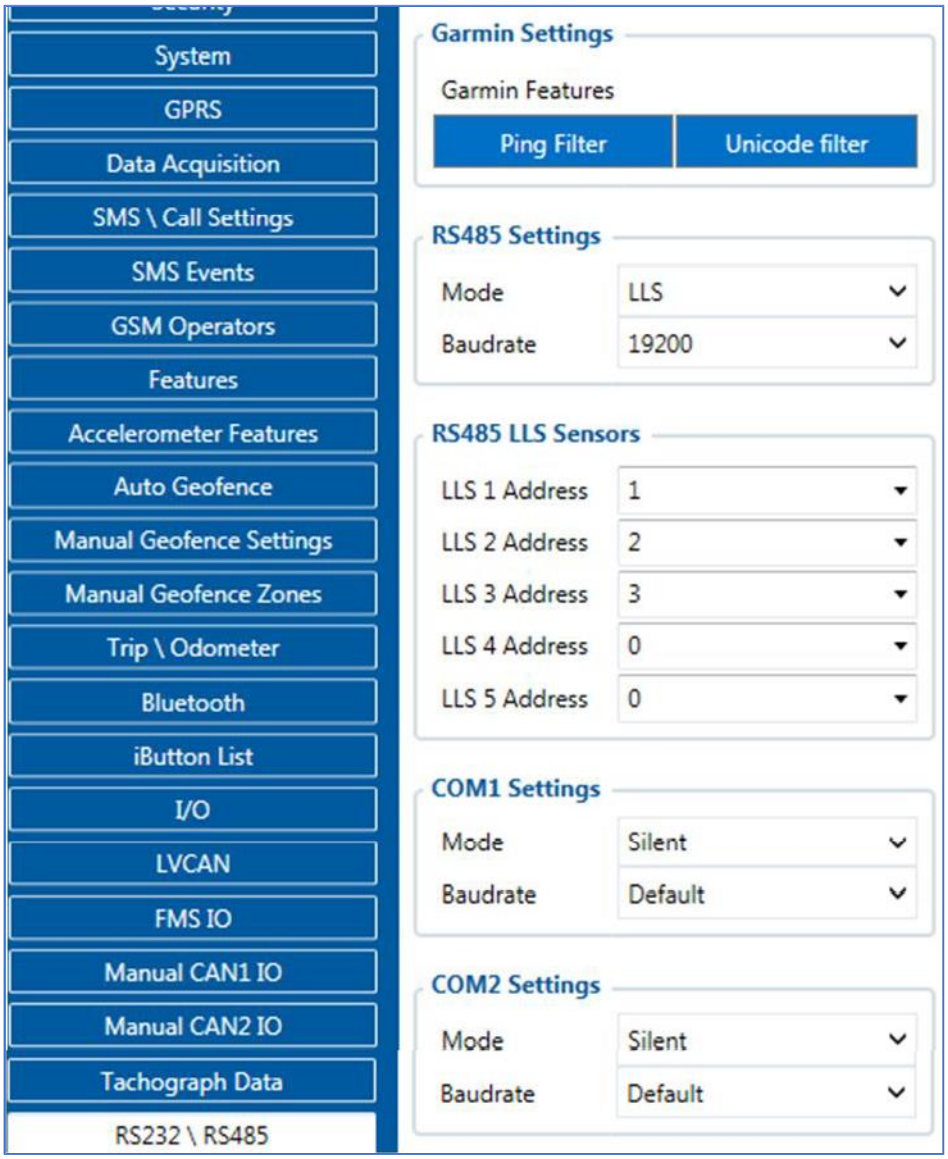


fig. 7.7. Specifying addresses of tilt sensors in the RS-485 network

2) Enable "**LLS fuel level**" parameter data transmission by setting the priority of the desired sensor to "**Low**" instead of "**None**" (fig. 7.8).

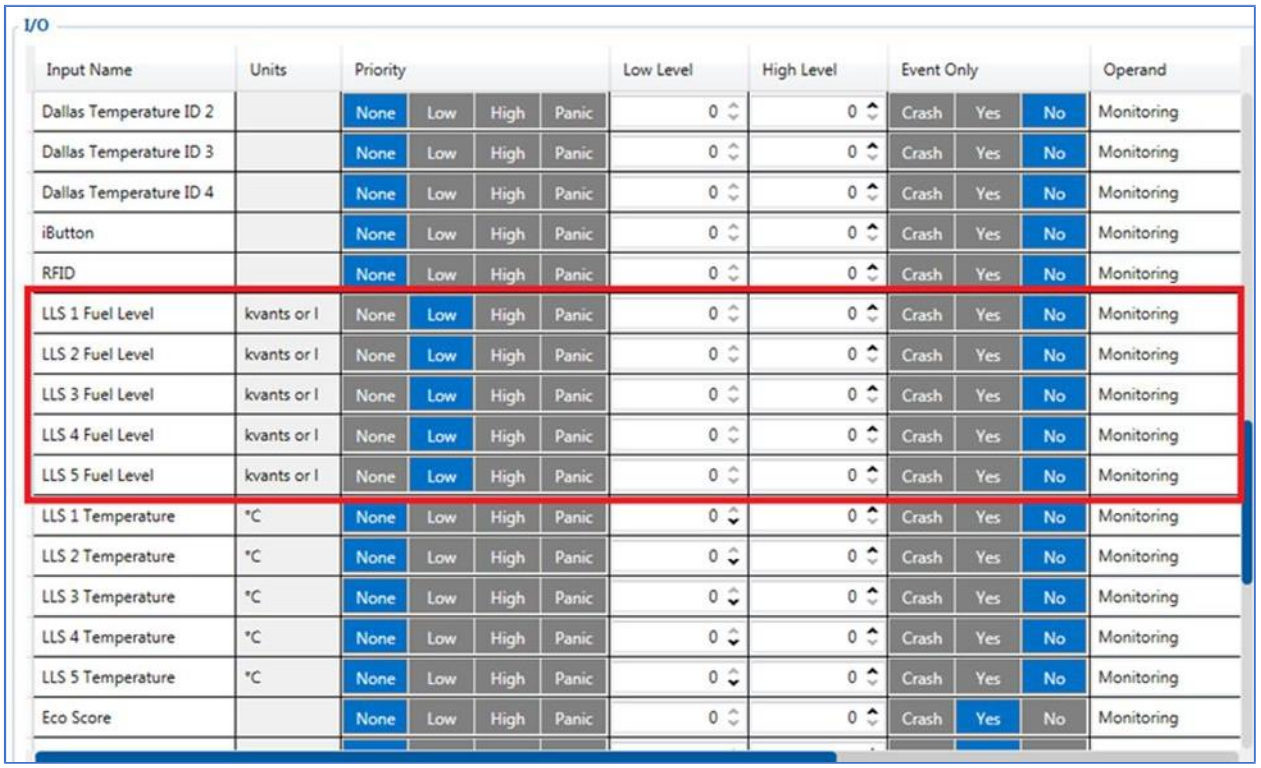


fig. 7.8. Turning on the data transmission

The Teltonika GPS tracker sends sensor values in the following parameters:

- "Sensor1 angle" – io_201
- "Sensor2 angle" – io_203
- "Sensor3 angle" – io_210
- "Sensor4 angle" – io_212
- "Sensor5 angle" – io_214

8 ADDITIONAL INFORMATION

8.1 STORAGE

It is recommended to store eurosens Degree RS/CAN in dry enclosed areas.

Sensors 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 sensors with substances that cause metal corrosion and/or contain aggressive impurities.

The storage period of sensors should not exceed 12 months.

8.2 DISPOSAL

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

Displays do not contain precious metals in amount mandatory for accounting.

8.3 TECHNICAL SUPPORT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8.4 CONTACTS

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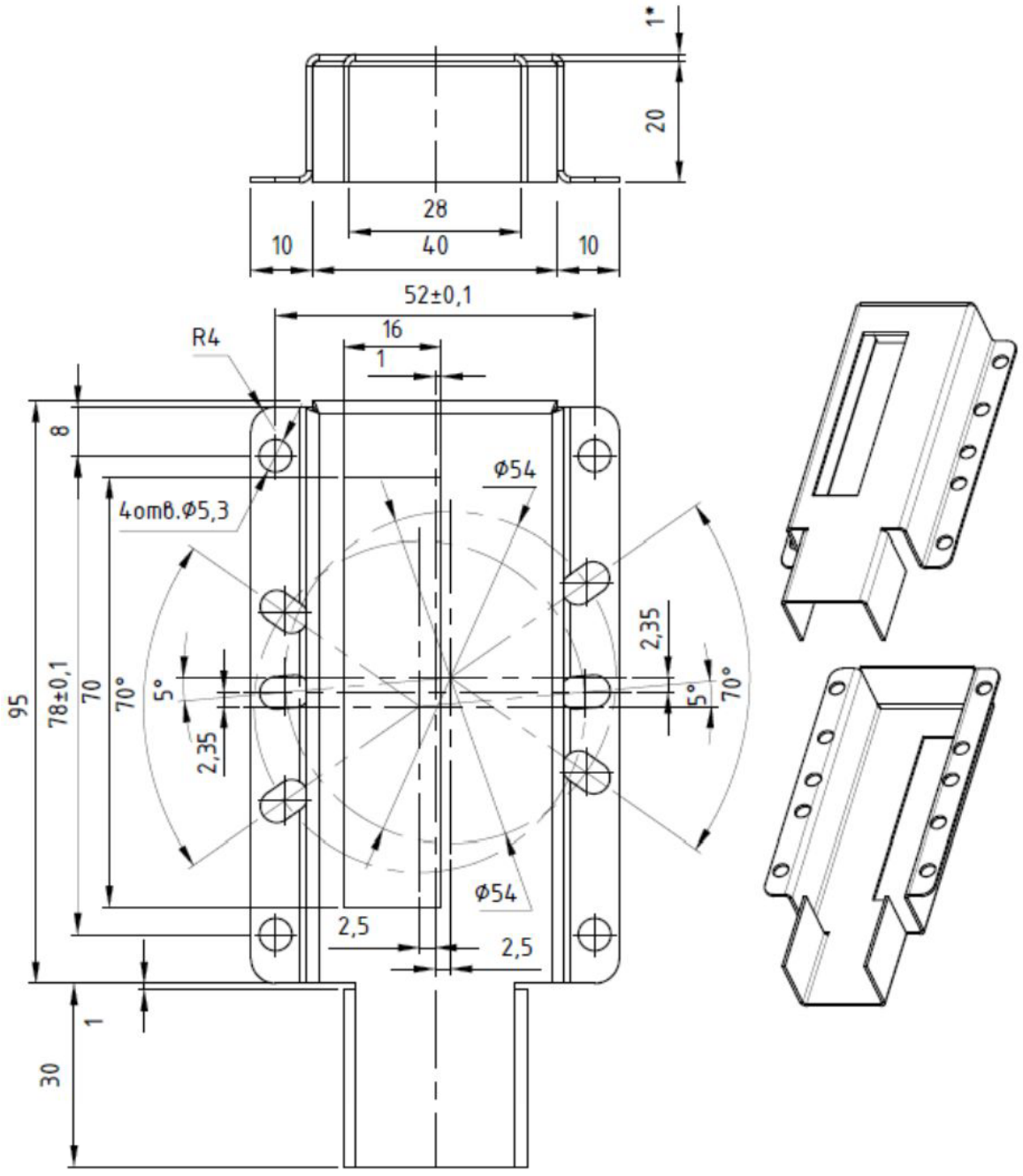
Website - www.eurosenstelematics.com

APPENDIX 1. OVERALL AND MOUNTING DIMENSIONS



Supply package of eurosens Degree 485/CAN

1. Sensor – eurosens Degree 485/CAN
2. eurosens MK Degree (mounting kit)
3. Metal protective cover – eurosens Degree Cover
4. eurosens Degree Cover MK (mounting kit for protective cover)
5. Bag with zip lock, 180 x 250 mm
6. Corrugated box, 180 x 115 x 90 mm (T23)
7. Fuse KLS5-270-1-003(3A)
8. Fuse holder KLS5-708

**Cable is ordered separately and is not included in the package!*

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