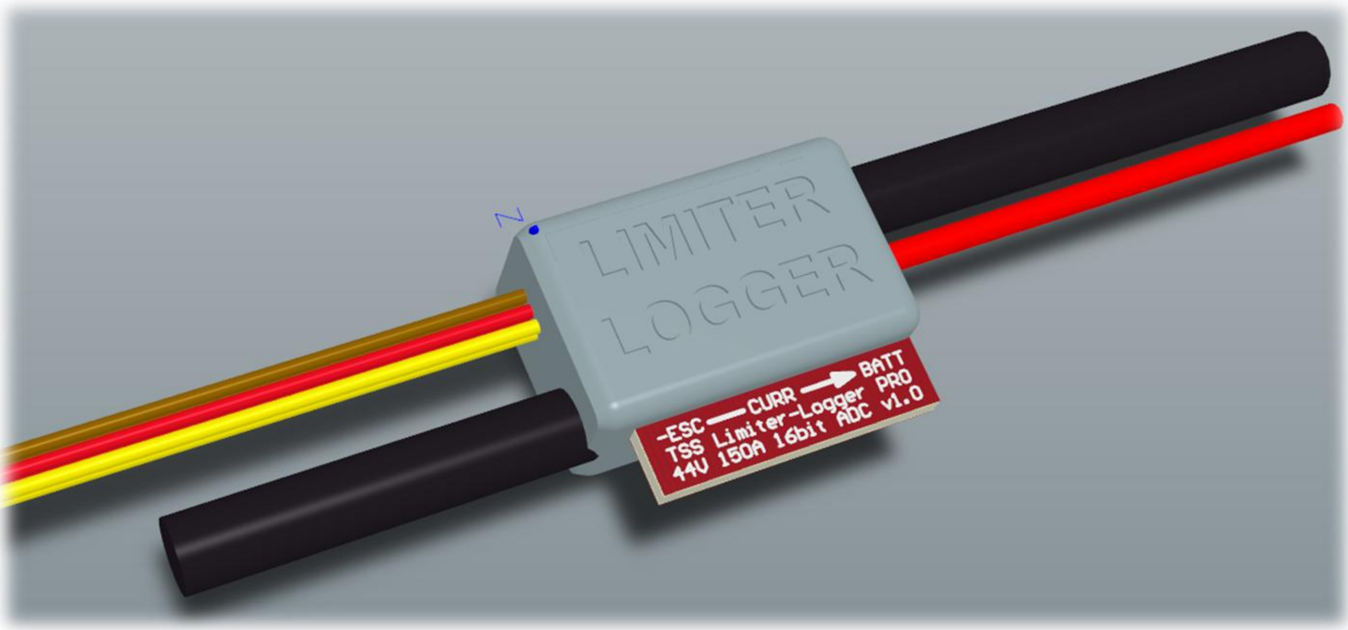
http://tsslimiter.com

Energy limiter for radio controlled models

TSS Limiter (v.1.0 – v.4.5)

User manual



Russia, Zelenograd 2024

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Caution!

- **The red LED is constantly on!** This problem is typical for limiters versions 1.0.x and 1.1.x. It may also appear on later versions if the firmware update was interrupted for some reason.
  To restore the operation of the limiter, use the detailed instructions: https://disk.yandex.ru/i/aDo465sFD-gT3A
- **It is forbidden to use the power switch of the electric motor speed controller in the negative wire, this will lead to failure of the limiter!** Use only the recommended connection diagram.
- **It is forbidden to use the limiter with ESC that have galvanic insulation!** In case of urgent need, it is strongly recommended to connect the power and signal grounds of the ESC with a wire with a minimum length, and external BEC, located as close as possible to the ESC (Appendix 1). These actions are performed at your own risk!
- **Limitation BEC voltage for version 3.0.1.** This version has a smaller margin for permissible voltage levels, do not use a BEC voltage greater than 5V, this may damage the limiter!

- **Restriction for versions 1.0.x.** **Automatic race mode reset is only possible with battery configurations of 3S and higher. When using a 2S battery, racing mode must be reset using the button.**

http://tsslimiter.com

Technical specification

Parameter	Versions 1.x, 2.x	Versions 3.x (Lite and Pro)	Versions 4.x (Start and Pro)
MCU version	32bit mcu		
Type of communication interface	BLE 5.0 (Bluetooth Low Energy)		
Communication Interface range	100m (in line of sight), except Start 4.0. For Start 4.0 – 5m		
Adc type	delta-sigma 16bit	delta-sigma 24bit	
Sampling frequency	300 Hz	10 kHz	
Measured voltage	0 – 43V (10S)	0 – 52V (12S)	
Voltage measurement accuracy	±0.1% + ±5mV	±0.05% + ±5mV	
Measured current (up to 20 sec)	1 – 150A		
Measured current (DC)	1 – 100A		
Current measurement accuracy	±0.5% + ±50mA	±0.25% + ±40mA	
Measured energy	0 – 300kWh		
Energy measurement accuracy	±1.0%	±0.5%	
Limiter shunt resistance	0.25mOhm		
Receiver signal (PPM 3.3-10V)	0.7 – 2.3ms	0.4 – 2.3ms (supported T-FHSS SR)	
BEC voltage	4 – 8.4V * (recommended 5 – 8.4V*)		4-12V

Current consumption (from BEC)	6mA	14mA	< 0.3mA
Current consumption from the battery with the kill switch off	At 12V: 0.4mA At 36V: 1.4 mA		< 0.3mA
Working temperature range	0 – 50^{o}C		
IP rating	IP67		
Dimensions of the device (w/o wires)	22.5 x 19.5 x 10.5mm	21 x 18 x 10mm (Lite) 22.5 x 19 x 10mm (Pro)	24 x 24 x 8.5mm (Start) 18 x 17.5 x 9 mm (Pro)
Weight (Including all wires and plugs)	18g	13g (Lite mini), 19g (Lite), 16g (Pro mini), 22g (Pro)	12g (Start mini), 16.5g (Start), 11.5g (Pro mini), 14.5g (Pro)
Signal wires	240 ±30mm receiver wire, 40±20mm ESC wire		
Type of signal wires	22AWG (JR) or 26AWG (JR)		
Type of the power wire	AWG10 (AWG13 – for mini version)		
Logger (only Pro version)	51 min for 10Hz	106 min for 10Hz	
Logger write frequency	1 – 10Hz	1 – 100Hz	
RPM and speed measure	Only v.2.0	Only v.3.5 Pro	–
Status	Discontinued	Discontinued	Active

* Version 3.0.1 has a maximum voltage limit of 5V. This voltage must not be exceeded!

http://tsslimiter.com

Useful links

- Telegram channel: https://t.me/TSSLimiterNews (All news about firmware updates, new versions of programs are posted in this channel);
- Network drive with new versions of firmware and programs: https://disk.yandex.ru/d/s9IeueLSqpWJFA
- https://tsslimiter.com Main site.

Introduction

The energy limiter for radio-controlled models (hereinafter the limiter) is intended for calculation and limitation of the energy consumed by the model.

The device is equipped with the Bluetooth Low Energy (BLE) interface for communication with mobile devices or computers which allows to perform its settings and receive the current readings without need of having direct access to and its removing from the model.

The device can be used both for running the competitions to limit the energy consumed by the model from the accumulator and for training intentions to set the model and take the actual readings on current, voltage, energy and consumable battery capacity.

The device fully meets the Naviga requirements which allow using it in all kinds of registered or non-registered competitions according to Naviga rules. In event of rule changes, the new array of device settings will be available in new firmware upgrades of the device. The firmware upgrade is performed through the user`s phone or PC, you need not send the device anywhere. The firmware upgrade procedure is described below.

Each device instance has its own unique 32-bit number used for identification.

The limiter has the system for voltage control before racing and after racing which allowing the judge to check the voltage level without need of having the model opened.

Description of device operation

The startup algorithm for energy calculation is presented in Figure 1:

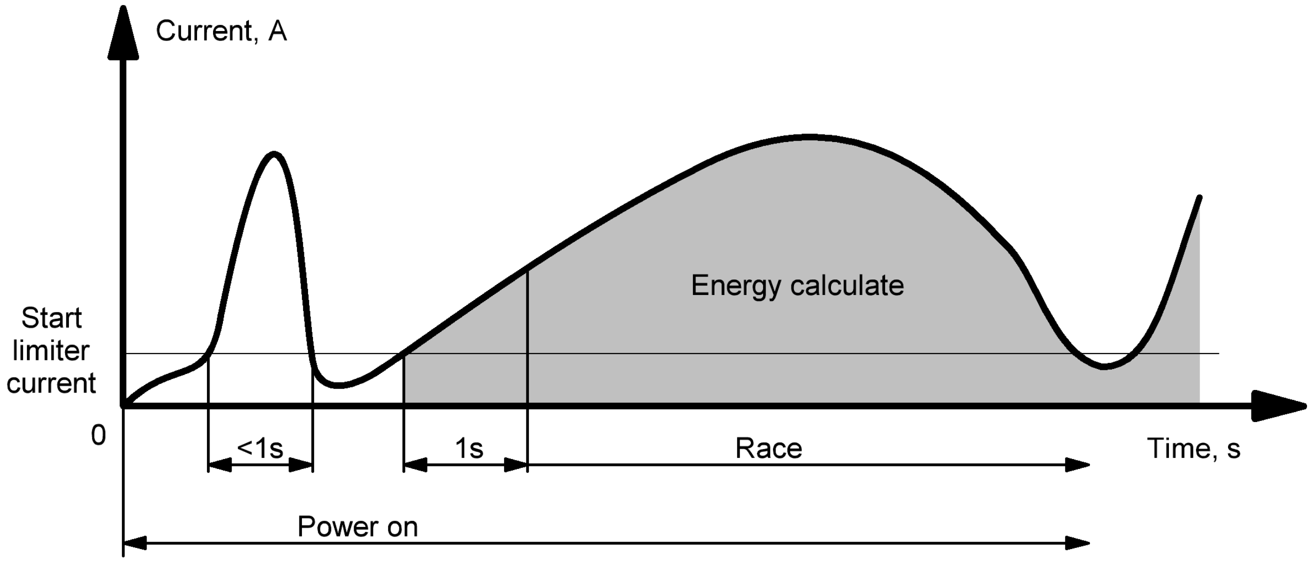


Figure 1. The startup of energy calculation

The user can check the engine start any number of times provided that check time will be less than 1 second or if the current will be less than the starting current for energy calculation.

The device operation principle in the mode of energy limiter is presented in Figure 2. Until the moment when the current energy value exceeds the maximum, the competition runs in a common way, as if without the limiter. After exceeding the energy maximum, the soft limitation of the top speed takes place by changing the control signal from the receiver to the ESC.

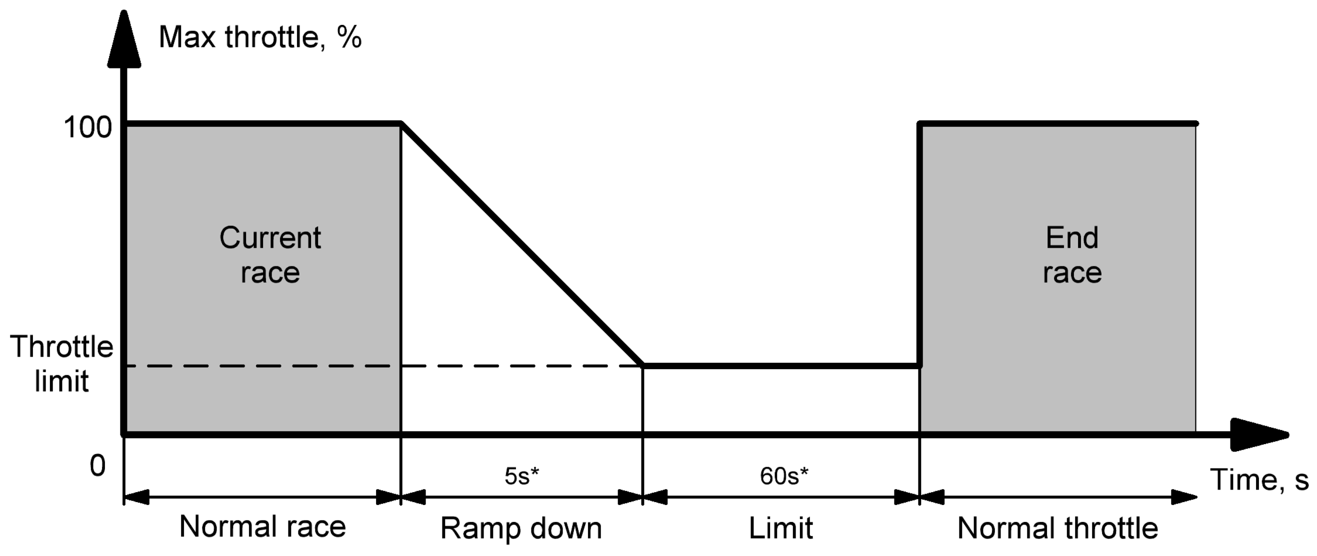


Figure 2. Transfer to the energy limitation mode

After the limit time is expired, the limiter will switch to the mode without restrictions, in this mode, the model can reach the starting bridge to complete the race.

If the ESC power is turned off (using emergency switch) during a race or during a rampdown, the limiter, when turned on again, will continue to calculate the energy or rampdown if the energy has already exceeded its peak.

Reset of the limiter to the initial state from the state of the running race is possible only after fully disable battery from limiter, or manually using button.

Indication

The device has a green LED indication.

With the indication you can understand what mode the device is in and what settings are used.

Indication is carried out periodically according to the following algorithm:

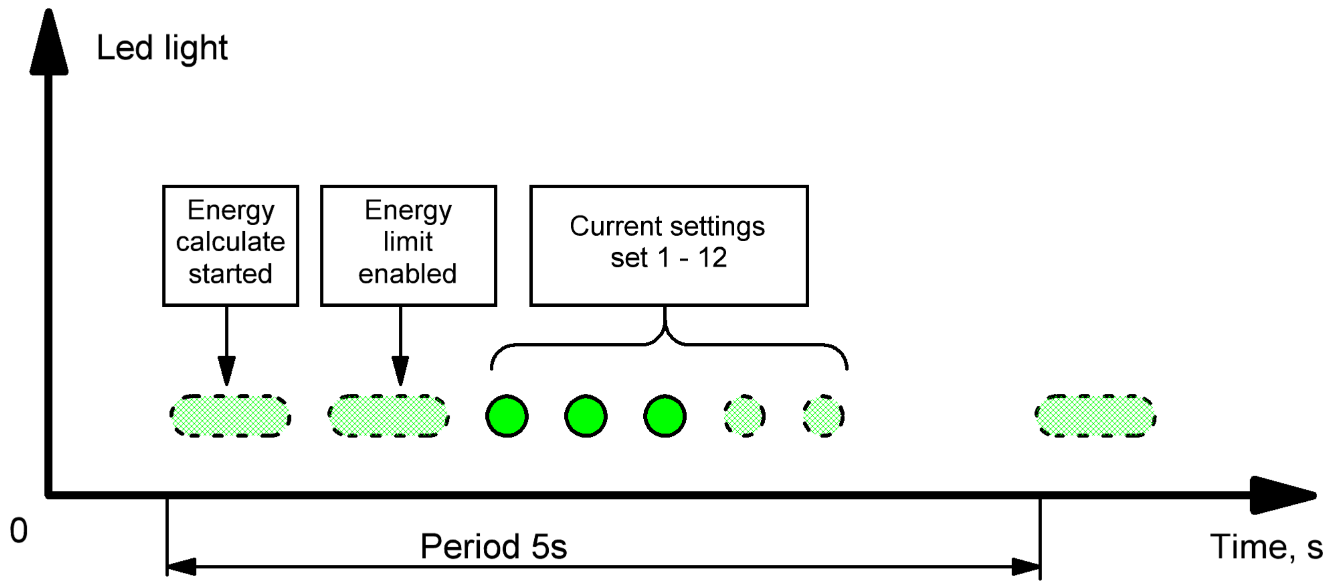


Figure 3. Device LED indication.

Duration of long flashes is 0.75 s, duration of short flashes is 0.25 s. Long flashes always mean that the device is in energy counting mode (race mode).

Before starting, you need to make sure that the energy counter is reset and the device is in standby mode, in this case there will be only short flashes showing the current set of settings.

If a set of settings with a number greater than 12 is used, it will be displayed in one flash, lasting 3 seconds!

All other information including the actual values of currents, voltages, energy, capacity, temperature, etc., are displayed via a mobile phone and Windows program.

Preset settings

The device has 6 sets of preset settings. These settings cannot be changed and 1 – 5 sets fully comply with the Naviga rules.

Settings set number	Purpose	Energy limitation
0	Training mode, telemetry only	∞
1	Mini Eco, Mono, Hydro	21Wh
2	Eco Expert, Mono I, Hydro I	60Wh
3	Mono II, Hydro II	120Wh
4	FSR-E	180Wh
5	Mini FSR-E	42Wh (2Wh in FW before 23.2)

For all sets of preset settings, the following settings of limitation are used:

Settings	Value	Note
Start current	3A	
Throttle limitation (% from full)	0%	That is a complete shutdown
Time of rampdown	5s	
Time of throttle limitation	60s	

Team class settings used in Russia

Supported in firmware 25.2 and newer. The device has 2 additional sets of preset settings. These settings cannot be changed and are fully compliant with SMSIF rules.

Settings set number	Purpose	Energy limitation
6	Mini Eco Team	21Wh
7	Eco Team	60Wh

For this sets of preset settings, the following settings of limitation are used:

Settings	Value	Note
Start current	3A	
Throttle limitation (% from full)	30%	
Time of rampdown	5s	
Time of throttle limitation	60s	

Full list of the device settings

Some settings are only available in the Windows program!

The device contains general settings used for the device as a whole and sets of settings for racing.

General settings

Settings	Value	Note
User name	3 - 31 characters	Example: Sergey Turnaev
User password	3 - 31 characters	
Registration number	8 – 9 symbols	Example: RUS-0153
Current set of settings	1 – 14	
Realtime data update freq.	1, 2, 5, 10Hz	
Logger frequency (version Pro < 3.5)	1, 2, 5, 10Hz	
Logger frequency (version Pro >= 3.5)	1, 2, 5, 10, 25, 50, 100Hz	
Motor poles (version Pro 2.0 and 3.5)	2, 4, 6, 8, 10, 12, 14, 16, 18, 20	

Sets of the settings for race

In total, the device has 14 sets of settings, 6 (8 - 13) of which are user-defined and are subject to change.

Settings	Value	Note
Setting name	1 - 31 characters	
Energy limit threshold	1 – 300000Wh	
Current at the counting energy start	2 – 10A	
Throttle limitation	0 – 99%	In limiting mode
Time of rampdown	1 – 999s	
Time of throttle limitation	1 – 999s	Before restarting the limiter

Connection diagram

Connection diagrams are shown in Figure 4 and Figure 5. Device measures the current in the negative (black) power wire. It is necessary to connect the power wires in such a way that the direction of electric current flow corresponds to the direction of the arrow on the limiter body so that the end of the arrow points to the wire connected to the battery. In new versions of limiters on the body there is the designation ESC - ESC side and BAT - battery side.

Note! The limiter should be connected first of all to the negative power wire of the ESC; after power is applied, it is forbidden to disconnect this wire, this may damage the limiter!

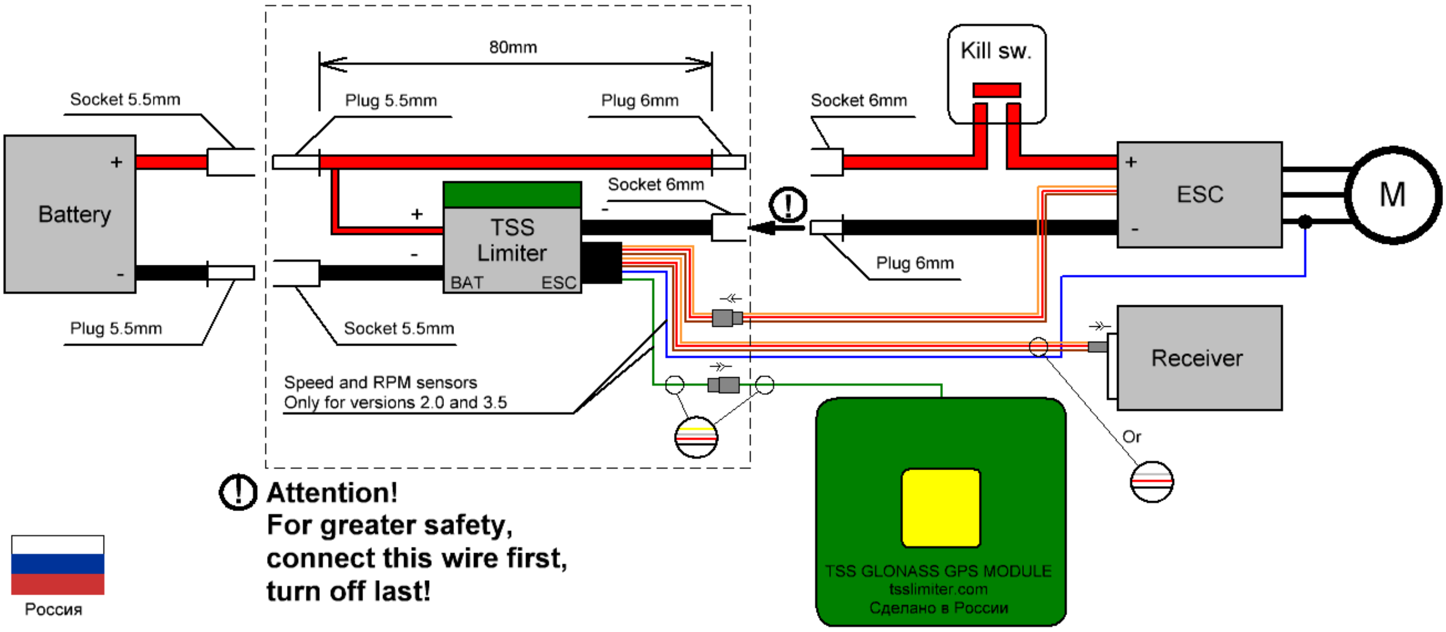


Figure 4 Standard connection diagram of the limiter

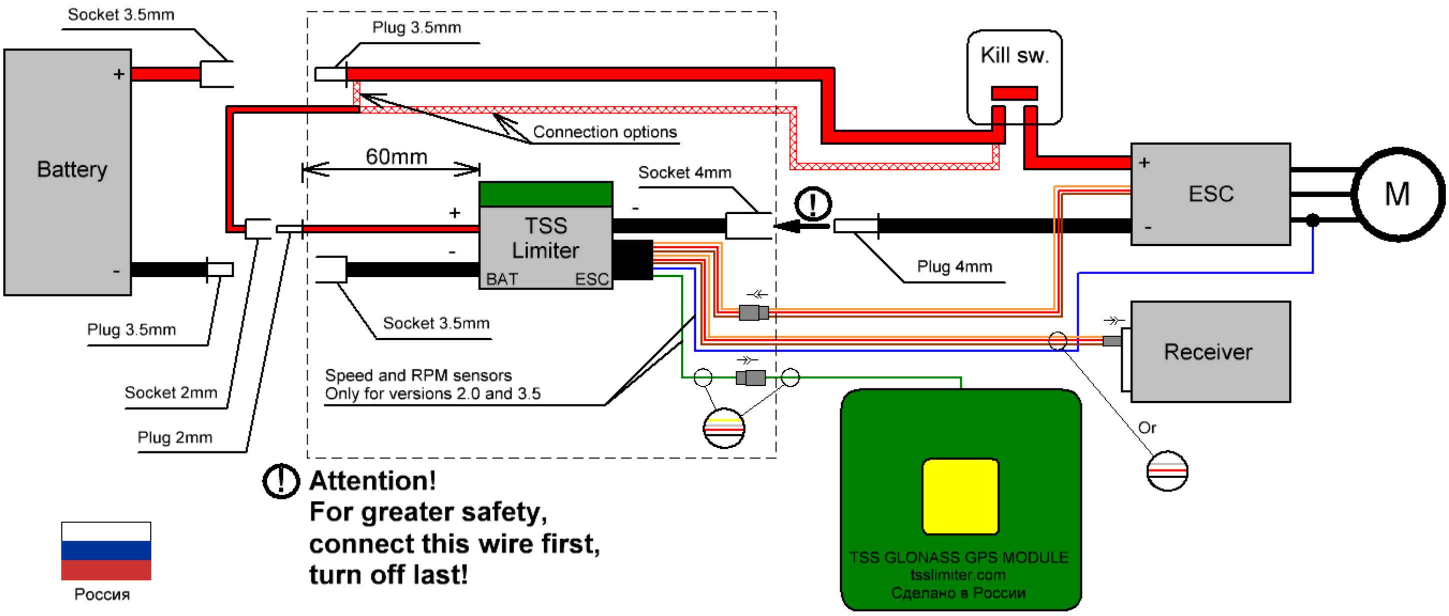


Figure 5 Recommended connection diagram of the limiter for mini classes

Limiter location in the model

To ensure maximum limiter telemetry range, do not place the red power wire near the limiter antenna; it is optimal to place it next to the limiter power wires. When installed in a model, the limiter should be oriented with the antenna up, as high as possible. Installing the limiter sideways or with the antenna down can significantly reduce the telemetry range.

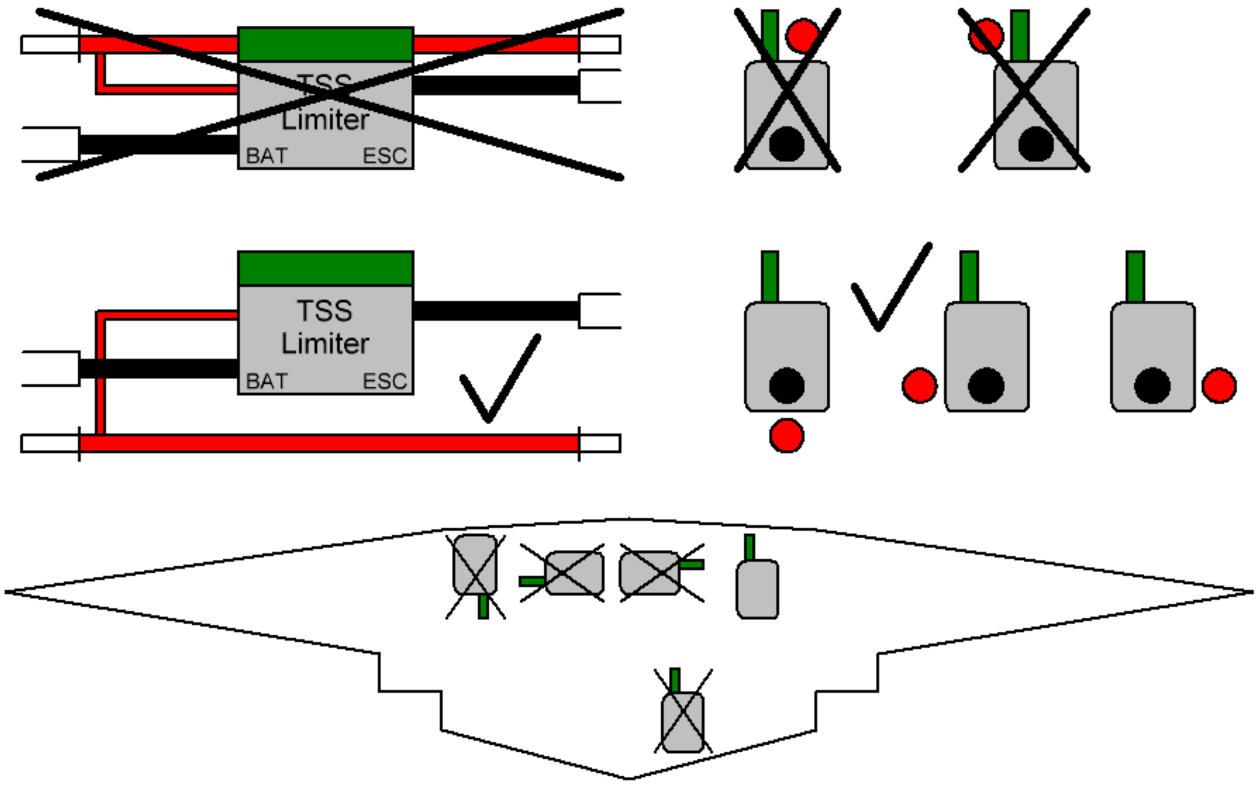
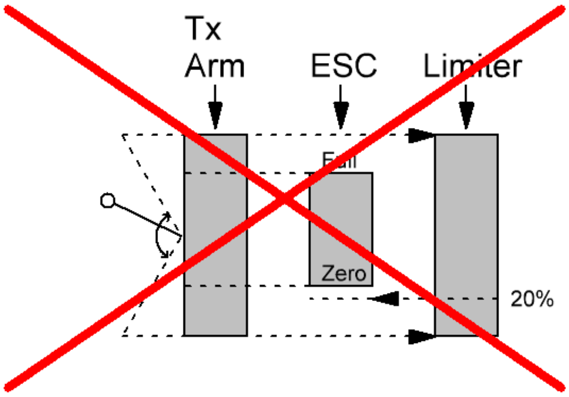
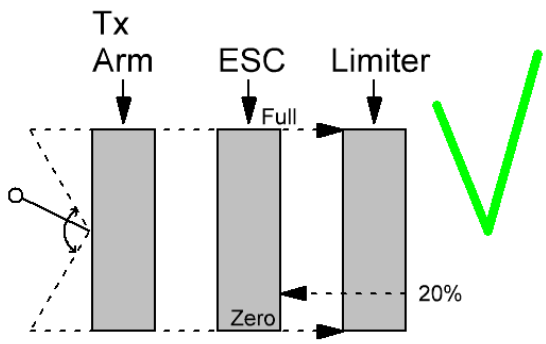


Figure 6. Limiter location in the model

Setting of throttle grip

Using a limiter, pay special attention to the correspondence of the throttle grip position on the transmitter with positions of zero and full throttle in the ESC. The limiter counts the limit (0% by default) from the zero position of the throttle grip on transmitter, therefore, If the ESC uses a narrower operating range, it will result in a faster turn-off then ramp-down time!





Setting by button

Device can be particular set up by the button connected through power wire (red) and signal wire (yellow) going into the receiver. Normal state of button is open.

If necessary connect a button, disconnect the limiter from the receiver connecting it then to the button, perform the required actions and reconnect the limiter to the receiver.

Functions of setting by button is given in the table:

Function	Parameter	Note
Reset of energy calculation	Hold down for 5 - 13 seconds and release.	There should be three long green flashes. Indication can be updated with delay in one period
Switching the set of settings up *	Push once	Only if the energy calculation is not started. Cyclically switching between 0–5 sets
Switching the set of settings down *	Hold down for 1 second	Only if the energy calculation is not started. Cyclically switching between 0–5 sets
Password reset	Hold down for 30 ± 10 seconds	Only if the energy calculation is not started.
Manual start of bootloader	1.Hold down before limiter switching on; 2.Enable limiter BEC power;	In normal device operation it is not used. Required if there are problems with updating the firmware in a regular manner.

	3. release button as soon as the red(or green for v.3.5) LED goes out	

Since the period of indication is 8 seconds, it is recommended to switch the sets of settings no faster than one increment over the period of indication, otherwise, it may not be clear which set has been turned on, since the display will be delayed.

* In firmware starting from version 23.3, to switch a set of settings, you first need to manually reset the energy calculation using the button (press for 5-13 seconds and release), this action unlocks the ability to switch settings. After this, you need to make one single clicks, this will completely unlock the switching of settings using the button. Thus, starting from the second press, switching settings will be available.

Limiter settings

The main program for configuring the limiter and reading logs is the TSSLimiterAppPC program for Windows 10. Windows 11 is also supported. The program consists of two parts:

- **TSSLimiterX.exe** – limiter scanner for judging, changing limiter settings, reading logs, updating firmware.
- **TSSLogViewer.exe** – program for viewing logs.

Application for Android operating system (version 6 and above) **TSSLimiterApp.apk** contains a scanner of limiters for judging, can be used to view telemetry during the race, can be used to change the limiter settings and general settings.

The latest versions of programs are always located on a network drive at:

https://disk.yandex.ru/d/s9IeueLSqpWJFA

For **Android** and **iOS** operating systems, you can use the **nRFToolbox for BLE** program, which uses a text format for setting up the limiter and viewing telemetry:

nRF Toolbox for BLE (Android)

nRF Toolbox for BLE (iOS)

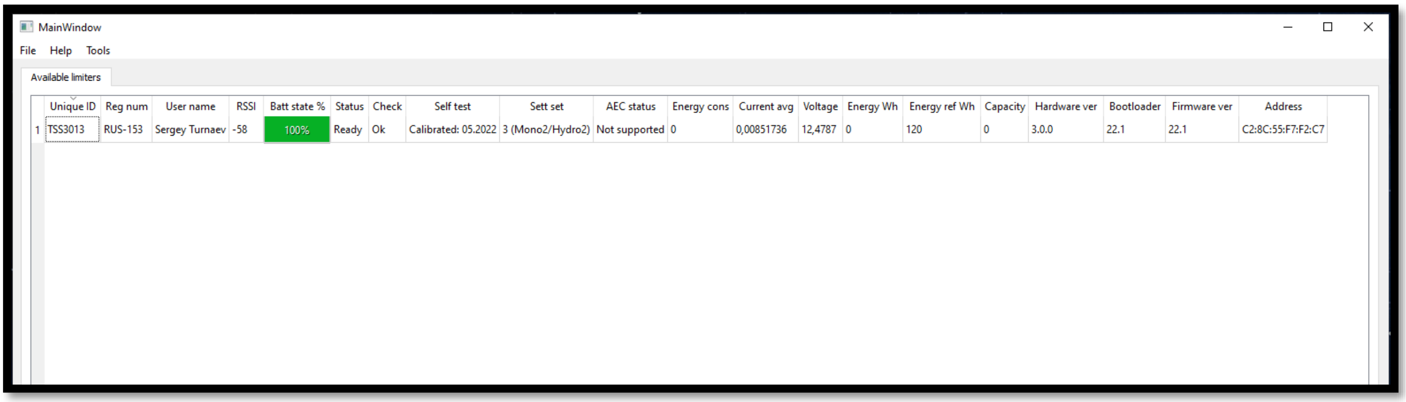
TSSLimiterX (Windows 10)

When using a desktop computer, you will need to purchase a USB – BLE5.0 module and be sure to install the driver from the website of the manufacturer of this module. Not all BLE modules can work correctly with the standard Windows driver. For driver installation, please contact the module manufacturer.

Unzip the archive with the TSSLimiterAppPC.rar program to any folder on your computer and run the TSSLimiterX.exe file. Connect the limiter according to the recommended scheme and turn on the power.

Limiter Scanner

The scanner is used to quickly view information about nearby limiters; in the scanner you can see basic information about the limiter owner, current operating mode, firmware version, etc. The scanner window is shown in the figure below:



The scanner contains the following information:

Unique ID – unique identifier of this limiter, has TSSxxxx format;

Reg num – participant registration number, RUS-12345 format;

User name – user name (participant);

RSSI – signal level from the limiter (the closer to zero, the closer the limiter is to the computer);

Batt state % - percentage of energy spent in the race (from 0 to 100%);

Status – Current status of the limiter.

Possible options:

- **Ready** – ready to start;
- **Race** – race mode;
- **Limited** – energy spent;

Check – result of voltage check before and after start.

Possible options:

- **Ok** – no deviations from the rules were found;
- **Start overvoltage!** – excess voltage before the race (it is necessary to check the participant's model with a multimeter!);
- **End undervoltage!** – voltage drop below the permissible threshold (it is necessary to check the participant's model with a multimeter!);
- **ESC SIGNAL WIRE CONNECT WRONG!** – incorrect connection of the signal wire. It is necessary to check the model of this participant for connection of the signal wire of the electric motor speed controller, bypassing the limiter;
- **RED WIRE BROKEN!** – damage to the measuring wire. It is necessary to check the integrity of the participant's red measuring wire.

Self-test – limiter self-test result.

Possible options:

- **Voltage reverse!** – voltage polarity reversal detected, immediately disconnect the limiter and check the connection diagram!

- **Calibrate error** – limiter calibration error. This limiter cannot be used for competitions, contact the manufacturer!
- **Current reverse!** – limiter power wire connection error, check the connection diagram!
- **Self-test error** – limiter self-test error, contact the manufacturer!
- **Calibrated: 01.2024** – calibration date. Displayed if there are no errors. It is recommended to use limiters calibrated no more than 2 years ago at competitions;

Sett set – the current set of settings used in the race;

AEC status – the current state of the Active Energy Control mode. This mode is experimental and it is not recommended to enable it;

Energy cons – relative energy consumption. If the value is above 100%, there may not be enough energy for the entire race, if the value is below 100%, there will be a reserve for the energy consumed;

Current avg – average value of the measured current;

Voltage – current value of voltage on the battery;

Energy Wh – current value of energy consumed during the race;

Energy ref Wh – current energy limitation threshold;

Capacity – current value of capacity consumed during the race in mAh;

Hardware ver – hardware version of the limiter;

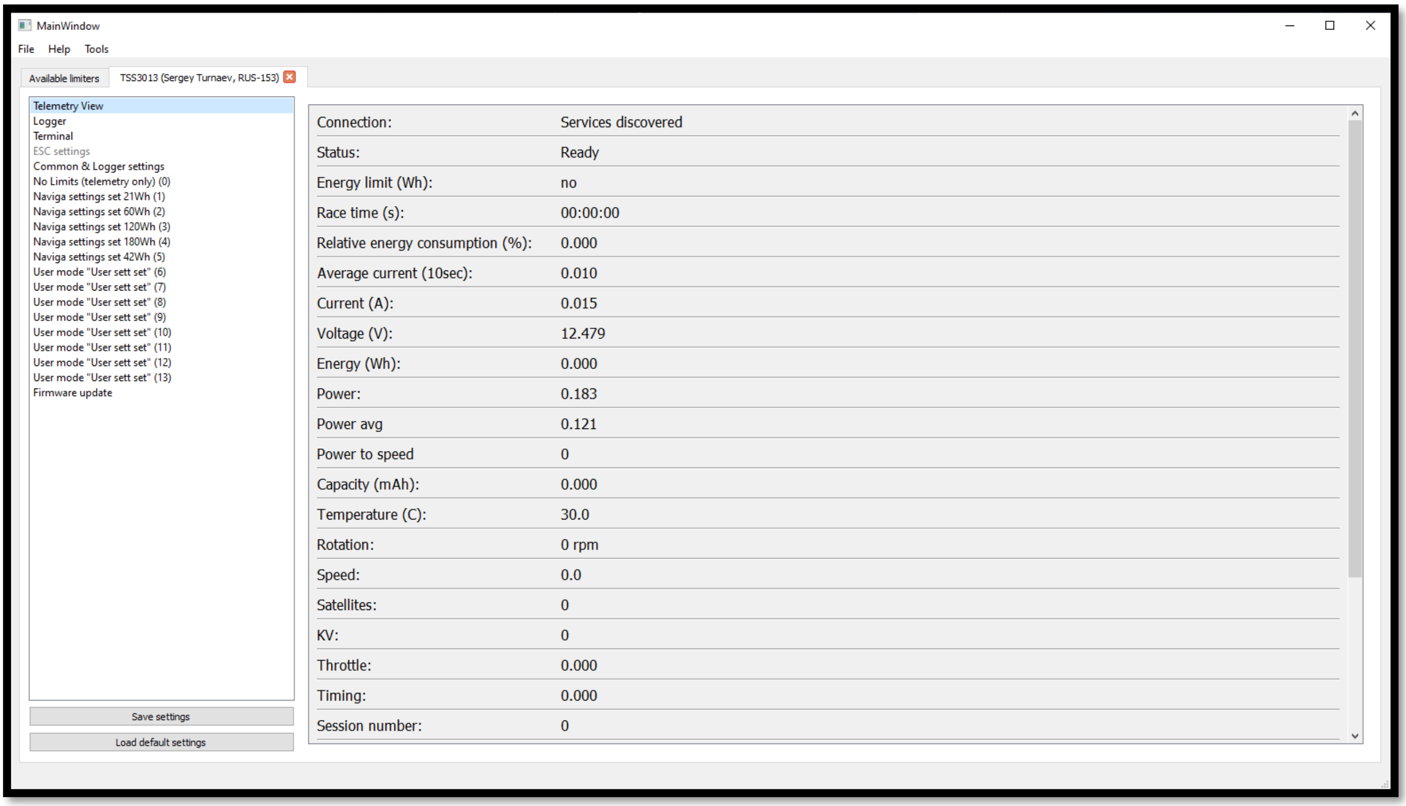
Bootloader – software version of the bootloader;

Firmware ver – software version of the firmware;

Address – address of the BLE device.

Connecting to the limiter via TSSLimiterX. Main window

Double-click on the line of the limiter you are interested in in the scanner window and wait a bit (In case of a significant waiting time, it is recommended to check whether the driver for BLE is installed correctly and install the driver from the manufacturer's website manually). A connection to the limiter will be established, and you will see the following window:



The menu on the left consists of the following sections:

- **Telemetry View** – viewing telemetry;
- **Logger** – viewing logs saved in the limiter and downloading them to your computer;
- **Terminal** – UART terminal of the limiter interface, completely duplicates the UART interface in nRFToolbox for BLE;
- **ESC settings** – section for setting up regulators with a built-in limiter;

- **Common & Logger settings** – section for general limiter settings, all the basic settings required for participating in competitions are specified here;
- Below are the **sets of settings**: No Limits – mode without limits, 5 sets of settings for participating in competitions according to the Naviga rules, 8 user sets of settings, where you can change absolutely all the settings of the limiter;
- **Firmware update** – limiter firmware update menu. In this section, you can check for firmware updates for your limiter and automatically download and update it from the Internet, or update it manually by opening the firmware file.

Telemetry View

This window displays all the main telemetry parameters:

- Race status;
- Energy limit;
- Race time;
- Relative consumption in percent (economizer);
- Average current for 10 seconds;
- Current;
- Voltage;
- Spent energy;
- Power consumption;
- Average power for 10 seconds;
- Power to speed ratio;
- Spent capacity;
- Limiter temperature;
- Engine speed;
- Speed;
- Number of revolutions per volt of the engine;

- Some service data.

Logger Menu

For limiters with a built-in logger (Versions 1.0, 1.1, 1.2, 2.0, 3.5, 4.5 with firmware version 23.2 and newer), there is an option to read the log of the past race.

This menu contains the following buttons:

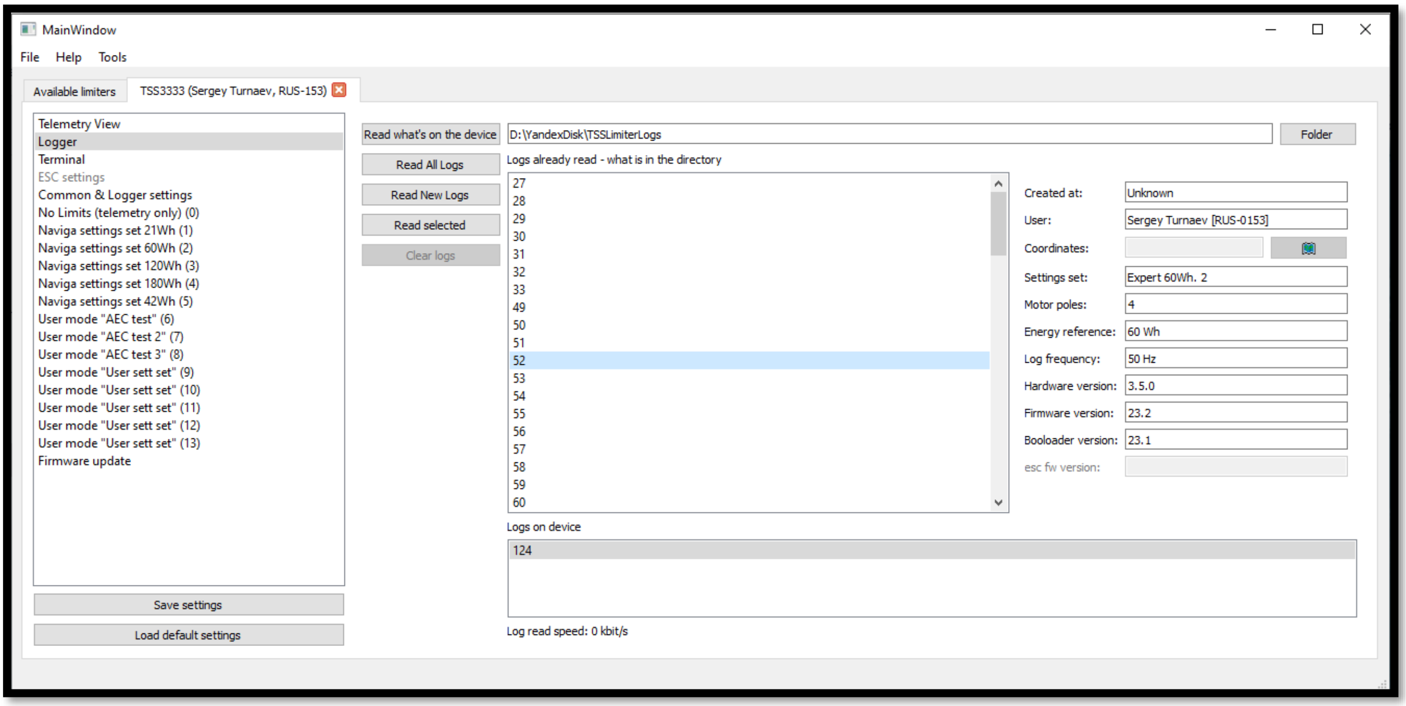
- **Read what's on the device** – Read the list of logs from the device. This function displays all the logs that are in the memory of this limiter and displays the list in the "Logs on device" window;
- **Read All Logs** – Read all logs from the limiter. The function reads all the logs in the limiter and saves them on the computer in the folder specified above;
- **Read New Logs** – Read all new logs. The function reads all new logs from the limiter. Logs that have already been saved on the computer before will not be read again;
- **Read Selected** – Read the selected logs. You can select the logs you are interested in in the "Logs on device" window and read the necessary ones;
- **Clear Logs** – Clear the logger memory. This function is not required in the TSS limiter logger, the logs are always written in a circle.

The Logs already read – what is in the directory list contains a list of all the logs of this limiter that were saved on the computer in the folder specified above.

The panel on the right allows you to view brief information about the log:

- **Created at** – Date of creation (only when connecting a speed sensor);

- **User** – User name;
- **Coordinates** – Coordinates of the model launch location. You can click the button to the right and see the point on the map;
- **Settings set** – The set of settings used when recording this log;
- **Motor poles** – Number of motor poles;
- **Energy reference** – The energy limit value set in this run;
- **Log frequency** – Log recording frequency;
- **Hardware version** – Hardware version of this limiter;
- **Firmware version** – The firmware version of this limiter at the time the log was written;
- **Bootloader version** – The firmware version of the bootloader of this limiter at the time the log was written;
- **Esc fw version** – The firmware version of the controller with a built-in limiter at the time the log was written.



Logs loaded into memory can be opened by double-clicking on the log number in the list.

Terminal

The terminal allows you to change settings and view telemetry using text (console) commands. This interface is deprecated and should be used when other interfaces cannot be used.

List of supported console commands

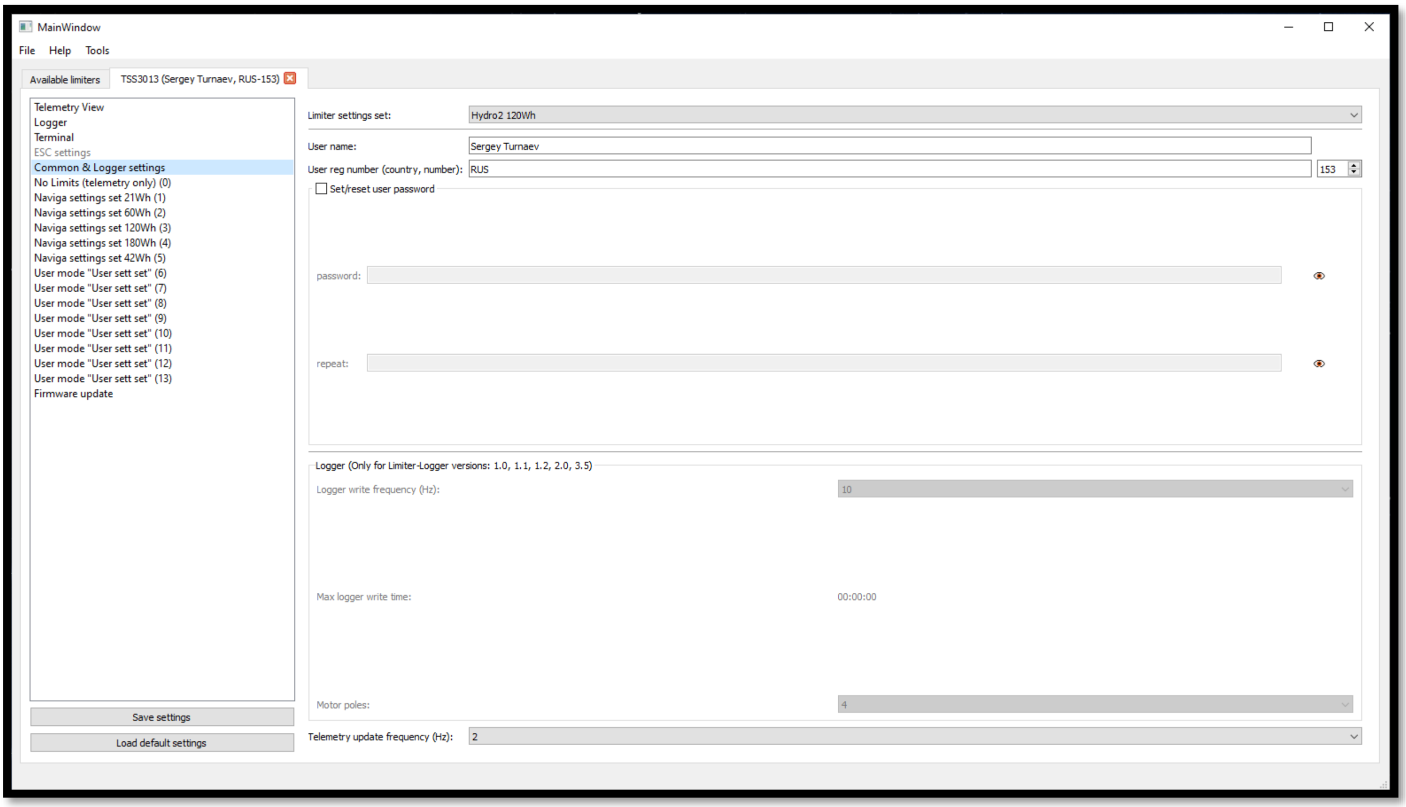
Commands can be entered at the bottom of the console as text. Commands may be with parameters and without them; if there is a parameter, then after the command a colon is set, and the parameter is entered. If the parameter is a number, then input of spaces or other non-digit characters is not allowed. **Bold** marked the most important commands.

Command	Parameter	Note
GetUserName	-	Show user name
GetUserRegNum	-	Show registration number
Password:	4 - 31 characters	If the password has been set, this command unlocks the settings record.
SetUserName:	3 - 31 characters	SetUserName:Sergey Turnaev
SetUserPassword:	4 - 31 characters	SetUserPassword:12345ABC If parameter empty, then no password
SetUserRegNum:	7 - 9 parameters	SetUserRegNum:RUS-5555
SetSettSet:	0 – 14	SetSettSet:8 Set current used settings set

GetSettSet:	0 – 14	GetSettSet:4 Request selected settings set
GetSettSet		GetSettSet - without parameter, returns current settings
Stop		Stop sending data
Start		Enable sending data
Data		One-time current data request
SetSettName:	4 – 31 characters	Settings set name
SetEnergyRef:	1 – 300000	Energy limitation
SetStartCurrent:	2 – 10	Current at the counting energy start
SetThrottleLim:	1 – 99	throttle limitation
SetRampDownTime:	1 – 999	Complete rampdown time
SetLimitTime:	1 – 999	Time of throttle limitation
Help		Displays list of commands
GetFwInfo		Display the firmware version
iOS		Режим отображения, оптимизированный под iOS
Android		Режим отображения, оптимизированный под Android. (по умолчанию включен)

In case the user password is set, the current settings can be changed only after entering the password with the “Password:” command. With each subsequent connection, the password must be repeated.

Common & Logger settings



The general settings section allows you to set the following parameters:

The current set of settings in accordance with the Naviga rules or one of the user sets;

User name;

User registration number (Country code and number);

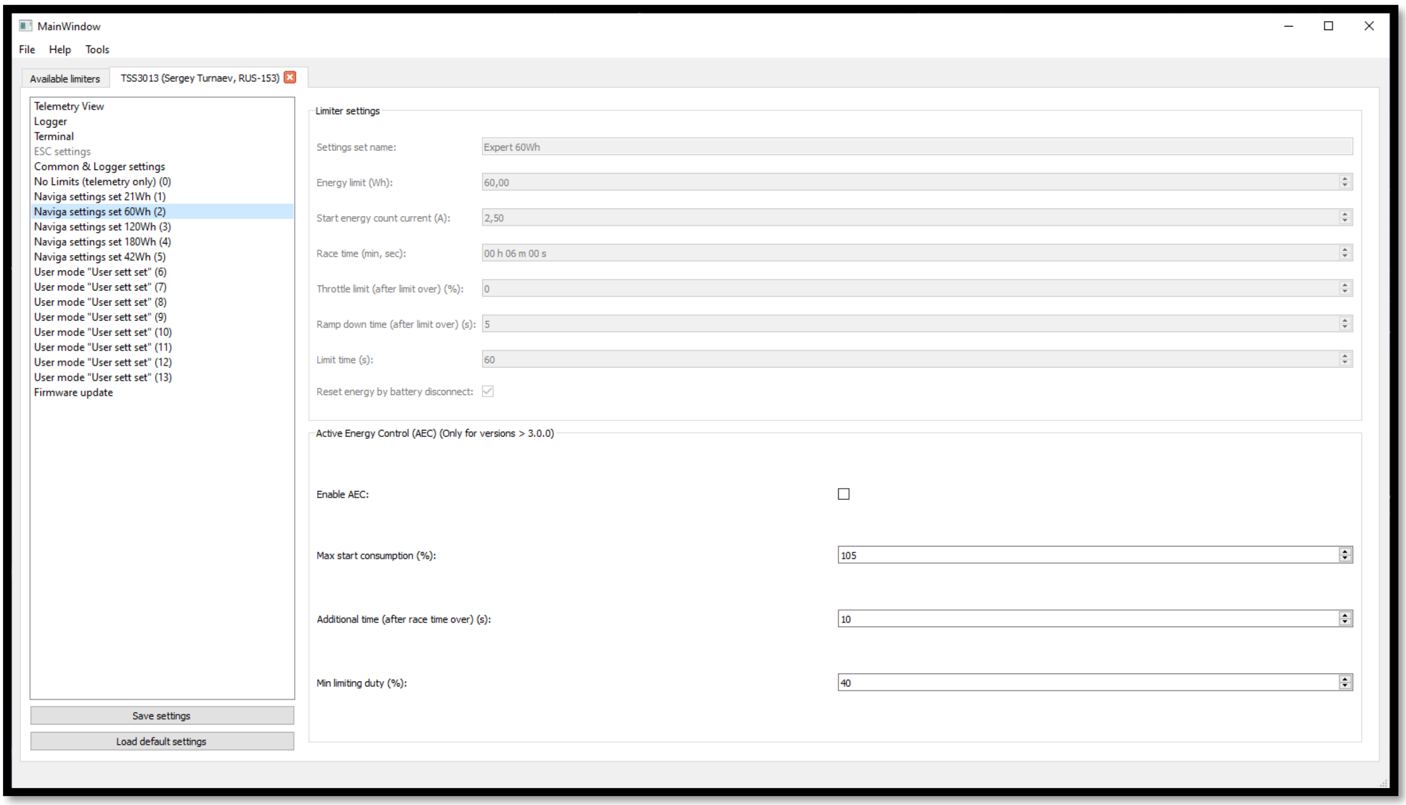
Password for access to the limiter.

Logger settings allow you to set the following parameters:

- Log recording frequency in Hz, from 1 to 100 Hz. Depending on the limiter version, not all recording frequencies are available;
- Number of motor poles, for the speed sensor.

In this section, you can also set the telemetry data update frequency; it is recommended to leave it at 2 Hz.

Naviga settings set, User mode

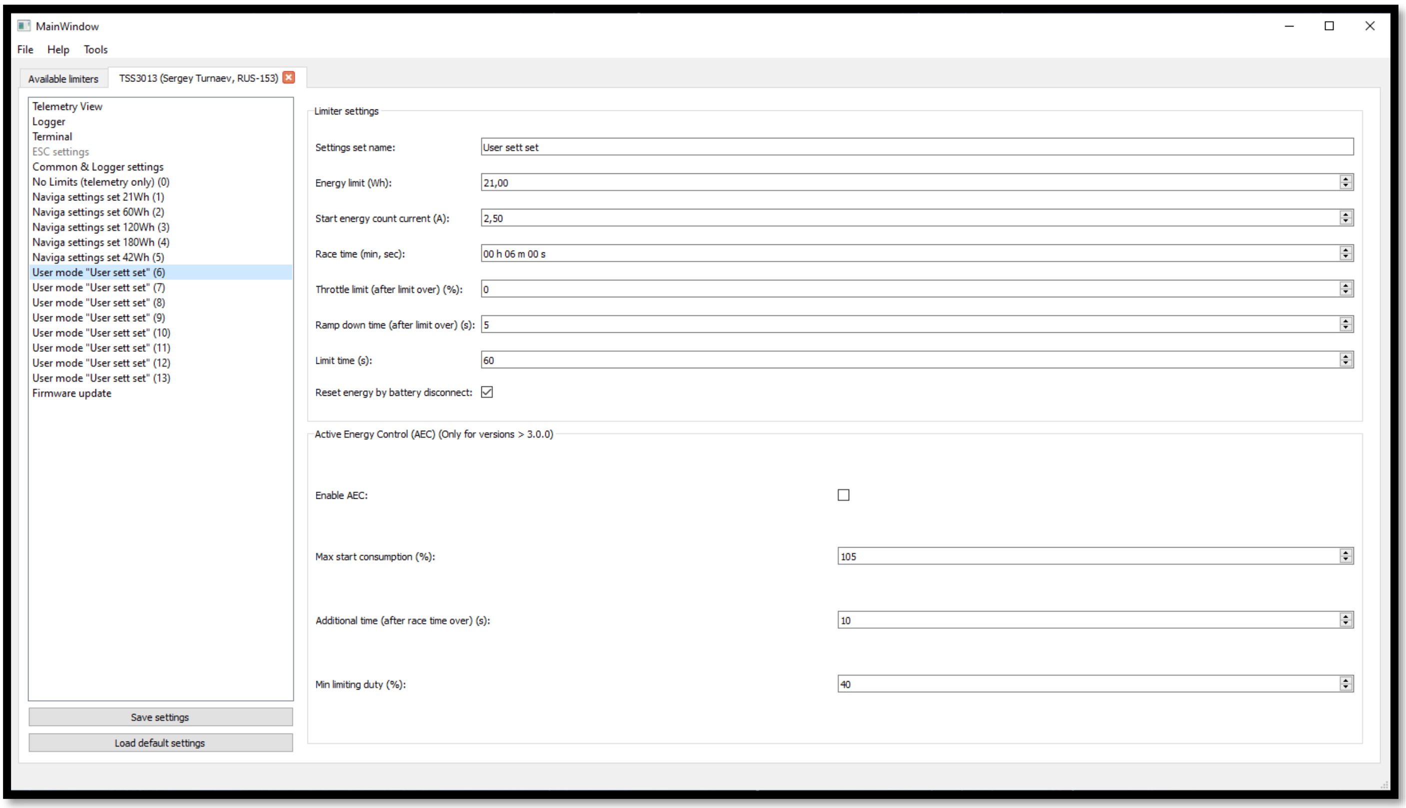


To participate in competitions, settings sets must be used in accordance with the Naviga rules. Depending on the firmware version, the settings sets may differ. Starting with firmware version 24.2, the limiters support the following settings sets:

- Naviga settings set 21Wh (1). 21Wh, for the "mini" classes;
- Naviga settings set 60Wh (2). 60Wh, for the "expert", "mono-1", "hydro-1", "eco team" classes;
- Naviga settings set 120Wh (3). 120Wh, for the "mono-2", "hydro-2" classes;
- Naviga settings set 180Wh (4). 180Wh, for the "FSR-E" class;
- Naviga settings set 42Wh (5). 42Wh, for the "mini FSR-E" classes.

Starting with firmware version 25.1, two additional presets have been added for the "eco team" classes, **which are used ONLY in Russia. These presets cannot be used in official Naviga competitions!**

- Eco team mini Rus 21Wh(6). 21Wh, for the "Eco Team mini" class in Russia;
- Eco team Rus 60Wh(7). 60Wh, for the "Eco Team" class in Russia;



In addition to the main settings, there are 4 user settings, where you can change all the available parameters of the limiter:

Settings set name;

Energy limit;

Start energy count current;

Race time;

Throttle limit (after limit over);

Ramp down time (after limit over);

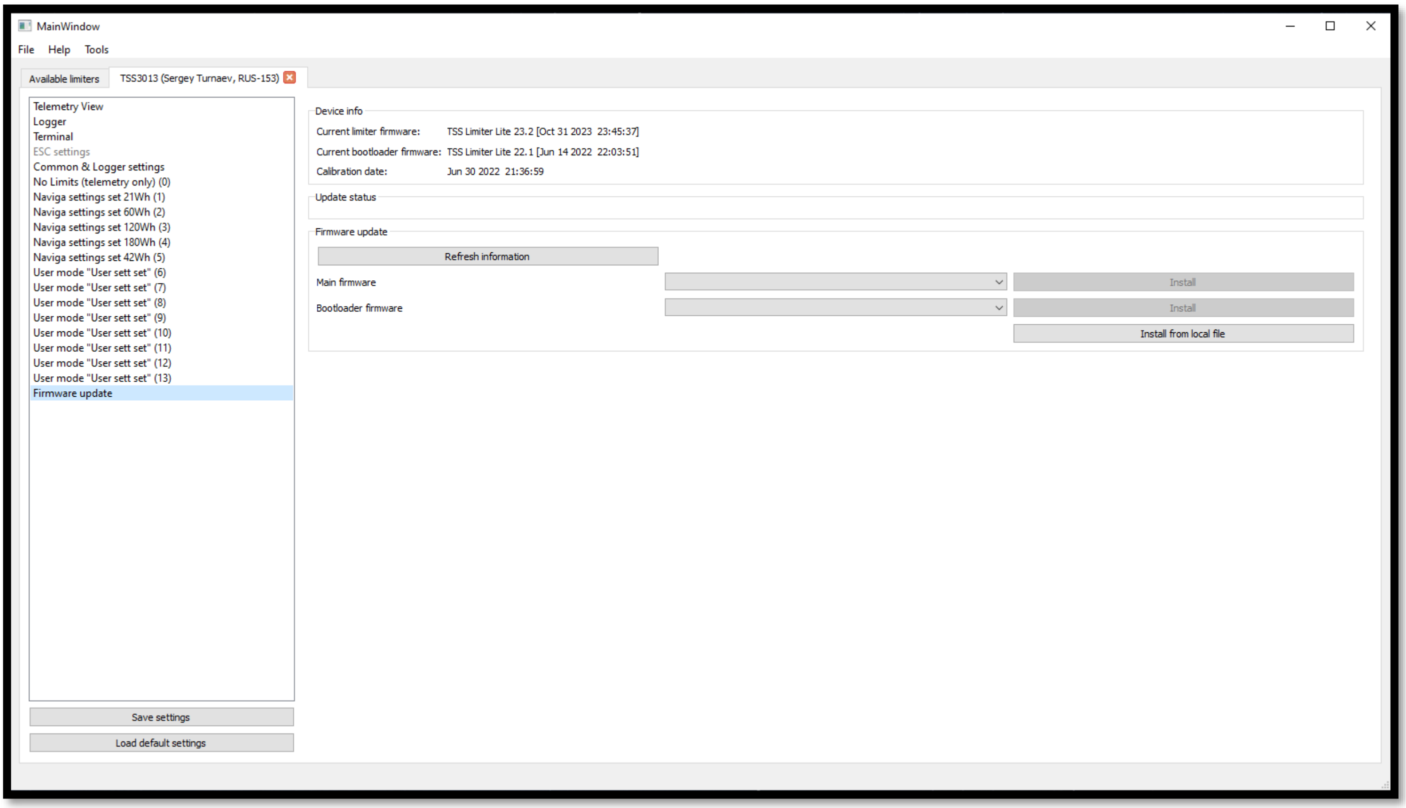
Limit time;

Reset energy by battery disconnect. An obsolete setting, should always be enabled.

Active Energy Control (AEC)

This mode is experimental and is not recommended for use.

Firmware update



The firmware update menu allows you to download and install the firmware via the Internet, or select the firmware from a file. The update starts immediately after opening the file.

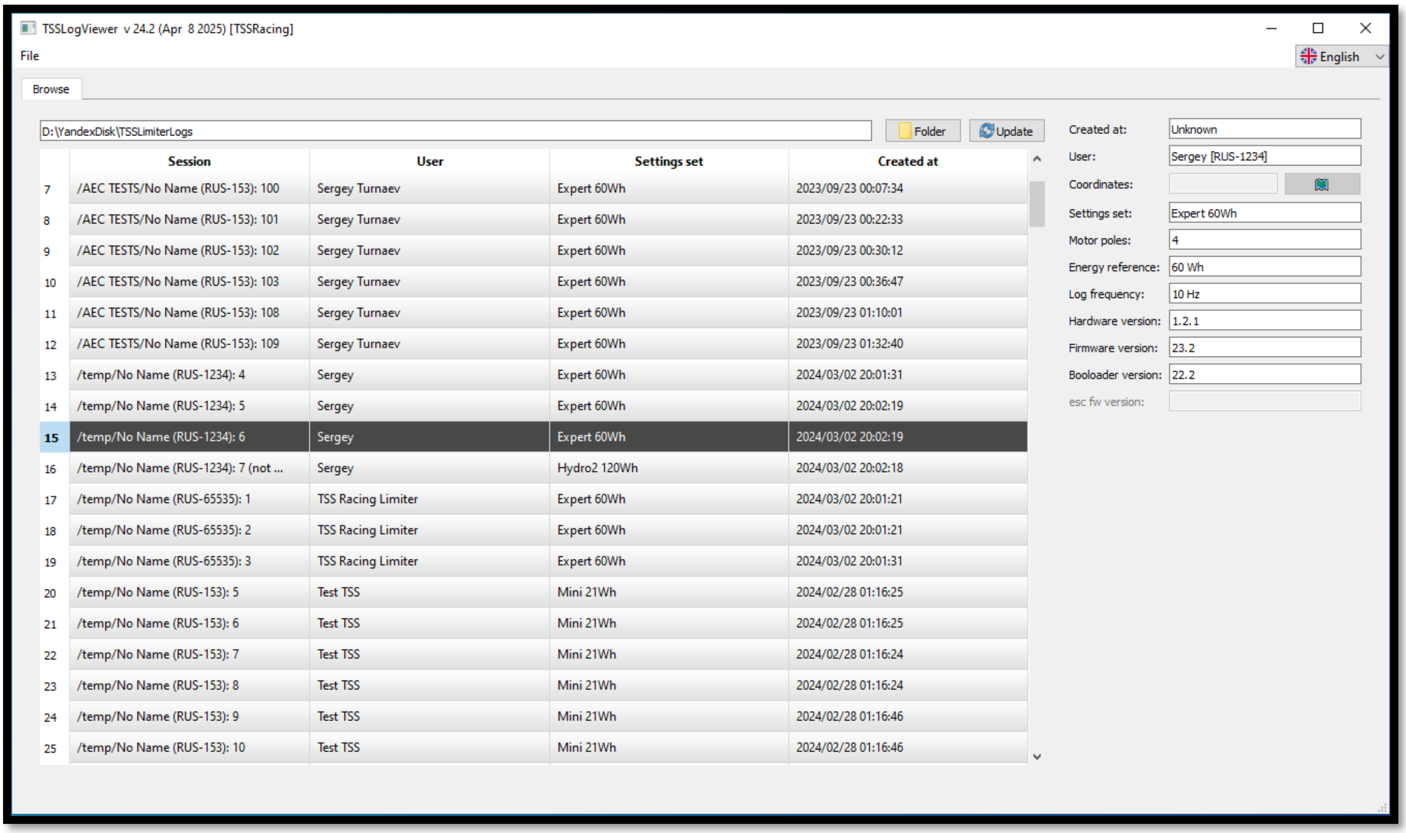
In case of problems during the update and the inability to correctly launch the main firmware, it is recommended to use the Tools -> Restore limiter menu.

Firmware files can be downloaded manually from a network drive (Last Firmwares folder):

https://disk.yandex.ru/d/s9IeueLSqpWJFA

Viewing logs

The **TSSLogViewer.exe** program is used to view logs. It allows you to see graphs of changes in current, voltage, temperature, capacity, energy, relative consumption, revolutions, and speed over time. Speed and revolutions are not available in all limiter versions. When opening the program, you must select the folder in which the logs are saved, and then select the required log. The user can sort logs by time, user name, session number, and set of settings. On the right in the window with the list of logs, you can see additional data about the log, similar to the data in the **TSSLimiterX.exe** window. Logs are opened in separate tabs by double-clicking on the log line.

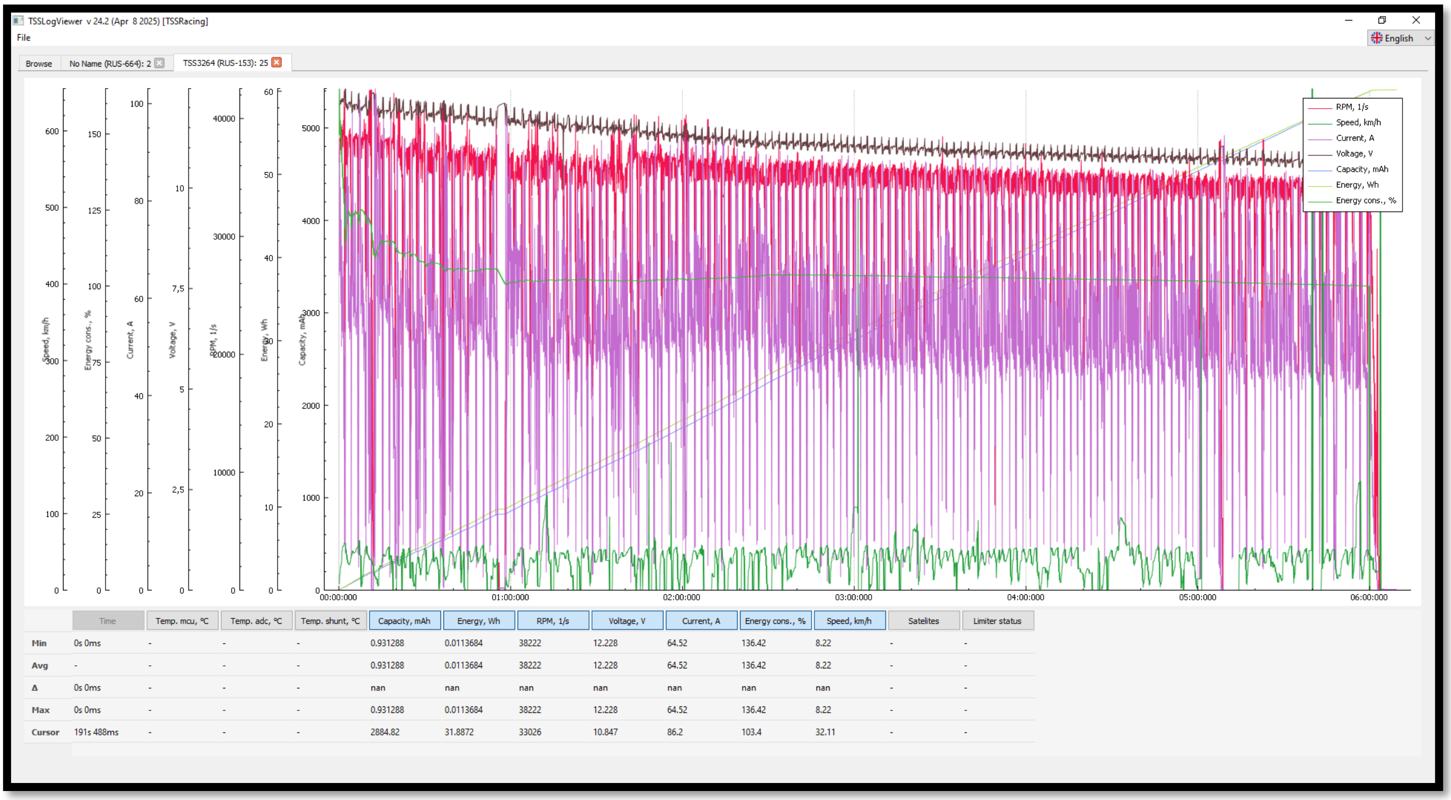


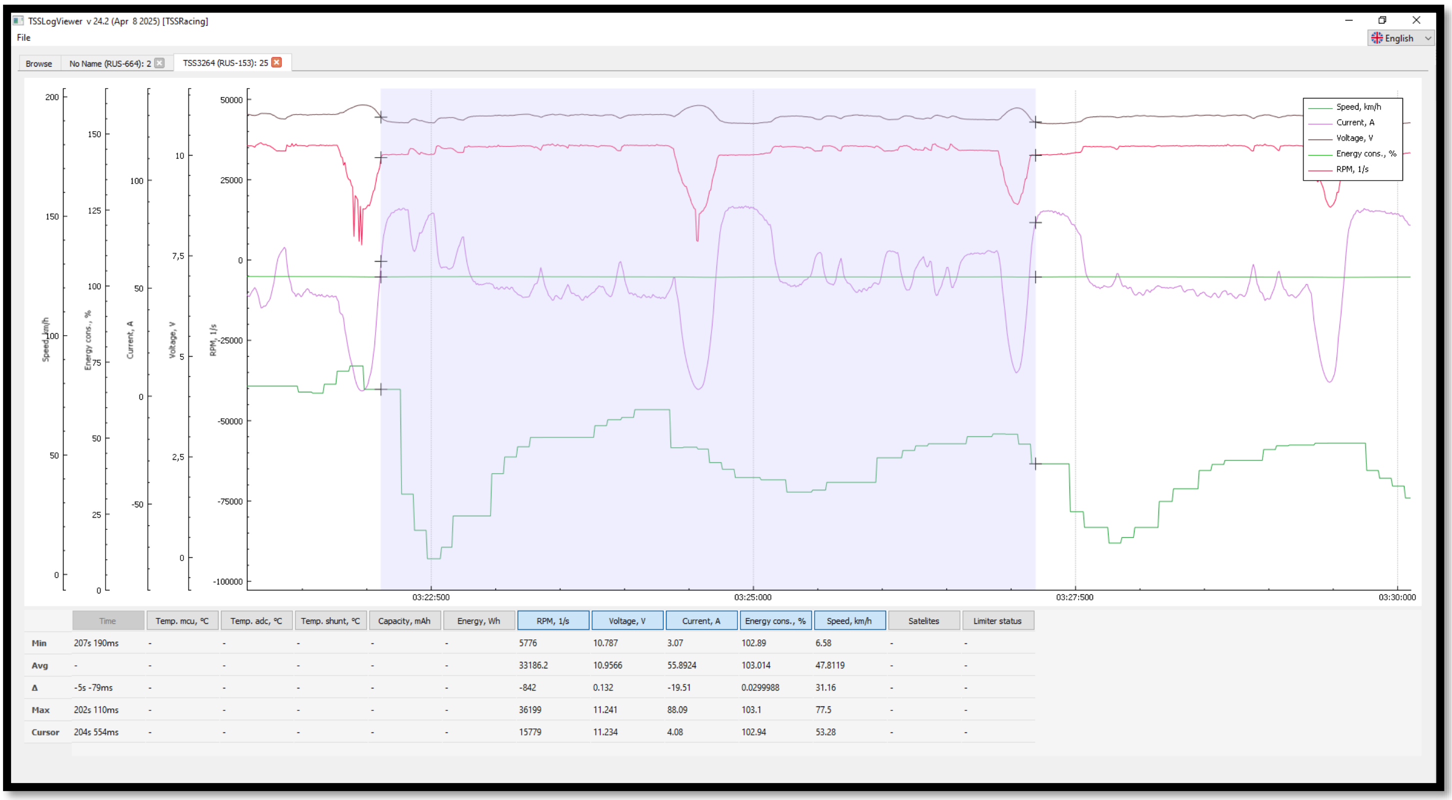
The log viewing window contains the main window with graphs of the selected parameters over time, one or more ordinate axes, a list of available parameters with buttons to enable their display, a table for viewing the maximum, minimum and average values for the entire log or in the selected time range.

The following combinations are used to navigate the graphs:

- **Shift along the abscissa axis** - hold down the left mouse button and move the graph left and right;
- **Scaling along the abscissa axis** - is carried out with the mouse wheel;
- **Selecting a graph** - left-click on the desired graph or its ordinate axis;
- **Shift along the ordinate axis** - select the graph, then hold down the left mouse button and move the graph up and down;
- **Scaling a graph** - select the graph, then scale using the mouse wheel;

- **Selecting the desired area** - selection is carried out by holding down the right mouse button and moving the cursor. Selection is used to calculate the average, minimum and maximum values of the parameters in the selected section of the graphs.

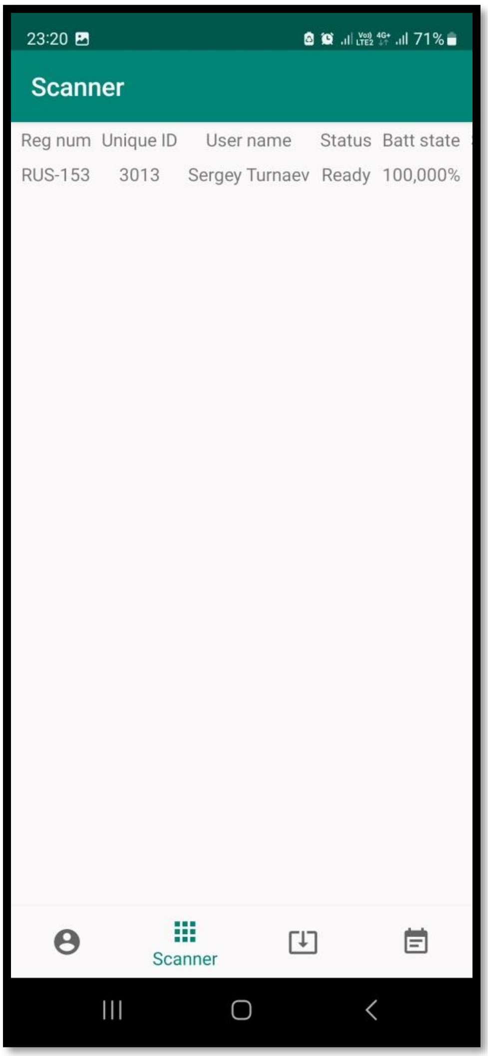


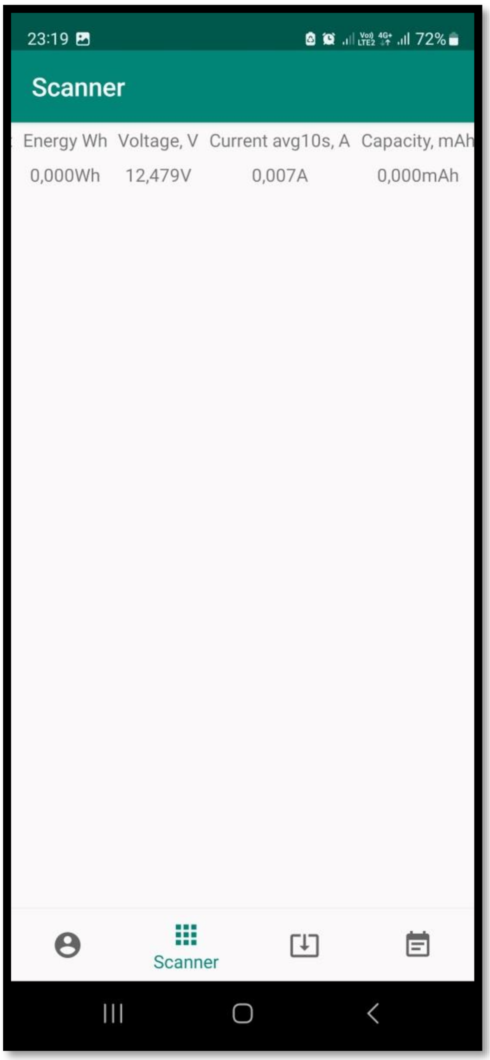


TSSLimiterApp

This application can be installed on a phone with the Android operating system, it allows you to view data from limiters located nearby, connect to the desired limiter, view telemetry, change basic settings. This application is no longer supported and is provided on an "as is" basis, crashes or unstable operation are possible on some phones.

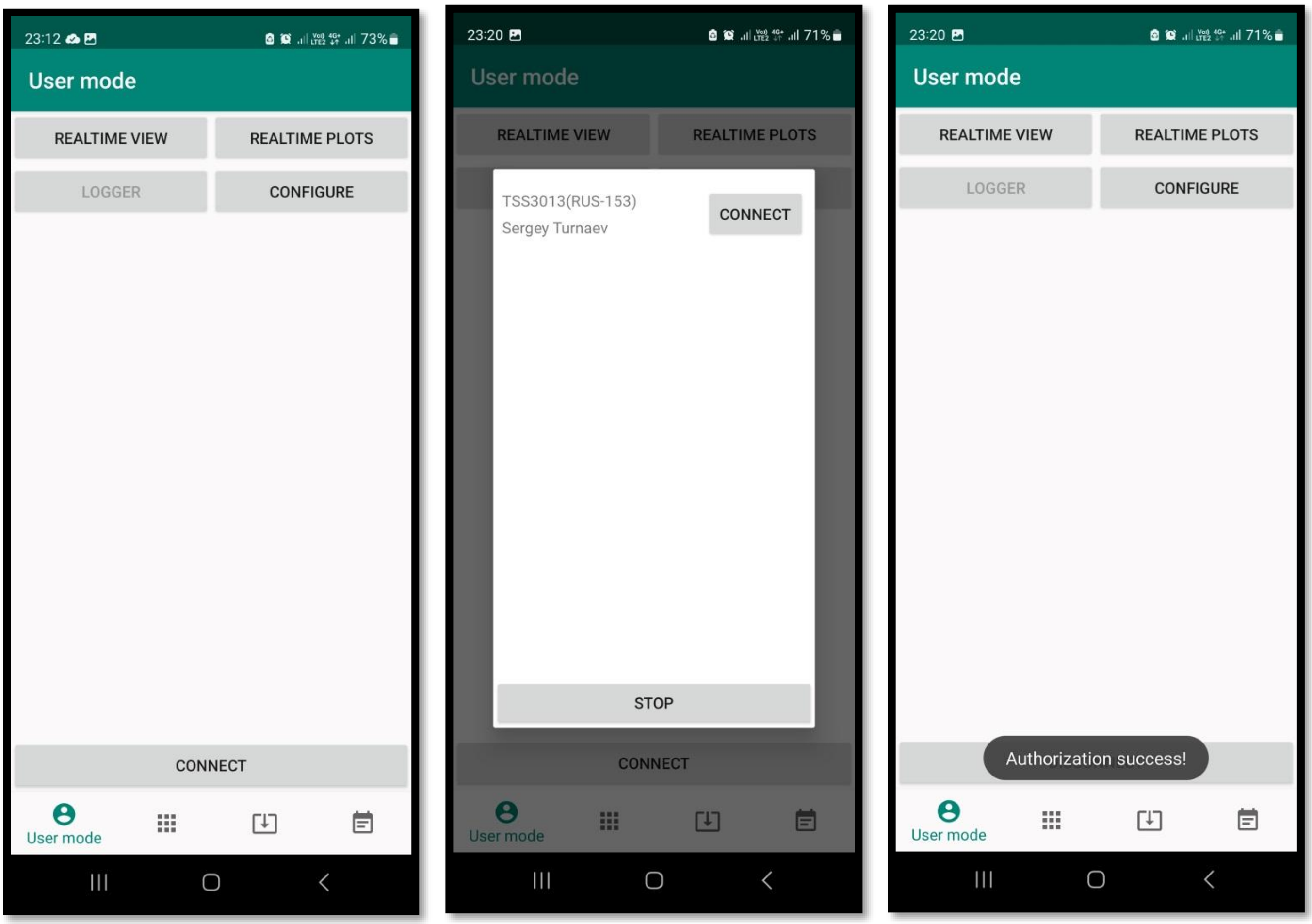
Limiter Scanner Menu





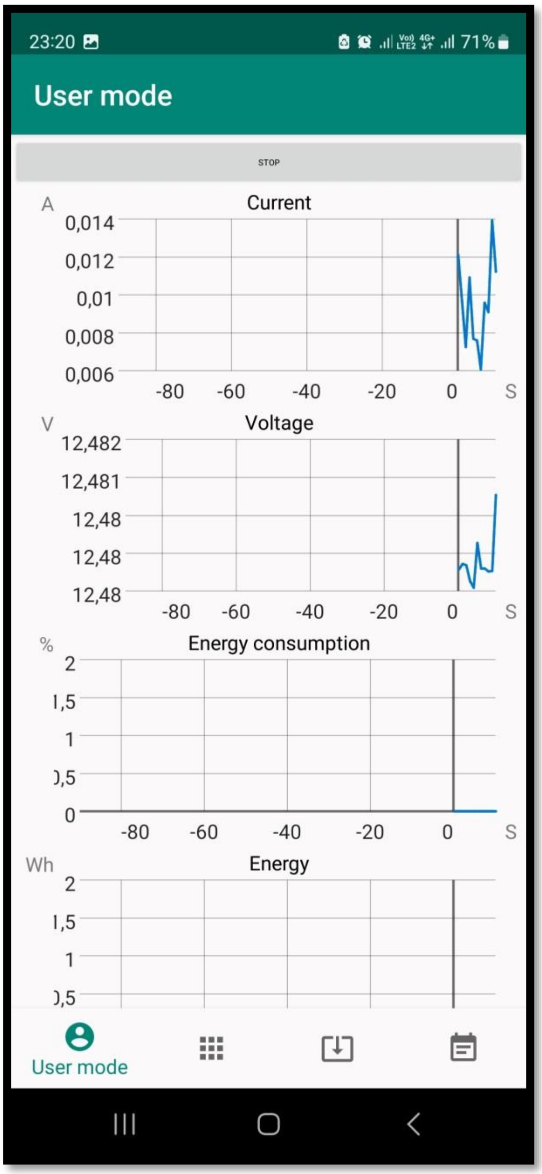
To enter the scanner, you need to press the second button from the bottom. The scanner displays the same information as the scanner in the Windows program. Some parameters may be missing.

Limiter connection menu



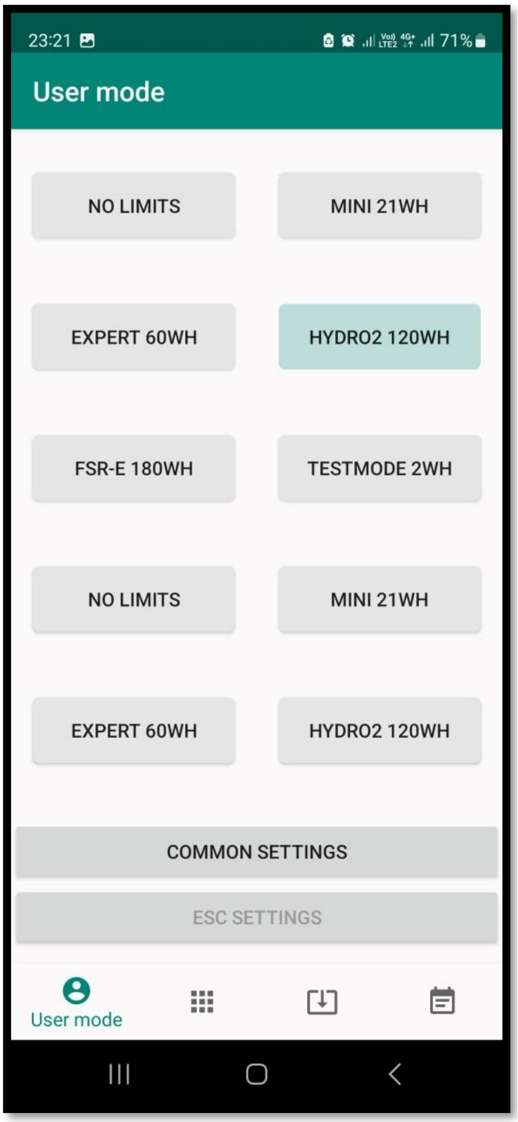
To connect to the limiter, you need to press the first menu button at the bottom (User mode) and press the Connect button. After that, a list of limiters available for connection will be displayed. Limiters may be added to this list with some delay. To connect to the limiter, you need to press the Connect button to the right of the limiter in the list. It is strongly recommended to set the user name and registration number for your limiter, so that if there are many limiters on the air, you do not confuse yours with someone else's. After connecting, if you have a password, it will be requested, after which you will see a notification about successful authorization "Authorization success!".

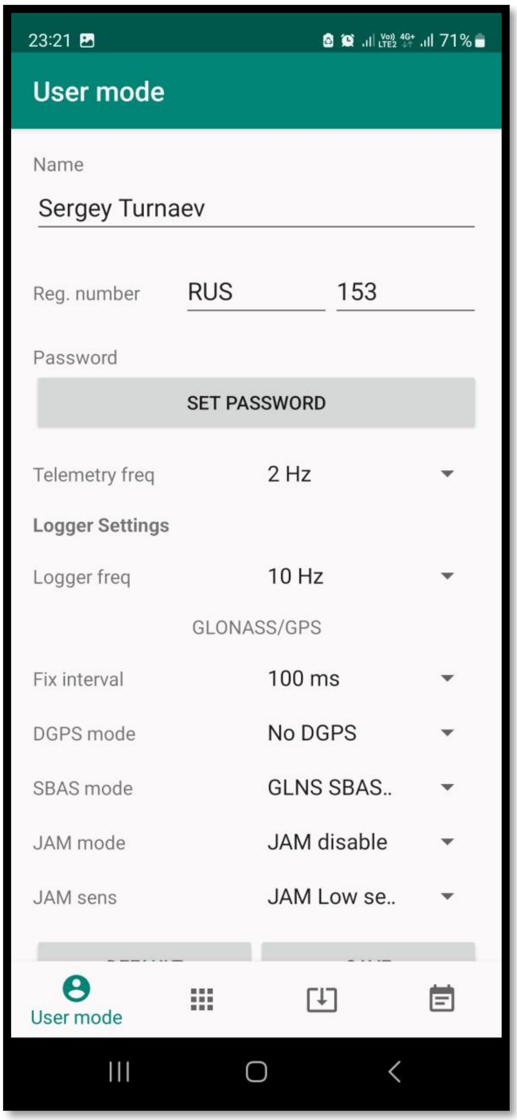
Telemetry menu (Realtime view, Realtime plots)



The telemetry menu allows you to see all the main parameters in real time, either as current values or as graphs. Some parameters may not be available in some limiter versions.

Configure menu





In the settings menu, you can select the current set of settings and change the general settings of the limiter: user name and registration number, and also set a password.

The set of settings is changed by clicking on the button corresponding to the desired set of settings, saving is done automatically.

To change the user name, registration number and password, enter the "Common Settings" menu

It is not recommended to change other settings through this menu, for these purposes use the program for Windows.

nRFToolbox for BLE

This program allows you to change the limiter settings via the terminal (console) using text commands. The list of commands is described in the section "List of supported console commands". In addition, the program allows you to update the limiter firmware using a phone. Both an Android version and an iOS version are available. Both programs are third-party applications and you should contact their developers for questions about their operation.

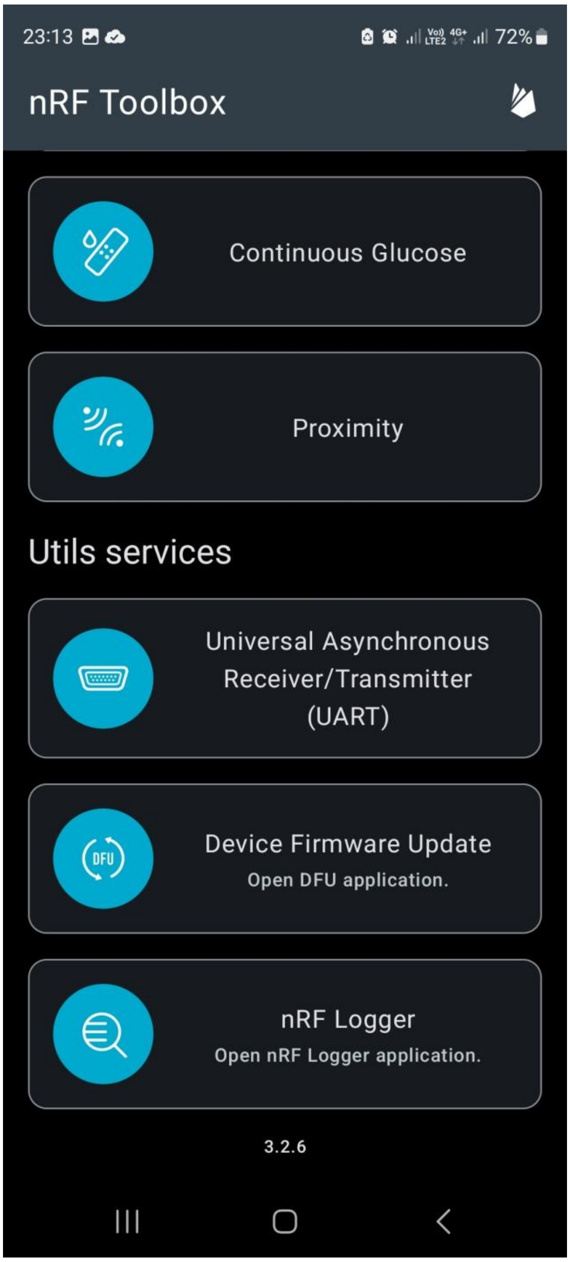
The main sections of the nRFToolbox for BLE menu used are:

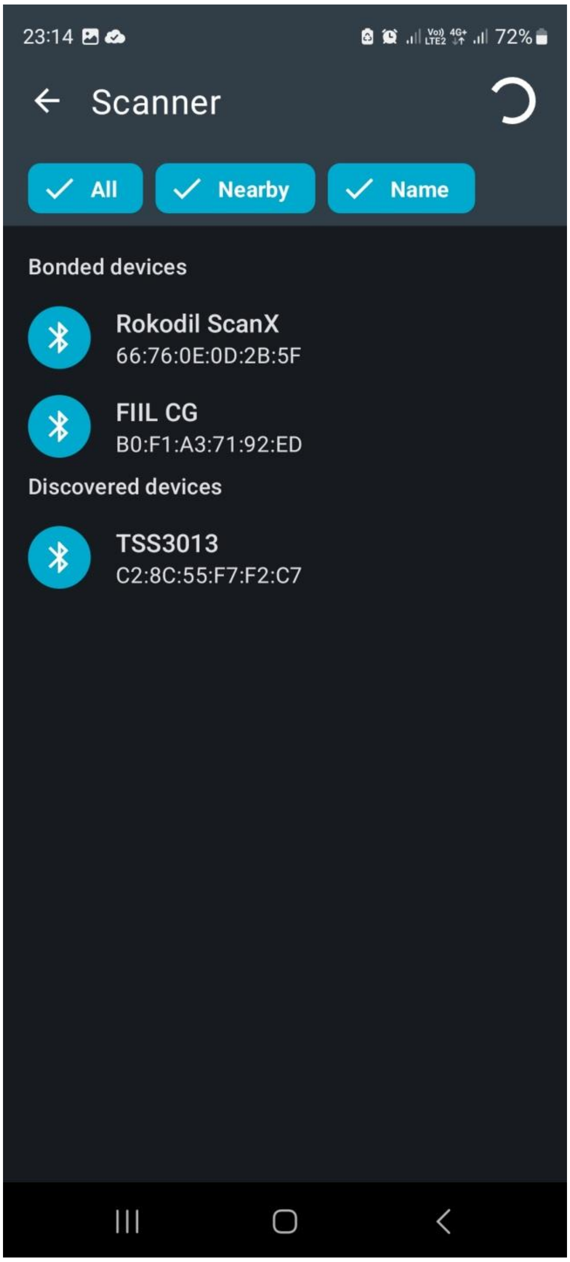
- UART - the terminal menu, allows you to change settings and view telemetry in text form;
- Device Firmware Update (DFU) - the firmware update menu, allows you to open the firmware file in *.zip format and load it into the limiter.

UART menu

Sequence of actions

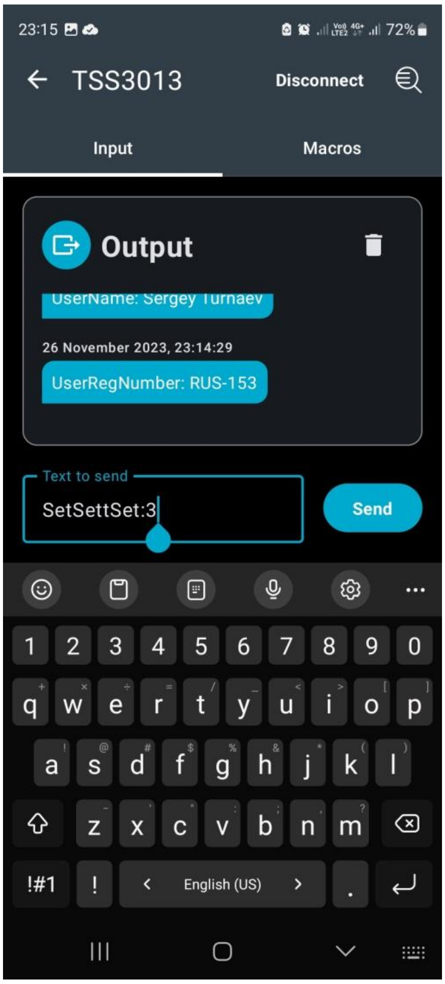
- Install the **nRF Toolbox for BLE** program and run it;
- Open the **UART** menu, press the **Connect** button and select the limiter, it always has the name TSS xxxx, where xxxx is its unique number.



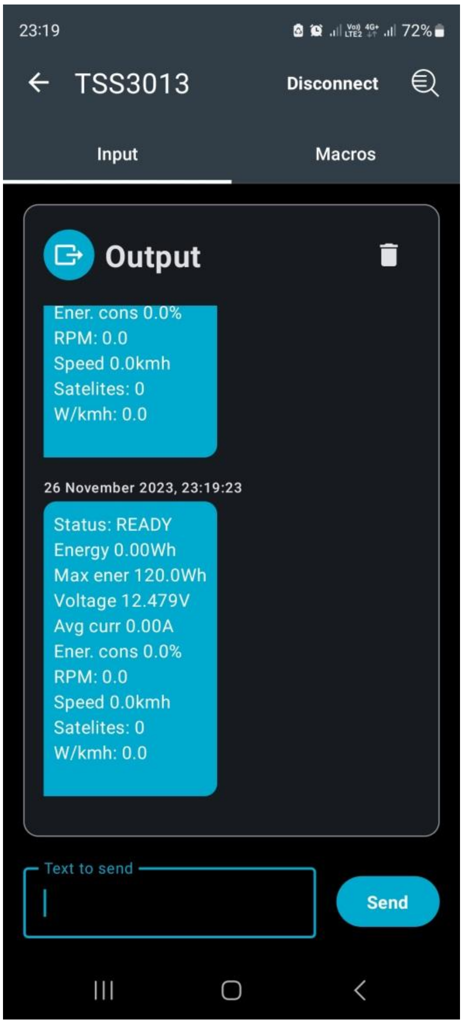


When connected, the limiter will display information about its firmware version, calibration date, user name and current set of settings:

If necessary, the user can change the set of settings, enable telemetry output or enter other commands by typing them at the bottom of the window in the "text to send" field and pressing the "send" button. If a password is set, it will need to be entered before sending other commands.



When telemetry is enabled by sending the "Start" command, the Input tab displays the current parameters sequentially, including: voltage, current, average current for 10 seconds, consumed capacity, consumed energy, maximum available energy, temperature, current status, etc. The exact list of parameters depends on the firmware version and the limiter version.



The **Status** parameter can take the following values:

- **READY** - Ready for operation
- **RACE** - Energy calculation started
- **OVERVOLT** - Overvoltage detected upon switching on
- **UNDERVOLT** - Undervoltage detected after a race
- **LIMITED** - Limit mode enabled, energy out
- **ERROR** - Error

Firmware update via nRFToolbox for BLE (DFU menu)

The device supports firmware updates via the phone.

Download the firmware update file from the network drive. Save the file to an downloads folder on the phone.

Network drive (Last Firmwares folder): https://disk.yandex.ru/d/s9IeueLSqpWJFA

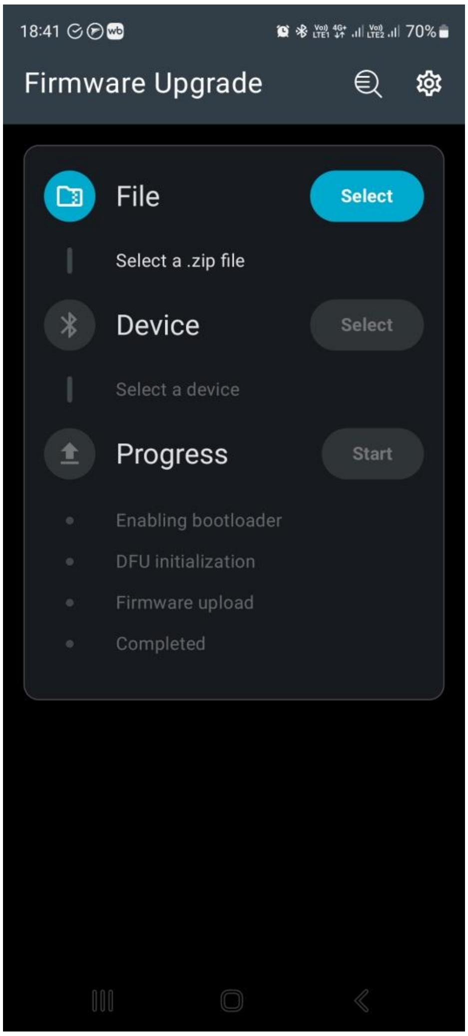
Before starting the update process, make sure that the device is not in the energy counting mode, otherwise the update is impossible.

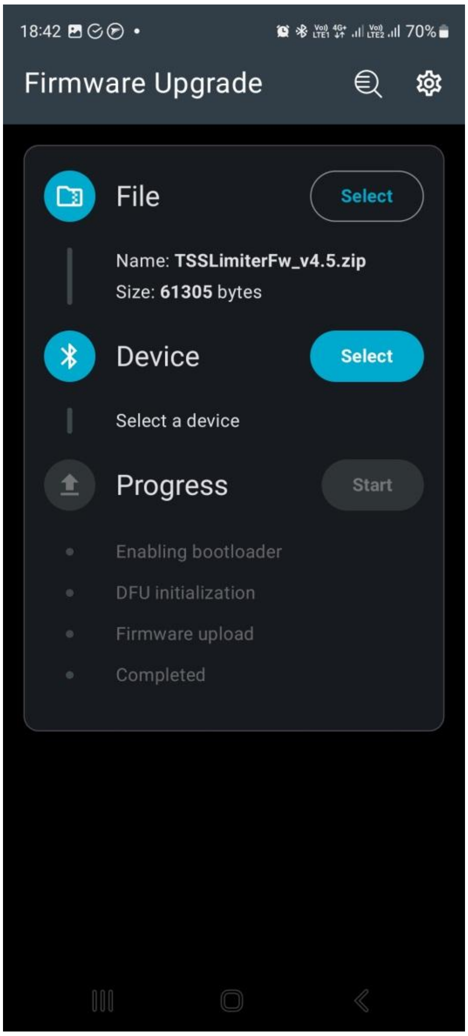
If a password was set to write settings, then connect to the device as described in the "UART Menu" section, and enter the password in the console, then press the **Disconnect** button (If only the console is visible, then you need to swipe the screen from right to left). Exit the UART menu by pressing the "back" button. After entering the password, you have five minutes to start the firmware update. If there is no password, you can immediately proceed to the next step.

Sequence of actions when updating firmware:

In the main menu of **nRF Toolbox for BLE**, open the **DFU** section.

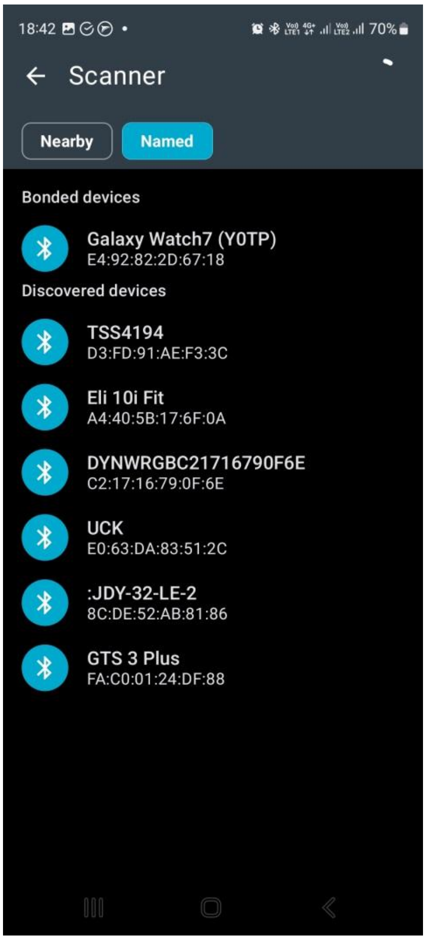
Click the File -> Select button and find the firmware file in the phone memory that you downloaded from the network drive in the previous step. Make sure that the file name is displayed in the program.

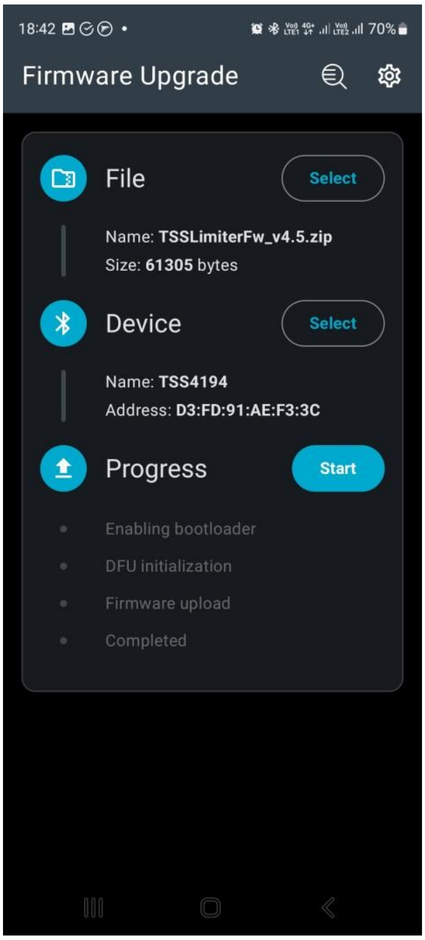




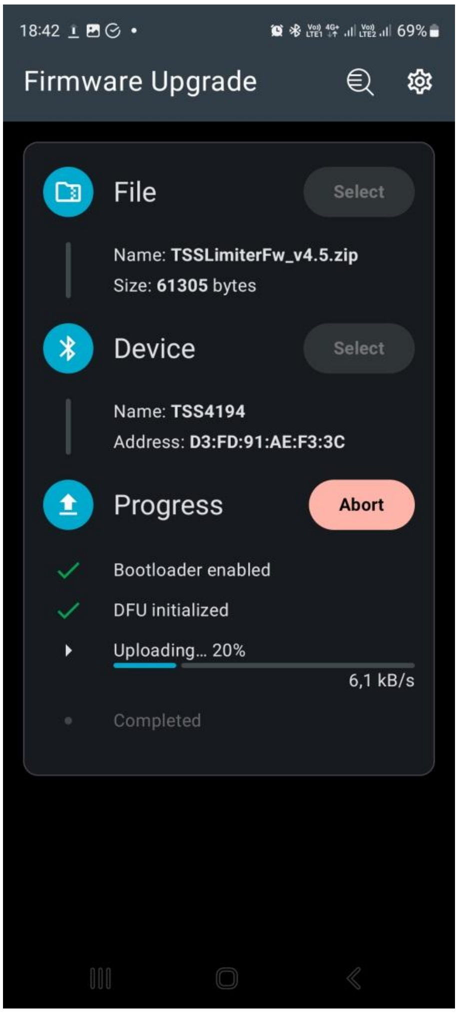
Press the Device -> Select button to select the device. The limiter will be displayed in the list of all BLE devices nearby. The limiter name always has the format TSSxxxx, where xxxx is the unique number of this limiter. If the limiter is updated in the bootloader mode, its name will be displayed as TSSxxxx_BOOT. For limiters with an old version of the bootloader firmware, the name in the bootloader mode can be TSSLimiterBLE_DFU or

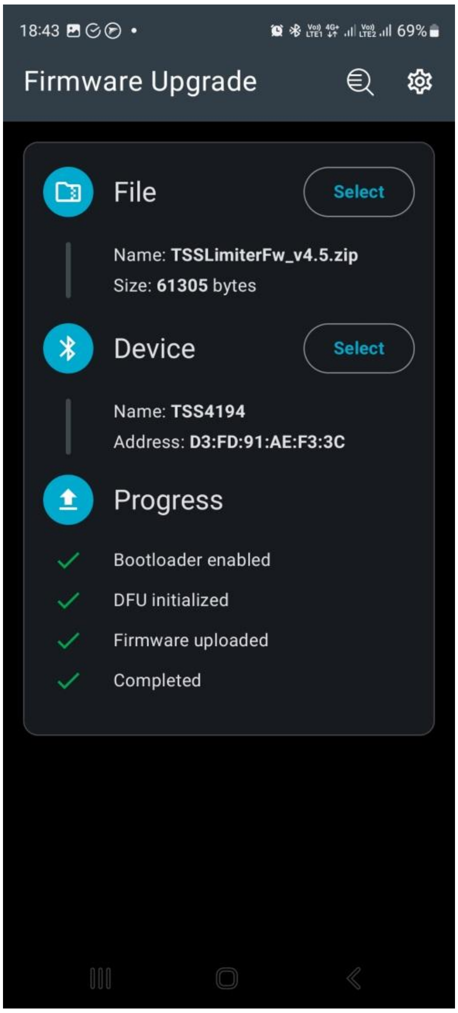
TSSxxxx_Bootloader. Make sure that after selecting the limiter, its name is displayed in the program window.





Press the Progress -> Start button and wait for the firmware update process to complete. Updating the firmware takes approximately 20-30 seconds, depending on the version of the limiter and the purity of the radio broadcast.





Wait until the update process is complete.

In case of problems with the start of the firmware update or problems during the firmware update process, as well as damage to the limiter firmware, it is recommended to update the limiter firmware in the bootloader mode (the bootloader is a non-updatable part of the firmware, flashed by the manufacturer), to do this, start the bootloader and update the firmware as follows:

- Turn off the power of the device.
- Connect the limiter configuration button.
- Press and hold the button.
- Turn on the power. You will see that the LED is constantly on, as soon as it goes out after a few seconds, immediately release the button.

- The device will go into bootloader mode and will be displayed in the device selection menu on the phone as: TSSxxxx_BOOT or TSSxxxx_Bootloader or TSSLimiterBLE_DFU.
- Repeat all the steps for updating through the **DFU** menu from the very beginning. In this case, you do not need to go to the **UART** menu to enter the password.

Warranty and servicing

Manufacturer guarantees that the device has been tested at production site, calibrated and is fully operational. In case of a factory defect detection, the device can be made warranty repair within 12 months from the date of sale, this period as agreed may be extended to the time of delivery by mail.

The warranty does not cover damage of the device caused by connection errors, exceeding the maximum permissible values of currents and voltages, and the associated overheating.

For warranty service please contact us by e-mail.

Manufacturer

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Moscow, Zelenograd

124498, Proezd 4922, house 4, building 4.

E-mail: tsslimiter@gmail.com

Web Site: http://tsslimiter.com