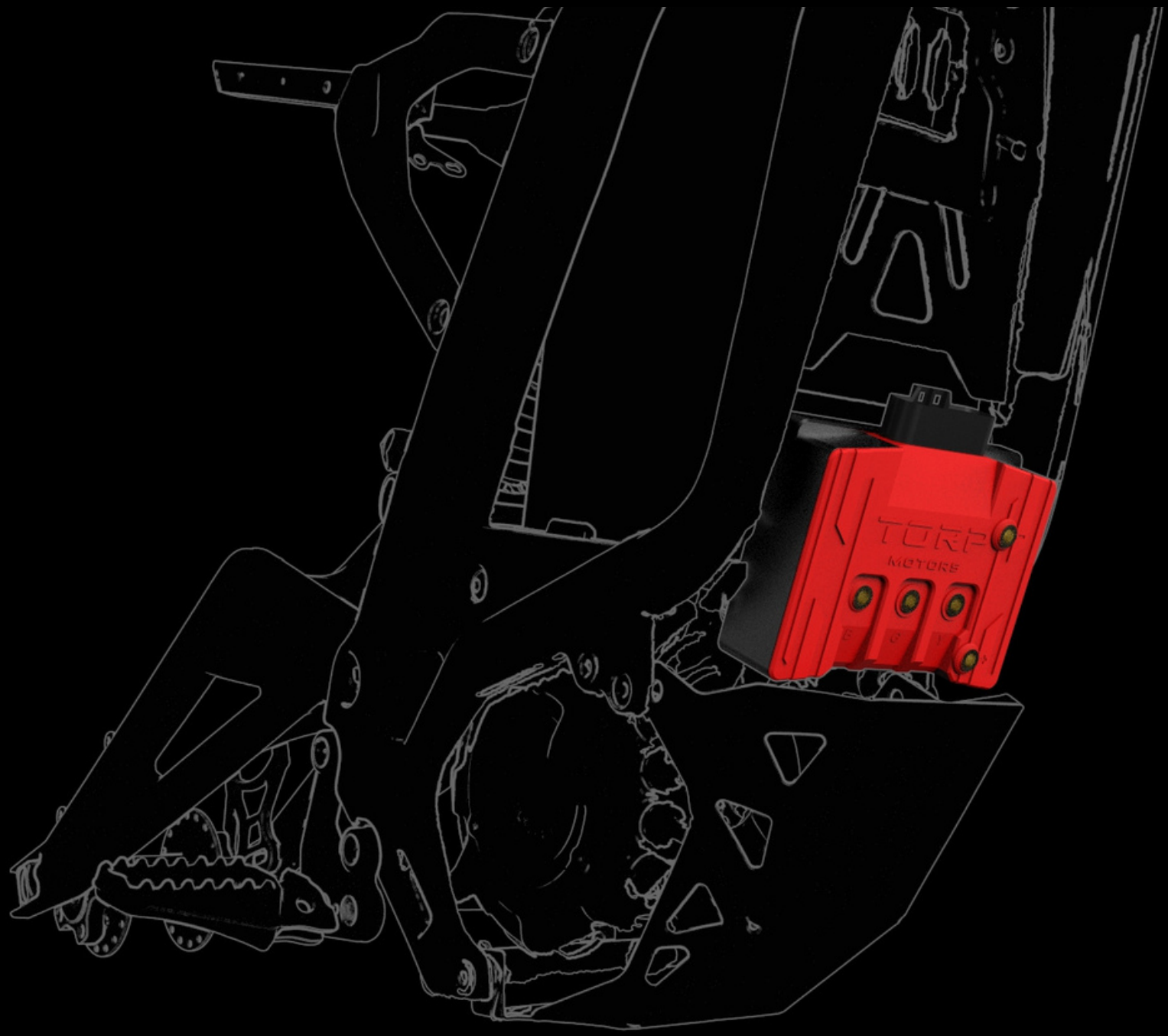
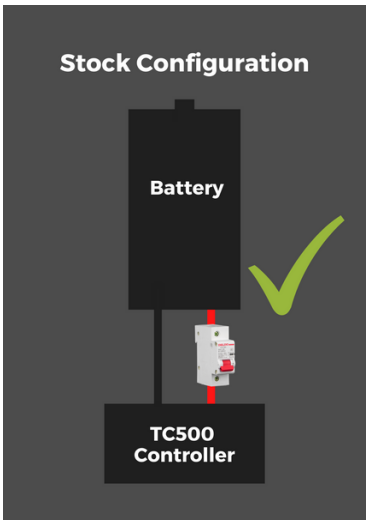
TORP TC500 CONTROLLER.

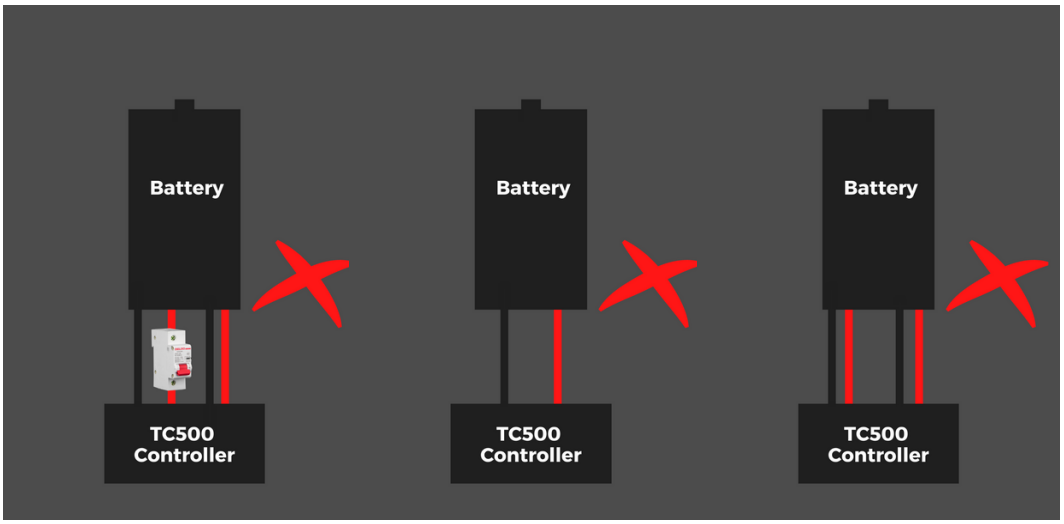
User Manual for Surron Light Bee



IMPORTANT.

Please read and carefully follow the instructions in this manual. **The TC500 controller must always be used with a stock SurRon/Segway circuit breaker (fuse)! Not using the circuit breaker with the TC500 controller is dangerous and can cause serious damage!**





Use only tools and screws that came with the controller. Using the tools and screws that were not included in the parcel, not following these instructions, or not using the circuit breaker, can cause serious damage to you and your bike, and voids your 2-year warranty.

INTRODUCTION.

TC500 controller is compatible with:
-SurRon Light Bee/Segway X260
-Torp Motor TM25
-SurRon Ultra Bee.
TC500 is not compatible with Segway X160. TC500 controller is also **not compatible with motor model number P/N: 11100-YQ2A-0100**. Please check your motor model number before installing the TC500 controller. In general, all SurRon/Segway X260 motors, manufactured after 2018 are compatible with the TC500 controller.

TC500 controller is compatible with both versions of the stock display (L1 E & the off-road version). Both speed and the distance are displayed on it. For the additional options, like battery monitoring and settings, you will have to use your smartphone or buy a Torp Display, that is sold separately.

This is a plug&play controller that needs no previous knowledge of electronics and programming for installation and setup. Everything needed for successful installation is included in the box.

THE BOX CONSIST OF:

- TC500 controller
- Wiring harness
- 5 phase screws with washers
- 2 hex keys and 4 bolts
- 4 stickers
- Heat sink
- Short instruction

All the settings and diagnostics are managed through an intuitive and easy-to use smartphone app for Android and IOS. The users can use their smart-phone as a display during the rides and to set up all the controller`s features through the app.

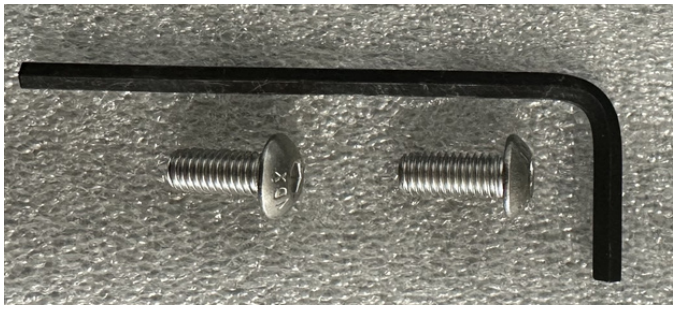
INSTALLATION.

Before starting with the installation, drain the bike`s capacitors.

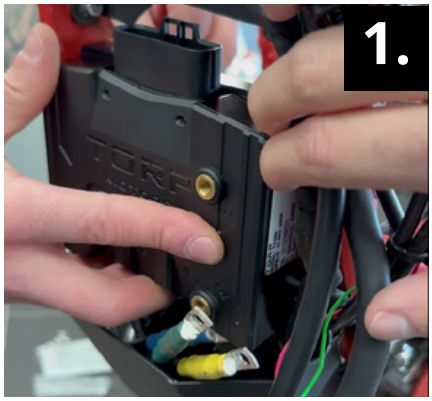
1. Switch off the fuse
2. Switch on the bike and wait for the capacitors to drain.

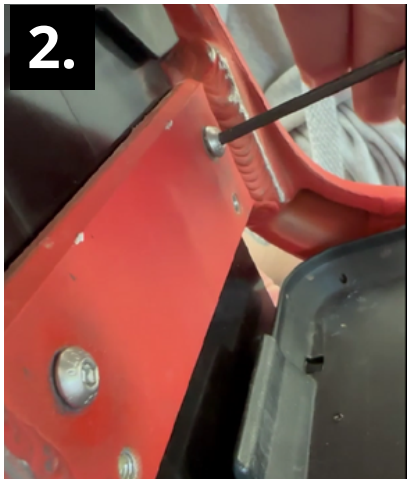
Now you can start removing the stock SurRon controller and the battery from the frame, and lower the skid-plate that covers the wiring.

USE SMALLER BOLTS TO MOUNT THE CONTROLLER ON THE BIKE.



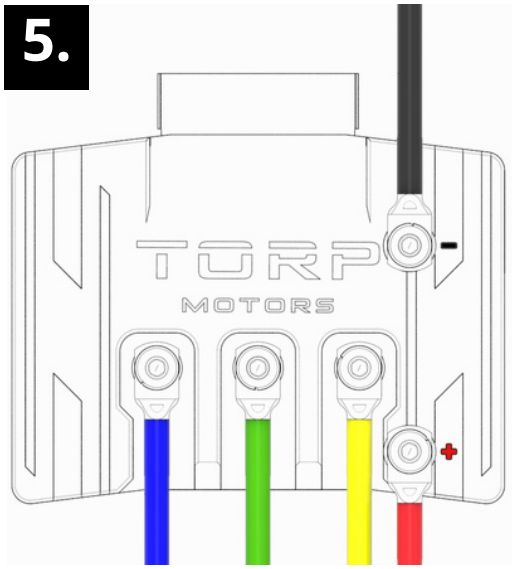
STEP 1:
Place the controller in a way that the holes on its back align with the upper holes on the bottom front of the frame.





STEP 2:
Insert each screw in one hole and fasten them by using a smaller hex key.

STEP 3:
There are 5 screws with washers already on the controller. Remove them from the controller and start connecting the controller to the phase motor wires.



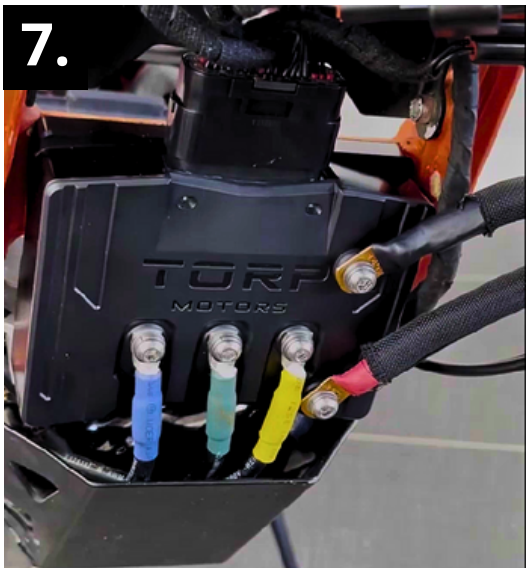
DON`T MESS THIS ONE UP!
STEP 5:
Connect the power and phase motor wires as shown on the picture using the screws with washers that you have removed from the controller in the previous step:
Power Wires:
-The red battery wire to the positive (+) electrode
-The black battery wire to the negative (-) electrode
Phase Motor Wires:
-The Blue motor wire to the letter B
-The Green motor wire to the letter G
-The Yellow motor wire to the letter Y

STEP 6:
Use a larger hex key to gently fasten the screws with washers. **The Max Torque that should be used is 3.5 Nm! Only tools included in the package must be used for installation!** **Any damage caused by exceeding the max torque of 3.5 Nm and/or using tools different from the ones included in the package, is not covered by warranty!**

STEP 7:

Use the wire harness that came with the controller to connect the controller to the bike. Connect the largest connector to the controller and the three smaller connectors to the bike`s wiring, in the same way the stock controller has been connected.

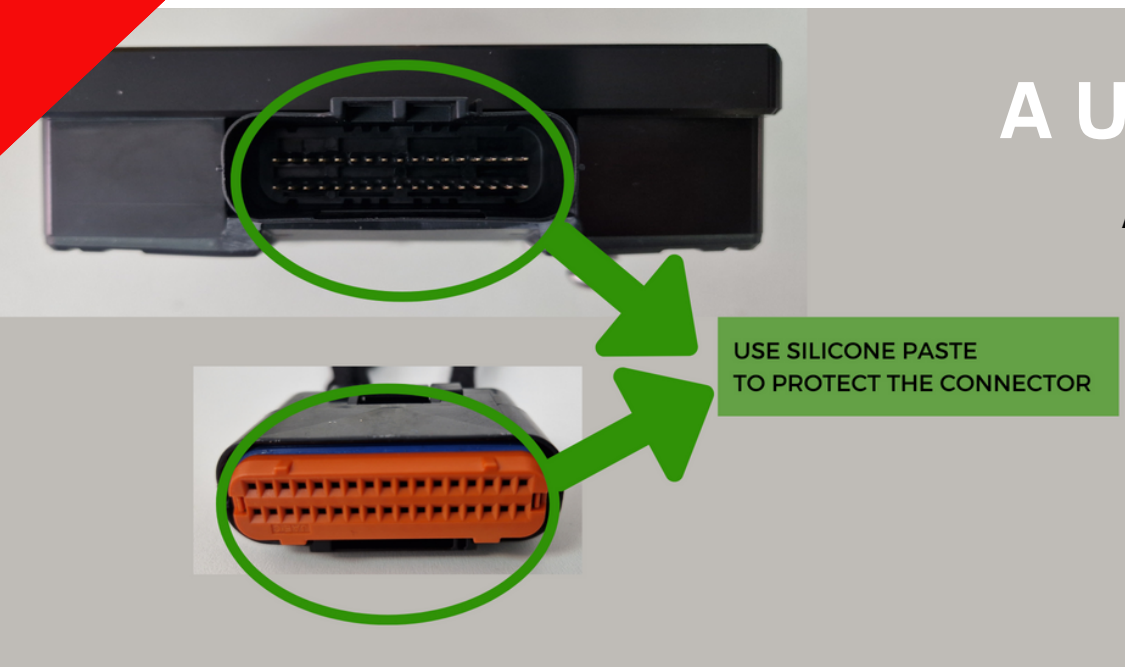
There are also 2 more connectors with a cap on it. To which the Torp Display and Thumb throttle are connected. See page 20.



IMPORTANT!

When pressed together, all connectors **must** make a **clicking sound.** Especially make sure that **the main connector is pressed hard and clicks when pressed.**

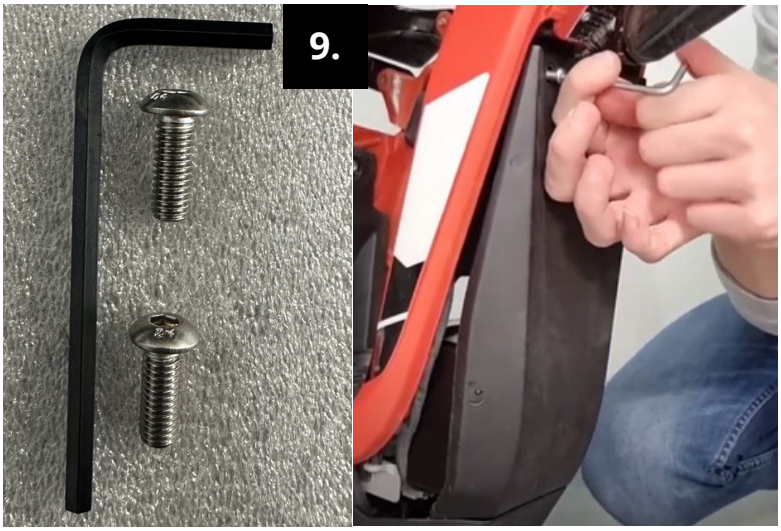
If connectors are not properly pressed together and connected, dirt and moisture can enter and cause the controller irreparable damage.



A USEFUL TIP.

Apply silicone grease to the controller and the main connector for additional protection from dirt and moisture.

STEP 8:
Take the plastic shield that came with the controller and mount it by placing its lower part into the skid plate.

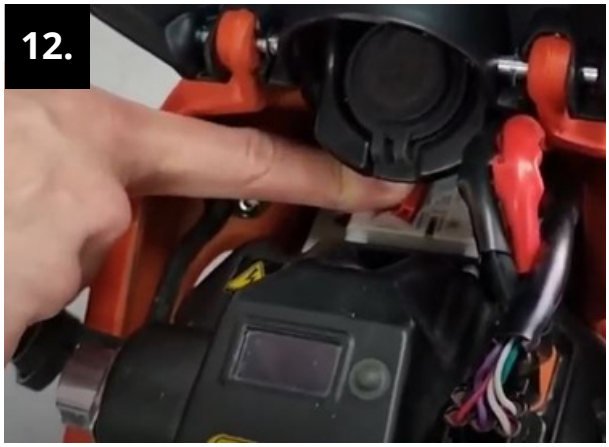


STEP 9:
Use the longer M6 screws and a larger hex key to fasten the shield to the frame.

STEP 10:
Put the battery back to the frame.

STEP 11:
Connect the battery to the battery power connector and to the 6-pin connector.

STEP 12:
Turn the fuse back on. Always use the Controller with the stock SurRon/Segway fuse!



CONNECT THE CONTROLLER TO THE APP

for further setup.

HOW TO CONNECT?

To connect the TC500 controller with the Torp Controller App, first go to the Google Play Store (Android) or AppStore (IOS) and download the App to your smartphone.

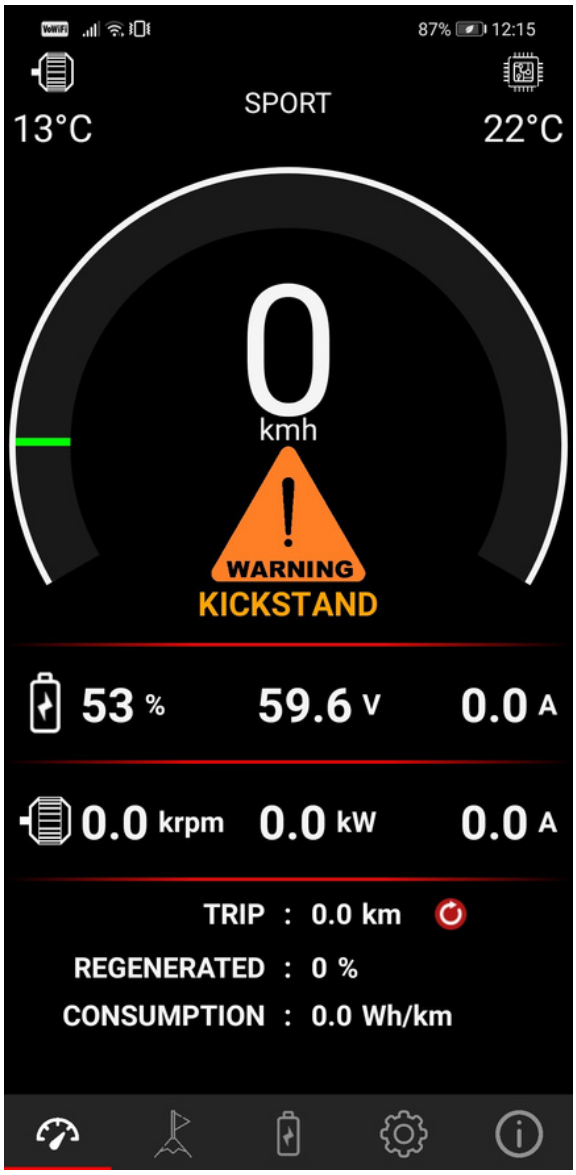
-Allow the App to access the phone's location, photos and media and accept the Terms & Conditions.

-Put the key into the ignition and turn on your bike.

-The App will automatically detect your controller.

-Choose your controller from the list. The Bluetooth ID can be found on the label on the side of the controller.

-Now you are connected and can start setting up your controller.



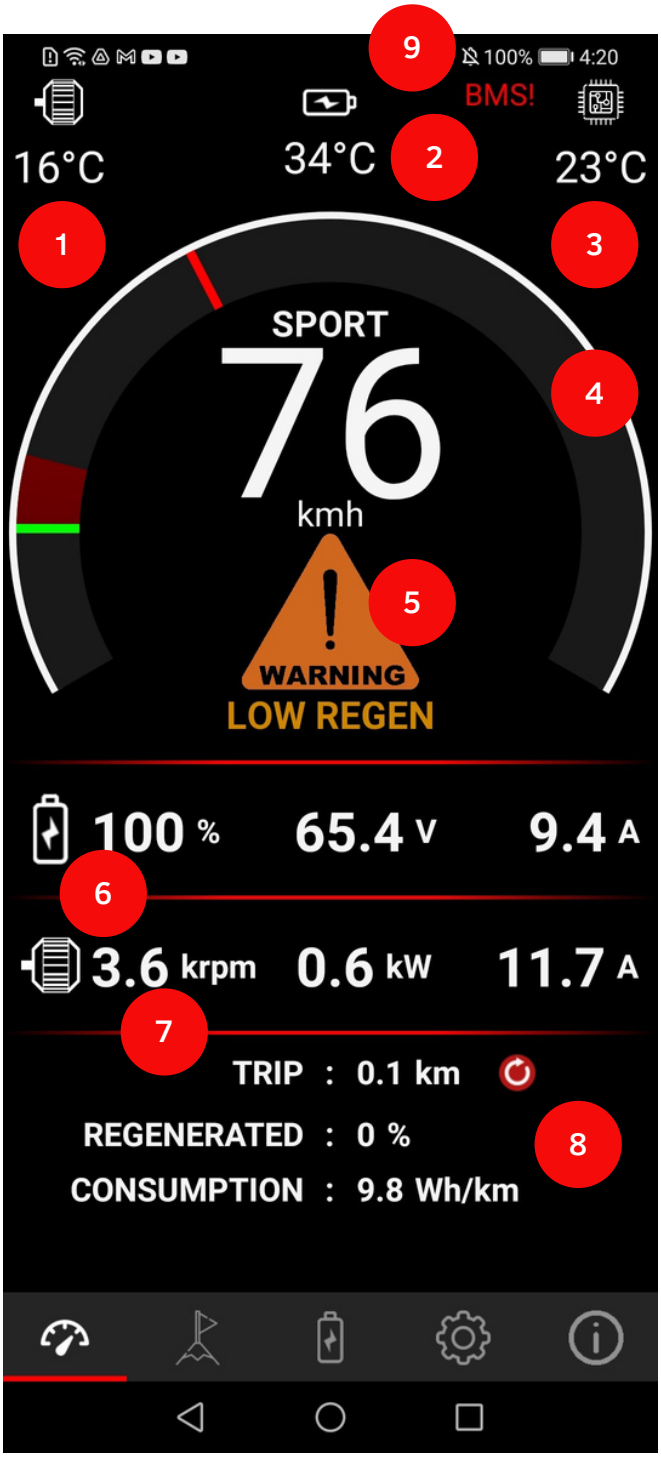
IMPORTANT: After the installation make sure to calibrate the throttle and Hall sensors! Go to the 5th screen of the Torp App and click the CALLIBRATION button. Then follow the setup Wizard. CALLIBRATION must be repeated after each firmware update!

We suggest you always ride with the app set to the 1s screen. This is how the Torp Controller App will be able to recognize potential errors which will help our support team with detecting and solving any problems that might occur with the controller.

THE APP OVERVIEW.

1st Screen: GAUGE

The TC500 controller is compatible with the stock SurRon display, where you will be able to track your speed and distance. However, we recommend using your smartphone as the display during the rides.
The first screen serves as a gauge, showing all your riding information in real time. Here are also displayed all the potential errors and warnings.



1-Motor Temperature: **Monitor** the Motor Temperature in real-time.

2-Battery Temperature: Monitor the battery temperature in real-time.

3-Controller Temperature: Monitor the battery temperature in real-time.

4-Power Gauge: Displays the power.

5-Warnings & Errors: All Warnings and Errors are displayed here. More details on their meaning can be found in a table below.

6-Battery Info: State of charge (SOC), battery voltage, and battery current.

7-Motor Info: Motor RPMs, Motor Power and Motor Current.

8-Predict your Trip: Check the distance you have passed, the amount of regenerated energy, and the consumption of the battery. You can plan your trip based on this information.

9-BMS!: There is a problem with BMS communication. Please check the wiring!

THE LIST OF WARNINGS AND ERRORS

Connect to the controller with the Torp App to see the Warning and Error messages on the 1st screen in the app.

-KICKSTAND: Your kickstand is lowered. Lift it to start riding.
-CRASH SENSOR: Crash sensor activates in case of a fall. Turn the bike off and turn it back on after a few seconds to continue riding.

LIMIT:

-TEMP CONTROLLER: The temperature of the controller has reached the top limit value. The power will be gradually reduced.
-TEMP MOTOR: The temperature of the motor is rising. To prevent overheating, the power will be gradually reduced. The motor temperature limit is set in the “Motor Temp Cuttoff” settings on the "Settings" screen.
-MOTOR TEMP SENSOR: Motor temperature sensor is not connected. Power is limited.
-LOW VOLTAGE: The battery is almost drained or there is a voltage sag due to the acceleration. The power will be gradually reduced.
-LOW REGEN: The battery is nearly full. The regen will be reduced.
-BATTERY TEMP: Battery temperature has reached limit values so the power will be reduced.
-BMS TEMP: Discharge mosfets in BMS have overheated. Power will be gradually reduced.

CUTOFF:

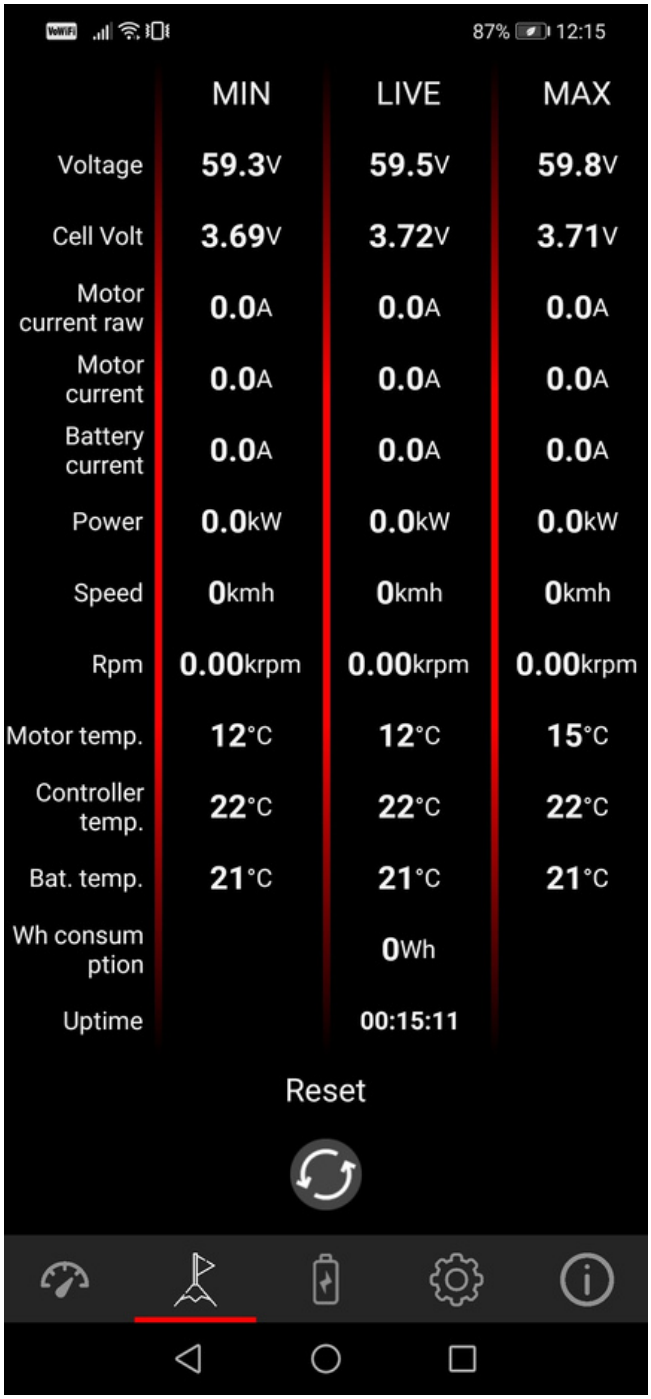
-CUTOFF LOW VOLTAGE: The battery is completely drained and the bike will not start. You can set the cutoff value in Voltage Min setting in the App (3rd Screen) . Charge the battery to continue riding.

-OVERVOLTAGE: Battery voltage is above 90V.
-UNDERVOLTAGE: Battery voltage dropped under the values set in the controller`s settings. Charge the battery.
-OVERCURRENT: Motor Current is above permitted limit.
-CONTROLLER OVERTEMP: Controller has overheated. Wait for it to cool down to continue riding.
-MOTOR OVERTEMP: Motor has overheated. Wait for it to cool down to continue riding.
-PHASE FET: MOSFET error: Controller`s phase is in short-circuit. Contact the manufacturer.
-HALL SENSOR: Motor Hall Sensor connector is not connected, or there is a problem with the Hall Sensor itself. Check the wiring.
-THROTTLE PROBLEM: The problem with a throttle wiring was detected, that has been solved in the meantime. Turn your bike off and on again to continue riding.
-THROTTLE #1: Throttle ADC rises too fast. Throttle plus(+) short on gnd(-).
-THROTTLE #2: Throttle not connected. Probably throttle plus(+) wire is broken.
-THROTTLE #3: Throttle plus(+) and gnd(-) shorted.
-THROTTLE #4: Throttle gnd(-) not connected or broken.
-THROTTLE #5: Throttle plus(+) shorted on signal.

-**CUTOFF THROTTLE:** The throttle has been activated while the bike is being turned on.
-1st solution: Release the throttle when turning on the bike;
-2nd solution: Re-calibrate the throttle (see the "Setting up the Throttle" section of this document) ;
-3rd solution: Check the wiring.
-**CUTOFF BATTERY TEMP: The battery** has overheated. The bike will stop until it cools down.
-**HALL PROBLEM:** The Hall sensor disconnected during the ride. Check the wiring.
-**HALL DISCONNECTED:** The Hall sensor disconnected during the ride. Check the wiring.
-**CUTOFF BMS TEMP:** The BMS mosfet temperature has reached the limit. The bike will stop until it cools down.
-WATER IN CONNECTOR (works with HW version 1.4 and higher): Water entered the main connector. Turn off the bike immediately, disconnect the main connector, and dry it out.

2nd Screen: PEAKS

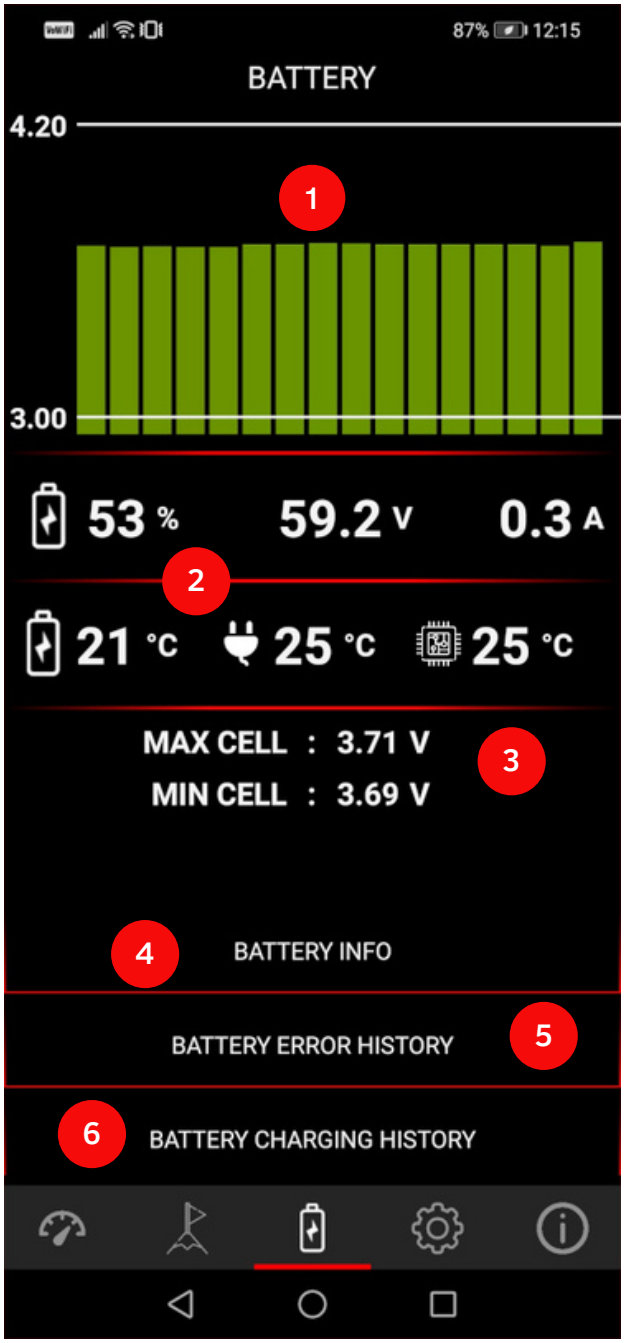
Check all the minimal and maximal values that occurred during your ride.



3rd Screen: BATTERY INFO

You will be able to see all the functions of this screen only with the stock SurRon battery and stock BMS. It also works with the bypassed battery, but with limited display of data (battery current, cycles and SOH will not be displayed correctly).

Use this screen to determine the health of your stock SurRon battery. The screen shows you the state of health of each of the battery cells and can serve as a useful tool to check the health of the battery or to determine the cause of battery malfunctions.



1 - Battery Cell Voltage: Check the voltage of each battery cell. The more the columns are aligned, the healthier the battery.

2- Battery Overview: Check the SOC, battery voltage, battery current, battery temperature, charging MOSFET temperature, and discharging MOSFET temperature in real-time.

3-Min & Max Battery Cell Voltage: Minimal and maximal battery cell voltage. Lesser the difference, healthier the battery.

4-Battery Info: Check the current stats of battery cells, charge cycles, battery estimated mileage, including errors, warnings, battery cell temperature,...

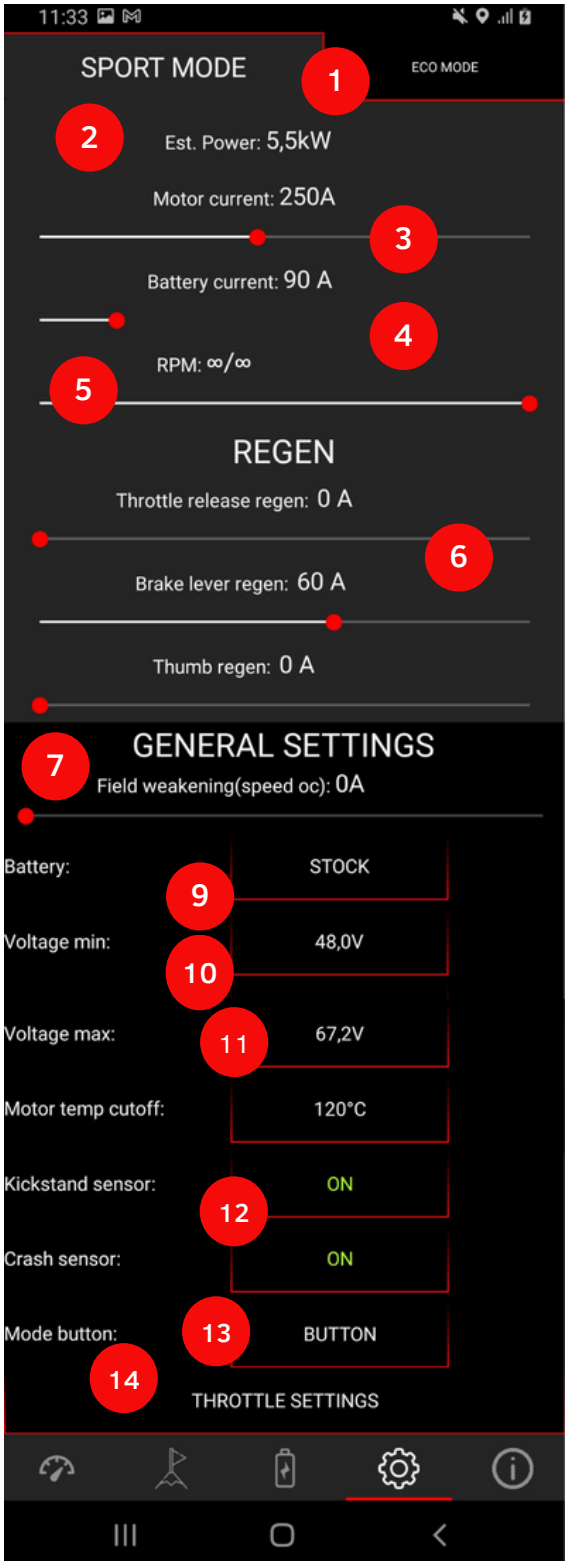
5-Battery Error History: An overview of all-time battery errors.

6-Battery Charging History: Check the charging history information of your battery.

4th Screen: CONTROLLER SETTINGS

Before your first ride you should tune your controller according to your riding preferences and the battery you are using.
The app allows the user to enter certain values that can potentially harm the battery, motor or other parts. We suggest you to use the settings that have been preset in the app by default.

Note that the TC500 controller is not an original SurRon/Segway part, therefore you are using it strictly at your own risk. The damages that are caused by using the controller are solely your responsibility.



1-Sport & Eco Mode: Choose the desired mode by pressing the mode button on the handle bar of your bike.

After that, set the parameters in a tab according to the chosen mode (Sport/Eco).

2-Estimated Power: Power estimate sets itself automatically, according to the chosen settings. It is calculated by taking into account the battery current, motor current and voltage (voltage is set according to the battery type).

3-Motor Current: Motor Current affects the torque of the motor. It is most noticeable at a lower speed.

4-Battery Current: Battery Current affects the maximum power. It also affects torque, which is most noticeable at medium and higher speeds.

5-RPM/Speed: Set the maximum speed limit. In case you choose ∞your speed is not limited.

6-Regen Type: The Controller supports the regen from the original SurRon brake signal and the regen from the throttle release. By moving either slider, set the amount of the regenerated current. Both regen types can be activated simultaneously. In case the battery is fully charged, the LOW REGEN warning will appear on the 1st screen.

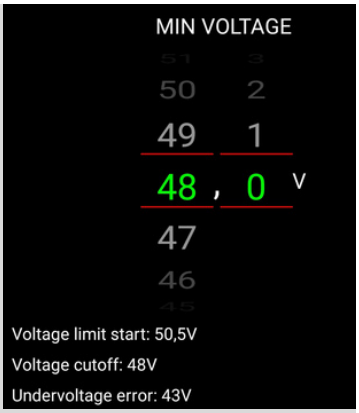
7-Field Weakening: This option will increase the top speed of your bike, but it comes with its own set of advantages and disadvantages:
Advantages: more speed, more torque on high speed
Disadvantages: less range, increased motor temperature.
We recommend setting the current to below 50 A to minimize potential drawbacks.

8-**Battery Type:** TC500 controller is compatible with:

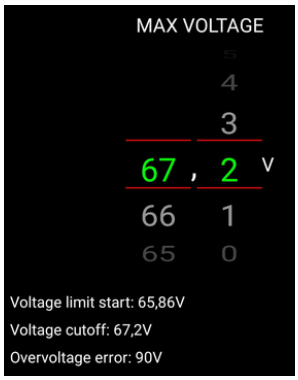
-stock Surron Light Bee/Segway X260 battery,
-bypassed stock Battery,
-custom 60V battery, and
-72V custom battery.

Select the battery you use and the Controller will set the minimal and maximal voltage to the optimal values. The selected Battery Type affects the limits that can be set within the App. The controller is compatible with a max 20s battery setup.

9-**Min Voltage:** Minimal and maximal voltages are set automatically, according to the battery type you choose from the menu above. You can also customize the voltage values for each Battery Type, but we recommend you use the controller within the limits of preset values. Customize the settings carefully, while setting the “Min Voltage” too low can cause the battery to over-discharge. When reaching the "Voltage cutoff value", the power will be gradually reduced. Once the "Voltage cutoff value" is reached, the motor will stop and an UNDERVOLTAGE error will be displayed on the 1st screen of the App.

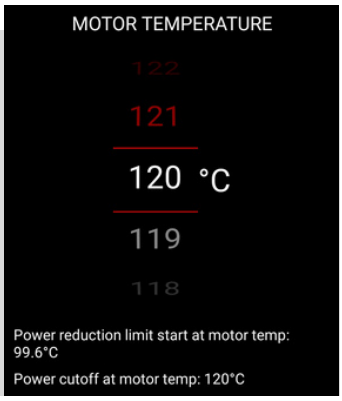


10-**Max Voltage:**



Max Voltage affects the regen. If the voltage of the battery is between the "Voltage limit start" value and the "Voltage cutoff" value, the regen is reduced. If the voltage of the battery is above the "Voltage cutoff", the regen is automatically disabled. If the battery voltage is above 90V, the "Overvoltage error" is displayed and the bike stops.

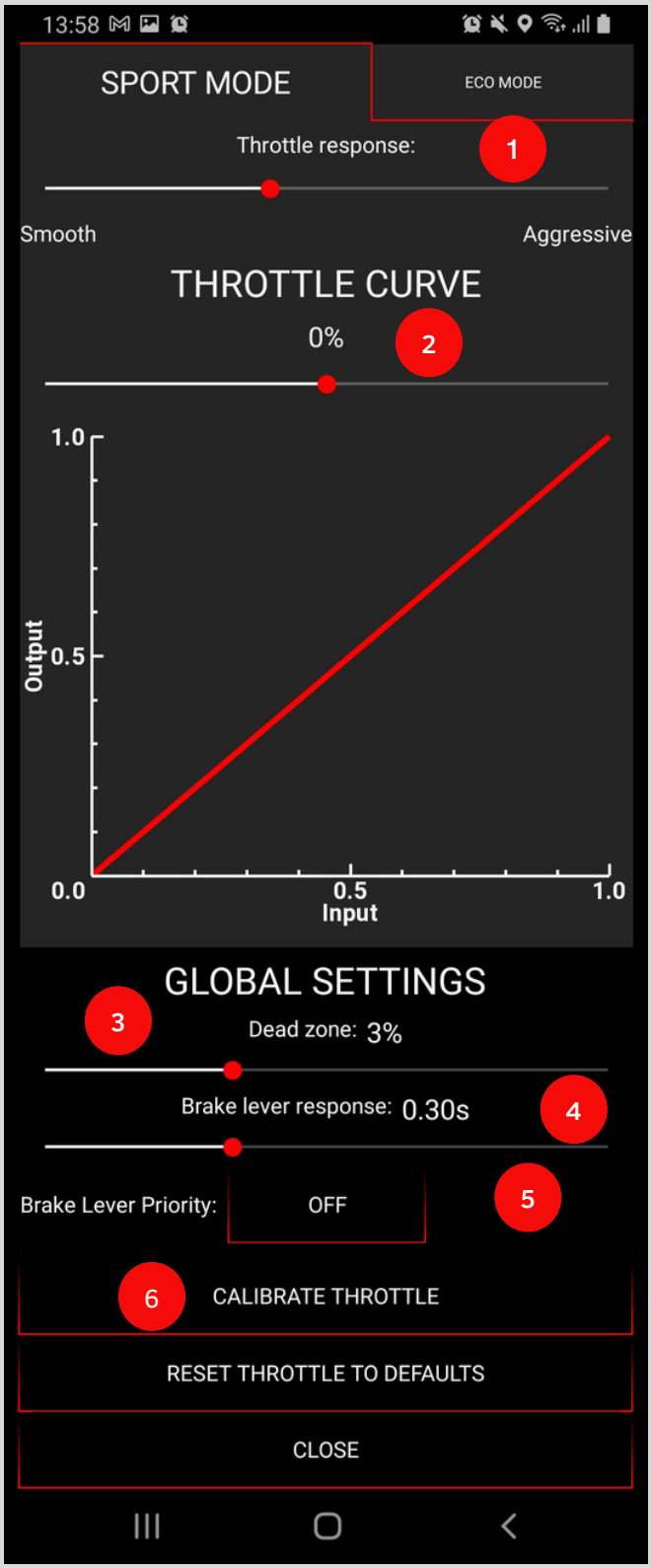
11-**Motor Temperature Cutoff:** Set the max temperature at which you would like for the controller to limit the power. The controller will gradually limit the power before reaching the max motor temperature.
The temperature at which the controller starts limiting the power is indicated at the bottom of the screen.
Setting the motor temperature to the red values can cause the motor to overheat and fail.



12-**Kickstand and Crash sensor:** The TC500 controller is compatible with stock SurRon Kickstand and Crash sensors. You can simply turn them on and off through the App. In case the Kickstand is ON and the kickstand is lowered, the motor will not run and you will see a KICKSTAND warning on the first screen on your App.
The same, in case the Crash Sensor is ON, and you fall, the motor will turn off and you will be presented with the CRASH SENSOR warning on the first screen of your App. In this case, turn off the bike, wait for a few seconds and turn it on again.

13-Mode Button: Set whether or not you would like to use a mode button on the bike`s handlebar. You have 3 options:
-OFF: The mode button on the bike is disabled. Your bike will remain in the SPORT MODE
-BUTTON: You can switch between ECO and SPORT modes with the mode button on the bike
-TORP DISPLAY: Switch between the ECO and SPORT modes using the TORP DISPLAY.

14-Throttle Settings:
Set the throttle response according to your preferences and calibrate the throttle.



1-Throttle Response:
Use the slider to adjust the throttle response. Slide the slider to the right, for a more agresive throttle response.
2-Throttle Curve: Slide the slider and adjust the throttle input and output values, which affect the throttle behavior.
-Slide right for the Degressive Throttle curve: As you increase the throttle, the power output grows faster. This means the bike responds more quickly even when a little throttle is used. This setting is recommended for high-powered trial rides and jumps.
-0% for a Linear Throttle Curve: This type of curve is simple and provides a predictable throttle response.
-Slide Left for the Exponential Throttle curve: Choose this setting for better control and sensitivity at high throttle levels, while keeping a gentle power delivery at low throttle levels. It offers precise control with a small throttle and strong power boosts at the higher throttle. This setting avoids sudden power jumps, making the bike easier to handle. It's perfect for beginners.

3-Dead Zone:
Set the range of the throttle twist that will be ignored by the controller.

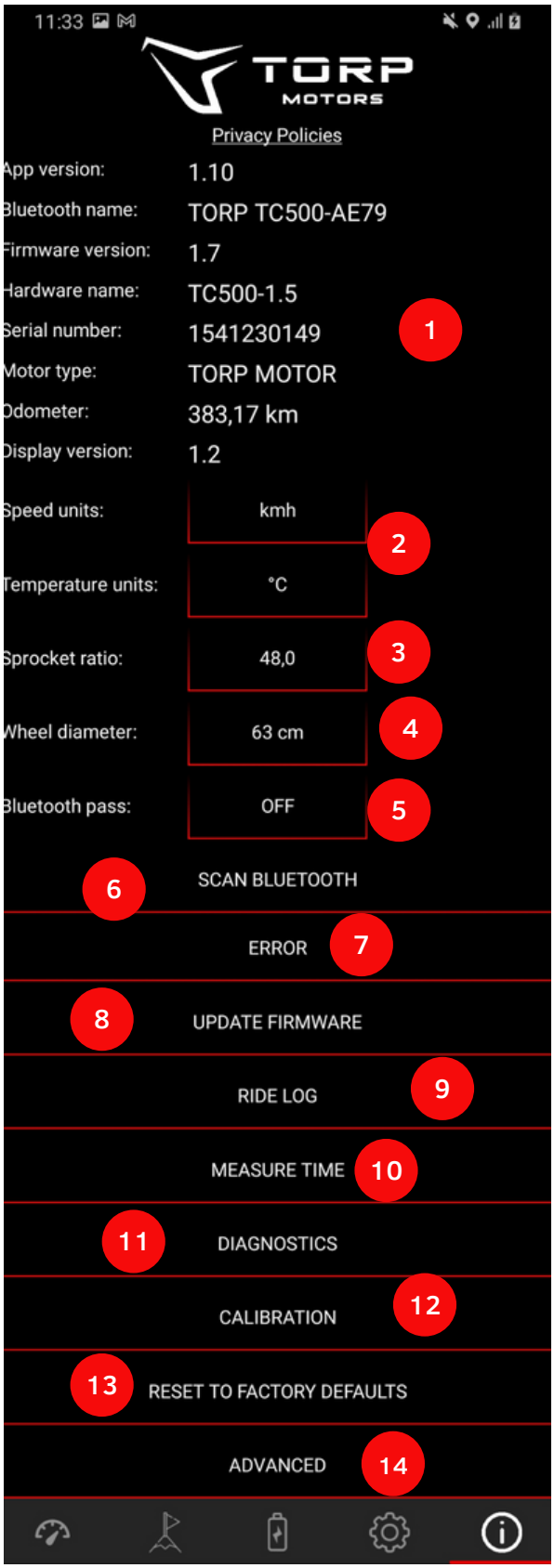
4-Brake lever response:
Adjust the brake lever regen response. Slide the slider to the right for a smoother regen response.

5-Brake lever priority:
By enabling this feature the brake (sensor) will take priority over the throttle (default stock SurRon behavior). BEWARE: In case you are twisting the throttle and pressing the brake lever at the same time, the bike will stand still. Once you release the brake, the bike will take off.

6-Calibrate Throttle:
Throttle calibration is required after the controller is installed for the 1st time or
in case you have switched the stock SurRon throttle for another brand. Follow the instructions in the Throttle Calibration window and in the "Setting up the Throttle" section of this document on page 19.

5th Screen: APP SETTINGS

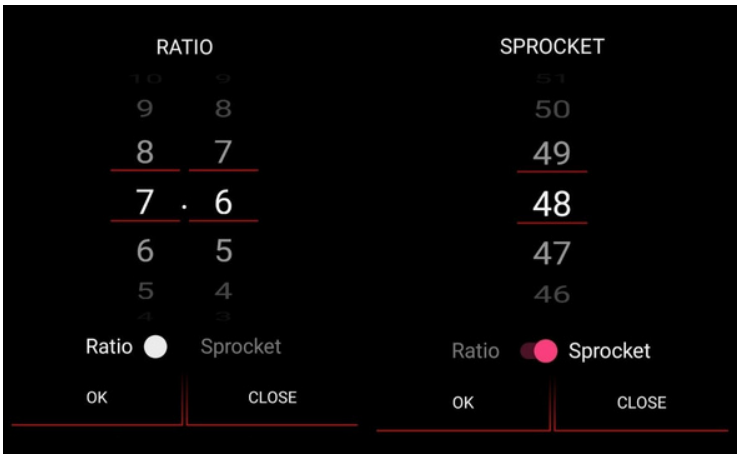
Use this screen to identify your controller and to adjust the general settings. This screen is also useful in case of controller malfunctions, since it allows you to share errors and ride logs with Torp support team.



1-General Information: Check the App and Controller Firmware versions and update them in case there is a newer version available. The App can be updated through the Play Store or App Store (depending on whether you are using Android or IOS). You can also see the identification parameters of your controller, like Bluetooth name, Hardware name, and Serial number, as well as a version of the display.

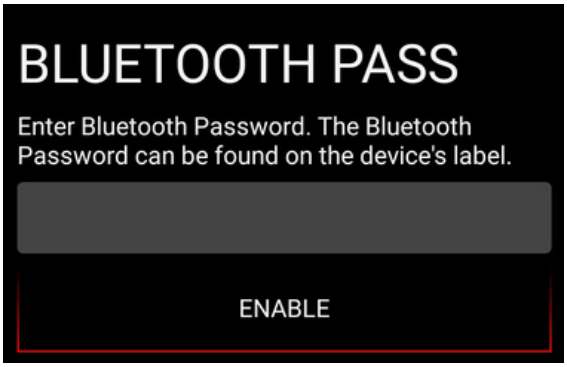
2-Speed and Temperature Units: You can choose between Metric and US Standard units. The chosen units will be applied to other sections of the App.

3-Sprocket Ratio: Change the sprocket tooth count or ratio. This function comes in handy in case you are using sprockets that are not the same size as the stock Surron/Segway sprockets. This option will affect the displayed speed, both on the stock LCD and in the App.



4-Wheel Diameter: Choose the values that correspond to your wheel. Wheel diameter will affect the displayed speed.

5-Bluetooth Pass: In case you want additional protection for your controller, enter a Bluetooth password, which can be found on the controller`s label. Bluetooth pass will be required every time you will connect to the App with a new device.



6-Scan Bluetooth: Use it for connecting to your device.

7-Error: The list of all controller errors since the last time it was disconnected from the battery. This list is useful in determining the causes for controller malfunctioning.

8-Update Firmware: Check whether a new Firmware is available. In case it is, press the button to update.

9-Ride log: You can check your ride on the map or send your ride-log file with all the stats to the chosen email address.

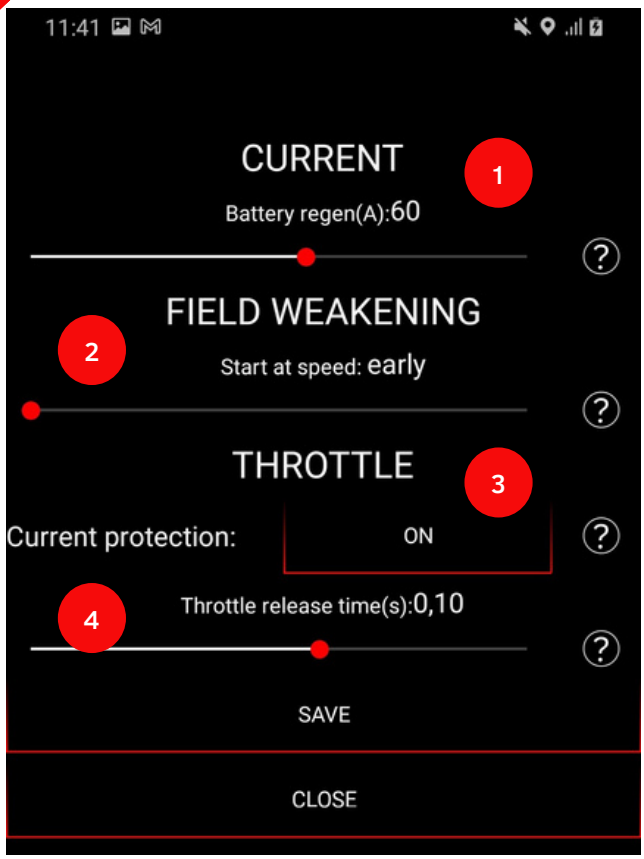
10-Measure Time: Measure the acceleration of your e-bike.

11-Diagnostics: An overview of all technical characteristics of the Controller that can help with determining the cause of potential errors.

12-Calibration: IMPORTANT: Calibration must be done before each first use of the controller and after each firmware update! Click on the calibration button and follow the wizard to calibrate the motor and throttle.

13-Reset to Factory Defaults: Reset your controller to the factory settings. By pressing this button you will lose all the settings you have made previously. After you reset your controller to the Factory Defaults, you will need to re-calibrate the throttle and HALL Sensors.

14-Advanced: Press this button for some additional settings regarding CURRENT, FIELD WEAKENING, and THROTTLE.



1-CURRENT-Battery regen: This option limits the max amount of current flowing back into the battery during regeneration. Adjust this setting based on your battery and the charging power capabilities of the battery.

2-FIELD WEAKENING-Start at speed: Use the slider to set the speed at which field weakening will activate. This option impacts motor efficiency and field weakening performance. If you want maximum efficiency, set it to 'late'.

3-THROTTLE-Current protection: Some throttles might consume more current than expected. If throttle errors 3 or 5 arise, this might be the reason. Disabling this option will also deactivate the short-circuit detection on the throttle handle.

4-THROTTLE-Throttle release time: The time from when the throttle lever is released until the value drops to zero. Reduce if you want a quicker throttle release response.

ADDITIONAL SETTINGS.

SETTING UP THE CONTROLLER ACCORDING TO THE BATTERY TYPE

Before using the Controller, you should fine-tune its settings according to the Battery you are using. The TC500 Controller supports*:
-SurRon Stock 60V Battery
-SurRon Stock Bypassed 60V Battery
-Custom 60V Battery
-Custom 72V Battery

The app will adjust the parameters to optimal values based on your Battery Type. You can adjust Motor and Battery Current according to how much torque you prefer. You can also customize the voltage values for each Battery Type, but we recommend you use the controller in the limits of preset values.

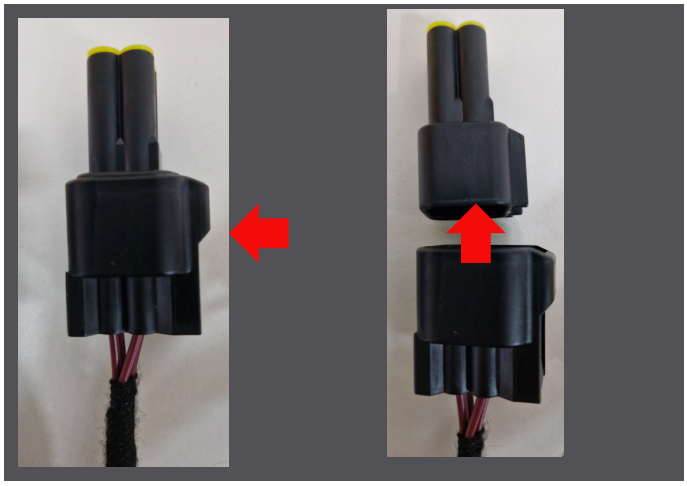
*A Torp Controller can be also used with other batteries, but you should keep in mind that in this case the voltage of the fully charged battery should not be above 84V, and minimal battery voltage should not be less than 36V.

TORP DISPLAY.

Torp Display allows you to track your controller and battery data in real-time and to switch between the riding modes. Additional options will be added through regular firmware updates.

INSTALLATION

First, remove the protective cap from the connector by pressing firmly to its side and pulling it out of the connector.



The Torp Display is being installed directly to the controller`s wiring harness, as shown on the photo.

You will need Firmware version 1.4 or higher in order for the display to function. In case you are using the 1.3 version of the Torp App, follow the following steps:

1. Go to the App Store and update the Torp App to the latest version
2. When the update is complete, go to the 5th screen in the Torp App and press the UPDATE FIRMWARE button. Once the update is complete, re-calibrate the throttle and Hall Sensors.

TORP DISPLAY AS A MODE BUTTON

To use the Torp Display as a MODE BUTTON, you should go to the Settings Screen in the Torp App (4th screen) and tap on the MODE BUTTON option at the bottom of the screen. There you should choose TORP DISPLAY as your mode button option.

ACCESSING THE DISPLAY SETTINGS

Use the up and down arrows and the ON/OFF button on the top of the display to access and move through the settings of the display. Once you reach the settings section you would like to change, hold the ON / OFF button on the top of the display to select the item to change. To move to another row, just hold the top button a bit longer.
Here you can set up your preferred speed units (mph/kmh) and temperature units (C / F).

3 s to activate
6 s do deactivate

STOCK MODE

Stock mode allows you to ride your bike in the road-legal configuration. This option is functional with the Torp Display. To activate it, you should hold the MODE button on the Torp Display for 3 seconds until the STOCK sign appears. To deactivate it, hold the MODE button for 6 seconds.

For additional support contact us at:

support@torp.hr

with:
-your Serial Number (S/N)
-a detailed description of the error, with photos and videos

and our team will get back to you with the solution.

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