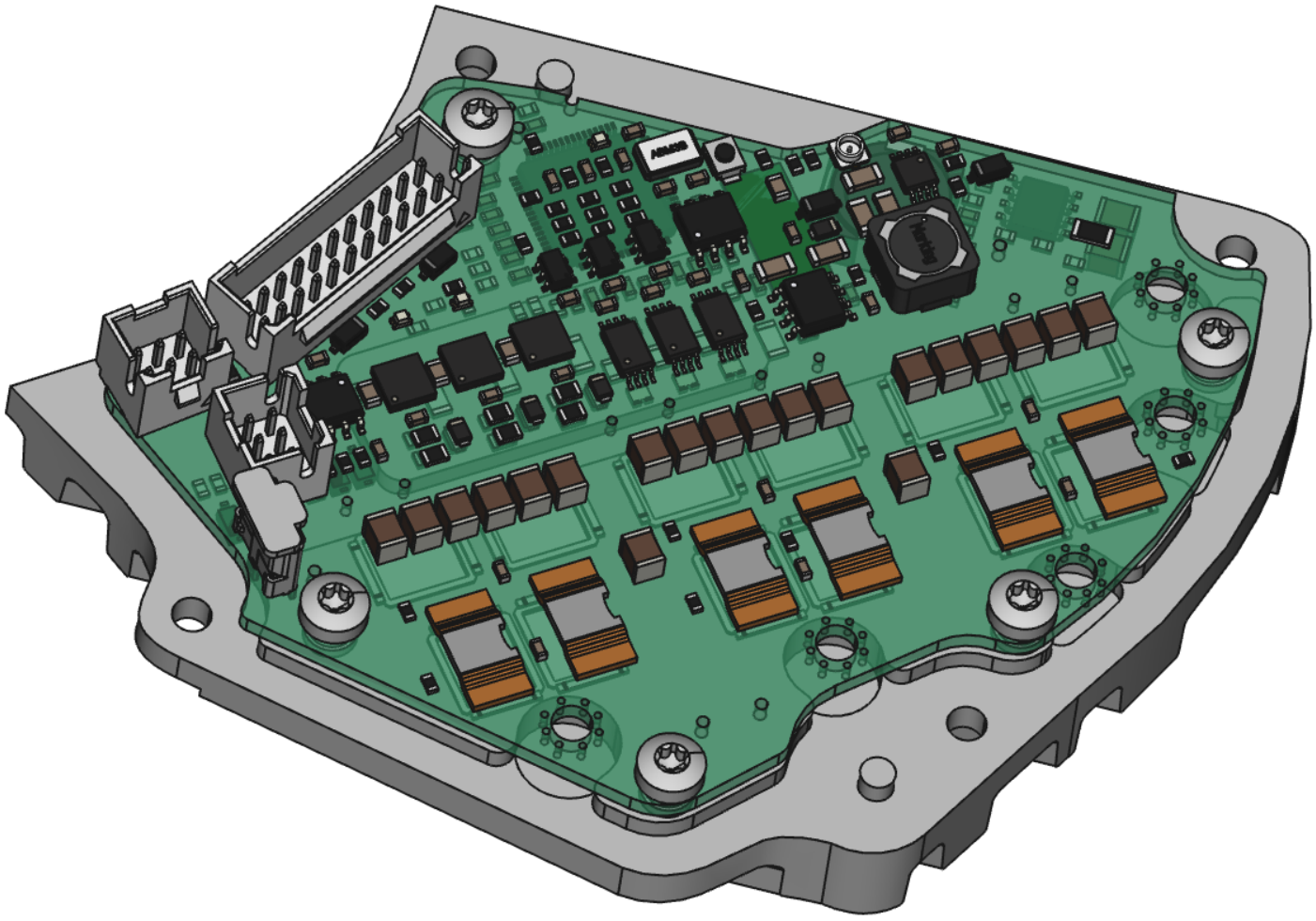
LUNA M600 Ludicrous V2
USER MANUAL



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Abstract

The purpose of this document is to provide general user guidance for the installation and operation of the enhanced Luna M600 Ludicrous V2 controller.

Controller Operating Specs

Parameter	Value	Unit
Max Input Voltage	84	Vdc
Max Phase Current (5 sec burst)	100	Apk
Max Battery Current	60	A
Standby Current	<100	uA
SW Frequency	20	kHz
Max Speed	30000	eRPM
Motor temp cutoff	120	°C

Don’t operate the controller beyond the listed values. Listed values are subject to change.

These are *controller* specs, when installed on an M600 drive unit, other limits will likely apply, like motor thermal overload or battery sag and available battery current.

A stock M600 motor can flow about 30 phase Amps peak (30Apk) continuously and will get very hot (120°C). Pushing more Amps (the V2 controller can do 100Apk) will increase motor temperature quickly and hit thermal cutoffs, so be mindful about the motor thermal capacity. Check the app temperature gauge to learn how your system behaves.

Similarly, a 48V battery could limit the power delivery by sagging too low at high power.

If your controller is already installed, you can skip to the connection chapter

Required tools and hardware

In order to install the controller into an existing M600 drive unit, the following tools are necessary:

- M600 drive unit
- M600 Ludicrous V2 controller
- Torx screwdriver
- Android smartphone
- VESC Tool - Luna Edition Android app:
  https://public.3.basecamp.com/p/3vQFDVjrG7emSnoEdNCAhiPi

Installation

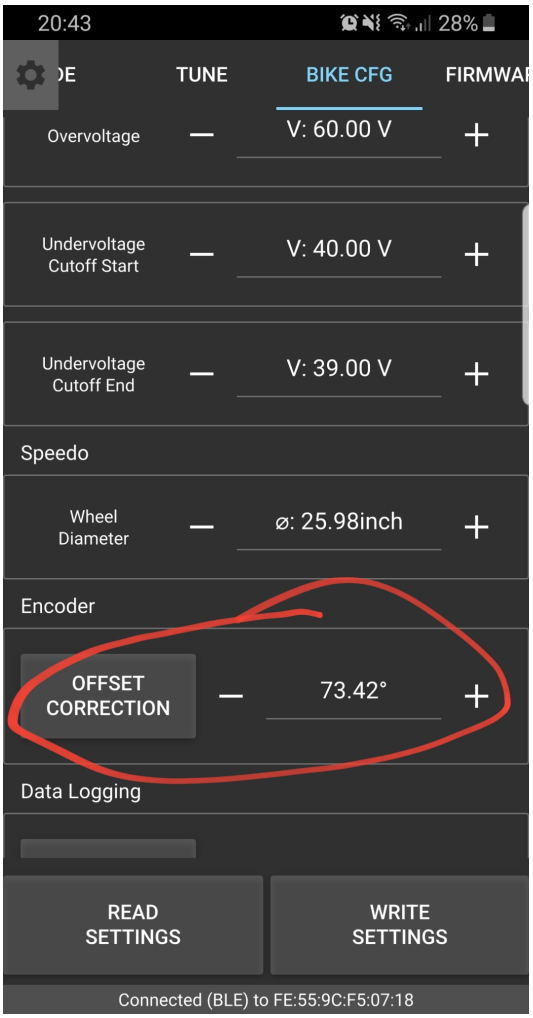
- Remove the stock controller by removing the 4 torx screws and unplugging the 5 signal and power cables. This is a bit easier if the chainring is removed first.
- Install the gasket on the new controller heatsink
- Take the new controller and connect the black 2 wire cable (temp sensor), then the wide 20-wire signal connector, then the 6-wire PAS connector and finally XT60 battery and MR60 connectors. This is just a guideline to make the connections with a bit less effort.
- Insert the controller assembly in place. Its a very tight fit and there are lots of wires that can block the installation, try to move them out of the way, otherwise the board can break. The bluetooth antenna is particularly delicate and prone to damage if it gets pinched during installation.
- Install and tighten the x4 torx screws
- Connect the battery and power ON the system from the display button. The display should show ERROR 08 which means that the encoder offset should be programmed.

Encoder Offset Detection

The M600 drive unit takes the rotor position feedback from a magnet glued at the tip of the rotor shaft. This cylindrical magnet is not keyed, so it ends up glued in a random position which needs to be detected in order to have a functioning drive unit.

This detection process is done through the VESC Tool android app:

- Download the app from:
- Open the app
- Power up your M600 drive unit
- Connect to the controller over Bluetooth
- Go to BIKE CFG tab
- Tap READ Settings
- Tap Offset Detection. The motor will spin slowly forward and backwards and the angle offset will be acquired.



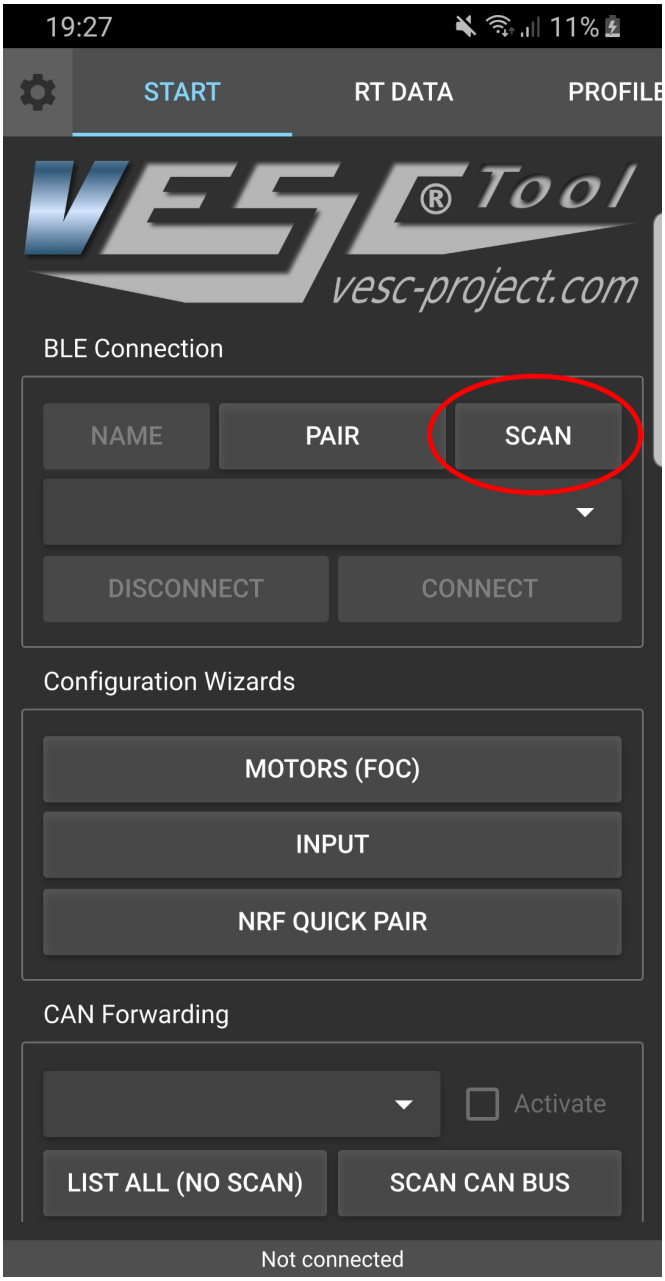
- Tap WRITE SETTINGS to write this into the controller memory.

The controller is now ready to run

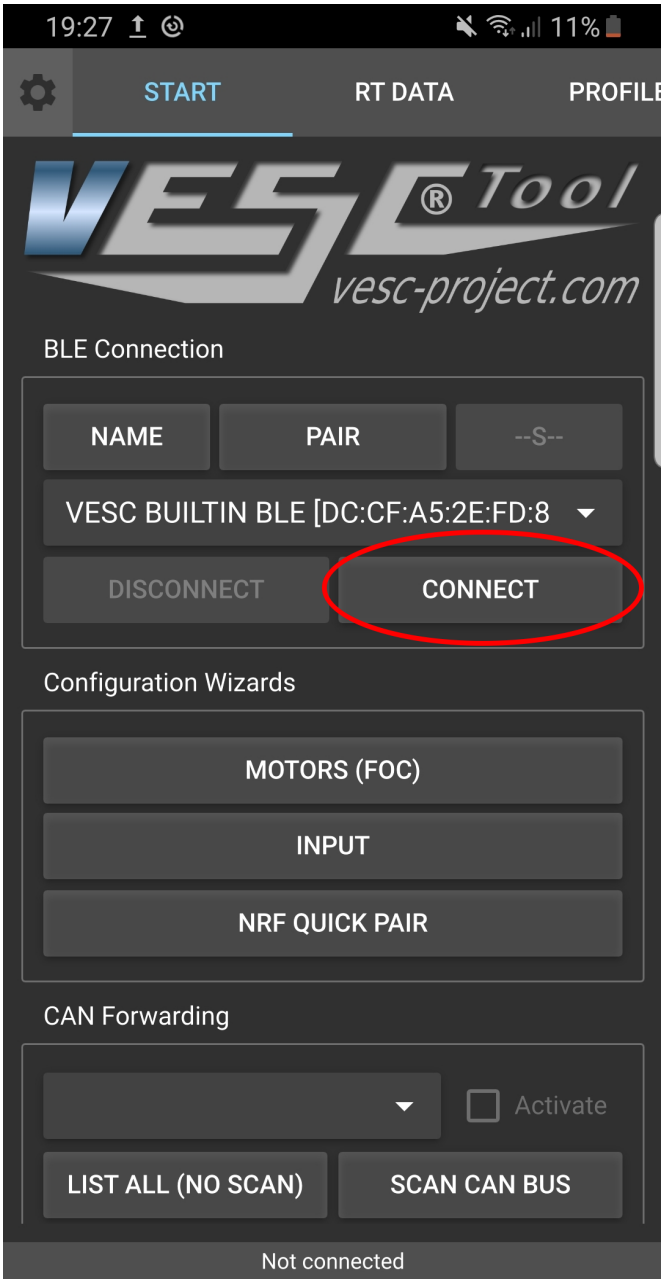
Connecting to VESC Tool

Get the VESC Tool Luna Edition Android app from here: **Download the app installer**

Here is a video tutorial to cover the basics of the connection:
WIRELESS CONNECTION - VESC-Tool Mobile Tutorial

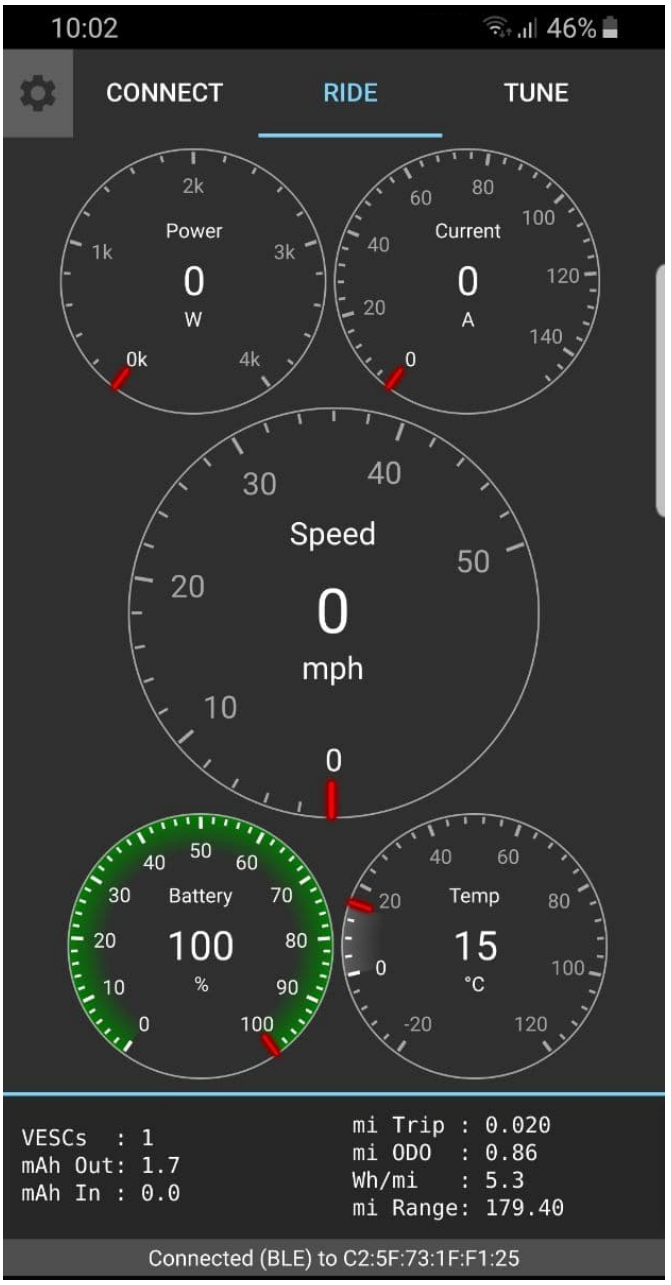


1. Open the VESC Tool App and tap *SCAN*



2. When your VESC shows up, click CONNECT. Note there may be more than one Bluetooth Low Energy (BLE) device in the air.

3. Your M600 is now connected! After a couple of seconds the controller will transfer the custom Luna UI to the phone.



4. In the RIDE tab you can see live data coming from the controller. We added a Motor Temperature gauge, as the Ludi V2 can easily drive the motor to its temperature limits.

VESC Tool is also available for Linux and Windows PCs here:
VESC Tool Downloads

The app will not run on IOS smartphones because Apple doesn't allow open source licences in their App Store.

Vesc Tool on Mac laptops is not officially supported, but someone provides unofficial Mac releases here:
https://github.com/rpasichnyk/vesc_tool/releases
We didn't test these so use them at your own risk.

Customizing Power Delivery Preferences

Power Levels

The M600 platform allows the user to set assist levels, by default divided in 5 levels.

When set to 9 levels, it modifies the torque (or phase current) produced by the M600 in the following way:

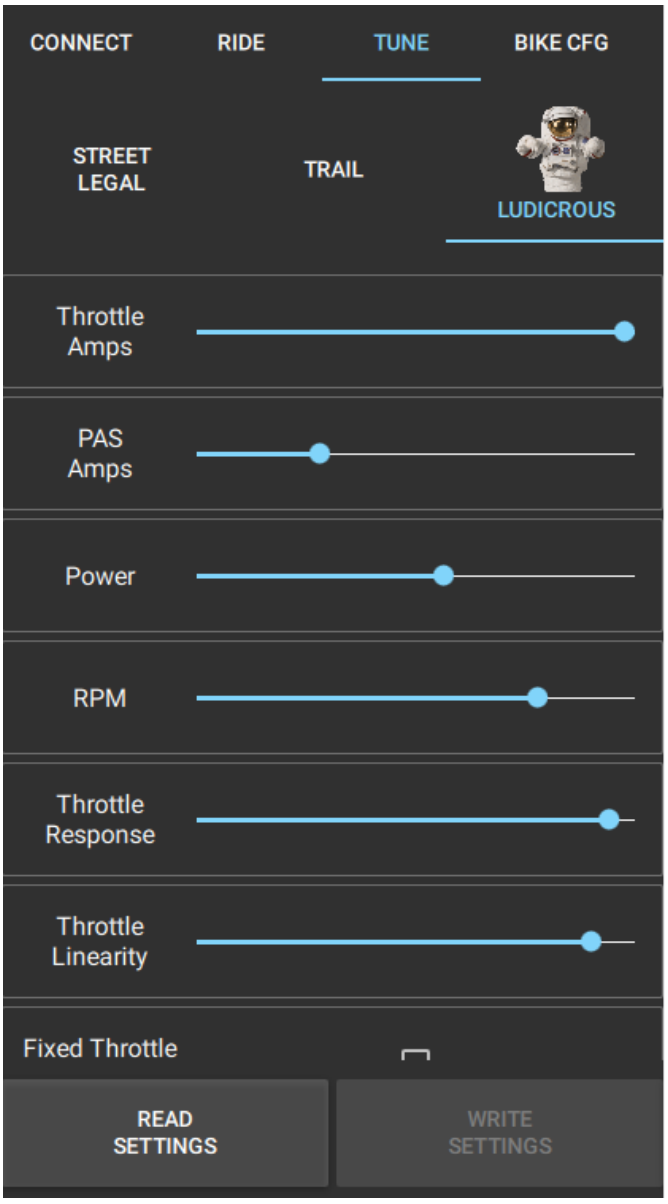
PAS LEVEL	Available torque
LEVEL 9	100%
LEVEL 8	88.8%
LEVEL 7	77.7%
LEVEL 6	66.6%
LEVEL 5	55.5%
LEVEL 4	44.4%
LEVEL 3	33;3%
LEVEL 2	22.2%
LEVEL 1	11.1%
LEVEL 0	Throttle and PAS disabled

These torque reductions are applied to the pedal assist algorithm. The throttle always has 100% of the torque available at all times.

In the **TUNE** page you can store 3 different tuning profiles:

- **STREET LEGAL**
- **TRAIL**
- **LUDICROUS**

The profile names are fixed, but the actual tuning is fully configurable.



By tapping the WRITE button, the selected profile will be stored in the controller.

Each profile has these parameters to tune:

- **Throttle Amps**
  The throttle controls the phase Amps, and this slider sets the max available phase current at the throttle. Torque output is directly proportional to phase current, so the slider is ultimately setting the amount of torque your motor produces.

- **PAS Amps**
  The Torque-based Pedal Assist algorithm provides motor torque based on crank torque. This slider sets the max phase Amps produced by PAS.

- **Power**
  Maximum power limit. Decreasing power will mostly affect mid-high speed performance.

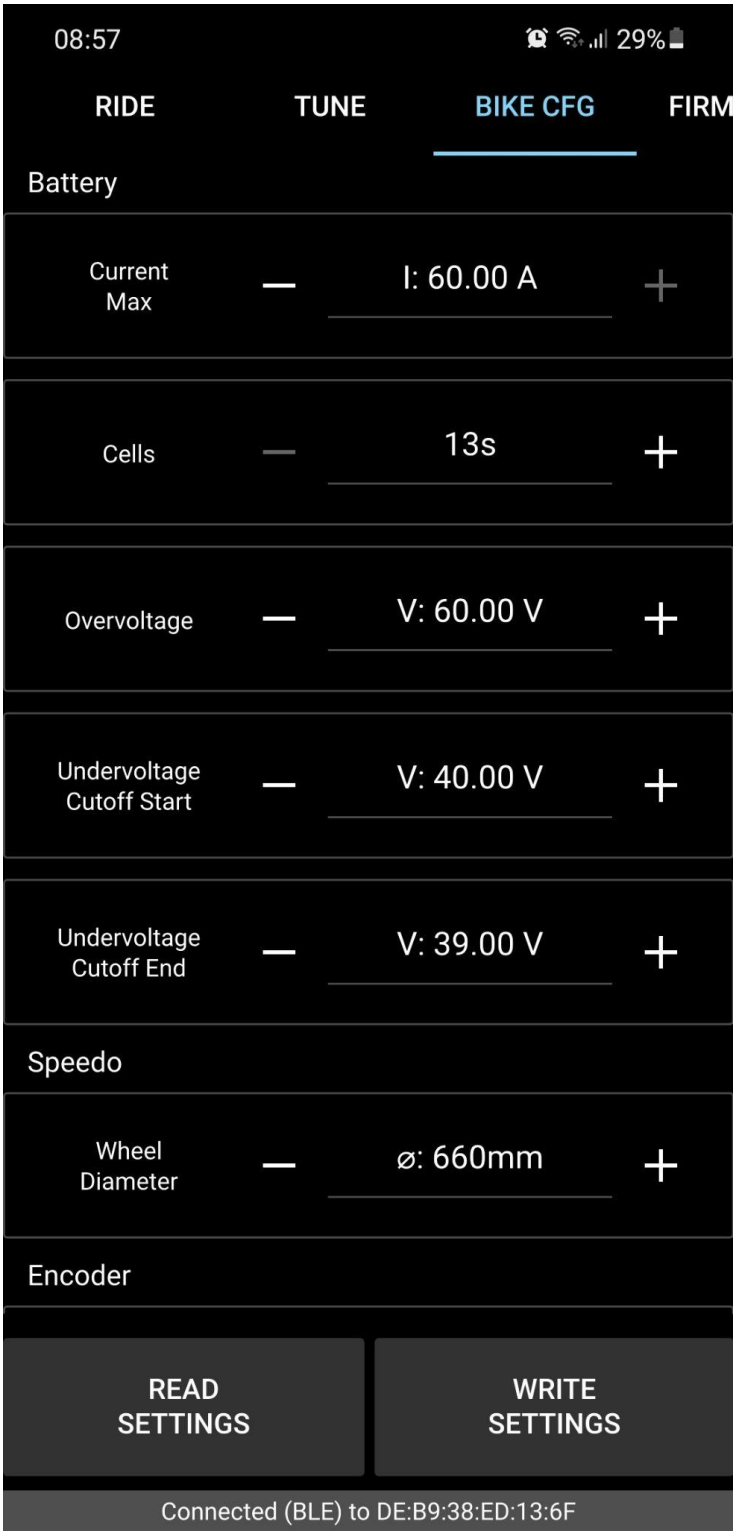
- **RPM**
  Set motor RPM limit

- **Throttle Response**
  The sharpest throttle response is achieved by reducing the ramp-up time to only 0.3 seconds. For a more smoother response, the slider can increase the ramp-up time to up to 3 seconds.

- **Torque Linearity**
  With the slider maxed out, the Throttle angle vs Torque will be fully linear. Reducing linearity will reduce the Torque in the initial part of the throttle, making it smoother on the low end.

- **Fixed Throttle Amps**
  When checked, the throttle current limit will be fixed at its maximum setting, equivalent to level 9. When not checked, throttle torque follows the display levels (1 to 9). Setting level 0 always disables both throttle and PAS.

On the **BIKE CFG** tab you can set your battery and wheel size parameters.



- **Battery current max**
  Limits your battery current to avoid exceeding its cell ratings. For example, each Q30 cell can supply 25A in short bursts.

- **Overvoltage**
  When the battery exceeds this voltage, a fault will be asserted.

- **Undervoltage Cutoff Start**
  At this voltage the torque available is 100%.

- **Undervoltage Cutoff End**
  At this voltage the torque available is 0%. Torque is linearly decreased between UV cutoff start and end to prevent the battery from sagging too low.

- **Wheel diameter**
  Used to calculate the speed from the wheel sensor. Wheel speed is shown in the display, in the apps, and in the logs. Go to Vesc Tool settings if you prefer imperial or metric units.

- **Encoder offset**
  Perform an encoder offset detection routine.

- **Invert motor direction**
  Some bafang motors are wired backwards. If the throttle spins the motor in the wrong direction, toggle this switch to reverse it.

- **Logging Directory**
  In order to store datalogs, this path needs to be defined.

Log Analysis

Here is probably the most in depth video about datalogging and analysis so far:

https://www.youtube.com/watch?v=1dm12zB78Ic

Downloads and resources

- ☐ VESC Tool Luna Edition Android app: Download the app installer
- ☐ M600 Ludicrous V2 firmware: Download firmware
- ☐ VESC Tool source code: https://github.com/vedderb/vesc_tool
- ☐ VESC Firmware source code: https://github.com/vedderb/bldc/ (Luna code not merged yet)