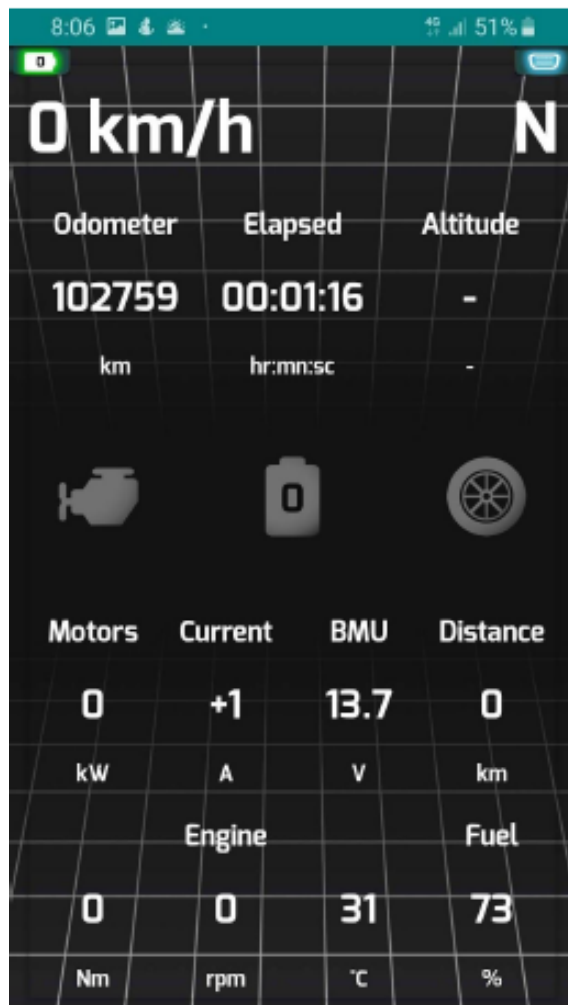


# PHEV Watchdog App Guide

V1.0 (OpenSource, please edit as you see fit)

|                                      |    |
|--------------------------------------|----|
| General Main Screen data fields      | 2  |
| Battery data fields                  | 3  |
| Cells and charger data fields        | 4  |
| Trip data fields                     | 5  |
| Motors data fields:                  | 6  |
| Trips History                        | 7  |
| Trips History Details                | 8  |
| Trips History Details (cont.)        | 9  |
| About the Battery Condition List     | 10 |
| Battery Condition List Expanded      | 11 |
| Battery (Cell) Voltage Map           | 12 |
| Battery (Cell) Heat Map              | 12 |
| Battery (Cell) Voltage Optimized Map | 13 |
| Check Faults                         | 13 |
| Settings                             | 13 |
| About/Privacy                        | 13 |
| App Power Management                 | 14 |



Speed is retrieved from the car's data, and displayed by the Dog as is. Dashboard's always shows a difference of ~10% as in some countries it is mandatory to display never less than the real speed. In order to achieve this most automotive manufacturers increase the displayed speed by a safe margin.

### General Main Screen data fields

Left to right, top to bottom:

- Speed (Car Data)
- Direction (inferred from Mobile GPS)
- Odometer (Car Data)
- Elapsed time (Mobile System Clock)
- Altitude (Mobile GPS, averaged)
- Operation Mode (inferred from Car Data)
- Motors Combined Power (inferred from Car Data)
- Current:

+ve value - total current draw from the battery (motors, ac, etc.).

Maxim observed value: 80A.

-ve value - total current in from; wall charger, regen braking or generator.

Maximum observed values:

Wall charger 6-16A,

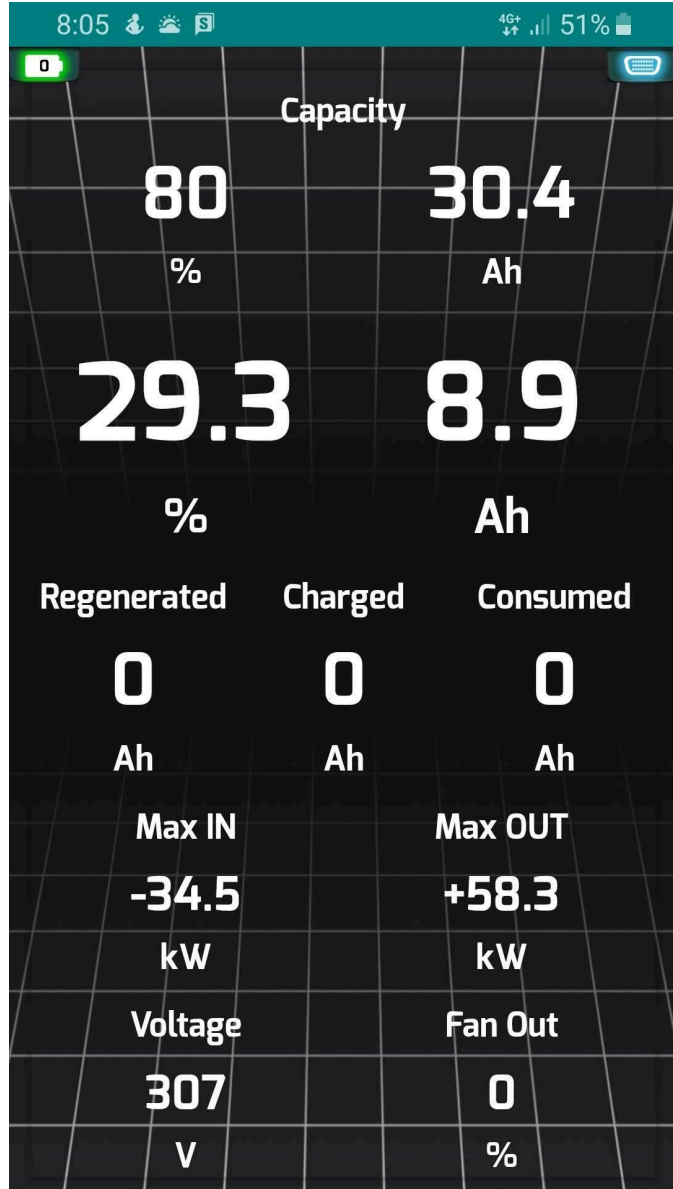
CHAdEMO (fast charger) 20- 50A

Regen braking from 1-60A

- Distance (inferred from Car Data)
- BMU Voltage of 12V system
- Engine (torque and RPM) (Car Data)
- Temperature of engine coolant
- Fuel Level (Car Data, moving averaged)

And at the top some control field about the GPS Status (from Mobile and not shown here), bluetooth and OBD connections.

Fields marked as "Car Data" are an exact copy of data received from the OBD connection.



## Battery data fields

### - State Of Health

SoH %age is inferred from a generally accepted nominal capacity value of 38 Ah as new (or 46 Ah for cars with the new battery).

### - Total Reported Capacity (Ah, Car Data)

### - State Of Charge (inferred from Present Charge / Total Capacity)

### - Present Charge level (Car Data)

### - Regenerated Charge (Inferred from Car Data)

Regenerated Charge is the accumulated value of gained Charge (from regenerative braking AND engine-powered generator).

### - Charged

### - Consumed Charge (Inferred from Car Data)

The accumulated value of used Charge.

### - Max Input Power (Car Data)

### - Max Output Power (Car Data)

### - Present Voltage - Drive Battery total Voltage

### - PWM Fan Output (Car Data)

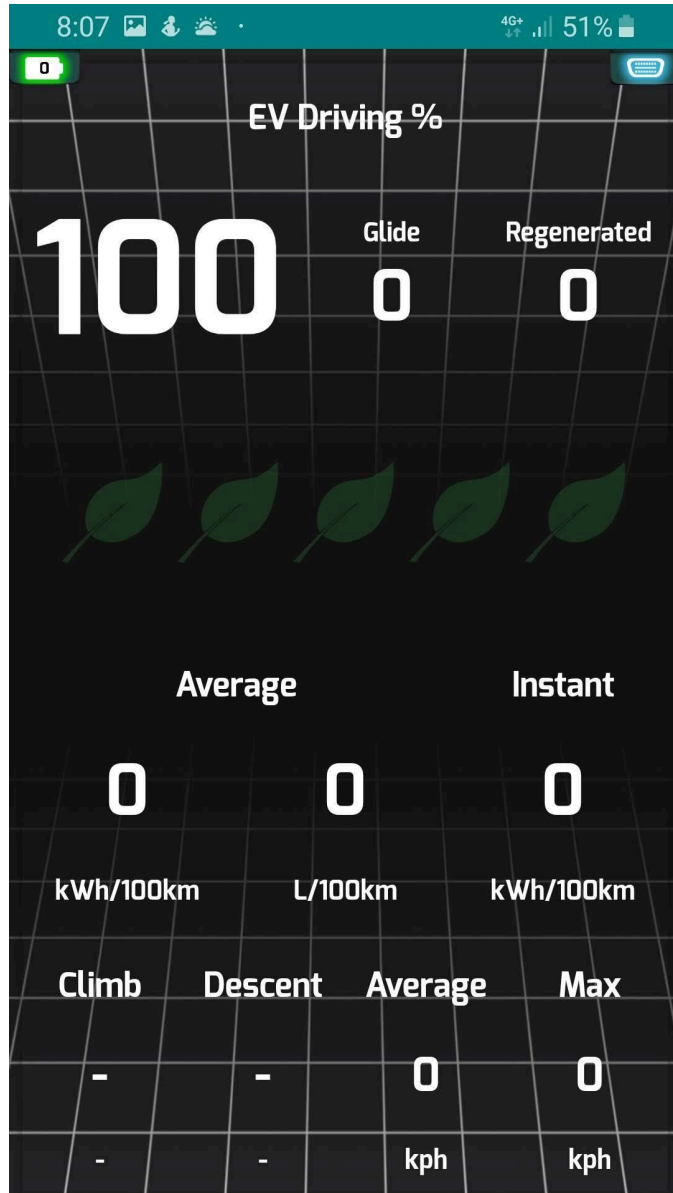
V

|                     |       |                 |          |
|---------------------|-------|-----------------|----------|
| 8:06 4G+ 51%        |       |                 |          |
| AC/DC               |       | DC/DC           | Usage    |
| 10.45               |       | 0.06            | 67.14    |
| -                   |       | -               | -        |
| Stationary Charging |       |                 |          |
| -                   |       | -               |          |
| -                   |       | -               |          |
| Min Voltage         |       | Max Voltage     |          |
| 1                   | 3.832 | 41              | 3.843    |
| #                   | V     | #               | V        |
| Module Min Temp     |       | Module Max Temp |          |
| 5                   | 13    | 10              | 15       |
| #                   | °C    | #               | °C       |
| Average             |       | Target          | Max Diff |
| 3.837               |       | 3.84            | 0.011    |
| V                   |       | V               | V        |

### Cells and charger data fields

- AC/DC: total Amps charged from wall/destination chargers.
- DC/DC: total Amps charged with CHAdeMO (fast charger)
- Usage: total Amps used (including hybrid mode)
- Stationary Charging data (?)
- Cell with minimum Voltage, ID and value (Car Data)
- Cell with maximum Voltage, ID and value (Car Data)
- 8-Cell Module with minimum temperature, ID and value (Car Data)
- 8-Cell Module with maximum temperature, ID and value (Car Data)
- Cells average Voltage (Car Data)
- Cells target Voltage (Car Data)
- Maximum Voltage difference (inferred)

Not much to add here, almost everything comes from OBD.



Energy consumption is inferred from:  

$$\text{Accumulated}([\text{Consumed Charge}] * [\text{Voltage}]) / [\text{Distance Traveled}]$$
 The accumulated value is very precise, as it is the sum of observed values in very small portions of time...

Again most of the time this doesn't match the value reported by the MMCS... For those who are skeptic, just do the math at the end of your trip to see who's right.

## Trip data fields

- Total % of EV driving (inferred from Car Data)
- Total % of Glide driving (inferred from Car Data)
- Total % of Regenerated driving (inferred from Car Data).
- Eco score (inferred from Car Data)
- Energy consumption (inferred from Car Data, averaged)
- Fuel consumption (inferred from Car Data, averaged)
- Instant energy rate (inferred from Car Data)
- Climb (inferred from Mobile GPS)
- Descent (inferred from Mobile GPS)
- Average speed (inferred from Car Data, averaged)
- Maximum speed (inferred from Car Data)

EV driving is the actual driving in pure electric mode (no internal combustion engine (ICE) whatsoever). You'll find this won't match the value reported by the MMCS (don't know why), but the former is right.

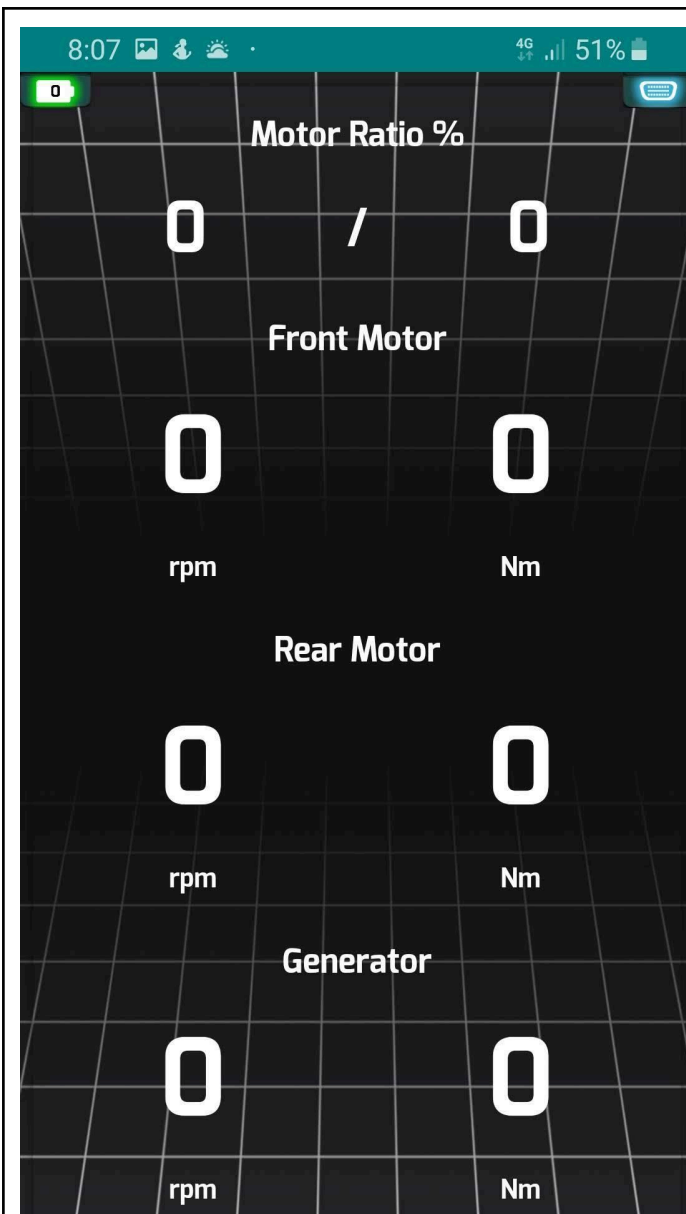
Glide records the % of EV driving (no ICE) that is done in pure Glide, which means speed above zero and zero torque for both motors. Which is achieved by moving with B0 and no pressure on the accelerator pedal. Regenerated records the % of EV driving (no ICE) achieved with regenerative braking.

Fuel consumption is inferred from:  

$$\text{Accumulated}([\text{Fuel Spent}]) / [\text{Distance Traveled}]$$
 being [Fuel Spent] calculated from [Fuel Rate]  
 Fuel rate is inferred from the air flow going into the engine, which is reported by the OBD.  
 Here the values matches the ones reported by MMCS, but the latter seems to have some kind of delay and you'll find the Fuel consumption reported by the "dog" to be much more accurate.

Climb and Descent, are accumulated values observed from the Altitude data field.

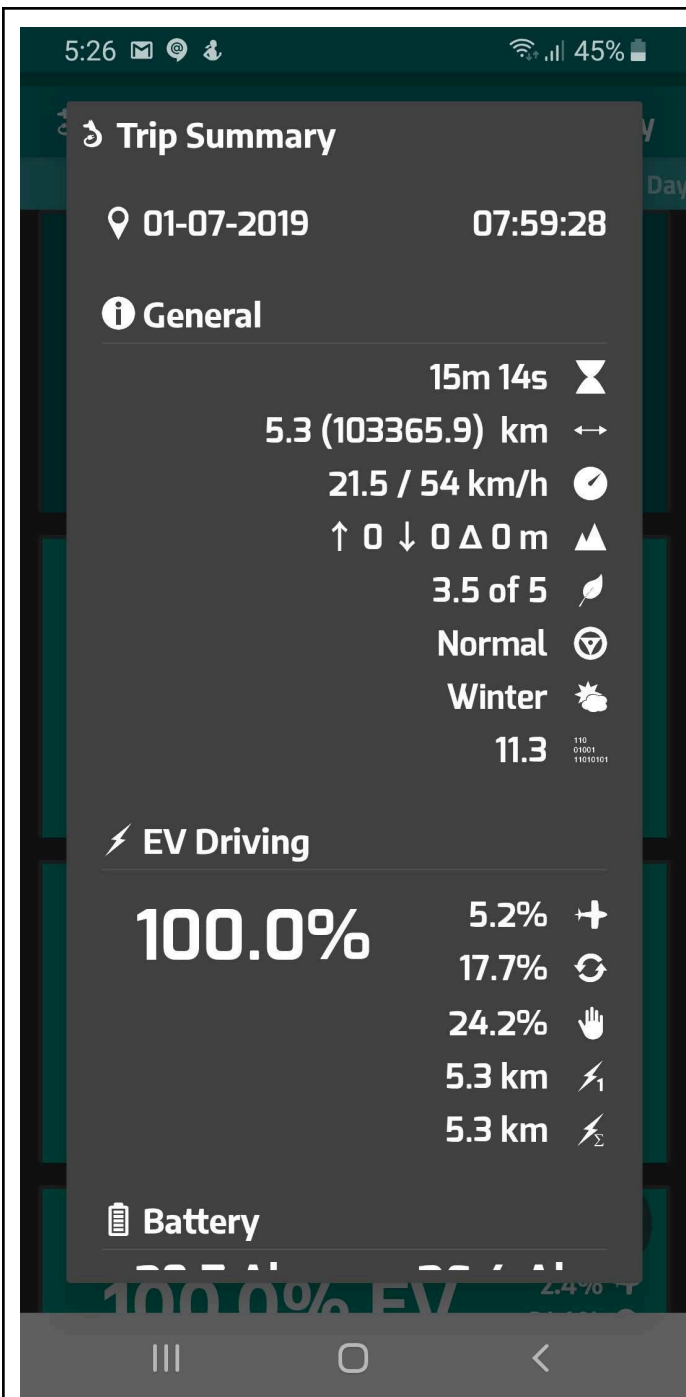
Average speed is a simple average  $[\text{Distance Traveled}] / [\text{Elapsed Time}]$  and maximum the top observed value of the [Speed] data field



### Motors data fields:

- Motors Ratio (inferred from Car Data)  
Corresponds to the power distribution (torque) between front and rear motors.
  - Front Motor RPM (Car Data)
  - Front Motor Torque (Car Data)
  - Rear Motor RPM (Car Data)
  - Rear Motor Torque (Car Data)
  - Generator RPM (Car Data)
  - Generator Torque (Car Data)  
Is always zero or minus (charging).
- + Torque means motor is powered,  
- Torque means motor is regenerating (charging).

| <div> <div> PHEV Watchdog Trips History </div> </div>   |  |
|---|--|
| <div> Trips Week </div>   |  |
| <div> <div> <div> 03-11-2017 07:54:49 20m 34s </div> <div> 69.2% EV <div> 16.0% + 25% ↺ </div> </div> <div> 11.3 kWh/100km = 0.6 kWh ⚡ 4.7 L/100km = 0.2 L </div> <div> 2 / 5 km 15.3 / 62 km/h </div> </div> </div>    | <div> Trips History </div> <p>First it should be understood that the "dog" segments the data into "trips".</p> <p>The user is responsible to start and stop the "recording" of a trip... Once you stopped it, that trip is over, and closed. However you are able to merge with previous later.</p> <p>This screen will report the current status for the current trip. After ending a trip, you still have the possibility to view the stats, as all are kept by the "dog".</p> <ul style="list-style-type: none"> <li>- Date, Time, Trip duration</li> <li>- Total % of EV driving (inferred from Car Data)</li> <li>- Total % of Glide driving (inferred from Car Data)</li> <li>- Total % of Regenerated driving (inferred from Car Data).</li> <li>- kWh consumption</li> <li>- Fuel consumption</li> <li>- EV only trip distance / Total trip distance</li> <li>- Average / maximum km/hr</li> </ul> <p>Going into the tabs there is much more detail...</p> |
| <div> <div> <div> 03-11-2017 07:07:54 46m 50s </div> <div> 94.4% EV <div> 28.5% + 16% ↺ </div> </div> <div> 19.4 kWh/100km = 4.3 kWh ⚡ 0.6 L/100km = 0.1 L </div> <div> 20 / 22 km 28.1 / 92 km/h </div> </div> </div>  |  |
| <div> <div> <div> 02-11-2017 17:18:07 41m 16s </div> <div> 100.0% EV <div> 18.7% + 26% ↺ </div> </div> <div> 19.5 kWh/100km = 4.5 kWh ⚡ 0.0 L/100km = 0.0 L </div> <div> 22 / 23 km 33.5 / 88 km/h </div> </div> </div> |  |
| <div> <div> <div> 02-11-2017 07:07:23 1h 32m 38s </div> </div> </div>   |  |



## Trips History Details

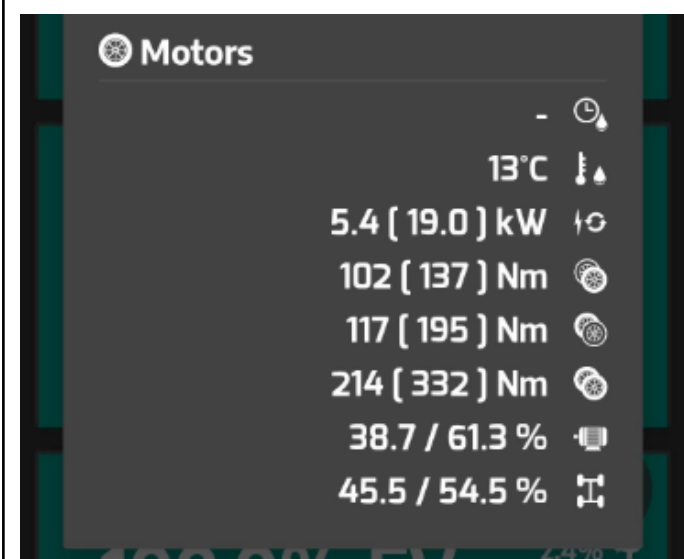
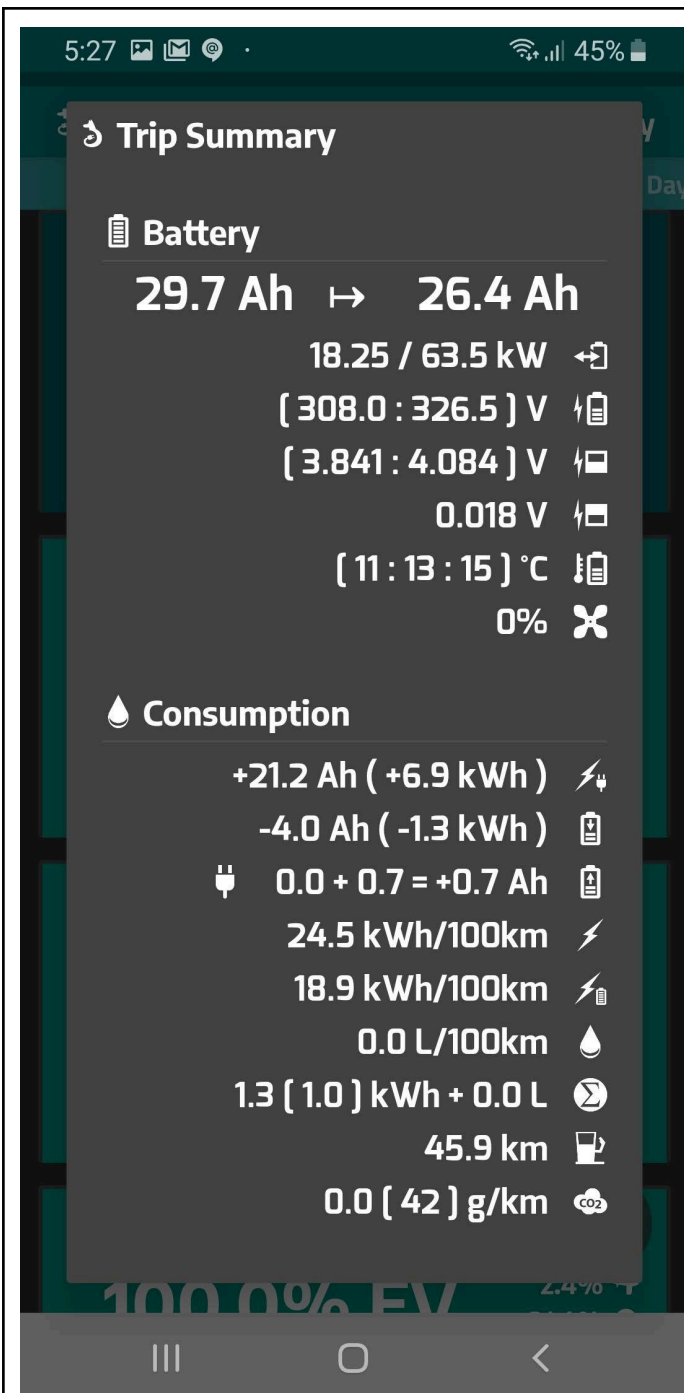
- Date, Time,

General:

- Trip duration
- Total trip distance
- Average / maximum speed
- Accumulated Climb (inferred from Mobile GPS)
- Accumulated Descent (inferred from Mobile GPS)
- Eco score (inferred from Car Data)
- Driving style
- Season
- Data resolution (average commands per second)

EV Driving:

- Total % of EV driving (inferred from Car Data)
- Total % of Glide driving (inferred from Car Data)
- Total % of Regenerated driving (inferred from Car Data).
- Stopped time without moving
- Total distance before the engine started for the first time.
- Total trip distance on pure electric



## Trips History Details (cont.)

### Battery:

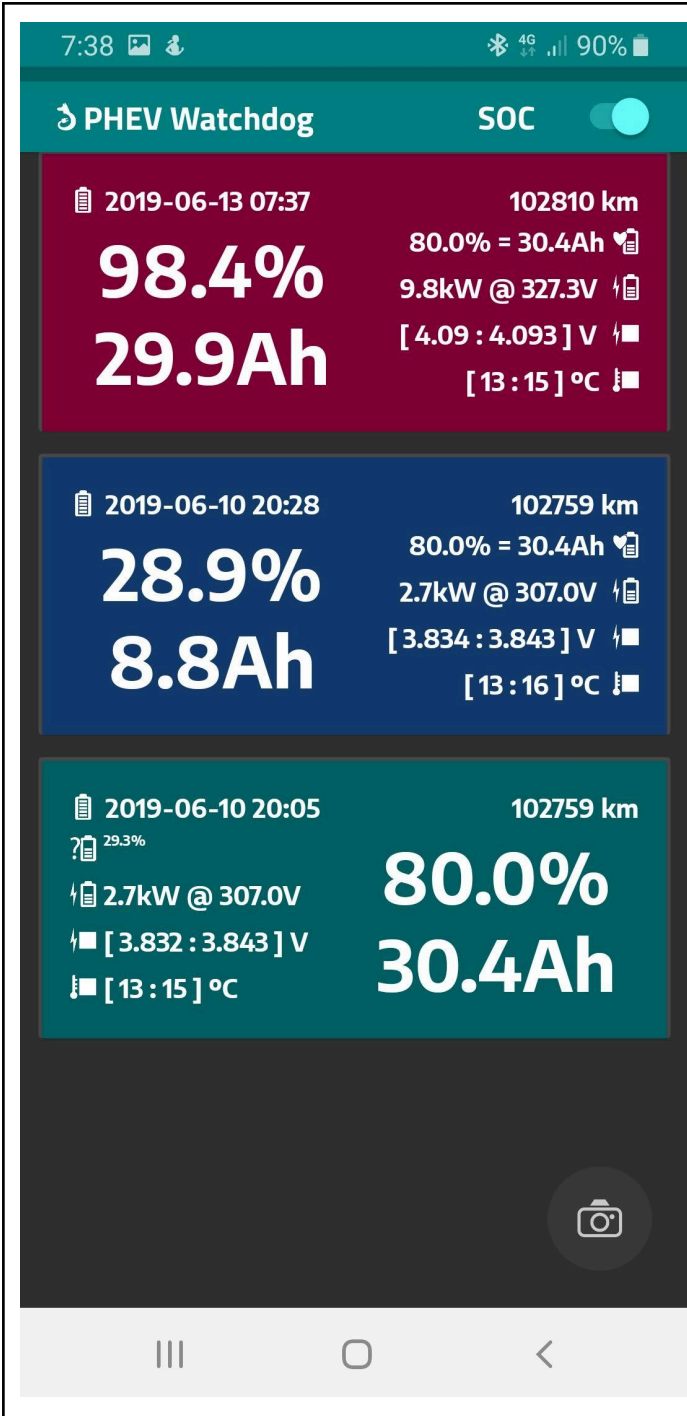
- Charge at beginning and end of trip
- Max observed battery input / output power
- Min / Max observed battery voltage
- Min / Max observed battery cells voltage
- Max observed battery cells voltage difference
- Battery modules temperature min:ave:max
- Cooling PWM Fan Output (Car Data)

### Consumption:

- Total charge difference since last trip (recharged)
- Total consumed charge
- Total charged during trip (gen and regen)
- Overall average electric consumption
- Wall to wheel ave electric consumption (excluding charging)
- Overall average fuel consumption
- Total electricity including (excluding) charging and fuel
- Total distance traveled since last refuel
- Total (announced) Carbon Dioxide emissions

### Motors:

- Total time of engine running (total number of times engine started)
- Max observed engine coolant temperature
- Average (max) observed regenerative brake power
- Max observed (announced) torque at the front motor
- Max observed (announced) torque at the rear motor
- Max observed (announced) combined torque of motors
- Average observed motor ratio (front/back)
- Average observed wheel ratio (front/back)



## About the Battery Condition List

The red one

- Maximum State of Charge (SoC) 29.9Ah.

The blue one

- Minimum State of Charge 8.8 Ah.

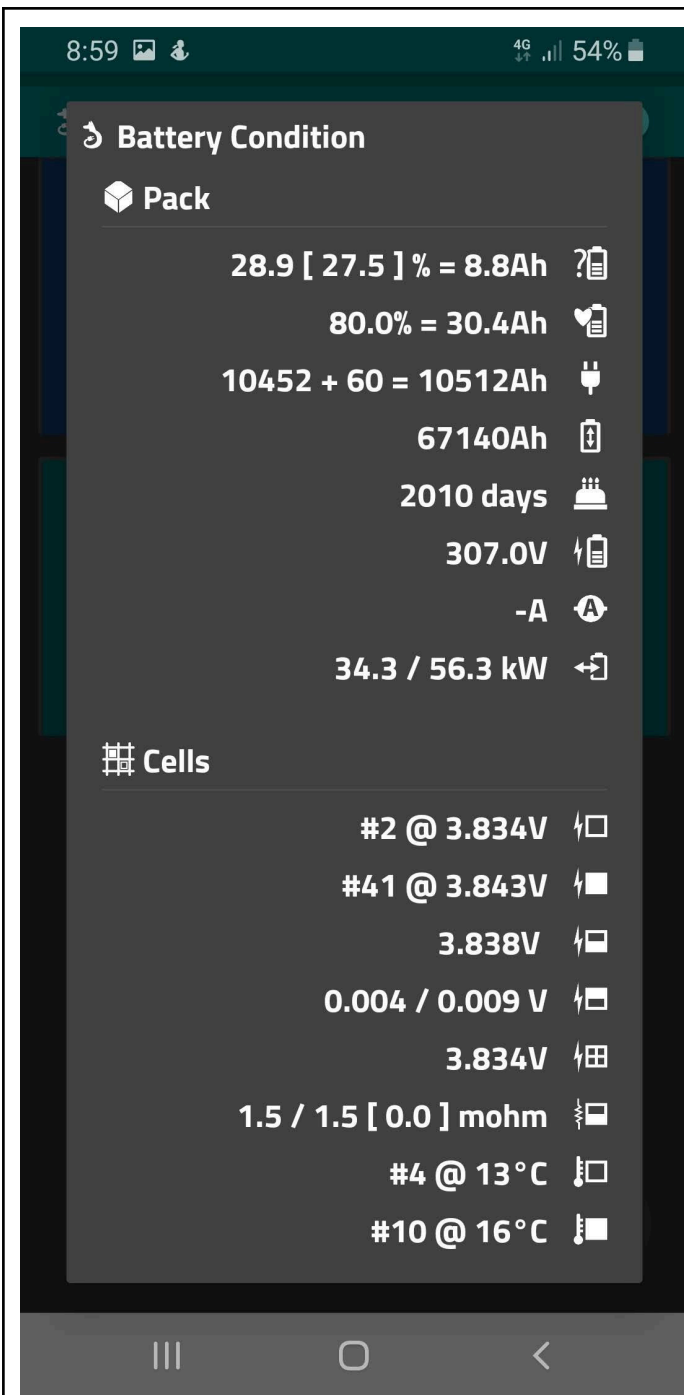
The green one

- State of Health (SoH) 30.4Ah.

SoC %age is calculated from SoH, in a 100% charged battery SoC = SoH but in empty battery SoC = 0% but SoH stays the same.

The battery's SoC is normally never absolutely 100% but very close to it. It is also sometimes over 100% right after charging stop but drops below 100% in a short time. It's believed this is due to inaccurate measurement and failure to adjust for the electrolyte diffusion effect.

No update is actually good (unless SoH increases). You'll get a new green card for every change in SoH observed, and only then. Between green cards you can get one red card or blue card (maximum and minimum SoC observed).



## Battery Condition List Expanded

Not shown here: Date, Odometer reading

Pack:

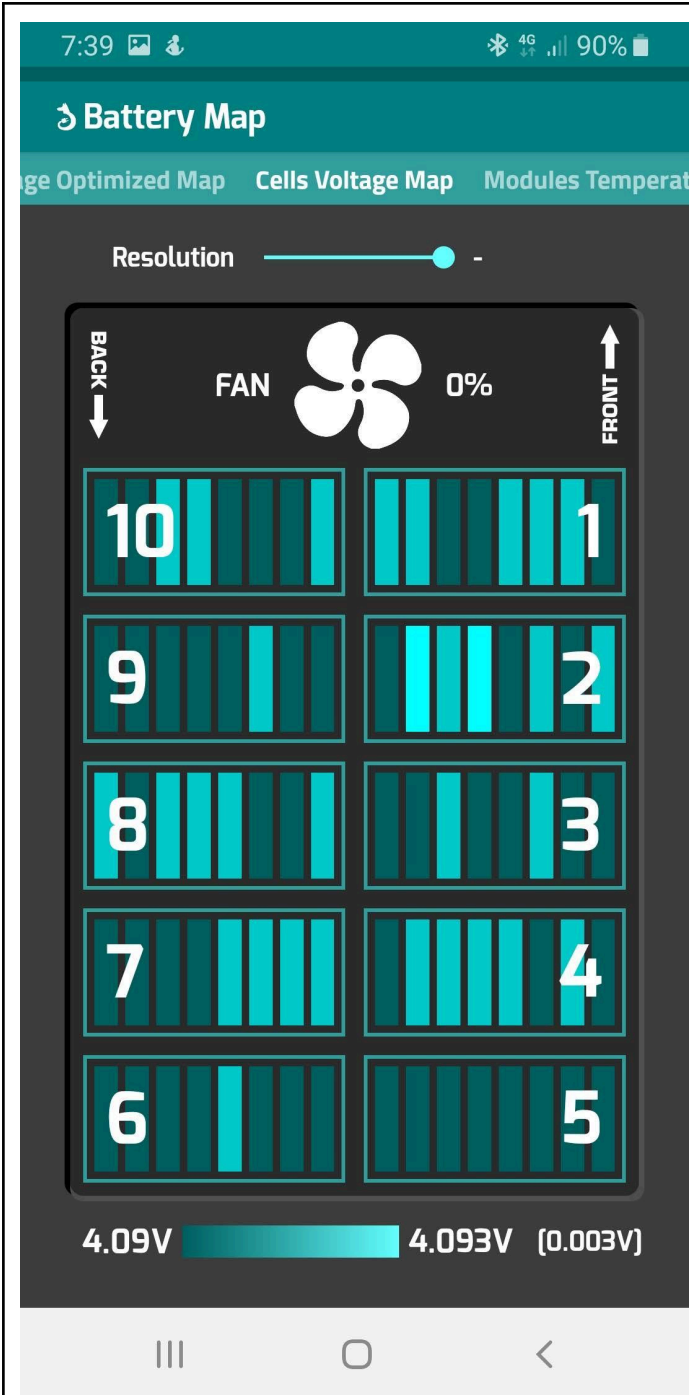
- State of Charge (SoC), actual charge
- State of Health (SoH), actual capacity
- Total current charged through AC/DC + DC/DC
- Total current charged and discharged since manufacturing
- Battery age since manufacturing
- Present Voltage - drive battery voltage
- Electric current of battery
- Max observed Input Power / Max Output Power

Cells:

- Cell with minimum Voltage, ID and value
- Cell with maximum Voltage, ID and value
- Cells average Voltage
- Max difference of (average-lowest) / (highest-lowest) cell Voltage
- Reference voltage with balancer driven (lowest battery cell Voltage)
- Min / max cell resistance (max difference between)
- 8-Cell Module with minimum temperature, ID and value
- 8-Cell Module with maximum temperature, ID and value

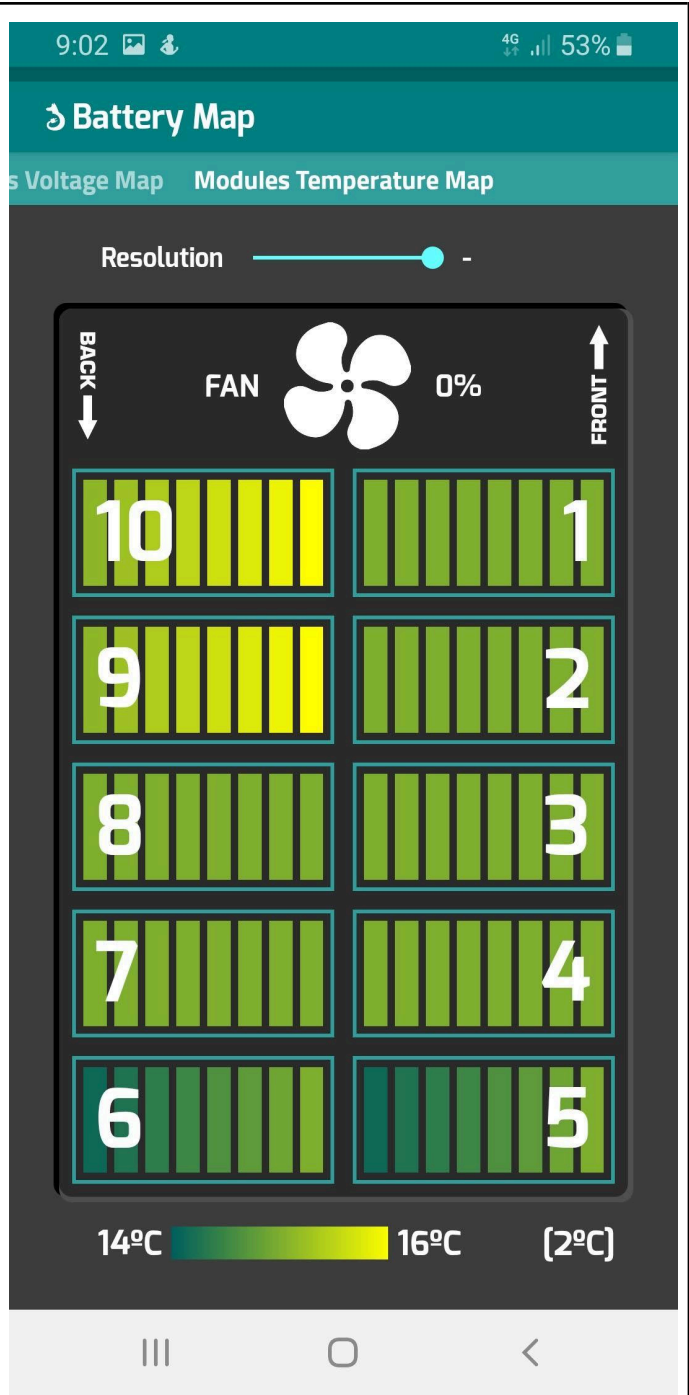
Other (not shown, scroll down in app):

- BMU Voltage of 12V system / Integrated Gate-commutated Thyristor power supply Voltage
- Cooling fan PWM output power



**Battery (Cell) Voltage Map**

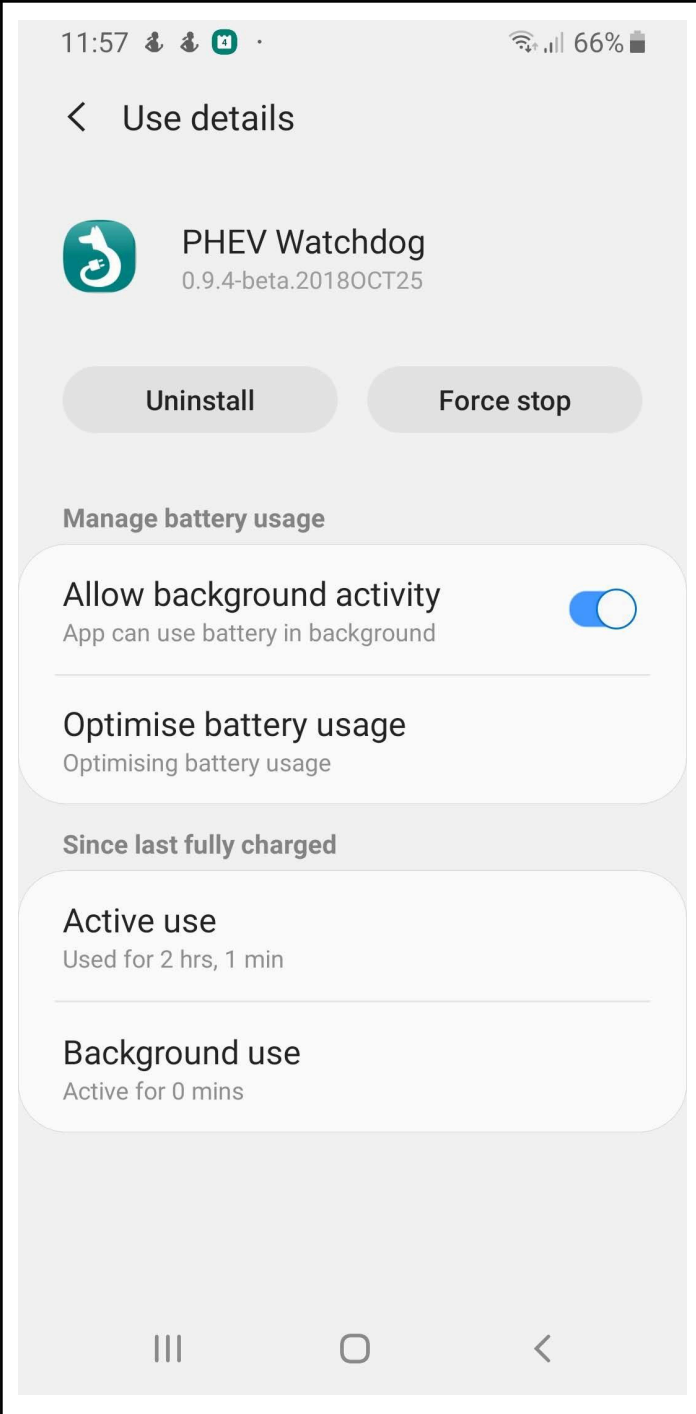
Pictorial representation of Cells' Voltages  
(resolution adjustable).



**Battery (Cell) Heat Map**

Pictorial representation of Cells' temperatures  
(resolution adjustable).



|  |  |
|--|--|
|  | <h2>App Power Management</h2> <p>It is recommended to change the power settings to allow the Dog to run in the background. From Android 6+ all apps are battery optimised.</p> <p>The expected PHEV Watchdog App behavior for the following situations are as follows:</p> <ul style="list-style-type: none"> <li>- OBD2 on / App on / mobile screen on - full function</li> <li>- OBD2 on / App on / mobile screen off - will most probably put Android in doze mode and suspended Apps unless background power settings are enabled.</li> <li>- OBD2 on / App on / focus on another app - will depend on your Android build + mobile resources available at the time.</li> <li>- OBD2 on / App on / focus on another app / mobile BT used for phone or music - will depend on your Android build + mobile resources available at the time.</li> </ul> <p>Android is designed to pause or kick Apps from the stack if resources are low generally and especially in favour of the foreground App. Some Android builds allow to prioritize or exclude Apps from this optimization. The Dog does require a bit of system resources as it pulls data constantly.</p> |
|--|--|