# Appendix G: Data Logger Operation & Sample Output

## Data logger Operation

The data logger records the operation and charging of the Marmot and makes this data accessible to its end user. The data logger will create detailed daily logs as well as update a summary log with daily summaries. All of the data is provided in comma separated value format (.csv) and can be opened with Microsoft Excel. The folder structure is described below.

|  |  |
| --- | --- |
| Folder | Description |
| Dailylogs | Contains all of the detailed logs; one file per calendar day. |
| Summary | Contains one file which has a summary of each day’s data. |

Once per second, the data logger records several variables that are transmitted on the vehicle’s CAN bus. The variables, their descriptions, and the units that they are measured in are listed below.

|  |  |  |
| --- | --- | --- |
| Variable | Descriptions | Units |
| Battery Voltage | The voltage of the battery packs. | Volts |
| Battery Current | Amount of current flowing into/out of the battery packs. Positive numbers indicate that energy is being used to operate the vehicle. Negative numbers indicate that the vehicle is taking energy (i.e. Charging). | Amps |
| Battery Power In | This is the product of the Battery Voltage and Battery Current when the vehicle is charging. Battery Power In is zero when the vehicle is operating. | Kilowatts |
| Battery Power Out | This is the product of the Battery Voltage and Battery Current when the vehicle is operating. Battery Power Out is zero when the vehicle is charging. | Kilowatts |
| Motor Voltage (AC) | AC Voltage at the motor. | Volts |
| Motor Current (AC) | AC Current at the motor. | Amps |
| Vehicle Speed | The speed of the vehicle. | Kilometers/Hour |
| Motor Speed (RPM) | The speed of the motor. | Revolutions Per Minute |
| State of Charge | State of charge of the battery packs (from 0-100%). | % |
| Charging | Is the vehicle currently charging? | Boolean (1 for Yes, 0 for No). |
| Operating | Is the vehicle currently turned on? | Boolean (1 for Yes, 0 for No). |
| Driving | Is the vehicle currently driving? (Speed is non zero). | Boolean (1 for Yes, 0 for No). |

Inside the daily log files, each row represents one second’s worth of data. The top of each day’s file also contains a summary of the day (or the day thus far). This summary is made up of variables that were integrated over time to produce the running sums. The following list describes the variables, how they are calculated, and the units that they are measured in.

|  |  |  |
| --- | --- | --- |
| Variable | Description | Units |
| Odometer | Total distance driven by the vehicle. This is calculated by integrating the vehicle’s speed over time. | Kilometers |
| Battery Energy In | The total energy that the battery has gained this day by charging. | Kilojoules |
| Battery Energy Out | The total energy that the battery expended this day. | Kilojoules |
| Hours Charging | Sum of the time that the vehicle has spent charging. | Hours |
| Hours On | Sum of the time that the vehicle has spent turned on. | Hours |
| Hours Driving | Sum of the time that the vehicle has spent driving. | Hours |

At the end of each day, the data logger will update the summary file with the previous day’s summary.

## Accessing Logs

The data logger files can be accessed in one of two ways – through Wi-Fi or Ethernet. Wi-Fi is recommended for ease of use.

To connect to the data logger via Wi-Fi, connect to the hot spot called ‘Marmot01’. The password is ‘Hardrock01’. The connection may state that it is ‘Limited’, ignore this warning. In File Explorer, open \\192.168.114.1\ to access daily logs and summary file.

To access the data logger through Ethernet, plug an Ethernet cable into the data logger’s outer enclosure. The file directory can then be accessed at 192.168.113.201; however you will have to set your own computer's IP to a static IP on the 113 subnet. In File Explorer, open [\\192.168.113.201\](file:///\\192.168.113.201\) to access daily logs and summary file.

Every few weeks move the data logger’s files to a directory on the computer, to free up space for more logs. If the data logger is low on space, it will automatically delete the oldest daily logs.

## Sample Output

A few lines of sample output for a daily log are provided below. It displays the vehicle accelerating from stopped to full speed and then coasting at full speed for a few seconds. The summary at the top of the file is for the full trip that the vehicle completed that afternoon (much more than the few seconds of operation displayed below).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Date | Odometer [km] | Battery Energy Out (Operating) [kJ] | Battery Energy In (Charging)[kJ] | Hours Charging [h] | Hours Operating [h] | Hours Running [h] |
| 2015-03-30 | 19.40776667 | 7.200587149 | 0 | 0 | 0.6275 | 0.545385559 |
|  |  |  |  |  |  |  |
| Time Stamp | **Battery Current [A]** | **Battery Voltage [V]** | **Battery Power Out (Operating) [kW]** | **Battery Power In (Charging)[kW]** | **Motor Current [AC A rms]** | **Motor Voltage [AC V rms]** |
| 13:05:38 | 0.8 | 313.77 | 0.251016 | 0 | 0 | 0 |
| 13:05:39 | 0.8 | 313.78 | 0.251024 | 0 | 0 | 0 |
| 13:05:40 | 0.8 | 313.78 | 0.251024 | 0 | 0 | 0 |
| 13:05:41 | 0.8 | 313.78 | 0.251024 | 0 | 0 | 0 |
| 13:05:42 | 0.8 | 313.79 | 0.251032 | 0 | 0 | 0 |
| 13:05:43 | 1.3 | 313.75 | 0.407875 | 0 | 11 | 4.875 |
| 13:05:44 | 62 | 310.04 | 19.22248 | 0 | 220 | 74.625 |
| 13:05:45 | 82.3 | 307.71 | 25.324533 | 0 | 172 | 138.6875 |
| 13:05:46 | 91.6 | 306.58 | 28.082728 | 0 | 143 | 176.0625 |
| 13:05:47 | 99.2 | 305.76 | 30.331392 | 0 | 129 | 205.3125 |
| 13:05:48 | 106 | 304.94 | 32.32364 | 0 | 120 | 235.4375 |
| 13:05:49 | 117 | 303.89 | 35.55513 | 0 | 117 | 267.5625 |
| 13:05:50 | 129.4 | 302.65 | 39.16291 | 0 | 116 | 275.8125 |
| 13:05:51 | 140.4 | 301.76 | 42.367104 | 0 | 124 | 265.8125 |
| 13:05:52 | 128.4 | 302.11 | 38.790924 | 0 | 122 | 277.6875 |
| 13:05:53 | 107.2 | 303.32 | 32.515904 | 0 | 116 | 279.8125 |
| 13:05:54 | 85.7 | 304.67 | 26.110219 | 0 | 99 | 287.5 |
| 13:05:55 | 72.4 | 305.5 | 22.1182 | 0 | 96 | 286.75 |
| 13:05:56 | 56.2 | 306.69 | 17.235978 | 0 | 88 | 288.0625 |
| 13:05:57 | 42.8 | 307.86 | 13.176408 | 0 | 78 | 276.375 |
| 13:05:58 | 36 | 308.31 | 11.09916 | 0 | 82 | 283.8125 |
| 13:05:59 | 33.1 | 308.53 | 10.212343 | 0 | 77 | 286.4375 |
| 13:06:00 | 37.9 | 308.71 | 11.700109 | 0 | 72 | 270.75 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Vehicle Speed [km/h] | Motor Velocity [RPM] | SOC [%] | Time Charging [h] | Time Operating [h] | Vehicle Run Hours [h] |
| 0 | 0 | 47 | 0 | 1 | 0 |
| 0 | 0 | 47 | 0 | 1 | 0 |
| 0 | 0 | 47 | 0 | 1 | 0 |
| 0 | 0 | 47 | 0 | 1 | 0 |
| 0 | 0 | 47 | 0 | 1 | 0 |
| 0 | 1 | 47 | 0 | 1 | 1 |
| 4.12 | 239 | 47 | 0 | 1 | 1 |
| 11 | 550 | 47 | 0 | 1 | 1 |
| 15.12 | 787 | 47 | 0 | 1 | 1 |
| 19.8 | 977 | 47 | 0 | 1 | 1 |
| 23.2 | 1157 | 47 | 0 | 1 | 1 |
| 26.11 | 1334 | 47 | 0 | 1 | 1 |
| 30.5 | 1516 | 47 | 0 | 1 | 1 |
| 33.12 | 1687 | 47 | 0 | 1 | 1 |
| 36.13 | 1839 | 47 | 0 | 1 | 1 |
| 38.14 | 1943 | 47 | 0 | 1 | 1 |
| 40.1 | 2004 | 47 | 0 | 1 | 1 |
| 40.13 | 2040 | 47 | 0 | 1 | 1 |
| 41.1 | 2053 | 47 | 0 | 1 | 1 |
| 41.1 | 2052 | 47 | 0 | 1 | 1 |
| 40.13 | 2041 | 47 | 0 | 1 | 1 |
| 40.7 | 2020 | 47 | 0 | 1 | 1 |
| 40.1 | 2004 | 47 | 0 | 1 | 1 |