

Estimating Battery SoC Using Voltage

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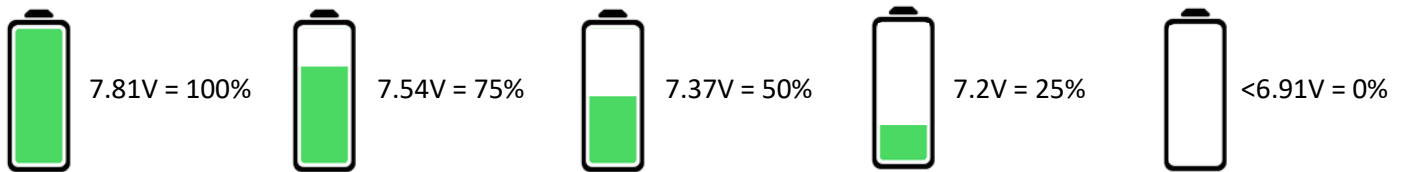
Calculations & Estimates

$$I^{Max}(mAh) = \frac{\text{Total Battery Capacity (V)}}{\text{Resistor}(\Omega)} * 1000 \rightarrow \frac{7.81V}{100\Omega} * 1000 = 78.1 mAh$$

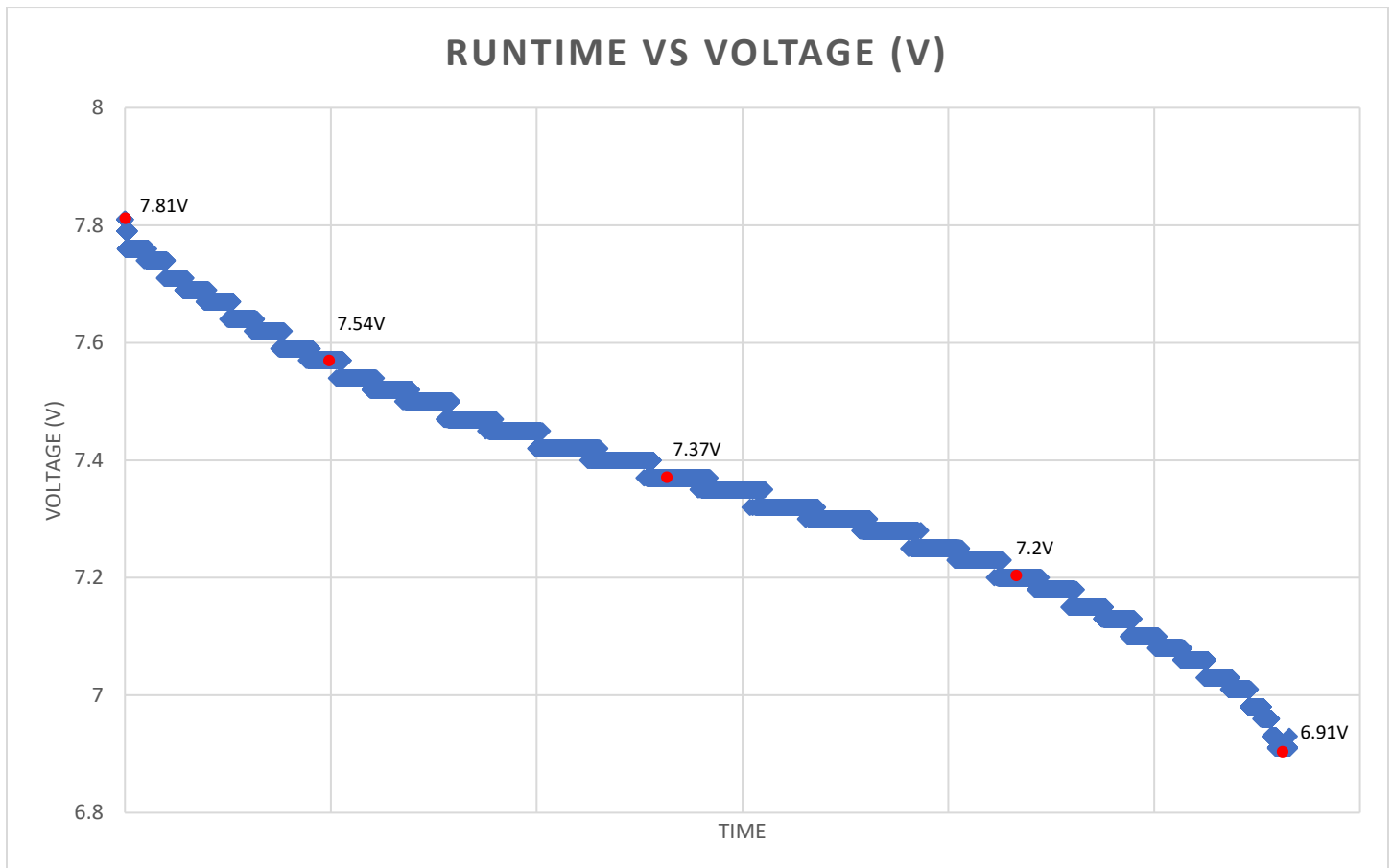
$$\text{Expected Runtime} = \frac{\text{Total Battery Capacity (mAh)}}{I^{Max} (mAh)} \rightarrow \frac{600 mAh}{78.1 mAh} = 7.68 \text{ Hours of Expected Runtime}$$

$$\text{Actual Runtime} = \frac{\# \text{ of Records}}{\text{Speed(hz)} * 3600 \frac{\text{seconds}}{\text{hour}}} \rightarrow \frac{145,572 \text{ records}}{10 \frac{\text{hz}}{\text{second}} * 3600 \frac{\text{seconds}}{\text{hour}}} = 4.04 \text{ Hours of Actual Runtime}$$

Visual Examples of Battery State of Charge Estimates Can be Made over the One Full Discharge Cycle



Assuming that we're discharging our 9V battery at a constant rate of 10hz with a 100Ω resistor, we found that one full discharge cycle lasts approximately 4 hours. Our results below, indicate that the battery died after reaching 6.91V in 4.04 hours so we'll utilize the length of time as our indicator over the battery's true state of change rather than its current voltage reading because the voltage readings do not decrease over a predicted decline to 0V.



Beginning Data Readings & End Results:

	A	B	C		A	B	C		A	B	C
1	Resistor	Runtime	Voltage(V)	40398		4807158	7.54	145543		17425560	7.28
2	10	1051	7.81	40399		4807277	7.54	145544		17425681	7.28
3		1167	7.81	40400		4807396	7.54	145545		17425805	7.28
4		1284	7.81	40401		4807515	7.57	145546		17425925	7.28
5		1400	7.81	40402		4807633	7.57	145547		17426045	7.28
6		1517	7.81	40403		4807753	7.54	145548		17426165	7.28
7		1633	7.81	40404		4807872	7.54	145549		17426285	7.28
8		1750	7.81	40405		4807991	7.57	145550		17426406	6.91
9		1865	7.81	40406		4808110	7.54	145551		17426527	6.91
10		1982	7.81	40407		4808229	7.54	145552		17426647	6.91
11		2099	7.81	40408		4808348	7.57	145553		17426767	6.91
12		2215	7.81	40409		4808467	7.54	145554		17426887	6.91
13		2331	7.81	40410		4808587	7.54	145555		17427008	6.91
14		2448	7.81	40411		4808706	7.57	145556		17427128	6.91
15		2564	7.81	40412		4808824	7.57	145557		17427249	6.91
16		2680	7.81	40413		4808943	7.54	145558		17427369	6.91
17		2797	7.81	40414		4809062	7.54	145559		17427489	6.91
18		2914	7.81	40415		4809182	7.54	145560		17427610	6.91
19		3030	7.81	40416		4809300	7.54	145561		17427731	6.91
20		3146	7.81	40417		4809419	7.54	145562		17427851	6.91
21		3262	7.81	40418		4809538	7.54	145563		17427972	6.91
22		3379	7.81	40419		4809658	7.54	145564		17428092	6.91
23		3495	7.81	40420		4809777	7.54	145565		17428216	6.91
24		3611	7.81	40421		4809895	7.54	145566		17428336	6.91
25		3728	7.81	40422		4810014	7.54	145567		17428456	6.91
26		3845	7.81	40423		4810134	7.54	145568		17428577	6.91
27		3960	7.81	40424		4810253	7.54	145569		17428697	6.91
28		4077	7.81	40425		4810370	7.54	145570		17428817	6.91
29		4194	7.81	40426		4810488	7.54	145571		17428937	6.91
30		4310	7.81	40427		4810607	7.57	145572		17429058	6.91
31		4426	7.81	40428		4810727	7.54	145573		17429181	6.91
32		4543	7.81	40429		4810846	7.54	145574		17429302	6.91
33		4659	7.81	40430		4810964	7.54	145575		17429422	6.91
34		4775	7.81	40431		4811083	7.54	145576		17429542	6.91
35		4892	7.81	40432		4811203	7.54	145577		17429663	6.91
36		5008	7.81	40433		4811322	7.54	145578		17429783	6.91
37		5125	7.81	40434		4811441	7.54	145579		17429904	6.91
38		5241	7.81	40435		4811560	7.54	145580		17430025	6.91
39		5357	7.81	40436		4811679	7.54	145581		17430145	6.91
40		5474	7.81	40437		4811798	7.54	145582		17430265	6.91

Source Code:

∞ Lab_15 | Arduino 1.8.16

File Edit Sketch Tools Help



Lab_15 §

```
#include <SPI.h>
#include <SD.h>
File myFile;

unsigned long runMillis;
int analogInput_vol = A0;
float vout = 0.0;
float vin = 0.0;
float R1 = 30000.0;    // Onboard resistor 1 value
float R2 = 7500.0;     // Onboard resistor 2 value
int svalue = 0;

void setup() {
    Serial.begin(9600);
    pinMode(analogInput_vol, INPUT);

    // Setting up & Initializing SD Card
    Serial.println("Initializing SD Card...");
    if (!SD.begin(4)) {
        Serial.println("Initializing failed!");
        while(1);
    }

    // Preparing SD card & file for writing
    SD.remove("log.txt");
    myFile = SD.open("log.txt", FILE_WRITE);
    // If File Successfully Opens, Write to File
    if (myFile) {
        myFile.println("Voltage(V)\tRuntime");
        Serial.println("Voltage(V)\tRuntime");
    }
    else {
        Serial.println("Error with initializing SD Card.");
    }
    myFile.close();
    delay(1000);
}

void loop() {
    svalue = analogRead(analogInput_vol);    // This reads the value from the sensor
    vout = (svalue * 5.0) / 1024.0;
    vin = vout / (R2 / (R1 + R2));

    Serial.print(vin); Serial.print("\t\t");
    runMillis = millis(); Serial.print(runMillis);

    // Opening the file for writing
    myFile = SD.open("log.txt", FILE_WRITE);
    if (myFile) {
        myFile.print(vin); myFile.print("\t\t");
        myFile.println(runMillis);
        Serial.println("\t\t\tData added/written to SD card");
    }
    myFile.close();

    delay(100);
}
```