The 250mAh, 15C, TEnergy battery was tested for compatibility with the NichDrop. The battery was discharged through a 1.73Ohm load over approx 9 minutes. The resulting discharge curve is shown in blue below.

Figure - Discharge of the battery over a 1.73 Ohm load

The low battery voltages are due to the battery’s internal resistance. The red line is the battery’s source voltage. That is, the voltage measured over its terminals plus the voltage drop over its internal resistor. The value of this internal resistor was calculated to be 0.50 Ohms.

To determine the internal resistance the following method was used. First, the no-load battery voltage was measured. Then the battery was attached to a known load of 1.73 Ohms and the battery voltage was measured again. The internal resistance was calculated with the following formula:

Where ILoad is the current through the load and Rs is the internal battery resistance. Table 1 shows the results of this experiment.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Battery** | **Vnoload** | **Vload** | **Rload** | **I** | **Vir** | **Rs** | **Avg Rs** |
| 1 | 4.15 | 3.09 | 1.73 | 1.786127 | 1.06 | 0.520627 |  |
| 1 | 4.145 | 3.22 | 1.73 | 1.861272 | 0.925 | 0.496972 |  |
| 1 | 4.139 | 3.244 | 1.73 | 1.875145 | 0.895 | 0.477297 |  |
| 1 | 4.127 | 3.199 | 1.73 | 1.849133 | 0.928 | 0.501857 |  |
| 1 | 4.128 | 3.221 | 1.73 | 1.86185 | 0.907 | 0.48715 | 0.49678 |
| 2 | 4.18 | 3.3 | 1.73 | 1.907514 | 0.88 | 0.461333 |  |
| 2 | 4.165 | 3.327 | 1.73 | 1.923121 | 0.838 | 0.43575 |  |
| 2 | 4.16 | 3.307 | 1.73 | 1.911561 | 0.853 | 0.446232 |  |
| 2 | 4.15 | 3.283 | 1.73 | 1.897688 | 0.867 | 0.456872 |  |
| 2 | 4.152  Table - Results from battery internal resistance calculations | 3.285 | 1.73 | 1.898844 | 0.867 | 0.456594 | 0.451356 |

Both batteries from the table were Single Cell 250mAh, 15C rated, Lithium Polymer batteries from TEnergy. The internal resistance taken to work with was the highest of the averages, 0.50 Ohms.

The critical voltage is the voltage below which the microprocessor will reset when the dropoff is activated. This voltage can be calculated using the formula below:

Where Vcrit is the critical battery voltage, Vmin is the microprocessor’s minimum operating voltage, INich is the current through the nichrome wire during the dropoff and Rs is the battery’s internal resistance. With Rs = 0.5Ω, Vmin = 2.0V and INich = 2.5A, the minimum value of Vcrit is 3.25V. This value is below the minimum battery voltage of 3.5V (for safe operation). Therefore, the value of Vcrit can be anything above 3.5V. Vcrit was chosen conservatively to be 3.6V and Vlow was chosen to be 3.7V.

Figure - Discharge of the battery over a 1.73 Ohm load

From Figure 2 it can be determined that the useable energy in this battery is approximately 200mAh. This equates to 4 years and one month with an average sleep draw of 5 micro amps.