Analysis of charge and discharge of a Solar Lithium Battery

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Abstract

The purpose of this research is to observe the behavior of lithium batteries when they are being discharged and recharged to compare the data obtained in the experiments with the data provided by the manufacturer. With the data acquired we will be able to design an energy backup system for refrigerators, so that when the energy system of the house is not available the refrigerator continues working.

Introduction

After Hurricane Maria passed through Puerto Rico in September 2017, it caused major damage to the island's energy system. These meteorological events caused the citizens of Puerto Rico to have no electricity for a long time. Without electricity the food and medicines that are stored in the refrigerators are exposed to rot or expiration which creates an unexpected situation for the citizens. The medicines that must be stored in refrigerators are damaged and this leads to having to buy more new medicines or find a way to keep medicines cold. So, refrigerators are an appliance of first necessity because in addition to storing the food and the medicines that are so necessary for some of the citizens of Puerto Rico. This allows us to use solar battery backup systems that are recharged with solar panels.

Objective

The objective of this research is to be able to observe the behavior of a lithium battery when it is in discharge and recharge to compare the observed behavior of the same with the behavior indicated by the manufacturer. An energy backup system for the refrigerators will then be designed, so that they can continue working efficiently once an incident occurs where the house energy system is out of service. This could solve the problem that medicines and foods that are stored in the refrigerator are not rotten or damaged.

Tools

- Voltmeter: it was used to measure the battery voltage
- Amperemeter: it was used to measure the battery's Amp
- Laser temperature sensor: it was used to measure the battery's temperature during the study and tests
- Lithium Battery (MO99)

Methodology

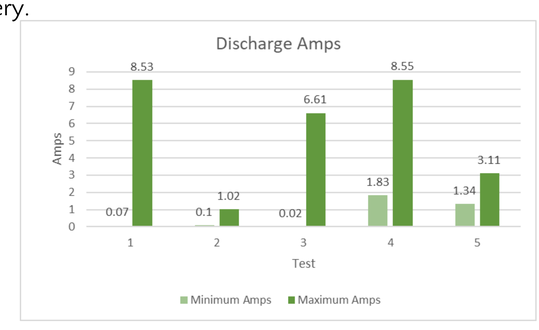
Hours	Charge %	Remaining charge percentage	temperature degrees F	Voltage	Voltage DC	Amps	Ampere Hours	Amps output	Watts output	Watt Calculated	Watt DC
5:30 p.m.	99.1	0.9	86.1	121	26.1	3.42	79.2	1.900826446	230	230	89.262
6:00 p.m.	91.1	8.9	85.4	121	26.1	3.4	72.5	1.859504132	225	225	88.74
6:30 p.m.	84.7	15.3	84.9	121	26.1	3.35	67.8	1.867768595	226	226	87.435
7:00 p.m.	78.4	21.6	84.9	121	26	3.39	62.8	1.867768595	226	226	88.14
7:30 p.m.	71.1	28.9	85.2	121	26	3.42	56.9	1.884297521	228	228	88.92
8:00 p.m.	63.5	36.5	85.1	121	25.8	3.48	50.9	1.867768595	226	226	89.784
8:30 p.m.	57.4	42.6	85.8	121	25.8	3.5	46	1.917355372	232	232	90.3
9:00 p.m.	50.6	49.4	84.3	121	25.7	3.51	40.5	1.900826446	230	230	90.207
9:30 p.m	43.8	56.2	84.3	121	25.7	3.5	35.1	1.900826446	230	230	89.95
10:00 p.m.	36.2	63.8	83.4	121	25.7	3.52	29.1	1.900826446	230	230	90.464
10.30 p.m.	30.5	69.5	83.4	121	25.6	3.49	24.5	1.884297521	228	228	89.344
11:00 p.m.	24.5	75.5	82.7	121	25.4	3.46	19.7	1.876033058	227	227	87.884

- Perform 5 lithium battery discharges up to 30% with a 3.1 cubic feet cooler.
- Perform 5 lithium battery discharges up to 30% with a 22 cubic feet cooler.
- Perform 5 lithium battery discharges up to 30% with a 28 cubic feet cooler.
- Perform 5 discharges of lithium battery up to 30% with a 22 cubic feet refrigerator, a fan and 4 led bulbs.
- Perform 5 lithium battery discharges up to 30% with a TV and 4 LED bulbs.
- Perform 5 recharges of the lithium battery with an electric generator.
- Perform 5 recharges of the lithium battery with a household receptacle.

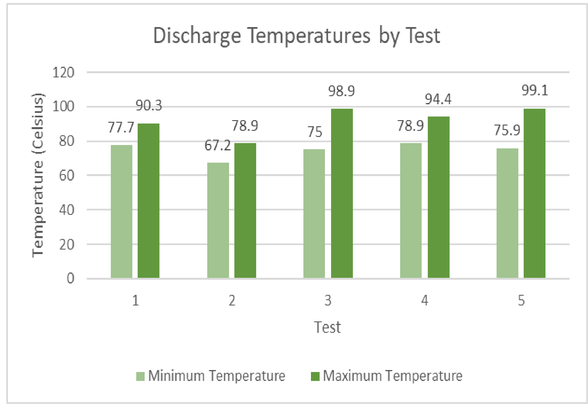
With each of the discharge and recharging experiments the following data will be taken:

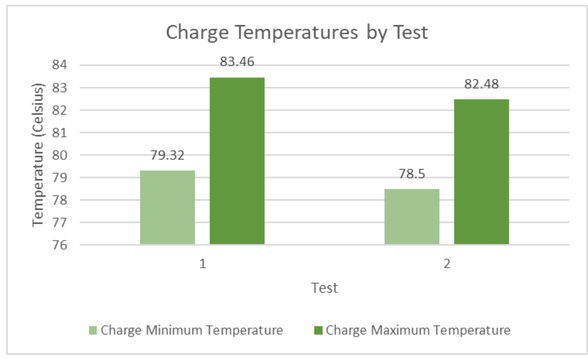
- Battery Voltage
- Battery Amperage
- Watts Output
- Battery Charge Percentage
- Temperature
- Amp Hours

With the data obtained we tabulated it in the Excel platform and created graphs to observe the behavior of the lithium battery.



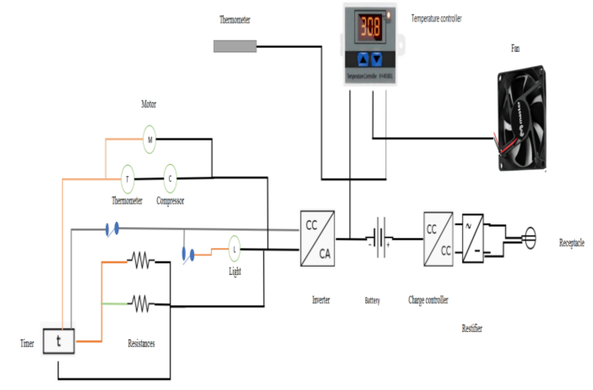
Data





Analysis and Results

The results obtained from the tests and the data provided by the manufacturer show a difference of 13.97% in the discharge time because the battery lasted longer than the manufacturer tells us. While in the recharge time it was shown that there is 0% between the data obtained from the tests and the data provided by the manufacturer because it lasted the time stipulated by the manufacturer.



Conclusion

According to the data obtained, we managed to observe that the behavior of the lithium battery agrees with the data provided by the manufacturer. With the results we designed three fully functional models of back-up systems for refrigerators.

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