

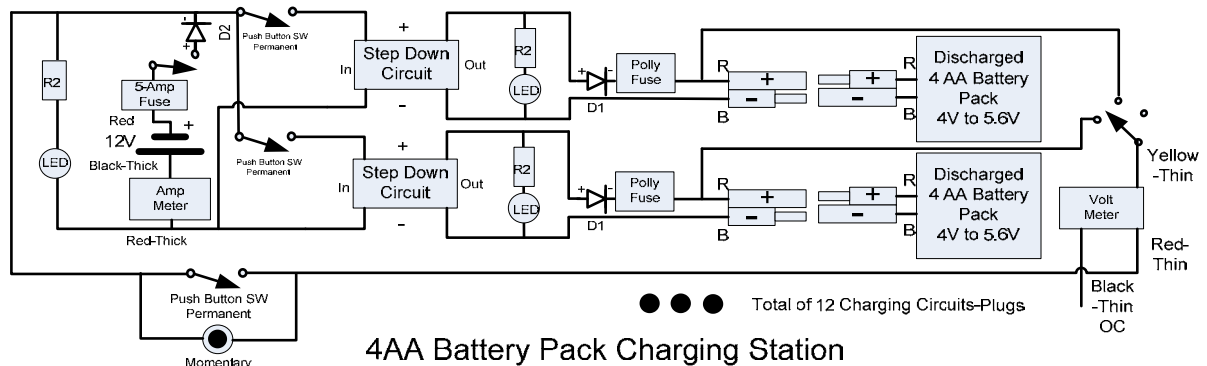
Battery Pack Charging Station

(5/12/2016)

12 Port NiMH Charging Station for 4AA cell bat packs

The idea is to have separate circuit for each battery pack. On-off switch on input. A rotary switch is for testing output voltages. Amp meter be on one test point of input circuit with chart showing charging output current if needed to use.

Be able to charge AA, AAA, D, and C individual cells. D2 is a 5 amp 1000v diode. D1 is a 3amp 20v Schottky diode. R2 is 30-50k ohm. No-12 step-down circuits were used. 5 amp resettable push button resettable fuse was added to positive side of input. Spacing about 1.25" between centers of charging units. A 0.9A 30v polyfuse is used to limit the flow in case of short circuiting the output.



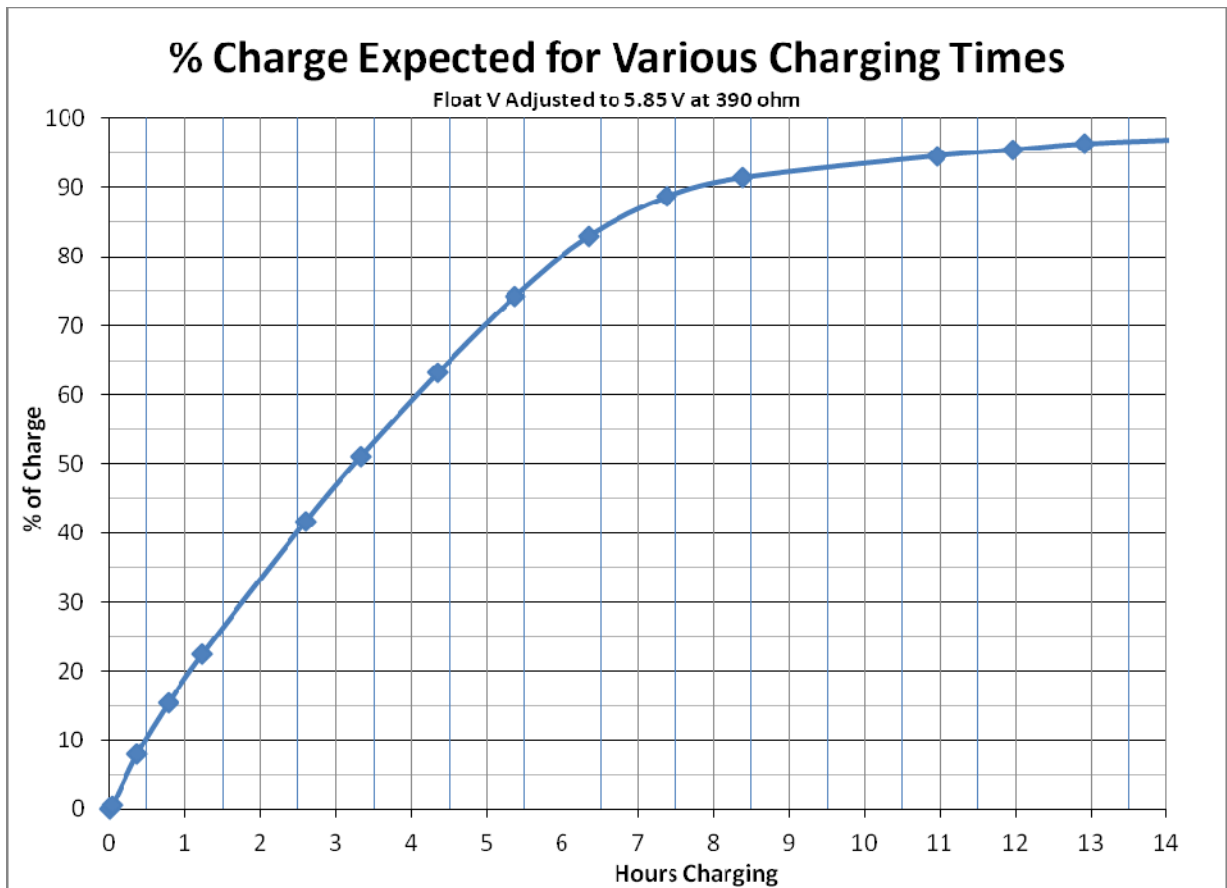
15 different Step down circuits were purchased from eBay and tested for workability and power conversion efficiency. No-12 was found to be the best. The circuit is described on eBay as “DC-DC 4.5V-28V to .8V-20V step down module power supply for arduino”. Currently sells for under a dollar. The pot was pried off with a knife blade and a 25 turn 100k ohm precision pot was put in its place.

No-3 volt-amp meter was use: EBay description of “0-33V 0-3A DC Voltmeter Ammeter 4 Bit Digital LED 12V”



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Float Voltage-Current Determination

Assuming one is charging old or new 4 NiMH emb 2200mah cells in series. Using this charger with the configuration it has ended up with, charging time around 24hrs or greater. Then the float voltage is best set using a 390 ohm resistor and adjusting the current to 10 ma. This done using fully charged cells. One ends up with a voltage of about 5.85 to 6.00 volts while the 390 ohm is still connected. With an open circuit voltage of 6.00 to 6.10 volts.

Theoretically float current can go to .05C. or 110 ma without heating it or loosing much lifetime. My target was to be less than 20ma when fully charged. In a primitive survival environment one doesn't like to waist power or life time of the cell.

I have tested float charging at 400 ma (130 deg F) for weeks a found that it does shorten the life of the cell. It took about 6 weeks for it to evaporate water out of the cell and kill it. I wouldn't float charge a cell at over 300ma (105 deg F) for vary long at a time. This is about .13C and seems to be the safe limit. Try not to heat the cell due to changing above 113 deg F or warm to the touch.

New cells tend to run a bit higher in voltage until broken in. They will increase in capacity for a while then start to decrease. Emb's will last for about 1000 charges (about 3 years if charged

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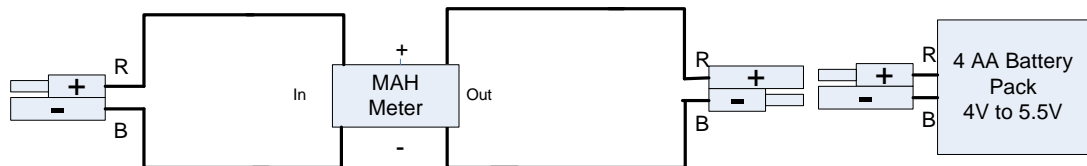
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each day). Better to not discharge totally each time. Expect some week cells to show up that will need to be weeded out during the beginning weeks.

The fully charged cell at 1.42-1.44 V will rapidly lose some of its charge (150-200mah) over the first week or so of storage. Then as time progresses it settles down into 18% loss of charge for each year of storage. So in a primitive environment as a general rule put the cells into immediate use as soon as you take them off the charger.

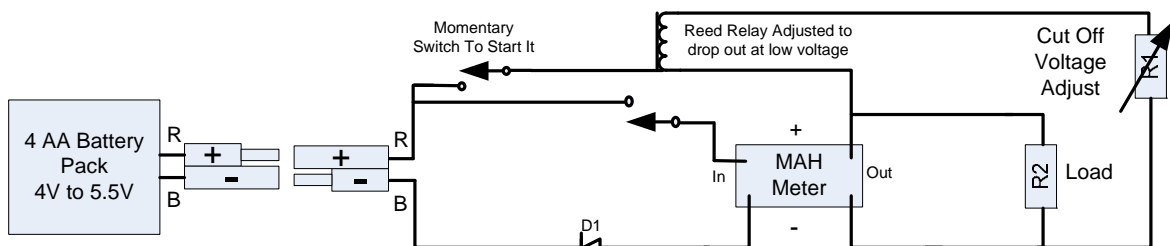
MAH Meter for Amount of Charge Measurements

A eBay “USB charger doctor capacity meter battery current voltage 3.5v-9v” mah measuring meter was used in the following circuits to measure how much charge the 4cell battery packs ended up with. The meter gets reset by pushing a button on the side when powered up. Unplugging it and repowering up does not reset it. The current needed to run the meter is 3.8 ma and is not measured by the meter.



USB mah Meter for Charging Measurements

The above is used with the charging station. The below is used after it is charged to discharge it and measure mah. R1 is used to adjust the voltage that the load drops out at. Use a 500 ohm 25 turn potentiometer. Adjust drop out (turn off) voltage to be 3 to 3.5 V. Note that 3.6 volts is 4 times .9 volts (lowest voltage one should go). R2 is the load 30 ohms. Use a spring loaded Togo sw dpdt for the start sw.



USB mah Meter for Discharging Measurements

D1 is a 3amp 20v Schottky diode. This protects against reverse polarity hook ups that would damage the mah meter. Decided not to use Diode D1 for it had too much of a voltage drop.

Adjustment procedure: Turn both pots to a low resistance. Turn up resistance on R1 pot controlling the input to the meter until it just turns off the power at about 3 to 3.5 v. Check it by going high and toggling the momentary switch and turning voltage down the voltage to arrive at power off V.

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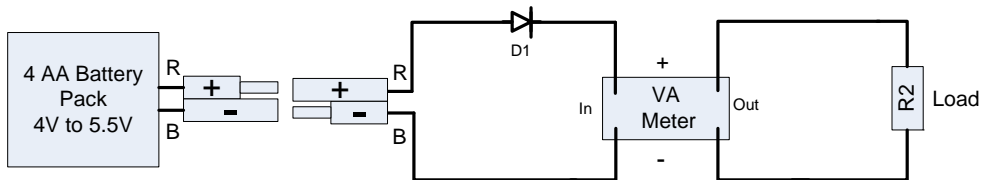
Note: The voltage drop across the meter at .1 amp is about .02 V from input to output. The turn on voltage is anything above about 4.2 Volts. The turn off is at or below 3.2V.

From spreadsheet analysis of fully charged battery packs, tested by discharging using USB-mah meter circuit above. On the average for a full charge results in a USB meter reading of 1776 +/- 125 mah and that the actual is 1.258 times this or about 2234 mah for emb AA NiMH cells.



USB-VA (volt amp meter) for measuring bat PK State of Charge

A eBay “USB Amp Volts Current Digital Meter” meter was used in the following circuit to measure how much charge the 4 cell battery packs ended up with. R2= 30 ohms. VA meter is a USB volt amp meter.



USB-VA Meter for Discharging Measurements

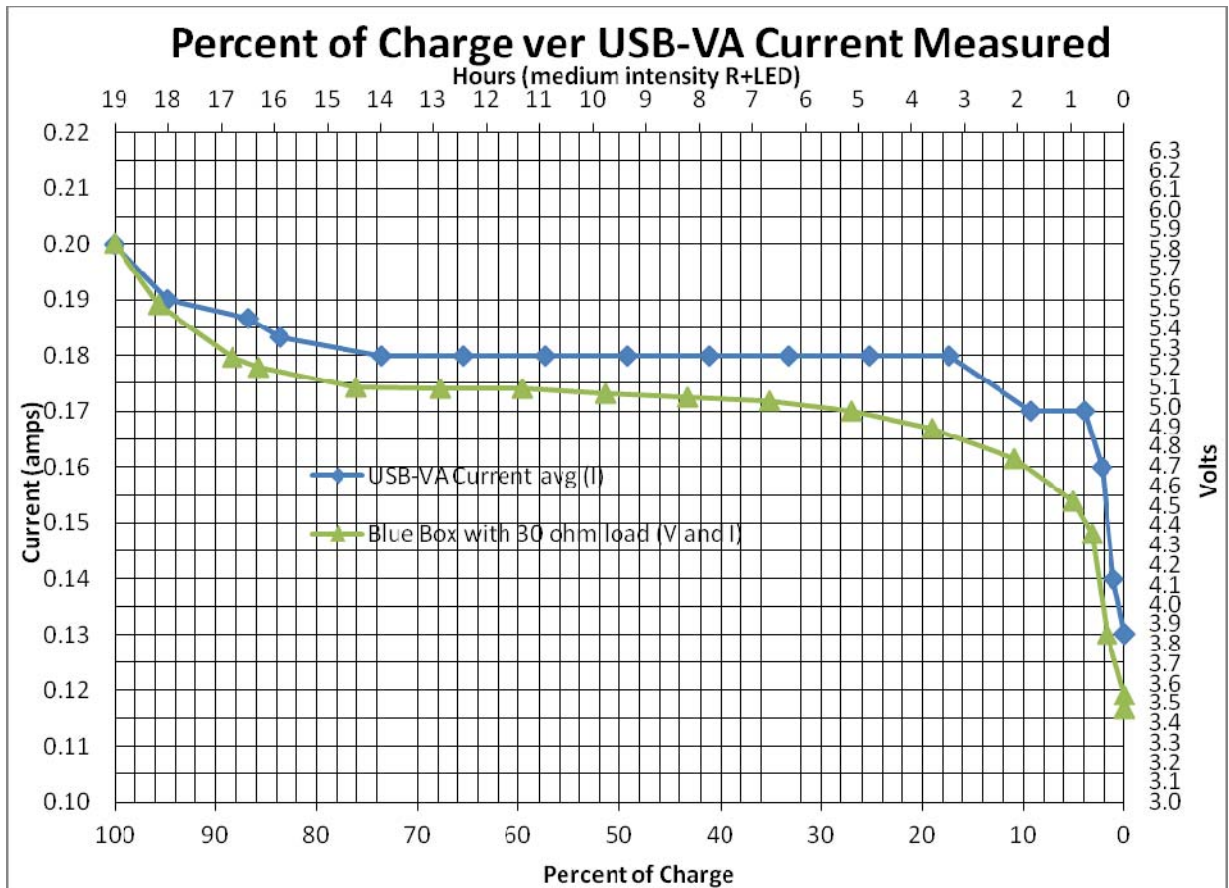
D1 is a 3amp 20v Schottky diode. Decided not to use Diode D1 for it had too much of a voltage drop.

The USB-VA meters for a full charge resulted in an average reading of 5.70v +/- .063v at .20 amp when plugged into a fully charged battery pack.



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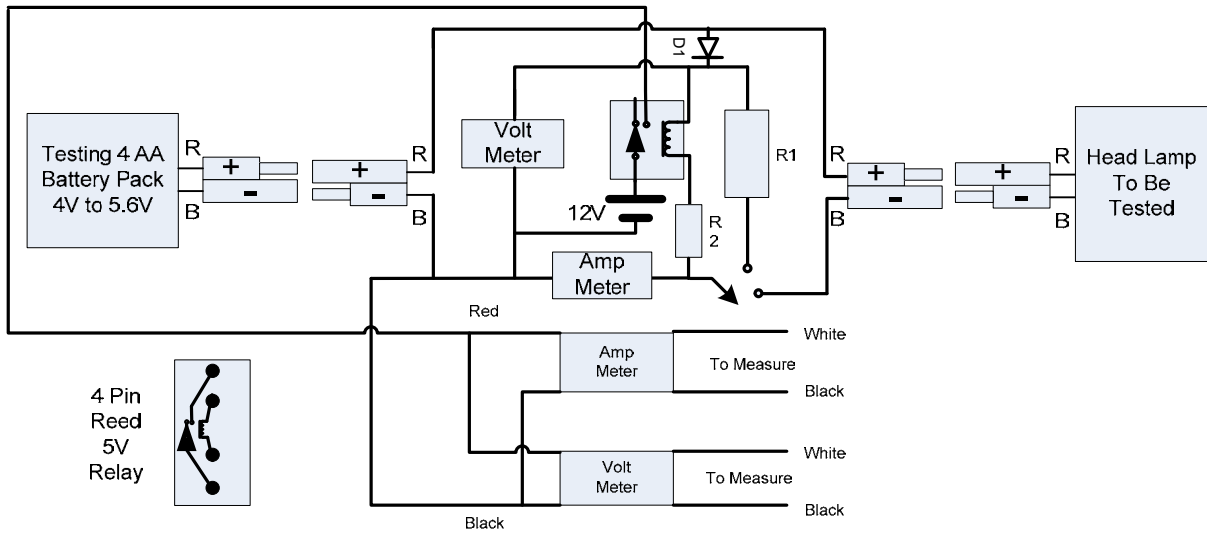


A 4AA Cell Battery Pack Tester (The Blue Box)

Measuring discharging current and voltage is the only sure way to measure state of charge. This measures discharge current and voltage into a 30 ohm resistor. If the current is lower than expected and voltage is higher than usual then suspect a bad connection in the bat pack being tested. A reed solenoid is used to turn on the meters when the bat pack is plugged in to be tested. R1=30 ohms 6 watt. R2= 150 ohms .5 watt. R3=33kohm for LED pilot light. The 12 volt internal battery is made up of 8-AAA cells and needs recharging about every 100 hrs of run time. Decided not to use Diode D1 for it has too much of a voltage drop.

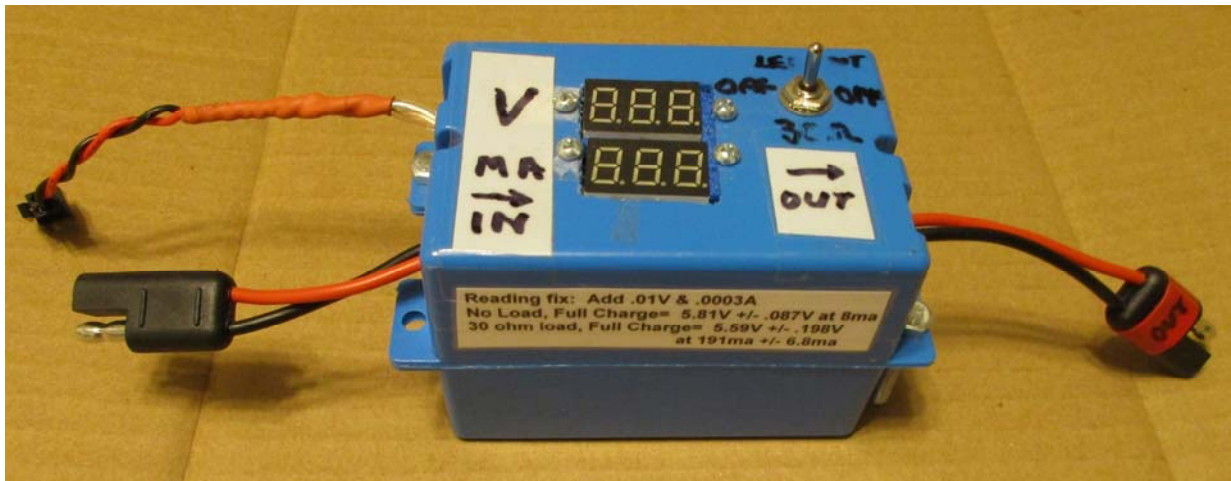
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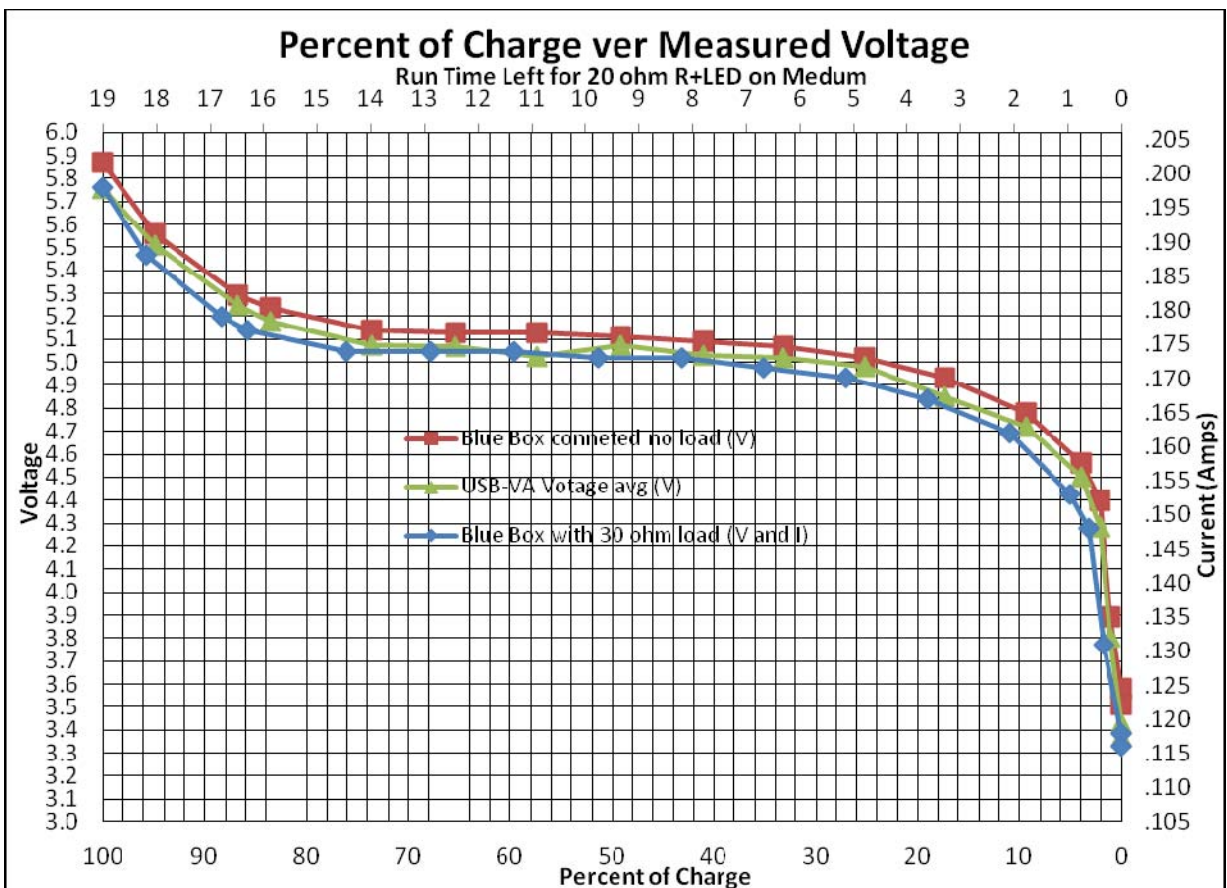
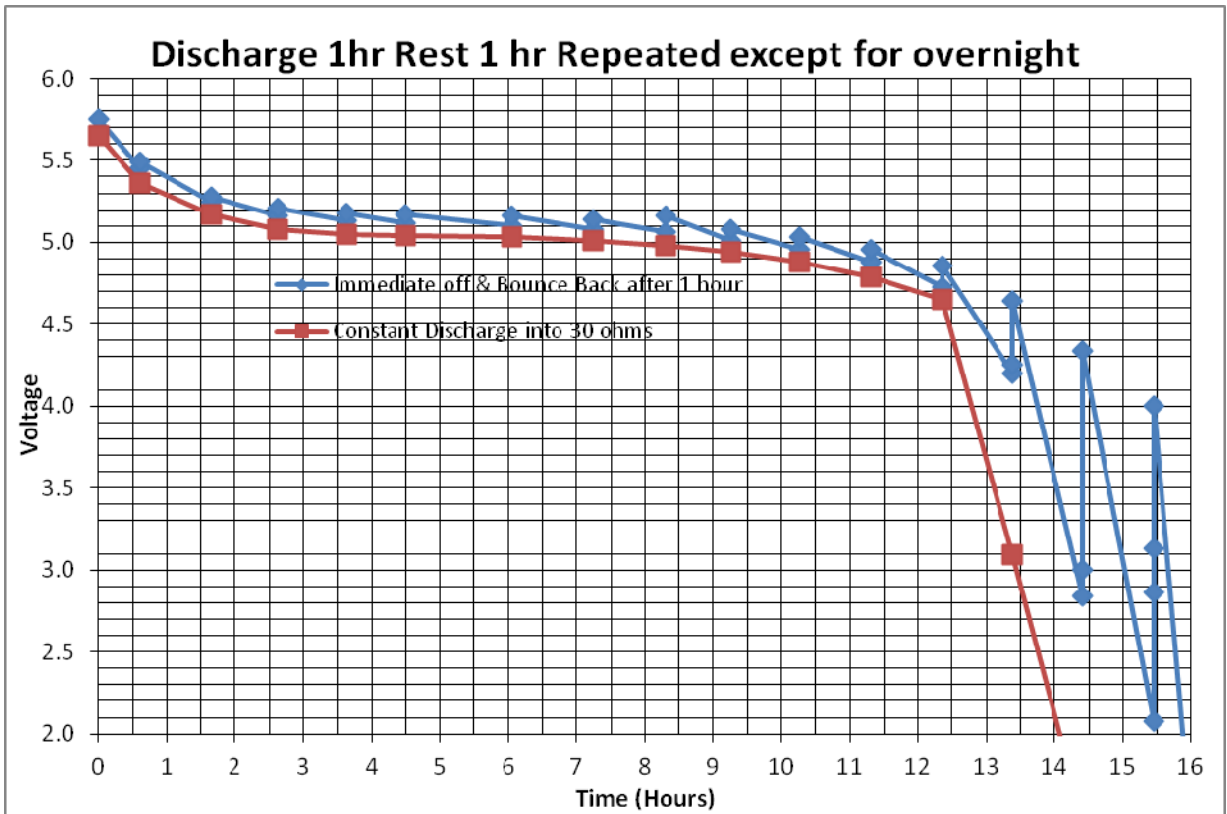
4 AA Cell Battery Pack Percent of Charge Tester using 3-digit wall mount amp and volt meters

For a full charged battery pack, the blue box gave an average reading of 5.81v +/- .087v for no load and 5.59v +/- .198v at 191ma +/- 6.8 when the 30 ohm load is in the circuit.



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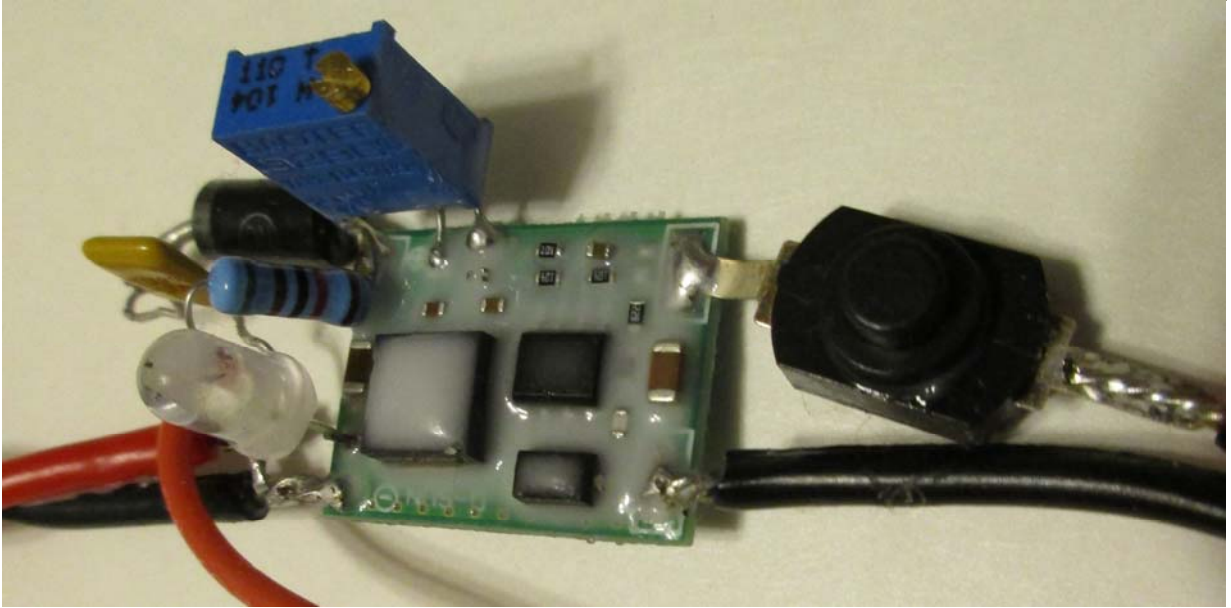
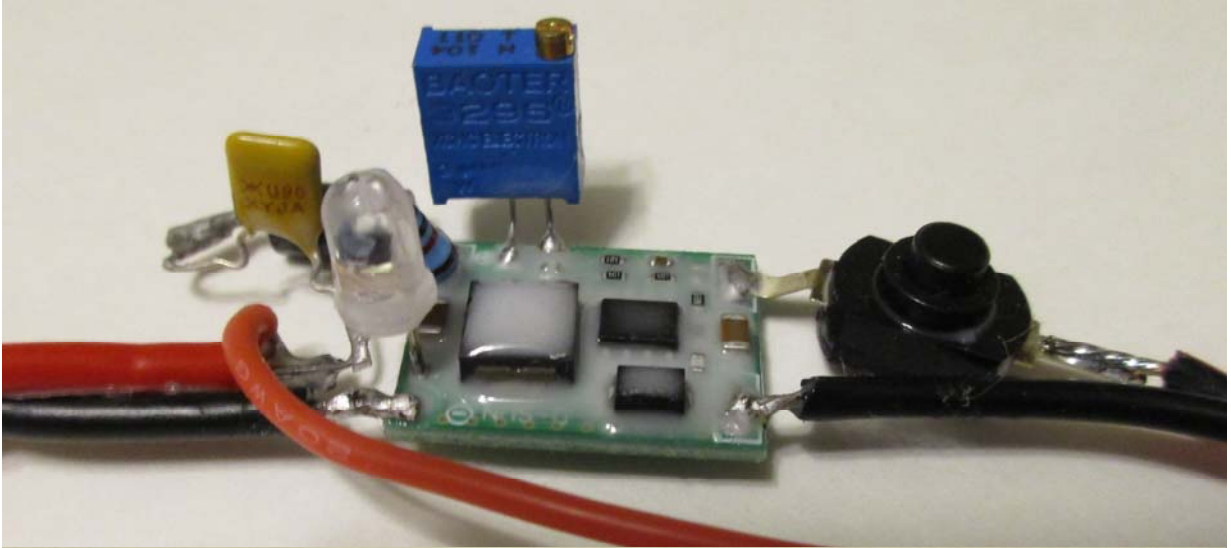
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Close up of the Circuit modificaitons



Silicon rubber was added to seal it from water. The type I silicon works well and has a high resistance.