COMPARISON OF METHOD FOR CHARGING ULTRACAPACITOR

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Abstract - **Different charging methods are studied in the paper. In this there is a comparison for charging methods of ultra capacitor. Four methods are explain for comparison of ultra capacitor-Constant current charging method, Constant voltage charging method, Bulk charging method. In this paper the comparison of charging for ultra capacitor on the basis of time and efficiency has been explained. Each charging method has different procedure and has its own advantages and disadvantages.**

I. INTRODUCTION

Ultrcapacitor is an efficient energy storage device [1]. In 1957, General Electric engineers first noticed the electric double layer capacitor effect while experimenting with devices using porous carbon electrode. In 1966, the researchers at Ohio accidently discovered again the effect while working on experimental fuel cell designs. Regarding with the advances made on both materials and manufacturing process, Tecate Group Power Burst® product showed a superior advantage amongst all other ultracapacitors in the market. Today the high performance characteristics of Maxwell Technologies' ultracapacitors allow the system designer to develop hybrid power system solutions that cost less and perform better than non-hybrid solutions.

Ultracapacitors have very high capacitance, in the range of hundreds to thousands of farads. Compared to other capacitors, the ultracapacitors have higher energy density but when put against batteries or fuel cells, they cannot stack up well. Although ultracapacitor have very low energy density than batteries, they have special applications when large power peaks are to be supplied for a very short duration. Ultracapacitors first worked as 'support' to batteries. Attractive features of ultracapacitor are: higher power handling capacity and much longer shelf and cycle life than batteries. Long considered an enigma because of price, the advent surface area, excellent conductivity, high power density, and superior chemical and physical stability, herald a new era of practical usage. The advantages of using ultracapacitor technology are quite extensive. It is beneficial because of very high efficiency, high current capability, wide voltage range, wide temperature range, condition monitoring (state of charge and state of health), long cycle life, long operational life, life extension for other energy sources, ease of maintenance and straight forward integration. These ten reasons gives additional flexibility. Batteries cannot be charged and discharged at similar high rates like ultra capacitors.

Ultra capacitors are also known as super capacitors. Two main types of ultra capacitors are pseudo capacitor and double layer capacitor. Their structures are somewhere like a battery, which contains electrolyte with electrodes immersed. The positive and negative electrodes are separated by a separator. The electrodes are made with porous.

2. METHODS OF CHARGING

1.1 Constant voltage charging

Constant voltage charging is also known as constant potential charging . This method is used to maintain the same voltage input to the ultracapacitor throughout the charging process, regardless of the ultracapacitor's state of charge .

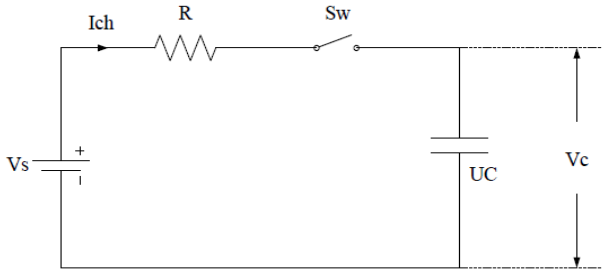


Fig -1: (a) Circuit for realizing constant voltage source where, Vs= Source Voltage, Ich= Charging Current, R= Resistance, Sw= Switch, UC= Ultracapacitor, Vc= Charging Voltage.

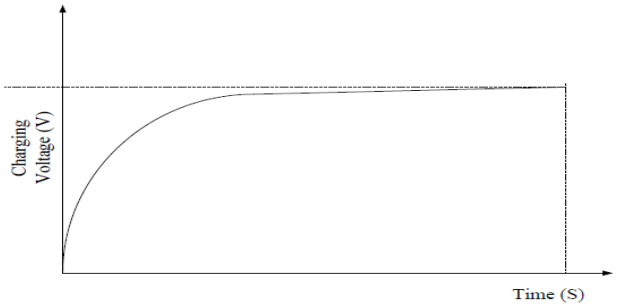


Fig -1: (b) Constant voltage charging

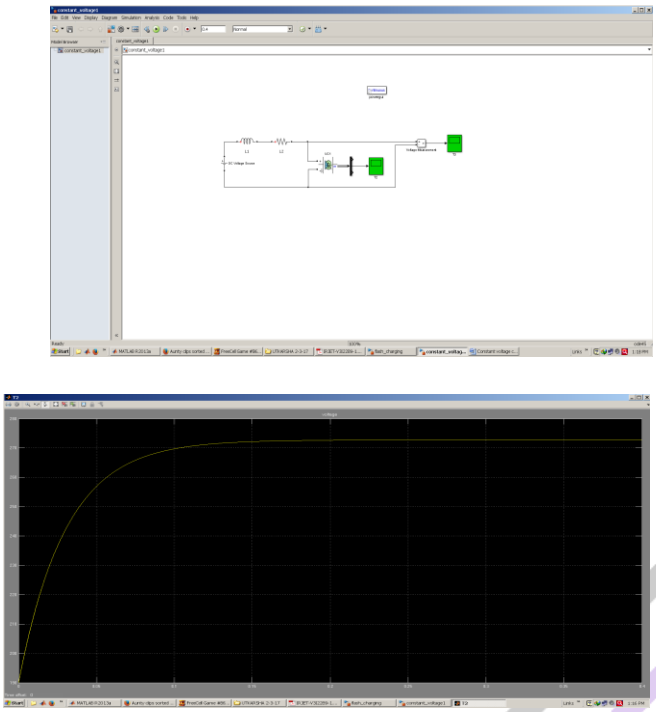


Fig 1(c)-Matlab simulation of constant voltage charger

1.2 Constant current charging

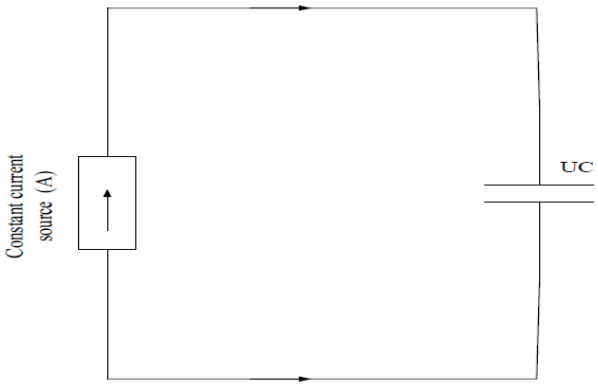


Fig 2: (a) circuit for realizing constant current source.

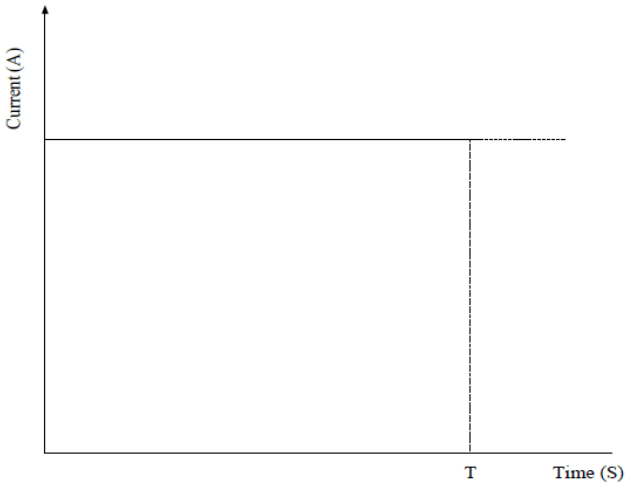
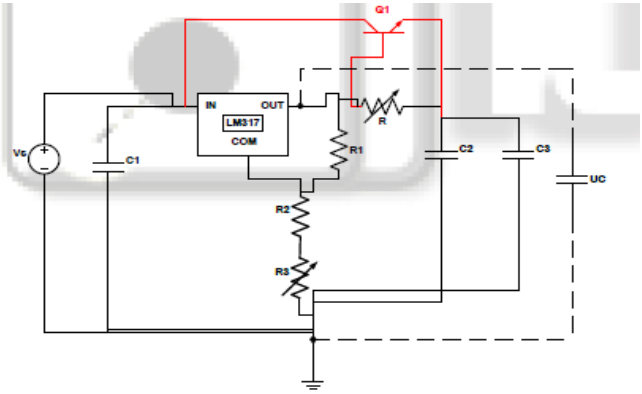


Fig. 2: (a) Constant current charging

In Constant current charging method supplies a constant current.Depends on ultracapacitor's temperature and state of charge .where an ultracapacitor is often required to obtain a full charge overnight. It varies a voltage to maintain a constant current flow.

1 MIN	2.30
2	3.43
3	4.65
4	5.72
5	6.66
6	7.75
7	8.75
8	9.75
9	10.57
10	11.46

1.3 Bulk Charger



Ultra capacitor is capable of receiving wide range of charging current.And it consists of LM317 IC transistor Q1.The LM317 voltage has a resistance divider R1 R2 R3.Q1 is connected to internal circuit for supply of more current.C1 C2 C3 filtered out the ripples.

TIME[MIN]	VOLTAGE
0	8.9
1	9.67
2	10.15
3	10.61
4	11.03
5	11.41
6	11.76

IV. CONCLUSION

The charging of ultra capacitor in less time is much necessary in electric vehicle industry. In this paper constant current and bulk charging is compared on the basis of time and efficiency. The comparison of other method on the baisis of time and efficiency is explained further.

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