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Application of Supercapacitor in Ride through Condition

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***Abstract*—** At present, energy storage devices plays vital roles; due to radial is development in their properties and control scheme. The super-capacitor play an important role due to varied applications, because it can supply high power for significant amount of time and can be charge more quickly, also the super capacitor is an efficient storage that offers fast charging and discharging ability and with high reliability . In this paper we are going to concentrate on various parameters of super capacitor i.e. equivalent circuit and also application of the super capacitor for ride-through power demand. This Paper introduced a combined working of Supercapacitor and battery is studied by using MATLAB Simulink.

***Index Terms*—** Ride through, Supercapacitor.

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I. INTRODUCTION

Recently, the research work is going in the field of energy storage device. The some of the storage device are supercapacitors, flywheel etc. Supercapacitors or ultracapacitors are also known as electrochemical double layer capacitors. Supercapacitors have the advantages of large power density, fast charging or discharging with high current rates, and long cycle life. Although they have poor energy density, they are an interesting choice for energy storage for applications where high power is needed for only a few seconds, such as pulse-power supply system's [4]. The difference between lead acid battery, conventional capacitor and supercapacitors are listed in tabulated form .This is taken from [3].also the Supercapacitor require no or less maintenance.

With such advantage of supercapacitors, over other conventional capacitor and battery the combined working or individual working of it is of main interest. The supercapacitors are mainly used in ride through condition.
Ride through condition means the requirement of large amount of power for the short time duration.it can be also explained as; consider an example of generator as a backup System during normal condition the main source supply the power to the system. When mains goes off generator start but it require some few sec of time to supply power the span of this few sec is called as ridethrough.for the few second of time we can use supercapacitors.

Available performance	Lead acid battery	Conventional capacitor	Supercapacitor
Charge time	1 to 5 hrs.	10^{-3} to 10^{-6} s	0.3 to 30 s
Discharge time	0.3 to 5 hrs.	10^{-3} to 10^{-6} s	0.3 to 30 s
Energy(Wh/Kg)	10to100	<0.1	1 to 10
Power density	<1000	<100000	<10000
Life cycle	<1000	>500000	>50000
Charge/discharge efficiency	0.7-0.85	>0.95	0.85 - 0.98

TABLE 1.

II. BASIC Block diagram

In this paper, we are analyzed the combined working of battery and Supercapacitor. We are familiar about the various use of battery in many applications like electrical Vehicles, UPS etc. In the comparison of battery and Supercapacitor is as shown in TABLE 1. From the analysis table, Supercapacitor is very efficient as compare to battery.

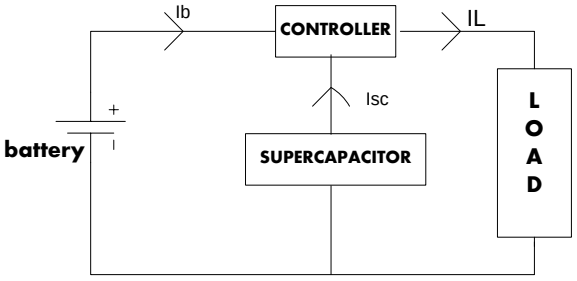

Fig.1. Basic block diagram

In this scheme the working of Supercapacitor and battery is studied individually and combinely. The main concept of this scheme is that the battery should be protected during extreme condition. The scheme consists of three main components battery, Supercapacitor, controller etc.

Case I- During normal running condition i.e. during normal load condition, the supply to the load is given from battery. In this case the total load current is equal to the total current supplied by battery. In this case the battery should not be overloaded. For this case the working of controller is that it Passes supply to load from battery and Supercapacitor remains in charging mode.

Case II- this case is for abnormal condition, the current requirement to load is much higher than the input supply.so during abnormal condition the extra energy is supplied from supercapacitor.in this case the total load current is the sum of battery current and Supercapacitor current.

III. CONTROL CIRCUIT:

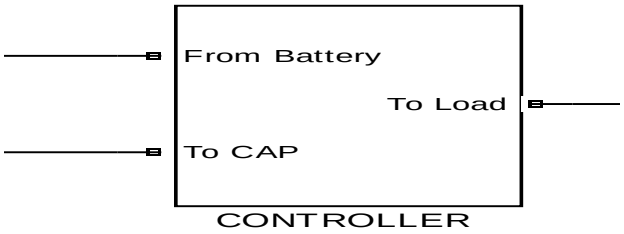

Fig. 2. Controller circuit

The purpose of controller is to operate as a automatic switch between supercapacitor and battery.The controller used is microcontroller. Most probebaly the action of the controller is based on the condition at load side.As meintined in basic control scheme caseI,case II. Figure 3 indicate the operation of controller.

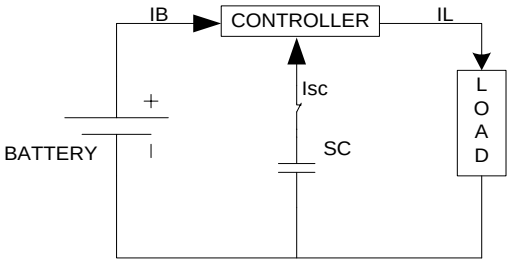

Fig. 3 basic operation scheme

During case I the controller acts as a open switch.,As shown by off conditon in figure 3 .for case II controller acts as closed switch as showen by on condition. what controller do is, it cmopair the load current with a reference value proviede,if the load current exceed the reference value the controller take supercapacitor in circuit and additional energy is supplied by supercpacitor.Thus battrery is procted from extrem condition.

The another function of controller is to monitor battery voltage and supercapacitor voltage.During charging mode,controller maintain the capacitor voltage in specified reference limit. If voltage level exceed the reference value then charging circuit cutoff, while if voltage level goes below reference value then the charching circuit comes in service and start charging the capacitor.

The other condition we consider, when load is increase to the high value such that both battery and capacitor unable to supply the load then controller should cutoff both battery and capacitor from circuit.

IV. Matlab Simulation:

The MATLAB model shown above contains four part battery, Controller, supercapacitors and resistive load. For simulation Purpose the battery used is lead acid battery with rating of 9 volt. The supercapacitors used are of rating 10 F, 2.7 volt .the complete simulation is carried out by considering resistive load only. And the performance of both battery and capacitor are studied.

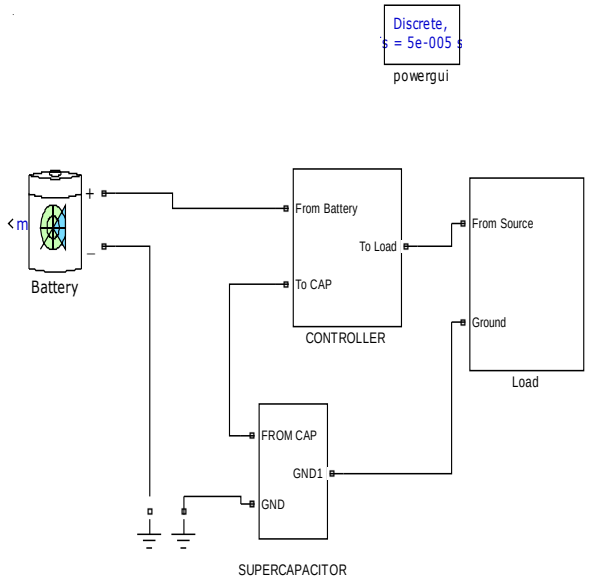

Fig. 4 Matlab model

In this model, we analyzed the individual working of battery and supercapacitors only. During abnormal condition supercapacitors Comes in service and battery goes out of service .The complete simulation result is discussed in later section

V. Simulation result:

The graphs below show the MATLAB Simulink results for working of battery and supercapacitors. Starting from top the first two graphs indicate load current and load voltage. In this model load used is completely a resistive type. The load applied for duration of one second.as shown from graphs. For second 2-3 and 5-6 the load is applied .but the difference is that at next level the load is increase. So that the current requirement by load is more.

The graphs third and fourth represents the input voltage and source current. The graphs 5th and 6th represent the supercapacitors voltage during discharge condition and supercapacitors current during load condition.

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As indicated in graphs during load condition, the current requirement at load is increase. Controller comes in picture and it brings supercapacitors in service. During time period 2 to 3 sec, the load increases in that case the Additional energy is supplied by supercapacitors to load and for this movement battery is out of service, as shown by graphs in fig.5

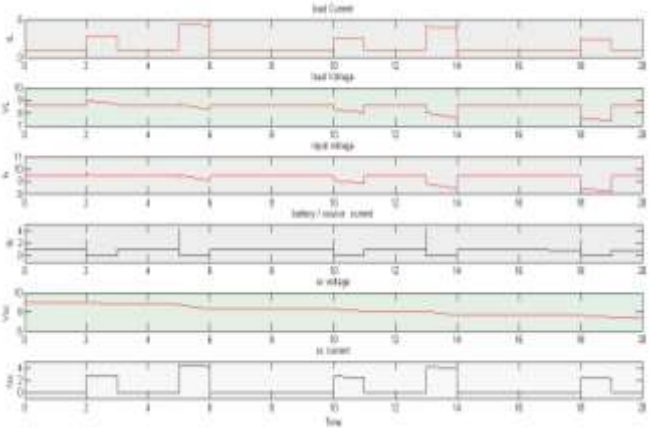
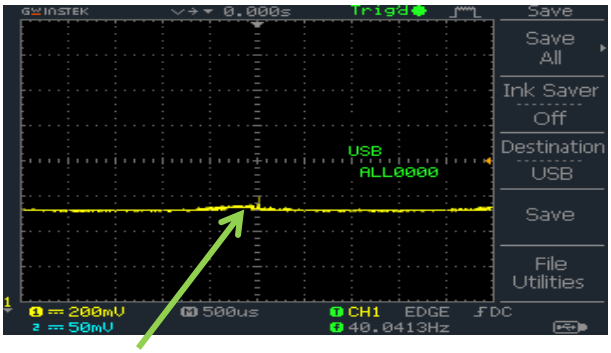


Fig 5 simulation results

VI. Hardware model and results:

VII.

Fig6.Actual hardware model



Load current

Fig6 Motor current

Fig.6 motor current and Supercapacitor current graph during switching

VIII. Conclusion

Thus in this paper we concentrated on the operation of supercapacitors during ride through condition. With the help of supercapacitors the life of battery is increase. By using this combination the overall characteristic of battery is improved and the performance of battery is improved.

The use of Supercapacitor and battery together as well as individual improve the system performance. References

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