

## **Abstract**

A supercapacitor is an energy storage device which has high power density, longer life cycle, higher operating temperature range and fast charging and discharging time. In present work charging performance of a supercapacitor bank attached with a solar photovoltaic system has been studied. Since solar power is very much dependent on the climatic conditions, it is very important to maintain high charging efficiency during charging process of the electrical energy storage elements attached with PV system.

This study includes charging and discharging characteristics of supercapacitor bank, charging performance of the supercapacitor bank in MPPT (maximum power point tracking) and in direct (without MPPT) mode. A comparison has been done for both the charging modes. For efficient charging of a supercapacitor from solar PV module a charge controller is designed with maximum power point tracking (MPPT), by which supercapacitor can be charged in shortest time. For achieving our objectives the whole system is simulated in MATLAB/Simulink simulation software. From the simulation results we have compared the performance of both charging systems. After obtaining the simulation results, the hardware based on simulated system is designed. The system includes a controller scheme controlled by a microcontroller, which generates a suitable PWM (pulse width modulation) for a DC-DC converter and transfers maximum power to the supercapacitor. P&O (perturb and observe) algorithm is used to implement the MPPT in this work. An Arduino UNO microcontroller is embedded with buck converter to implement the MPPT control in fabricated hardware. A data logger system has been developed to identify the characteristics of supercapacitor charging and discharging and also to analyse the performance of charging systems. The results for both simulated and hardware system shows that charging time of supercapacitor bank with MPPT controller has reduced significantly in comparison to without MPPT controller. In simulation, charging of five 110 F supercapacitor in series at identical conditions takes 170 sec to get fully charged without MPPT. However, charging time reduces to 115 sec if charging is done using MPPT controller. The results for fabricated hardware also confirm the above trend. In similar conditions, five 350F supercapacitors in series takes 513 sec in charging without MPPT controller, while the MPPT charge controller takes only 385 sec to charge.