

ABSTRACT

Renewable energy such as solar power is increasingly important in overcoming the energy crisis. Solar panels generate electrical energy that is typically stored in lithium-ion (Li-ion) batteries. However, the use of Li-ion batteries without an adequate monitoring and protection system can cause overcharging, overcurrent, and voltage imbalance, which shortens battery life and reduces system efficiency. To overcome this problem, a BMS specifically design for solar panel systems is required. This study aims to design and implement a BMS for Solar Energy Harvester panels to optimize charging, monitor, and balance voltage in Li-ion batteries. The BMS system is designed using a PCB implemented with electronic components such as an LM317 IC as a voltage and current regulator, a voltage sensor, an INA219 sensor module for current measurement, and an ESP32 microcontroller. The results of sensor characterization and calibration show high measurement accuracy, with an average error for the voltage sensor on three consecutive batteries of 0.164%, 0.446%, and 0.313%, and an average error for the current sensor of 0.501%. Testing of the balancing system with four variations in initial voltage conditions showed that the BMS successfully balanced the voltage of each battery cell to reach a stable voltage of 3.7 V. The designed BMS has been successfully implemented and is capable of monitoring and balancing the Li-ion batteries used in the Solar Energy Harvester panel system.

Keywords : *BMS, Solar Panel, Passive Balancing, Solar Energy Harvester.*