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Title: Maximizing Overall Electrical Power System Efficiency in Pico/Nano-Satellites with Innovative Plug-and-Play Battery Charging System

Many CubeSat investigations are designing their own electrical power systems (EPS.) Due to the size constraints of the CubeSat standard, these EPSs, more often than not, implement Maximum Power Point Tracker (MPPT) systems to squeeze the maximum amount of power possible out of the solar panels. While there had been a lot of focus on different MPPT techniques, there has been little emphasis on what to do with the power after the MPPTs, other than storing unused power in a battery, often lithium ion or lithium polymer chemistries. Some investigations have implemented traditional bi-state constant current, constant voltage battery chargers. This method works well and maximizes battery lifetime. However, due to the variable nature of the net power available in space, this method requires accurate orbit predictions and modeling to minimize unused power and still tends to allow for a large amount of unused power dissipated as heat in the solar panels. The system developed at UAHuntsville, for ChargerSat-1, uses high-efficiency USB power management ICs (PMICs) in a feedback loop to always keep the MPPTs active by charging the batteries at a variable charge current. The system adjusts the charge current based on satellite current draw and MPPT output voltage. Methodology and system specifics will be discussed. Overall, this load management system allows for large overall EPS efficiency increases compared to the bi-state method, and due to the modular nature of ChargerSat-1's hardware development, can easily be implemented in any 1U or 2U system using MPPTs.