DESIGN OF PI CONTROLLED BATTERY CHARGER USING PFC RECTIFIER FOR USE IN DUAL-TARIFF PV ENERGY SYSTEM

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ABSTRACT

The major drawaback of the solar photovoltaic (PV) system mainly due to costly capital cost and low efficiency. The dual-tariff system was introduced to reduce the capital installation cost by manipulate the lower off-demand tariff offered by utility company. In the dual-tariff PV system, the battery charger circuit will use the charging current from PV system to charge the battery during the day and the grid current during the night.

The rectifiers in AC-DC (Alternating Current-Direct Current) energy conversion in the battery charger circuit contribute to low power factor and high total harmonic distortion (THD) which consequently contribute to low efficiency of the system. The objective of the project are to develop Proportional Integrator (PI) controlled battery charger based on Power Factor Correction (PFC) rectifier for use in dual-tariff PV energy system and to analyze the efficiency contribution of such system under normal operation.

From the simulation and hardware results, it is shown that a diode rectifier circuit for battery charger before compensation contains resistive load with output capacitor filter results in distorted supply current being drawn in the supply system and contains high composition of harmonic components. The conventional circuit was modified by introducing boost and active power factor correction with PI controlled. The active power filter circuit is utilized using PIC16F877 microcontroller. In this technique, the supply current was controlled and corrected to a continuous current waveform and in phase with the voltage supply. The total harmonic distortion was corrected to 2.16%. The developed battery charger system was proven to capable of reducing the THD from 286.25% to 2.16%

For future works, addition of voltage controlled loop (VCL) at the load side of the rectifier circuit is suggested to further improve the compensation technique in AC-DC converter. The

voltage control loop system will monitor all the changes at the load and forces the reference voltage to follow the changes. This technique will improve the overall efficiency of the system. It is also recommended that the hardware prototype is equiped with the PV current charging circuit with maximum power point tracker (MPPT) technique to ensure that the battery charger circuit operates in maximum efficiency during 24 hours of operation in the dual-tariff system. The change over circuit may be introduced to swiftly change the battery charger operation during the transition from PV system to grid and vice versa.