Experimental analysis of Charge Controllers: Comparative Insights into Conventional, Smart, and IoT-Based Intelligent Designs for Islanded PV Systems

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Abstract

This paper presents the experimental and simulation implementation of an IoT-integrated intelligent MPPT (Maximum Power Point Tracking) charge controller tailored for Islanded mode photovoltaic (PV) systems. Comparatively experimentation with three charge controllers were used for standalone PV system to draw constant power of 250/500Wp from off-grid PV system on charging and discharging on intermittent weather conditions for two weeks respectively Conventional, Smart and Intelligent controllers. Adopting advanced control algorithms, real-time data monitoring, and smart decision-making, the system achieves significant improvements in efficiency, reliability, and energy management is conducted through MATLAB and PVGIS simulations. Main performance parameters such as charging efficiency, load handling, and adaptability under variable solar irradiance are evaluated. The research validates the superiority of intelligent controllers using IoT over traditional designs in islanded mode solar applications.

Keywords

PV System, MPPT, IoT tools, Smart Load, PVGIS, MATLAB.