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Analysis of Accurate Direct-Estimation of the Maximum Power Point and Thermal Characteristics of High Concentration Photovoltaic Modules

Authors : Yan-Wen Wang, Chu-Yang Chou, Jen-Cheng Wang, Min-Sheng Liao, Hsuan-Hsiang Hsu, Cheng-Ying Chou, Chen-Kang Huang, Kun-Chang Kuo, Joe-Air Jiang

Abstract : Performance-related parameters of high concentration photovoltaic (HCPV) modules (e.g. current and voltage) are required when estimating the maximum power point using numerical and approximation methods. The maximum power point on the characteristic curve for a photovoltaic module varies when temperature or solar radiation is different. It is also difficult to estimate the output performance and maximum power point (MPP) due to the special characteristics of HCPV modules. Based on the p-n junction semiconductor theory, a brand new and simple method is presented in this study to directly evaluate the MPP of HCPV modules. The MPP of HCPV modules can be determined from an irradiated I-V characteristic curve, because there is a non-linear relationship between the temperature of a solar cell and solar radiation. Numerical simulations and field tests are conducted to examine the characteristics of HCPV modules during maximum output power tracking. The performance of the presented method is evaluated by examining the dependence of temperature and irradiation intensity on the MPP characteristics of HCPV modules. These results show that the presented method allows HCPV modules to achieve their maximum power and perform power tracking under various operation conditions. A 0.1% error is found between the estimated and the real maximum power point.

Keywords : energy performance, high concentrated photovoltaic, maximum power point, p-n junction semiconductor
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