Short-Current-Pulse Based Adaptive Maximum-Power-Point Tracking for Photovoltaic Power Generation System

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It has been known that the optimum operating current I_{op} for maximum-power-point tracking (MPPT) of a photovoltaic (PV) is proportional to its short current I_{sc} under various illuminance conditions. In the first place, this paper proved that the relation is still valid even under various temperature conditions. Fig.1 shows an example of this characteristic and the proportional parameter k is approximated to 0.92.

The conventional system based on the above relation required a monitor PV unit to detect I_{sc} and there have been several problems on system redundancy, parameter variation caused by unevenly distributed illuminance and characteristic mismatch between the monitor PV and the main PV. It is shown in Fig.2 that k is a variable that depends on shade patterns on the PV. The variation of k detrimentally affects performance of MPPT.

This paper proposes a short-current-pulse based approach with identification of k (Fig.3). The MPPT of the system is performed by short-circuiting the main PV intermittently to detect I_{sc} pulse, which contributes simplification of the system by omitting the monitor PV. In the system, I_{op} can be easily calculated by multiplying amplitude of the I_{sc} pulse by k, and is used as a current command to the chopper. In order to compensate for variation of k, the on-line parameter identification is employed by operating the transistor (FET) for short-circuiting in its active region to change its conductivity from 0 to 100%. This operation allows to perform real-time P-I curve scanning. The FET intermittently turns on for only 80[μs] and the P-I curve scanning is carried out for 25[ms] every several minutes. Fig.4(a) and (b) show P-I curves and operation results of the system. (a) corresponds to uniformed illuminance conditions, and (b) is under conditions with shade. From these results, it is verified that the proposed method can track the optimum operating points even under varied k.

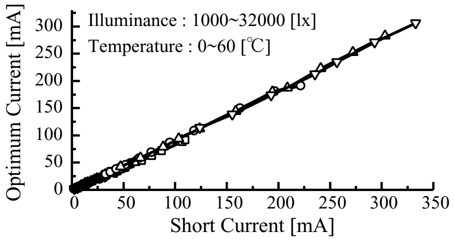

Fig. 1. Optimum current against short current.

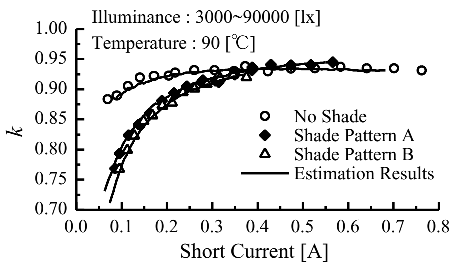

Fig. 2. Estimation results of k.

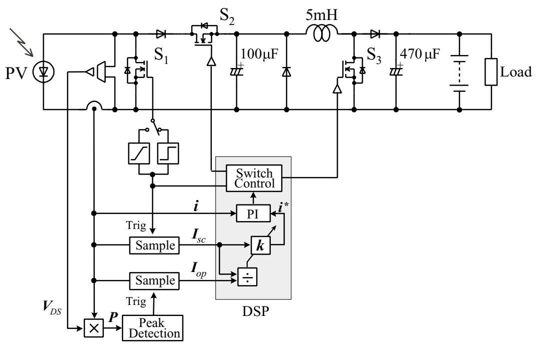

Fig. 3. System configuration.

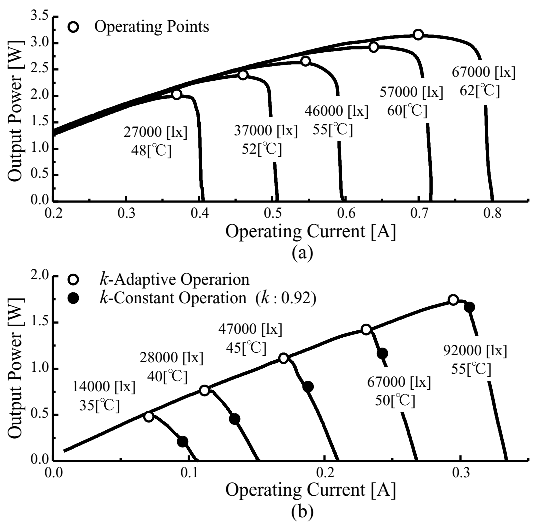

Fig. 4. P-I characteristics and operating points.