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DEVELOPMENT OF A NOVEL MPPT CONVERTER WITH AUTO-OSCILLATING CONTROL
CIRCUIT

Abstract

A high reliability analogue MPPT converter is presented in this paper. The unit was developed for small satellite missions where both efficiency and budget constraints are the main design considerations.

The presented MPPT converter has been developed within the frame of an educational satellite project, on the basis of a flight proven design of BME SRG. The predecessor was used in a long-term interplanetary mission. Since its application further developments have been made, resulting in a novel design with improved control circuit. The proposed analogue control method ensures autonomous operation of the MPPT unit: for the sake of reliability it neither relies on the onboard computer nor contains sensitive microcontroller. The principle of the control method is based on measuring the output current of the converter and generating the oscillation around the MPP by means of a peak value rectifier implemented in the control circuit. Thus, a versatile solution was obtained with a tracking efficiency above 95%. The design was optimized for a high efficiency power subsystem that lacks shunt unit. As a consequence, in addition to the maximum power tracking mode a second operation mode was also defined. In order to prevent the batteries from overcharging the MPPT converter is set to output voltage regulation mode. Additional protection circuits ensure the safety of the batteries even if a single point failure occurs. The proposed auto-oscillating MPPT converter, developed for unregulated 28V bus system with buck topology, can be easily adapted to most satellite power system architectures.

The paper introduces the design aspects and the hardware architecture of the developed MPPT converter, describes the main steps of the optimization procedure and presents the experimental results to verify the theoretical work. Technical considerations of the executed test procedures are also discussed, touching upon the difficulties arose in performing representative and cost-effective test solutions.