Abstract

With the depletion of fossil fuels and skyrocketed levels of CO₂ in our atmosphere, renewable resources, generated from natural and clean resources, have caught the eyes in recent years from both the industries and governments all over the world due to their environmental friendliness. Harvesting these energy resources and increasing their penetration rate into the utility grid depends on finding high-efficiency, high-reliability, and cost-effective power electronics converters. Recently, the trend in Power Electronics is to integrate the electronics into the source Photovoltaic (PV) or the load (light). For PV and outdoor lighting applications, this imposes a harsh, wide-range operating environment on the power electronics. And thus, the reliability of power electronics converters becomes a very important and crucial issue. It is required that the power electronics, used in such harsh and uncontrolled environments, to have a reliability indices, namely: lifetime, which match with the source or load one. For example, integrating the inverter to the PV module necessitates that the integrated-inverter has a lifetime that matches the PV module, 25 years or more. This eliminates the reoccurring cost of inverter replacement that haunts current PV system return on investment (ROI). Hence, the reliability of these power electronics is considered as a design parameter, where the expected operating conditions are used to predict the reliability of the system and design accordingly. Although not everyone agrees with the methodology or underlying data, MIL-HDBK-217 has long been considered a standard for computing Mean Time Between Failure (MTBF) as an assessment of reliability, and thus serves as an excellent relative yardstick for comparison. MIL-HDBK-217 is based on probability distribution. A new methodology to calculate the MTBF of a PV-Module-Integrated-Inverter (MII) is presented, which takes in consideration the usage model of the inverter - the statistical distribution of expected operating temperature and power processed rather than a single (worst-case) operating point. On the other hand, new inverter topologies have been proposed, primarily for single-phase power conversion applications, to improve the overall reliability of the PV system. A high-reliability capacitor technology, like film capacitor, is used instead of the bulky and lifetime limiting electrolytic capacitor.

Biographical Information

Souhib Harb received the B.S. degree from Yarmouk University, Irbid, Jordan, in 2008, and the M.S. degree from the University of Central Florida, Orlando, in 2010, both in Electrical Engineering. During his masters, he worked on a new Three-port Micro-Inverter with Power Decoupling Capability for Photovoltaic (PV) Applications. In August, 2010, he has started his PhD degree at the Electrical Engineering Department at Texas A&M University, College Station, Texas, where he is currently a PhD candidate. During his PhD studies, he has been focusing on designing, simulating, building, and testing DC/AC inverters for grid-connected PV applications. The “High-Reliability” is the salient advantage of these inverters, which is a crucial issue for PV-Module-Integrated-Inverter (PV-MII) applications. His research interests include power electronics for Renewable Energy applications, the reliability of power electronic converters, DC/DC and DC/AC converters, and nonlinearity phenomenon in Power Electronics.