

Reliability analysis of Power electronic circuits in Grid-connected Photo-voltaic system using fiabilipy-2.7 Python package - Priyadarshini Kori

About the speaker

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Abstract

The current trend in Photo-voltaic (PV) systems for residential applications is towards Grid-connected Systems, with powers between 1 KW and 5 KW. In these applications, a major issue is the maintenance cost, which is directly related to reliability. In a typical system, the PV cells have an operational life in excess of 20 years. But the power stage in the PV systems usually has a much shorter operational life. Therefore it is necessary to know the reliability of power stage in Grid-connected Photo-voltaic system. Reliability is the key necessity in power electronic components by which the life time, number of failures and associated cost is estimated.

This proposal is about the reliability analysis of power electronic circuits (DC-DC converter and Inverter) in Grid connected Photo-voltaic system using python package tool fiabilipy 2.7. The analysis is mainly based on estimating the Mean Time between Failures (MTBF) and reliability of three different DC-DC converter topologies (Buck, Boost and Buck-boost), Inverter, and combined power stage (series-parallel arrangement) of the system using the fiabilipy-2.7 tool. For the reliability analysis, failure rate of each component of the system is necessary. Therefore the failure rate calculation is done using part count method based on MIL-HDBK-217 (Military handbook) standards. The calculated failure rate values of each component are used in the fiabilipy-2.7 tool to analyze the reliability.

Fiabilipy-2.7 is a python package providing functions to learn engineering reliability. Using this package each component of converter and Inverter are built, put them together to build a complete system and finally MTBF and reliability of the system is easily evaluated using this tool. The analysis is done through graphs (reliability Vs time) using pylab and matplotlib python package. By comparing the results of reliability of three different converters, it is evident that among step-down converters, Buck-boost is more reliable and among step-up converters, Boost converter is more reliable. Then the reliability of different arrangement (series-parallel) of power stage in Grid connected photo-voltaic system is also analysed.

All the calculations are done through computation using free open source python programming language. By using fiabilipy-2.7 python package tool, analysis of reliability of complex systems became simple and easy.

The tools and libraries of python used in this project are:
fiabilipy-2.7, numpy, sympy, matplotlib, pylab, math.