EQUIVALENT CIRCUITS FOR SIMULATING THE OPERATION OF SOLAR CELLS IN PHOTOVOLTAIC SYSTEMS: AN OVERVIEW

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Abstract: The equivalent circuits are a common tool used to compute the I-V curves of solar cells in the possible conditions of operation at different values of solar irradiance and ambient temperature. The number of parameters involved in these equivalent circuits is from three to seven, according to the level of accuracy required in the analysis. Many physical phenomena must be explained by these parameters. The main mechanisms are: the photo-generated current; the diffusion current and the drift current inside a p-n junction; the recombination losses; the ohmic losses along the lateral surfaces due to imperfect edge insulation; the ohmic losses in the collection of photo-generated current on the frontal grid of crystalline silicon cells. The simulation of I-V curves in different conditions of operation includes also the behavior in the presence of partial shading. In this case the action of bypass diodes, connected in parallel with a string of cells, complicates the shape of the I-V curves, making arise in the P-V curves new local maximum power points, besides the global maximum power point. It is no longer placed around 80% of the PV generator's open circuit voltage. This situation imposes new challenges for the maximum power point trackers which are fundamental for the successful operation of the PV systems. The presentation will address these abovementioned issues.