EE770: Assignment 3: Deadline: Sunday, 29th March, 2020, 11:55 PM

Instructions

Since all of you are getting the same problem to solve, I would differentiate between the submissions based on the quality of graphs, clarity of explanation and overall organization of the report. Also, note that if you engage in plagiarism (copy + paste from others reports etc) you will be penalized. You must share the code (m-files for Matlab, Jupyter notebooks / python files for Python) you used to arrive at results.

You need to upload on Moodle or send us by email one PDF file with your typed response. If you choose to email, send it to nagabhavyajyothi@gmail.com and yogesh419federer@gmail.com and cc to naren@ee.iitb.ac.in with following subject: EE770: Assignment 3 (Your Name, Roll Number).

For this problem, refer to the datasheet of Jinko Solar 72 cell multi-Si PV module. In the datasheet, you should refer to the module with following model number: JKM300P (300 W module). Don't worry about the power tolerance of the module for this assignment.

1. Calculate the initial guesses for the necessary parameters for the single diode model.
2. Extract the five parameters of the single diode model.
3. Generate the I-V curve of the PV module at STC and plot it. Identify Pmax, Voc, Isc and FF.
4. Generate the I-V curve of the PV module at STC with two times the Rs as compared to what you got for part 3, with other four parameters remaining same. Calculate the percentage change in Pmax, Voc, Isc, FF in this situation as compared to the baseline scenario you had for part 3. Which of these parameters is most affected? Why? Also, note that corrosion / interconnect degradation is often manifested as increase in series resistance.
5. Shunt resistance decrease is an important indicator for Potential Induced Degradation. Refer to the five parameters you calculated in part 3 as a baseline scenario. From the value of Rsh obtained in part 3, reduce the shunt resistance in steps (take between 5 to 10 steps) to reach 50 OHM. For each of these steps, calculate the percentage degradation in Pmax, FF, Voc, Isc as compared to baseline scenario, and plot it with respect to Rsh. Explain the nature of the graphs. Explanation should attempt to address at least following questions: *Beyond what point, does the shunt resistance reduction begin to affect module power? If you were to increase the shunt resistance 10 times as compared to what you found in part 3, what effect it's likely to have on module power?*
6. Refer to the baseline five parameters calculated in part 3 for this question. Use the translation equations to plot I-V curves of this module at 1000 W/m^2 and temperatures from -20 ^{o}C to 80 ^{o}C with a step of 10 ^{o}C on the same graph. Now plot the Pmax, Voc, Isc, FF as a function of temperature. Explain the nature of the graphs of these parameters with respect to temperature. Explanation should attempt to address at least following questions: *Why does a particular parameter increase or decrease with temperature? How much power reduction should one expect for every 10 ^{o}C rise in the module temperature?*
7. Refer to the baseline five parameters calculated in part 3 for this question. Use the translation equations to plot I-V curves of this module at various irradiances and temperatures. Assume that the module is being electrically characterized in an environmental chamber which can control the intensity of light falling on the module and the module temperature independently. Assume that the irradiance can be varied from 700 – 1200 W/m^2 while the module temperature can be independently varied from 25 ^{o}C to 60 ^{o}C. Generate a contour plot (heatmap) where X axis is

module temperature, Y axis is irradiance and the color / contours are the Pmax of the module and explain. Explanation should attempt to address at least following questions: *What are the maximum and minimum values of Pmax? What kind of climates would be best suited to extract maximum power from PV modules? Can you give some examples of such places on Earth?*