University of Delaware
Department of Electrical and Computer Engineering
ELEG620: Solar Electric Systems

Homework #4
Solar Modules

1. Consider two solar cells, the first has an open circuit voltage of 0.55 V and a short-circuit current of 1.3 A, the second has 0.60 V and 1.0 A for these parameters respectively. Assuming that both cells obey the ideal diode law, and both have an ideality factor of 1, calculate the open-circuit voltage and short-circuit current of the combination of the cells when they are connected in:

a) parallel
b) series

2. Consider a solar cell module containing 40 identical solar cells, with each giving an open-circuit voltage of 0.60 V and short-circuit current of 3 A under bright sunshine. The module is now short-circuited whilst under bright sunshine and one of the solar cells is partially shaded. Find the power dissipated in the shaded solar cell as a function of the fractional shading of this cell. You may assume the cells obey the ideal diode law and you may neglect temperature effects.

3. Briefly discuss some of the degradation and failure modes for solar cell modules, clearly indicating whether the mode is degradation or failure and if it reversible or not. For each mode, is there some way to circumvent the degradation or failure?

4. A nominal 12 V solar cell module contains 36 identical solar cells connected in series, each with a short circuit current of 3 A. The fill factor and open circuit voltage of each are typical for commercial solar cells.

a. Draw and label as appropriate the expected IV characteristic of this solar cell module operating at 25 C.

b. One of the solar cells has been accidentally installed the wrong way i.e. the polarity is reversed. Draw the IV characteristic for the module in this situation, describing why it looks the way it does.

c. If the incorrectly connected solar cell is shaded what effect on the IV characteristic and output power will be seen, and why?

d. Would the presence of an integral bypass diode in parallel to the incorrectly connected solar cell help? Discuss.