Memorandum

To: Senior Management

CC: Michael Cuomo and Tyler Pelton

From: Michael Cazzola and Ram Gopalakrishnan

Date: 3/9/2009

Re: Identification of Maximum Power Point

Overview

Our task was to analyze the effect of temperature and insolation on the Maximum Power Point (MPP). Based on our results, we provided a description of the effects of Maximum Power Point Tracking (MPPT) on the overall system's efficiency.

Data Collection

Based on the data collected from the Insolation report, we chose to sample data at temperatures and insolations based on Easton, PA over the course of the year. From the data gathered in the Insolation analysis, we decided to create data points varying insolation from 0 to 1000 W/m^2 in steps of 50 W/m^2. We also used temperature values of 20, 40, 50, 60, 70, and 90 ºF for all of the insolation values.

Figure 1 represents a model of a photovoltaic system with a constant voltage source as the sun. As we ran our analysis, we varied the insolation by changing the voltage source, and varied the ambient temperature of the photovoltaic array by altering the property of the array model. We measured current and voltage at the output of the array to determine the MPP.

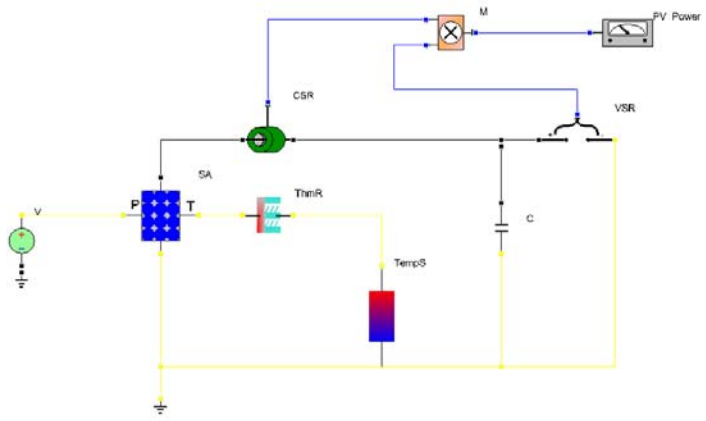

Figure 1

Data Analysis

We began our analysis of Fixed Power Point using a Fixed Voltage of 288V. We chose this value as it is a standard engineering approximation as 70% of the Voc (400V) will be at the knee of the I-V curve. We calculated the percentage power loss for the months of February, July, and October. In each case, we used the maximum, average, and minimum temperatures for the month. We also used the average insolation for each month based on the data acquired from T001. From this analysis, we found that the percentage energy loss increases exponentially above ~70 ºF. The data we found is shown in Figure 2.

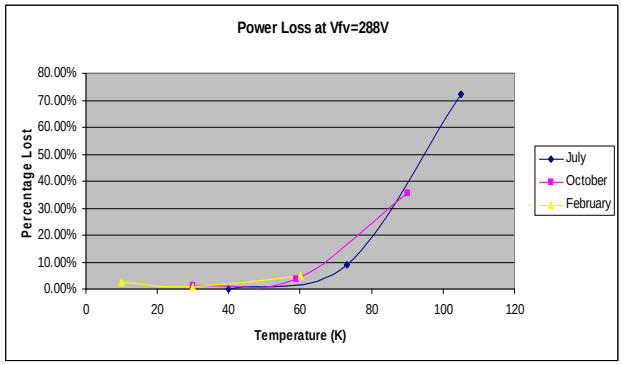

Figure 2

In an effort to minimize the power loss, we decided to choose a more conservative fixed power point of 257V. Again using temperature maximums, averages, and minimums, and the average insolation values for each month, we re-evaluated our power loss. We found that with the lower Fixed Voltage Point, the power loss severely decreased. Figure 3 shows our results.

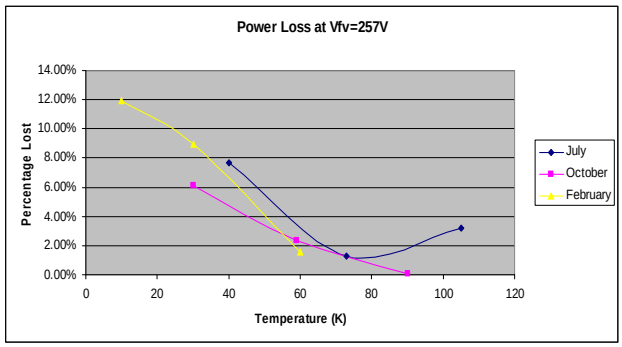

Figure 3

Conclusions

As our task was to evaluate the worth of a MPPT system, we chose two different scenarios where we would set our fixed voltage at both the 70% of the Voc, and a conservative Fixed Voltage value. Our results indicated that with the conservative value, we loose the least amount of power, with an average loss of approximately 4.2%. When using the higher Fixed Voltage, we found an average power loss of approximately 4.4%. The main difference between the two cases is that in the extreme situations, the conservative Fixed Voltage will sustain a lower percentage of power loss of approximately 12%, where as the higher Fixed Voltage will result in a 72% loss in the extreme temperatures.

Based on our results, if we were to proceed with a Fixed Power Point, we would recommend a voltage of 257V to reduce the percentage of lost power. To continue our analysis on the worth of the MPPT, Action Item T013 will be produced to compare possible MPPT control algorithms.