Smart Solar Energy

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Abstract

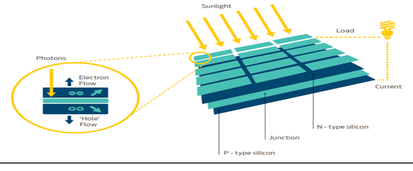
Solar photovoltaic (PV) installations are traditionally stand-alone systems without module level integrated computation. However, it is possible to utilize real-time processes to adaptively reconfigure the solar PV operating point so that they can increase their performance depending on the environmental conditions. Certain systems use DC-DC converters to match the load voltage and current specifications. Phone chargers require specific data configurations to be able to charge and this project focused on developing a small scale, portable system.

For this project, we built a phone charger that is dependent on solar energy using a buck converter with the goal of developing a smart system that can indicate the operating condition to show the maximum power point.

Objectives

PV phone charger which gives visual feedback on the charging state of the PV panel.

- Measure and understand the V-I and P-V characteristics of a PV panel and discover the Maximum Power Point (MPP)
- Develop and build a MPP LED indicator
- Apply the PV power to charge a phone using a buck converter



Methodology

Overview

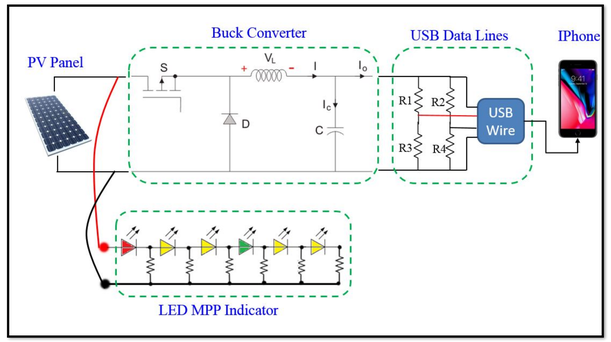


Figure 1 – PV and charger schematic

PV Panel - photovoltaic panel made of semiconductor materials, becomes electrically charged when exposed to sunlight. Serves as DC power supply.

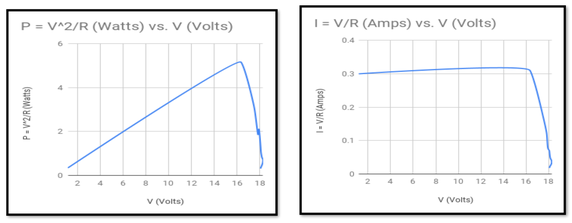


Figure 2- PV P-V and I-V curves

MPP LED indicator- max power point indicator to aid in the visual determination of how efficient the solar panels are working.

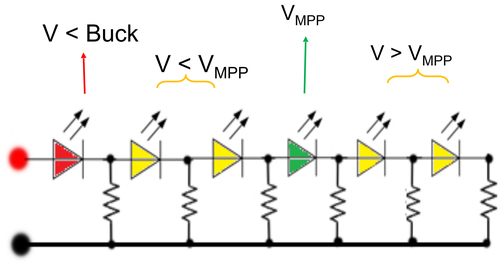
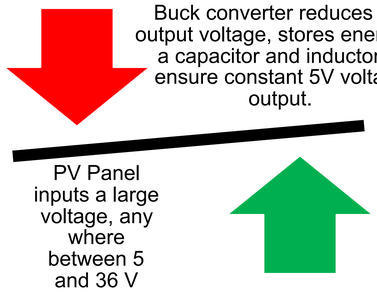


Figure 3- LED indicator circuit schematic

Buck converter– a DC-DC power converter that reduces the input voltage to serve the load's needs at high efficiency. It is important because the voltage input from the PV panel is too much for USB to handle. Continues to switch diode and transistor on and off at high frequencies.



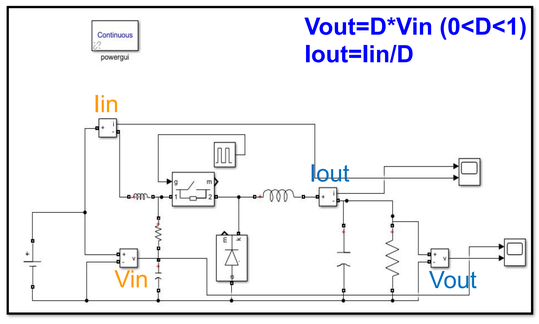


Figure 4- Buck converter schematic

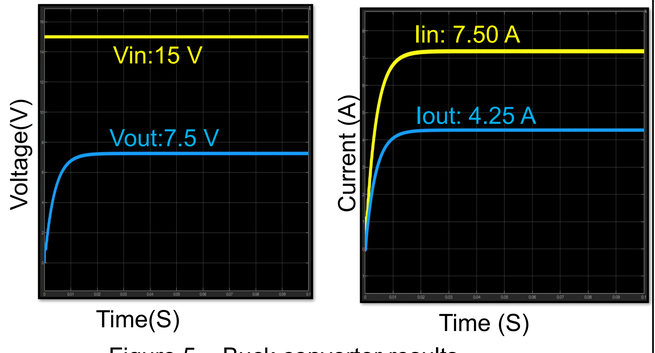


Figure 5 – Buck converter results

Test Results

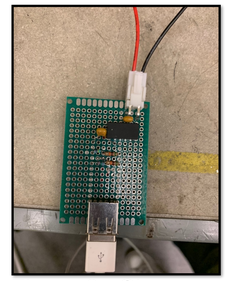


Figure 6– Charger PCB top view

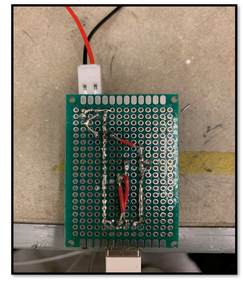


Figure 7– Charger PCB bottom view

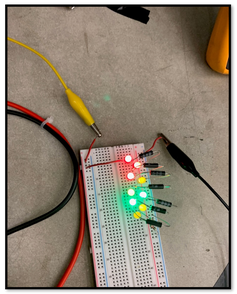


Figure 8–MPP indicator Vin > 20 V

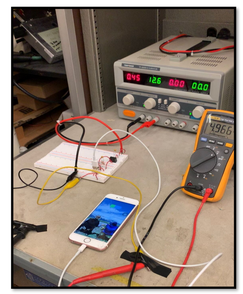


Figure 9– Charger working indoor

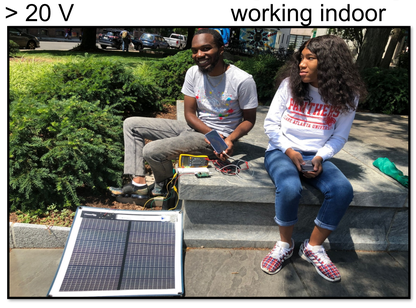


Figure 10- Charger working outdoor, working at least 5W

Conclusion

It is possible to create a low cost solar powered cellphone charger that works efficiently. Although solar powered systems are sustainable there are many things that one needs to consider before implementing these systems at home or businesses. In the future, we intend on developing a DC off-grid micro grid system and provide system level protection.

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