



# Design and Development of Closed Loop Control of Buck and Boost Converter for PV Module

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## ABSTRACT

Tremendous use of PV energy is growing day to day to an unimaginable way. Utilizing PV generated power as it is generated is not an economical way. Hence closed loop control of converters like buck and boost converter with PV source gives an effective way of controlling. In this paper closed loop control of Boost and Buck converter is presented. Four solar cells are arranged and output is taken from it. The current and voltage waveforms were presented.

**KEYWORDS** – Boost, buck converter, PV module, solar cell

## I. INTRODUCTION

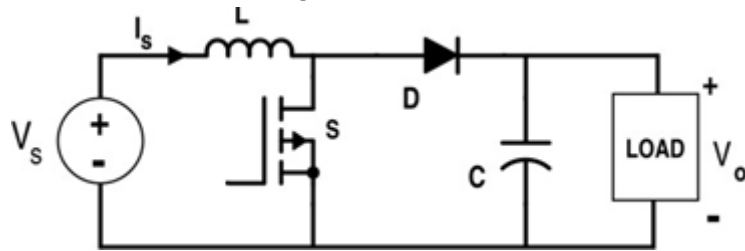
Solar power generation systems are in widespread use around the globe. Today people are getting more and more attracted towards the renewable energy system due to its vast benefits. Especially, the solar energy is found to be the best option for the generation of electricity because of its easy availability. There are many advantages of the sun's energy i.e. cleanness, it creates relatively less noise, it is easy to install and integrate when compared to other sources of energy in addition to its abundant availability [1] The Boost converter has the merit of simple structure, it is also a basic form of multi-input converter topology for integration of new energy sources, so Boost converter is used to achieve maximum power of solar cells in this paper.[2]

## II. BOOST CONVERTER

The output voltage of PV is increased deploying a boost converter. The Boost converter has the advantage of simple structure, so Boost converter is used to achieve maximum power cells in this paper. The input voltage source is connected to an inductor. The solid-state device which operates as a switch is connected across the source. Here MOSFET is used as switch because of its numerous advantages like Ability to scale down in size, It has low power consumption to allow more components per chip surface area, MOSFET has no gate diode, It read directly with very thin active area, They have high drain resistance due to lower resistance of a channel. The second switch used is a diode. The diode is connected to a capacitor, and the load and the two are

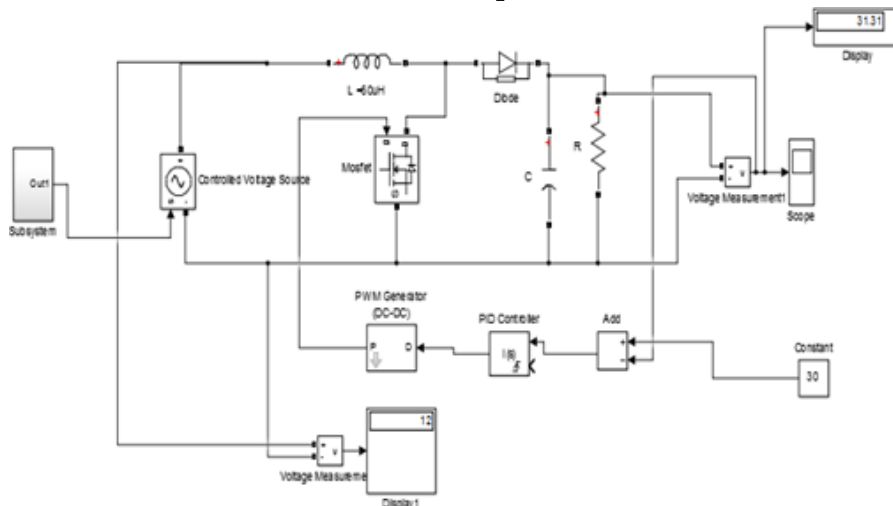
connected in parallel as shown in the figure. The inductor connected to input source leads to a constant input current, and thus the Boost converter is seen as the constant current input source. And the load can be seen as a constant voltage source. The controlled switch is turned on and off by using Pulse Modulation (PWM)

**Circuit Diagram of Boost Converter**



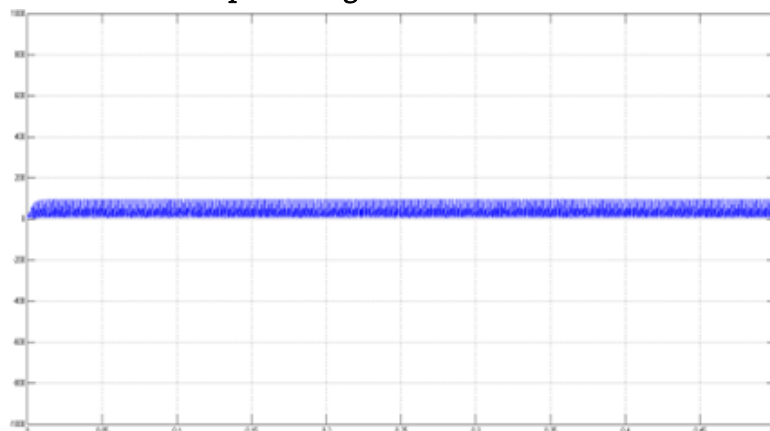
Closed loop control is a process by which the output voltage is maintained constantly by obtaining the feedback of the loop. So instead of open loop, closed loop is advantageous. Here closed loop is implemented using PWM generator and PID controller Block. In PID controller block we apply Integral control alone.

**Simulation of closed loop Boost converter**

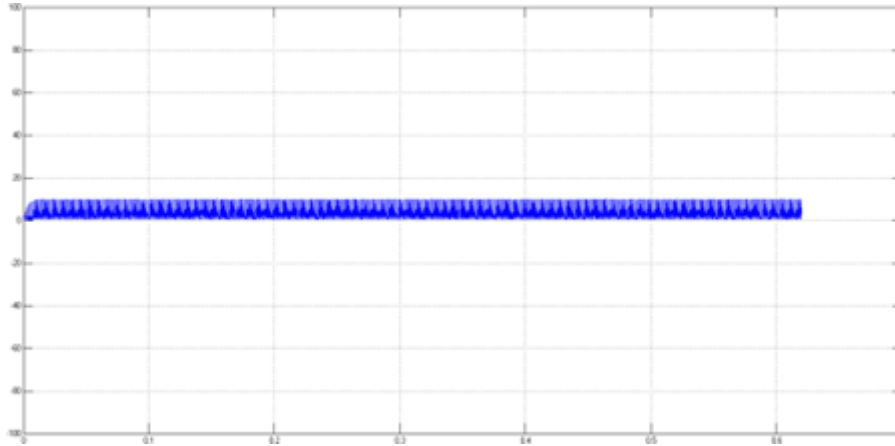


The output voltage of boost converter is shown in the figure below. The output voltage value is set as reference value in the constant block and compared with the actual output of boost converter taken as reference and given to Integral controller. Then the output of controller is given to the PWM generator. This generated pulse is given to the MOSFET.

**Output Voltage of Boost Converter**

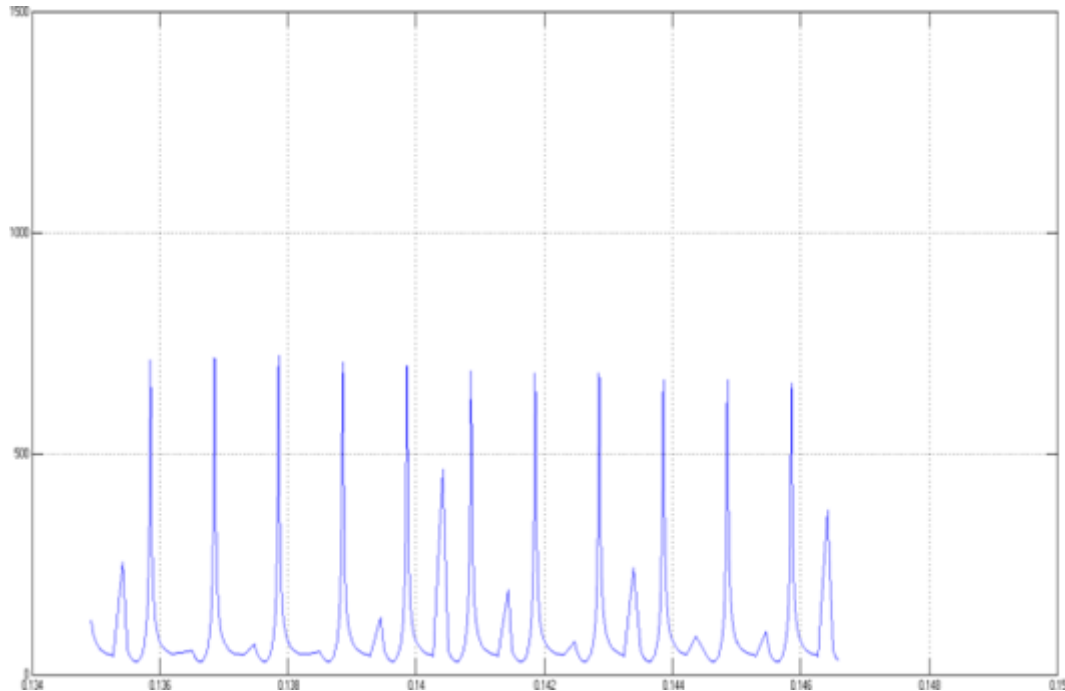


### Output Current of Boost Converter



### THD of Boost converter

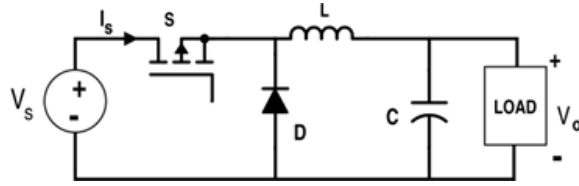
Total Harmonic Distortion (THD) of boost converter is given in the diagram below.



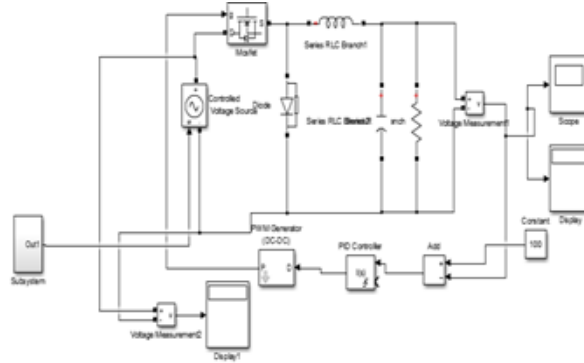
### III. BUCK CONVERTER

**Buck converter** reduces the input DC voltage to a specified DC output voltage. The input voltage source is connected to a controllable solid state device which operates as a switch. The solid state device can be a Power MOSFET or IGBT. Power MOSFET and IGBT can be turned off by simply having the voltage between the GATE and SOURCE terminals of a Power MOSFET. In this project MOSFET is used. The second switch used is a diode. The switch and the diode are connected to a low-pass LC filter which is appropriately designed to reduce the current and voltage ripples. The load is a purely resistive load. The input voltage is constant and the current through load is also constant. The load can be seen as current source.

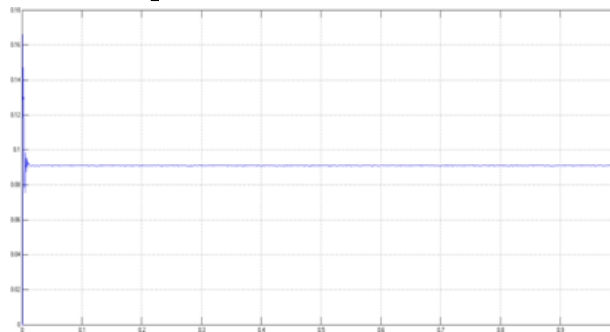
**Circuit Diagram of Buck Converter**



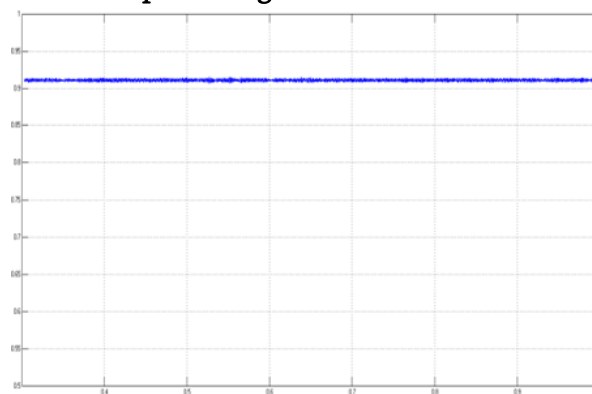
**Simulation of closed loop Buck converter**



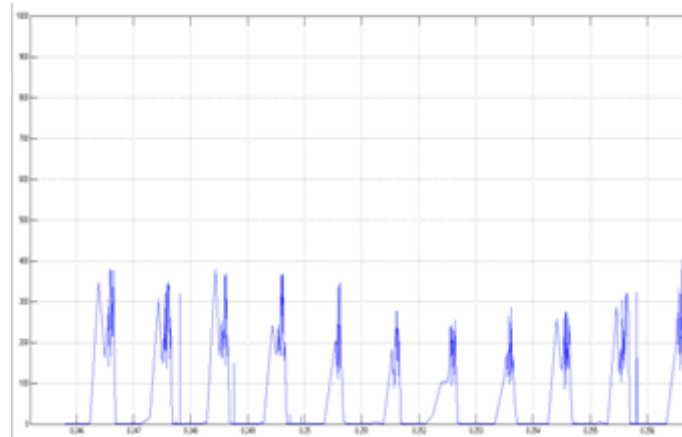
**Output Current of Buck Converter**



**Output Voltage of Buck Converter**



**THD waveform of Buck Converter**

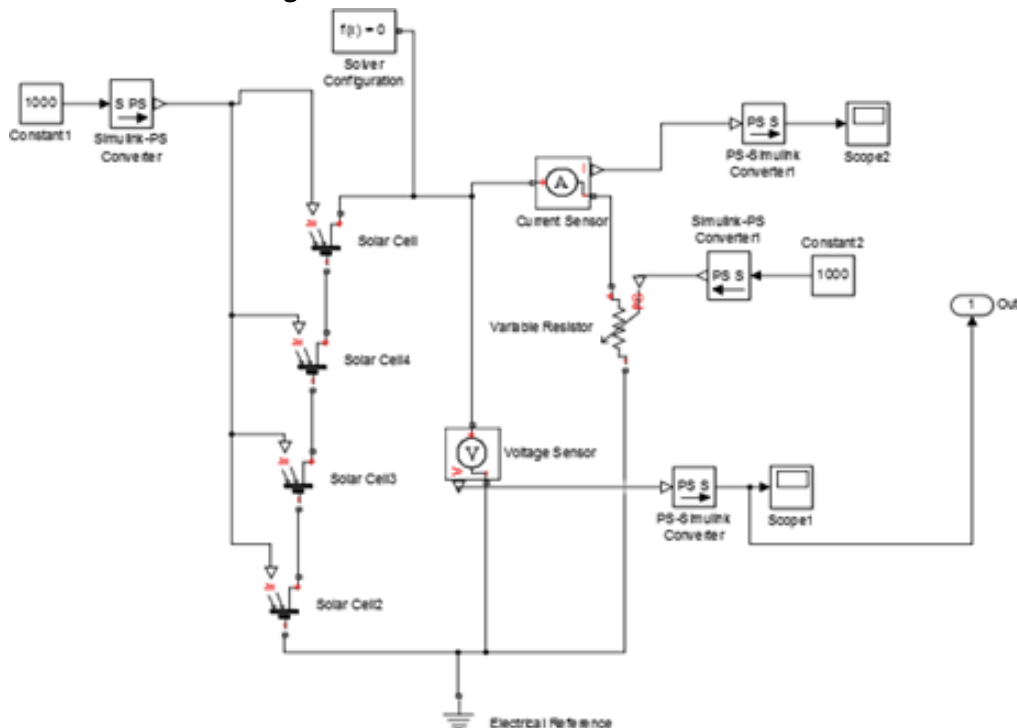


**IV. SOLAR CELL**

When light shines on a photovoltaic (PV) cell also called a solar cell that light may be reflected, absorbed, or pass right through the cell. The PV cell is composed of semiconductor material; the “semi” means that it can conduct electricity better than an insulator but not as well as a good conductor like a metal.

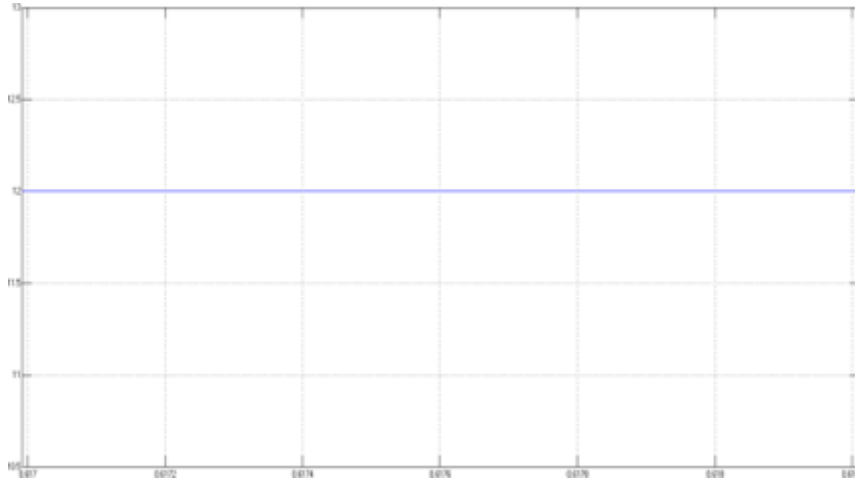
The solar cell was simulated in MATLAB. Here four cells are connected in series. Here the main block used are PS to Simulink converter and Simulink to PS converter. An output voltage of 12V is obtained from this solar Cell.

**Simulation Diagram of Solar cell for both Boost and Buck Converter**



### Output voltage of Solar cell

The outputs voltage waveform of solar cell is illustrated below.



### V. CONCLUSION

In this paper solar generated power is altered with boost and buck converter topologies. Later on this power could be used to charge all type of batteries especially for electric vehicles. Solar cell output is given to both converter is simulated by MATLAB/Simulink simulation tool and simulation results are verified. THD waveforms were given. The output current and output voltage simulation waveforms are illustrated and analyzed..

### VI. REFERENCES

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